MTR CORPORATION LIMITED

CONTRACT C6014-14E

PROCUREMENT OF NEW TRAINS

Particular Specification

Volume 1 of 4

August 2015

MTR CORPORATION LIMITED

CONTRACT C6014-14E

PROCUREMENT OF NEW TRAINS

PARTICULAR SPECIFICATION

WORKING DOCUMENT

VOLUME 1 OF 4

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CONTRACT C6014-14E
PROCUREMENT OF NEW TRAINS
PARTICULAR SPECIFICATION
WORKING DOCUMENT

CONTENTS

[VOLUME 1 OF 4]

Section 1: Introduction

Section 2: Definitions and Abbreviations

Section 3: Scope of the Works

Section 4: System Description and Performance Requirements

Section 5: Infrastructure Constraints

Section 6: Car Body Structure and Exterior

Section 7: Interior of Car Body

Section 8: Cab Facilities and Layout

Section 9: Operation and Control

Section 10: Train Management System

Section 11: Traction and Braking Equipment

Section 12: Bogies and Suspensions

Section 13: Pneumatics and Air Distribution Systems

Section 14: Gangways and Couplers

Section 15: Air Conditioning and Ventilation

Section 16: Doors

Section 17: Auxiliary Electrical Supply

[VOLUME 1 OF 4 (CONT'D)]

Section 18: Communications

Section 19: Not Used

Section 20: Materials and Workmanship Requirements

Section 21: Design Requirements

Section 22: Testing Requirements

Section 23: Training Requirements

Section 24: Spare Parts, Special Tools and Test Equipment

Section 25: System Assurance

Section 26: Maintenance Requirements

Section 27: Quality Management

Section 28: Environmental Requirements

Section 29: Programme

Section 30: Site Arrangements

Section 31: Interface Arrangements

Section 32: Attendance

[VOLUME 2 OF 4]

APPENDICES

Appendix A: Schedules of Drawings

Appendix B: Codes and Standards

Appendix C: Schedule of Tests

Appendix D: Not Used

Appendix E: Schedule of Delivery

Appendix F: Engineer's Preliminary Programme, Project Calendar, Schedule of Critical Dates and Schedule of Key Dates

Appendix G: Site Layout and Works Areas

Appendix H: Rules and Procedures for Working Within or Adjacent to the Railway

- Annex 1 P-Licensing System - Caring and Coaching System for New Contractor Workers
- Annex 2 Contractor Fitness for Duty Management

Appendix I: Designated Contracts and Interfacing Systems

- Annex 1 P-way Interface (Track Data)
- Annex 2 Overhead Line/ Traction Power Supply System Interfaces
- Annex 3 ATC Interfaces
- Annex 4 Communications Interfaces
- Annex 5 Platform Screen Door Interfaces
- Annex 6 Depot Interfaces
- Annex 7 Electric Vehicle Interfaces
- Annex 8 Not Used
- Annex 9 Dynamic Route Map Interfaces
- Annex 10 Cab Simulator System Coordination

Appendix J: Not Used

Appendix K: Not Used

Appendix L: Interior Styling Schedule

[VOLUME 2 OF 4 (CONT'D)]

Appendix M: Life Cycle Cost

Appendix N: Design Data

Appendix O: Delivery of Equipment

Appendix P: Configuration Control Programme

Appendix Q: List of Named Suppliers

[VOLUME 3 OF 4]

ROLLING STOCK STANDARDS

RS/C6014/01:	Data Transmission and Management
RS/C6014/02:	Constructional and Workmanship Requirements
RS/C6014/03:	Electrical and Design Requirements
RS/C6014/04:	Electromagnetic Compatibility
RS/C6014/05:	Software
RS/C6014/06:	Cables
RS/C6014/07:	Pneumatic Equipment
RS/C6014/08:	Fire Performance
RS/C6014/09:	Wheelsets
RS/C6014/10:	Pantograph
RS/C6014/11:	Battery
RS/C6014/12:	Operation and Maintenance Manual
RS/C6014/13:	Noise Performance and Measurement
RS/C6014/14:	Operability Design Guidelines
RS/C6014/15:	Keys and Locks
RS/C6014/16:	LED Lighting Standard

[VOLUME 4 OF 4]

Drawings

SECTION 1

INTRODUCTION

August 2015

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1 INTRODUCTION

1.1 Background to the Specification

1.2 Use of the Specification

1.3 Standards

1 INTRODUCTION

1.1 Background to the Specification

1.1.1 The Particular Specification describes the particular requirements for the passenger carrying rolling stock for the Urban Lines (hereinafter referred to as "trains") and associated equipment necessary to facilitate operation and maintenance by the Employer. The trains shall be capable of being operated to provide a passenger service on the Urban Lines consisting of the Kwun Tong Line, Tsuen Wan Line, Island Line, Tseung Kwan O Line, Tseung Kwan O Line Extension and West Island Line. The trains shall also be capable of being operated to provide a passenger service on the future Kwun Tong Line Extension currently under construction.

1.1.2 The Particular Specification consists of 32 Sections, 17 Appendices, the Drawings listed in Appendix A and 16 Rolling Stock Standards listed in Appendix B.

1.2 Use of the Specification

1.2.1 The Particular Specification shall be read in conjunction with the Conditions of Contract for Engineering Works (Major) (hereinafter referred to as the Conditions of Contract), the General Specification for Electrical & Mechanical Engineering Works (hereinafter referred to as the General Specification), the Drawings and all other documents which comprise the Contract.

1.2.2 To the extent that any provision of the Particular Specification is inconsistent with any provision of the Conditions of Contract, the provisions of the Conditions of Contract shall prevail.

1.2.3 Not used.

1.2.4 To the extent that any provision of the Particular Specification is inconsistent with any provision of the General Specification, the provisions of the Particular Specification shall prevail.

1.2.5 The Contractor shall ensure that none of the above documents are read in isolation. They are complementary documents and shall be read in conjunction with one another.

1.2.6 The Particular Specification is hereinafter referred as PS. The reference to the clauses in the PS is prefixed by the letters "PS" (for example, Clause 21.3.4 of the Particular Specification is written as PS 21.3.4).

1.2.7 In the event of any conflict between the requirements of particular parts of this Particular Specification, the order of precedence shall be Sections, Appendices, Rolling Stock Standards and Drawings.

1.2.8 Not used.

1.3 Standards

1.3.1 The Contractor shall comply with the Employer's Rolling Stock Standards listed in Appendix B.

1.3.2 Where international or national standards are quoted, the Contractor may propose to work to equivalent internationally or nationally recognised standards. Their use shall be subject to Approval. Submission for Approval are to be supported by a copy of the proposed standards, a detailed comparison of the quoted and proposed standards and, where applicable, an English translation of the proposed standard.

SECTION 2

DEFINITIONS AND ABBREVIATIONS

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2 DEFINITIONS AND ABBREVIATIONS

2.1 Definitions

2.2 Abbreviations

2.3 Abbreviations for Locations

2 DEFINITIONS AND ABBREVIATIONS

This Section includes a list of all definitions and abbreviations applicable to the PS in addition to those provided in the Conditions of Contract and the General Specification.

2.1 Definitions

The following definitions are applicable to the PS:

2.1.1 ***"C Trains"*** means the trains procured by the Employer for the West Island Line and operating on the Urban Lines.

2.1.2 ***Not Used***

2.1.3 ***"Duty Cycle"*** means the total running time of the compressor on load with respect to the total time for the vehicle in service with all compressors running normally on a train, i.e.

$$\text{Duty Cycle} = \frac{\text{Total Compressor Running Time On Load}}{\text{Total Vehicle Service Time}} \times 100\%$$

2.1.4 ***"K Trains"*** means the existing trains procured by the Employer for the Tseung Kwan O Extension and operating on the Urban Lines.

2.1.5 ***"Kwun Tong Line Extension"*** means the railway extension of the existing Kwun Tong Line from the existing Yau Ma Tei Station to the new Whampoa Station. Two new underground stations will be built, namely Ho Man Tin and the new terminus station Whampoa.

2.1.6 ***"M Trains"*** means the Urban Lines Trains other than C Trains and K Trains.

2.1.7 ***"Main Reservoir Pipe"*** means a main pipeline connecting all cars of the train consist to distribute compressed air to trainborne pneumatic equipment.

2.1.8 ***"Platform Screen Doors"*** means the full-height sliding doors or partial height sliding gates located at a platform edge operating in conjunction with train passenger doors.

2.1.9 ***"Pump-down"*** means transferring all refrigerant to the condenser side before stopping the compressor of the air conditioning unit.

2.1.10 ***"Round Trip"*** means the satisfactorily operation of the trains to provide passenger service according to the normal train service headway on the following round journeys:

(a) stations between North Point to Po Lam or LOHAS Park for the TKL
(b) stations between Yau Ma Tei to Tiu Keng Leng for the KTL
(c) stations between Whampoa to Tiu Keng Leng for the future KTL after KTE is opened
(d) stations between Central to Tsuen Wan for the TWL
(e) stations between Kennedy Town to Chai Wan for the ISL

2.1.11 ***"Service Condition"*** means the condition in which a train is ready for passenger service with all trainborne equipment including the emergency and standby systems available and functioning to the required performance as specified in the PS, without any preventive maintenance or cleaning work overdue beyond the tolerance.

2.1.12 ***"Train Unit"*** means the train cars coupled together semi-permanently and integrally controlled. Refer to PS 4.5.1 for detailed definition of Train Unit.

2.1.13 ***"Tseung Kwan O Line Extension"*** means the operating railway extension of the Tseung Kwan O Line from Tseung Kwan O Station to LOHAS Park Station. Bifurcated train service is being provided between Tseung Kwan O Station and the LOHAS Park Station.

2.1.14 ***"Tung Chung Line Trains"*** means the existing trains operating on the Tung Chung Line.

2.1.15 ***"Urban Lines"*** means the operating lines on the existing railway network comprising the Kwun Tong Line, Tsuen Wan Line, Island Line, Tseung Kwan O Line, Tseung Kwan O Line Extension and West Island Line as well as Kwun Tong Line Extension currently under construction.

2.1.16 ***"Urban Lines Train"*** means the existing trains and operating on the Employer's Urban Lines comprising M trains, K Trains and C Trains.

2.1.17 ***"West Island Line"*** means the railway extension of the existing Island Line from the existing Sheung Wan Station to the terminus station Kennedy Town.

2.2 Abbreviations

The following abbreviations shall apply to the PS:

AC	Alternating Current
ACP	Auxiliary Control Panel
ATC	Automatic Train Control
ATO	Automatic Train Operation
ATP	Automatic Train Protection
ATDC	Automatic Train Doors Control
ADO	Automatic Doors Open
ADC	Automatic Doors Close
CBTC	Communications-Based Train Control
CCTV	Closed Circuit Television
CM	Coded Manual
COC	Conditions of Contract
CPA	Centralised Public Announcement
CPU	Central Processing Unit
DC	Direct Current
DCC	Depot Control Centre
DCU	Display Control Unit
DDSP	Design Data Submission Programme
DI	Design Information
DLP	Defect Liability Period
DMS	Drawing Management System
DRM	Dynamic Route Map
DSD	Deadman Safety Device
DVAS	Digital Voice Announcement System
DVAU	Digital Voice Announcement Unit
DVI	Digital Visual Interface
DVR	Digital Video Recorder
EBR	Emergency Brake Relays
EID	Electronic Information Display
EIDS	Electronic Information Display System
EDD	Electronic Destination Display
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ETND	Electronic Train Number Display
FEA	Finite Element Analysis
FMECA	Failure Modes, Effects and Criticality Analysis

FRACAS	Failure Reporting And Corrective Action System
FSM	Flashing System Map
FTA	Fault Tree Analysis
GS	General Specification
HAZOP	Hazard and Operability Study
HMS	Hostler Master Switch
HP	Hostler Panel
IP	Internet Protocol
IRS	Interface Requirements Specification
LAN	Local Area Network
LED	Light Emitting Diode
LPU	Local Processing Unit
LRU	Line Replaceable Unit
MAC	Media Access Control
MCB	Miniature Circuit Breaker
MCP	Master Control Panel
MIL	United States Military Standard
MMI	Man-Machine Interface
MTBF	Mean Time Between Failure
MDBF	Mean Distance Between Failure
MTTR	Mean Time To Repair
NTH	Non-Traffic Hour
O&M	Operating and Maintenance
OCC	Operation Control Centre
PA	Public Address
PIS	Passenger Information System
PS	Particular Specification
PSD	Platform Screen Door
PTT	Press-To-Talk
PWM	Pulse Width Modulation
RAL	Name of colour matching system (German)
RAM	Reliability, Availability and Maintainability
RFI	Radio Frequency Interference
RFID	Radio Frequency Identification

RM	Restricted Manual
SAP	System Assurance Plan
SDD	System Design Document
SEMP	System Engineering Management Plan
SEMS	System Engineering Management System
SIR	Safety Interlock Relay
SRD	System Requirement Document
SSD	System Specification Document
TBC	Traction Brake Controller
TCN	Train Communication Network
TMS	Train Management System
TO	Train Operator
WPA	Wi-Fi Protected Access
WRU	Workshop Replaceable Unit
ZVR	Zero Velocity Relay

2.3 Abbreviations for Locations

The following abbreviations for running lines and locations shall apply to the PS:

URL	Urban Lines
KTL	Kwun Tong Line
TWL	Tsuen Wan Line
ISL	Island Line
TKL	Tseung Kwan O Line
TCL	Tung Chung Line
WIL	West Island Line
KTE	Kwun Tong Line Extension
KBD	Kowloon Bay Depot
TWD	Tsuen Wan Depot
CWD	Chai Wan Depot
TKD	Tseung Kwan O Depot
SHD	Siu Ho Wan Depot
EHC	Eastern Harbour Crossing
LAT	Lam Tin Station
NOP	North Point Station
QUB	Quarry Bay Station
YAT	Yau Tong Station
TIK	Tiu Keng Leng Station
TKO	Tseung Kwan O Station
HAH	Hang Hau Station
POA	Po Lam Station
LHP	LOHAS Park Station
CEN	Central Station
ADM	Admiralty Station
WAC	Wan Chai Station
CAB	Causeway Bay Station
TIH	Tin Hau Station
FOH	Fortress Hill Station
TAK	Tai Koo Station
SWH	Sai Wan Ho Station
SKW	Shau Kei Wan Station
HFC	Heng Fa Chuen Station
CHW	Chai Wan Station
TST	Tsim Sha Tsui Station
JOR	Jordan Station
YMT	Yau Ma Tei Station
MOK	Mong Kok Station

PRE	Prince Edward Station
SSP	Sham Shui Po Station
CSW	Cheung Sha Wan Station
LCK	Lai Chi Kok Station
MEF	Mei Foo Station
LAK	Lai King Station
KWF	Kwai Fong Station
KWH	Kwai Hing Station
TWH	Tai Wo Hau Station
TSW	Tsuen Wan Station
SKM	Shek Kip Mei Station
KOT	Kowloon Tong Station
LOF	Lok Fu Station
WTS	Wong Tai Sin Station
DIH	Diamond Hill Station
CHH	Choi Hung Station
KOB	Kowloon Bay Station
NTK	Ngau Tau Kok Station
KWT	Kwun Tong Station
KET	Kennedy Town Station
SYP	Sai Ying Pun Station
HKU	HKU Station
WHA	Whampoa Station
HOM	Ho Man Tin Station

SECTION 3

SCOPE OF THE WORKS

August 2015

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3 SCOPE OF THE WORKS

3.1 General

3.2 Named Suppliers

3.3 Engineering Design

3.4 Testing and Commissioning

3.5 Handing Over of Trains

3.6 Not Used

3.7 Spare Parts, Special Tools and Testing Equipment

3.8 Designated Contractors

3.9 Options

3 SCOPE OF THE WORKS

3.1 General

3.1.1 The scope of the Works shall comprise, unless specifically excluded, the design, manufacture, supply, delivery, installation, testing, commissioning and rectification of defects during the Defects Liability Period for 78 trains, in consists of 8 cars, and associated equipment necessary to facilitate operation and maintenance of the trains including special tools and test equipment, spare parts, Operation and Maintenance Manuals and training, and all Options exercised by the Employer under the Contract.

3.1.2 The scope of the Works excludes the supply of the following:

(a) Train borne ATC equipment

(b) Fire extinguisher

(c) Door Chime System

(d) Electronic Information Display System equipment (except the interface between GSM Modem Assemblies and EIDS, EID panels and all inter-car cable connections)

Items (a) to (d) will be free issued by the Employer. The Contractor shall provide installation, testing and commissioning of these equipment in accordance with PS18, PS Appendix I Annex 3 and PS Appendix I Annex 4.

3.2 Named Suppliers

The Contractor shall include in the scope of the Works for the supply of the following equipment procured from the Named Suppliers:

(a) Train borne Radio Sets (TRS)

(b) In-cab Closed Circuit Television (In-cab CCTV)

(c) Not used

(d) RFID Tags for Train Radio System

(e) RFID Tags and System Reconfiguration for RFID Axle Box Temperature Detection System

The details of the Named Suppliers are stipulated in Appendix Q and the details of the equipment are stipulated in Appendix I Annex 4 for items (a) to (e).

3.3 Engineering Design

3.3.1 The Contractor shall set up a system engineering management system to carry out the conceptual engineering design and detailed engineering design in accordance with the requirements in PS 21.

3.3.2 The design shall ensure the trains meet the requirements of the PS for safe and efficient operation, ease of maintenance and correct functioning between the trains and the interfacing equipment on the Urban Lines.

3.3.3 The Contractor shall provide a full-scale foamcore mock-up of the cab, driving console and controls (refer to PS 8), and a full-scale engineering mock-up of the cab (refer to PS 8) and the saloon (refer to PS 7), and a full scale underframe mock up (refer to PS 6) to facilitate design Approval. The manufacture of the first train shall not commence unless the mock-ups are Approved.

3.3.4 The Contractor shall provide the necessary information to allow the Engineer to carry out simulation calculations to verify and validate the specific energy consumption of the trains (refer to Appendix M).

3.4 Testing and Commissioning

3.4.1 The Contractor shall carry out the Works Tests including first article inspections and routine inspections, combined test, EMC and TMS integration tests, type and routine testings of the cars and equipment, at the Contractor's premises in accordance with the requirements in PS 22 and Clause 2 of Appendix C.

3.4.2 The first train manufactured shall undergo the adjustment tests, ATC system combined test, and the reliability proving test at the Contractor's test track (refer to Clause 2.27 of Appendix C) prior to its delivery to Hong Kong.

3.4.3 The type and routine commissioning testing in Hong Kong shall be carried out in Siu Ho Wan Depot, Urban Line Depots and on the Urban Lines (refer to PS 22.10 and Clause 3 of Appendix C).

3.4.4 The Tests on Completion, Integrated Test and Test Running shall be undertaken in accordance with PS 22.11, PS 22.12 and Clauses 4 and 5 of Appendix C to include the testing with the interfacing equipment on the Urban Lines and demonstrate to the satisfaction of the Engineer that the trains are suitable for passenger service on the Urban Lines.

3.5 Handing Over of Trains

The Contractor shall hand over the trains to the Employer in accordance with the Schedule of Delivery in Appendix E upon the completion of the Tests on Completion, Integrated Test and Test Running with the interfacing equipment on the Urban Lines to the satisfaction of the Engineer. The trains handed over to the Employer will be put into passenger service on the Urban Lines.

3.6 Not Used

3.7 Spare Parts, Special Tools and Testing Equipment

3.7.1 The Contractor shall recommend to the Engineer the spare parts for the trains for running maintenance (refer to PS 24.2.1). The spares parts shall be determined based on the Approved running maintenance schedule and shall be adequate for the period commencing from the handover of the first train up to one year after the handover of the last train.

3.7.2 The Contractor shall recommend to the Engineer the special tools and testing equipment as stipulated in PS 24.3.

3.8 Designated Contractors

The Contractor shall carry out design, interfacing, installation, testing and commissioning activities with other systems interfacing with the trains as detailed in the PS 31 and Appendix I.

3.9 Options

The Contract contains the following Options, in addition to the original scope of Works of the Base Contract, to be exercised by the Employer in accordance with the Form of Tender:

3.9.1 Option 1A – Supply of additional 15 trains by Dec 2023

The scope of Works for this Option shall include providing the design, manufacture, supply, delivery, installation, testing, commissioning and rectification of defects during the Defects Liability Period for an additional 15 trains in accordance with all the requirements as stipulated in this Specification. Spare parts for running maintenance in accordance with PS 3.7.1 and PS 24.2.1 shall also be recommended. The train shall be delivered according to the programme as stipulated in Section 1.2 of Appendix E and Clauses 1.2, 3.2.2 and 3.3.2 of Appendix F.

3.9.2 Option 1B – Supply of additional 15 trains by Dec 2035

The scope of Works for this Option shall include providing the design, manufacture, supply, delivery, installation, testing, commissioning and rectification of defects during the Defects Liability Period for an additional 15 trains in accordance with all the requirements as stipulated in this Specification. Spare parts for running maintenance in accordance with PS 3.7.1 and PS 24.2.1 shall also be recommended. The train shall be delivered according to the programme as stipulated in Section 1.3 of Appendix E and Clauses 1.3, 3.2.3 and 3.3.3 of Appendix F.

SECTION 4

SYSTEM DESCRIPTION AND

PERFORMANCE REQUIREMENTS

August 2015

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4 SYSTEM DESCRIPTION AND PERFORMANCE REQUIREMENTS

4.1 Introduction

4.2 Business Requirements

4.3 Customer Service Requirements

4.4 Operational Requirements

4.5 Particular Requirements

4 SYSTEM DESCRIPTION AND PERFORMANCE REQUIREMENTS

4.1 Introduction

4.1.1 This Section defines the principal business, customer service, operational and particular performance requirements of the train.

4.1.2 The trains shall provide commuter and leisure journeys for the widest possible anthropometric range of the Hong Kong population including those with special needs.

4.1.3 The trains shall be interchangeable train to train with the Urban Lines Trains.

4.1.4 The trains shall be capable of being operated to provide the required passenger service in conjunction with the operations of the Urban Lines Trains in accordance with the working time tables for the Urban Lines.

4.2 Business Requirements

4.2.1 The exterior livery and interior of the trains shall deliver an image of high quality and promote the status of the Corporation as the premium transport service in Hong Kong. Whilst the overall design requirements are defined herein the Contractor shall meet the design requirements to achieve the visual design as specified in PS 6 and 7.

4.2.2 The trains shall produce a modern, comfortable, cheerful interior conveying an impression of speed, efficiency, and safety while maintaining a strong Corporate image of care for passengers.

4.2.3 The trains shall be designed and constructed for operational safety both under normal operating and maintenance conditions and in the event of equipment failure.

4.2.4 The features of the trains including the train consist arrangement shall be optimised to maximise the performance and minimise the energy consumption cost, train operation and maintenance cost.

4.3 Customer Service Requirements

4.3.1 Speed

The commercial speed of the trains shall achieve the trip times as specified on Drg. No. C6014-14E/TSEG/080/001, Drg. No. C6014-14E/TSEG/080/002, Drg. No. C6014-14E/TSEG/080/003 and Drg. No. C6014-14E/TSEG/080/004 with a condition of minimum of 4% coasting and fully laden load (refer to PS 4.5.4) on all Urban Lines.

4.3.2 Saloon Environment

(a) The train environment shall be comfortable with air-conditioning and adequate ventilation (refer to PS 15).

(b) An adequate lighting level shall be provided (refer to PS 7).

(c) The train interior space shall be optimised and the free floor area in the saloon shall be maximised.

(d) The capacity requirements are specified in PS 7.4.

(e) A wide gangway shall be provided to connect the saloons of adjacent cars, providing a maximum clear view through the train and capacity for standing passengers and for effective evacuation during an emergency. Detailed requirements are specified in PS 14.

4.3.3 Train Reliability

(a) The trains shall achieve the reliability requirement as specified in PS 25.7.

(b) The trains shall achieve the availability requirement as specified in PS 25.8.

4.3.4 Passenger Information

Signage shall be easily understood by passengers with effective and coordinated use of graphic and text. All signs shall be bilingual in Chinese and English. Detailed requirements are specified in PS 7.13.

4.3.5 A public address system shall be provided using high quality recording and digitisation in Cantonese, Putonghua and English for routine announcements. Detailed requirements are specified in PS 18.

4.3.6 Passenger alarm facilities with clear instructions shall be provided in the compartments for passengers to gain the attention of the train operator and establish a two-way voice communication in emergency situations. Detailed requirements are specified in PS 18.

4.3.7 On-board passenger information displays shall be provided. Detailed requirements are specified in PS 18.

4.3.8 Disabled Passengers

Appropriate provisions shall be provided for the use of disabled passenger. Detailed requirements are specified in PS 7.

4.3.9 Commercial Aids

(a) Simple advertising panels with enlarged train cards shall be installed inside trains.

(b) Electronic information displays for advertising with "animated graphics" shall be provided.

Detailed requirements are specified in PS 7.

4.4 Operational Requirements

4.4.1 Compatibility

(a) Although it is not required that the Train Units of the new trains be interchangeable with the Train Units of the Urban Lines Trains, it should be noted that the trains shall be compatible with the Signalling, Communication equipment, Overhead Line Supply, Platform Screen Doors and Trackwork for the Railway. Detailed Interface requirements for the above systems are specified in Appendix I.

(b) The trains shall comply with the following technical constraints of the Railway:

(i) Nominal gauge of running track 1,432 mm.

(ii) Running rail type UIC 60 and BS 90A on ISL/TKL and KTL/TWL respectively, modified to a common profile (refer to Drg. No. OD8/501/00001/0057).

(iii) Minimum horizontal track curvature of radius 300m in running tracks and 140m in depots. Minimum vertical track curvature of radius 1,500m.

(iv) Maximum gradient 3 %

(v) Maximum static axle load shall not exceed 17 tonnes.

(vi) Kinematic Envelope shall be as defined in PS 5.

(vii) Nominal power supply system voltage 1,500 VDC from overhead current supply equipment.

(viii) Design speed of 90 km/h and maximum operating speed of 80 km/h.

(ix) The full length of a train shall be 180 - 185m and be able to work on platforms of 183m in length. A maximum of 8 cars shall constitute a train consist.

(x) Main vehicle dimensions such as the train door pitch, shall be as defined on Drg. No. C6014-14E/TSEG/010/013.

4.4.2 Performance

The traction and braking control shall consider the available adhesion including wet weather condition in open areas. The traction and braking control shall achieve the PS requirements including the following target values with an adhesion not exceeding 19% (if necessary, the adhesion may be assumed to be not exceeding 20% for acceleration only):

(a) Max speed for design purpose: 90 km/h
(b) Max speed in service: 80 km/h
(c) Acceleration: 1.3 m/s^2
(d) Max jerk rate: 0.8 m/s^3
(e) Service ATO brake rate: 0.8 m/s^2
(f) Max service brake rate: 1.35 m/s^2
(g) Emergency brake rate: 1.4 m/s^2
(h) Level of coasting: 4% and fully laden load

4.4.3 Recovery Operation - Emergency Push Out

(a) Automatic mechanical couplings shall be provided at train ends to facilitate the emergency push out operation (refer to PS 9.11.1 and PS 14.2.7).

(b) In emergency push-out operation, the trains shall be able to assist an Urban Lines Train and vice versa.

(c) In Restricted Manual mode and on a level track, a train with any loading from tare to fully laden shall be capable of starting and accelerating a defective train which is:

(i) either a train or an Urban Lines Train;
(ii) fully laden; and
(iii) with parking brakes applied.

This would then be followed by a 3 % gradient for 1.5 km and on level track for 2 km where the passengers would be detrained. The complete consist shall then be capable of returning from any point on the system to the nearest depot. The train speed for emergency push-out operation shall be at any speed up to 10 km/hr.

(d) The emergency push-out operation shall also be achieved with the same conditions in PS 4.4.3 (c) except without parking brakes applied at the defective train. Facility shall be provided for the Urban Lines Train to control and synchronise the emergency brake application of the coupled trains during emergency push-out operation (refer to PS 9.11.1(a)).

4.4.4 Emergency Evacuation

Emergency evacuation shall be possible by the following routes:

(a) through the train front and / or rear descending to track level;

(b) via saloon side-doors with the assistance of the train operator to a track side walk-way in those tracks that are located within the immersed tube only;

(c) through the train front or rear to an assisting train of either a train or Urban Lines Train, coupled to the train being evacuated.

4.4.5 Loss of Power Supply

(a) Emergency systems (refer to PS 17) shall continue to function for 1 hour after a power failure due to loss of the traction or auxiliary power supplies.

(b) Hopper windows (refer to PS 7) shall be provided for additional ventilation in the event of a power failure.

4.4.6 The train operating principles shall be consistent with those of the Urban Lines Trains in order that human errors due to inadvertent use of train operating procedures applicable to only the Urban Lines Trains will be precluded, and in order that the training for experienced train operators of the Urban Lines Trains will be minimised. Control or operating logic conflicting with the existing practices shall be avoided. Copies of the Employer's train operation procedure for the Urban Lines are available for the Contractor's reference. Detailed requirements are specified in PS 9.

4.4.7 The saloon layout shall be optimised to facilitate boarding and alighting and to minimise the dwell time at stations.

4.4.8 The cab design shall incorporate ergonomic and human factors to optimise design, comfort, operability and defect and recovery handling. Standardising of equipment and configurations shall be considered to minimise differences with the Urban Lines Trains. Detailed requirements are specified in PS 8.

4.4.9 Facilities as specified in this PS shall be provided to assist the train operator to undertake his duty at station stops to minimise station dwell time.

4.4.10 The control equipment and its operation shall be safe, reliable and userfriendly. Equipment status monitoring and fault diagnosis facilities shall be provided and designed to give recovery advice to the train operator so as to minimise the recovery time.

4.4.11 Other Emergency Requirements

(a) A train with traction equipment inoperative in one Train Unit shall be able to continue passenger service under ATO control for one complete round trip.

(b) A fully laden train shall be able to work one round trip in Restricted Manual mode (refer to PS 9).

(c) With a single Train Unit failure, with parking brakes applied on the failed Train Unit, it must be possible to motor at fully laden load from any point on the running line to the next station, or refuge siding, detrain all passengers, and then proceed either to refuge siding or depot. The above would be performed in Restricted Manual mode. The train speed shall be at any speed up to 10 km/hr.

(d) In Coded Manual mode make one complete round trip with one Train Unit inoperative at fully laden load.

(e) Emergency jacking points shall be provided to lift the car body together with the bogies (refer to PS 6).

(f) Due to geographical reasons, there may be flooding problems posed to the Railway and there are mainly two types of flooding including water and mud flooding. If the level of the water/mud does reach above the rail foot but below the rail top, it is a requirement that the train shall be able to

operate to a maximum speed of 22 km/h in order to maintain a minimum degree of train service under a flooding condition.

4.5 Particular Requirements

4.5.1 Train Consist (refer to Drg. No. C6014-14E/TSEG/010/009 and C6014-14E/TSEG/010/017 for the conceptual train consist and Train Unit).

(a) The trains shall consist of 8 cars comprising 6 power cars and 2 trailer cars. Alternative train consist design meeting all other PS requirements would also be considered. The Contractor shall demonstrate that the line regenerative energy ratio of the alternative train consist is the same or better than the 6 power cars and 2 trailer cars configuration.

(b) The train formation shall be compatible with the depot facilities (refer to Appendix I Annex 6). For example, the train shall comprise 3 Train Units , i.e. 3 cars (ACB) + 2 cars (BC) + 3 cars (BCA) to suit the lifting equipment.

(c) The configuration of Train Units shall be optimised (refer to PS 4.2.4) in order to meet the overall performance requirements (refer to PS 4.4.2), the emergency duties (refer to PS 4.4.3 and PS 4.4.11), the traction and brake characteristics (refer to PS 11.1.6), the rolling stock parameters for ATC Interface (refer to Appendix I Annex 3) and RAMS targets (refer to PS 25.6 to 25.9).

(d) In order to avoid the speed/distance measurement errors associated with slip/slide on motored axles which would adversely affect the performance of the Automatic Train Control (ATC) system, the cars with a driving cab and ATC equipment shall be trailer cars.

(e) In order to avoid excessive uplift force being applied to the overhead supply wire during the emergency push out operation (refer to PS 4.4.3), the pantograph of the Urban Lines Train is mounted on the second car, so that a minimum distance of 26.8 metres will be maintained between any adjacent raised pantographs. Similar design consideration shall also apply to pantograph spacing in normal service.

4.5.2 Noise Performance Requirements

a) The noise performance requirements shall comply with RS/C6014/13.

b) The Contractor shall appoint a specialist acoustic consultant, whose credentials shall be submitted for Approval, to assist the development of the rolling stock and perform independent audits and verification of the Contractor’s design at agreed intervals. The acoustic consultant shall

have proved experience in the noise control of trains in similar operating environment.

c) The acoustic consultant shall be responsible for the noise testing of the cars for final verification.

d) The acoustic consultant shall have a proven expertise in theoretical and practical noise control of trains from design through verification and commissioning.

e) Noise control shall be based on a validated computer model examining airborne and structure borne noise levels of the entire car and key noise sources.

4.5.3 Ride Quality

The trains shall provide a high quality of ride comfort which is smooth and free from jerks (refer to PS 12).

4.5.4 Load Cases

The following load cases referred to as M1 to M6 shall be used for design purposes:

M1	Train in tare condition
M2	Train in average load condition with 200 passengers per car
M3	Not used
M4	Train in fully laden condition with 312 passengers per car
M5	Train in crush laden condition with 450 passengers per car
M6	Not used

The load cases shall be based on a passenger weight of 60 kg.

4.5.5 Life

The trains shall be designed to meet the requirements of the PS for a minimum operational life of 40 years.

SECTION 5

INFRASTRUCTURE CONSTRAINTS

August 2015

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5 INFRASTRUCTURE CONSTRAINTS

5.1 Kinematic Envelope

5.2 Conditions

5.3 Verification

5.4 Wind Loading

5.5 Axle Load

5.6 Train Weights

5 INFRASTRUCTURE CONSTRAINTS

5.1 Kinematic Envelope

The vehicle shall not exceed the Kinematic Envelope shown in Drg. No. C6014-14E/TSEG/010/001 under the conditions specified in PS 5.2.

5.2 Conditions

5.2.1 Kinematic Envelope

The following conditions shall apply under any combinations:

(a) Speeds up to and including 90 km/h.

(b) All conditions of wheel wear and suspension creep.

(c) 0.1g lateral acceleration applied to the body centre of gravity to account for the combined effects of cant deficiency curving (up to 110 mm) and vehicle lateral accelerations due to track irregularities.

(d) Installed cant of up to 150 mm (nominal).

(e) Air suspension normally inflated, deflated or over inflated.

(f) All conditions of car loading.

(g) Maximum car build tolerance.

(h) Forces due to a side wind of the parameters quoted in PS 5.4.

(i) Suspension parameters at the most disadvantageous limits of tolerance and maintenance limit.

(j) Track parameters and tolerances as defined in Appendix I Annex 1.

5.2.2 Kinematic Envelope in Stations

The car shall not exceed the "local reduction in Kinematic Envelope in stations", shown hatched in Drg. No. C6014-14E/TSEG/010/001 under the conditions stated in PS 5.2.1 except as modified as follows:

(a) Zero cant deficiency.

(b) Zero installed cant.

(c) Zero wind loading.

(d) Stationary, with the body side doors opening, with the body side doors open and passengers entering or leaving the train.

(e) Moving at a maximum speed of 65 km/h with doors closed and with dynamic movements caused by the track irregularities as shown on Drg. No. C6014-14E/TSEG/010/004.

(f) Track parameters and tolerances for track within stations as defined in Appendix I Annex 1.

5.2.3 Kinematic Envelope in Depot Maintenance Tracks

The car shall not exceed the Kinematic Envelope in depot maintenance tracks shown in Drg. No. C6014-14E/TSEG/010/002 under the conditions stated in PS 5.2.1 except as modified as follows:

(a) Speeds up to and including 22.5 km/h.

(b) 0.03g lateral acceleration applied to the body centre of gravity to account for the combined effects of cant deficiency curving and vehicle lateral accelerations due to track irregularities in depot maintenance tracks.

(c) Zero installed cant.

(d) Vehicle in tare condition.

(e) Zero wind loading

(f) Track parameters and tolerances for track within depot maintenance tracks as defined in Appendix I Annex 1.

5.3 Verification

5.3.1 The method for calculating the Kinematic Envelope shall be submitted for Approval.

5.3.2 The Kinematic Envelope calculations for all appropriate conditions listed in PS 5.2, including those for local reduction in Kinematic Envelope through stations, shall be submitted for Approval.

5.3.3 The Contractor shall carry out vehicle sway test as specified in PS 22 and Appendix C to verify the method specified in PS 5.3.1.

5.4 Wind Loading

5.4.1 For abnormal conditions such as typhoon signal no. 8 being hoisted, the speed of side wind shall be taken as 130 km/h in surface section. The specific wind pressure shall be taken as 785 N/m^2 for wind speed of 130 km/h.

5.4.2 Lee side suction shall be allowed for as an additional factor of 20%.

5.5 Axle Load

5.5.1 The maximum permitted axle load will be 17 tonnes.

5.5.2 The variation of axle load on each power car axle shall not exceed by more than 2% from the average of the axle loads of each power car.

5.5.3 The variation of wheel load on the wheels on one side of a car shall not differ by more than ±4% from the average of the wheel loads on both lines of the wheels on the same car. For each axle, the wheel load shall not differ by more than ±4% from the average wheel load of this axle.

5.5.4 All completed vehicles shall be weighed to demonstrate that the requirements of PS 5.5 have been achieved.

5.6 Train Weights

5.6.1 The maximum permitted tare train weight shall not exceed 320 tonnes for the 8 car train consist as specified in PS 4.5.1.

5.6.2 The load cases due to passenger capacity shall refer to PS 4.5.4.

5.6.3 The Contractor shall submit a procedure for controlling the car weight to meet the weight management requirements as specified in PS 21.6.

5.6.4 The Contractor shall carry out weighing tests in accordance with PS 22 and Appendix C.

SECTION 6

CAR BODY STRUCTURE AND EXTERIOR

August 2015

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6 CAR BODY STRUCTURE AND EXTERIOR

6.1 General

6.2 Styling Considerations

6.3 Car Body Structure

6.4 Strength Requirement

6.5 Repair and Maintenance

6.6 Jacking Lifting and Towing

6.7 Car Body Insulation

6.8 Aerodynamic Considerations

6.9 External Features and Fittings

6.10 Exterior Lighting

6.11 Glazing

6.12 Materials Fit and Finish

6.13 Schedule of Colour and Finishes

6.14 Stepping Distance

6 CAR BODY STRUCTURE AND EXTERIOR

6.1 General

6.1.1 This Section shall be read in conjunction with the referenced Drawings and Interior and Exterior Styling Schedule (Appendix L).

6.1.2 Any proposed change from the specified dimensions shall be submitted for Approval.

6.1.3 The Contractor shall propose a car body profile which meets the specified requirements for kinematic envelope, ride quality, structural strength, styling considerations and maintainability. The proposed body profile shall have sides which are contoured similar to Drg. No. C6014-14E/TSEG/010/014 to maximise the body cross section within the limits of the kinematic envelope (refer to PS 5.1) and to minimise the stepping distance at station platforms (refer to PS 6.14).

6.1.4 The Contractor shall construct a full scale underframe mock-up in accordance with Appendix F to demonstrate that adequate consideration has been given to the layout of the major equipment, piping, cable ducting and conduits in respect of weight distribution (refer to PS 21.6) and maintenance access (refer to PS 26) during design and manufacturing phases in accordance with SEMS (refer to PS 21).

6.1.5 Not used.

6.1.6 Not used.

6.2 Styling Considerations

6.2.1 The objectives to be incorporated into the design of the exterior of the train are:

(a) to give the impression of a reliable, efficient and modern train;

(b) to be aesthetically pleasing and up to date during its life;

(c) to maintain the family styling with the Urban Lines Trains;

(d) to create a strong corporate image.

6.2.2 The new cab exterior shall be provided with coloured artwork of the Employer's Identity logo. The size and artwork of this Identity logo will be provided by the Engineer in the design stage. The logo shall be applied through adhesive and shall be durable for outdoor conditions.

6.2.3 The Contractor shall propose the method to apply the exterior livery of the carbody as shown in Drg. Nos. C6014-14E/TSEG/060/001, C6014-14E/TSEG/060/003 and C6014-14E/TSEG/060/005 and Appendix L for Approval.

6.3 Car Body Structure

6.3.1 The car body shall be designed and constructed from aluminium or stainless steel for a life as defined in PS 4.5.5 under the loading conditions defined in PS 4.5.4 and the requirements of PS 6. The car body shall not exhibit any signs of degradation such as fatigue, Stress Corrosion Cracking and etc. throughout its service life.

6.3.2 The Contractor shall demonstrate, by a programme of finite element analysis and testing, that the requirements of PS 6.4 shall be achieved.

6.3.3 Results of finite element calculations shall be submitted for Approval before the commencement of manufacture.

6.3.4 Exterior Finish

(a) The exterior of the cars shall be bare metal for both aluminum and stainless steel carbody and shall have a durable finish designed to minimise the visual effects of deterioration due to aging.

(b) The Contractor shall provide details of all maintenance operations necessary to maintain the exterior finish of the cars in a serviceable condition, such as the removal of stains and repair of minor damage and scratching.

(c) As an alternative to the bare aluminium carbody, the Contractor may propose a means of corrosion protection to be applied to the exterior surface, subject to the Approval by the Engineer. Solely corrosion resistant paint is not acceptable.

6.3.5 The car body shall be designed and constructed to ensure that, with the crush laden (M5) car condition, the body will retain an approved camber between bogie centres. The static deflection at the centre line of the car body at the crush laden (M5) car condition shall not exceed 15 mm.

6.3.6 The pre-production carbody which has been used for load tests shall not be used in the production of the train cars for passenger service.

6.4 Strength Requirement

6.4.1 Proof Loads

The body structure shall withstand the following loading conditions without permanent deformation or any form of damage or deterioration:

(a) A longitudinal compressive force of 1 500 kN distributed over the coupler mounting faces combined with the most adverse vertical loading condition.

(b) A longitudinal tensile force of 1 000 kN distributed over the coupler mounting faces combined with the most adverse vertical loading condition.

(c) A longitudinal compressive force of 600 kN at windowsill height in cars with cabs and at waist rail height in cars without cabs, reacted at waist rail height at the other end of the car. This load shall be applied in combination with the most adverse passenger loading distribution.

(d) A longitudinal compressive force of 300 kN at cant rail height combined with the most adverse vertical loading condition.

(e) A vertical load of 1.5 times the crush laden (M5) car condition with the car body supported at the secondary suspension positions and with loads distributed to represent actual loading conditions.

(f) A vertical load of 1.1 times the tare (M1) car condition with the car supported at the lifting points.

(g) A twist load corresponding to a car having one bogie derailed with the other remaining on level tangent track. The bogies shall have the secondary suspension acting in the most disadvantageous condition. There shall be a vertical height difference of 257 mm between the wheels on one side of the derailed bogie (resting on track bed) and those on the other side of the bogie (resting on a rail). The car shall be in the crush laden (M5) condition plus a 15% dynamic increment.

(h) A longitudinal force equivalent to 5g times the mass of the heaviest bogie, applied to the body centre pivot at the traction centre position. This load shall be applied with the most adverse passenger loading condition.

(i) A vertical load equivalent to 2g times the mass of the heaviest bogie suspended from its normal body to bogie connection points, with the car body being lifted from the car end jacking points (refer to PS 6.6.3) on the adjacent headstock. The other end of the car shall be supported at the secondary suspension position.

6.4.2 Fatigue Loads

(a) Assessment of fatigue shall be in accordance with BS 7608: 1993 for steel cars, and in accordance with BS 8118: Part 1: 1991 for aluminium components. Allowable stresses shall be to the mean minus 2 standard deviation level.

(b) The car structure shall withstand the following loads such that the sum of the individual partial damages for all load cases does not exceed unity. The damages shall be summated using Miner's Rule as defined in the standards referenced in PS 6.4.2 (a).

(i) Vertical loading of 10^8 cycles of the stresses caused by the car in the fully laden (M4) condition cycling at ± 0.1g;

(ii) 10^7 cycles of the stress range caused by a car in the fully laden (M4) condition subjected to a lateral acceleration of ± 0.1g;

(iii) 10^6 cycles of the stress range caused by passenger loading/ unloading from the tare (M1) condition to the fully laden (M4) condition;

(iv) 10^7 cycles of the stress range caused by a car in the fully laden (M4) condition accelerating under maximum traction conditions followed by braking at maximum service braking rate.

6.4.3 Collision and Energy Absorption

(a) The car structure shall be designed to meet C-II requirements to BS EN 15227 such that, in the event of a collision of a force greater than that which can be absorbed by the couplers and anti-climbers, energy shall be absorbed by plastic deformation in the action of the car between headstocks and bolster before plastic deformation occurs elsewhere in the structure.

(b) The arrangement of energy absorption devices within the couplers and anti-climbers shall maximise the energy absorption capacity of the cars. As a minimum, the arrangement shall withstand the following two train collision scenarios without causing damage to the car structure:

(i) An 8-car train in the tare (M1) condition to impact with a similar train with parking brakes applied at speeds of up to 22.5 km/h;

(ii) An 8-car train in the tare (M1) condition impacts with a fixed concrete buffer stop at speeds of up to 11 km/h.

(c) The cab, including panels, framework, detrainment door (refer to PS 8.16), including the windscreen (refer to PS 6.11), shall comply with the the requirements for impact resistance specified in BS EN 15152: 2007.

(d) An anti-climbing device shall be provided at the ends of all cars which shall prevent overriding of the vehicle ends in the event of a collision.

6.4.4 Body Mounted Equipment

The equipment and mountings shall withstand the loads resulting from the following accelerations:-

(a) Proof Loads

Vertical	± 2.0g
Transverse	± 1.0g
Longitudinal	± 5.0g

(b) Fatigue Loads

10^7 cycles of:-

Vertical	± 0.15g
Transverse	± 0.15g
Longitudinal	± 0.20g

6.5 Repair and Maintenance

The headstocks, drag box and bolsters shall preferably be attached by a method which shall facilitate replacement of complete assemblies if damaged in service.

6.6 Jacking Lifting and Towing

6.6.1 There shall be provision for jacking, lifting and towing points on the cars and bogies to conform with the train maintenance philosophy given in PS 26.

6.6.2 The Contractor shall propose the type and positions of lifting and jacking points to meet the requirements of Appendix I Annex 1 and Appendix I Annex 6. The final arrangement shall be submitted for Approval.

6.6.3 Jacking points shall also be provided at ends of the cars for re-railing the car in the event of derailment. The Contractor shall consider the layout of

the track and infrastructure as detailed in Appendix I Annex 1 to ensure that the jacking points are suitably positioned.

6.6.4 Towing points shall be provided at all 4 corners of each car to meet the requirements of Appendix I Annex 6 Clause 3.6.1.

6.6.5 Jacking and lifting points shall be clearly marked for ease of identification from the trackside. The detailed interface and method of identification shall be submitted for Approval.

6.7 Car Body Insulation

6.7.1 The car body shall be insulated to minimise noise and heat transmission through the structure and reduce air conditioning energy requirements.

6.7.2 Any insulation shall be protected against degradation, shall not allow migration of particles into the car interior and shall be retained even when access panels are opened.

6.8 Aerodynamic Considerations

6.8.1 The Contractor shall consider the following in the design of the train:-

(a) Tunnel portals shown in Appendix I Annex 1.

(b) Ambient conditions, in particular the wind speeds, detailed in GS Clause 2.1.

(c) Platform Screen Doors in accordance with Drg. No. C6014-14E/TSEG/077/004, at speeds up to 90 km/h.

(d) Protrusions and recesses which disturb airflow or form dirt traps which are difficult to clean shall be avoided.

6.8.2 Exterior light assemblies shall be flush-mounted as shown on Drg. No. C6014-14E/TSEG/060/004.

6.8.3 All external cab controls shall be flush-mounted.

6.8.4 Wipers shall not be "parked" perpendicular to high velocity airflow.

6.8.5 Glazing and any associated framing shall be flush fitted in accordance with PS 6.11.

6.8.6 Pantograph fairings within the car roof profile shall be provided to maintain the car body profile as far as possible in the area of the pantograph well.

6.8.7 Drainage shall be provided to avoid water accumulation within the pantograph well. The Contractor may make use of the car gutter to avoid drainage running down the side of the car.

6.8.8 Pressure Transient Requirements

(a) When trains are entering, exiting or running through tunnels, bridges, viaducts and stations, pressure pulses felt by passengers or train operators shall be limited to the following maximum pressure changes:

(i) 800 Pa in any 4 second period

(b) When two trains are passing each other in opposite direction within a tunnel, the maximum pressure changes shall be limited to:

(i) 800 Pa in any 4 second period

(c) The peak-to-peak pressure pulses on passing trains shall be limited to 1.44 kPa.

6.9 External Features and Fittings

6.9.1 Wipers

(a) Wipers shall be fitted to clean the windscreens in front of the Train Operator Console and the Auxiliary Console (refer to Drg. No. C6014-14E/TSEG/060/004).

(b) Wipers shall sweep the largest possible arc to maximise the cleansed area to meet all the external vision requirements of the train operator, including the viewing of signal sight lines, from both the seated and standing positions. The same swept area shall be provided on the Auxiliary windscreen.

(c) The wipers shall resist the local air speeds at the edges of the windscreen. The force with which the wiper is held against the windscreen shall be limited to avoid the danger of scratching the surface of the glass. Wipers shall not lift off the wiper area at maximum train speed.

6.9.2 Windscreen Washers

(a) A windscreen washer system shall be fitted to wash the windscreens in front of the Train Operator Console and the Auxiliary Console.

(b) The washer reservoir shall have a minimum capacity of 7 litres.

(c) The washer reservoir shall be refillable from the exterior of the car.

6.9.3 Steps

(a) Steps shall be provided to facilitate entry into the cab from rail or cess level (refer to Drg. No. C6014-14E/TSEG/060/004).

(b) The step width shall be a minimum of 400 mm and the step depth a minimum of 180 mm, with a minimum aperture height of 165 mm.

(c) The steps shall have an anti-slip surface.

(d) The steps shall be aerodynamically shaped.

6.9.4 Horn

(a) A horn shall be fitted at each cab and hostler position.

(b) The horn shall meet the requirements of PS 13.14.

(c) The mounting arrangement for the horn shall protect it from damage by flying objects such as ballast, and shall not allow accumulation of leaves, rubbish, water or debris which could affect the performance.

(d) The mounting arrangement shall ensure the uninterrupted operation of the horn even under adverse weather conditions.

6.9.5 Electronic Train Number Display and Electronic Destination Display

(a) A train number display (refer to PS 10.4.5) shall be provided in the upper part of the windscreen on the Auxiliary side of the cab as shown on Drg. No. C6014-14E/TSEG/060/001 and shall be clearly visible as the train enters a platform.

(b) A destination display (refer to PS 10.4.4) shall be provided in the upper part of the windscreen on the driver side of the cab as shown on Drg. No. C6014-14E/TSEG/060/001and shall be clearly visible as the train enters a platform.

6.9.6 Detrainment Door

The requirements for the detrainment door (as part of the Emergency Detrainment Device) are detailed in PS 8.16. The door shall meet the performance requirements with minimum effect on the car's front end design.

6.9.7 Cab Side Doors

Cab side doors (refer to PS 16.3) shall be provided as shown on Drg. No. C6014-14E/TSEG/060/004.

6.9.8 Roof

(a) The train roof shall be smooth with all fittings flush mounted into the roof profile. Any resulting recesses shall be adequately drained. A gutter shall be provided to prevent rain from dripping onto passengers at the door positions (refer to Drg. No. C6014-14E/TSEG/060/004) and dripping onto train operators at the cab side door positions.

(b) A pantograph well (refer to RS/C6014/10) adequately rated at 1500VDC shall be provided on the car roof in accordance with Appendix I Annex 2 Clause 1.5 for accommodating the pantograph.

6.9.9 Passenger Bodyside Doors

Passenger bodyside doors (refer to PS 16.2) shall be positioned as shown on Drg. No. C6014-14E/TSEG/010/013.

6.9.10 Target Holder

Provision shall be made on both ends of the car for fixing a target (refer to Appendix I, Annex 6).

6.9.11 Fairing

(a) An aerodynamic fairing shall be installed around the coupler opening as shown on Drg. No. C6014-14E/TSEG/060/001.

(b) The cab fairing shall not interfere with the operation of the coupler and shall not affect the performance of the detrainment ramp or other equipment.

(c) Detrainment door arms shall be positioned such that impact on the appearance of the fairing is minimised. Any slotting shall have the minimum height and width possible. There shall be no detriment to the smooth appearance of the transition from body to fairing.

6.9.12 Vents

(a) Vents shall be provided as shown on Drg. No. C6014-14E/TSEG/060/001.

(b) Vents shall be kept as small as possible and shall be designed to minimise see-through.

6.9.13 Not Used

6.10 Exterior Lighting

6.10.1 General

(a) Exterior lights shall be mounted as defined in Drg. No. C6014-14E/TSEG/060/004.

(b) The design shall enable the replacement of lighting units or bulbs to be completed within 15 minutes from the exterior of the train.

(c) Lighting units shall be sealed to BS EN 60529: 1992 IP65.

(d) Moisture, condensation and dirt shall not collect behind any glazing covers, either in operation or following maintenance.

6.10.2 Headlights

(a) One rectangular, white headlight shall be fitted below the windscreen on each side of the cab front as shown on Drg. No. C6014-14E/TSEG/060/004.

(b) The headlight shall be housed within a formed recessed panel and shall be covered by a red screen printed glass panel which shall have a clear section at each light position.

(c) The headlight shall be a halogen, double filament unit providing day time head lamp and night time head lamp. In normal operation during daylight, the day time head lamp shall be lit. In the hours of darkness, the night time head lamp shall be lit.

(d) If it is necessary to step down the supply DC voltage for the halogen lights, an electronic transformer having an efficiency of greater than 80% shall be used.

(e) The headlights shall be angled to avoid dazzling the train operators of oncoming trains.

(f) The headlights shall comply with the following luminous intensity requirements according to Appendix 3 of GM/RT 2483: 2004:

Table 6-1 Day time head lamp luminous intensity
(The following notation is used: U = up; D = down; L = left; R = right)

Angle above optical axis, at all angles to the left and right	Maximum luminous intensity (cd)
>4° U	1,200
>3° U to 4° U	4,000
>2° U to 3° U	13,000
>1° U to 2° U	90,000

Table 6-2 Day time head lamp luminous intensity

	Minimum luminous intensities (cd) at specified angles with reference to the optical axis		
	5° L to >2° L	2° L to 2° R	>2° R to 5° R
1° U to >0° U	6,000	35,000	6,000
0° U,D to 1° D	6,000	35,000	6,000
>1° D to 2° D	6,000	6,000	6,000

Table 6-3 Night time head lamp luminous intensity

Angle above optical axis, at all angles to the left and right	Maximum luminous intensity (cd)
>4° U	400
>3° U to 4° U	1,000
>2° U to 3° U	1,200
>1° U to 2° U	5,000

Table 6-4 Night time head lamp luminous intensity

	Minimum luminous intensities (cd) at specified angles with reference to the optical axis		
	5° L to >2° L	2° L to 2° R	>2° R to 5° R
1° U to >0° U	300	1,200	300
0° U,D to 1° D	3,000	26,000	3,000
>1° D to 2° D	3,000	3,000	3,000

(g) The headlights shall be able to automatically switch to night time head lamp, as detailed in PS 9.9.11. The train operator shall be able to switch the headlights to day time head lamp in the cab, as detailed in PS 8.8.4 (k).

6.10.3 Tail Lights

(a) One circular red tail light shall be fitted below the windscreens on each side of the cab front, as shown on Drg. No. C6014-14E/TSEG/060/004.

(b) The tail lights shall comply with the following luminous intensity requirements according to Appendix 4 of GM/RT 2483: 2004:

Table 7-5 Tail light luminous intensity

Vertical	Horizontal	Minimum luminous intensity (cd)	Maximum luminous intensity (cd)
0° U, D	0° L, R	100	250
0° U, D	5° L, R	40	120
5° D	0° L, R	40	120
5° U	0° L, R	40	120

(c) The tail lights shall be automatically switched on, as detailed in PS 9.9.11.

(d) The tail lights shall be mounted similarly to the headlight as specified in PS 6.10.2(b). The tail light glazing shall be red.

6.10.4 RM Lights

(a) One rectangular amber flashing light shall be mounted in the centre of the cab front above the detrainment door as shown on Drg. No. C6014-14E/TSEG/060/004.

(b) The lights shall be visible from 100 m, under all weather conditions, over a total arc of 160 degrees measured from the centre line of the train.

(c) The lights shall be automatically switched on in Restricted Manual mode, as detailed in PS 9.9.12.

(d) The lights shall be fitted in a recessed panel and shall be covered by a clear glazed panel.

6.10.5 Bodyside Indicator Lights

(a) One amber light shall be fitted above door level at the centre of each body side.

(b) All the lights on one side shall be visible down the length of the train, on straight track, when viewed from either of the cab side doors on that side of the train.

(c) The lights shall be visible from platforms through the platform screen doors.

6.11 Glazing

6.11.1 General

(a) All glazing shall be made from laminated safety glass or toughened safety glass to BS 857:1967 unless otherwise stated.

(b) Cab windscreens and the bodyside windows (including those in the cab and passenger doors) shall not cause visual distortion or reflection under any ambient lighting conditions.

(c) There shall be no visible defects within the viewing area of the glazing.

(d) The train operator's external vision shall not be affected by any interior lighting conditions (refer to PS 8.5).

(e) All glass, except the cab windscreens, shall be tinted. The colour may be achieved by using a tinted interlayer or by tinting the body of the glass.

(f) The tint shall not affect the train operator's perception of signals, signal colours, platform monitors, or any other information displays.

(g) The tint shall not fade throughout the service life of the car.

(h) All windows shall be bonded directly into the body structure.

(i) All windows shall be flush with the car profile in order to provide minimum aerodynamic resistance.

(j) The window design shall allow for ease of removal and replacement of glass from outside the train.

(k) The Contractor is required to use Sikaflex 265 or an Approved equivalent for glazing bonding system.

(l) The bonding system shall maintain the integrity of the glazing in the event of a trainborne fire or an external fire in a tunnel.

(m) All windows shall be sealed and water tight for the life of the train and shall meet the testing requirements of Appendix C.

(n) Edges of all cab and bodyside glazing shall be screen printed black as shown on Drg. Nos. C6014-14E/TSEG/060/001 and C6014-14E/TSEG/060/003 to conceal any structure or trim detail and to protect the bond from UV light.

(o) Cab and bodyside glazing shall meet the light and solar heat transmittances given below:-

	Light Transmission (min)	Solar Heat Transmission (max)
Cab Windows	76 %	72 %
Bodyside Windows	47 %	49 %

(p) Toughened safety glass to BS 857:1967 shall carry out heat soaking test according to the following requirements to prevent glass selfbreakage in service due to the presence of Nickel Sulphide inclusion:

(i) Glass shall be both tempered and heat soaked to achieve the requirements as specified in PS 6.11.

(ii) Tempering shall be performed on a roller hearth furnace eliminating tong marks.

(iii) Glass shall be heat conditioned (heat soak cycle) at a mean oven of 290 ± 10℃ to BS EN 14179 so as to prevent failure in service due to insufficient germination of Nickel Sulphide inclusions

(iv) Edge work, holes, and notches in tempered glass shall be completed before tempering and shall comply with requirements of the manufacturer's tempered glass specification.

(v) Glass equal to or under 12 mm thick (before lamination) shall have arris edges. For glass over 12 mm thick the edges shall be flat grounded to give a flat profile with smooth arris. Edges shall have a frosted appearance.

(vi) Roller wave shall be measured periodically after the tempering stage has been completed. Roller wave distortion shall be measured by manufacturer's standard measurement method. Maximum allowable peak to tough variation shall be 0.05 mm with a maximum sag at the leading and trailing edge of 0.25 mm. Roller waves shall be unnoticeable when viewed from a distance of 3 metres.

(q) The records of the glass production shall be submitted which shall include details of:

(i) Location and details of the raw glass production plant.

(ii) Location and details of the glass processing and treatment plant.

(iii) Details of the toughening and heat soaking ovens and processes including temperature and periods of heat soaking.

(iv) Delivery records of each batch of glass delivered to the project site such that the details of individual pane can be traced back to raw production, processing and treatment when required.

(v) Installation and as built information linking the above production information to the completed installation.

6.11.2 Cab Windows

(a) Cab windows shall be provided as illustrated in Drg. Nos. C6014-14E/TSEG/060/001 and C6014-14E/TSEG/060/004.

(b) Visibility through all cab windows shall not be impaired, with all auxiliary equipment operating normally, under any of the ambient conditions specified in GS Section 2.

(c) The windscreens shall comply with the functional requirements as specified in BS EN 15152: 2007. The requirements for impact resistance and spalling specified in BS EN 15152: 2007 shall apply to all the windscreens to provide the maximum safety to the train operator.

(d) The clear window width of the cab windscreens at a position 2,500 mm above rail level shall be greater than 565 mm.

6.11.3 Car Bodyside Windows

(a) Bodyside windows and bodyside door windows shall be provided as defined in Drg. No. C6014-14E/TSEG/010/013.

(b) Passenger bodyside and bodyside door windows shall be double glazed. The inner pane shall be constructed from laminated safety glass and the outer pane shall be constructed from toughened safety glass.

(c) The space within the double glazed units shall be hermetically sealed and free from misting for a period of 7 years.

(d) The double glazed windows shall be such that, following breakage of the outer pane, the inner pane shall withstand 25 pressure pulse cycles of 1.2 kN/m^2 without shedding glass particles.

(e) Hopper windows shall be fitted to all passenger windows as detailed in PS 7.12.2 for emergency ventilation only, and shall be designed to allow easy opening by passengers, even after prolonged periods of closure.

(f) The hopper windows shall not rattle under any conditions or inadvertently open when subjected to the external pressure pulses experienced on the railway.

6.12 Materials Fit and Finish

6.12.1 All exterior panels, glazing and components shall be flush fitting and neatly finished.

6.12.2 Bodyside rippling shall be kept to a minimum. The exterior of the car body shall be smooth and free of protuberances, sharp edges and weld spatter.

6.12.3 The flatness and profile of the bodysides shall be measured using a 1,000 mm long straight edge or profile gauge which, when placed on any continuous surface, shall not reveal a gap greater than 2.0 mm, however for every 300 mm in length, no gap shall greater than 1.0 mm.

6.12.4 The adhesive applied in proximity of car body structure and exterior shall not contain any chloride, which is a precursor for Stress Corrosion Cracking.

6.13 Schedule of Colour and Finishes

6.13.1 All painted items shall match the colour and finish of the unpainted car body. The Contractor shall submit samples of the proposed colour match and finish of the cab front and of the car body material for Approval. Colour systems specified in PS 7.3.2 shall be used.

6.13.2 All painted items shall be painted to a finish in accordance with Appendix L.

6.13.3 Not used.

6.13.4 Not used.

6.13.5 Not used.

6.13.6 The colour and finish of all painted items shall not fade or deteriorate due to mechanical washing, UV radiation, or any condition usually encountered in a service or maintenance environment for a minimum period of 20 years.

6.13.7 Where decals are used, they shall meet the following requirements:-

(a) The decals shall be made of reflective film.

(b) The decals shall not require replacement for any reason for at least 7 years.

(c) The decals shall meet the following requirements for the service life specified in (b):-

(i) The decals shall not stretch, shrink, or blister.

(ii) The decals shall not stain.

(iii) Decal colours shall not fade or suffer any colour disfigurement.

(iv) Replacement decals shall match in terms of size and colour of the existing decals.

(v) Decals shall be easily removable at the end of their service life.

(vi) Decals shall have a high abrasion resistance and be resistant to all chemicals and contaminants likely to be encountered in service.

(vii) The sticker adhesive shall be general purpose emulsion/water based, UV resistant, removable adhesive with an excellent initial tack and hold power to fix on the car body and door panel.

(viii) After removal, the adhesive shall not leave any residue on the car body or door panel which would attract dirt and impair the train's appearance. The residual adhesive stayed on the car body or door panel material shall be less than 30% in area of the total adhesive area. The recommended adhesive strength is no less than 1100 N/m for the car body surface.

(ix) The decal should be resistance to water, mild alkalis, mild acids, and salt.

(x) The tensile strength of the decal shall be of minimum 9000N/m.

(xi) The decal shall comply with fire performance requirements as specified in RS/C6014/08.

(d) Not used.

6.13.8 The materials for the exterior livery shall be suitable for the environmental conditions as specified in GS Section 2.

6.14 Stepping Distance

6.14.1 The door system shall be designed to minimise the stepping distance and the gap between the platform screen doors and the passenger bodyside doors in the opened position, in order to avoid passenger trappage.

6.14.2 A nominal stepping distance of not greater than 69 mm for passenger bodyside doors shall be achieved between the outer edge of the car floor in the doorway area and the platform edge on straight platform. The nominal gap between passenger bodyside doors in the opened position and platform screen doors of not greater than 112 mm, shall be achieved on straight platforms at height up to 750 mm above floor level. These requirements shall be applied for URL and KTE. For WIL, different setting out of platform screen door will be developed to be compatible with these targeted dimensions. The detailed interface for WIL shall be reviewed and coordinated during detailed design stage.

6.14.3 Not used.

6.14.4 For calculation purposes

(a) the platform edge shall be taken as 1645 mm from the centre-line of the track;

(b) the platform screen door setting out shall be taken as 1660 mm from the centre of the track;

(c) the train shall be assumed to be on straight track.

6.14.5 The Contractor shall submit calculations to demonstrate that the required nominal stepping distance and nominal gap between passenger bodyside doors in the opened position and platform screen doors will be achieved.

SECTION 7

INTERIOR OF CAR BODY

August 2015

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7 INTERIOR OF CAR BODY

7.1 General

7.2 Evaluation Requirements

7.3 Overall Concept

7.4 Passenger Capacity

7.5 Interior Panels

7.6 Seating

7.7 Passenger Retention

7.8 Flooring

7.9 Lighting

7.10 Commercial Aids

7.11 Communications

7.12 Environmental Control

7.13 Signage

7.14 Fire Fighting Equipment

7.15 Maintainability

7.16 Safety Requirements

7.17 Hostler Cubicle

7.18 Saloon Smoke Detection

7 INTERIOR OF CAR BODY

7.1 General

7.1.1 The objective of the interior design shall be to create a quality environment for commuter and leisure journeys for the widest possible range of demographic types of Hong Kong population including the disabled.

7.1.2 To enable the Employer to render a quality service, the design shall be user-friendly, clean, safe and modern.

7.1.3 The basic configuration shall be similar to the M Trains, C Trains and K Trains. The Contractor is encouraged to view the interior of the M Trains, C Trains and K Trains in order to maximise his understanding of the requirements. In all instances, the requirements of this PS shall apply.

7.1.4 This Section shall be read in conjunction with the referenced Drawings and Interior and Exterior Styling Schedule (Appendix L).

7.2 Evaluation Requirements

7.2.1 Industrial and Ergonomics Specialist

(a) Apart from meeting the functional requirements laid down in this PS, the saloon interior shall be designed with due ergonomic and aesthetic considerations.

(b) The Contractor shall submit for Approval the Curriculum Vitae of the industrial and ergonomics specialists.

7.2.2 Programme

(a) The Contractor shall submit for Approval, as part of the requirements of PS 29, a staged programme detailing the process for achieving the requirements of this Section. The process shall demonstrate that the requirements are successfully integrated with the engineering requirements of this PS. The programme shall be submitted during SEMP Stage 1.

(b) The programme shall identify, but not be limited to, the following activities:

(i) Perspective drawings and artist's impressions to demonstrate the Contractor's understanding of the required style, image and aesthetics.

(ii) Dimensional drawings indicating all key dimensions.

(iii) Reference samples of components such as straphangers (refer to PS 7.9) and seats (refer to PS 7.8).

(iv) A full-scale, half-car-length engineering mock-up of the saloon interior.

(v) Design review meetings amongst the Engineer, the Contractor and his industrial design specialists.

(vi) Ergonomic trials on the full-scale engineering mock-up, including but not be limited to the following:

(1) The Electronic Information Display and Dynamic Route Map sight line trials.

(2) Trials on the passenger seat profile and the passenger alarm device.

(vii) Retrofitting of equipment on the full-scale engineering mock-up, including at least one set of the Electronic Information Display and Dynamic Route Map and two sets of the saloon door drive mechanism and In-Saloon CCTV cameras.

7.2.3 Full-Scale Engineering Saloon Mock-up

The full-scale engineering saloon mock-up shall represent the required image, style and aesthetics and shall include the following:

(a) Gangway

(b) Gangway end cubicles including the hostler cubicle

(c) Multi-purpose area.

(d) Production standard surface finishes, materials, tolerances, panel fits and colours.

(e) Access required for maintenance purposes to all equipment such as light fittings, door gears, saloon smoke detection equipment, In-Saloon CCTV cameras, Electronic Information Display and saloon air conditioning control access panels.

(f) All engineering features such as fasteners, panel locks, exhaust and return air grilles, and wherever possible proposed production items shall be used.

(g) All saloon features such as grabpoles, grabrails, grabhandles, draughtscreens, signages, advertisement cards and fire extinguisher shall be included.

(h) Fully representative production light fittings which shall be used to measure lighting levels and demonstrating the desired lighting balance and ambience.

(i) Fully representative production seats for evaluation.

(j) Electronic Information Display and Dynamic Route Map shall be functional for evaluation such as sight lines.

(k) At least two sets of saloon doors and In-Saloon CCTV cameras shall be functional for evaluation.

7.2.4 Erection, Transportation and Retrofitting

(a) The full-scale engineering mock-up shall be erected at the Contractor's premises for evaluation.

(b) The Contractor shall submit a list of equipment from those specified in PS 7.2.3 that will not be available during the mock-up development stage for Approval during SEMP Stage 1.

(c) The Contractor shall retrofit the equipment in PS 7.2.4(b) to the fullscale engineering mock-up once the equipment become available.

(d) The Contractor shall be required to modify the full-scale engineering mock-up in accordance with the Engineer's comments. All design changes and modifications shall follow the Configuration Control Programme requirements (refer to Appendix P).

7.3 Overall Concept

7.3.1 Styling

(a) The overall requirement for the train interior is to retain the general layout of the M Trains, C Trains and K Trains while improving the ceiling, lighting, colours, surface textures, methods of fixing/attaching internal fittings and equipment, and general aesthetics.

(b) The overall image of the train shall be open and friendly, reassuring the passengers of the safety and reliability of the train service.

(c) Large glazed areas and body side windows, shall have high clarity and facilitate the viewing of station names.

(d) The interior design shall ensure compliance with the maintenance and reliability requirements as detailed in PS 26.

(e) The detailed description of the styling requirements in Appendix L shall be read in conjunction with this Section.

(f) Elements of the interior not covered in Appendix L shall follow the same design intent of this Section in all respects such as quality, style, detailing and types of finishes.

(g) Simple controls shall be used for any passenger-operated features.

7.3.2 Colours

(a) Colours specified in Appendix L have been taken from various colour systems. The Contractor shall use the appropriate system as specified in Appendix L to propose colours.

(b) Where the same colour is proposed for different types of finishes or materials, the maximum effort shall be made to ensure matching of colours. The Contractor shall use the most difficult material as a datum for matching the colours of other materials.

(c) The Engineer will confirm the colour scheme for the train interior upon Approval of the full-scale engineering mock-up.

7.3.3 Finishes

(a) Finishes used shall be free from any visible marks or defects.

(b) Finishes used shall satisfy the cleaning requirements detailed in PS 7.15. For instance, 'lightly-textured' finishes as detailed in Appendix L shall facilitate efficient cleaning by cloth and cleaning solution while providing a finish which disguises scratches and knocks.

(c) The gloss levels quoted are stated as percentage gloss. Unless otherwise stated, all finishes shall be smooth and in solid colour.

7.3.4 Samples

(a) To ascertain durability and colour consistency, the Contractor shall supply samples of all materials and finishes used on the train.

(b) Upon Approval of the range of materials and decorative panels, the Contractor shall submit 4 numbered samples (150 mm x 150 mm) of each finished panel with different colour, material and finishes, and flooring material. These samples will be retained by the Engineer as a basis for assessing colour consistency, surface finishes, deterioration and quality. Any deviation from these samples during production shall not be accepted.

(c) Not used.

(d) The Contractor shall also supply sufficient samples to the Engineer to establish the acceptable colour range and finish variation for the interior.

(e) The Contractor shall submit samples of the grades of aluminium or stainless steel car body finish (500 mm x 500 mm) within six months following the Contract Award in order for the Engineer to approve the finish to be incorporated on the mock-up.

7.3.5 Materials

(a) All materials shall meet the fire performance requirements as specified in RS/C6014/08.

(b) All materials shall meet the safety requirements as specified in PS7.16.

(c) Interior glazing shall conform to BS 857:1967 standard.

(d) Flooring materials shall meet the requirements as specified in PS 7.8.

(e) Materials used shall meet the maintenance and cleaning requirements as specified in PS 7.15.

7.3.6 Dimensions

(a) The key dimensions for cars with cabs are indicated on Drg. No. C6014-14E/TSEG/100/001.

(b) The key dimensions for cars without cabs are indicated on Drg. Nos. C6014-14E/TSEG/100/002, C6014-14E/TSEG/100/003, C6014-14E/TSEG/100/004 and C6014-14E/TSEG/100/005.

(c) The ceiling height shall be at four levels:

(i) Along the longitudinal centre line of the ceiling shall be a minimum of 2035 mm above finished floor level.

(ii) The ceiling above the seating bays without advertisement cards and Electronic Information Display shall be a minimum of 1890 mm above the finished floor level.

(iii) The ceiling above the seating bays with advertisement cards shall be a minimum of 1800 mm above the finished floor level.

(iv) The ceiling above the seating bays with Electronic Information Display shall be a minimum of 1800 mm above the finished floor level.

(d) The ceiling height, with all projecting features such as lighting, shall be maximized to ease access/egress. Minimum height beneath the lighting shall be 1970 mm above the finished floor level.

(e) Clear throughway height in doorways shall be a minimum of 1920 mm above the finished floor level.

(f) The floor level through the inter-car gangway shall be flat and unobstructed (except for the bridge plate).

7.4 Passenger Capacity

7.4.1 Passenger Capacity

(a) Provision shall be made for bench seats and multi-purpose areas in accordance with the layout in Drg. Nos. C6014-14E/TSEG/010/017, C6014-14E/TSEG/100/001, C6014-14E/TSEG/100/002, C6014-14E/TSEG/100/003, C6014-14E/TSEG/100/004 and C6014-14E/TSEG/100/005.

(b) Multi-purpose Area

(i) Two types of multi-purpose areas shall be provided in accordance to the layout in Drg. Nos. C6014-14E/TSEG/100/001, C6014-14E/TSEG/100/002, C6014-14E/TSEG/100/003, C6014-14E/TSEG/100/004 and C6014-14E/TSEG/100/005:

- Multi-purpose area in accordance with Drg. No. C6014-14E/TSEG/100/013.

- Enlarged multi-purpose area in in accordance with Drg. No. C6014-14E/TSEG/100/014.

(ii) Not used.

(iii) Not used.

(iv) Grabrails and grabhandles shall be installed at the multi-purpose areas and enlarged multi-purpose area as specified in PS 7.7.6 and Drg Nos. C6014-14E/TSEG/100/013 and C6014-14E/TSEG/100/014.

7.4.2 Passenger Anthropometry

The passenger anthropometry shall be based on the 5th percentile female to 95th percentile male of the Hong Kong Chinese population as defined in RS/6014/14 Clause 7.6.

7.5 Interior Panels

7.5.1 General

(a) A systematic approach shall be adopted for the sizes and proportions of all interior panels. Access panels shall be considered as part of the interior design concept.

(b) All panels shall be installed to avoid creaking, rattling or drumming during service.

(c) Panels shall be modular and fully interchangeable, i.e. not coach-built.

(d) Large, one-piece mouldings which restrict access to other fittings and inhibit removal for repair or replacement shall be avoided.

(e) Horizontal ledges that may allow dust settlement shall be avoided.

(f) The panels shall be of sufficient structural integrity to avoid distortion or damage.

(g) The Contractor shall ensure the absence of hazards to passengers or staff such as sharp edges either in the finished cars or on or behind panels when removed to provide access for maintenance.

(h) Any hinged or removable panel shall be secured from falling whilst being opened or removed, and free of sharp edges and corners.

(i) The finished surface of the interior panels shall be suitable for the application and removal of cured self-adhesive commercial advertisements by experienced workers without suffering from any visible degradation.

(j) The Contractor shall demonstrate compliance with the requirements of the application and removal of the cured self-adhesive commercial advertisements as specified in PS 7.5.1 (i) on the pre-production train/ engineering mock-up.

7.5.2 Fixings and Catches

(a) All fixings and catches shall be concealed unless the method of fastening is visually harmonious with the overall styling.

(b) All panels shall be easily removable and replaceable incurring the minimum of disturbance to adjacent areas and flooring. All panels shall not require the use of any sealants or other compounds for replacement. Lining panels shall not restrict access to equipment.

7.5.3 Joints

(a) The number of joints within the train interior shall be minimised.

(b) All exposed edges shall be pre-finished with a uniform and radiused edge.

(c) All panel joints throughout the ceiling and body side panels shall be consistently treated and shall be visually compatible and harmonious with the overall scheme. All tolerance gaps shall be uniform and minimised.

(d) There shall be effective sealing against dirt, foreign bodies and water between all panels and adjacent elements of the interior trim.

(e) Tolerance gaps shall not unveil or provide access to equipment or the space behind panels. The gaps shall either be masked from behind or fitted with an appropriately finished item.

7.5.4 Panels and Door Locks

(a) The key and the lock mechanism shall be designed in accordance with RS/C6014/15.

(b) The key shall be required to access the following:

(i) all interior maintenance panels, such as the door coving panel, the ceiling coving panel and the hostler cubicle

(ii) operate the Emergency Handle of the passenger alarm device (refer to PS 7.11.4(h))

(iii) operate the door isolation device (refer to PS 16.2.8)

(iv) operate the door internal manual release device (refer to PS 16.2.10(a))

(c) The key escutcheon shall be of minimal size with the minimum visual impact on the appearance of the interior.

7.5.5 Service Life of Panels

(a) Panels used shall have the same service life as the train as detailed in PS 4.5.5.

(b) Panels used shall maintain their original shape without distortion under changes of temperature, or corrode throughout their service life.

(c) Panel coatings shall have a durability of 20 years, during which the panel finish shall:

(i) Not blister
(ii) Not scratch, dent or crack
(iii) Not discolour or lose its gloss level
(iv) Remain colour fast
(v) Show no signs of colour deterioration

(d) All panels shall withstand the cleaning of graffiti, rub marks and scuffing by cleaning agents without causing any damage or colour degradation.

7.5.6 Saloon Ceiling Panels

(a) The ceiling shall house lighting and their associated components. (refer to Drg. No. C6014-14E/TSEG/100/020).

(b) Maintenance access shall be provided for all ceiling mounted components such as the return air grills, return air temperature sensor and air filters.

(c) Access to test, maintain and replace these components shall be achieved from within the saloon by one competent maintenance staff using hand tools within 20 minutes. The Contractor shall demonstrate achievement of this requirement.

(d) The ceiling shall incorporate an insulation between the warm saloon and the chilled air in the air conditioning plenum in order to prevent condensation.

7.5.7 Ceiling Coving Panels

(a) The ceiling coving shall be used for carrying passenger alarm emergency handles, public address loudspeakers, signages, advertisements and graphical display boards (refer to Drg. Nos. C6014-14E/TSEG/100/001, C6014-14E/TSEG/100/002, C6014-14E /TSEG/100/003, C6014-14E/TSEG/100/004, C6014-14E/TSEG/100/005, and C6014-14E/TSEG/100/020).

(b) The system of coving shall be modular in design, providing a consistent linear band along the car.

(c) Advertisement card holders shall be designed for maximum simplicity of use, are to be provided over the seat bay at the coving, except at the multi-purpose areas and enlarged multi-purpose areas.

(d) Any advertisement card shall be removed or replaced within a maximum of 20 seconds, though the method of retention shall inhibit unauthorised removal.

(e) The length of the coving panels for those mounted with advertisement cards or the Electronic Information Display shall be the same and shall be symmetrical with the centreline of the seat bay.

(f) Those coving panels mounted with Electronic Information Display shall be able to hinge down and get over the grabrail over the seat. When

hinged down the ceiling coving panel shall be positively retained to prevent unintentional movement.

7.5.8 Door Coving Panels

(a) Door coving panels shall be fitted at each doorway to cover the door equipment.

(b) The Dynamic Route Map (refer to PS 10.4) shall be mounted on each door coving panel in accordance with the general arrangement as shown in Drg. Nos. C6014-14E/TSEG/100/001, C6014-14E/TSEG/100/002, C6014-14E/TSEG/100/003, C6014-14E/TSEG/100/004, C6014-14E/TSEG/100/005, C6014-14E/TSEG/100/016 and C6014-14E/TSEG/100/020.

(c) When hinged down the door coving panel shall be positively retained to prevent unintentional movement.

7.5.9 Saloon Window Panels

(a) The window panel shall be a single-piece bodyside panel, installed horizontally between the door pillar coving panel on either side, and vertically between the ceiling coving and bench seat.

(b) A flexible trim (refer to Appendix L) shall seal the panel and the window frame. The trim shall conceal any fastenings in the fixed glazing area, while allowing the opening of the upper hopper windows without obstruction.

(c) It shall be possible to replace the sealed window units without removal of the window panel and the flexible trim.

7.5.10 Door Pillar Coving Panel

(a) The door pillar coving panel shall interface with the window panel at the draughtscreen and be fitted vertically between the ceiling coving and floor coving.

(b) Passenger alarm microphones and the door manual release device shall be incorporated into the door pillars and flush mounted onto the door pillar coving panels (refer to Drg. Nos. C6014-14E/TSEG/100/001, C6014-14E/TSEG/100/002, C6014-14E/TSEG/100/003, C6014-14E/TSEG/100/004 and C6014-14E/TSEG/100/005).

(c) The design of the door pillar shall ensure that the door prevents hand trapping whilst the doors are in operation.

7.5.11 Door Pillar Floor Coving

(a) The door pillar floor coving shall cover the lower bodyside around the base of the door pillars. It interfaces with the floorboards, treadplates, seat plinth end panels and the door pillar coving panel.

(b) The coving to floor interface shall align with the treadplate to floor visual interface giving a continuous straight edge to the floor covering.

(c) The coving shall align in height with the bodyside door kickplate.

(d) The profile, finish and edge of the coving shall match and align with the bodyside floor coving in the multi-purpose area.

7.5.12 Bodyside Door

(a) The bodyside door cladding panel shall provide an inner surface to the door leaf and a robust, decorative finish and shall shroud window fixings.

(b) A bodyside door kickplate shall be fitted to provide a robust surface at foot level. This shall be set flush with the surface of the cladding panel and align in height with the door pillar floor coving panel.

7.5.13 Cab End Bulkhead

(a) A recess shall be provided at the cab end bulkhead for the fire extinguisher (please refer to PS 7.14).

(b) A kickplate shall be fitted to provide a robust surface at foot level. It shall align in height with the door pillar floor coving.

7.5.14 Cab Saloon Partition Door

(a) The cab saloon partition door cladding panel shall provide an inner surface to the door leaf and a robust, decorative finish.

(b) A kickplate shall be fitted to provide a robust surface at foot level. This shall be set flush with the surface of the cladding panel and align in height with the cab end bulkhead kickplate.

(c) The finished surface of the door panels shall be suitable for the application of commercial advertisements as specified in Drg. No. C6014-14E/TSEG/100/017.

(d) Not used.

7.5.15 Gangway Swing Panels and Gangway End Cubicles

(a) The housings shall incorporate wide opening access doors forming a curved lead into the gangway itself.

(b) The access doors shall not obstruct maintenance access to the equipment housed in the cubicles.

(c) A fixed panel shall be provided on the housing to house the fire extinguisher (left hand panel only) and the recessed gangway grabhandles (both sides).

(d) A small transparent cover may be required on the housing to enable certain critical indicator lights to be seen from the saloon. All transparent covers, if fitted, shall be made from toughened glass to BS 857:1967.

7.5.16 Train End Ceiling Panels and Gangway Ceiling Panels

(a) The train end ceiling and gangway ceiling shall house the car end ventilation fans (refer to PS 15.22) and gangway lights (Refer to PS 7.9 for lighting requirement).

(b) Train end ceiling panels and gangway ceiling panels shall be fitted to provide maintenance access to the ventilation fans and gangway lights.

(c) The Contractor shall ensure the air grille design to prevent any hazardous traps to passengers or staff in accessing the ventilation fan blade from saloon interior without panel opening.

7.5.17 Materials

(a) Suitable grade of honeycomb composite and glass reinforced plastic (GRP) shall be provided for use as vehicle interior panels.

(b) The honeycomb composite and GRP shall comply with the fire performance requirements in RS/C6014/08 and the durability requirements in PS 7.5.5.

(c) The compliance of (b) above shall be demonstrated by suitable testing.

7.6 Seating

7.6.1 Spatial Arrangement

(a) The saloon shall be fitted with stainless steel bench type seats longitudinally disposed along each side of the car as shown in Drg. Nos. C6014-14E/TSEG/010/017, C6014-14E/TSEG/100/001, C6014-14E/TSEG/100/002, C6014-14E/TSEG/100/003, C6014-14E/TSEG/100/004 and C6014-14E/TSEG/100/005.

(b) Not used.

7.6.2 Seat Profile

(a) Dished seats shall be installed which prevent sliding due to normal accelerations/decelerations.

(b) The design of the seats shall be based on the concept shown on Drg. No. C6014-14E/TSEG/100/021.

(c) Ergonomic trials shall be conducted to review the seat design (refer to PS 7.2.2(b)(vi)). Approval on the seat design will be given upon satisfactory results from the ergonomic trials

(d) The finish of the stainless steel passenger seat shall be beadblast satin non-directional finish. A stainless steel sample will be provided by the Engineer to the Contractor within two months after the award of Contract to demonstrate the required finish of the passenger seat. The Contractor shall fabricate the passenger seat in accordance with the sample finish and the Approved seating profile.

7.6.3 Construction Requirements

(a) All seats of the same type shall be interchangeable.

(b) The seat surface shall be smooth with no sharp edges or projecting corners to snag passengers' clothing.

(c) The seat surface shall be easily cleanable and the edges shall integrate with the draughtscreen smoothly to ensure no dirt traps are present.

(d) There shall be no manufacturing marks of any kind on the seat surface.

(e) The seat shall be mounted on totally enclosed plinths and be capable of carrying an evenly distributed load of 125 kg per place of seat without damage or permanent deformation.

(f) The seat plinth shall form a closed base underneath the seat.

(g) The front face of the plinth shall be blended visually with the floor by the continuation of the floor covering material up the front of the plinth.

(h) The plinth shall be capped with a stainless steel end panel interfacing with the bodyside door coving.

(i) All joints between the seat plinth and the floor covering and the bodyside coving shall be sealed to BS EN 60529: 1992 IP54, and designed to avoid the creation of dirt traps or the use of visible fasteners.

(j) The space enclosed by the plinth may be employed to house equipment or devices that do not normally require access during service checks (refer to PS 26.3.2).

(k) Simple and quick maintenance access to the enclosed equipment in the seat plinth shall be provided. The design shall permit access to the enclosed equipment within 10 minutes by two competent maintenance staff.

(l) If a hinged design is adopted, then the seat pan shall be positively retained to prevent unintentional movement in the hinged up position.

(m) The Contractor shall demonstrate the equipment access arrangement of the passenger seat in the engineering mockup.

(n) The seats shall have the full service life of the train without any degradation.

7.7 Passenger Retention

7.7.1 General

(a) Grabpoles, grabhandles and grabrails shall be supplied and installed in accordance with in Drg. Nos. C6014-14E/TSEG/100/013, C6014-14E /TSEG/100/014, C6014-14E/TSEG/100/015, C6014-14E/TSEG/100/016, C6014-14E/TSEG/100/017, C6014-14E/TSEG/100/018 and C6014-

14E/TSEG/100/019. The items shall be finished in accordance with the Interior and Exterior Styling Schedule (Appendix L refers).

(b) All grabpoles, grabhandles and grabrails shall be fabricated from stainless steel tube and shall have a common finish.

(c) All grabhandles, grabpoles and grabrails shall be of diameter subjected to Engineer's Approval.

(d) Not used.

(e) All grabpoles, grabhandles and grabrails shall comply with the following loading requirements without permanent deformation of the grabpoles, grabhandles, grabrails or their attachments to the car:

(i) Horizontal load of 900 N applied as a point load at any point of any grabpole or grabhandle span, superimposed by an uniformly distributed load of 1 300 N/m.

(ii) Vertical load of 900 N applied as a point load at any point of any grabrail span, superimposed by an uniformly distributed load of 1 300 N/m. This load is assumed to include any straphangers fitted to the span.

(f) All interfaces and joints shall be simple, avoid dirt traps, smooth to the touch with no burrs or edges, facilitate disassembly yet be tamper resistant and reliable. Concealed fastenings shall be used.

(g) A minimum clearance of 50 mm shall be maintained around any grabpole, grabhandle and grabrail.

(h) Colour Section

(i) All grabpoles and grabhandles shall have an embossed diamond pattern, sand blast finishes and yellow color RAL1023 applied by means of powder coating in the middle portion as specified in Appendix L.

(ii) For the central grabpoles, the seat mounted grabhandles, the doorway grabhandles, the gangway grabpoles and grabhandles, the height and position of the colour contrasted section shall be as detailed in Drg. Nos. C6014-14E/TSEG/100/013, C6014-14E /TSEG/100/014, C6014-14E/TSEG/100/015, C6014-14E/TSEG/100/016, C6014-14E/TSEG/100/017, C6014-14E/TSEG/100/018 and C6014-14E/TSEG/100/019.

For the vertical grabpoles of the seat bench, the height and position of the colour contrasted section shall be 170 mm measured from the centre of the horizontal grab rail and 950 mm measured from the floor level

(iii) Not used.

(i) All grabpoles, handles, and seat structures shall be capable of withstanding without permanent deformation, all loads due to normal operation and forces generated by passenger or luggage impact during accelerations of up to 3 g.

7.7.2 Central Grabpole and Grabrail Assembly

(a) Central vertical poles and grabrail assembly shall be fitted along the longitudinal centre line of the car in accordance with Drg. Nos. C6014-14E/TSEG/010/017, C6014-14E/TSEG/100/019.

(b) Grabpoles shall not contribute to the structural strength of the car body.

(c) Grabpole fittings visible to passengers shall be minimal and integrate into the design of the interior. Fittings at floor level shall not produce a hazard to passengers and shall not trap dirt.

(d) Joints of grabpoles and grabrails shall be flush with no sharp edges or sharp fixings

(e) The complete grabpole assembly shall be easily assembled and disassembled for maintenance access to the ceiling by one competent maintenance staff in 5 minutes.

(f) Not used.

7.7.3 Seat Mounted Grabhandle

(a) Inclined grabhandle shall be positioned at every draughtscreen to assist passengers passing through the train in accordance with Drg. Nos. C6014-14E/TSEG/100/015 and C6014-14E/TSEG/100/019.

(b) Not used.

(c) All visible joints in the grabhandle assemblies shall be minimised with no visible fasteners.

(d) Any fastenings used to interface the grabhandles to the draughtscreen assembly shall be concealed, flush, and invisible to the passenger at normal sight angle.

(e) Not used.

7.7.4 Doorway Grabhandle

(a) A grabhandle shall be securely mounted on each door pillar without reducing the clear throughway (refer to PS 7.3.6(g)) in accordance with Drg. No. C6014-14E/TSEG/100/016.

(b) Any fastenings shall be concealed and fitted in the vertical plane rather than horizontally.

(c) The mounting location of the door pillar grabhandles shall not prevent or interfere with the opening of the doorgear covers.

7.7.5 Gangway Grabpole and Grabhandle

(a) The gangway grabpole and grabhandles shall be provided in accordance with Drg. No.C6014-14E/TSEG/100/018.

(b) The grabpole shall be fitted in the centre of the gangway.

(c) The grabhandles shall be recessed into the gangway end fixed panelling on both sides.

7.7.6 Multi-purpose Area Grabrail and Grabhandle

(a) The arrangements of multi-purpose area and enlarged multi-purpose area (refer to PS 7.4.1) shall refer to Drg. Nos. C6014-14E/TSEG/100/013 and C6014-14E/TSEG/100/014).

(b) One horizontal grabrail shall be fitted in the multi-purpose area below the window level to facilitate access by wheelchair passengers.

(c) Not used.

(d) Draughtscreen shall be fitted on the side closest to the doorway only. No draughtscreen shall be fitted on the side next to the multi-purpose area. A seat mounted grabhandle shall be fitted on the side next to the multi-purpose area as shown in Drg. No. C6014-14E/TSEG/100/013. The seat mounted grabhandle on another side closest to the doorway shall be the same as the other seat mounted grabhandle as detailed in PS 7.7.3.

(e) Not used.

7.7.7 Straphangers

(a) Vandal proof straphangers shall be fitted in accordance to Drg. Nos. C6014-14E/TSEG/100/006 and C6014-14E/TSEG/100/020 for the locations of the straphanger.

(b) The design of the straphangers and the method of fixing shall be in accordance with the Drg. No.C6014-14E/TSEG/100/024.

(c) "Pull-off" test shall be carried out on a completed straphanger assembly to determine the appropriate performance under load. Minimum load to be achieved shall be 2 000 N.

(d) The Contractor shall carry out an endurance test on the straphanger with the following requirements:

(i)	Load:	25kg vertical
(ii)	Cycles:	250,000 cycles minimum and the endurance test shall be stopped until straphanger failure
(iii)	with Frequency:	From -30 degree through +30 degree and then back again to -30 degree is 1 Hz
(iv)	Twisting angle:	±90 degree with Frequency: from -90 degree through +90 degree and then back again to -90 degree is 1Hz

(e) Bending load test and twisting load test shall be carried out to determine the maximum bending performance under load. The minimum load to be achieved shall be the maximum bending load allowable for straphanger construction except the straphanger core. The core of the straphanger shall not be failed in the bending load test.

7.7.8 Draughtscreens

(a) The glazed portion of the draughtscreens and its surround shall have sufficient strength to resist the loads defined in PS 7.16.

(b) The draughtscreen shall be of toughened safety glass to BS 857:1967. The Contractor shall carry out heat soak testing defined in PS 6.11.1 (p).

(c) Replacement of the glass shall not require the use of any adhesive or sealant.

(d) The exposed edges of the glass shall be chamfered or rounded to ensure passenger safety.

(e) Glazing shall be resiliently mounted in fittings designed to allow easy replacement.

(f) Visible fastenings will not be acceptable on the sides or bottom face of the draughtscreen support.

(g) The glazing shall run parallel to the inclined grabpole at its front edge and to the bodyside at its back edge.

7.8 Flooring

7.8.1 General

(a) The car floor shall be continuous over the complete area of the saloon and shall be free from traps, gaps and holes (refer to Drg. No. C6014-14E/TSEG/100/023).

(b) The quality of the flooring shall reflect the design philosophy in PS 7.1.

(c) Floor colouring shall comply with the pattern as shown in C6014-14E/TSEG/100/023 and in accordance with the Interior and Exterior Styling Schedule Appendix L.

(d) Floor covering in combination with the sub-floor shall meet the fire performance requirements of RS/C6014/08.

(e) The slip resistance of the flooring coving shall meet the minimum requirement of the R10 of DIN 51130.

(f) The transition between saloon floor and gangway vestibule between cars shall be smooth and free from steps and unduly steep gradients which would impede the flow of passengers between cars.

(g) The Contractor shall submit for Approval, a programme of testing to satisfactorily demonstrate the requirements of PS 7.8.3 and 7.8.4 are met.

7.8.2 Joint

(a) Floor covering material shall be laid with the minimum number of joints.

(b) Floor covering shall be so arranged to ensure that the bend radius required at the plinth base does not coincide with a joint in the covering that will affect the visual continuity between the plinth and floor.

(c) Where joints occur, they shall not coincide with those of the floor boards.

(d) Joints shall be sealed against the ingress of dirt, moisture and water.

(e) Any sealant used shall be coloured to match the background colour of the floor covering.

7.8.3 Flooring Life

(a) The floor covering shall have a service life of 20 years.

(b) Floor covering and coving shall be securely fixed to the car floor for the specified life of the train.

(c) Floor covering shall show no signs of wear and the colour shall not fade for the specified service life. A full abrasion test programme shall be submitted for Approval.

(d) It shall be feasible to replace all, or sections of the floor covering and coving during the life of the train if necessary.

(e) The flooring shall not be damaged or discoloured by any materials usually encountered in depot or service use.

7.8.4 Cleaning Requirements

(a) Flooring shall remain colour fast under the following BS EN ISO 105: Part A01: 1996 conditions:-

(i) light
(ii) shampoo
(iii) dry cleaning
(iv) water spotting
(v) acid spotting
(vi) alkali spotting
(vii) rubbing

(b) Flooring shall be easily cleaned with the minimum of effort using readily available cleaning agents meeting the requirements as specified in PS 7.15.

(c) Flooring shall not require glazing, polishing or any other post-production re-finishing to maintain its finish.

(d) Flooring shall suit the cleaning schedules as detailed in PS 26 and during service and shall not appear dirty between scheduled cleaning.

7.8.5 Treadplates

(a) Treadplates at all saloon side doorways shall be metallic and slip resistant.

(b) Material of the treadplates shall not deteriorate upon acid washing.

(c) There shall be no logo, name or other trademark engraved or stamped on the treadplate.

7.8.6 Not used.

7.9 Lighting

7.9.1 General

(a) The car lighting consists of two longitudinal rows of LED luminaire tubes in accordance with the general arrangement as depicted in Drg. Nos. C6014-14E/TSEG/100/001, C6014-14E/TSEG/100/002, C6014-14E /TSEG/100/003, C6014-14E/TSEG/100/004, C6014-14E/TSEG/100/005 and C6014-14E/TSEG/100/006.

(b) All luminaires shall be of LED type and fittings shall be protected and diffused. No exposed light sources will be accepted.

(c) LED luminaires and control gears shall be sealed to IP 52 and IP 54, BS EN 60529:1992, respectively to prevent the ingress of dirt and foreign objects.

(d) LED luminaires shall comprise white LED chipsets having CCR not less than 80 Ra and colour temperature of 4000 K with tolerance of ± 200 K. After one year, two years and 50,000 operation hours, the colour temperature shall be within ±5%, ±8% and ±10% of the initial value respectively.

(e) LED luminaires shall be designed to withstand switch cycles of 100,000 and test shall be conducted to prove the compliance.

(f) Alternative light source other than LED lighting system may be considered subject to Approval by the Engineer. The Contractor may propose alternative solution meeting the maintainability, reliability and energy cost requirements.

(g) The Contractor shall replace all the LED lighting with a newly improved LED lighting if :

i) The total cumulative failure rate of the LED luminaires and controlgears within its life exceeds 5% with 20% of LEDs failed in a LED luminaire is constitute as a failure of the LED luminaire; or

ii) The illumination level at floor level drops below 95% and 90% of the initial illumination level after one-year and two-year operation respectively, by assuming 19 hours daily operation.

7.9.2 Visual Effect

(a) The light fittings shall be arranged such that no shadows shall be cast on seated passengers, signage or advertising panels. The Contractor shall take into consideration the strong directional light output characteristics of LED luminaires for the lighting design so as to avoid glare and to achieve a uniform illuminated, comfortable and aesthetic pleasing saloon environment.

(b) Lighting shall not reduce the view through windows by seated passengers as a result of reflections.

(c) Seated or standing passengers shall not be dazzled by any interior lighting.

(d) Consistency of colour and temperature shall be maintained throughout the interior.

(e) Lights shall not be perceived to flicker.

(f) The light fittings shall be arranged such that no shadows will be cast on seated passengers, signage or advertising panels.

7.9.3 Lighting levels

(a) Illumination levels quoted below are maintained illuminance which is the average illuminance over the reference surface at the end of the complete maintenance cycle i.e. it is the minimum value to which the illuminance is allowed to fall.

(b) A maintenance factor of 0.9 shall be applied to the lighting design to take into account the various depreciation factors such as dirt on luminaries and diffuser and lamp lumen depreciation. The installation shall meet the service illumination throughout its life of 50,000 hours.

(c) Glare Index shall be taken as 25 (maximum). Requirement on uniformity shall follow the Table 1 of BS EN 13272:2001.

(d) The average illuminance shall be:

i) ≥350lux at floor level;
ii) 350 – 450Lux at ceiling coving and information area.

(e) There shall be no shallowing or light cut-off, and reflection from the grabrail, on the ceiling coving panels and the associated EID/DRM LCD panels.

(f) The emergency lights shall be arranged so that all the door bays shall be sufficiently illuminated to achieve a minimum illumination level of 30 lux, measured at floor level, and 10 lux, measured at floor level other than doorway, under emergency situation.

7.10 Commercial Aids

7.10.1 Advertisements

(a) The advertisement cards and the Electronic Information Display shall be installed on the ceiling coving panel in the following manner (refer to Drg. Nos. C6014-14E/TSEG/100/001, C6014-14E/TSEG/100/002, C6014-14E /TSEG/100/003, C6014-14E/TSEG/100/004 and C6014-14E/TSEG/100/005):

(i) Each seat bay except at the multi-purpose area and enlarged multi-purpose area shall either install advertisement cards or Electronic Information Display.

(ii) They shall be installed on alternative seat bay.

(iii) Each pair of opposite seat bays except at the multi-purpose area and enlarged multi-purpose area shall have both advertisement cards and Electronic Information Display.

(b) Not used.

(c) The advertisement cards to be positioned at the ceiling coving panel will have the dimensions 1390 mm (Length) x 292 mm (Height) x 1.5-2.0 mm (Thickness).

(d) The advertisement cards shall not sag or otherwise display an untidy appearance. All edges shall be covered once in place.

(e) Each advertisement card shall be located such that it cannot migrate out of position.

7.10.2 Electronic Information Display

(a) Electronic Information Displays (refer to PS 10.4.3)shall be provided over the seat bay at the coving as specified in PS 7.10.1(a) and Drg. Nos. C6014-14E/TSEG/100/001, C6014-14E/TSEG/100/002, C6014-14E/TSEG/100/003, C6014-14E/TSEG/100/004 and C6014-14E/TSEG/100/005.

(b) The Contractor shall conduct ergonomic trials to maximise the visibility of the Electronic Information Displays to the passengers.

7.10.3 Dynamic Route Map

Dynamic Route Map shall be provided on the door coving panels (refer to PS 10.4.2).

7.11 Communications

7.11.1 Passenger Alarm Device

(a) Passenger alarm device shall be provided to enable passengers to gain the attention of the train operator and initiate a two-way communication in accordance with PS 18.

(b) The passenger alarm device shall include Passenger Alarm Emergency Handle, Passenger Alarm Microphone and Public Address Loudspeaker.

(c) There shall be five sets of Passenger Alarm Microphones and Passenger Alarm Emergency Handles per car to be distributed on door pillar panels as shown in Drg. Nos. C6014-14E/TSEG/010/011, C6014-14E/TSEG/100/001, C6014-14E/TSEG/100/002, C6014-14E/TSEG/100/003, C6014-14E/TSEG/100/004 and C6014-14E/TSEG/100/005.

7.11.2 Public Address (PA) Loudspeakers

(a) The train shall be fitted with a public address system audible from any position in the train. Performance requirements are detailed in PS 18.

(b) The PA loudspeakers shall be located and equally spaced along the ceiling coving panel.

(c) The number, size, location and spacing of the PA loudspeakers shall be carefully designed to:

(i) meet the performance requirements in PS 18.4.

(ii) integrate with the ceiling coving panel profile and the saloon interior styling.

(d) The PA loudspeakers shall be flush and resiliently mounted on the ceiling coving panel.

(e) The PA loudspeakers shall be readily accessible for maintenance purposes.

(f) PA loudspeaker grilles shall be so designed to prevent malicious damage to the speakers.

7.11.3 Passenger Alarm Microphones

(a) The microphone shall be flush mounted on the door pillars.

(b) The centre of the microphone unit shall be 1 470 mm from finished floor level.

7.11.4 Passenger Alarm Emergency Handles

(a) The operation of the Emergency Handle shall enable a passenger to speak to the train operator via the adjacent microphone.

(b) The Emergency Handle shall be a pull down type switch located on the ceiling coving panel.

(c) The Emergency Handle shall be designed to eliminate the possibility of accidental activation.

(d) When the pull down handle is operated, it shall be spring biased in the operated position. The original position can be resumed by an approved key.

(e) The Emergency Handle shall resist a downward pull load of 900 N at its installed location with no permanent deformation to any part of the handle assembly. This shall be demonstrated by a type test as specified in PS 22.

(f) Operation of the Emergency Handle shall illuminate:

(i) a red LED indicator integrated with the Handle assembly to enable the train operator to identify, in a crowded train, which Handle has been activated.

(ii) the bodyside indicator as detailed in PS 16.2.11.

(g) The status of the Emergency Handle shall be monitored by the TMS (refer to PS 18.4.15).

7.11.5 In-Saloon CCTV Cameras

(a) In-Saloon CCTV cameras shall be provided to capture images from train saloons and transmit the images to driving cab through the In-Saloon CCTV System in accordance with PS 18.7.

(b) There shall be at least 32 cameras installed evenly in the 8 train saloons. The Employer has developed an indicative distribution of 4 cameras in each saloon as shown in Drg. No. C6014-14E/TSEG/010/015. The Contractor may propose alternative locations for installation to achieve the full coverage in each train saloon and submit to the Employer for Approval.

7.12 Environmental Control

7.12.1 Air Conditioning

(a) Air conditioning outlet vents shall be located between the coving panel edges and the ceiling panels.

(b) The air outlets ducts shall be so arranged to achieve the air conditioning performance specified in PS 15.

(c) All grilles, covers and meshes shall be designed to prevent the deliberate insertion of objects or trapping of limbs and be highly resistant to accidental or deliberate damage. They shall be readily removable for cleaning but shall be of a design that inhibits settlement of dust or dirt on visible surfaces.

7.12.2 Hopper Windows

(a) Hopper windows shall be incorporated at each bodyside window except at the multi-purpose area and enlarged multi-purpose area without affecting the specified Emergency Ventilation.

(b) The hopper window frame shall be discrete and as flush as possible.

(c) The hopper window shall incorporate a positive locking mechanism and with appropriate signage. The locks shall be highly robust to withstand passenger abuse and easy to operate.

7.13 Signage

7.13.1 Types of Signage

The following 3 categories of signage will be displayed in the interior:-

(a) Static signage appropriate to operating and maintenance staff (such as safety and procedural) and name plates (such as door number plates, car number plates and gangway end identification plate)

(b) Static signage shall include:

(i) General regulations such as "Let's keep the air fresh" or "Let's keep the train clean".

(ii) Customer behaviour encouragement such as "Please offer your seat to the disabled" or "Please offer your seat to anyone in need".

(iii) Operation instructions such as the passenger alarm device, hopper window and the cab to saloon door.

(iv) Warning labels such as "Mind the platform gap" and "Keep clear of doors".

(v) Emergency signs such as the emergency exit signage and directions to emergency exits.

(c) Dynamic information in the form of the Electronic Information Display detailed in PS 7.10.2.

7.13.2 Design and Supply of Signage

(a) The provisionof the signage described in PS 7.13.1(a) above, shall be the responsibility of the Contractor.

(b) The design of the signage described in PS 7.13.1(b) and (c) above, in terms of the artwork, nomenclature, content and colour, will be provided by the Engineer during the design stage. The Contractor shall supply the signage in accordance with the Engineer's design. The artwork and layout of the signages for the existing Urban Lines Train is shown in the Employer's Corporate Signage Manual Volume 3 Rolling Stock Signage which will be available for inspection upon request.

(c) All signs within the passenger areas shall be in Chinese and English.

(d) The labels for the emergency signage/instructions shall be reflective type.

7.13.3 Positioning of Signage

(a) The Engineer will determine the position for the Contractor to fix the signage in PS 7.13.1(b).

(b) The Contractor shall be responsible for the integration of all of the signage into the interior design such that it shall complement the interior styling.

(c) Individual signs shall be fixed so as to enable easy replacement by authorised personnel but discourage unauthorised removal.

(d) The positional location of individual signs shall be suitably defined to enable them to be installed or replaced accurately and neatly by unskilled staff.

(e) The door number identification plate shall be provided adjacent to each doorway.

(f) The car numbering information shall be integrated within the passenger alarm signage to be designed by the Engineer.

(g) Information and warning signs shall be located in the ceiling and door coving panels.

7.14 Fire Fighting Equipment

7.14.1 Two fire extinguishers will be free issued by the Employer and shall be fitted by the Contractor in each car at the cab end bulkhead and the gangway end (refer to Drg. Nos. C6014-14E/TSEG/100/001, C6014-14E/TSEG/100/002, C6014-14E/TSEG/100/003, C6014-14E/TSEG/100/004 and C6014-14E/TSEG/100/005).

7.14.2 Each extinguisher shall be securely mounted in the stowage position such that it does not protrude into the passenger space. The extinguisher shall be secured by a means which shall prevent rattle and accidental dislodgement but which shall allow the extinguisher to be easily released by a passenger in an emergency.

7.14.3 The fire extinguisher will be of a type approved by the Hong Kong Fire Services Department.

7.14.4 The fire extinguisher will be dry powder type class ABC of 5 lb charged capacity each, complete with pressure gauge and to the dimensions as specified in the Drg. No. OD4/362/00510/0261.

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7.15 Maintainability

7.15.1 Maintenance Requirements

(a) The interior design shall minimise maintenance and meet the requirements detailed in PS 26.

(b) Maintenance requirements specific to interior panels and flooring are detailed in PS 7.5 and 7.8 respectively.

(c) Equipment located behind interior trim panels shall be provided with adequate provision for access. Such provision for access shall be integrated into the design of the interior and have minimum visual impact.

7.15.2 Cleaning Requirements

(a) The interior layout, materials, and detail design of the car interior shall be such that one person can clean one car interior of all litter, clean up spillage of solids and liquids within 5 minutes.

(b) The design shall facilitate ease of cleaning and avoid trapping dirt.

(c) Cleaning requirements specific to interior panels and flooring are detailed in PS 7.5 and 7.8 respectively.

7.15.3 Cleaning Philosophy

(a) The Contractor shall submit for Approval the cleaning materials proposed for the cleaning of the interior, including graffiti remover.

(b) All materials selected by the Contractor shall facilitate easy cleaning. Materials shall all be capable of being cleaned by the methods specified in PS 26 without any deterioration in the material's appearance, shape or property.

(c) The interior design shall facilitate maintenance of a clean appearance.

(d) The interior design must provide a rewarding environment to clean and maintain.

(e) Cleaning performance must not decline with time.

(f) The Contractor shall ensure that there are no dirt traps or areas in the interior which cannot be reached or accessed by the cleaning equipment.

(g) To aid cleaning, forms shall employ smooth lines with minimal projections.

7.16 Safety Requirements

7.16.1 Strength of Fixtures and Fittings

(a) All fixtures and fittings, such as grabpoles, grabrails, straphangers, draughtscreens and seat structures, shall be capable of withstanding, without permanent deformation, all loads due to normal service use as well as the forces generated by passenger or luggage impact during accelerations of up to 3 g.

(b) The Contractor shall submit calculations to verify the strength requirements for all fixtures and fittings, such as grabpoles, grabrails, straphangers, draughtscreens and seat structures referred to in PS 7.16.1 (a) above.

7.16.2 Safety and Security

(a) Safety shall be paramount and shall be reflected in all aspects of the design.

(b) The following shall be carefully considered:

(i) All projecting elements shall be rounded

(ii) All external corners shall be rounded

(iii) Gaps between elements shall not create hazardous traps

(iv) All components shall remain secure if impacted and any broken elements should not leave projections

(v) Easy access to replace items if damaged shall be provided

(vi) Ensure consistency of location and operation logic for all key safety elements, such as alarms, information and fire extinguishers. All notices shall be adjacent to the referred item and clearly displayed, whilst being co-ordinated with one another

(vii) In the event of an accident, the integrity, shape and location of all elements shall contribute to the safety and well-being of passengers, both from injury and ease of evacuation

(c) Access to safety equipment, such as fire fighting equipment and passenger communication, positions shall be clearly indicated and unobstructed.

(d) The materials (such as surface coating, metals, insulants, adhesives and fluids) used in the construction of the interiors shall not give rise to health hazards for passengers and staff. The materials shall also be suitable for normal repair operations (such as welding and cutting) without the need for staff to be protected by other than normal means.

(e) No material used in the construction of the train shall be capable of supporting fungus, mildew, rotting or infestation.

(f) The interior of the train shall be designed to avoid pockets where illegal substances (such as drugs and explosives) can be stowed.

7.17 Hostler Cubicle

7.17.1 General

(a) Hostler controls shall be provided to enable motoring, coasting, braking and emergency braking during shunting and marshalling operations in accordance with PS 9.

(b) Hostler controls shall be located at the autocoupler end of all cars not equipped with a train operator's cab, mounted within a lockable gangway cubicle (refer to PS 7.5.11).

(c) A positive retaining device shall be provided to latch the gangway cubicle panel in the opened position.

(d) When uncoupled, an unobstructed view towards the gangway exterior shall be maintained when the operator is operating at the hostler position.

(e) Hostler cubicle shall consist of :

(i) A fixed Hostler Control Panel (refer to PS 7.17.2).

(ii) A portable Pendant Controller (Refer to PS 7.17.3).

(iii) Autocoupler Secondary Coupling Device Control (refer to PS 14.3.3). The secondary coupling device control handle shall prevent the gangway cubicle door from being closed if the secondary coupling device is not in the fully engaged position.

(iv) Brake Isolation Cock (refer to PS 11.16)

(v) Main Reservior Pipe Isolation Cock (refer to PS 13.9.10).

(vi) Autocoupler Electrical Isolation Switch (refer to PS 14.3.1(h)) and shall be sealed in the engaged position.

(vii) Power supply socket (refer to PS 8.10.7(b)).

(f) No live electrical terminals shall be exposed to the operator in the hostler cubicle.

7.17.2 Hostler Control Panel

The Hostler Control Panel shall be positioned at the hostler cubicle with the following:

(a) Switches and Pushbuttons

(i) Hostler Master Switch

A key locked four-position switch (refer to PS 9.5.10).

(ii) Uncouple Pushbutton

Momentary pushbutton (refer to PS 9.7.3).

(iii) Auxiliary ON Pushbutton

Momentary pushbutton (refer to PS 9.2.1).

(iv) Auxiliary OFF Pushbutton

Momentary pushbutton (refer to PS 9.3.1).

(b) Indicators

(i) Service Brake Indicator

The indicator shall be a bi-colour indicator indicating the local service brake status. Yellow colour for brake applied and Green colour for brake released (refer to PS 9.12.2).

(ii) General Fault Indicator

The indicator shall be provided to signify the failure of any subsystem that would prevent operation from that hostler position, indicating the requirement to operate from another hostler or cab (refer to PS 9.12.2).

(iii) Power Fault Indicator (refer to PS 9.12.2)

(iv) Auxiliary Fault Indicator (refer to PS 9.12.2)

(v) Ventilation Fault Indicator (refer to PS 9.12.2)

(c) Overspeed Alarm

The alarm shall be activated when the overspeed protection is operated (refer to PS 9.6.7(c)) and the tone shall be same as the Over Speed Alarm in cab (refer to Appendix I Annex 3).

7.17.3 Pendant Controller

(a) The Pendant Controller (refer to PS 9.6.3) shall be a hand held device incorporating the following:

(i) Digital Speedometer

(ii) Horn Pushbutton

Momentary pushbutton and yellow in colour.

(iii) Motor Pushbutton

Momentary pushbutton and black in colour.

(iv) Brake Pushbutton

Momentary pushbutton and red in colour.

(v) Deadman Safety Device

(b) The Pendant Controller shall be ergonomically designed to facilitate single hand operation.

(c) A strap to permit the suspension of the Pendant Controller around the operator's neck shall be included.

(d) The cable lead of the Pendant Controller shall be long enough to permit operation at the edge of the gangway opening.

(e) An automatic cable rewind and holding device shall be provided which shall

(i) extend the cable lead to the required length by pulling the cable; and

(ii) hold the cable lead when stop pulling; and

(iii) rewind the cable lead when pull again.

(f) The automatic cable rewind and holding device shall not cause excessive stress or wearing of cable during stowage and operation.

(g) No failure mode of the automatic cable rewind device shall prevent the cable from being extended.

(h) Means of neat storage of the Controller on a bracket and space to allow the cable to hang freely in the event of failure of the automatic rewind device shall be provided.

7.18 Saloon Smoke Detection

7.18.1 General

(a) A saloon smoke detection system shall be provided suitable for railway application in each car to enable saloon smoke alarm to be reported to the train operator. The quantity and locations of the installation for the saloon smoke detectors shall ensure the optimised detection, with best protection against vandalism and least visual impact to the passengers. The Contractor shall propose and submit the details of the saloon smoke detection system for Approval.

(b) The detection system shall be designed to give a fast and accurate response with minimised nuisance activation.

(c) The detection system shall be able to distinguish between dusty tunnel/saloon environment and other smoke/fume sources such as diesel fumes from smoke being caused by saloon fire.

(d) Faulty or dirty detector shall be reported to the TMS (refer to PS 10.5.13).

(e) The detection system shall be able to be checked, calibrated and replaced from the saloon including the sensitivity test.

(f) The detection system shall be designed to require no maintenance or adjustment between car overhauls as specified in PS 26.3.3.

7.18.2 Saloon Smoke Alarm

(a) Indication for saloon smoke alarm shall be provided on local control panel which shall not be visible to the passenger.

(b) Saloon smoke alarm shall be reported to the TMS (refer to PS 10.5.13).

(c) The saloon smoke alarm shall be reset by the train operator via the TMS if the system resumes normal (refer to PS 10.5.13).

(d) The saloon smoke alarm shall be capable of being reset locally from the saloon if remote reset has failed.

SECTION 8

CAB FACILITIES AND LAYOUT

August 2015

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8 CAB FACILITIES AND LAYOUT

8.1 General

8.2 Ergonomic Design

8.3 Ergonomic Considerations

8.4 Train Operator's Duties

8.5 Vision Requirements

8.6 Styling Considerations

8.7 Basic Layout

8.8 Zone A Train Operator Console and Window

8.9 Zone B Auxiliary Console and Window

8.10 Zone C A Side Cab Back Wall

8.11 Zone D B Side Cab Back Wall

8.12 Zone E Ceiling

8.13 Seating

8.14 Cab Lighting

8.15 Cab Doors

8.16 Emergency Detrainment Device

8.17 Cab Flooring

8.18 Internal Panels

8.19 Colour

8.20 Signage

8 CAB FACILITIES AND LAYOUT

8.1 General

8.1.1 The interior of the cab shall be designed to meet the following objectives:

(a) An aesthetically attractive, pleasing interior which enhances the train operator's working environment

(b) Be comfortable for the train operator

(c) Be able to meet functional requirements

(d) Allow efficient, safe and stress-free execution of operating tasks

(e) Efficient and safe detrainment procedures

(f) Be easy to clean and maintain

(g) Be able to withstand daily wear and tear over the life of the train

(h) Be easy to manufacture, e.g. using proprietary controls and displays wherever possible

(i) Smooth integration with the cab front design

(j) Comply with the operability and ergonomic requirements of RS/C6014/14

8.1.2 The general arrangement of the cab controls, indications and seat shall enable all normal driving functions to be achieved while the train operator is seated.

8.1.3 Windows shall provide good all-round visibility and prevent the ingress of any rain.

8.1.4 All the cab facilities, with the exception of signages, shall be properly marked with either pictograms or labels/markings in English only (refer to PS 8.7.3). The signages shall be in English and Chinese (refer to PS 8.20). The position, colour, pictograms and characters shall be submitted for Approval.

8.1.5 All materials used shall satisfy the fire performance requirements as detailed in RS/C6014/08.

8.1.6 Noise levels within the cab shall meet the requirements as specified in RS/C6014/13.

8.1.7 A cab air conditioning system shall be provided to meet the requirements and performance detailed in PS 15.21.

8.1.8 All components unless otherwise specified shall have the full service life of the train.

8.1.9 Details of the cab arrangement, layout of the control consoles and maintenance requirements shall be submitted for Approval.

8.2 Ergonomic Design

8.2.1 Industrial & Ergonomics Specialist

(a) Apart from meeting the functional requirements laid down in this PS, the cab shall be designed with due ergonomic and aesthetic considerations.

(b) The Contractor shall submit for Approval the Curriculum Vitae of the industrial and ergonomics specialists.

8.2.2 Cab Design Programme

(a) The Contractor shall submit for Approval, as part of the requirements of PS 29, a staged programme detailing the processes for achieving the aesthetic and performance requirements of this section and thereby demonstrate their integration with the engineering requirements of this Specification. The programme shall be submitted during SEMP Stage 1.

(b) The Contractor shall be required to construct two full-scale mock-ups:

(i) Foamcore mock-up of the cab interior

(ii) Engineering mock-up of the cab interior and exterior

(c) The cab ergonomic design process shall include the following activities:-

(i) Ergonomic survey of the driving cabs of the Urban Lines Train and the operating procedures.

(ii) Perspective drawings and artists impressions to demonstrate the Contractors understanding of the required style, image and aesthetics.

(iii) Dimensional drawings indicating key dimensions such as the overall length, door positions and clear openings, and sight lines.

(iv) General layout drawings showing the arrangement of equipment within the cab, taking full account of access, maintenance, cooling, cabling and fixing requirements.

(v) Review and development of pictograms on pushbuttons, switches and indicators.

(vi) A full-scale foamcore mock-up of the cab interior to demonstrate the concept design.

(vii) Reference samples of components such as seats, lights, pushbuttons and indicators.

(viii) A full-scale engineering mock-up of the cab interior and exterior.

(ix) Design review meetings/presentations amongst the Engineer, the Contractor and his industrial design specialist.

(x) Ergonomic trials on the foamcore mock-up and the full-scale engineering mock-up, including but not be limited to the following:

(1) Interior and exterior sight line trials.

(2) Train operator trials on the use of cab equipment and facilities such as the detrainment ramp operation, driver's seat and auxiliary seat, operability of cab controls and the correct interpretation of pictograms.

(xi) Retrofitting of major equipment on the full-scale engineering mock-up such as the cab door drive mechanism and trainborne video display screens for TMS, In-cab CCTV and In-saloon CCTV.

(xii) Not used.

(xiii) Not used.

8.2.3 Full-Scale Engineering Cab Mock-up

The full-scale engineering cab mock-up shall represent the required image, style and aesthetics and shall include the following:

(a) Interior

(i) Surface finishes, materials, tolerances, panel fits and colours shall comply with production standard.

(ii) Access required for the purpose of maintenance to all equipment such as light fittings and door gear access panels should be functional.

(iii) All engineering features such as fasteners and panel locks, wherever possible actual production items shall be used.

(iv) Representative production interior and exterior light fittings for measuring lighting levels and demonstrate the desired lighting balance.

(v) Representative production cab air conditioning control panel and vents.

(vi) All information displays such as the In-cab CCTV, In-saloon CCTV and TMS shall be functional for evaluation.

(vii) All control pushbuttons and indicators shall be represented by actual production items. Where illuminating controls are required then this feature shall be represented on the mock-up.

(viii) Exterior glazing such that sight lines and the elimination of internal reflections can be verified.

(ix) Fully representative production seats complete with all adjustments such as the train operator's seat sliding mechanism (refer to PS 8.13).

(x) Fully representative detrainment door and the associated mechanism (refer to PS 8.16).

(b) Exterior

(i) Representative production standard exterior profile.

(ii) Exterior maintenance access such as light fittings and windscreen washer bottle.

(iii) Representative production standard external features and fittings such as destination display, train number display, lightings, wipers and cab steps. Actual production items shall be used wherever possible.

(iv) Representative production standard cab doors and detrainment door. They shall be fully functional for evaluation (refer to PS 16.7.1).

(v) The cab mock-up shall include an exterior of the proposed stainless steel or aluminum carbody section of sufficient length to demonstrate the jointing arrangement and the matching of panels between the cab GRP and carbody.

8.2.4 Construction

The structural integrity of the full-scale engineering mock-up, in particular for the detrainment door, shall be strong enough for repeated use for ongoing training purpose.

8.2.5 Erection, Transportation and Retrofitting

(a) The foamcore mock-up shall be erected at the Employer's premises in Hong Kong whereas the full-scale engineering mock-up shall be erected at the Contractor's premises for evaluation.

(b) The Contractor shall submit a list of equipment from those specified in PS 8.2.3 that will not be available during the mock-up development stage for Approval during SEMP Stage 1.

(c) The Contractor shall retrofit the equipment in PS 8.2.5(b) to the fullscale engineering mock-up once the equipment become available.

(d) Not used.

(e) The Contractor shall be required to modify the full-scale engineering mock-ups in accordance with the Engineer's comments. All design changes and modifications shall follow the Configuration Control Programme requirements (refer to Appendix P).

(f) Not used.

8.3 Ergonomic Considerations

8.3.1 The Train Operator

The cab shall be designed in accordance with the anthropometric requirements as specified in RS/C6014/14.

8.3.2 Sit/Stand Work Station

(a) The seating and control arrangements shall permit the train operator to carry out all the tasks detailed in PS 8.4 from either the seated or

standing position. This shall allow the train operator to change or adjust posture to avoid tiredness and to increase vigilance.

(b) The design shall allow clear external sight lines such that the full range of train operators can meet the vision requirements detailed in PS 8.5.

(c) Access and egress through the cab side doors and the emergency exits shall not be impeded by cab seats or control equipment.

(d) The train operator's seat design shall be comfortable, supportive, flexible and adjustable to maintain comfort for all train operators over a 4 hour period.

(e) An adjustable footrest shall be provided to allow a comfortable posture to be achieved by all train operators.

(f) Adequate legroom shall be allowed for all train operators.

(g) The work station shall allow comfortable reach to all regularly used controls.

(h) The train operator's head swing envelope, whilst in the seated or standing operation position, shall remain clear of the cab structure.

8.3.3 Control Layout

(a) The design shall conform to good ergonomic principles as specified in RS/C6014/14, in particular with regard to the following:-

(i) The grouping of controls into different zones to satisfy ergonomic and operating needs

(ii) The size of controls, switches, displays and indicators

(iii) The separation of controls and switches

(iv) The viewing distance (relaxed) to displays and indicators

(v) The comfortable and easy reach of controls

(vi) The determination of colours for displays and indicators

(b) Specific requirements for a particular control are detailed in the relevant Section.

8.4 Train Operator Duties

8.4.1 Job Purpose

The train operator is responsible for passenger train safety and the efficient operation of the trains (both on running lines and in depots and sidings) in accordance with the working timetables or special schedule. The train operator executes the duties in compliance with the relevant Employer's manuals or documents.

8.4.2 Main Train Operator Tasks

(a) Train preparation - As detailed in PS 9.2.

(b) Manual operation - As detailed in PS 9.6

(c) Automatic Train Operation will be the predominant mode of operation.

(d) Saloon door opening and closing at platforms using controls provided on the Train Operator Console. The train operator shall also be required to operate these door opening and closing controls, (repeated on both cab back walls), whilst standing at the corresponding cab side doors.

(e) Communication with the passengers, Traffic Controller in the Operation Control Centre, Depot Controller and train operator.

(f) Safety monitoring, defects and incidents handling, and co-ordination of safety procedures and actions.

(g) Observation of track signals as described in PS 8.5.

(h) Observation of Platform Screen Doors by means of a combination of platform edge and cab mounted monitors (In-cab CCTV) allowing the train operator a full view of the platform and Platform Screen Doors from the seated position.

(i) Vision and shunting within the depot environment.

(j) Observation and control during train coupling and uncoupling.

8.4.3 Functional Responsibilities

(a) Equipment Operating Skills

The train operator is required to operate the Controller Handle, switches and equipment (such as TMS, Radio, DVAS and PA) installed in the

driving cab. The required operating skills and the associated training requirements shall be kept to a minimum.

(b) Decision Making

Based on job knowledge, the train operator is required to make quick and logical decisions to handle train defects or to deal with emergency incidents, without referring to supervisor.

(c) Fault Detection and Reporting

With the aid of the TMS, the train operator shall be able to diagnose fault symptoms, identify train defect(s) and initiate appropriate actions to recover train service, independently or with the assistance from other staff, if necessary but the design shall minimise the operating tasks.

(d) Supervision/Management

Through the communication system of the train (refer to PS 18), the train operator shall be able to obtain direct supervision from the train staff supervisor. During the handling of train defect or dealing with an incident, the train operator communicates or consults when required with Traffic Controller in the Operation Control Centre or the Station Local In-charge.

8.5 Vision Requirements

8.5.1 General

(a) The cab design shall maximise the train operator's vision through the cab windscreens and the cab side windows.

(b) The vision requirements detailed in PS 8.5 shall be met by both seated and standing train operators.

(c) Consideration shall be given to a change in train stopping distance of ± 0.5 m as detailed in Appendix I Annex 3 Clause 4.4.

(d) Sight lines shall not be distorted by glass as required by PS 6.11.

(e) Reflections from indicators, displays and console wash lighting shall not adversely affect the train operator's vision by day or by night.

(f) The colour of the glass shall not affect the perception of signals, platform monitors or any other exterior displays, as required by PS 6.11.

8.5.2 Signal Sight Lines

(a) Signals will be positioned to the side of the track within a height range of track level to a maximum height of 3.5 m.

(b) Signals will be positioned predominantly to the right hand side of the track, at a distance of no more than 750 mm outside the structure gauge.

(c) The train operator, without head or body movement, shall have full sight of all signals down to a distance of 4 m or less, measured between the front of the train and the signal.

8.5.3 Vision of the Train Operator Console

The train operator shall have a full view of all displays and controls in the cab in both the seated and the standing positions.

8.6 Interior Styling Considerations

8.6.1 All shapes shall have rounded edges and corners, and to minimise the number of protrusions, in order to reduce injury on impact and to ease cleaning.

8.6.2 Styling aspirations require that the design shall possess:

(a) A neat layout
(b) Be easy to use
(c) Colours as defined in PS 8.19
(d) Matt finishes
(e) Flush fitting surfaces
(f) Flush controls whenever possible

8.6.3 The controls shall integrate with the styling but be commensurate with durability, cleaning and safety.

8.7 Basic Layout

8.7.1 General

The cab general layout shall be in accordance with Drg. No. C6014-14E/TSEG/110/001 and shall take account of the structural requirements detailed in PS 6.4.

8.7.2 Equipment Grouping

(a) Equipment shall be grouped in the cab to support the main train operator tasks defined in PS 8.4 and located for ease of use, operating sequence, frequency of use, functional relationship between controls and displays and for the safety critical nature of the information or control task.

(b) Whilst the detailed design of the equipment layout shall be done by the Contractor in accordance with the Specification requirements, the Employer has developed a preferred grouping arrangement of the cab controls, and they are located into the following major equipment zones as shown in Drg. No. C6014-14E/TSEG/110/001:

(i) Zone A Train Operator Console and Window
(ii) Zone B Auxiliary Console and Window
(iii) Zone C "A Side" Cab Back Wall
(iv) Zone D "B Side" Cab Back Wall
(v) Zone E Ceiling

Each of the major equipment zones shall be divided into sub-zones to indicate the preferred controls grouping.

(c) The Contractor may propose alternative equipment grouping arrangement, together with ergonomic and operability justifications, for Approval.

(d) The cab controls shall be classified into the following functions in view of their type of usage:

(i) Normal
(ii) Backup
(iii) Emergency

8.7.3 Control Panels

(a) Spatial Arrangement

(i) Controls shall be located on the Train Operator Console, Auxiliary Console, Cab Back Wall Cubicles (A Side and B Side) and the ceiling.

(ii) The function and performance requirements of the controls are detailed in PS 9.

(b) Construction

(i) All panels, controls and instrument fixings on the Train Operator Console and the Auxiliary Console shall be invisible to the train operator.

(ii) Access to any control or instrument for maintenance purposes shall not be possible without an approved key as defined in RS/C6014/15.

(iii) Panels shall be strong, not dent nor corrode during the life of the train.

(iv) Panels and controls shall be sealed to BS EN 60529: 1992 IP65.

(v) Simple access shall be provided for replacement of illuminated light sources on all illuminated equipment by one maintenance staff within 30 minutes.

(c) Pushbuttons and Indicators

(i) Unless otherwise stated, all pushbuttons shall be nonilluminating, momentary pushbuttons, flush mounted and approximate dimensions 25 mm (square or circular).

(ii) Unless otherwise stated, all indicators shall be flush mounted and approximate dimensions 25 mm (square or circular).

(iii) All illuminated pushbuttons or indicators shall be illuminated with multiple LED light sources. Each light source shall be supplied by separate supply circuits to minimise the risk of failure.

(iv) Non-illuminated pushbuttons shall match illuminated pushbuttons in their physical appearance and method of operation.

(v) Illuminated pushbuttons or indicators shall be of a type that shows the difference between the "on" and "off" state.

(vi) Control illumination and instrument panels shall not reflect in the cab windscreens.

(vii) The indications shall be illuminated only when the associated circuits are operative.

(viii) Unless otherwise specified, high intensity LEDs of minimum intensity of 20 mcd 45° viewing angle shall be provided for the indications in the driving cabs and the hostler position.

(d) Pictograms

(i) In order to make the controls more user friendly to the train operator and to reduce space required to label controls, the Contractor shall design a coherent set of standard pictograms to replace legends to sign all pushbuttons, switches and indicators controls.

(ii) The design shall be based on the existing use of pictograms on rail cab controls and related applications, as well as the relevant international standards for pictograms.

(iii) The Contractor shall develop suitable test method and conduct ergonomic test with the train operators to ensure that the pictograms are fit for purpose and require minimum amount of training. The Contractor shall revise the design in accordance with the findings from the ergonomic test.

(iv) The pictograms for the pushbuttons and indicators shall be applied directly on the switchgears.

(v) The pictograms for the switches, such as the windscreen wiper control, may be applied on the panels.

(vi) The pictograms on the illuminated pushbuttons and indicators shall be designed to maximise the visibility to the train operators in the "on" state.

(vii) The pictograms on the switchgears and the panels shall be durable for the service life of the switchgears.

(e) Legends

(i) The Contractors shall submit a list of the legends for the remaining controls, such as MCBs, for Approval.

(ii) The legends for the controls shall be clearly marked in English on the panels.

(iii) The type font shall be Helvetica Medium with a minimum character height of 4 mm. All legends shall be in mixed case.

(iv) The legends on the panels shall be durable for the service life of the train.

(f) MCB Labels

(i) The MCB panel shall incorporate grey colour coded labels for the MCB supply in the following three categories:

(1) MCB supplied by D1 (refer to PS 17.4.1)
(2) MCB supplied by D2 (refer to PS 17.4.1)
(3) MCB supplied by AC volt

(ii) The grey colour coded label shall be easily distinguishable between the three sources of MCB supply as well as the legends on the label.

(iii) The colour of the legends on the MCB labels shall be identical for the three sources of MCB supply.

8.7.4 Train Operator Position

(a) A Train Operator Console and seat shall be arranged as shown in Drg. No. C6014-14E/TSEG/110/001.

(b) It shall be located to meet the sighting, reach and comfort requirements of this Section.

8.7.5 Auxiliary Position

(a) An Auxiliary Console shall be arranged as shown in Drg. No. C6014-14E/TSEG/110/001.

(b) It shall be located to meet the sighting, reach and comfort requirements of this Section.

(c) The Auxiliary position shall include a perch seat as detailed in PS 8.13.3.

8.7.6 Detrainment Walkway

(a) A clear, unobstructed walkway shall be provided between the cab/saloon partition door and the detrainment door. The walkway shall be centrally located to allow train-to-train detrainment.

(b) The clear opening width of the detrainment doorway shall be 980±20 mm.

(c) The minimum width of the detrainment walkway down the detrainment ramp shall be 875 mm.

8.7.7 Cab Side Doors

A cab side door with an opening as shown on Drg. No. C6014-14E/TSEG/110/001 shall be provided on each side of the cab. The cab side doors and cab layout shall allow:

(a) Unobstructed access into and across the cab
(b) Easy access into and from the seats
(c) Free movement within the cab
(d) Quick egress from the train operator's seat in emergencies

8.7.8 Emergency Detrainment Device

An emergency detrainment device shall be centrally located at the front of the cab. It shall allow detrainment as defined in PS 8.16 to track or to another train.

8.7.9 Cab/Saloon Partition Door

A double leaf partition door shall be located at the rear of the cab to provide the facilities detailed in PS 16.5.

8.7.10 Cab Back Wall Cubicle

A Side and B Side cab back wall cubicles shall be positioned to accommodate the requirements for seating and access to cab side and rear doors. The A Side equipment cubicle shall accommodate the train operator's seat as detailed in PS 8.13.

8.7.11 Ceiling Panel

(a) The ceiling panel shall be used for location of lighting and air conditioning outlets as defined in PS 8.12.

(b) The ceiling panel shall allow sufficient headroom for all train operators.

(c) The ceiling panel shall be extended at the sides to conceal cab side door operating and control gear, but incorporate access for maintenance.

8.8 Zone A Train Operator Console and Window

8.8.1 General Layout

(a) Zone A shall be divided into eight sub-zones, A1 to A8, as defined in Drg. No. C6014-14E/TSEG/110/002.

(b) There are three console mouldings on the Train Operator Console:
(i) Main Train Operator Console moulding
(ii) Trainborne Radio and control console moulding
(iii) DVAS and PA control console moulding

(c) The Trainborne Radio Control Unit (refer to PS 8.8.3(a)) and the DVAS and PA Master Control Panel (refer to PS 8.8.5(a)) shall be mounted on a separate and removable moulding or equipment housing from the main Train Operator Console so that the communication equipment can be upgraded in the future without any interruption to the Train Operator Console.

(d) The pushbuttons (with the exception of Horn, Emergency Stop and ATO Start Pushbuttons) and indicators as specified in PS 8.8.4 and 8.8.7 below shall be:

(i) located towards the interface between sub-zones A3 and A6.

(ii) matched functionally, such as the General Fault Reset Pushbutton to be located above the General Fault Indicator.

8.8.2 Sub-Zone A1

(a) Destination Display and Controls

A destination display shall be provided on the upper part of the windscreen as specified in PS 6.9.5 and PS 10.4.4. The destination shall be visible inside the cab.

(b) Sun Visor

(i) A sun visor shall be fitted which shall be extendable down to height such that a minimum clear vision will be maintained through the window to enable a safe driving decision to be made by the train operator.

(ii) It shall be freely adjustable stopping at any height and remaining steady at the position set.

(iii) It shall not rattle or vibrate excessively as to affect the visibility of the train operator under all train operating conditions.

(iv) It shall be possible to secure the sun visor in the stowed position.

(v) It shall be non-reflective.

(vi) It shall permit an acceptable level of visibility through the sun visor.

(vii) It shall not cause colour distortion of the track signal.

8.8.3 Sub-Zone A2

(a) Trainborne Radio Control Unit and Loudspeaker (refer to PS 18.2)

(i) The equipment housing for the Trainborne Radio Control Unit and the loudspeaker shall be designed to be easily removable from the Train Operator Console (refer to PS 8.8.1(b) & (c)).

(ii) Refer to Appendix I Annex 4 Clause 2 for the dimensional details of the Trainborne Radio Control Unit and the loudspeaker.

(b) TMS Display and Controls (refer to PS 10.8)

8.8.4 Sub-Zone A3

(a) Primary Train Operator Display (PTOD)

The Primary Train Operator Display (PTOD) will be free issued by the Employer (refer to Appendix I Annex 3).

(b) Duplex Pressure Gauge

(i) The Duplex Pressure Gauge shall be an analogue pointer device with single scale indicating brake cylinder pressure and main reservoir pipe pressure as specified in PS 13.11.1 and RS/C6014/07 Clause 8.4.

(ii) Markings, numerals and characters shall be white on a black background and shall comply with BS 3693: 1992.

(iii) The display should be side or back lit.

(iv) Numerals and text shall be in Helvetica Medium.

(v) The pointer shall have parallel sides, except that the end shall taper such that the tip is the same width as the scale markings.

(vi) Not used.

(vii) The gauge shall have a range of 10% greater than the main reservoir pipe safety valve pressure.

(c) Emergency Stop Pushbutton (refer to PS 9.9.5)

(i) Emergency Stop Pushbutton shall be a red "mushroom" type button.

(ii) It shall have a minimum diameter 55 mm and shall protrude approximately 30 mm from the surface to facilitate operation in an emergency.

(iii) The pushbutton shall be designed such that it will provide an obvious visual indication to the train operator that it has been operated.

(d) ATO Start Pushbutton (refer to Appendix I Annex 3)

(i) The ATO Start Pushbutton shall be momentary operation.

(ii) It shall be designed to avoid accidental operation, such as shielded by a few mm raised rim.

(e) General Fault Reset Pushbutton (refer to PS 9.12.1)

(f) Brake Proving Pushbutton (refer to PS 9.12.2)

(g) Parking Brake Pushbutton (refer to PS 9.12.2)

(h) Uncouple Pushbutton (refer to PS 9.7.3)

(i) Driverless Operation Pushbutton (refer to PS 9.12.6)

(j) ATDC Cut Out Switch (refer to Appendix I Annex 3)

(k) Day Time Head Lamp/ Night Time Head Lamp Pushbutton (refer to PS 6.10.2)

(l) ATP Overspeed Alarm (refer to Appendix I Annex 3)

(m) Not used

8.8.5 Sub-Zone A4

(a) DVAS and PA Master Control Panel (refer to PS 18.4)

The equipment housing for the DVAS and PA Master Control Panel and the microphone (refer to PS 8.8.5(b)) shall be designed to be easily removable from the Train Operator Console (refer to PS 8.8.1(b) and (c)).

(b) DVAS and PA Microphone (refer to PS 18.4)

(i) The microphone and the associated coiled cable cord shall be positioned on the DVAS and PA Master Control Panel equipment housing to ensure the safe, neat and convenience operation of the microphone and the surrounding controls.

(ii) It shall be connected to the equipment housing via a suitable plug or socket.

(iii) The microphone recess shall be easily cleaned and adequately drained.

(c) Trainborne Video Display (refer to PS 18.3.4 and PS 18.7.9)

The screen shall be shrouded to prevent sunlight causing reflections or glare. The screen image shall not reflect in the windscreen or other cab windows at night.

8.8.6 Sub-Zone A5

(a) Windscreen Wiper/ Washer Switch (refer to PS 6.9)

(i) The Windscreen Wiper/Washer Switch shall control the windscreen wiper and washer of both windscreens.

(ii) The following control functions shall be integrated within the controller:

(1) Park or OFF function
(2) Slow speed operation
(3) High speed operation
(4) Wash function

(iii) The switch shall be ergonomically designed and the physical appearance of the switch shall be matched with the rest of the controls on the consoles.

(b) "A Side" Reading Light Pushbutton (refer to PS 8.14.2)

It shall operate the reading light above the Train Operator Console.

(c) Radio Handset (refer to PS 18.2)

(i) Handset shall be a telephone style handset with a press-to-talk facility.

(ii) A coiled cable shall be provided which shall neatly stow in a recess on the console and not be prone to being caught or tangled.

(iii) It shall be connected to the Console via a suitable plug or socket.

(iv) The telephone recess shall be easily cleaned and adequately drained.

(d) Handgrip

(i) The handgrip shall be ergonomically designed to assist in the forward and rearward adjustment of the seat.

(ii) The handgrip shall be moulded into the Train Operator Console.

(iii) The handgrip shall be strong enough to withstand a force of 1500N without bending and repeated applications of the weight of a 95th percentile Hong Kong Chinese male train operator over the life of the train.

8.8.7 Sub-Zone A6

(a) Integrated Indicators Panel

(i) Cab Occupied Indicator (Yellow in colour) (refer to PS 9.12.2)

(ii) Line Volts Indicator (Green in colour) (refer to PS 9.12.2)

(iii) Door Closed Indicator (refer to PS 9.8.16 and PS 9.9.7)

It shall be a red colour indicator and be illuminated when the door proving loop is not completed or when the door proving loop cut out switch is operated.

(iv) Train Divided Indicator (refer to PS 9.12.2)

It shall be a bi-colour indicator, Green colour for normal and Red colour for train divided.

(v) Train Brake Proving Indicator (refer to PS 9.12.2)

It shall be a bi-colour indicator, Yellow colour for brake applied and Green colour for brake released.

(vi) Local Brake Proving Indicator (refer to PS 9.12.2)

It shall be a bi-colour indicator, Yellow colour for brake applied and Green colour for brake released.

(vii) General Fault Indicator (Red in colour) (refer to PS 9.12.2)

(viii) ATC Indications (refer to Appendix I Annex 3)

The Contractor shall provide indicators for the ATC health status information.

(ix) Not used

(x) Not used

(b) Horn Pushbutton (refer to PS 9.6.3)

(i) Horn shall be a yellow "mushroom" button of diameter 40 mm, and shall protrude approximately 25 mm from the surface to facilitate operation in an emergency.

(ii) It shall be clearly discernible from the large, red Emergency Stop Pushbutton.

(c) "A Side" Saloon Doors Controls

(i) "A Side" Doors Open Illuminated Pushbutton (refer to PS 9.8)

(1) The pushbutton shall be momentary and illuminate green.

(2) The illumination shall provide clear indication to the train operator, although not be so prominent as to cause glare or reflection in the trainborne video display monitors for TMS, In-cab CCTV and In-saloon CCTV.

(3) The pushbutton shall be located on the right hand side of the sub-zone A6.

(ii) "A Side" Doors Close Pushbutton (refer to PS 9.8)

(1) The "A Side" Door Close Pushbutton shall be located below the "A Side" Doors Open Pushbutton.

(2) It shall be designed to avoid accidental operation, such as shielded by a few mm raised rim.

(d) "B Side" Saloon Doors Controls

(i) "B Side" Doors Open Illuminated Pushbutton (refer to PS 9.8)

The Pushbutton shall achieve the same requirements in PS 8.8.7(c)(i), except that the controls will be located on the left hand side of the sub-zone A6.

(ii) "B Side" Doors Close Pushbutton (refer to PS 9.8)

(1) The "B Side" Door Close Pushbutton shall be located below the "B Side" Doors Open Pushbutton.

(2) It shall be designed to avoid accidental operation, such as shielded by a few mm raised rim.

(e) Door Announcement Pushbutton (refer to PS18.4.13(d)(v))

8.8.8 Sub-Zone A7

(a) Traction Brake Controller (refer to PS 9.6.2)

(i) The Traction Brake Controller shall have an ergonomically shaped handle.

(ii) The Traction Brake Controller shall incorporate a Deadman's Safety Device.

(iii) The Traction Brake Controller shall comply with the detailed operational requirements defined in PS 9.6.2.

(b) Mode Selector (refer to PS 9.5.2)

(i) The switch shall be within easy reach of the train operator with labels indicating mode positions clearly visible.

(ii) Mode positions shall be positively indented to confirm selection and prevent vibration or accidental knocking causing a change in selection.

8.8.9 Sub-Zone A8

(a) Grabhandle

(i) Handle shall be provided inside the cab, on both sides of each cab side door, to assist entry to the cab from rail level.

(ii) The minimum width between grabhandles shall be greater than 500 mm so as not to restrict access through the cab side doors.

(iii) Each grabhandle shall extend from the floor to a height at least 775 mm above the floor.

(iv) The grabhandle shall be of diameter 30 mm with a clearance of at least 40 mm around the handrail.

(v) All grabhandles shall withstand a horizontal load of 900 N applied as a point load at any point of handle span, superimpose by an uniformly distributed load of 1 300 N/m shall not bend and cause any permanent deformation on the grabhandle or their attachments carbody.

(b) Adjustable Footrest

A two-position adjustable footrest with a non-slip surface shall be provided under the Train Operator Console to ensure a relaxed seated position.

8.8.10 Summary of Controls and Facilities

Item	Name	Function	Type	Zone Position	Qty.
Zone A train operator's Console and Window					
A.1	Destination Display and Controls	Normal	Refer to PS 10.4.4	A1	1
A.2	Sun Visor	Normal	Adjustable sun visor	A1	1
A.3	Trainborne Radio Control Unit	Normal	Refer to PS 18	A2	1
A.4	TMS Display and Controls	Normal	Refer to PS 10	A2	1
A.5	Primary Train Operator Display (PTOD)	Normal	Refer to Appendix I Annex 3	A3	1
A.6	Duplex Pressure Gauge	Normal	Analogue Dial	A3	1
A.7	Emergency Stop	Normal	Red Mushroom Momentary Pushbutton	A3	1

Item	Name	Function	Type	Zone Position	Qty.
A.8	ATO Start	Normal	Momentary Pushbutton	A3	1
A.9	General Fault Reset	Normal	Momentary Pushbutton	A3	1
A.10	Brake Proving	Backup	Momentary Pushbutton	A3	1
A.11	Parking Brake	Normal	Yellow Illuminated Momentary Pushbutton	A3	1
A.12	Uncouple	Normal	Momentary Pushbutton	A3	1
A.13	Driverless Operation	Normal	Momentary Pushbutton	A3	1
A.14	ATDC Cut Out	Normal	3-Position Rotary Switch	A3	1
A.15	Day Time Head Lamp/ Night Time Head Lamp	Normal	Momentary Pushbutton	A3	1
A.16	ATP Overspeed Alarm	Normal	Refer to Appendix I Annex 3	A3	1
A.17	Not used				
A.18	DVAS and PA Master Control Panel	Normal	Refer to PS 18.4	A4	1
A.19	DVAS and PA Microphone	Normal	Refer to PS 18.4	A4	1
A.20	Trainborne Video Display Unit	Normal	Monitor and integrated controls	A4	1
A.21	Windscreen Wiper and Washer	Normal	4-Position Rotary Switch	A5	1
A.22	"A Side" Reading Light	Normal	Pushbutton	A5	1
A.23	Radio Handset	Normal	Telephone handset	A5	1
A.24	Handgrip	Normal		A5	1
A.25	Cab Occupied	Backup	Yellow Indicator	A6	1
A.26	Line Volts	Backup	Green Indicator	A6	1
A.27	Door Closed	Normal	Red Indicator	A6	1
A.28	Train Divided	Backup	Bi-colour Indicator : Green and Red	A6	2
A.29	Train Brake Proving	Backup	Bi-colour Indicator : Green and Yellow	A6	1
A.30	Local Brake Proving	Backup	Bi-colour Indicator : Green and Yellow	A6	1
A.31	General Fault Indicator	Normal	Red Indicator	A6	1
A.32	ATC Indications	Normal	Indicators	A6	
A.33	Door Announcement	Normal	Momentary Pushbutton	A6	1
A.34	Not used				
A.35	"A Side" Doors Open	Normal	Green Illuminated Momentary Pushbutton	A6	1
A.36	"A Side" Doors Close	Normal	Momentary Pushbutton	A6	1
A.37	"B Side" Doors Open	Normal	Green Illuminated Momentary Pushbutton	A6	1
A.38	"B Side" Doors Close	Normal	Momentary Pushbutton	A6	1
A.39	Horn	Normal	Yellow Mushroom Momentary Pushbutton	A6	1
A.40	Traction Brake Controller	Normal	4 function with Deadman's Safety Device	A7	1
A.41	Mode Selector	Normal	6 function locking selector	A7	1
A.42	Grab Handle	Normal		A8	1
A.43	Adjustable Footrest	Normal	2-position	A8	1

8.9 Zone B Auxiliary Console and Window

8.9.1 General Layout

(a) The Auxiliary Console shall allow starting of the train and train preparation tests from the left hand side of the cab and shall provide an installation for the backup and other less frequently used controls.

(b) Zone B shall be divided into four sub-zones, B1 to B4, as defined in Drg. No. C6014-14E/TSEG/110/003.

(c) The DVAS and PA Auxiliary Control Panel (refer to PS 8.9.3(a)) shall be mounted on a separate and removable moulding or equipment housing from the main Auxiliary Console so that the communication equipment can be upgraded in future without any interruption to the Auxiliary Console.

8.9.2 Sub-Zone B1

(a) Train Number Display and Controls (refer to PS 6.9.5 and 10.4.5)

(b) Sun Visor (refer to PS 8.8.2(b))

8.9.3 Sub-Zone B2

(a) DVAS and PA Auxiliary Control Panel (refer to PS 18.4)

The auxiliary control panel console shall be installed at an angle to the table surface.

(b) DVAS and PA Microphone (refer to PS 8.8.5(b))

(c) Control Pushbuttons

(i) Emergency Stop Pushbutton shall be identical to that specified in PS 8.8.4(c).

(ii) ATO Start Pushbutton shall be identical to that specified in PS 8.8.4(d).

(iii) Horn Pushbutton shall be identical to that specified in PS 8.8.7(b).

(iv) Parking Brake Pushbutton shall be identical to that specified in PS 8.8.4(g).

(v) "B Side" Reading Light Pushbutton shall be identical to that specified in 8.8.6(b), except that it controls the reading light above the Auxiliary Console.

8.9.4 Sub-Zone B3

(a) Fire Extinguisher

(i) The Auxiliary Console shall provide a recess for the fire extinguisher (refer to Drg. No. C6014-14E/TSEG/110/003). The fire extinguisher will be free issued by the Employer and shall be fitted by the Contractor in each Auxiliary Console. The extinguisher shall be securely retained within the recess with a quick release retaining bracket.

(ii) The fire extinguisher will be identical to the one specified in PS 7.14.

(b) Bardic Lamp

(i) Space shall be provided for a Bardic Signal Lamp (refer to Drg. No. C6014-14E/TSEG/110/007).

(ii) The method of stowage shall prevent unauthorised removal of the lamp except by the use of an approved key as detailed in RS/C6014/15.

(c) Target Holder (refer to Drg. No. C6014-14E/TSEG/990/010)

(d) Detrainment Plate

(f) Space shall be provided for a train operator's bag, measuring 370 x 300 x 150 mm.

(g) Graphandle shall meet the requirements specified in PS 8.8.9 (a)

8.9.5 Sub-Zone B4

(a) The control panel shall include the following sealed switches:

(i) Autocoupler Electrical Isolation Switch (refer to PS 14.3.1(h)) shall be a sealed two-position switch. The default position of the switch is isolated position.

(ii) Cab End Main Reservoir Pipe Isolation Cock (refer to PS 13.9.13 and PS 14.2.7 (b)). The default position of the cock is isolated position.

(b) This control panel shall be recessed into the Auxiliary Cubicle.

8.9.6 Summary of Controls and Facilities

Item	Name	Function	Type	Zone Position	Qty.
Zone B	**Auxiliary Console and Window**				
B.1	Train Number Display and Controls	Normal	Refer to PS 10.4.5	B1	1
B.2	Sun Visor	Normal	Adjustable sun visor	B1	1
B.3	DVAS and PA Auxiliary Control Panel and Microphone	Backup	Refer to PS 18	B2	1
B.4	Emergency Stop	Backup	Red Mushroom Momentary Pushbutton	B2	1
B.5	ATO Start	Backup	Momentary Pushbutton	B2	1
B.6	Horn	Backup	Yellow Mushroom Momentary Pushbutton	B2	1
B.7	Parking Brake	Backup	Yellow Illuminated Momentary Pushbutton	B2	1
B.8	"B Side" Reading Light	Normal	Pushbutton	B2	1
B.9	Fire Extinguisher	Emergency		B3	1
B.10	Bardic Lamp	Emergency		B3	1
B.11	Target Holder	Normal		B3	1
B.12	Detrainment Plate	Emergency		B3	1
B.13	Train Operator's Bag Stowage	Normal		B3	1
B.14	Grab Handle	Normal		B3	1
B.15	Autocoupler Electrical Isolation	Emergency	Sealed 2-Position Switch	B4	1
B.16	Cab End Main Reservoir Pipe Isolation	Emergency	2-Position Cock	B4	1

8.10 Zone C "A" Side Cab Back Wall

8.10.1 General Layout

Zone C shall be divided into five sub-zones, C1 to C5, as defined in Drg. No. C6014-14E/TSEG/110/004.

8.10.2 Sub-Zone C1

(a) This control panel shall be recessed to ensure that train operator will not hit his head on the controls during the seat sliding operation.

(b) Each control shall be labelled and comprised a sealed switch. The height of the panel shall be suitable to allow train operator to operate the controls and to read the labels for the controls.

(c) The panel shall be covered with a transparent panel, which shall be arranged such that it will not close; and hence provide a visual indication; if one of the sealed switches has been operated.

(d) Provision shall be made for the panel in the open position to be suitably restrained.

(e) The following sealed switches shall be included:

(i) Brake Loop Cut-out Switch (refer to PS 9.9.6)

(ii) Door Proving Loop Cut-out Switch (refer to PS 9.9.7)

(iii) Safety Cut-out Switch (refer to Appendix I Annex 3) shall be a 4-position rotary switch.

(iv) Brake Loop Selector Switch (refer to PS 9.12.3 (b))

8.10.3 Sub-Zone C2

This sub-zone shall mount the following pushbuttons, switches and indicators:

(a) Auxiliary ON Pushbutton (Refer to PS 9.2.1)

(b) Auxiliary OFF Pushbutton (Refer to PS 9.3.1)

(c) Pantograph Selector (refer to PS 9.4). A 4-position rotary switch controlling:

(i) All three pantographs up
(ii) Unit 1 pantograph up
(iii) Unit 2 pantograph up
(iv) Unit 3 pantograph up

(d) Pan Down Pushbutton (Refer to PS 9.4)

(e) Power Fault Indicator (Refer to PS 9.12.2 (d))

(f) Auxiliary Fault Indicator (Refer to PS 9.12.2 (d))

(g) Ventilation Fault Indicator (Refer to PS 9.12.2 (d))

(h) EIDS Reset Pushbutton (Refer to PS 18.5.6(n))

8.10.4 Sub-Zone C3

This sub-zone shall mount the following saloon/cab doors controls and indicators:

(a) "A Side" Doors Open Pushbutton shall be identical to that specified in PS 8.8.7(c)(i).

(b) "A Side" Doors Close Pushbutton shall be identical to that specified in PS 8.8.7(c)(ii) except the raised rim shall be replaced with a flagged spring biased red cover to avoid accidental actuation.

(c) All Doors Proved Closed Indicator shall be identical to that specified in PS 8.8.7(a)(iii).

(d) "A Side" Doors Bypass Switch shall be a 2-position rotary switch.

(e) Door Announcement Pushbutton

(f) Not used

(g) "A Side" Cab Door Open Pushbutton

(h) "A Side" Cab Door Close Pushbutton

(i) Cab Main Light Pushbutton

8.10.5 Sub-Zone C4

(a) Train operator's seat shall satisfy the requirements specified in PS 8.13.

(b) A document holder and a clip board holder shall be located close to the train operator's seat.

(c) Side grabhandle shall meet the requirements specified in PS 8.8.9(a)

(d) A smoke hood box shall be installed at the cab back wall panel, located at the lower “A” side of the train operator’s seat.

(i) The thickness of the box shall be 0.8mm made of Stainless Steel AISI 304, sized 150(L) x 80(W) x 200(H).

(ii) The box shall contain a hinged cover with a locking pin at the side. The closed cover shall be able to retain the smoke hood and enable the display of the instruction for the smoke hood.

8.10.6 Sub-Zone C5

(a) An air inlet vent shall be provided which shall be sized to provide adequate cooling to the cubicle equipment.

(b) Power Supply Socket

(i) To enable the use of 220V AC portable electrically operated equipment, the driving cab and the hostler position shall be equipped with an AC metal clad surface mounting 13A switched socket outlet fitted with an indicator in accordance with BS 1363 Part 2: 1995.

(ii) The socket outlet shall be easily accessible.

(iii) The supply shall always be available, whenever AC supply is available.

(iv) The AC supply shall be provided from an isolation transformer. The centre tapping of the transformer output winding shall be earthed to the carbody.

8.10.7 Summary of Controls and Facilities

Item	Name	Function	Type	Zone Position	Qty.
Zone C	**"A" Side Cab Back Wall**				
C.1	Brake Loop Cut-out	Emergency	Sealed 2-Position Switch	C1	1
C.2	Door Proving Loop Cut-out	Emergency	Sealed 2-Position Switch	C1	1
C.3	Safety Cut-out	Emergency	Sealed 3-Position Switch	C1	1
C.4	Brake Loop Selector	Emergency	Sealed 2-Position Switch	C1	1
C.5	EIDS Reset Pushbutton	Normal	Momentary Pushbutton	C2	1
C.6	Auxiliary ON	Normal	Momentary Pushbutton	C2	1
C.7	Auxiliary OFF	Normal	Momentary Pushbutton	C2	1
C.8	Pantograph Selector	Normal	4-Position Rotary Switch	C2	1
C.9	Pan Down	Normal	Momentary Pushbutton	C2	1
C.10	Power Fault	Backup	Red Indicator	C2	1
C.11	Auxiliary Fault	Backup	Red Indicator	C2	1
C.12	Ventilation Fault	Backup	Red Indicator	C2	1
C.13	"A" Side Doors Open	Backup	Green Illuminated Momentary Pushbutton	C3	1
C.14	"A Side" Doors Close	Backup	Momentary Pushbutton with a flagged spring biased red cover	C3	1
C.15	All Doors Proved Closed	Backup	Red Indicator	C3	1
C.16	"A" Side Door Bypass	Backup	2-Position Switch	C3	1
C.17	Door Announcement	Normal	Momentary Pushbutton	C3	1
C.18					
C.19	"A" Side Cab Door Open	Backup	Momentary Pushbutton	C3	1
C.20	"A" Side Cab Door Close	Backup	Momentary Pushbutton	C3	1
C.21	Cab Main Light	Normal	Pushbutton	C3	1
C.22	Train Operator's Seat	Normal	Adjustable with armrests	C4	1
C.23	Document/Clip Board Holder	Normal	Collapsible Pouch	C4	1
C.24	Side Handrail	Normal		C4	1
C.25	Power Supply Socket	Normal		C5	1

Item	Name	Function	Type	Zone Position	Qty.
C.26	Vent	Normal		C5	1
C.27	Smoke Hood Box	Emergency	Stainless Steel Box	C4	1

8.11 Zone D "B" Side Cab Back Wall

8.11.1 General Layout

Zone D shall be divided into five sub-zones, D1 to D5, as defined in Drg. No. C6014-14E/TSEG/110/005.

8.11.2 Sub-Zone D1

The B Side cab back wall shall be fitted with a coat hook for a train operator to hang a jacket without it obstructing any switches or controls and without it being exposed to any particularly dirt areas.

8.11.3 Sub-Zone D2

Sub-zone D2 shall be arranged in an identical manner to the sub-zone C3 as described in PS 8.10.4, with the exception that the controls shall control the B Side saloon and cab doors.

8.11.4 Sub-Zone D3

(a) Auxiliary seat shall satisfy the requirements specified in PS 8.13.

(b) Side grabhandle shall be identical to that specified in PS 8.8.9(a)

8.11.5 Sub-Zone D4

(a) MCB panel shall consist of miniature circuit breakers as detailed in PS 9.

(b) The panel shall be covered by a transparent cover.

8.11.6 Sub-Zone D5

A vent shall be provided identical to that specified in PS 8.10.6.

8.11.7 Summary of Controls and Facilities

Item	Name	Function	Type	Zone Position	Qty.
Zone D "B" Side Cab Back Wall					
D.1	Coat Hook	Normal		D1	1
D.2	"B" Side Doors Open	Backup	Green Illuminated Momentary Pushbutton	D2	2
D.3	"B" Side Doors Close	Backup	Momentary Pushbutton with a flagged spring biased red cover	D2	1
D.4	All Doors Proved Closed	Backup	Red Indicator	D2	1
D.5	"B" Side Door Bypass	Backup	2-Position Switch	D2	1
D.6	Door Announcement	Normal	Momentary Pushbutton	D2	1
D.7					
D.8	"B" Side Cab Door Open	Backup	Momentary Pushbutton	D2	1
D.9	"B" Side Cab Door Close	Backup	Momentary Pushbutton	D2	1
D.10	Cab Main Light	Normal	Pushbutton	D2	1
Item	**Name**	**Function**	**Type**	**Zone Position**	**Qty.**
D.11	Auxiliary Seat	Normal		D3	1
D.12	Side Handrail	Normal		D3	1
D.13	MCB Panel	Normal	MCB's labelled	D4	1
D.14	Vent	Normal		D5	1

8.12 Zone E Ceiling (Refer to Drg. No. C6014-14E/TSEG/110/006)

8.12.1 Air Conditioning Vents

(a) An adjustable air supply vent shall be provided to adjust airflow onto the train operator's head, or to direct the airflow away from the train operator if so desired, to ensure a draught-free environment.

(b) The air return vent and the air supply vent shall be located to avoid short circuit of cool air.

8.12.2 Air Conditioning Control Panel shall be provided incorporating:

(a) Air speed control which shall allow adjustment of the speed and quantity of conditioned air into the cab.

(b) Air temperature control which shall allow adjustment of the cab temperature within the range defined in PS 15.21.

8.12.3 A cab main light shall provide general illumination throughout the cab as specified in PS 8.14.1.

8.12.4 Reading lights shall provide illumination as specified in PS 8.14.2.

8.12.5 Detrainment light shall be mounted in the ceiling to provide illumination as detailed in PS 8.14.3, during an emergency detrainment.

8.12.6 Summary of Controls and Facilities

Item	Name	Function	Type	Zone Position	Qty.
Zone E Ceiling					
E.1	Reading Light	Normal		E	2
E.2	Cab Main Light	Normal		E	1
E.3	Detrainment Light	Emergency		E	1
E.4	Cab A/C Control	Normal	Control Panel	E	1
E.5	Air Supply	Normal	Vent	E	1
E.6	Air Return	Normal	Vent	E	1

8.13 Seating

8.13.1 General

(a) The train operator and auxiliary seat shall be installed in the locations shown in Drg. No. C6014-14E/TSEG/110/001.

(b) The seats shall be designed in accordance with the ergonomic requirements detailed in PS 8.3.

(c) The design and location of the seats shall allow train operator to meet the vision requirements detailed in PS 8.5.

(d) The upholstery material shall be designed to avoid causing the train operator to perspire excessively. The colour and finish shall be as defined in PS 8.19.

(e) The Contractor shall submit prior to production, a full size operational sample of each seat for Approval. The sample shall be used to define the quality of the production seat and act as a reference throughout production (refer to PS 8.2.2(b)(vii)).

(f) All production seats must meet the quality defined by this sample seat.

(g) The sample seat shall be held by the Contractor for the duration of the Contract and be available for inspection by the Engineer at all times.

(h) The Contractor shall submit for Approval, a programme of hardness testing to establish acceptable values for the hardness of the seat headrest, cushion, squab and lumbar support of the production seat. The testing shall be conducted on fully trimmed upholstered items in accordance with BS EN ISO 2439: 2001.

(i) Fully trimmed upholstered items to the agreed hardness shall form part of the reference sample seat.

(j) The seats shall meet strength standard UIC ORE B106 : 1971 RP2 1980.

(k) All upholstery, trim and other materials used in the seat construction shall meet the fire performance requirements detailed in RS/C6014/08.

8.13.2 Train Operator Seat (Refer to Drg. No. C6014-14E/TSEG/110/009)

(a) Foam stiffness or a seat suspension system shall minimise critical vibration frequencies being transmitted to the train operator. Foam thickness shall be such that for the chosen foam stiffness, the foam will not bottom out for the heaviest train operator.

(b) In order to assist 5th percentile females getting onto the seat and to assist with seat height adjustment, the seat support shall include a simple bar type step.

(c) Fore/Aft Sliding

(i) The train operator seat shall incorporate a mechanism in addition to the fore/aft seat position adjustment described in PS 8.13.2(d), which shall allow ease of access into and out of the seat.

(ii) The seat shall be designed to mount on the rear "A Side" Cab Back Wall Cubicle in order to maximise access during cab entry and exit.

(iii) The force required to stow the seat shall be submitted for Approval.

(iv) The seat mechanism shall operate without failure throughout the life of the train, when maintained in accordance with the agreed maintenance requirements. It shall be protected from the ingress of dust, fluids and debris likely to restrict its operation.

(v) The seat mechanism shall not form any obstruction or aperture likely to cause tripping or other injury.

(d) Seat Adjustments

(i) The seat shall be equipped with power mechanism, either electric or pneumatic, for vertical adjustment of the seat frame in a simple and safe process. The powered adjustment mechanism shall be able to stop at any height within the range.

(ii) Seat adjustment controls for cushion height and back-rest angle shall be located on the seat frame at opposite hand to the handgrip on the Train Operator Console, which shall move together with the seat back and cushion when adjusting the height.

(iii) A fore/aft adjustment control shall be located to the front of the seat cushion.

(iv) All seat adjustment controls shall remain within easy reach and at cushion height, for all seat adjustment positions.

(v) None of the controls shall interfere with, or cause confusion with, the seat sliding control.

(e) Head-rest

(i) The seat shall incorporate an adjustable head-rest to protect the train operator's head from hitting the Cab Back Wall Cubicle during normal operation at any seat height.

(ii) The head-rest, when folded down, shall have adequate clearances to ensure scuffing of the head-rest and the cab back wall cubicle does not occur in the fore/aft sliding operation from the cubicle recess at any seat height.

(f) Arm-rests

(i) The arm-rest length shall be designed not to restrict forward seat movement.

(ii) Arm-rests shall rotate to vertically upward.

(g) Maintainability

(i) The train operator's seat shall be designed such that it can be removed and installed by one competent maintenance staff within 20 minutes.

(ii) The height adjustment powered mechanism shall be designed such that it can be removed and installed by one competent maintenance staff within 15 minutes. 8.13.3

8.13.3 Auxiliary Seat

(a) A perch seat shall be provided for occasional use by a trainee, instructor or inspector.

(b) The seat shall not impede access to the "B Side" cab bodyside door.

(c) The seat shall be fitted using quick release fastenings to allow simple maintenance access to equipment behind the bulkhead.

8.13.4 Requirements for Seat Life

(a) Each seat assembly shall have the full service life of the train as detailed in PS 4.5.5, with the exception of the upholstery materials.

(b) The leather seat upholstery shall have a life equivalent to half the service life of the car.

(c) Tests shall be conducted to demonstrate the seat life (assembly and cover), including a Martindale (rub test) test to BS EN ISO 12947: 1999.

(d) Upholstery shall achieve bursting strength to BS EN ISO 13938: 1999 and a breaking load to BS EN ISO 13934: Part 1: 1999.

(e) Upholstery shall not crack or fade during the service life of the seat.

(f) Seat upholstery shall withstand all contaminants normally encountered in service such as water, grease, oil and grit.

8.13.5 Requirements for Seat Maintenance

(a) All seat upholstery shall be easily cleanable with no dirt traps.

(b) Seat design shall reflect maintenance requirements and a need to minimise the cost of items requiring replacement due to wear or misuse.

(c) Upholstery shall remain colour fast under the following BS EN ISO 105: Part A01: 1996 conditions:-

(i) light
(ii) shampoo
(iii) dry cleaning

(iv) water spotting
(v) acid spotting
(vi) alkali spotting
(vii) rubbing

8.13.6 Seat Integrity

(a) To ensure seat integrity the complete seat shall be designed to meet the test requirements of BS EN 61373:1999.

(b) At the completion of the test programme, the seat shall be stripped down for examination and the results shall be submitted for Approval.

8.14 Cab Lighting

8.14.1 Main Light

(a) A main cab light shall be provided in the ceiling.

(b) This light shall provide general illumination throughout the cab to an average level of 200 lux at floor level.

(c) The light shall have a colour temperature of 4000 K.

(d) The light shall not reflect in the windscreen, other cab windows, trainborne video display screen for In-cab CCTV and In-saloon CCTV, or other console displays.

(e) The light shall be switched by the control detailed in PS 8.10.4 and PS 8.11.3. It shall also be automatically switched on at full illumination when the cab/saloon partition door is opened, including in the event of an emergency detrainment.

8.14.2 Reading Light

(a) Reading lights shall be provided in the ceiling above the Train Operator Console and Auxiliary Console.

(b) These lights shall provide a narrow beam of light sufficient to allow reading at the console without illuminating the complete console.

(c) The average light level, measured at the console, due to this light alone shall be 300 lux.

(d) The light shall not reflect in any cab window, trainborne video display screen for In-cab CCTV and In-saloon CCTV or other console displays.

(e) Controls shall be provided as specified in PS 8.8.6 and PS 8.9.3.

8.14.3 Detrainment Light

(a) A detrainment light shall be mounted in the cab ceiling.

(b) It shall provide an average light level of 80 lux on the detrainment ramp when in the deployed position.

(c) The light shall automatically illuminate upon deployment of the Emergency Detrainment Device.

8.15 Cab Doors

8.15.1 General

(a) Cab doors comprising 2 powered external sliding doors or sliding plug doors as stipulated in clause 16.3.1, a saloon/cab partition door and an emergency detrainment door shall be located as shown in Drg. No. C6014-14E/TSEG/110/001. When the train is moving, the cab doors shall be remained closed and locked. Activation of cab door open pushbutton shall not alter the status of the cab doors and the train performance.

(b) All external cab doors shall meet the sealing, locking and performance requirements detailed in PS 16.

(c) All external cab doors shall withstand the aerodynamic pressure pulses and glazing requirements detailed in PS 6.8 and PS 6.11.

8.15.2 Cab Bodyside Doors

(a) A single leaf door shall be provided on each side of the cab as specified in PS 16.3 (refer to Drg. No. C6014-14E/TSEG/110/001).

(b) The cab side doors controls shall be as detailed in PS 8.10.4 and PS 8.11.3.

8.15.3 Cab/Saloon Partition Door

A cab/saloon partition door shall be provided as specified in PS 16.5.

8.15.4 Emergency Detrainment Door

The emergency detrainment door shall be provided as part of the Emergency Detrainment Device detailed in PS 8.16.

8.16 Emergency Detrainment Device

8.16.1 General

(a) The device shall comprise a detrainment door and ramp that operate as shown in Drg. Nos. OD1/307/00009/0001, OD1/307/00009/0002 and OD1/307/00009/0003.

(b) The detrainment device shall allow the detrainment of 2 500 passengers in a maximum period of 28 minutes, including deployment time.

(c) The minimum headroom height through the detrainment door shall be 1920 mm for all modes of detrainment.

(d) The design life of the Emergency Detrainment Device shall be equal to the life of the train.

(e) A fully functional production type installation shall be provided in the cab mock-up to review and prove the design of the emergency door.

(f) Testing shall be conducted to demonstrate that the requirements of PS 8.16 have been satisfied (refer to Appendix C Clause 2.11.4).

(g) The Contractor shall carry out demonstrations to confirm compliance with the train-to-train detrainment with another train and Urban Lines Train (refer to PS 8.16.2).

8.16.2 Detrainment Modes

(a) The emergency door shall have two basic modes of operation:

(i) Train-to-Track detrainment

(ii) Train-to-Train detrainment

(b) In the Train-to-Track detrainment mode:

(i) It shall function as a detrainment ramp.

(ii) The deployment of the detrainment ramp shall not be more than 3 steps.

(iii) The detrainment ramp shall consist of a primary ramp and a secondary ramp.

(iv) Once manually activated, the deployment of the secondary ramp and the handrails shall be fully automated and the ramp shall be rendered ready for immediate use.

(c) In the Train-to-Train detrainment mode

(i) It shall function as a sliding plug door.

(ii) The emergency door shall be opened in the sliding mode towards the A Side, followed by the position of a detrainment plate in between the two coupled cabs by the train operator all in less than 90 seconds.

(iii) The door shall not infringe with any parts of its own cab end canopy nor the opposite cab end canopy in the opened position.

(d) The emergency door shall be configured such that its primary mode of operation is as a ramp whereas its secondary function is as a sliding plug door. This logic shall always apply when the train is in service.

8.16.3 Mechanism

(a) The detrainment door mechanism shall be robust and durable. Its fitness for purpose shall be proven by type test as stipulated in Appendix C Clause 2.11.4.

(b) The mechanism shall be designed to prevent rattling, chafing or mechanical degradation in any way during its service life in the stowed position.

(c) When operated, the mechanism shall function in a safe and secure manner that inspires confidence in use of the device amongst potentially disoriented users. Loud noises shall be avoided during deployment.

(d) The deployment rate shall be controlled to minimise risk of injury to users or other third parties in front of the train. It shall allow sufficient time for an able bodied person to move out of the way if an unexpected release of the ramp occurs.

(e) For the automatic deployment of the secondary ramp, its rate of deployment shall be carefully designed to reduce the risk of passenger injury in an attempt to rush out into the ramp.

(f) The mechanism shall be designed to be safe for use by untrained users presenting no finger traps or other dangers when deployed.

(g) The walking surface of the deployed detrainment ramp and the emergency detrainment plate shall be:

(i) stiff
(ii) clear and flat
(iii) anti-slip, even when wet

(h) The deployed ramp shall make an angle with the track of less than 15°.

(i) The edges of the ramp shall be clearly marked with fluorescent reflective label with directional signs.

(j) Handrails shall be provided along the full length of the detrainment ramp to assist the detrainment of passengers.

(k) An emergency hand-held torch shall be attached to the device.

(l) The security of the device's operating mechanism shall be monitored by the Door Proving Loop as detailed in PS 9.9.7. Microswitches provided to monitor the device's operating mechanism security shall be weatherproof to BS EN 60529: 1992 IP65.

(m) A detailed safety study shall be conducted on the Emergency Detrainment Device as stipulated in PS 25. Special consideration shall be given to the situations of :

(i) Failure to deploy
(ii) Accidentally deployed

8.16.4 Deployment

(a) The device shall be easily operated under the following conditions:

(i) all types of straight and curved track as specified in Appendix I Annex 1.
(ii) all train loading conditions, including fully deflated suspension.
(iii) all environmental conditions as specified in GS Section 2.
(iv) easy to deploy by one 5th percentile Chinese female.

(b) The method of deployment shall be simple to operate and easy to understand, requiring only limited instructions.

(c) The emergency door shall be opened and the ramp deployed by an untrained member of the public in less than 1 minute (refer to PS 8.16.2(b)). The satisfactory achievement of this shall be determined by type test using untrained persons in a simulated emergency situation.

(d) The method of deployment shall be designed to safeguard against the possibility of accidental deployment. Deployment shall require a specific and deliberate act.

8.16.5 Stowage

(a) The deployed emergency ramp door shall be stowed and restored to the normal position in 5 minutes or less by one trained person.

(b) The stowed condition achieved in this time shall be a fully operational state, not an intermediate un-set state. Any specialised tools required for stowage shall be suitable for in-cab storage and provision shall be made to stow them where they shall not rattle or obstruct other routine cab activities.

(c) When stowed, the door shall in its aperture preventing any draughts, dirt or water entering the cab and it shall not generate any wind related or other noise. The arrangement shall comply to BS EN 60529: 1992 IP65.

(d) The stowage time for the detrainment plate shall be 90 seconds maximum.

8.16.6 Strength

(a) The device shall withstand a passenger load applied over the complete ramp area of 6 passengers/m^2, each of mass 60 kg, under all deployed conditions. An additional safety factor of 1.5 shall also be incorporated.

(b) The device shall not suffer cosmetic, structural or other damage when operated.

8.16.7 Reliability

(a) The device shall deliver 99.99% reliability on opening.

(b) For reliability calculation purpose, the frequency of usage shall assume to be once per annum across the whole fleet of trains.

8.17 Cab Flooring

The cab floor shall be fitted with the same covering and board as that specified for the saloon flooring in PS 7.8.

8.18 Internal Panels

8.18.1 Internal cladding panels comprising:-

(a) Wall panels
(b) Ceiling panels
(c) Pillar cladding
(d) Console panels
(e) Cab rear panels

8.18.2 The panels shall allow access for maintenance or repair to any components, wiring or ducting. The panels shall cover all wiring, ducting, piping and structure.

8.18.3 The number of fixings shall be minimised. No fixings shall be visible or accessible to the train operator. Access into consoles or electrical cabinets shall only be possible by the use of an approved key as detailed in RS/C6014/15.

8.18.4 All gaps between panels shall be designed to project a neat, flush and parallel appearance.

8.18.5 All corners and edges in the cab shall have a radius of no less than 5 mm. Wall to floor, and wall to ceiling joints shall have covings of a minimum radius of 50 mm to facilitate cleaning.

8.18.6 The panels shall be easily cleaned. There shall be no dirt traps.

8.18.7 The panels shall not be prone to breakage or denting, in everyday use. The finish shall not deteriorate significantly over the life of the train.

8.19 Colour

8.19.1 Colours used shall follow the National Colour System (NCS).

8.19.2 The Contractor shall follow the colour scheme as specified in the following table:

Item	Description	Colour
1	Instrument and control panels	Black NCS 8502R
2	Console upper surfaces	Grey NCS 5500N
3	Console lower surfaces	Grey NCS 1000N
4	Side and rear wall panels	Grey NCS 6502Y
5	Pillars	Grey NCS 6502Y
6	Ceiling panels	Off White NCS 0502Y
7	Seating upholstery	Red NCS 2080 Y90R Black NCS 9500N
8	Seat mouldings	Grey
9	Traction Brake Controller and Mode Selector	Black NCS 8502R
10	Floor	Same as saloon flooring as specified in Appendix L

8.19.3 The gloss level shall be 50±10% unless otherwise specified. Adjacent panels shall be selected to minimise the visual difference between the gloss levels.

8.20 Signage

8.20.1 General

Wherever possible graphic symbols shall be used. Where text is employed it shall be in the English and Chinese language.

8.20.2 Cab Emergency Doors

The signage used on the cab/saloon partition door and the Emergency Detrainment Device shall be submitted for Approval.

SECTION 9

OPERATION AND CONTROL

August 2015

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9 OPERATION AND CONTROL

9.1 General

9.2 Train Systems Initialisation

9.3 Train Systems Shut Down

9.4 Pantograph Control

9.5 Modes of Operation

9.6 Train Movement Control

9.7 Coupling and Uncoupling Operation

9.8 Passenger Door Control

9.9 Safety Related Controls

9.10 Train and Passenger Information Management

9.11 Emergency Operations

9.12 Special Controls

Table 9-1 Traction Brake Controller Handle Position

9 OPERATION AND CONTROL

9.1 General

9.1.1 The design of train operating and control principles shall be consistent with those of the Urban Lines Trains in order to preclude human errors due to inadvertent use of the accustomed train operating procedures and minimise the training for train operators of the Urban Lines Trains.

9.1.2 For the purpose of this Section, the basic operation and control requirements are specified according to the experience gained from the Urban Lines Trains. Operating or control logic conflicting with the existing practices shall be avoided. Copies of the Employer's train operation procedures for operating the Urban Lines Trains are available for the Contractor's reference.

9.1.3 This Section shall be read in conjunction with PS 4 - System Description and Performance Requirements, PS 8 - Cab Facilities and Layout, PS 10 - Train Management System, PS 18 - Communication and RS/C6014/14 - Operability Design Guidelines to ensure proper integration of human factors into the specific operation and control requirements, along with the train systems hardware, software, data and other elements.

9.1.4 Unless otherwise specified, all the operation and control circuits shall be 110VDC supplied. These 110VDC supplied systems/equipment shall function satisfactorily at battery supply voltages of 110 VDC (nominal) between 77VDC and 137.5VDC according to IEC 60077-1:1999.

9.1.5 The design of train control and monitoring systems shall avoid any frequent nuisance trippings and / or frequent false alarms which will cause disruption to operation of drivers and maintenance staff. In case of occurrence, the attendance by the drivers/maintenance staff shall not add any substantial burden to their normal duty. On the other hand, the Contractor shall be liable for rectification, to undertake any necessary actions including fault diagnosis and system modifications to prevent the recurrence of frequent nuisance trippings and / or frequent false alarms, within the time period as mutually agreed by the Engineer and the Contractor.

9.2 Train Systems Initialisation

The following control arrangement shall be provided for preparation of the train:

9.2.1 When the Auxiliary On pushbutton (refer to PS 8.10), either it is located in the driving cab or hostler cab, is pressed and released, the following systems/equipment shall be automatically activated:

(a) train management system (refer to PS 10);
(b) DC circuit (refer to PS 17.4);
(c) emergency systems (refer to PS 17.1.4);
(d) current collector equipment (refer to PS 11.6.1) and the auxiliary air compressor for the pantograph (refer to PS 13.7); and
(e) communication system (refer to PS 18.1.4).

9.2.2 When the pantograph is raised and comes into contact with the live overhead line wire and collected the 1,500VDC traction supply (refer to Appendix I Annex 2), the following system/equipment shall be automatically activated:

(a) auxiliary converter (refer to PS 17.1.1);
(b) air compressor (refer to PS17.1.1);
(c) AC circuit (refer to PS 17.3);
(d) cab and saloon air conditioning units (refer to PS 15.10); and
(e) lighting (refer to PS 7.11)

9.3 Train Systems Shut Down

The following control arrangement shall be provided for shut down of the train:

9.3.1 When the Auxiliary Off pushbutton (refer to PS 8.10) either in the driving cab or hostler cab is pressed and released, the shutdown sequence of the systems/equipment shall be automatically initiated in the reversed order of PS 9.2.

9.3.2 The following functions shall be performed in addition to the above shutdown sequence:

(a) After the completion of pumping down the refrigerant of the air conditioning system (refer to PS 15.15.9), the auxiliary converters shall be shut down.

(b) In order to avoid arcing between the pantograph carbon strips and the overhead line wire, all 1,500VDC systems/equipment including auxiliary converters and air compressors shall shut down before the associated pantograph is lowered down.

(c) The emergency systems (refer to PS 17.1.4) shall remain energised from the battery supply for a minimum of 120 sec when the Auxiliary Off control is activated (refer to PS 9.3.1). After this 120 sec, the battery power supply shall be switched off completely (refer to PS 17.4.1). The above

timing function shall be easily adjustable by maintenance personnel between 60 to 300 sec.

9.4 Pantograph Control

9.4.1 Selective Pantograph Raising Function

The Pantograph Selector (refer to PS 8.10.3(c)) shall be used in conjunction with the Auxiliary On Pushbutton (refer to PS 8.10.3(a)) to enable any/all pantographs to be raised on the train. The train systems shall respond according to PS 9.2.

9.4.2 Emergency Pantograph Lowering Function

(a) Once the Pan Down Pushbutton (refer to PS 8.10.3(d)) either it is located in the driving cab or hostler cab, is pressed and released, it shall override the normal shutdown sequence (refer to PS 9.3.2(a) and (b)) and immediately lower all the pantographs on the train and trip the high voltage equipment supplied by the traction supply.

(b) The activation of the Pan Down pushbutton shall not affect the normal operation of the systems/equipment listed in PS 9.2.1.

9.5 Modes of Operation

9.5.1 The modes of operation and direction of movement of the train shall be determined by the position of the mode selector (refer to PS 8.8.8(b)) or the hostler master switch (refer to PS 7.17.2).

9.5.2 The mode selector shall have the following six valid sequential positions i.e. it shall not be possible to directly select Auto mode from the Shutdown position, or vice versa, without previously having selected each of the other modes:

(a) Shutdown

All controls except the auxiliary functions specified in PS 9.2 to 9.4 shall be inoperative. Emergency brake shall be applied in this mode of operation.

(b) Reverse

Manual driving in a reverse direction without any guidance provided by the automatic train control system and the maximum speed is limited to 22 km/h.

(c) Standby

Minimum control function of some train systems, such as, train management, door and communication, shall be provided for train standing by purpose. In this mode of operation:

(i) the traction controls shall be inoperative; and

(ii) emergency brake shall be applied, if the safety proving circuit is not energised (refer to PS 9.9.5) or the brake loop circuit is not completed (refer to PS 9.9.6); or

(iii) full service brake shall be applied, if the safety proving circuit is energised and the brake loop circuit is completed.

(d) Forward

Manual driving in a forward direction without any supervision provided by the automatic train control system other than a maximum speed limit of 22 km/h.

(e) Coded Manual

Manual driving in a forward direction with speed control provided by the Automatic Train Control system (refer to Appendix I Annex 3). ATP protection is provided.

(f) Auto

Automatic driving in a forward direction by the Automatic Train control system (refer to Appendix I Annex 3).

The forward and reverse modes shall also be referred as the Restricted Manual mode in this PS. This also refers to the forward and reverse modes selectable from the hostler master switch (refer to PS 9.5.10).

9.5.3 Each switch position shall be detented and clearly identifiable.

9.5.4 The mode selector shall prevent any undefined states being achieved when changing mode.

9.5.5 Permitted mode changes shall only be possible when zero velocity is proved (refer to Appendix I Annex 3). Mode changes attempted at train speeds greater than zero velocity shall cause the emergency brake to be applied other than when selecting Coded Manual from Auto mode.

9.5.6 The mode selector shall include a key switch mechanism, incorporating two positions (Locked and Unlocked) that shall be controlled only by the approved train operator key (refer to RS/C6014/15).

9.5.7 The key switch shall mechanically inhibit the rotation of the mode selector, unless the train operator key is inserted and rotated to the unlocked position.

9.5.8 The train operator key shall be physically retained in the unlocked position, thus removal of the key shall only be possible in the locked position. The selection of the locked position shall only be possible with the mode selector in the shutdown position.

9.5.9 When the train is operated from the hostler cab (refer to PS 7.17) via the hostler master switch (refer to PS 7.17.2), the traction and braking system control functions shall be provided.

9.5.10 The hostler master switch shall be key locked and have the following four valid sequential positions i.e. it shall not be possible to directly select reverse mode from the normal position, or vice versa, without previously having selected each of the other modes:

(a) Normal

All controls except the auxiliary function specified in PS 9.2 to 9.4 shall be inoperative. The normal position is used to complete the brake loop circuit (refer to PS 9.9.6) when the car is coupled in the middle of a train.

(b) Forward

Manual driving in a forward direction with an overspeed protection provided by the traction and braking system i.e. to remove the traction power and apply the emergency brake when the target speed limit of 22 km/h is exceeded (refer to PS 11.3.14).

(c) OFF

Similar to the normal mode except different effect to the brake loop circuit i.e. the off position is used to complete the above brake loop circuit when the car is at the end of a train.

(d) Reverse

Manual driving in a reverse direction with an overspeed protection provided by the traction and braking system i.e. to remove the traction power and apply the emergency brake when the target speed limit of 22 km/h is exceeded (refer to PS 11.3.14).

9.5.11 The hostler master switch shall be unlocked only by the approved train operator key and the key shall be retained in both forward and reverse position. Removal of the key shall only be possible in the normal and off position.

9.6 Train Movement Control

9.6.1 In addition to the automatic control of train movement provided by the ATC system (refer to Appendix I Annex 3), the train movement shall be manually controlled by the use of traction brake controller (refer to PS 8.8.8(a)) or pendant controller (refer to PS 7.17.3).

9.6.2 Traction Brake Controller

(a) The traction brake controller shall provide the manual driving inputs to the traction and braking system and convert the traction and braking demand linearly according to the degree of inclination of the controller handle (refer to Table 9-1).

(b) The operation of the controller handle shall be a horizontal motion along a single axis and there shall be no backlash throughout the whole range of angular movement of the controller handle disregard its direction of motion. The controller handle shall be designed to prevent ingress of dust or small debris.

(c) The traction brake controller shall provide signals to the safety proving system (refer to PS 9.9.5).

(d) The traction brake controller shall be operative only when the Coded Manual or Restricted Manual modes are selected (refer to PS 9.5.2).

(e) There shall be a deadman safety device feature incorporated into the controller to protect the train in the event of the incapacity of the train operator, when driving in manual operating modes. Release of the deadman safety device for a preset value of time, except that when the traction brake controller handle is placed in the full service braking or emergency positions (refer to Items 8 and 9 of Table 9-1), shall stop the train by activating the emergency brake in all manual operating modes.

(f) The deadman safety device shall be monitored by both the safety proving system and the Event Recorder (refer to PS 10.7.2).

(g) The design of the traction brake controller shall ensure that it is impossible to override the specified safety features particularly the deadman safety device by using any easily available object.

(h) The controller shall incorporate four distinct positions or operating ranges (refer to Table 9-1):-

(i) Coasting (refer to Item 1 of the Table 9-1)

This position shall inhibit the power contactors control (refer to PS 11.5) and also provide a zero traction/braking effort demand.

(ii) Motoring (refer to Items 2 to 5 of the Table 9-1)

This range shall initiate the power contactor control and provide the tractive effort demand.

(iii) Braking (refer to Items 6 to 8 of the Table 9-1)

This range shall initiate the power contactor control and provide the brake effort demand.

(iv) Emergency (refer to Item 9 of the Table 9-1)

This position shall initiate the emergency brake application.

(i) The characteristics of the tractive effort/braking effort output versus the traction brake controller position shall be according to Table 9-1.

(j) All positions shall be visually identified by engraved position identifications.

(k) The controller handle shall be spring biased towards the full service braking position (refer to Item 8 of Table 9-1) when unattended.

(l) The level of spring force and the operating resistance of the controller handle and the deadman device shall not cause any stress or fatigue hazard to the train operator for an average 8 hours of continuous train operation by using the traction brake controller. As a minimum requirement, for the controller handle, a maximum operating resistance by whole hand grip of 120N and angular displacement of 45° for both direction of motion shall be adopted. Limb support by using the arm rest

of the train operator's seat shall be adopted if necessary (refer to PS 8.13.2(f)). Unless an alternative deadman safety device is identified by the ergonomic design activities as specified in PS 8.2, the deadman safety device shall be thumb operated and the operating force shall be 9 to 22N. The alternative deadman safety device is subject to Approval.

(m) The length of the lever of the controller handle shall be determined by the mechanical advantage of the system according to the train operator position and the limitations of the 5th percentile female train operator. Handle shape shall be cylindrical, spherical or shaped to fit the hand grip but with no sharp edges. Anti-slip texturing shall be applied.

9.6.3 Pendant Controller

(a) The control function provided by the pendant controller of the hostler cab (refer to PS 7.17) shall be similar to the traction brake controller except for the limited traction and braking requirements as specified below.

(b) The design of the pendant controller shall facilitate the train operator using a single hand and a strap shall be provided to permit it to be suspended around the train operator's shoulder when in use.

(c) The cable lead of the pendant controller shall be long enough to enable the train operator to operate the train when standing at the end of the gangway.

(d) The cable lead of the pendant controller shall be designed to prevent entanglement with any equipment inside the hostler cab or with the train operator's feet/legs during train operation.

(e) Means of neat and secure storage of the pendant controller on a hook, and space to allow the cable lead to hang freely when not in use, shall be provided.

(f) Four (4) pushbuttons shall be provided in the pendant controller:

(i) Horn

Push to sound the horn.

(ii) Motoring

Continuously pressing this pushbutton together with the deadman safety device shall initiate the power contactor control (refer to PS 11.5) and the limited demand of tractive effort. The tractive effort

shall be controlled such that it is adequate to start the Train Unit/ train on a 3% up gradient and then is similar to the +10° inclination of the controller handle (refer to Item 3 of Table 9-1).

(iii) Braking

Continuously pressing this pushbutton together with the deadman safety device shall provide a limited demand brake effort similar to the -10° inclination of the controller handle (refer to Item 6 of Table 9-1). The brake effort shall be adequate to stop a Train Unit/ train on a 3% down gradient.

(iv) Deadman safety device

Continuously pressing this pushbutton shall release the emergency brake.

(g) A numeric digital speedometer shall be provided in the pendant controller for indicating the train speed through the associated traction and braking system of that Train Unit of train via the TMS. The digital speedometer shall be of at least three digits with one decimal place in the scale of km/h and shall use seven segment LED or 5×7 dot matrix displays. The display shall be clearly readable at distances up to 600mm, and the speed display update rate shall not be lower than 2Hz.

9.6.4 Modes of Train Movement Control

The traction and braking equipment shall respond to the following three modes of train movement control: Auto, Coded Manual and Restricted Manual.

9.6.5 Auto Mode

The traction and braking equipment shall respond to the ATC system.

9.6.6 Coded Manual Mode

The traction and braking equipment shall respond to the traction brake controller handle positions. At a speed of 80 km/h the tractive effort shall be removed. At a speed of 3 km/h below the target speed provided by the ATC system, the overspeed alarm will be activated and emergency brake shall be applied when the speed exceeded the target speed (refer to Appendix I Annex 3). The characteristics of the tractive effort/braking effort output versus the traction brake controller position shall be as defined in Table 9-1.

9.6.7 Restricted Manual Mode

(a) The traction and braking equipment shall respond to the traction brake controller handle positions or to the pendant controller according to the driving position chosen.

(b) Driving from the Traction Brake Controller:

The characteristics of the tractive effort/braking effort output versus the traction brake controller position shall be identical to the Coded Manual mode except that the maximum speed will not be permitted to exceed 22 km/h by the ATC system. At a speed of approximately 19 km/h, the overspeed alarm will be activated and emergency brake shall be applied (refer to PS 9.9.2) when the speed exceeded 22 km/h. When the train is operated in Traction Fall-Back mode (refer to PS 9.12.4), the above overspeed protection shall be provided by the traction and braking system.

(c) Driving from the Pendant Controller:

The tractive effort produced shall be smoothly increased for running to a maximum speed of 22 km/h. It shall be able to start a 2, 3 or 5 cars Train Units at a 3% up gradient. In addition, at a speed of 20 km/h the tractive effort shall be removed. At a speed greater than 19 km/h, the overspeed alarm in the hostler cab shall be activated (refer to PS 7.17.2(c)) and the emergency brake shall be applied when the speed is greater than 22 km/h.

9.7 Coupling and Uncoupling Operation

9.7.1 The train movement control requirements associated with the coupling and uncoupling operation shall refer to PS 9.6.

9.7.2 When Coupling from the Driving Cab

(a) When two trains are moved close enough that the two coupler faces are mating against each other, the mechanical, pneumatic and electrical coupling process shall be performed automatically without any intervention from the train operator.

(b) After the pneumatic valves and electrical boxes of the couplers are mated together in PS 9.7.2(a) above, the actual passages of pneumatic air and electrical connections between the two trains shall be established by a cab end Main Reservoir Pipe isolation cock (refer to PS 13.9.13) and an autocoupler electrical isolation switch (refer to PS 14.3.1(h)). This isolation cock and isolation switch shall be provided in the driving cab to

enable the train operator to select the combination of connections either pneumatically or electrically between the two trains or both after the completion of automatic coupling process. The default position of the cab end Main Reservoir Pipe isolation cock and the autocoupler electrical isolation switch at the driving cab shall isolate both passages of pneumatic air and electrical connections.

(c) When the autocoupler electrical isolation switch is operated, all electrical connections via the electrical box of the autocoupler shall be made. Otherwise, the two electrical coupling connections between the two trains shall be isolated from each other.

(d) When the cab end Main Reservoir Pipe isolation cock is operated, the pneumatic air connection via the main air pipe of the autocoupler shall be made. Otherwise, the two pneumatic coupling connections between the two trains shall be isolated from each other.

(e) The selection of the pneumatic air and electrical connections specified above shall be independent and shall not affect each other.

9.7.3 When Uncoupling from the Driving Cab

(a) An uncouple pushbutton shall be provided in the driving cab (refer to PS 8.8.4) to control the position of the coupler pin of the automatic coupler.

(b) When the uncouple pushbutton is kept pressed, the coupler pin of the automatic coupler shall be retracted completely to facilitate the mechanical uncoupling process.

(c) When the automatic couplers are uncoupled, the electrical boxes shall be automatically retracted and protected by covers sealed to IP 44 of IEC 60529. Except this cover, all remaining parts of the electrical boxes shall be sealed to IP 65 of IEC 60529.

9.7.4 When Coupling from the Hostler Cab

Requirements for coupling from the hostler cab shall be as PS 9.7.2 except that:

(i) No autocoupler electrical isolation switch operation is required to establish the actual passage of electrical connections between the two Train Units i.e. the default position of the autocoupler electrical isolation switch in the hostler cab shall establish the passage of electrical connections (refer to PS 14.3.1(h)); and

(ii) Actual passage of pneumatic air connections between the two Train Units shall be established by operation of an autocoupler pneumatic isolation cock (refer to PS 14.3.1(e)).

9.7.5 When Uncoupling from the Hostler Cab

Requirements for uncoupling from the hostler cab shall be as PS 9.7.3 except that:

(i) The uncouple pushbutton shall be provided in the hostler cab and the position of the coupler pin of the gangway coupler, if any, shall be controlled by the position of the hostler master switch i.e. the coupler pin of the gangway coupler shall be retracted completely to uncouple the two gangways when the hostler master switch is placed in either forward or reverse position.

(ii) The pneumatic air connections between the two Train Units shall be isolated by operation of an autocoupler pneumatic isolation cock (refer to PS 14.3.1(e)) before uncoupling from the hostler cab.

9.7.6 Train Divide Detection

(a) An independent circuit, namely the train divide detection circuit, shall be provided to detect and prove that the mated autocouplers are mechanically coupled and not broke away.

(b) As a minimum requirements, the above detection circuit shall be able to detect the correct positions and conditions of the mating faces of the two coupler heads

(c) In case any Train Unit of a train is accidentally uncoupled or broke away, this circuit shall be able to perform the following functions:

(i) positively detect the train is physically divided;
(ii) detect precisely the point of train separation and report this to the train operator; and
(iii) interrupt the brake loop circuit (refer to PS 9.9.6).

This event shall also be logged in the Event Recorder.

9.8 Passenger Door Control

9.8.1 The normal operation of the saloon doors shall be under the control of the train operator from the active cab, controls in the non-active cab shall be isolated.

9.8.2 The passenger doors system shall consist of the control functions of doors open, doors close, doors proving and doors isolation.

9.8.3 The driving cab shall be equipped with control circuits that shall operate the doors independently on each side of the train. Each side, i.e. left and right, shall be designed to be totally independent from each other ensuring that any failure of one side shall not affect the other.

9.8.4 Each circuit shall be designed to ensure that under no circumstances, on a moving train, shall it be possible for a train door to be opened due to an incorrect operation by the train operator or due to a single point failure.

9.8.5 Operation of the passenger doors shall only be possible when the mode selector is moved away from the "shut down" position. Once the passenger doors have started opening they shall continue the opening operation irrespective of the mode selector position.

9.8.6 When the mode selector is moved away from the "shut down" position and all safety proving conditions are satisfied, an ATC door enable signal will be provided for passenger doors on the corresponding side of the train by the ATC system (refer to Appendix I Annex 3) to activate the associated side of door control circuit.

9.8.7 Upon receiving this door enable signal, the associated door open pushbuttons on the Train Operator Console (refer to PS 8.8.7) and cab back wall (refer to PS 8.10.4 or 8.11.3) shall be illuminated to signify the door open control circuit of that side of passenger door is operative. When the illuminated door open pushbutton is pressed and released by the train operator, the door open signal shall be transmitted to the individual door control units (refer to PS 16.2.6) through two dedicated pair of hardwired trainlines i.e. one pair dedicated for each door side for door opening operation. The doors shall start to open after an adjustable time delay. This time delay shall be adjustable, in steps of 0.1s, from 0 to 5 seconds as a parameter in the door control unit (refer to PS 16.2.12(c)). This door open time delay shall only be applicable when the doors are open from a fully closed and locked condition. Once the passenger doors have started opening in response to a valid door open command, both the ATC door enable signal status and the mode selector position shall have no effect to the door opening operation.

9.8.8 When the door close pushbutton on the Train Operator Console or cab back wall is pressed and released, a door close signal shall be sent to the door control units through another two dedicated pair of hardwired trainlines i.e. one pair dedicated for each door side for door closing operation. The doors shall start to close after a time delay of 3 seconds.

This time delay shall be adjustable, in steps of 0.1s, from 0 to 5 seconds as a parameter in the door control unit (refer to PS 16.2.12(c)).

9.8.9 The design of these trainlines shall ensure that no wrong side failure shall be allowed to produce any incorrect door control signal particularly the undemanded passenger door open signal or incorrect passenger door opening side.

9.8.10 The door control devices located on both Train Operator Console and cab back wall shall serve the purpose of:

(a) a parallel control inputs providing an identical control functions; and

(b) a backup control function in the event of any failure occurred in one of the parallel control devices.

The circuit integrity of these control devices shall be monitored by the TMS, any abnormality detected shall be reported to the train operator and logged into the Event Recorder.

9.8.11 Only the correct side of the passenger door control circuit shall be operative according to the ATC door enable signal provided by the ATC system to safeguard against wrong side activation (refer to PS 16.2.6).

9.8.12 Not Used

9.8.13 An additional signal will be provided by the ATC system as an Zero Velocity signal (refer to Appendix I Annex 3) directly to the door control unit (refer to PS 16.2.6(c)). This zero velocity signal will only be given out when the train speed is measured below 0.5km/h and shall be used as an independent signal to enable the door control unit for door operation.

9.8.14 These ATC Door Enable and Zero Velocity signals shall be transmitted through a dedicated interface control hardwired trainlines between the ATC system and the door control circuits. The design of these control wires shall ensure that no wrong side failure shall be allowed to produce an undemanded ATC Door Enable or Zero Velocity signals.

9.8.15 ATC Signals Bypass

(a) In the event that the ATC door enable signal or the Zero Velocity signal is not available due to the ATC system failure, two bypass switches, namely, A Side and B Side Door Bypass switches (refer to PS 8.10.4 and PS 8.11.3), shall be provided to bypass these ATC signals. When the A Side or B Side Door Bypass Switch is operated, the corresponding side of

Door Opening Push Buttons shall be illuminated to signify the ATC interlocks are bypassed from the associated door opening circuit of that side and it is ready for door opening operation.

(b) The design of these A Side and B Side Door Bypass Switches shall ensure that no single point failure will produce an undemanded bypass output signal from the switch.

(c) The status of these A Side and B Side Door Bypass Switches shall be monitored by the TMS. Operation of the A Side or B Side Door Bypass Switch shall be reported to the train operator and recorded in the Event Recorder.

(d) Operation of either the A Side or B Side Door Bypass Switch shall inhibit the train movement by inhibiting traction control and application of full service brake until both switches positions are resumed from the bypass position.

9.8.16 An independent hardwired door proving circuit (refer to PS 9.9.7) shall be provided to monitor and report the doors status via the TMS and the Door Closed Indicator and Bodyside Indicator Lights (refer to PS 9.9.7(e)).

9.8.17 In the event that the train is shutdown, i.e. the Auxiliary Off control has been activated, all passenger doors shall be operated to the default state of the closed position and all passenger doors controls shall be disabled.

9.8.18 Change-end Operation

The following sequential control functions shall be provided for use when the train arrived at the terminal station where changing the controlling cab is required:

(a) when the mode selector is moved to the "shutdown" position, all saloon doors shall stay in the previous condition either opened or closed ;

(b) then the mode selector of the other driving cab is moved away from "shutdown" to take over the controls, all saloon door states shall remain unchanged;

(c) thereafter the door state shall follow the operation of the associated door control pushbutton of the active cab.

9.8.19 The passenger door control circuit shall interface with the ATC system to provide Automatic Train Doors Operation. Selection of Automatic Train Doors Operation and control signals from the ATC system shall be

reported to TMS and recorded in the Event Recorder. Details shall refer to Appendix I Annex 3.

9.8.20 Other operation requirements of the passenger door system control shall refer to PS 10.5.4 and PS 16.2.

9.9 Safety Related Controls

9.9.1 Deadman Safety Device

In order to ensure the alertness of the train operator during manual train operation, a deadman safety device shall be provided to monitor the status of the train operator. The detailed requirements of the deadman safety device shall refer to PS 9.6.

9.9.2 Over Speed Protection Device

The detailed requirements of the over speed protection provided by the ATC system and the traction and braking system shall refer to Appendix I Annex 3 and PS 9.6.7 respectively.

9.9.3 Not used.

9.9.4 Passenger Alarm

In the event the passenger(s) needs to communicate with the train operator, a passenger alarm system shall be provided to facilitate an effective and reliable communication between the driving cab and saloon of the above passenger(s). The detailed requirements of the passenger alarm shall refer to PS 18.4.15.

9.9.5 Safety Proving Circuit

For illustration purpose, a conceptual circuit diagram of the Safety Proving Circuit is shown in Drg No. C6014-14E/TSEG/417/001.

(a) The safety proving circuit shall be a dedicated hardwired circuit which operates the Safety Interlock Relays (SIR).

(b) When either one of the SIRs is de-energised, the emergency brake of the train shall be applied via the brake loop circuit (refer to PS 9.9.6).

(c) The safety proving circuit shall only be operative when the train is operating in the active cab.

(d) In order to set up the safety proving circuit, the following conditions shall be fulfilled:

(i) The train is at standstill. The required relay interlock is provided by the zero velocity relays (ZVRs) which are driven by the ATC system (refer to Appendix I Annex 3);

(ii) The Restricted Manual mode is selected;

(iii) The traction brake controller handle is in the emergency position (refer to Item 9 of Table 9-1) and adequate brake pressure is achieved (refer to PS 9.9.5(e)(i));

(iv) The emergency brake relays (EBR) which are driven by the ATC system (refer to Appendix I Annex 3) are energised; and

(v) None of the emergency stop pushbuttons being activated.

(e) The following safety proving circuit performance requirements shall be fulfilled:

(i) A brake cylinder governor shall be used to positively indicate that adequate brakes are applied i.e. it shall drop out at a brake cylinder air pressure giving sufficient brake force to hold a crush laden train on a 3% grade under the most adverse wind loading.

(ii) Each EBR shall control a separate SIR via the safety proving circuit in order to meet "2-wire stop and start" requirements.

(iii) The "2-wire stop and start" features of the traction and braking equipment shall be separated for all modes. One contact from each SIR relay shall be connected in series with the associated power contactors control logic circuit in order to meet the requirement as specified in PS 11.5.

(iv) If either SIR drops out, the other shall also drop out subsequently and remain in the dropped out state except in the event of ATC system failures, such as, if the EBRs drop out with the train at standstill (output from the zero speed channels of the ATC unit is presented to energise the ZVRs) and brakes are proved applied, the SIRs shall not drop out thus preventing an unnecessary penalty of emergency brake application.

(v) In the event that the EBR is de-energised by the ATC system when the train is moving (i.e. the ZVRs are dropped out), the SIRs shall drop out thus causing a penalty of emergency brake application.

(vi) In the event that the EBR is de-energised by the ATC system when the train is stationary with the brakes released, the SIRs shall drop out thus causing a penalty of emergency brake application.

(vii) The SIRs shall also drop out in the event of a deadman safety device operation (refer to PS 9.6.2(e)) or if an emergency stop push button is pressed in the active cab.

(viii) One contact from each SIR relay shall be connected in series with the brake loop circuit in order to complete the brake loop when the train is operating from the active cab.

(f) In the event of ATC equipment failure, the Safety Cut-Out Switch shall be operated to enable the reset, fall back operations or setting up of safety proving circuit. Detailed requirements of the Safety Cut-Out Switch shall refer to Appendix I Annex 3.

9.9.6 Brake Loop Circuit

(a) The brake loop circuit shall be a dedicated hardwired circuit which directly controls the emergency brake application. The emergency brake shall not be released except when the brake loop is completed.

(b) The brake loop shall include a pair of hardwired trainlines.

(c) One of the above hardwired trainline shall be fed through the safety proving circuit (refer to PS 9.9.5(e)(viii)) from the active cab of the train.

(d) In any middle Train Unit of a train, all hostler master switches (refer to PS 7.17) shall be placed to a "middle of train" position i.e. the "normal" position and the main reservoir pressure shall also be proved by the associated main reservoir governor (refer to PS 13.5.1).

(e) If the rear car of the train is the A car, the mode selector of the rear driving cab shall be placed in the "shutdown" position. If the rear car of the train is not the A car, the hostler master switches shall be placed to an "end of train" position i.e. the "off" position and the autocoupler proved "uncoupled" via an electrical interlock on the coupler electrical box. This shall also allow another train wire (refer to PS 9.9.6(f)) to be fed from the rear of the train.

(f) The return path of the above train wire after completing the circuit stipulated in PS 9.9.6(c) to 9.9.6(e), shall perform the following control circuit functions so that when it is de-energised:

(i) the emergency brake of each car of a train shall be applied; and

(ii) the traction power of each power car of a train shall be cut off.

(g) The integrity of the above two train wires shall be continuously monitored. Any abnormality, such as false feed, shall be detected and reported to the train operator via the TMS. This event shall be logged in the Event Recorder.

(h) In the event that both brake loop circuit and the redundant circuit (refer to PS 9.12.3) are failed, the brake loop cut out switch (refer to PS 8.10.2(e)) shall be operated to override the above interlocking functions and control directly the emergency brake and traction circuit.

(i) When the brake loop cut out switch is operated, train movement shall only be allowed by using the Restricted Manual mode only.

(j) Operation of the brake loop cut out switch shall be reported to the train operator and logged into the Event Recorder.

9.9.7 Door Proving Loop Circuit

(a) The door proving loop circuit shall be a dedicated hardwired circuit which provides monitoring function for each passenger door, cab door and emergency door to prove these doors are closed.

(b) The door proving loop shall monitor that:

(i) all passenger doors are closed and locked;

(ii) both non-controlling cab doors are closed and locked;

(iii) both emergency doors are closed and locked; and

(iv) all passenger alarm emergency handles are not activated.

(c) Not used.

(d) The power of the door proving loop circuit shall be supplied from the active cab only.

(e) The output of the door proving loop circuit shall only be present when there is continuity through all monitored devices. The state of the door proving shall be:

(i) visually indicated in the active cab (refer to PS 8.8.7).

(ii) interlocked with the driving controls (refer to PS 9.9.7(f)).

(iii) interlocked with the ATC start circuit (refer to Appendix I Annex 3).

(iv) visually indicated by the bodyside indicator lights on each car exterior (refer to PS 6.10.5). When any passenger alarm handle is operated, the bodyside indicator light of the car shall flash. When any passenger door or cab door in a non-controlling cab is not closed and locked the bodyside indicator light of the car shall be lit continuously. The flashing operation shall have priority.

(v) reported to both the TMS and the Event Recorder.

(f) When the output of the door proving loop circuit is lost, it shall cause the application of full service brake in the whole train and inhibition of any further train movement once the train has been proven to be stopped at a station by the ATC system, unless the door proving loop circuit is reestablished or is cut-out (refer to PS 9.9.7(h)). Loss of the door proving loop circuit output with a train speed greater than zero velocity shall have no effect on the performance of the train, until the train is stationary at a station stop.

(g) The integrity of the above door proving loop circuit shall be continuously monitored. Any abnormality, such as, false fed, shall be detected and reported to the train operator via the TMS. This event shall be logged in the Event Recorder.

(h) In the event of door proving loop circuit failure, operation of the door proving loop cut out switch (refer to PS 8.10.2(e)) shall override the above interlocking functions. The Door Closed Indicator shall be illuminated when the door proving loop cut out switch is operated.

(i) Operation of the door proving loop cut out switch shall be reported to the train operator and logged into the Event Recorder.

9.9.8 Event Recorder

In order to facilitate incident investigation, an Event Recorder shall be provided to record all essential information of the train system in real time. Detailed requirements of the event recorder shall refer to PS 10.7.

9.9.9 Smoke detection device

(a) An automatic smoke detection system which shall be able to detect the presence of smoke in the fresh air inlet duct, shall operate to report to the train operator and Event Recorder, and activate dampers so as to shut off the smoky air intake by operating in a 100% recirculation mode (refer to PS 15.7.3).

(b) An automatic smoke detection system which shall be able to detect the presence of smoke in the saloon, shall operate to report to the train operator and Event Recorder (refer to PS 7.18).

9.9.10 Primary Train Operator Display (PTOD)

The train speed shall be indicated by Primary Train Operator Display (PTOD) which will be provided by the ATC system (refer to Appendix I Annex 3) and shall be provided by the traction and braking system (refer to PS 9.6.3(g) and PS 9.12.4(b)(iii)).

9.9.11 Head and Tail Lights

(a) When the train system is initialised according to PS 9.2.1, the tail lights of the driving cab shall be automatically turned on.

(b) When the train is operating from a driving cab, the head lights of this active cab car shall be automatically turned on and its tail lights shall be automatically turned off when the mode selector is moved away from the "shut down" position.

(c) When the train is operating from the hostler cab, the tail light of the rear cab car shall stay whatever the position of the hostler master switch. No head lights shall be turned on for hostler driving.

9.9.12 Restricted Manual Mode Flashing Light

When the train is operating in Restricted Manual mode from the driving cab, the Restricted Manual mode flashing light of the active cab shall be automatically turned on when the mode selector is moved to the "forward" or "reverse" position.

9.10 Train and Passenger Information Management

During passenger service of the train, essential information shall be reliably supplied to the train operator and passengers by the train management and

communication system. The detailed requirements of the train and passenger information management shall refer to PS 10 - train management system and PS 18 - communication.

9.11 Emergency Operations

9.11.1 Push out

(a) As an essential part of the recovery performance requirements (refer to PS 4.4.3), the train shall be able to facilitate emergency push out operation to assist a defective Urban Lines Train or a defective train in the event of failure. A defective train shall also be able to be pushed out by either an Urban Lines Train or another train.

The push out operation shall be conducted either:

(i) with parking brake applied in the defective Urban Lines Train or defective train, when a train is used to push out a defective Urban Lines Train or a defective train. In this case the coupling shall be mechanical only; or

(ii) without parking brake applied in the defective train, when a defective train is being pushed out by an Urban Lines Train. The trains shall be mechanical, pneumatic and electrical coupled. Facility shall be provided for the Urban Lines Train to control and synchronise the emergency brake of the coupled trains. Emergency brake of the defective train shall be applied in case the two trains are separated, any Emergency Stop pushbuttons in the defective train leading cab is operated or emergency brake is applied in the assisting Urban Lines Train.

Details requirements for push out operation involving an Urban Lines Train and a train are described in Appendix I Annex 7 Clause 3.3.

(b) The associated coupling and uncoupling operations shall refer to PS 9.7. In order to avoid consequential failure caused by coupling to the faulty electrical or pneumatic equipment of the defective train, the cab end Main Reservoir Pipe isolation cock and autocoupler electrical isolation switch will be used to isolate the affected equipment prior to coupling for push out (refer to PS 9.7.2(b))

(c) When a train is coupled with the Urban Lines Train, due to the different arrangement of the electrical contact pins of the electrical box of the autocoupler (refer to Appendix I Annex 7), the electrical coupling mode will be isolated prior to mechanical coupling operation. After mechanical coupling is completed, electrical coupling shall be able to be achieved as

required in PS 9.11.1(a) when required. The contact pin arrangement of the cab end coupler electrical head shall be designed not to cause any equipment damages or abnormal behaviours, in the Urban Lines Train or the train, when the cab end electrical heads are coupled.

(d) When two trains are operated together in the push out operation and the electrical coupling mode is usable, the TMS shall be able to reconfigure the train communication network of the two trains automatically (refer to RS/C6014/01). Movement control of the coupled trains shall be able to be obtained at any driving cab within 1 minute after the electrical coupling has been completed without any intervention from the train operator.

9.11.2 Emergency Evacuation

(a) The requirements of the 3 routes of emergency evacuation by using the emergency door and/or the saloon side-door shall be referred to PS 4.4.4 and PS 16.4.

(b) Normally passengers are detrained to the track and this is called "train to track" detrainment. In this case, the emergency door shall be able to operate as an evacuation ramp to facilitate a safe "train to track" detrainment operation.

(c) In the event that the circumstances make the "train to track" detrainment inappropriate, then passengers may be detrained from one train to another and this is called the "train to train" detrainment. In this case, after the two trains are coupled, the emergency doors of the two trains will be opened and slided to the side without extending the detrainment ramp. Afterward, a detrainment plate will be used to place over the coupler between the two trains to work as a walkway for the above "train to train" detrainment. The design of the emergency door shall also ensure that this "train to train" detrainment operation shall be compatible with the Urban Lines Trains.

(d) When the emergency evacuation is carried out by using the emergency door, as long as the emergency door is opened, an electrical interlock shall be provided to automatically apply maximum service brake on the whole train disregard the position of the traction brake controller and the modes of operation, so that the train shall be automatically secured to facilitate safe emergency evacuation operation.

(e) Operation of the emergency door shall be logged into the Event Recorder.

9.11.3 Loss of Traction or Auxiliary Power Supply

In the event of loss of traction or auxiliary power supply, the emergency systems shall automatically operate and continue to function for a minimum 1 hour (refer to PS 4.4.5).

9.11.4 Tunnel Fire

In the event of a fire being present in the tunnel, the automatic smoke detection system shall operate to provide a full recirculation ventilation within the saloon (refer to PS 15.7.3). The normal functions of the train systems shall not be affected, in particular the train movement control function, so as to facilitate the transfer of passengers to a safe place.

9.11.5 Person Under Train

It shall be able to safely and efficiently jack the train from track level particularly in a tunnel or platform section with Platform Screen Doors (refer to Appendix I Annex 5). The design shall:

(a) provide a good identification marking and easy access to jacking points from track level;

(b) provide secure accommodation for the jacks in the jacking points; and

(c) minimise the need of using any special process, tools or equipment in order to complete the jacking process.

Detailed requirements shall comply with Appendix I Annex 6.

9.11.6 Flooding

In the event that there is flooding problems of either water or mud flooding posed to the Railway, if the level of the water/mud does reach above the rail foot but below the rail top, the train shall be able to operate under a Coded Manual mode (if the track signals are available for the ATC system) or Restricted Manual mode to a maximum speed of 22 km/h in order to maintain a minimum degree of train service under a flooding condition.

9.12 Special Controls

9.12.1 Defect Handling

(a) In order to facilitate an efficient and effective train system fault recovery, the three modes of defect handling functions as specified in PS 10.3.7 shall be provided.

(b) As a back up function to the TMS (also refer to PS 9.12.2), a general fault reset pushbutton shall be provided (refer to PS 8.8.4) to launch a systemwide reset operation of the whole train, including the door system, traction and braking equipment, auxiliary electrical supply system and air conditioning and ventilation system, to reset those miscellaneous faults of the train system. The above systemwide reset function shall not include the communication system and TMS in order to avoid unnecessary service delay due to system initialisation process of these systems. The general fault reset pushbutton shall be operative only when the mode selector is placed in the "standby" position.

9.12.2 TMS Back Up Operation

In the event that the display terminal (refer to PS 10.8) or the data transmission link (refer to PS 10.1.1) of the TMS is failed and the train operator cannot interact with the train system through the TMS, the following back up functions shall be provided to facilitate the train operator to continue normal passenger service of the train for at least one round trip without withdrawal the train from service immediately:

(a) communication controls;

(b) automatic train movement controls via the ATC system or manual train movement controls;

(c) brake system checks, including:

(i) Manual parking brake application

With the mode selector is placed in the forward or reverse position, once the parking brake pushbutton is pressed and released, all parking brakes of the train shall be applied and remained in an applied condition until the mode selector state is changed.

(ii) Manual brake proving

A train brake proving circuit shall be provided on the train to enable quick checking of the air brake system throughout the train consist. Each car shall be fitted with a pressure switch for the brake cylinder to give two indications, namely, local and train, to indicate the local and train brake cylinder pressure respectively. Each indicator shall be provided with two coloured LEDs: yellow and green; the yellow LED shall be illuminated when brake is applied and green LED shall be illuminated when brake is released. In the event that any local brake fails to release, the train indication shall

inform the train operator and he can find out locally from the hostler panel which car of train is suffering from brake defect, if necessary.

When the train system is initialised according to PS 9.2.1, the brake proving indicators of all non-driving cab car shall indicate the brake status accordingly. For the driving cab car, the brake proving indicators shall operative only when the brake proving pushbutton is pressed and the mode selector is either in Auto, Coded Manual or Restricted Manual mode in order to avoid distracting the attention of the train operator.

(d) Train system status indications

The indication lights listed in PS 8.8.7 and PS 8.10.3 shall be provided in the form of LEDs to inform the train operator about the train system status according to the following requirements:

(i) Cab occupied indicator shall be illuminated when the mode selector of the cab is moved away from the "shut down" position.

(ii) Line volts indicator shall be illuminated when the traction supply is available at any pantographs of the train.

(iii) Train divided indicator shall be illuminated when any one of the train divided devices (refer to PS 9.7.6) is activated.

(iv) Power fault indicator shall be illuminated when there is any fault such as overcurrent or earth faults in the traction and braking equipment.

(v) Auxiliary fault indicator shall be illuminated when any auxiliary power supply, such as, 3 phase or battery charging supply fails.

(vi) Ventilation fault indicator shall be illuminated when any air conditioning unit loses its ventilation function.

Except for the cab occupied and line volt indicators, any activation of the above fault indicators shall also illuminate the general fault indicator (refer to PS 8.8.7).

(e) Although the above requirements are based on a TMS back up purpose, all specified back up functions shall be available disregard the status of the TMS.

9.12.3 Brake Loop Circuit Back Up Control

(a) A redundant circuits shall be provided for the brake loop circuit (refer to PS 9.9.6) in the following manners:

(i) The circuit configuration particularly the safety proving parameters provided by the circuit interlocks of the redundant circuit shall be identical to the brake loop circuit.

(ii) There shall be no common mode failure between the redundant circuit and the brake loop circuit.

(b) A facility, namely, Brake Loop Selector Switch, to enable selection of either of the brake loop circuit and the redundant circuit shall be provided.

(c) Even though the redundant circuit has not been selected, the conditions of this redundant circuit shall be continuously monitored by the TMS. Any circuit fault occurred in these redundant circuits shall be reported to the train operator and recorded in the Event Recorder.

(d) The hostler cab shall not require a Brake Loop Selector Switch, since only one brake loop circuit shall be required to be energised.

(e) Operation of the Brake Loop Selector Switch shall be reported to the train operator and Event Recorder.

9.12.4 Traction System Fall Back Operation

(a) In the event that the ATC system is totally failed and no fall back operation can be provided even after the operation of the Safety CutOut Switch (refer to Appendix I Annex 3), a traction system fall back operation shall be provided to resume the train movement in the Restricted Manual mode only by operating the Safety Cut-Out Switch to the Traction Fall-Back position. Detailed operation of the operation of the Safety Cut-Out Switch shall refer to Appendix I Annex 3.

(b) Under the Traction Fall-Back operation, the following control functions shall be provided:

(i) setting up the Safety Proving circuit according to PS 9.9.5 except that the associated ATC circuit interlocks shall be overridden by the Safety Cut-Out Switch as shown in Drg. No. C6014-14E/TSEG/417/001;

(ii) overspeed protection as operated by the traction and braking system that shall monitor the train speed and ensure that it does not exceed the 22km/h limit. At a speed greater than this speed limit, the emergency brake shall be applied by interrupting the Safety Proving circuit; and

(iii) digitised speedometer as shown on the TMS display terminal (refer to PS 10.5.3(i)) to indicate the train speed via the traction and braking system. The performance of this speedometer shall be similar to the one specified in PS 9.6.3(g).

(c) Fail-safe design shall be provided for the overspeed protection of the traction and braking system. The Contractor shall demonstrate that in the event of a single failure or malfunction of any component in the above overspeed protection system, there shall be no unsafe consequences.

(d) The integrity of the overspeed protection system shall be continuously monitored. Any abnormality detected, such as, false fed, shall be reported to the train operator via the TMS and this event shall be logged in the event recorder.

(e) Operation of the Safety Cut-Out Switch to any position shall be reported to the Event Recorder.

9.12.5 Supplementary Controls

(a) Train number display and destination indicator

The train number display and destination indicator shall display train numbers and destination under the control of TMS. Train number and destination information in TMS is provided by the ATC system (refer to Appendix I Annex 3).

(b) Lighting controls

(i) Cab light

The cab light shall illuminate by:

(1) opening of the cab to saloon partition door; or
(2) using the cab main light switch.

(ii) Saloon light

The saloon lights including both emergency lights and AC lights shall turn on automatically when the DC and AC supplies respectively are available.

(iii) Reading light

The reading light shall be turned on by using the reading light control switch.

9.12.6 Driverless Turnaround Operation

(a) A Driverless Operation Pushbutton (refer to PS 8.8.4) shall be provided so that after the train has arrived the terminal station and with all passengers have alighted from the train, the driverless operation shall be activated by:

(i) closing of the passenger doors;
(ii) moving the mode selector back to the "shutdown" position;
(iii) pressing and releasing the driverless operation pushbutton to inform the ATC system that the train is ready for driverless operation.

(b) The ATC system will then perform the full automatic train turnaround operation including:

(i) operation of the train away from the arrival platform to the track siding according to the track signals;

(ii) stopping of the train in the track siding and changing of the control from one driving cab to the other;

(iii) operation of the train from the other cab from the track siding to the departure platform;

(iv) stopping of the train at the departure platform;

(v) when the train has been proved to be stopped correctly, opening of all saloon doors and driverless operation completed.

Afterwards the train operator will take over the control according to the change-end operation (refer to PS 9.8.18).

(c) For safety reasons, all emergency stop pushbuttons in the leading cab shall remain operative during the driverless mode.

(d) Interface requirements of the driverless operation shall refer to Appendix I Annex 3.

9.12.7 Not used.

9.12.8 Not used.

Item	Position	Effect
1	Coasting: The Traction Brake Controller handle is at 0° (with detent)	No driving/braking command
2	Limited Motoring: The Traction Brake Controller handle is moved to the $+10^o$ detent	Smooth increase in tractive effort for train starting
3	Motoring: The Traction Brake Controller handle remains at the $+10^o$ detented position	The tractive effort produced shall be smoothly increased for running to a maximum speed of 22 km/h
4	Motoring: The Traction Brake Controller handle is moved beyond the $+10^o$ detented position i.e. between $+10^o$ to $+45^o$	The tractive effort produced shall be smoothly increased for running to a maximum speed of 80 km/h (the reference value of tractive effort demand shall increase with increasing inclination linearly)
5	Full Motoring: The Traction Brake Controller handle is at $+45^o$ (with detent)	The reference value of tractive effort demand produced has its maximum value
6	Minimum Braking: The Traction Brake Controller handle is moved to -10° (with detent)	Smooth increase in service braking effort for the commencement of service braking mode
7	Braking: The Traction Brake Controller handle is moved between -10° to -40°	The reference value of service braking effort demand shall increase with increasing inclination linearly
8	Full Service Braking (default position): The Traction Brake Controller handle is moved to -40° (with detent)	The reference value of service braking effort demand produced has its maximum value
9	Emergency: The Traction Brake Controller handle is stayed at -45° (with detent)	Emergency braking

Note: The convention of the Traction Brake Controller handle position shall be:
Positive angular displacement means moving the Traction Brake Controller handle away from the train operator i.e. motoring mode.

Table 9-1 Traction Brake Controller Handle Position

SECTION 10

TRAIN MANAGEMENT SYSTEM

August 2015

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10 TRAIN MANAGEMENT SYSTEM

10.1 General

10.2 Performance Requirements

10.3 Train Operation Aids

10.4 Passenger Information System

10.5 Equipment Control and Monitoring

10.6 Maintenance Support

10.7 Event Recorder

10.8 Man-Machine Interface (MMI) Requirements

Table 10-1 Not Used

Table 10-2 Logic Table for the Control Commands

Table 10-3 Logic Table for the ATO Control Commands

Attachment 1 TMS MMI

10 TRAIN MANAGEMENT SYSTEM

10.1 General

10.1.1 The Train Management System (TMS) shall be a microprocessor based control system using the latest and proven technologies of semiconductor, software and data communication to control and monitor the major trainborne equipment, such as, the door, brake, propulsion, auxiliary and air conditioning systems, through the Train Communication Network (TCN).

10.1.2 The design of the TMS shall consider the train as a total complete system and the TMS shall provide a centralised function to control and monitor all its subsystems operation and fault status, fault data logging, incident investigation and reporting.

10.1.3 The TMS shall provide for real-time distributed control and modular processing of subsystems in a redundant manner with high reliability and availability in the adverse Urban Lines operating environment.

10.1.4 The TMS shall be designed for ease of fault diagnosis and maintenance.

10.1.5 The TMS shall function as an Event Recorder (refer to PS 10.7) to record operating status of critical control circuits and components.

10.1.6 The TMS shall be designed to minimise the need for individual trainline wires and hardwires across couplers. The type of TMS transmission link to be used shall preferably be a screened coaxial cable but a fibre optic cable or a shielded twisted cable may also be proposed as an alternative. These proposed links shall be proven in a comparable operating environment.

10.1.7 The TMS shall achieve a reliability of 1000 car kkm/failure.

10.1.8 The detailed requirements on the architecture and data management of the TMS shall refer to RS/C6014/01.

10.2 Performance Requirements

10.2.1 From power up initialization of the train, the Train Communication Network (TCN) of TMS shall complete its initialization and start data transmission within 20 seconds. The Train Systems Initialization shall then be started to perform checking of the healthiness and correct functioning of all trainborne systems which shall be completed within 2 minutes.

10.2.2 Once power up initialization is completed, operation of the Train Communication Network shall not be interrupted by occupation status of either driving cab.

10.2.3 In case of equipment failure causing malfunction or loss of a local processing unit (refer to RS/C6014/01), the TMS shall isolate and bypass the faulty local processing unit and resume full function within 5 seconds.

10.2.4 For the equipment status monitoring function, the total system response time from the change of equipment status to be shown up on the display unit shall not be greater than 500ms.

10.2.5 For train reformation process (refer to PS 10.3.4), the Train Communication Network shall complete the re-configuration and start data transmission within 20 seconds.

10.2.6 For train control purpose, the Train Communication Network shall be able to complete the data transmission of the train operator's command from the display terminal (refer to PS 10.8.2) to the output port of the local process unit (refer to RS/C6014/01) within 0.5 seconds.

10.2.7 Delays in displaying diagnosed fault message on the display unit (refer to PS 10.8.1) following a failure of equipment under monitoring shall be less than 2 seconds.

10.2.8 Failure to diagnose genuine faults or incorrect diagnosis without the presence of a fault shall occur at a rate of less than one per train per year.

10.2.9 Any failure of the TMS shall not affect the emergency performances specified in PS 4.4.

10.3 Train Operation Aids

10.3.1 General

(a) The TMS shall provide a centralised function to monitor all its subsystems operation, fault status and failure reporting to the train operator.

(b) Real-time information including diagnostic results and fault logs shall be reported to the train operator.

(c) In order to avoid saturation of the Train Communication Network due to the vast volume of data transmission of the real time information, the requirements of data managements specified in RS/C6014/01 shall be complied with.

10.3.2 Train Reformation

(a) During depot operation, it is required to reform the different Train Units into a train consist due to the operational and/or maintenance needs. In order to accelerate the train reformation process, an automatic train reconfiguration function shall be provided by the TMS without any additional control requirements from the train operator.

(b) At the end of the train reformation process i.e. the mechanical, pneumatic and electrical coupling requirements as specified in PS 14.2 are met and the auxiliary circuits of all concerned Train Units are energised (refer to PS 17.2), the automatic train re-configuration function shall be started immediately.

(c) The TMS communication network shall complete the re-configuration and start data transmission within 20 seconds after the completion of the above train reformation process.

10.3.3 Automatic System Monitoring and Information Display

(a) The TMS shall be used to monitor and display the operation status of all train systems and display the essential information to the train operator through the display terminal (refer to PS 10.8.2). The Contractor shall submit the list of the proposed system and/or subsystems that are to be monitored and displayed by the TMS with their interface details for Approval.

(b) As a minimum requirement, the following information shall be displayed on the train operator display terminal and shall be available in all operation modes (refer to PS 9.5) and also for driverless turnaround mode (refer to Appendix I Annex 3):

(i) General operational information including:

- Current station
- Destination
- TMS system date and time
- Train layout showing each individual car with its car type, car number and a number indicating its relative position when counting from the driving cab in which the display terminal is located
- Train orientation (the driving cab in which the display terminal is located should always be placed at the right hand side)
- Train travel direction (forward and reverse)

- Driving cab and hostler cab occupied status

(ii) Train information including:

- Brake related information including the status / value of
  - Mode selector position (refer to PS 9.5.2) (Auto / CM / Manual)
  - SIRs (refer to PS 9.9.5 (a))
  - brake loop circuits for both normal and redundant circuit (refer to PS 9.9.6)
  - brake loop cut out switch (refer to PS 9.9.6 (h)) for both cabs
  - safety cut-out switch (refer to Appendix I Annex 3) for both cabs
  - air suspension of each individual car
  - main air pressure of each individual car
  - loading of each individual car
  - brake application of each bogie (on / off / remote isolate / manual isolate)
  - each individual main air compressor (on / off / fault)

- Door related information including status of
  - door proving loop circuit (refer to PS 9.9.7)
  - door proving loop cut out switch (refer to PS 8.10.2 (e)) for both cabs
  - A side & B side door bypass switches (refer to PS 8.10.4 and PS 8.11.3) for both cabs
  - ATDC cut out switch (refer to Appendix I Annex 3)
  - each door including cab door (open / close / remote isolate / manual isolate) on each individual car
  - passenger alarm emergency handle (operate / not operate) on each individual car
  - emergency door (open / close) for both cabs
  - cab/saloon partition door (open / close) for both cabs

- Traction related information including status / value of
  - line volt for each individual motor car
  - each individual pantograph (up / down / autodrop detect / autodrop isolate)
  - each individual traction inverter (on / off / fault / remote isolate / manual isolate)
  - traction current for each individual motor car
  - train speed under all operation modes
  - train status (motoring / braking / coasting / emergency / parking)

- Auxiliary equipment related information including status / value of
  - each individual auxiliary inverter (on / off / fault / remote isolate / manual isolate)
  - each individual battery charger (normal / fault)
  - D2 (refer to PS 17.4.1(d)) of each individual Train Units
  - D1 (refer to PS 17.4.1(e)) of each individual Train Units
  - change over circuit (refer to PS 17.3(g))

- Air conditioning equipment related information including status / value of
  - each individual air-conditioning unit status (stage 1 cooling / stage 2 cooling / emergency / smoke detected / fault) and target temperature
  - each individual air-conditioning unit damper status (close / half open / fully open)
  - each individual air-conditioning unit saloon temperature (return air temperature)

- Other information including status / value of train coupling at each automatic coupler

(iii) Passenger information including:

- ETND display
- EDD display
- DRM related information including value of
  - Running Line
  - Current station
  - Destination
  - Platform side

(iv) Trainborne video display (refer to PS 18.3.4) information including:

- System selected for display (in-cab CCTV or in-saloon CCTV)
- Display control (On / Off)
- Automatic light control activation (Active / Inactive)
- Brightness control
- Contrast control
- Colour saturation control

- Selection of which system to be displayed (in-cab CCTV / in-saloon CCTV)
- Other configuration setup of the trainborne video display

(v) In-cab CCTV information including:

- Model (Auto / Manual) of in-cab CCTV (refer to
- Appendix I Annex 4 clause 3.5.3)
- Channel (Channel 1 / Channel 2) of in-cab CCTV (refer to Appendix I Annex 4 clause 3.5.3)
- Microwave reception status (healthy / fail) of in-cab CCTV (refer to Appendix I Annex 4 clause 3.5.3)

(c) The display shall also be integrated with the other screening functions to provide specific information of other trainborne systems.

10.3.4 Not used.

10.3.5 Not used.

10.3.6 Automatic Fault Reporting and Recording

(a) A diagnosis function shall be provided to ensure that unusual legitimate operations or genuine faults of trainborne equipment are identified, logged, and, if appropriate, reported to the train operator and illuminate the general fault indicator (refer to PS 8.8.10) for attention.

(b) Faults detected shall be classified into five criticality levels :

(i) Critical Fault

Fault which requires the immediate action/attention of the train operator is classified as critical fault.

(ii) Operating Event

Event which is triggered by the train operator and requires the attention of the Operation Control Centre (OCC).

(iii) Maintenance Event

Event which requires the attention of the maintenance staff after the train complete the scheduled service.

(iv) Record

A maintenance record which requires the attention of the maintenance staff during routine maintenance.

(v) Notice

Information or reminder to aid the train operator during normal service under defined conditions.

Based on the failure effect, the criticality level of each diagnosis requirements shall be designed and submitted for Approval.

(c) The TMS shall respond according to the following table :

Criticality Level		Response of TMS		
		Request Acknowledge[1]	Display of fault[2]	Log in to the memory[3]
1	Critical Fault	√	√	√
2	Operating Event		√	√
3	Maintenance Event			√
4	Record			√
5	Notice	√		

Note :

1 : Request the train operator in the active cab to acknowledge the occurrence of the fault through the train operator display.

2 : Display the fault message in the current fault screen.

3 : Record the fault/event in the memory.

(d) In addition to the classification of the fault message criticality level specified in PS 10.3.6(b), the fault information shall be prioritised into two groups, namely, primary and secondary. For primary group of fault information, it shall include those safety critical systems, such as, automatic train control, pantograph, traction and braking, doors, communication, ventilation and emergency lighting, whilst the other auxiliaries systems would be in the secondary group.

(e) For fault information in the primary category, fault message shall be transmitted upon occurrence through the ATC via the TMS to the OCC.

(f) Not used.

(g) Not used

(h) In addition, the TMS shall relay and transmit the fault data according to the following table :

Criticality Level		Transmission from TMS
		ATC[4]
1	Critical Fault	√
2	Operating Event	√
3	Maintenance Event	
4	Record	
5	Notice	

Note :

4: Transmit the fault message to the Operation Control Centre through the ATC interface.

(i) In order to facilitate incident investigation, an Event Recorder shall be provided by the TMS. Detailed requirements of the Event Recorder shall refer to PS 10.7.

10.3.7 Defect Handling

Based on the capability of the individual train systems and the associated failure effect, faults detected shall be handled by the following three modes:

(a) Automatic defect handling

(i) When a train system is reported faulty, it shall report to the TMS and automatically attempt to re-start.

(ii) For those system/equipment failure which significantly affect normal passenger service, they shall be managed automatically through the TMS and displayed to the train operator.

(b) Semi-automatic defect handling

(i) When a train system is reported faulty, it shall report to the TMS and advise the train operator to re-start it through the display terminal (refer to PS 10.8.2).

(ii) For those system/equipment failures which require operation decision to be made by the train operator, they shall be managed semi-automatically through the TMS and displayed to the train operator.

(c) Manual defect handling

(i) When a train system is reported faulty, it shall report to the TMS and advice the train operator how to re-start it remotely from the driving cab and/or locally in the concerned car.

(ii) For those system/equipment failures which require operation intervention to be made by the train operator, they shall be managed manually and displayed to the train operator.

In order to reduce the time for fault recovery (refer to PS 25.8.5), due consideration shall be given to ensure full automatic defect handling functions are provided as far as practicable.

10.3.8 Diagnosis Rules

(a) To facilitate the defect handling process specified in PS 10.3.7, the Contractor shall provide a complete set of diagnosis rules for TMS to identify the faults and perform appropriate defect handling activities according to the operability requirements specified in the Rolling Stock standard RS/C6014/14. Each diagnosis rule shall have a separate detection and clearing criteria which can be easily configurable.

(b) Each diagnosis rule shall have a separate time delay function for detection and clearing to avoid spurious fault detection and clearing.

(c) A fault shall be detected only if the detection criteria have been satisfied for a pre-defined period of time. Similarly, a fault shall be cleared only if the clearing criteria have been satisfied for a pre-defined of time.

(d) The pre-defined time delay shall be adjustable from 0 to 10 second with a minimum step of 100ms. The time delay shall be easily adjustable onsite by the maintainer.

(e) A easy to use program with pass word protected software running on Windows XP or higher operating system which shall form part of the special tools and test equipment (refer to PS 24.3), shall be provided for the maintainer to define and modify the above diagnosis rules. The Engineer may need new diagnosis rules in the future. The Contractor shall provide adequate spare hardware and software facilities for building up a minimum set of 100 new diagnosis rules.

10.4 Passenger Information System

10.4.1 General

(a) The passenger information system (PIS) shall comprise of the below four sub-systems :

(i) Dynamic Route Map (DRM),
(ii) Electronic Information Display (EID),
(iii) Electronic Destination Display (EDD),and
(iv) Electronic Train Number Display (ETND).

For each car, ten (10) nos. of DRM and four (4) nos. EID shall be provided. For general arrangements of these displays shall refer to Drg. Nos. C6014-14E/TSEG/100/001 and C6014-14E/TSEG/100/002.

For each driving cab, one (1) no. of EDD and ETND shall be provided. For general arrangements of these displays shall refer to Drg. No. C6014-14E/TSEG/060/001.

(b) Unless otherwise specified, the display boards shall be a tri-colours LED message display board, with minimum performances of: 16×16 dot matrix, 3mm diameter/dot and ± 65° viewing angle. In addition, all PIS equipment shall be sealed to IEC 60529 IP54.

(c) The DRM shall be protected by a replaceable tamper-proof front shield. The front shield shall be non-reflective, glareless and with light transmissivity of not less than 85% and complied with the material requirements in PS 20. The front shield shall not affect the colour quality of the display. It shall also be protected from fingerprints and scratching by hard substances. No special cleaning procedure for the front shield shall be required, i.e. the cleaning method shall be identical to those for the coving panels.

(d) Not used.

(e) The PIS shall achieve a reliability of 3000 car kkm/failure per train.

(f) Interface with TMS

The PIS shall meet the following interface requirements with the TMS:

(i) To transmit and receive the required information from TMS according to RS/C6014/01.

(ii) To display the real time, train number, name of route and names of next and destination stations in the display terminal.

(iii) Not used.

(iv) During the normal circumstances, the station code shall be updated according to the station information provided by the ATC system. In the event that the data transmission link between the ATC system and the TMS is failed, this fault shall be reported to the train operator and the TMS shall automatically perform the update of the station codes according to the following sequential control logic:

if
- the train speed is decreased to 0 km/h; and
- the passenger doors of the train has been commanded to open and close once;

then
- the station code of the next station shall be updated and displayed in the DRM and EIDS according to the system routes specified in RS/C6014/01.

(v) Whenever the operation of the data transmission link between the ATC system and the TMS is resumed, the above control functions of station code update shall be automatically transferred back to the ATC system via the TMS. This transferring process shall be continuously reversible until the intervention of the train operator as specified in PS 10.4.1(f)(vi) below.

(vi) The following control functions shall be provided to facilitate the train operator to control the PIS:

(1) remotely power on or off of the display boards of each sub-systems of the PIS through the display terminal;

(2) manually change the train number, name of route and names of next and destination stations through the display terminal or the thumb wheel switches (if provided); and

(3) manually reset the PIS to the default state for reinitialisation purpose by moving the mode selector to the shutdown position.

(g) Automatic Fault Diagnosis, LED Test and Self-test faciility

(i) The PIS shall be able to detect, at any time when the PIS is in operation, any hardware and software fault. The faults shall be monitored by the TMS.

(ii) The PIS shall be able to carry out a LED test when the LED test command is received from TMS. The LED test shall be able to be conducted on all EDDs and ETNDs separately.

(iii) The PIS shall be able to carry out a self-test when the self-test command is received from TMS. The self-test shall be able to be conducted on all DRMs.

10.4.2 Dynamic Route Map (DRM)

(a) General Requirements

(i) The Dynamic Route Map (DRM) shall include the Dynamic Route Map (DRM) displays, DRM servers, DRM controllers, content editor terminal, maintenance terminal, network accessories and other necessary equipment. The Contractor shall provide the GSM Modem Assemblies for the Real Time Transmission Facilities as stipulated in the Appendix I Annex 9.

(ii) The display content shall be distributed from the DRM controllers to the DRM displays in each car as stipulated in the Appendix I Annex 9. The display content shall be delivered without degradation from DRM controller.

(iii) The Contractor shall be responsible for the test and commissioning of all the DRM equipment and their interfaces with TMS, DVAS & PA, GSM Modem Assemblies and Doors including the route information, scheduled playback, content update, system status reporting, display control, data transmission, message broadcasting and OCC live messages broadcasting as stipulated in Appendix I Annex 9. Testings shall be conducted to confirm compliance with broadcasting of passenger information by train operator and OCC remote operation in the Urban Lines.

(iv) The Contractor shall provide accommodation including mountings, equipment cabinets and cable access for installation of all the DRM equipment. The locations of the equipment and mounting arrangements shall be submitted to the Engineer for Approval.

(v) The electrical connections of the DRM shall be of female connectors at the car-body side and shall be properly protected, secured and mounted.

(vi) All cases/enclosures of the trainborne equipment shall be earthed to the vehicle frame.

(vii) The Contractor shall provide DRM servers, DRM controllers, networks, control and power cables, all connectors, earthing connections and all associated equipment housings and mounting materials for the DRM.

(viii) The Contractor shall provide the appropriate AC and DC power supplies including the power supply interface and the protection device to the DRM equipment in accordance with PS 17.3 and PS 17.4. The Contractor shall also ensure that the power supply arrangement can fulfil the emergency power supply requirement in PS 17.4.

(ix) The electrical loads of the DRM shall be balanced between three phase output of the auxiliary supply as stipulated in PS 17.3. The power consumption for the DRM shall be submitted for Approval. Suitably rated MCBs shall be separately provided for DRM displays with AC power type and DC power type in each car of the train. Suitably rated MCB shall also be separately provided for the DRM equipment in each car of the train.

(x) The DRM shall be designed and supplied to meet the constructional and workmanship standard as stipulated in RS/C6014/02.

(xi) The DRM shall be designed and supplied to meet the Electromagnetic Compatibility and Electrical and Electronic design requirements as stipulated in RS/C6014/04 and RS/C6014/03. The tests shall only be conducted by internationally recognized and accredited laboratories. The test results and certificates from the test laboratory shall be submitted for the Approval of the Engineer.

(xii) All cables used for the DRM shall comply with RS/C6014/06 Cable Standards. The details of all cables, plugs and connectors used in the DRM shall be submitted for Approval.

(xiii) Unless otherwise specified, all equipment installed on the train shall comply with IP55 rating or achieve equivalent level of protection. The equipment installed inside electrical or control cubicles need not comply with the IP55 rating.

(xiv) The Contractor shall submit a complete detailed design for the DRM indicating the characteristics of each type of equipment in the system, design of application software, design of display content, cabling, interfaces, and the configuration to be used to provide the required services. Network diagrams and schematics shall be included indicating how the components shall be interconnected and the protocols between each Train Units shall be provided. The design shall have a provision for system expansion in the future to accommodate additional system demands for future phases and technology changes.

(xv) The DRM shall be designed to prevent system crash or data loss under power interruption at any time including normal operation, system updating, downloading etc. Upon power resumption after power interruption, switching on or system reset, the DRM shall be initialized, self-diagnostic (Refer to PS 10.4.1(g)) performed and all system functions resumed to normal working condition automatically. Manual intervention for resetting, adjustment or like shall not be required.

(xvi) The internal system clock shall have an accuracy of less than five seconds of deviation per year

(xvii) The Contractor shall supply two Content Editor Terminals and eight portable Maintenance Terminals complete with all associated hardware and software including OS, application and interface software. All software installed shall be fully licensed for a lifetime and the licenses shall be transferrable to the Employer.

(xviii) The Contractor shall submit a system design specification covering:

- System description and operating principle(s) of the proposed system and their proposed installation locations;
- Specification of proposed materials and equipment;
- Design and user interface of the DRM and the video rendering software;
- Message types, display behaviours and display templates for the DRM;
- Interfacing controls design and user interface; and
- Test plan and specification.

(xix) A demonstration test shall be conducted to verify the performance of the DRM. The Contractor shall submit a proposed configuration for the demonstration test including DRM controllers, DRM displays and network equipment for Approval showing the components performance, connectivity and proposed tests to be conducted. The tests shall include:

- DRM displays performance;
- Video performance;
- Coding performance;
- Network performance;
- Video switching;
- Video display;
- Interface with other systems; and
- System administration, configuration, operation and maintenance features.

(xx) The virus is defined to cover all automatic mechanisms which are designed to make systems containing software behave in an undesired way. The DRM server, DRM controller, CE Terminal and Maintenance Terminal supplied by the Contractor shall be installed with the anitvirus software for virus protection. The Contractor shall be responsible for the supply of life-time usage/definition updating licenses and the configurations of Live Update feature such that the latest virus definition file will be available from designated sources. The Contractor shall also ensure that all latest patches and service packs are properly installed before the delivery of such hardware.

(b) Performance Requirements

(i) The DRM shall be designed for a duty cycle of 19 hours operation per day, 365 days operation per year.

(ii) The DRM shall allow pre-recorded and ad-hoc operating and emergency message to be displayed on the screen either fully or partially covering the screen for a configurable period. The display effects shall include text (with scrolling function independently if necessary) and graphic overlays on the original screen. The screen shall be resumed after the time period of the operating and emergency message is expired. When the screen is only partially covered by the operating and emergency messages, the system shall allow the screen graphic to be modified in such a way to maximize the remaining screen display area. The duration of all

the display contents of text, graphic and video on DRM displays to be configurable.

(iii) The DRM shall not display incorrect information. A failure in any display units shall not affect the normal operation of other display units in the system.

(iv) With the given performance of DRM displays, the information content to be displayed on the DRM and any setting out the vertically inclined angle of the displays shall be well designed so that passengers can easily read the information from any seating or standing position within the saloon area under all artificial and natural lighting, including bright sunlight in open sections of the URL. All these information shall be proposed by the Contractor for Approval during the detailed design stage.

(v) The DRM shall allow insertion of new stations, new interchange stations and new destinations. The database shall be stored in flash memory thus allowing for update or changes to be easily implemented for new routes by the Employer.

(vi) All data and operational parameters of the DRM shall be user-configurable without the need to recompile the software or upgrade the hardware and/or firmware.

(vii) The convention of the DRM numbering shall be based on door numbering to be submitted for Approval during detailed design.

(viii) The Contractor shall conduct ergonomic trials to maximize the visibility of the DRM displays to the passengers.

(ix) The DRM shall be able to display the following operational information:

- Full network map;
- Running line;
- Travelling direction;
- Doors' opening side and status;
- Terminal, next and current station, interchange station and the corresponding line for interchange;
- Local information about destination;
- Safety promotion messages;
- Educational messages;
- Festival warm messages;
- General information and car location in terms of train and arriving platform facilities; and

- Special and emergency messages.

(x) The DRM shall provide route information and general operational information in the form of visual broadcast to passengers on board by:

- Installing the DRM displays;
- Providing DRM servers to interface with TMS, DVAS & PA, GSM Modem Assemblies and Doors for relevant image rendering;
- Providing DRM controllers in each car to distribute the display content to DRM displays in a LAN based video transmission network; and
- Providing covering panels and mounting facilities for the DRM displays, DRM servers, DRM controllers, power supply units and cables.

(xi) One DRM display per car and related system equipment shall be supplied by the emergency power requirements as stipulated in PS 17.4.

(xii) The Contractor shall customize the DRM and manage the stored media files.

(xiii) The interface shall be provided to the DRM for receiving the fault data and broadcasting general route information as well as special and emergency messages. The display messages shall be in synchronization with PA messages.

(c) DRM displays

(i) The DRM displays supplied shall be in Stretched Liquid Crystal Display (SLCD) with LED back light. The surface of the DRM display shall be non-reflective, glareless without affecting the colour quality of the display

(ii) At least one DRM display shall be clearly legible from any location within the saloon by a person with normal eyesight.

(iii) The DRM displays shall be able to display the required information in the form of animated graphics and text.

(iv) All equipment of the DRM displays shall be discrete and line replaceable units connected through plugs and sockets to facilitate maintenance.

(v) The DRM displays supplied shall comply with impact test as Clause 12.1.3 of EN 60065:2002 or equivalent standard without the need of external protection. The tests shall only be conducted by internationally recognized and accredited laboratories. The test report from the test laboratory shall be submitted to demonstrate compliance with impact test requirement for the Approval of the Engineer.

(vi) The Contractor shall submit detailed design drawings and 2 complete sets of DRM display prototypes for the Approval of the Engineer prior to final product fabrication. Factory tests shall be conducted at the factory/workshop for the prototypes provided to ensure that the DRM display meets the specified interfacing, functional and performance requirements.

(vii) The DRM display shall conform to the following requirement:

- Contrast: ≧ 1,000:1
- Maximum Brightness: ≧ 450 cd/m^2
- Response Time: ≦ 6 ms
- Resolution: 1920 x 540 pixels
- Colour Resolution: 16.7 million colours
- Antiglare screen surface
- MTBF: At least 100,000 hours
- Display size: Not less than 930mm x 240mm
- Power Consumption: ≦ 150 W

(viii) The DRM display completed with the power supply shall be designed in modular form to minimize the cable connections. The method of mounting shall allow easy installation to and removal. All the cable connection shall be of plug and socket type, and the male connect shall be mounted on the display side.

(ix) The DRM displays shall recover automatically and display the correct information upon the resumption of power supply. The DRM displays shall include a self-test facility that allows automatic checking of the equipment healthiness during power up.

(x) The DRM displays shall communicate with DRM controller for self-test facility, status, fault reporting, power on/off and operational parameters configuration including automatic brightness control on/off, brightness, contrast, saturation, etc. The Contractor shall submit the communication protocol to the Engineer for Approval during the detailed design.

(xi) The operational parameters of the DRM displays shall be user-configurable without the need to recompile the software or upgrade the hardware and/or firmware.

(xii) The DRM displays shall preferably provide a DVI and a HDMI interface but an additional Ethernet interface may also be proposed as an alternative for video connections with the DRM controller. The proposed Ethernet interface shall be proven in a comparable operating environment. Any noticeable delay or flickering shall not be acceptable. The communication protocol and technical specification of the proposed Ethernet interface shall be provided for the Engineer's Approval.

(xiii) The DRM display SLCD unit, which achieve professional grade HDTV LCD panel quality with no weak point to be observed with the naked eye and the images and the motion pictures presented shall be legible, readable and comfortable in use.

(xiv) Viewing angle of the DRM displays shall be greater than or at least 178° in both vertical and horizontal view with automatic brightness control with brightness, contrast and saturation correction with respect to the environmental change.

(xv) The DRM displays shall have a built-in photo sensor which shall automatically adjust the intensity of the display panel. At least two levels of LED illumination shall be provided to cater for the tunnel and overhead section ambient lighting condition. The Contractor shall submit the illumination intensity of the LEDs and the intensity variation between LEDs at the two levels to the Engineer for Approval. Also, the design of housing for the DRM displays shall not degrade the function of the photo sensor on the frame of the DRM displays.

(xvi) The brightness of the DRM displays shall be automatically diminished to the dimmest mode in case of the failure of the photo sensor.

(xvii) The DRM displays shall not at any time show blank screen under normal operation condition so that train operators can easily know whether the display panels function normally or not.

(xviii) All electronic components inside the DRM displays shall be water resistance.

(xix) The DRM displays shall be free from dead pixels.

(xx) Among the ten DRM displays installed in each car of the trains, nine DRM displays shall be supplied by AC power and one shall be supplied by DC power. The display supplied by DC power shall be located at each car's middle door in alternate which shall be submitted for Approval in the detailed design.

(xxi) The one DRM display supplied by DC shall be operated satisfactorily at battery supply voltages of 110V DC nominal between 77V and 137.5V.

(xxii) The DRM display shall be equipped with a highly efficient and reliable internal power supply converter to supply power for control and displaying functions. The noise power level generated by the converter shall be limited below 30dB in the audible frequency ranged from 20Hz to 20kHz.

(xxiii) The total weight of one DRM display shall not exceed 12 kg.

(xxiv) The DRM display shall be designed to make flushed with the covering panels of the saloon interface after installation. The mechanical interface arrangements shall be submitted to the Engineer for Approval.

(xxv) The built-in photo sensor as specified in PS 10.4.2(c)(xv) shall be located at either one side of the display surface. The exact location shall be submitted to the Engineer for Approval.

(d) Functional Requirement of DRM server

(i) The DRM server is the main control part of the whole DRM. The DRM server will control the traffic of its dedicated network, display sequence of messages, interface with different systems and manage all the DRM displays via the DRM controllers. The DRM server including the data storage media shall be of solid state type and capable of storing route map information and operation messages in textual format in both Chinese and English.

(ii) The DRM server will decode data received from all interfacing systems using an error detection and correction protocol. Data verification shall be conducted by the DRM server upon completion of downloading message files from USB flash drive / maintenance terminal. The message files / data shall be re-downloaded if error is detected in the data verification process. The DRM server shall communicate with the TMS, DVAS & PA, GSM Modem Assemblies and Doors and send the data to DRM controllers for broadcasting operational information, including route information, station announcement, special and emergency messages in pre-set conditions.

(iii) The DRM server shall be able to be expanded.

(iv) The DRM server shall check the messages inside the DRM controllers and pass the updated messages stored inside its local memory to every DRM controller at the beginning of operation.

(v) The DRM server shall issue instruction to DRM controller to invoke the display and broadcast of the message in sequence according to any pre-determined schedule, time of day or location as stated in the scheduling list. Message being displayed on all DRM displays shall be synchronized.

(vi) USB receptacle and Ethernet port shall be provided for updating the media content. The updating shall perform automatically with a newer version of media content.

(vii) The DRM server shall:

- Verify the availability of the connections to the TMS via the new hardwire cable;
- Verify the availability of the connection to DVAS & PA via the new hardwire cable;
- Verify the availability of the connection to GSM Modem Assemblies via the new hardwire cable;
- Verify the availability of the connection to Doors via the new hardwire cable;
- Carry out self-diagnostic functions, including testing of hardware and version checking during power up of the train;
- Automatically enter normal operating mode after successful tests and perform all functions; and
- Synchronize its display schedule and content with DRM controllers on the train continuously.

(viii) The DRM server shall start operate once the train is powered on and shall only stop in loss of power. The DRM server shall collect the diagnostic results from all DRM controllers and transmit the results to the TMS.

(ix) The DRM server shall, after powered up or as requested by the TMS, be equipped with self-diagnostic functions, including testing of hardware and version checking.

(x) After successful self-test after power-up, the DRM server shall poll the status of all equipment and automatically enter into normal operating mode to accept connection and data from the TMS for broadcasting. It shall also be ready to respond to polls by the TMS and return the health status of all equipment.

(xi) When the DRM is properly self-initiated but erroneous or no data is received from the TMS, a fault message including the equipment address and fault type shall be sent to the DRM server. The DRM server shall consolidate all the equipment fault messages of DRM and send to the TMS automatically. Moreover, a default screen shall be shown on all SLCD units. The Contractor shall submit the default screen for the Engineer's Approval.

(xii) The DRM server shall recognize the attributes attached to the files and schedules after download, and perform the responses below. The priority shall be in descending order.

Type of Contents / schedules	Action
Line specific – Information related to train locations	Ignore if the train is not in the specified line, and accept the contents otherwise.
Location based – Information related to train locations	Insert the contents to the schedule for broadcast when the train is running at the required location.
Date and Time specific – Information related to the date	Ignore if the train is not in the specified period, and accept the contents otherwise.

(e) Functional Requirement of DRM controller

(i) The DRM controller shall receive instructions from DRM server, control the display sequence of messages and send video signal to all DRM displays. The DRM controller (including the data storage media shall be of solid state type and capable of storing route map information and operation messages in textual format in both Chinese and English.

(ii) The DRM controller shall be connected to the DRM displays to broadcast route map information and operation message in textual format in a continuous manner during train operation. The DRM controller shall communicate with the DRM server to broadcast operational information, including route information, station announcement, special and emergency messages in pre-set conditions.

(iii) The DRM controller shall be able to be expanded.

(iv) The DRM controller shall be able to interface with the DRM displays and generate the image of route map completely.

(v) The DRM controller shall be able to receive route code from DRM server and broadcast the route information and media contents in approved formats. The Contractor shall submit the display formats for Approval.

(vi) USB receptacle and Ethernet port shall be provided for maintenance use.

(vii) The DRM controller shall:

- Carry out self-diagnostic functions, including testing of hardware and version checking during power up of the train;
- Automatically enter normal operating mode after successful tests and perform all functions; and
- Synchronize its display content with other DRM controllers on the train continuously.

(viii) The DRM controller shall start broadcast once the train is powered on and shall only stop in loss of power. The transition between segments shall be seamless, in the manner that each content clip being displayed shall be completed, before the display of the content of the next segment. No flicker or image loss shall be observed during transition between segments.

(ix) The DRM controller shall be able to distinguish left side and right side in reference with the driving direction. Content to be displayed on either side of SLCDs in a car shall be identical.

(x) The video signal of all DRM controllers on train shall be synchronized and networked. Noticeable delay or flickering shall not be acceptable. The Contractor shall provide a mechanism for Engineer's Approval on fine-tuning any video synchronization delay of the DRM controllers during initial system setup and future maintenance due to any degradation of equipment.

(xi) The DRM controller shall be able to recognize DRMs location in car basis and present the location of the car imposition on the next platform layout.

(xii) The DRM controller shall be able to monitor the healthiness of each DRM displays. Any loss of connection or failure of the DRM displays shall be report to the DRM server automatically.

(xiii) Each DRM controller shall be able to provide dual DVI display ports with a maximum resolution of 3840 horizontal pixels but a 10/100 Base-T Ethernet port may also be proposed as an alternative if the additional Ethernet interface specified in PS 10.4.2(c)(xii) is also proposed. Display on the SLCD units and display on all SLCD units driven by different DRM controllers under the control of the same TMS across the whole train set shall be synchronized.

(xiv) The DRM controller shall, after powered up or as requested by the DRM server, be equipped with self-diagnostic functions, including testing of hardware and version checking.

(xv) After successful self-test after power-up, the DRM controller shall poll the status of SLCDs and automatically enter into normal operating mode to accept connection and data from the DRM server for broadcasting. It shall also be ready to respond to polls by the DRM server and return the health status of SLCDs and itself.

(f) Technical Requirement of DRM server

(i) The DRM server shall have sufficient processing power to continuously perform the requirement as stipulated in PS 10.4.2(d). Real-time clock shall also be provided.

(ii) The microprocessor and controller shall have watch-dog function to monitor the operation of the processor and will reset the microprocessor in case of processor hang-up.

(iii) The enclosure of the DRM server shall be metallic.

(iv) The DRM server shall be fan-less design with low power consumption and the hardware decoder shall support H.264 with resolution of horizontal pixels up to 3840 and bit rate up to 80Mbps, and the display output shall support at least 16.7 million colours.

(v) A 10/100 Base-T Ethernet Ports shall be provided for connection with the maintenance terminal via hardware cables for system configuration, updating and fault log downloading. The Ethernet Ports shall be extended with an extension cable from DRM server to an easily access location without complex dismantling.

(vi) An external USB receptacle separate from DRM server shall be provided for local updating. The external receptacle shall be extended with an extension cable from DRM server to an easily access location without dismantling. Active USB extension cable with built-in amplifier circuit shall be provided if the cable length exceed 4 meters limitation.

(vii) To prevent system crash or data loss during remote updating via external USB flash drive, a push button shall be provided to command the DRM server for unplugging the USB flash drive. Indication shall be provided for readiness for unplugging.

(viii) A version- check function shall be provided to check the completeness of downloading and updating via thumb drive. The information of all updatable hardware/software items, including number of copied files, hardware version, database version, software version, firmware version and parameter setting version, shall be displayed on the screen of SLCD units for a configurable time interval.

(ix) Power supply module for providing power for the GSM Modem Assemblies of the Real Time Transmission Facilities (refer to PS 10.4.2(p)).

(x) Interface ports shall be provided for linkage with TMS, DVAS & PA, GSM Modem Assemblies and Doors for monitoring, control and broadcasting the operational information.

(xi) The storage size of the DRM server shall be at least doubled to the storage size of the DRM controller to hold all messages files that are either scheduled or non-scheduled, control firmware and other necessary system files. The memory shall be configurable for the allocation of new display content via a portable maintenance terminal.

(xii) The operation system of the DRM server shall be capable to tackle sudden power interruption to prevent any possible system crash or data loss.

(xiii) The DRM server shall be equipped with at least one analogue audio output port. The port shall have the following characteristics:

- Frequency response: 100Hz to 20kHz;
- Audio output level: 0 dBv;
- Total harmonic distortion: less than 2%;
- Signal to noise ratio: greater than 70dB; and
- Total hum level: 80dB below full rated output

(g) Technical Requirement of DRM controller

(i) The DRM controller shall have sufficient processing power to continuously perform the requirement as stipulated in PS 10.4.2(e) and decode the media stream for broadcasting. The decoded

contents shall be smooth at all times and no jitter or delay shall be noticeable.

(ii) The microprocessor and controller shall have watch-dog function to monitor the operation of the processor and will reset the microprocessor in case of processor hang-up.

(iii) The enclosure of the DRM controller shall be metallic.

(iv) The DRM controller shall be fan-less design with low power consumption and the hardware decoder shall support H.264 with resolution of horizontal pixels up to 3840 and bit rate up to 80Mbps, and the display output shall support at least 16.7 million colours.

(v) A 10/100 Base-T Ethernet Ports shall be provided for connection with the maintenance terminal via hardware cables for system configuration, updating and fault log downloading. The Ethernet Ports shall be extended with an extension cable from DRM controller to an easily access location without complex dismantling.

(vi) An external USB receptacle separate from DRM controller shall be provided for local updating. The external receptacle shall be extended with an extension cable from DRM controller to an easily access location without dismantling. Active USB extension cable with built-in amplifier circuit shall be provided if the cable length exceed 4 meters limitation.

(vii) To prevent system crash or data loss during remote updating via external USB flash drive, a push button shall be provided to command the DRM controller for unplugging the USB flash drive. Indication shall be provided for readiness for unplugging.

(viii) A version- check function shall be provided to check the completeness of downloading and updating via thumb drive. The information of all updatable hardware/software items, including number of copied files, hardware version, database version, software version, firmware version and parameter setting version, shall be displayed on the screen of SLCD units for a configurable time interval.

(ix) Interface ports shall be provided for linkage with the DRM displays for monitoring and control.

(x) The DRM controller shall be able to store at least 6 hours of the Full HDTV standard video clips for displaying on DRM in its built-in memory and shall be able to be expanded to store another 6 hours.

The memory shall be configurable for the allocation of new video clips via a portable maintenance terminal.

(xi) The operation system of the DRM controller shall be capable to tackle sudden power interruption to prevent any possible system crash or data loss.

(xii) The DRM controller shall be equipped with at least one analogue audio output port. The port shall have the following characteristics:

- Frequency response: 100Hz to 20kHz;
- Audio output level: 0 dBv;
- Total harmonic distortion: less than 2%;
- Signal to noise ratio: greater than 70dB; and
- Total hum level: 80dB below full rated output.

(h) Message Types and Display Behaviours

There shall be five categories of information to be displayed by the DRM in video format, namely: general passenger information, route information, and OCC live information, special and emergency information.

The different categories of information shall have different priority as tabulated below:

Priority	Information category
1 (Highest)	Emergency information
2	Special information
3	OCC live information
4	Route information
5 (Lowest)	General passenger information

(i) Emergency information

The DRM shall display the Emergency information of the train in video format via the interface with DVAS & PA.

(ii) Special information

The DRM shall display the Special information of the train in video format via the interface with DVAS & PA.

(iii) OCC live information

The DRM shall display the live messages, train pre-recorded special messages; and emergency messages which will be initiated by OCC through GSM Modem Assemblies.

(iv) Route information

The DRM shall display the route information of the train in video format via the interface with TMS, the information includes:

- Full network map;
- The line that the train is running on;
- The direction to which the train is travelling;
- Terminal station;
- Next station the train will arrive;
- Current station the train stop;
- Interchange station and the corresponding line for interchange;
- Passenger doors' opening side; and
- Passenger doors status (to be opened / closed).

(v) General passenger information

The DRM shall display the pre-stored general passenger information according to the playback schedule in video format includes:

- Local information about destinations (tourist spots ,etc);
- Safety promotion messages;
- Educational messages;
- Festival warm messages (date triggered);
- General information;
- Date and time; and
- Car location in terms of train and arriving platform facilities.

(i) Contents Updating

(i) The DRM shall be able to store downloaded message, graphics and video clips via maintenance terminal or encrypted USB thumb drive. USB receptacle and Ethernet port shall be provided for updating the media content. The updating shall perform automatically whenever a newer version of media content is detected.

(ii) The updating span for entire content, playback schedules, firmware database, application software, operational parameters on a train shall not exceed three hours. The routine content and playback schedules updating shall be completed within 30 minutes through thumb drive automatically.

(iii) The maintenance terminal shall able to update the system firmware database, application software, operational parameters, content and playback schedules simultaneously on train via the networking. The updating shall be performed as batch updating in train base i.e. no individual equipment updating required.

(j) Content Editor (CE) Terminal

(i) The Contractor shall provide two standalone content editor terminals at two locations to be designated by the Employer. It shall be in the form of a commercially available PC with full set of mouse keyboard and quad full HD monitors.

(ii) The CE Terminal shall be equipped with client programs and utilities for accepting, editing, scheduling and downloading of media contents and making copies of messages, graphics and video stored on maintenance terminals and external storage devices for uploading.

(iii) The CE Terminal shall support quad Full HD outputs with the maximum resolution up to 7680 horizontal pixels.

(iv) The CE Terminal shall be able to capture and accept multiple types of sources and files into the system for editing, creating animation with individual source file as building block and eventual displaying on the DRM. The supported files type shall be defined, named properly and stored in a particular location which shall be submitted for Approval during the detailed design. The accepted formats shall include at least the following types:

For video contents
- DVCam digital video clip;
- Digital BetaCam digital video clip;
- DVD video clip; and
- H.264/MPEG-4 AVC Digital High Definition video clip.

For graphical contents
- Windows BITMAP (*.bmp) file;
- GIF format (*.gif) file;
- TIF format (*.tif) file;

- PCX format (*.pcx) file; and
- JPEG format (*.jpg) file.

(v) The CE Terminal shall support text file formats that are commonly available in the market. As a minimum requirement, the equipment shall be capable of reading, editing and saving the following text file formats.

- Microsoft Word format (*.doc) file; and
- Unformatted Texts in Unicode or BIG5 coding.

(vi) The CE Terminal shall provide the following editing features for all video and graphical contents, as a minimum:

- Capture play start position (in second);
- Capture play stop position (in second);
- Appending two or more content clips; and
- Creation of transition effect, subtitle, control of contrast, brightness and colour and etc.

(vii) The CE Terminal shall provide editing features for all contents including creation of transition effect, subtitle, control of contrast, brightness and colour and etc. After the editing process, the CE Terminal shall encode the contents in to the file format as proposed in System Design Specification.

(viii) The CE Terminal shall allow the operator to define, as a minimum, the following display format and effects for text of operating messages which shall form part of the database:

- Font type, size and style;
- Display effects including scrolling left/right, checkerboard, blinds, strips and wipe;
- Display duration or scrolling speed; and
- Background of the text display.

(ix) For each file encoded by the CE Terminal, a unique ID shall be assigned based on line, location and date for determining the playback behaviour and messages priority on the DRM.

(x) For attributes of line and location, the CE Terminal shall allow the operator to specify the line, location and date respectively to the media content. These data shall form part of the database and shall be modifiable. The CE Terminal shall able pairing the media

content with the following triggering (graphical display content can be triggered by text data):

- Route codes of TMS;
- GSM Modem Assemblies data;
- DVAS & PA broadcasting code; and
- Door's side open / close status of Doors.

(xi) The CE Terminal shall enable the operator to create a play schedule of media contents to be broadcast in a loop basis. It shall allow the CE Terminal operator to define different schedules on line basis. The CE Terminal shall also enable the operator to configure timing for each media contents to be displayed in a play schedule.

(xii) For each schedule created by the CE Terminal, a unique ID, with no upper limit on length, shall be assigned. Moreover, the CE Terminal shall enable the operator to define the Line and location for determining the playback behaviour.

(xiii) For each play schedule, the CE Terminal shall enable the CE operator to define the total number of segments in the schedule. And for each segment, it shall be able to define the number and layout of the screen partitions.

(xiv) The CE Terminal shall allow the operator to:

- Define x,y co-ordinates for each partition;
- Define width and height of each partition;
- Define the come up direction of each partition;
- Define the transparency level of each partition;
- Define aspect ratio of the overall screen display;
- Define overall screen resolution; and
- Define the specific partition(s) for broadcasting the messages as specified in PS 10.4.2(h).

It shall be possible for the operator to perform the above definitions in a drag-and drop manner or by direct keyboard inputs.

(xv) A list of available media files in the CE Terminal shall be shown to the operator for the operator to attach any of the media contents to each screen partition by inputting the unique media content file ID or by drag-and-drop of the file to the desired partition.

(xvi) The CE Terminal shall calculate and show the total time of each schedule and partition. The CE Terminal shall also provide

summaries of the created schedules and the associated media contents. The formats and calculation methods shall be proposed to the Engineer for Approval.

(xvii) The MMI of the CE Terminal shall provide indication to the operator in case of logical error in scheduling, attribute assignment, error encountered during editing, encoding and transmission of files etc., and the design and logic of such indications shall be submitted for Approval.

(xviii) The CE Terminal shall provide a preview function to enable the operator to preview the visual display on the SLCD units imitating the display effect on DRM. This preview function shall also allow the operator to initiate the train location for evaluation of loop broadcasting.

(xix) The CE Terminal shall be pre-installed with the Engineer approved antivirus software for virus protection before delivery to site. The Contractor shall be responsible for the supply of life-time usage/definition updating licenses and the configurations of Live Update feature such that the latest virus definition file will be available from designated sources. The Contractor shall also ensure that all latest patches and services packs are properly installed before the delivery of such hardware.

(xx) The CE Terminal shall enable the operator to produce a package, in the format of USB Flash Drive or maintenance terminal, for uploading to trains. The package shall include one schedule and all Media Content files associated with this schedule. The CE Terminal shall be equipped with at least 8 numbers of USB 3.0 receptacles for this purpose.

(xxi) The CE terminals shall be commercially available computers by a recognized manufacturer. The minimum configuration shall be as follows:

- 4th Generation Inter® Core^{TM} i7-4770 Processor (or better);
- NVIDIA® GeForce® GTX 780 (or better);
- 32GB Dual Channel DDR4 2133MHz;
- 512GB SSD + 3TB 7200 RPM SATA Hard Drive 6.0 Gb/s;
- Four 21 inch FHD (1080p) LED Backlit Displays;
- Built-in 802.11 b/g/n/ac WLAN capability;
- RJ45 port, USB 3.0 port x 8; and
- Card readers.

(xxii) The following software shall be loaded before delivery:

- Latest Microsoft Windows Professional operating system; and
- Video/Image editing software, simulation software, downloading software, configuration software and all necessary utilities required to perform its functions as stipulated in PS.

(k) Maintenance Terminal and Software

(i) The Maintenance Terminal shall be in the form of notebook computer for the following functions:

- Content & playback schedule update and backup;
- System diagnostic;
- System configuration including default screen setting;
- Log files download and preview; and
- Network configuration.

The control parameters and adjustments data shall be exported to and imported from csv file format.

(ii) All data and operational parameters shall be user-configurable without the need to recompile the software or upgrade the hardware.

(iii) The Contractor shall supply eight commercially available notebook computers by a recognized manufacturer. The minimum configuration shall be as follows:

- 3rd Generation Inter® Core™ i7-3520M Processor (2.90 GHz, 4MB L3, 1600MHz);
- NVIDIA® NVS 5200M 1GB VRAM;
- 8GB Dual Channel DDR3 1600MHz;
- 512GB Solid State Drive, SATA 3;
- 13.3 inch FHD (1080p) LED Backlit Display;
- 6 hours battery life;
- Built-in 802.11 b/g/n/ac WLAN capability;
- RJ45 port, USB port x 2, HDMI out;
- Less than 2kg in weight; and
- Latest Microsoft Window Professional operating system.

One set of installation discs and recovery discs per maintenance terminal shall be handed over to the Employer upon the

completion of the Contract. The installation discs and recovery discs shall include all required software completed with lifetime licenses for repairing the maintenance terminal in the event of terminal crash.

(iv) The Maintenance Terminal shall be pre-installed with the Engineer approved antivirus software for virus protection before delivery to the Employer. The Contractor shall be responsible for the supply of life-time usage/definition updating licenses and the configurations of Live Update feature such that the latest virus definition file will be available from designated sources. The Contractor shall also ensure that all latest patches and services packs are properly installed before the delivery of such hardware.

(l) Provision for Future Expansion

(i) The Contractor shall make provision for the future extension of Employer network and insertion of new station in the system design.

(ii) Hardware and software tool shall be provided to carry out the change. The required software program shall run on latest Windows Professional Edition operating system computer.

(iii) The Contractor shall provide all the necessary detailed instructions and special equipment to enable the Employer to reprogram the DRM server and DRM controller to incorporate the future expansion.

(m) System Configuration

(i) Levels of access to the System and authority shall be provided at least 3 levels. Each level shall have its authority to control and access. System administrator shall able to set the priority of users in controlling functions.

(ii) The System shall record with timestamps all system messages and errors, including system and equipment healthiness and status in a system-log file in csv file format.

(iii) The System shall provide an internal system clock for generating the timestamps as well as for synchronizing the clocks, if present, of all equipment of the System.

(iv) The log files shall be viewable by using Microsoft Excel or Word program.

(v) The System shall provide a user interface for basic configuration of the system parameters and monitoring of status of System and SLCD units. Configuration functions shall be carried out via the Maintenance Terminal and the functions to be provided shall include the following:

- Car number configuration;
- System clock;
- Control of brightness, contrast and colour saturation;
- Firmware and application software update;
- Waiting span for system shut down after power loss;
- Fault and alarm configuration; and
- Fault viewing and reset.

(n) Miscellaneous Deliverable Items

(i) The proprietary tools and software necessary for installation, testing, data configuration, system configuration, system expansion and maintenance of the System.

(ii) Lifetime licenses to support the functioning of the System according to this PS. Where possible, the Employer shall be a sub-licensee on all software licenses when they are originally procured by the Contractor.

(iii) All software development tools and compilers, source codes, flowcharts, hardware drivers, firmware, middleware together with valid lifetime licenses of the tools and software which are to be developed for this Contract in accordance with the software development level classified in RS/C6014/05.

(o) Networks

(i) The network shall be an IP-based layer 2 or 3 network.

(ii) All network equipment shall conform to IEEE 802.11 standards, and shall be exempted from licensing requirement by OFCA.

(iii) The network shall be designed to minimize the needs for individual trainline wires and hardwires across couplers. All network cables employed for data transmission on trains shall be CAT5E Shielded Twisted Pair cables with individual pair screen.

(iv) Any failure of the network shall automatically be isolated and shall not affect the operation of other systems and interfaces.

(p) Real Time Transmission Facilities

(i) The Real Time Transmission Facilities consist of the existing OCC equipment, GSM Modem Assemblies and GSM Modem Assemblies Interface as stipulated in Appendix I Annex 9. The GSM Modem Assemblies shall provide a transmission mean to send operational messages, such as train service regulation messages, from OCC to the DRM in a real time manner within 30 seconds.

(ii) The GSM Modem Assemblies shall allow message of maximum size of 140 alphanumeric codes or 70 Chinese characters to be transmitted from the OCC to the GSM Modem Assemblies and displayed on the DRM displays.

(iii) Each message shall be sent to the DRM and ready for display within 30 seconds from the moment the OCC sends the message.

(iv) The Real Time Transmission Facilities shall allow messages to be sent to a selected train or all trains running in the Urban Lines.

(v) The GSM Modem Assemblies shall be available at all times and there is no need to undertake any startup / login process.

(vi) Two GSM Modem Assemblies shall be installed in each cab of the train as the real time data receivers.

(vii) The GSM Modem Assemblies and GSM Modem Assemblies Interface shall interpret messages sent from OCC through the public GSM Network, decode the messages, and transmit to the DRM.

(viii) The GSM Modem Assemblies and GSM Modem Assemblies Interface shall be equipped with all necessary software / hardware to convert the character code used by the public GSM Network Operator to ASCII or Big5 character code so that correct characters can be displayed in the DRM displays. Special Hong Kong Chinese characters in the range of FA40 to FAA3 shall also be able to be received and shall be displayed on the DRM displays.

(ix) The GSM Modem Assemblies and GSM Modem Assemblies Interface shall incorporate appropriate error checking functions to ensure integrity of the received data.

(x) The GSM Modem Assemblies and GSM Modem Assemblies Interface shall incorporate a system of hierarchical passwords to prevent the reception of unauthorized message by the DRM.

(q) System Interfaces

(i) The DRM shall interface with GSM Modem Assemblies as stipulated in Appendix I Annex 9.

- The DRM shall interface with the GSM Modem Assemblies in the agreed communication protocol and data format with the GSM service provider (refer to PS 10.4.2(p)).
- The DRM shall relay the received message to the DRM controller. The DRM controller shall interrupt the current displaying message and display the received real time message on DRM displays in a configurable period in accordance with the message priorities as stipulated in PS 10.4.2(h).

(ii) The DRM shall interface with TMS for route information, cab status, alarms and system status. Details refer to PS 10.4.1(f) and Appendix I Annex 9.

(iii) The DRM shall interface with DVAS & PA as stipulated in Appendix I Annex 9.

- The DRM shall interface with the DVAS & PA to obtain information of door status, next station, pre-recorded DVAS & PA message codes to display next station name, pre-recorded DVAS & PA text message in parallel with the audible announcement from DVAS & PA.
- The DRM shall interpret the DVAS & PA codes and transmit the corresponding codes to the DRM controller to instruct the display of corresponding station name or pre-recorded DVAS & PA messages stored in the Flash Memory of the DRM controller.

(iv) The DRM shall interface with Doors as stipulated in Appendix I Annex 9.

- The DRM shall interface with Doors to obtain information of door's side open/close status to display the corresponding message on DRM displays.
- The interface shall be provided in dry contacts signal and satisfy the interface requirement and submit for Approval during the detailed design.

10.4.3 Electronic Information Display System (EIDS)

Details shall refer to PS 18.5.

10.4.4 Electronic Destination Display (EDD)

(a) Performance Requirements

(i) The EDD shall be able to display the destinations and special messages according to RS/C6014/01.

(ii) The colour and the character size of the display shall be designed to achieve the required visibility by the train operators and the passengers, and also to match with the overall aesthetic design of the cab front.

(iii) The EDD shall be legible from the station platform on either side of the train at a minimum distance of 30 m ahead of the train and at an angle of up to 45 degree, by a person with normal eyesight.

(iv) The EDD shall be legible in direct sunlight when the train is running in open section, and in artificial light and darkness in underground section.

(v) There shall be no escape of light from EDD into the cab.

(vi) No incorrect information shall be shown by the EDD. The display shall be switched off if any fault is detected in the EDD.

(vii) A manual thumb wheel switch on the EDD shall be provided to allow the train operator to select the destinations and messages according to Drg. No. C6014-14E/TSEG/060/008, when no information is received from the TMS. A means shall be provided to allow the train operator to override and resume the control of EDD by TMS.

(viii) The manual thumb wheel switch shall be designed ergonomically to avoid unintentional input by the train operator. The numerical codes and the corresponding destinations and relevant messages according to Drg. No. C6014-14E/TSEG/060/008 shall be tabulated and shown on the back of EDD for a train operator to select and check.

(ix) An amber LED shall be provided on the rear of the EDD to indicate the status of the power supply.

(x) The time taken for the display of the correct destination after the initial power up of the train shall not exceed one (1) second.

(xi) Following a change of selection it shall take less than one (1) second for the EDD to change to the selected destination.

(xii) The EDD shall recover itself and display the correct destination within one (1) second when power supply is available.

(b) EDD Display Format

(i) The EDD shall be in the form of a 3 mm LED Dot Matrix display and shall be able to display the train destinations in both Chinese and English at the same time.

(ii) The Chinese characters shall be amber in colour with a minimum size of 120 mm (height). The English characters shall be in red with a minimum size of 65 mm for the upper cases, and 46 mm for lower cases.

(iii) Tri-colour LEDs shall be used to allow flexibility of changing the text colour in future.

(c) Mechanical Requirements

(i) The EDD completed with the power supply shall be designed in modular form to minimize the cable connections. The EDD shall be installed on each driving cab (refer to PS 8.8). Ergonomics and aesthetics shall be taken into account in the mounting and design of the display.

(ii) The protective glass or equivalent shall be provided to prevent any damage from heat and sunlight (colour fading), and shall not affect the colour quality of the display.

(iii) The method of mounting the EDD behind the windscreen in the driving cab shall allow easy installation and removal. All the cable connections to EDD shall be of plug and socket type, and the female connector shall be mounted on the car body side. Removal and installation of one EDD shall be completed by two trained maintenance staff within 20 minutes.

(iv) The enclosure shall be designed for modular plug-in type PCBs. Access to the electronics shall be achieved within 15 minutes for maintenance and service purposes.

(d) Electrical Requirements

(i) The power supply for the EDD shall be taken from the ac output of the auxiliary converter system (refer to PS 17.3). The supply shall be available when either one of the auxiliary converter set is running.

(ii) Suitably rated MCB shall be provided.

(e) Communication Interface

The data shall be transmitted from the TMS through a separate RS485 bus or the vehicle bus at a minimum data transmission rate of 9,600 baud.

(f) Provision for Future Expansion

(i) The software of the EDD shall be designed to allow new destinations to be incorporated easily by the Employer. The destination database shall be stored in flash memory thus allowing for update or changes to be easily implemented for new routes. The memory shall be sufficient to store up to 100 destinations and 20 messages.

(ii) Hardware and software tool shall be provided to carry out the change. The required software program shall run on Windows XP or higher operating system computer.

(iii) The Contractor shall provide all the necessary detailed instructions and special equipment to enable the Engineer to reprogram the unit to incorporate the new destinations.

(iv) Not used.

10.4.5 Electronic Train Number Display (ETND)

(a) Performance Requirements

(i) The ETND shall display the train running number for use by the operating staff on the Urban Lines.

(ii) The ETND shall be capable of displaying a three digit number in the range 000 to 999.

(iii) The ETND shall be legible from station platforms on either side of the train at a minimum distance of 25 m and at an angle of up to 45 degree, by a person with normal eyesight.

(iv) The ETND shall be legible in direct sunlight when the train is running in open section, and in artificial light and darkness in underground section.

(v) The colour and the character size of the display shall be designed to achieve the required visibility, and also to match the overall aesthetic design of the cab front. The design shall be submitted for Approval.

(vi) A thumb wheel switch on the ETND shall be provided to allow the train operator to select the correct train number when no information is received from the TMS. The corresponding train number shall be shown at the back of ETND to allow the train operator to confirm his selection. The thumb wheel switch shall be designed ergonomically to avoid erroneous input by the train operator.

(vii) A means shall be provided to allow the train operator to override and resume the control of ETND by TMS.

(viii) An amber LED shall be provided on the rear of the ETND to show the power on of the ETND.

(ix) The time taken for the display of the train number after the initial power up of the train shall not exceed one (1) second.

(x) The ETND shall recover itself and display the correct destination within one (1) second when power supply is available.

(xi) Following a change of selection it shall take less than one (1) second for the ETND to change to the selected train number.

(b) ETND Display Format

(i) The ETND shall be in 3 digits, each with amber 7-segment LED displays. The digit size shall be at least 100 mm x 60 mm.

(ii) The display of the ETND shall be maximized to enhance the legibility and visibility.

(c) Mechanical Requirements

(i) The ETND completed with the power supply shall be designed in modular form to minimize the cable connections. The ETND shall be installed on each driving cab to replace the existing train number plate. The size of the ETND shall not exceed the size of transparent area of the windscreen for ETND.

(ii) The method of mounting the ETND behind the windscreen in the driving cab shall allow easy installation and removal. All the cable connections to ETDN shall be of plug and socket type, and the female connector shall be mounted on the car body side. Removal and installation of one ETDN shall be completed by two trained maintenance staff within 20 minutes.

(iii) The enclosure shall be designed for modular plug-in type PCBs. Access to the electronics shall be achieved within 15 minutes for maintenance and service purposes.

(d) Electrical Requirements

(i) The power supply for the ETND shall be taken from the ac output of the auxiliary converter (refer to PS 17.3). The supply shall be available when either one of the auxiliary converter set is running.

(ii) Suitably rated MCB shall be provided.

(e) Communication Interface

The data shall be transmitted from the TMS through a separate RS485 bus or the vehicle bus.

10.5 Equipment Control and Monitoring

10.5.1 General

(a) The TMS shall provide an automatic data transmission function to transfer the required information, commands and signals for control and testing among the train systems.

(b) In order to ensure the safety integrity of the train systems, the TMS shall not intervene any safety related control function of the specific train system, such as, the door, traction and braking systems operation. The primary role of TMS shall be limited to reliably transmit the required data to and from the train systems.

(c) A testing function for system healthy check of the trainborne equipment shall be provided for the train operator via the display terminal.

(d) A data management strategy shall be submitted for Approval to define the design concepts of what and how the equipment information will be displayed (refer to PS 10.3.5), fault data will reported and recorded (refer to PS 10.3.6) and defect will be handled (refer to PS 10.3.7).

(e) The TMS shall provide an interface to all driving cab and hostler cab controls and indications, a system safety checking and monitoring function shall be provided to ensure the circuit integrity (for example, no conflicting commands are presented) and input/output validity (for example, no hidden fault persists due to contact jam). Detail requirements shall refer to RS/C6014/01.

(f) The data management strategy shall also address the classification and any special management of the safety critical/related signal. Detailed requirements shall refer to RS/C6014/01.

10.5.2 Driving Cab and Hostler Cab Control System

(a) As a minimum requirement, TMS shall interface and monitor the following signals in the driving cab:

- directional commands of forward and reverse
- motoring and braking commands
- tractive effort commands provided by the traction and braking controller (in the case of driving cab) and/or pendant controller (in the case of hostler cab)
- A side & B side door open and close commands
- A side & B side cab door open and close commands
- Emergency Stop pushbutton
- ATO Start pushbutton
- Overspeed alarm
- Parking brake command
- A side & B side door open and close pushbuttons
- horn pushbutton
- traction brake controller emergency position
- traction brake controller deadman safety device
- mode selector positions (shutdown, reverse, standby, forward, CM & Auto)
- brake loop cut out switch
- brake loop selector switch
- door proving loop cut out switch
- ATDC cut out switch

- safety cut-out switch
- auxiliary on pushbutton
- auxiliary off position
- pantograph selector switch
- pant down pushbutton
- A side & B side door bypass switches
- uncoupling pushbutton
- autocoupler electrical isolation switch

(b) As a minimum requirement, TMS shall interface and monitor the following signals in the hostler cab:

- Hostler master switch (normal, forward, off, reverse)
- auxiliary on pushbutton
- auxiliary off position
- pendant controller deadman safety device
- pendant controller horn pushbutton
- directional command of forward and reverse by the pendant controller
- motoring and braking commands by the pendant controller
- tractive effort commands provided by the pendant controller

(c) The TMS shall provide a man-machine interface to the train operator through the train operator display terminal (refer to PS 10.8.2) and status of the applicable equipment shall be correctly displayed.

10.5.3 Traction and braking system

The TMS shall provide the following functions:

(a) Monitoring and recording the traction energy consumption (refer to PS 11.6.12(c)) on a car basis.

(b) Providing a condition monitoring function for the temperature of the traction motor bearings (refer to PS 11.6.10(n)). Range of the temperature to be monitored shall follow the recommendations of the manufacturer.

(c) Facilitating the train operator to initiate the traction test according to the requirements specified in PS 11.6.13(a) and 11.6.13(b). Any fault detected shall be logged and recorded by the TMS.

(d) Recording and displaying any fault status of the wheel slip/slide protection system (refer to PS 11.13.3).

(e) Recording and displaying any identified permanently locked axle (refer to PS 11.13.4).

(f) Facilitating remote isolation of the failed traction and braking system isolation function on a car basis (refer to PS 11.3.16) and failed friction brake on a bogie basis (refer to PS 11.15.8). Remote isolation shall only be allowed when fault has been detected on the concerned equipment and cannot be reset.

(g) Recording and displaying acceleration rate and brake rate.

(h) Recording the accumulative mileage run of each traction motors for maintenance scheduling (refer to PS 10.6.2).

(i) Recording and displaying the train speed on the TMS display terminal under all operation modes and on the pendant controller during the hostler operation (refer to PS 9.6.3(g)).

(j) Interface with each of the traction converter and brake control unit to receive traction and braking system operational monitoring signals and detected faults.

(k) Monitoring the conditions of the control trainline signals according to the logic tables shown in Table 10-2. For any conflicting control commands, such as, both forward and reverse wires are energised, and both motoring and braking wires are energised, the TMS shall report the fault to the train operator and logged in the memory.

(l) Monitoring the integrity of the speed detection circuit and report when fault is detected (refer to Appendix I Annex 3).

(m) Monitoring the control commands received from the ATO (refer to Appendix I Annex 3). The traction and braking system shall be operated according to the logic table shown in Table 10-3. For any illegal logic state i.e. the faulty state occurred shall be reported to the train operator and logged in the memory.

(n) The status of each of the brake isolating cocks (refer to PS 11.15) shall be monitored by TMS.

(o) A vigilance alarm shall be activated by TMS when the train is driven in Forward (refer to PS 9.5.2 (d)) or Reverse (refer to PS 9.5.2 (b)) mode and the traction brake controller (refer to PS 9.6.2) has been placed and maintained at the same motoring position or coasting position for over five seconds. The vigilance alarm shall automatically be de-activated when

the traction brake controller has been moved away from the previous motoring / coasting position or when it is moved to any braking position.

10.5.4 Door System

The TMS shall provide the following functions:

(a) Interface with each of the door control unit to receive door operational monitoring signals and detected faults.

(b) Monitor and record the by-pass command activated by the train operator to control the train door by isolating the ATC safety signals when the ATC system failed (refer to PS 9.8.15).

(c) Not used.

(d) Monitor the healthiness status of each door pair, such as, the operating time, the fully closed signal provided by the door proving device (refer to PS 16.2.9(f).

(e) Monitor any operation of the manual emergency release device (refer to PS 16.2.10).

(f) Monitor the status of the mechanical lock switch and manual door isolation device (refer to PS 16.2.8).

(g) Facilitate maintenance adjustment of train door operational parameters (refer to PS 16.2.12 and PS 16.2.13).

(h) The TMS shall continuously monitor the conditions of the trainline door commands of open and close. For any conflicting logical commands, such as, both open and close wires are energized, the train system shall be responded according to PS 16.2.6. This fault shall be reported to train operator and logged in the memory.

10.5.5 Air conditioning system

The TMS shall provide the following functions:

(a) Interface with each of the air conditioning unit to receive air conditioning unit operational monitoring signals and detected faults including:

(i) cooling failure and operation of only mechanical ventilation (refer to PS 15.7.1(b)).
(ii) operation of emergency mode ventilation (refer to PS 15.7.2(e)).
(iii) operation of smoke mode ventilation (refer to PS 15.7.3(h)).

(iv) faulty or dirty smoke detector (refer to PS 15.9.4).
(v) operation of high pressure cut-out device, low pressure cut-out device and compressor unloading device (refer to PS 15.10.8).
(vi) operation of compressor motor overheating and overloading protection device (refer to PS 15.14.2).

(b) In order to ensure the passenger comfort and optimise the energy consumption of the air conditioning units, an automatic control of the air conditioning systems shall be provided according to the following conditions:

(i) Daily basis

For a preset period of time, such as, the non-traffic hours, all air conditioning units shall be automatically shut down by the TMS until the starting period of traffic hours is reached, then all air conditioning units shall be re-started again.

(ii) Passenger loading basis

Based on the passenger loading signal received from the air suspension system (refer to PS 10.5.7), TMS shall be able to change the target saloon temperature on a car basis. Two target saloon temperature settings with corresponding car loading trigger shall be used with the following logic:

Car loading	Target saloon temperature
> W2	T2
< W1	T1
Unknown	Same as previous
After power up	T1

(c) For backup purpose, an overriding function shall be provided to override the above commands of shutdown/re-start and temperature setting either by means of the individual local control of the air conditioning unit or via the train operator's input device through the TMS.

(d) All the above setting of non-traffic hours, W1, W2, T1 and T2 shall be easily adjustable by the maintenance personnel via the TMS.

(e) The saloon temperature of each car shall be monitored in real time and reported to the TMS.

(f) In order to reduce the inrush current due to simultaneous start of the air conditioning units, a staggering start arrangement shall be provided by the air conditioning units to control their starting sequence. TMS shall provide the necessary co-ordination to facilitate such feature.

(g) In the event that the smoke detection resumed normal, the train operator shall be informed and the damper system shall be resettable by the train operator via the TMS.

10.5.6 Auxiliary Supply System

(a) Interface with each of the auxiliary converter to receive auxiliary converter operational monitoring signals and detected faults.

(b) The TMS shall monitor the status of the auxiliary converter and record any failure (refer to PS 17.2.4(e) and 17.2.7(b)).

(c) The AC and DC supply shall be monitored by the TMS particularly the battery charger output (refer to PS 17.4.1(g)).

10.5.7 Suspension System

(a) Passenger loading on a car basis shall be measured and fed back to the TMS in real time for the controls of train systems, such as, traction and braking systems.

(b) The TMS shall monitor the passenger loading feedback signal and shall record and display when any abnormal passenger loading is detected.

(c) The health condition of the air suspension shall be monitored by TMS (refer to PS 12.11.3) and in the event of deflated airsprings a fault of criticality level 1 shall be reported. In addition, the status of the air suspension isolation cock (refer to PS 12.11.4) shall be monitored by TMS.

10.5.8 Pneumatic System

(a) The Main Reservoir Pipe pressure and brake cylinder pressure of each car shall also be reported to the TMS and recorded by Event Recorder.

(b) The run time and duty cycle of each air compressor of the train shall be recorded for maintenance scheduling (refer to PS 10.6.2).

(c) The status of the Main Reservoir Pipe isolation cock and cab end Main Reservoir Pipe isolation cock (refer to PS 13.9.14) shall be monitored by TMS.

10.5.9 Couplers

(a) The TMS shall receive positive indication from the automatic couplers for proving that they are correctly and fully coupled (refer to PS 14.3.1(d)).

10.5.10 DVAS and PA

(a) Interface with the DVAS and PA to receive operational monitoring signals and detected faults. In addition, the transfer of received ATC information and pre-recorded message trigger shall also be sent via the interface.

(b) Reporting of activated passenger alarm emergency handles and talk back selection (refer to PS 18.4.15).

10.5.11 Interface with Automatic Train Control System

The TMS shall interface with the Automatic Train Control (ATC) system in the active cab through a RS232 serial port to exchange data with the ATC. Detailed requirements shall comply with RS/C6014/01, Appendix I Annex 3 and Appendix I Annex 4.

10.5.12 Not used.

10.5.13 Saloon Smoke Detection System

The TMS shall interface with the saloon smoke detection system (refer to PS 7.18) to provide the following functions:

(a) Monitoring and reporting of the saloon smoke alarm (refer to PS 7.18.2(b)) and faulty / dirty smoke detector (refer to PS 7.18.1(d)).

(b) Remote reset of the saloon smoke detection system (refer to PS 7.18.2(c)).

10.5.14 Trainborne video display

The TMS shall interface with the trainborne video display (refer to PS 18.3.4) to provide the following functions:

(a) Display control - switch on or switch off the trainborne video display and the corresponding display control shall also be displayed on the TMS display terminal (refer to PS 10.8.2).

(b) Automatic light control - switch on or switch off automatic light control of the trainborne video display and the corresponding automatic light control shall also be displayed on the TMS display terminal (refer to PS 10.8.2).

(c) Brightness control - increment or decrement display brightness of the trainborne video display in 5 steps / sec.

(d) Contrast control - increment or decrement display contrast of the trainborne video display in 5 steps / sec.

(e) Colour saturation control - increment or decrement display colour saturation of the trainborne video display in 5 steps / sec.

(f) Selection of which system image to be displayed (in-cab CCTV or insaloon CCTV).

(g) Other configuration setup required for the trainborne video display.

10.5.15 In-Cab CCTV

The TMS shall interface with the in-cab CCTV (refer to PS 18.3) to provide the following functions:

(a) Mode control - switch between automatic and manual control mode (refer to Appendix I Annex 4 clause 3.5.3) and the corresponding mode control shall also be displayed on the TMS display terminal.

(b) Channel control - switch between channel 1 and channel 2 (refer to Appendix I Annex 4 clause 3.5.3) and the corresponding channel control shall also be displayed on the TMS display terminal.

(c) Microwave reception status - healthiness status of the microwave reception shall be received and shall be indicated on the TMS display terminal.

10.5.16 In-Saloon CCTV

The TMS shall interface with the in-Saloon CCTV (refer to PS 18.7) to provide the following functions:

(a) Mode selection - to choose between single, split and quad screen modes for displaying the camera images from the saloons (refer to PS 18.7.7(c)(vi)).

(b) Source selection - to select the camera or groups of camera to be viewed (refer to PS 18.7.7(c)(vii)).

(c) TMS shall send the “cab-occupied” control command via a hardwire signal to active the trainborne video display. The In-Saloon CCTV System shall automatically start to display the real time images on the screen on receiving such "cab-occupied" control.

(d) TMS shall report fault on receiving fault information of video storage failure from In-Saloon CCTV (refer to PS 18.7.8(h)).

(e) TMS on detection of a certain set of faults (e.g. activation of PAEH, saloon smoke alarm, train divided etc) shall be able to send the required quad screens information to In-Saloon CCTV such that the corresponding quad screens image shall be automatically displayed on the trainborne video display after the train operator has acknowledged the reported fault on the TMS display unit. Selection of which detected fault to have such automatic image selection function for In-Saloon CCTV shall be easily configured using the TMS maintenance terminal.

10.5.17 The TMS shall interface with the EIDS Panels (refer to PS 18.5.8) to provide the following functions:

(a) TMS shall monitor and record the healthy / fault status of each EIDS Panel and shall report faults upon receiving the fault status from EIDS Panels.

(b) TMS shall monitor the video signal which is being sent to each EIDS Panel and shall report faults in the event that the video signal could not be successfully displayed on each EIDS Panel.

10.6 Maintenance Support

10.6.1 Train Fault Record

(a) General

Detailed requirements of fault data management shall refer to RS/C6014/01.

(b) The additional information of conditions/parameters when a fault is detected shall also be recorded for the purpose of assisting failure investigation, they shall include but not limit to the following types:

(i) Fault type,
(ii) Car type and number,
(iii) Date and time the fault is detected,

(iv) Station name,
(v) Distance travelled,
(vi) Train speed, and
(vii) Date and time the fault is cleared (if applicable).

(c) In addition to the above train fault, the TMS shall be able to detect and record the significant variation of the critical train performance, such as, brake rate, door operating time and saloon temperature. Proposed detection scheme and type of performance variation to be recorded shall be submitted for Approval.

(d) The memory shall be capable of storing a minimum of 1000 faults data per car.

(e) Algorithms shall be provided to prevent the repeated detection and recording of a permanent failure on the train which will unnecessarily occupy the memory space.

(f) Options shall be provided for maintenance staff to overwrite the previous fault recorded based on a first-in-first-out principle, to stop the recording when the memory is full, or to record the first and the last few occurrences of the same fault only.

(g) Data recorded shall be retained for a minimum of 4 weeks with no external power supply present.

10.7 Event Recorder

10.7.1 An events recording device, with a minimum capacity of 24 hours for recording a minimum of 300 digital channels and 36 analogue channels continuous recording at a sampling rate of 10 samples per second, shall be provided and located in the middle Train Units i.e. BC car of a train.

10.7.2 This device shall monitor and flag any operation of critical function, such as, emergency brake applied by the train operator via the activation of emergency stop push buttons or deadman's safety device, emergency door. In addition, any abnormal operation shall be recorded including wrong side saloon door operation. Detailed monitoring arrangement shall be agreed with the Engineer.

10.7.3 The Event Recorder shall incorporate playback function for signals recorded and shall be supplied with a diagnostic software for analysing the recorded data. The diagnostic software shall allow the selection of which data to be displayed / viewed. In addition, the diagnostic software shall allow export of the recorded data into Microsoft Excel for analysis /

reporting. Such diagnostic software shall run on Windows XP or higher operating system computer.

10.7.4 The memory module used for the storage of data shall be removable to allow playback on other common commercially available Windows XP or higher operating system computer.

10.7.5 The Event Recorder shall be housed in a robust, lockable, crash and fire-resistant box and shall be stowed such that illegal tampering with the complete unit shall not be possible.

10.7.6 The location of the memory module used for the storage of data shall be carefully selected in order to ensure that all recorded data is protected from loss due to vibration, shock and impact force in the event of train collision. The memory module shall be able to withstand a shock of 30g in the direction of travel without any loss of the data.

10.7.7 The data recorded on the memory module shall be well protected and facilities shall be provided to prevent:

(i) Unauthorized access and the accidental erasure of the recorded data.
(ii) Removal of the memory module from the train by unauthorized person.

10.7.8 A memory reader shall be provided to enable the extraction of the data from the memory module when it is removed from the train and transfer to a Windows XP or higher operating system computer.

10.7.9 All extracted data shall be compatible with the operating system of Windows XP or higher and database of Microsoft Access or other compatible database software.

10.7.10 The TMS shall have sufficient capacity to retain information for a period of 120 minutes on rolling memory (first in first out basis) at a higher data sampling rate. The proposed number of signals monitored and the signal sampling rate shall be submitted for Approval.

10.7.11 The recorded data within any period of time shall be retrieved from the recorded data without ambiguity.

10.7.12 Data recorded shall be non-volatile type in the event of loss of train power supply and retained for a minimum of 4 weeks with no external power supply present.

10.7.13 Additional requirements of the Event Recorder shall refer to RS/C6014/01.

10.8 Man-Machine Interface (MMI) Requirements

10.8.1 General

(a) The purpose of MMI is to achieve effective, efficient and safe train control through integration of the train operator into the train control system.

(b) The train operator shall be provided with a display unit inside the driving cab in order to interact with the TMS.

(c) The display unit shall integrate with an input device of touch screen display to receive commands from the train operator.

(d) The display unit shall provide a user friendly work environment to minimize factors which degrade the train operator's performance or increase error.

(e) MMI design shall be such that operator workload, accuracy, time constraint, mental processing and communication requirements do not exceed the operator capabilities.

(f) MMI design shall also minimize personnel and training requirements within the limits of time, cost, and performance trade-offs.

(g) The MMI design shall refer to RS/C6014/14 on operability requirements.

(h) In order to provide a consistent environment for the train operator, the MMI shall be designed and constructed based on the TMS MMI provided in Attachment 1 with customization to suit the characteristics of the trains (e.g. car number and car type) and addition for new control and display features. The architecture, look and feel, flow and control for all the screens shall follow exactly as this TMS MMI.

10.8.2 Display Terminal

The display terminal shall be provided with a touch screen serving as input device so that the TMS is able to:

(a) receive display control command (for example, brightness setting, selection of page/menu),

(b) receive TMS control command (for example, remote brake isolation) from the train operator and

(c) receive fault alarm acknowledgement.

10.8.3 Control Requirements

(a) As long as the DC circuit (refer to PS 17.4) is started up, the display control functions (refer to PS 10.8.2) of the train operator display terminal shall be remained operative irrespective of the state of the driving mode.

(b) Once a driving mode other than shutdown is being selected (refer to PS 9.5), the various control functions for systems as detailed in PS 10.5 shall become available. In the non-active cab end, control functions for systems shall be disabled while the maintenance screens shall become accessible.

(c) If it is attempted to select a driving mode at both cabs apart from the shut-down mode (refer to PS 9.5.2(a)), the various control functions for systems as detailed in PS 10.5 shall be disabled at both cab ends until one of the cab end has its driving mode returned to shutdown.

10.8.4 MMI Proposal

(a) The proposed MMI shall be submitted in the form of a detailed description document and a simulation program.

(b) The simulation program shall be run on an IBM® compatible PC operating under Windows XP or higher operating system.

(c) The simulation program shall be able to show the exact MMI as proposed for the actual train operator display terminal including both display and control functions except that control of the touch screen may be simulated by keyboard or mouse function.

Table 10-1 Not Used

Motor Signal	Brake Signal	Forward Signal	Reverse Signal	Status[1]	Result
0	0	0	0	fault	as previous state
0	0	0	1	normal	as previous state
0	0	1	0	normal	as previous state
0	0	1	1	fault	as previous state
0	1	0	0	normal	as previous state
0	1	0	1	normal	brake in Reverse
0	1	1	0	normal	brake in Forward
0	1	1	1	fault	as previous state
1	0	0	0	fault	as previous state
1	0	0	1	normal	motor in Reverse
1	0	1	0	normal	motor in Forward
1	0	1	1	fault	as previous state
1	1	0	0	fault	as previous state
1	1	0	1	fault	as previous state
1	1	1	0	fault	as previous state
1	1	1	1	fault	as previous state

Remarks:

1 : For any status of "fault" shall be reported to the train operator and logged into the event recorder.

Table 10-2 Logic Table for the Control Commands

Motoring demand	Brake demand	Equivalent ATO demand	Status	Result
0	0	coasting	normal	coasting
0	1	braking	normal	brake in forward
1	0	traction	normal	motor in forward
1	1	braking	normal	brake in forward

Legends:

"1" means the corresponding command is requested.
"0" means the corresponding command is forbidden.

Table 10-3 Logic Table for the ATO Control Commands

Attachment 1
TMS MMI

CONTENTS

No.	TITLE	PAGE
1	INTRODUCTION	4
2	OPERATION	4
2.1	General Operation Flow	4
2.2	Operation Flow On Each Mode	7
2.2.1	Occupied Cab	7
2.2.2	Unoccupied Cab	12
3.	SCREEN FORMAT	17
3.1	General	17
3.2	General Layout	18
3.2.1	Title Bar	18
3.2.2	Train Configuration	19
3.2.3	Train Orientation	20
3.2.4	Brightness Control Window	23
3.3	Screen Display	24
3.3.1	Warning-up Screen	24
3.3.2	Initialize Completed Window	24
3.3.3	Now Operational Screen	25
3.3.4	Doors information Screen	26-1
3.3.5	Brakes/Air sup information Screen	27
3.3.6	Power information Screen	30
3.3.7	Auxiliary information Screen	35
3.3.8	Air Conditioner information Screen	36
3.3.9	PIS/CCTV Screen M ~~Communication Screen~~	41-1

No.	TITLE	PAGE
3.3.10	PIS information Screen	41-3E
3.3.11	Journey setting Screen	45
3.3.12	New Journey received Screen	52-1
3.3.13	CCTV Function	52-8
3.3.14	Dtrain direction Screen M Detrainment select Screen	52-29
3.3.15	Fault History Screen	53
3.3.16	Check information Screen	54
3.3.17	Current Faults Screen	55
3.3.18	Fault alert Screen	55
3.3.19	Hints Screen	56
3.3.20	Maintenance Menu Screen	66
3.3.21	Train Performance Screen	68
3.3.22	Equipment Performance Screen	69
3.3.23	TMS self check Screen	73
3.3.24	Sub-system check Screen	85
3.3.25	Transmission check Screen	91
3.3.26	Interface check Screen	96
3.3.27	Display check Screen	100
3.3.28	Trace data Screen	102
3.3.29	TMS fault mode Screen	105
3.3.30	On-board test menu Screen	108
3.3.31	On-board test Screen	111
3.3.32	Test result Screen	126
3.3.33	TMS shutdown Screen	127

1. Introduction

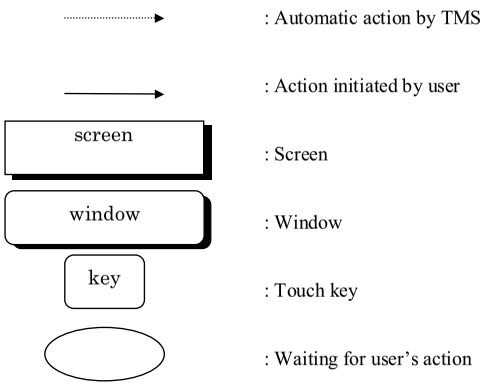
This document specifies the format and contents of screen pictures displayed on the Display unit of the Train Management System (TMS).
In order to provide a consistent environment for the train operator, TMS MMI designing(architecture, look and feel, flow and control) follows the MMI of TMS display in C651 TKE train. C

2. Operation

2.1 General operation flow

The Display unit is installed in to each cab.
The general operation flow of the Display unit in occupied cab (HCR="1") is shown in Fig. 2.1.1.
The general operation flow of the Display unit in unoccupied cab (HCR ="0") is shown in Fig.2.1.2.

(note)
Explanation of the marks in the figures of this document



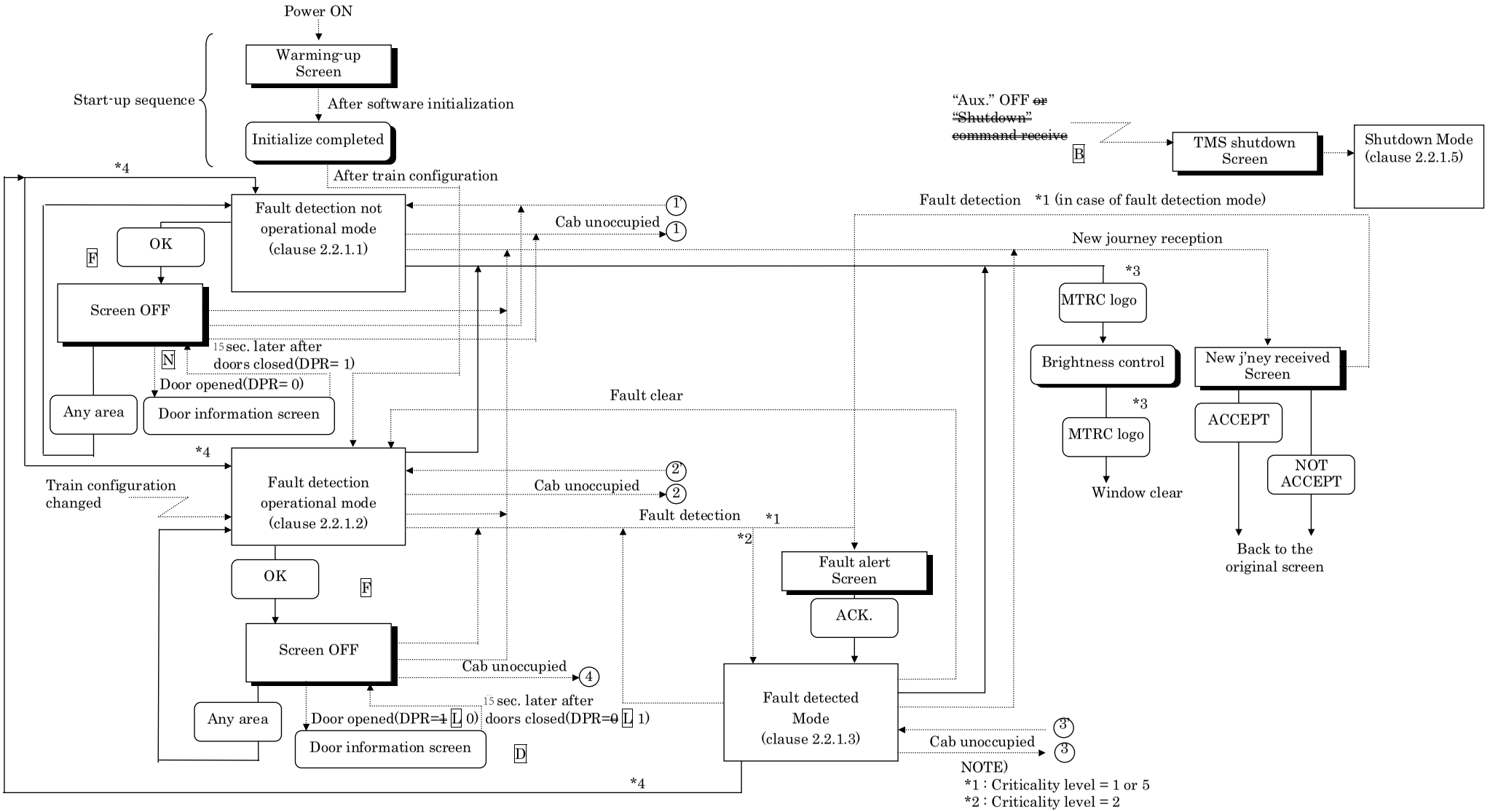
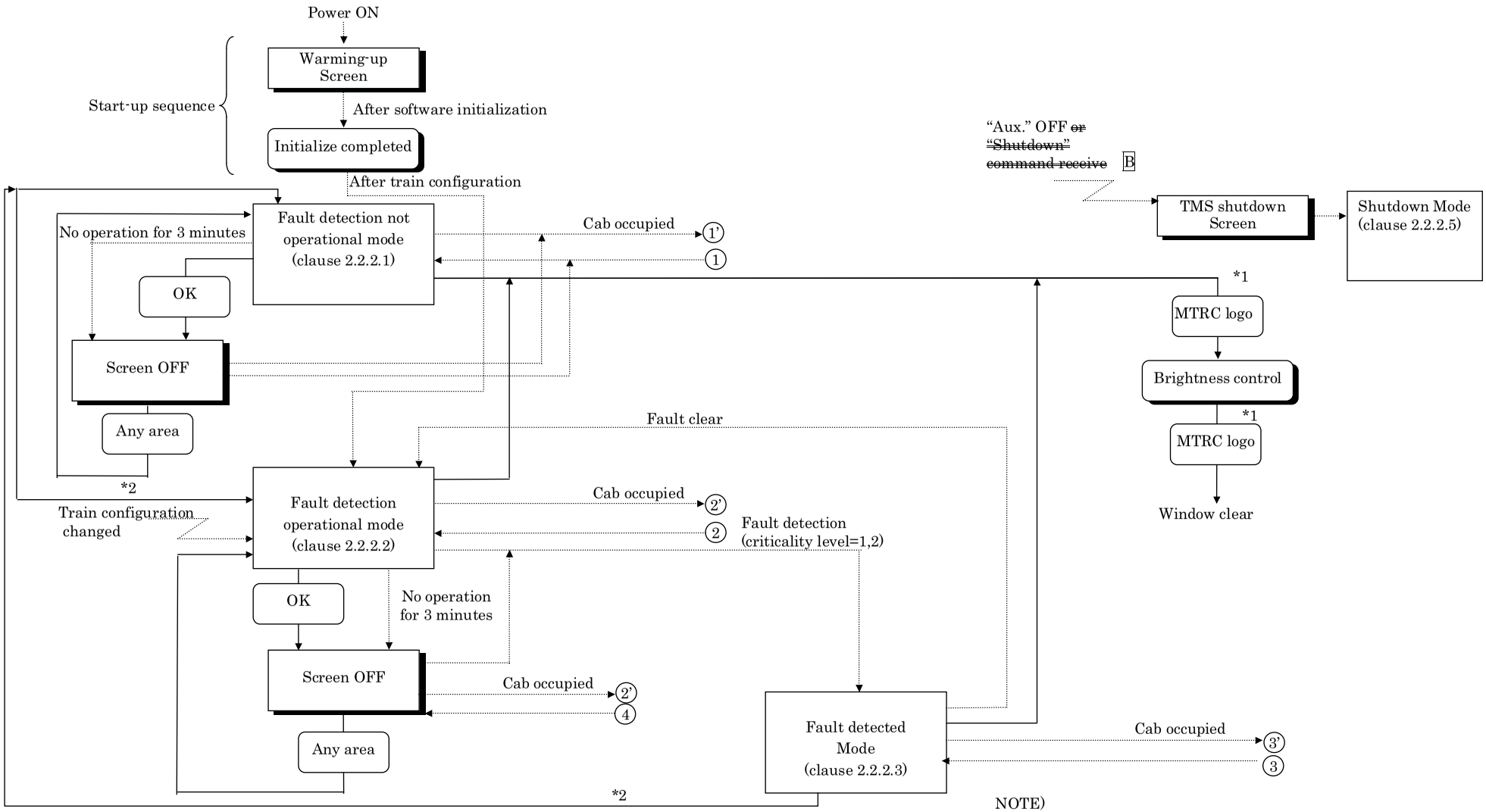


Fig. 2.1.1 General operation flow of the Display unit in occupied cab

NOTE)
*1 : Criticality level = 1 or 5
*2 : Criticality level = 2
*3 : When TMS is loading from/to MT, the symbol of loading is displayed instead of the MTRC logo
*4: When TMS fault mode is changed from unoccupied.

MITSUBISHI ELECTRIC CORPORATION., JAPAN								
CHANGE								DOCUMENT NO.
B	22. May. 09	F	27. Oct. 09	N	23. Mar. 10			JHAV438 5
D	28. Aug. 09	L	05. Jan. 10					



NOTE)
*1 : When TMS is loading from/to MT, the symbol of loading is displayed instead of the MTRC logo
*2: When TMS fault mode is changed from "TMS fault mode screen".

Fig. 2.1.2 General operation flow of the Display unit in unoccupied cab

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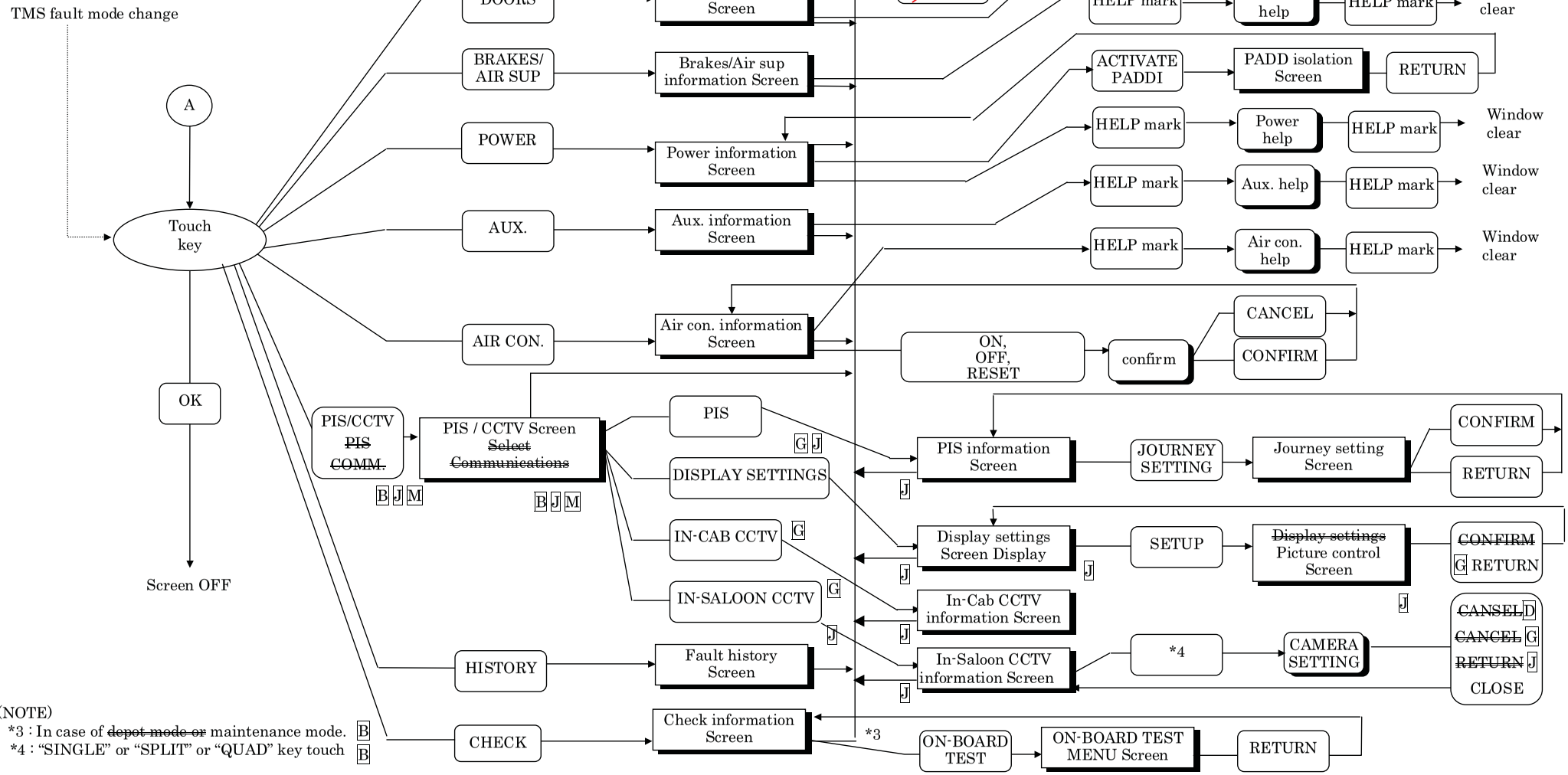
			CHANGE	DOCUMENT NO.
			B 22. May. 09	JHAV438

2.2 Operation Flow On Each Mode

2.2.1 Occupied cab

2.2.1.1 Screens of Fault Detection Not Operational Mode

Flow of instruction and operation is shown as follows;



(NOTE)
*3 : In case of ~~depot mode or~~ maintenance mode. B
*4 : "SINGLE" or "SPLIT" or "QUAD" key touch B

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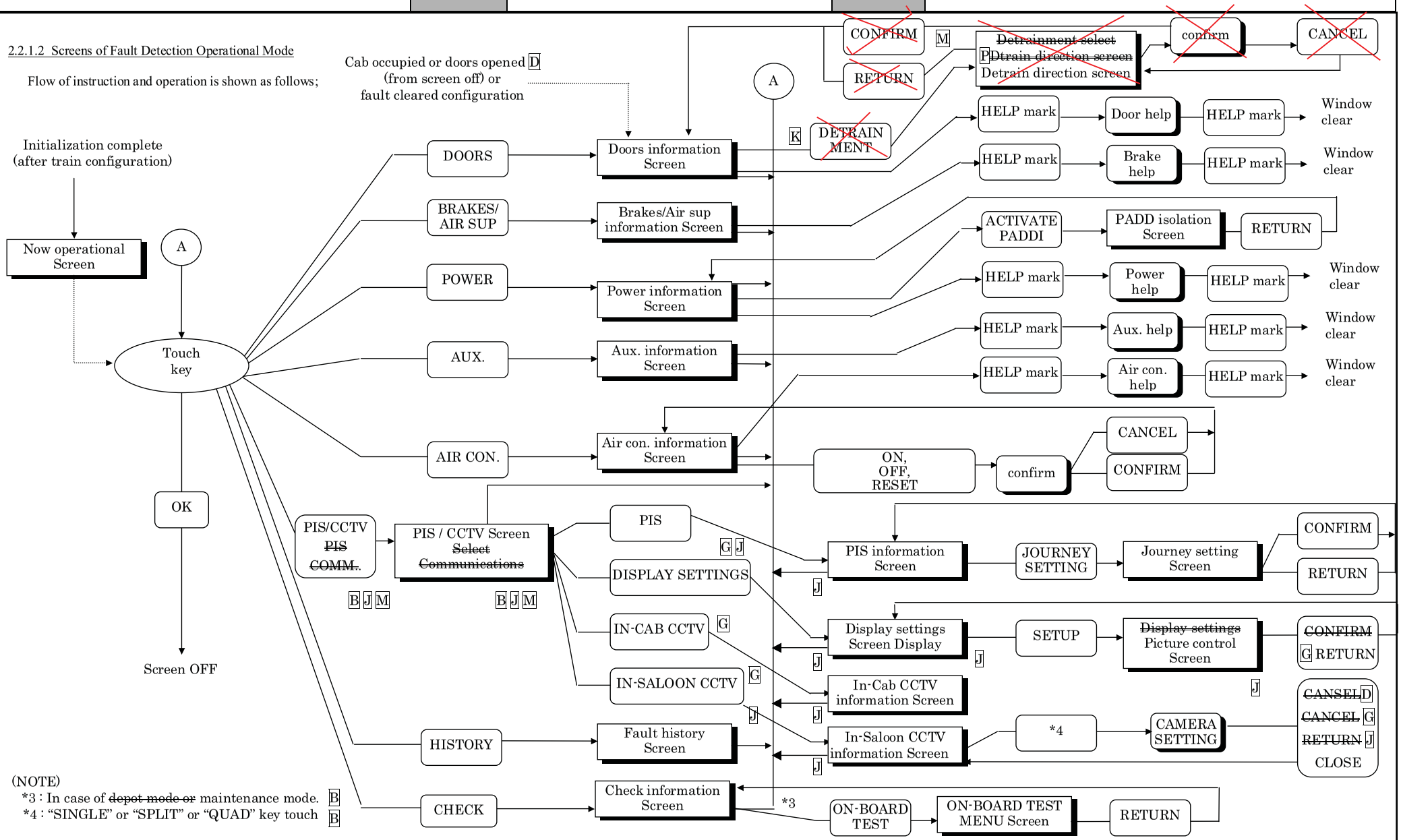
CHANGE								
B	22. May. 09	G	05. Nov. 09	K	17. Dec. 09	P	28. Apr. 10	JHAV438 7
D	28. Aug. 09	J	04. Dec. 09	M	28. Jan. 10			

2.2.1.2 Screens of Fault Detection Operational Mode

Flow of instruction and operation is shown as follows;



(NOTE)
*3 : In case of ~~depot mode or~~ maintenance mode. B
*4 : "SINGLE" or "SPLIT" or "QUAD" key touch B

MITSUBISHI ELECTRIC CORPORATION., JAPAN								DOCUMENT NO.
CHANGE								
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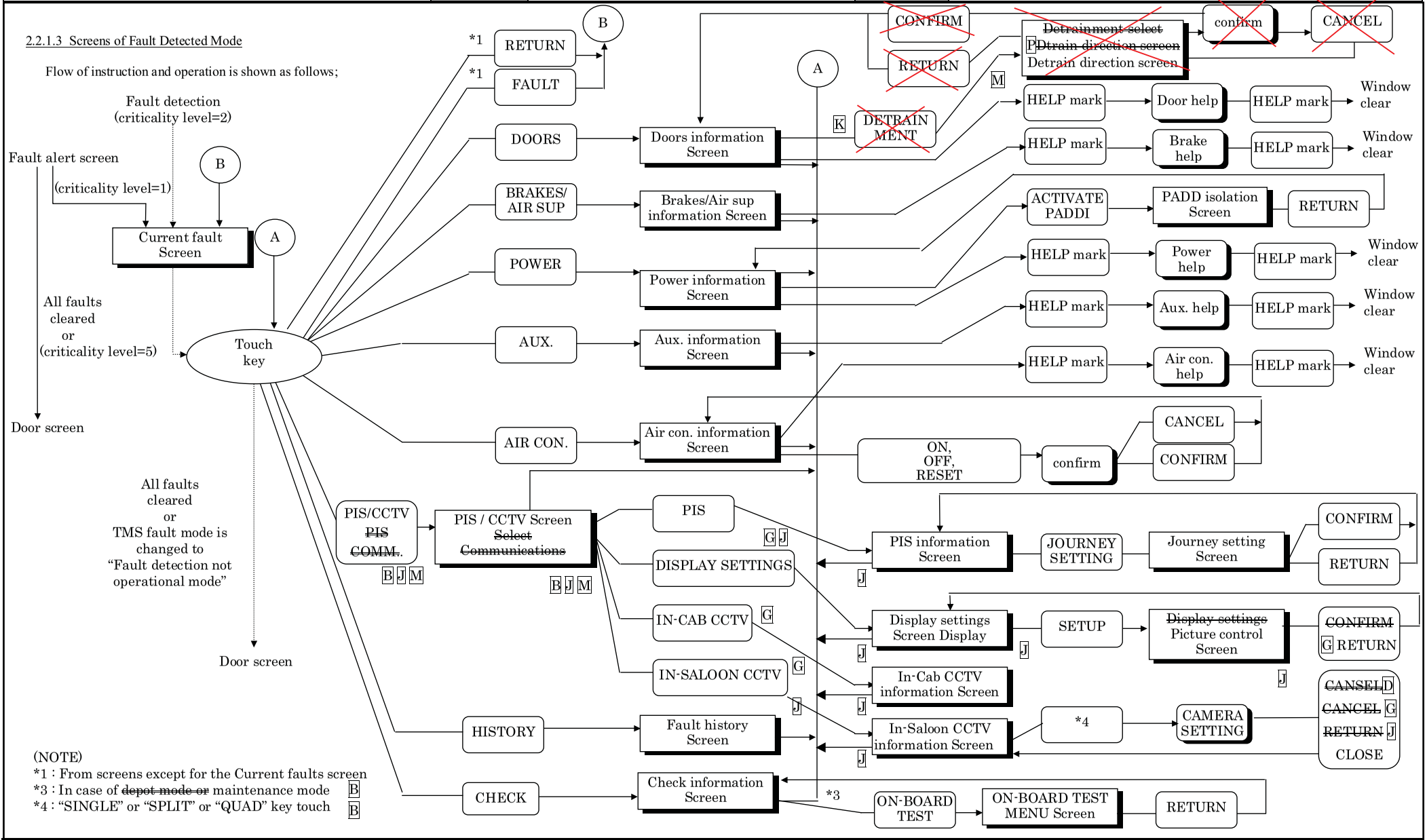
D	28. Aug. 09	J	04. Dec. 09	M	28. Jan. 10			

2.2.1.3 Screens of Fault Detected Mode

Flow of instruction and operation is shown as follows;



(NOTE)
*1 : From screens except for the Current faults screen
*3 : In case of ~~depot mode or~~ maintenance mode B
*4 : "SINGLE" or "SPLIT" or "QUAD" key touch B

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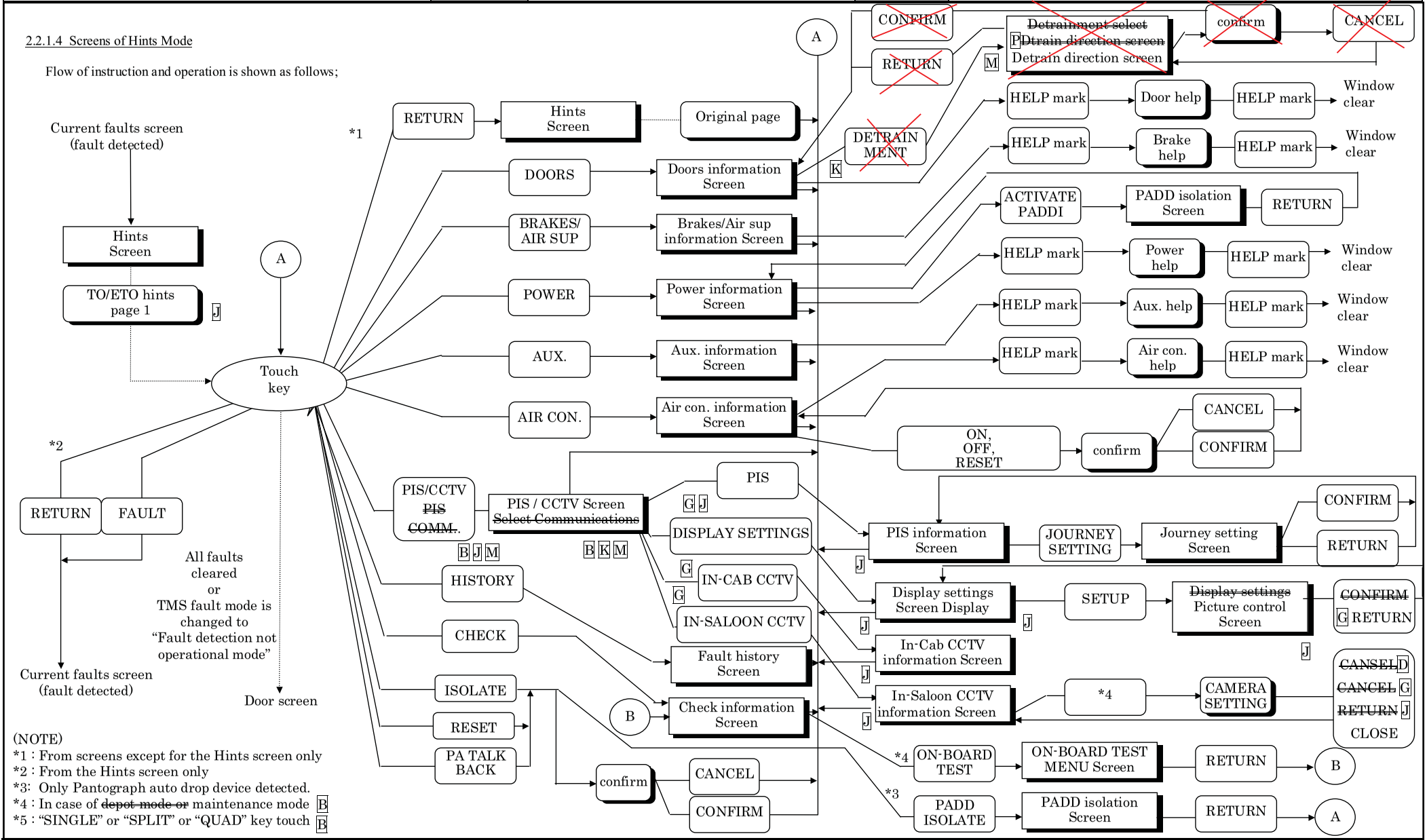
CHANGE								DOCUMENT NO.
B	22. May. 09	G	05. Nov. 09	K	17. Dec. 09	P	28. Apr. 10	JHAV438
D	28. Aug. 09	J	04. Dec. 09	M	28. Jan. 10			

2.2.1.4 Screens of Hints Mode

Flow of instruction and operation is shown as follows;

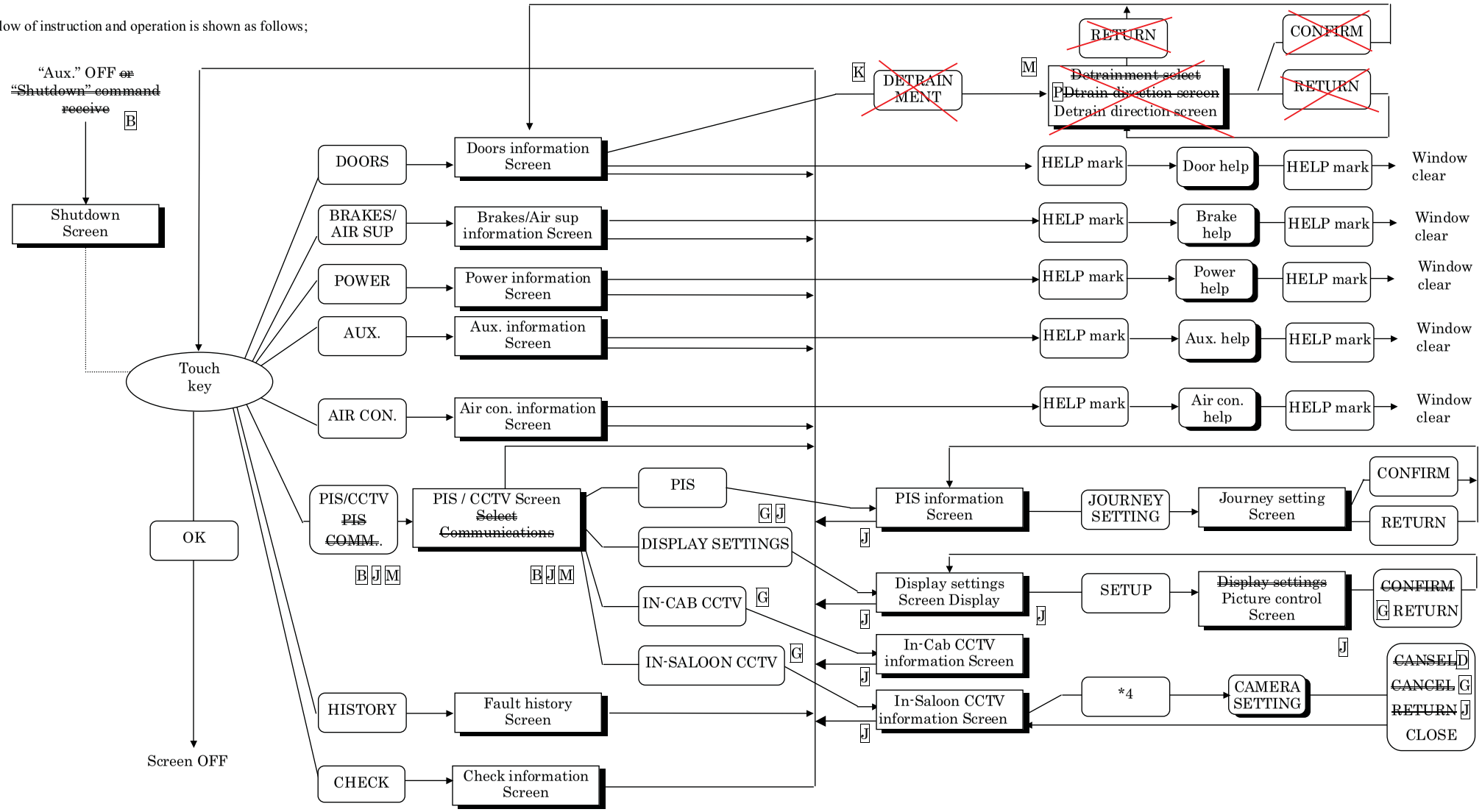


(NOTE)
*1 : From screens except for the Hints screen only
*2 : From the Hints screen only
*3: Only Pantograph auto drop device detected.
*4 : In case of ~~depot mode or~~ maintenance mode B
*5 : "SINGLE" or "SPLIT" or "QUAD" key touch B

2.2.1.5 Screens of Shutdown Mode

(NOTE)
~~*1 : In case of depot mode or maintenance mode~~ B
*4 : "SINGLE" or "SPLIT" or "QUAD" key touch B

Flow of instruction and operation is shown as follows;

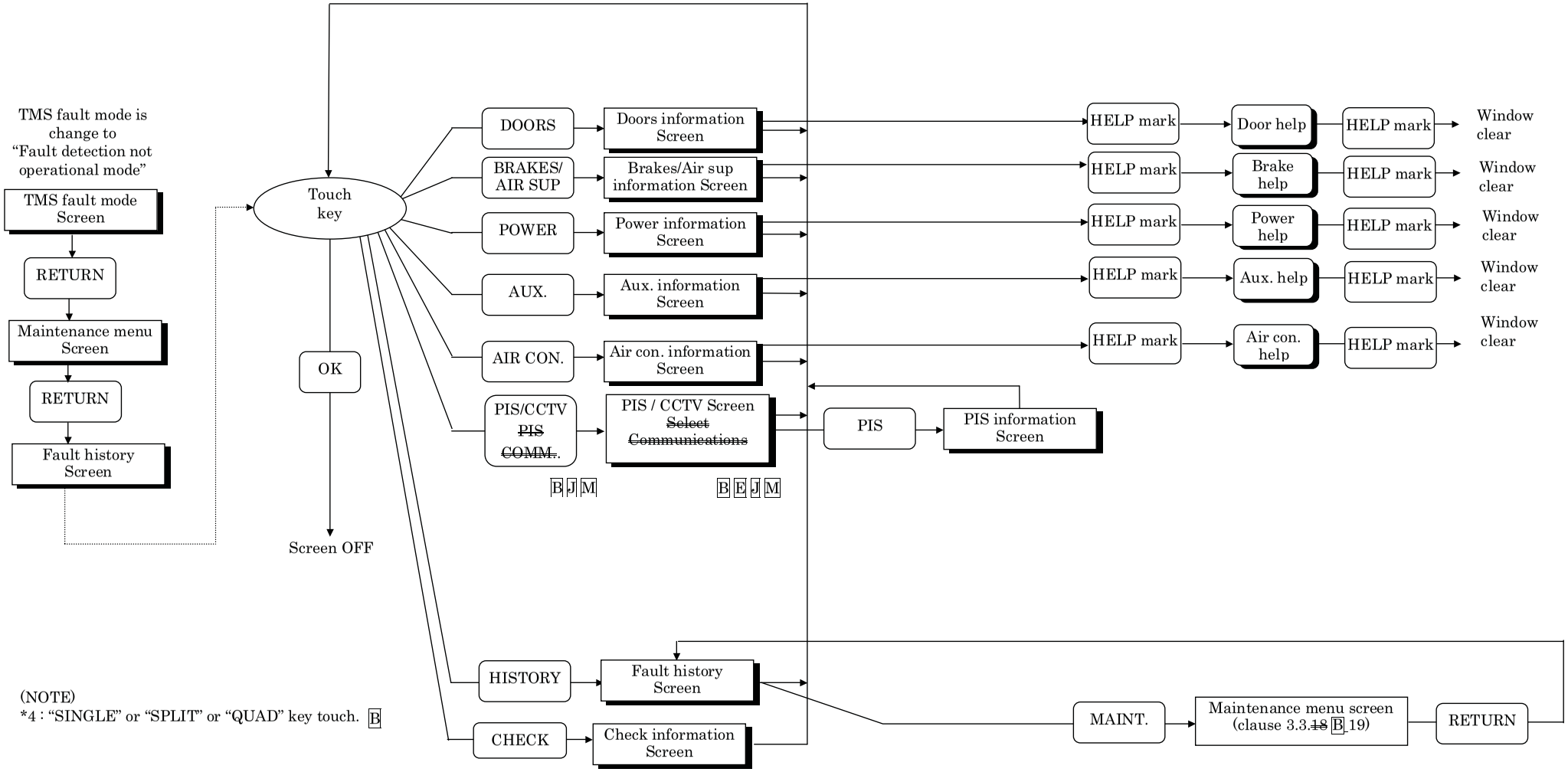


			MITSUBISHI ELECTRIC CORPORATION., JAPAN								
			CHANGE								DOCUMENT NO.
			B	22. May. 09	G	05. Nov. 09	K	17. Dec. 09	P	28. Apr. 10	JHAV438
			D	28. Aug. 09	J	04. Dec. 09	M	28. Jan. 10			11

2.2.2 Unoccupied cab

2.2.2.1 Screens of Fault Detection Not Operational Mode

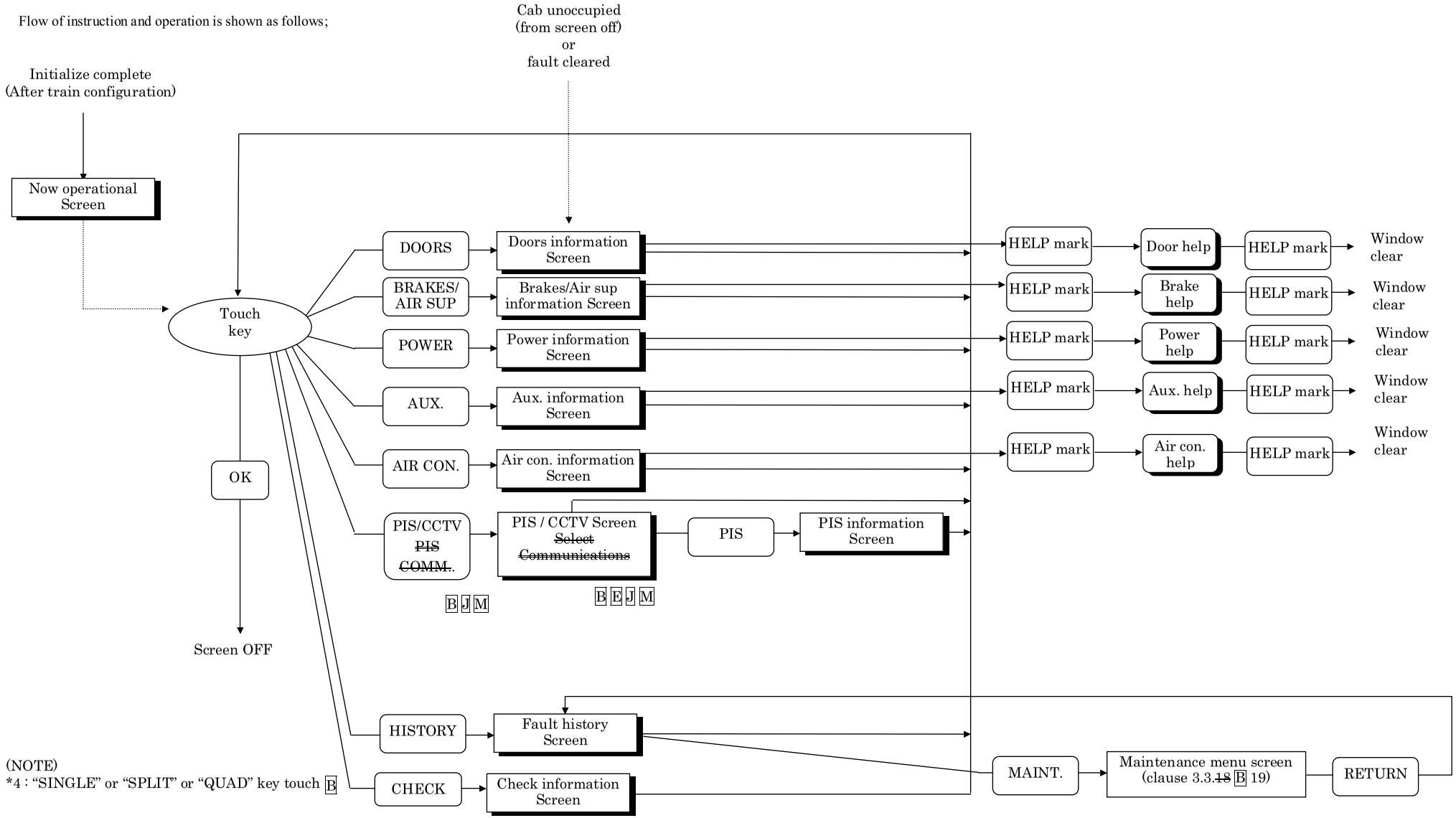
Flow of instruction and operation is shown as follows;



(NOTE)
*4 : "SINGLE" or "SPLIT" or "QUAD" key touch. B

2.2.2.2 Screens of Fault Detection Operational Mode

Flow of instruction and operation is shown as follows;



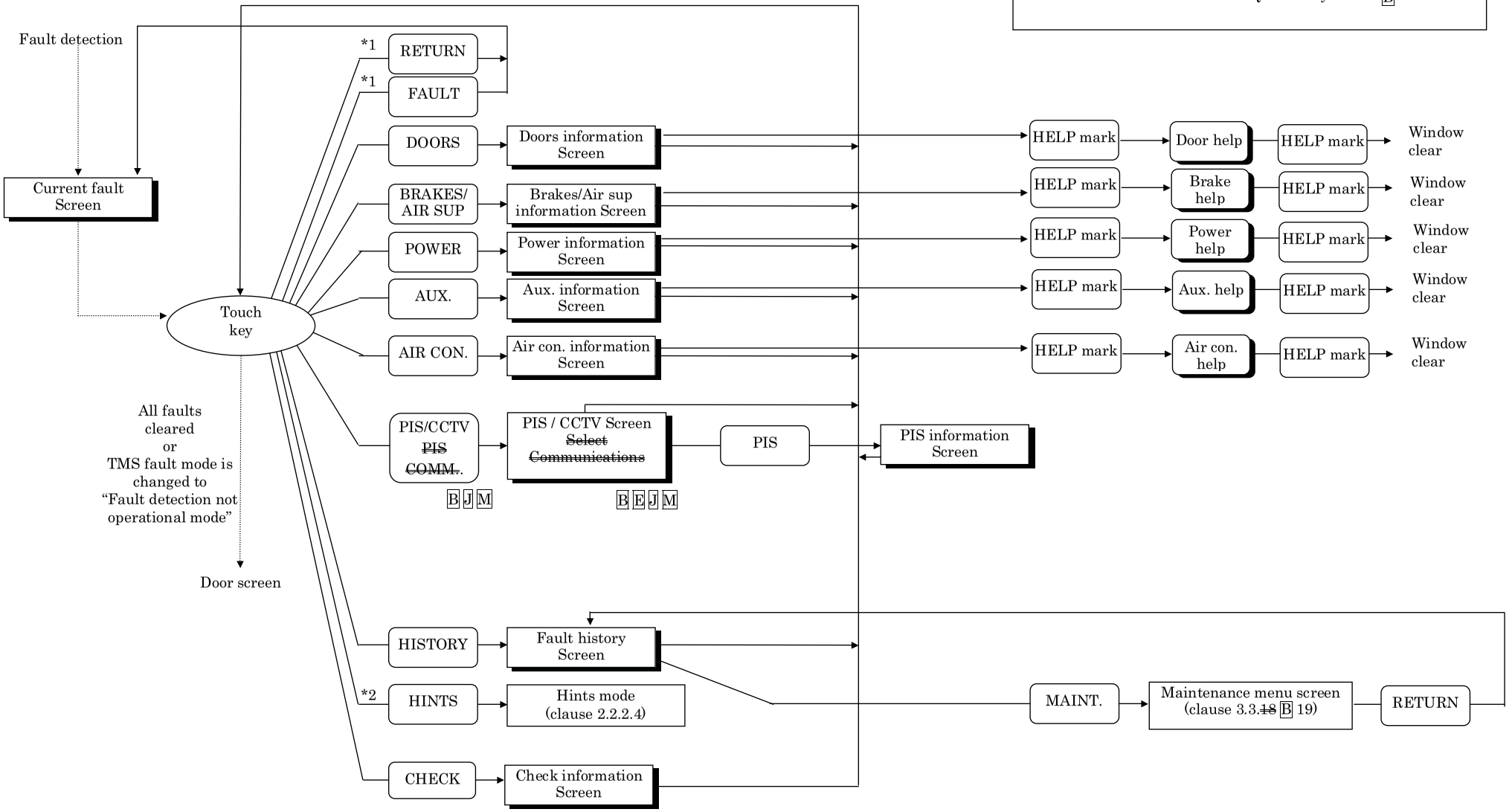
(NOTE)
*4 : "SINGLE" or "SPLIT" or "QUAD" key touch B

			MITSUBISHI ELECTRIC CORPORATION., JAPAN									
			CHANGE								DOCUMENT NO.	
			B	22. May. 09	E	24. Sep. 09	M	28. Jan. 10			JHAV438	13
			D	28. Aug. 09	J	04. Dec. 09						

2.2.2.3 Screens of Fault Detected Mode

Flow of instruction and operation is shown as follows;

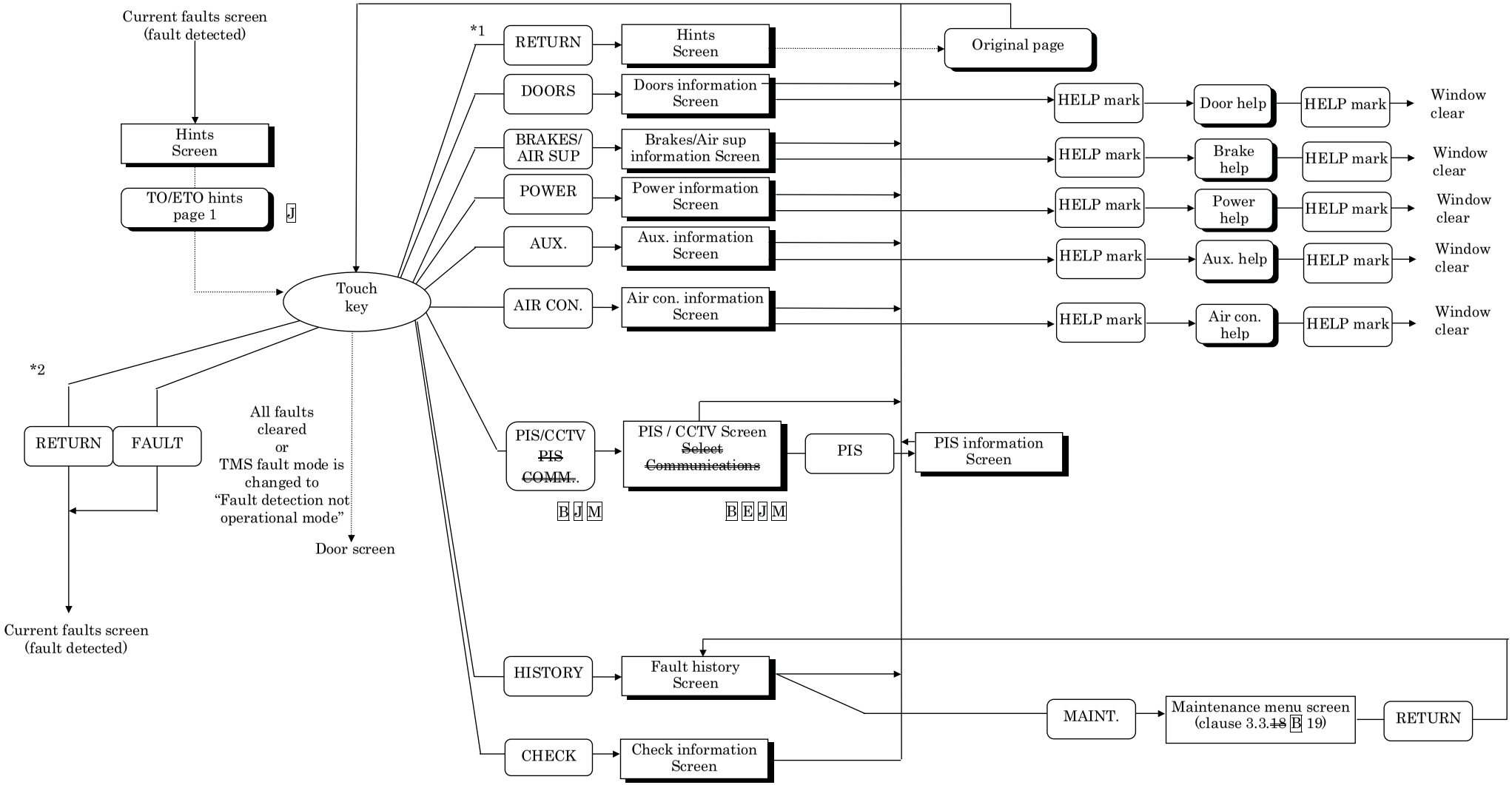
(NOTE)
*1 : From screens except for the Current faults screen.
*2 : Only from the Current faults screen.
*4 : "SINGLE" or "SPLIT" or "QUAD" key touch. B



2.2.2.4 Screens of Hints Mode

Flow of instruction and operation is shown as follows;

(NOTE)
*1 : From screens except for the Hints screen.
*2 : Only from the Hints screen.
*4 : "SINGLE" or "SPLIT" or "QUAD" key touch. B



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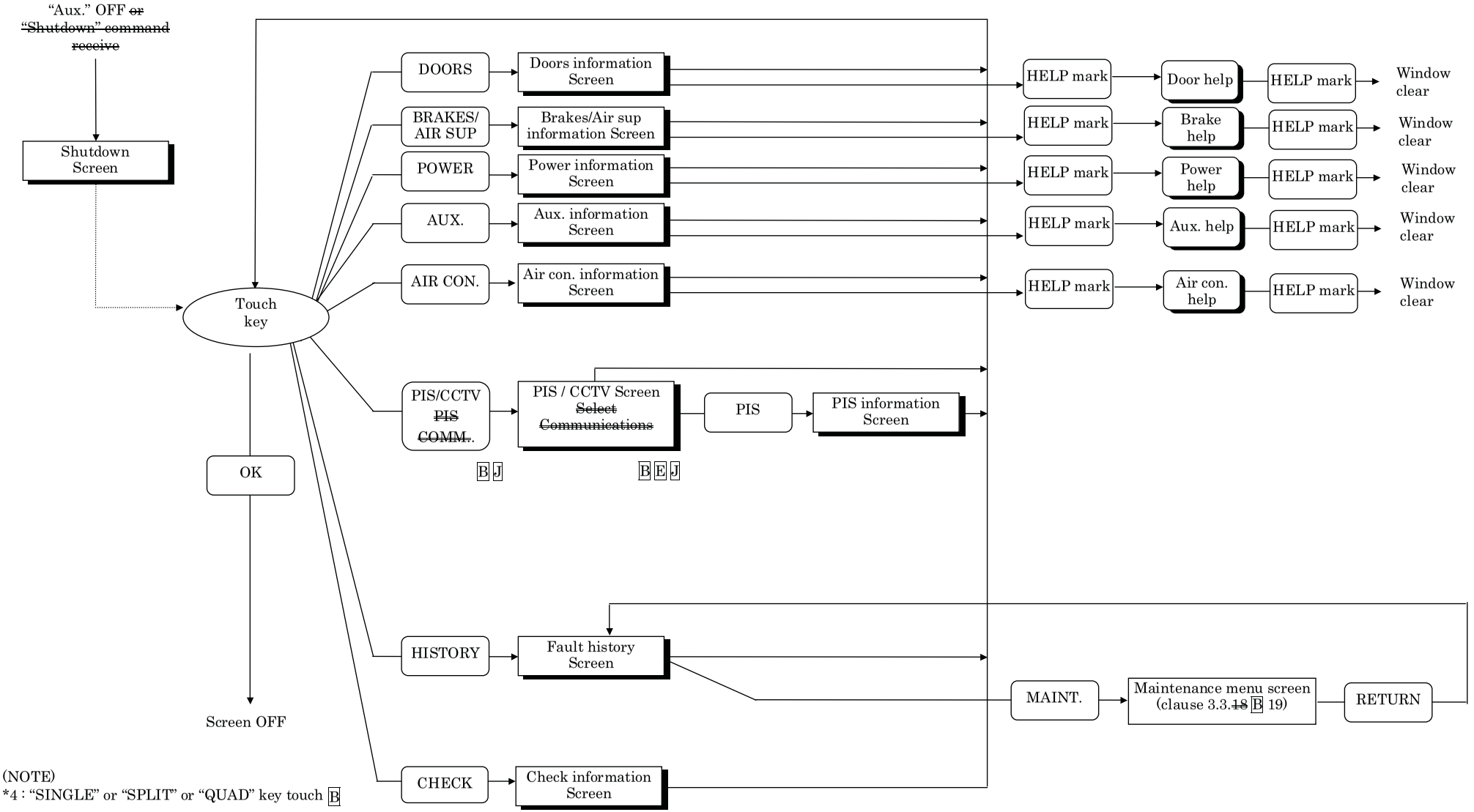
CHANGE								DOCUMENT NO.	
B	22. May. 09	E	24. Sep. 09	M	28. Jan. 10			JHAV438	15
D	28. Aug. 09	J	04. Dec. 09						

2.2.2.5 Screens of Shutdown Mode

Flow of instruction and operation is shown as follows;

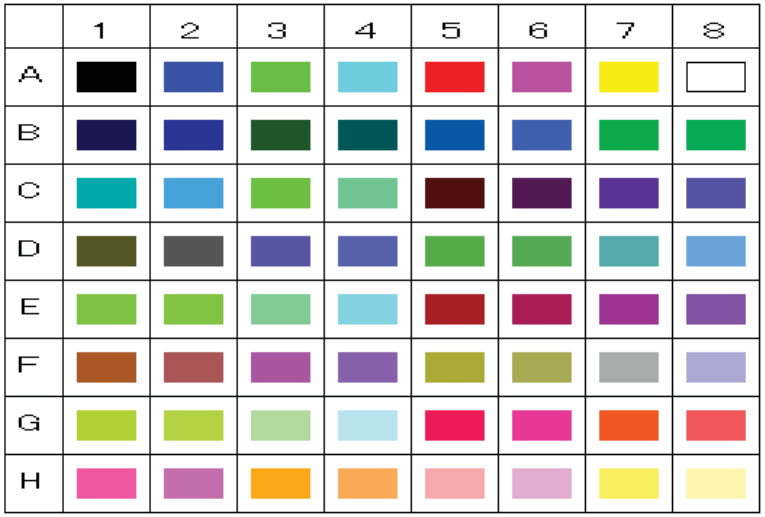


(NOTE)
*4 : "SINGLE" or "SPLIT" or "QUAD" key touch B

3. Screen Format

3.1 General

(1) Color code table



Color RGB percentage list

Color code	R	G	B
A1	0	0	0
A2	0	0	100
A3	0	100	0
A4	0	100	100
A5	100	0	0
A6	100	0	100
A7	100	100	0
A8	100	100	100
B1	0	0	8
B2	0	0	33
B3	0	33	0
B4	0	33	33
B5	0	33	8
B6	0	33	100
B7	0	8	0
B8	0	8	33
C1	0	8	8
C2	0	8	100
C3	0	100	33
C4	0	100	8
C5	33	0	0
C6	33	0	33
C7	33	0	8
C8	33	0	100
D1	33	33	0
D2	33	33	33
D3	33	33	8
D4	33	33	100
D5	33	8	0
D6	33	8	33
D7	33	8	8
D8	33	8	100

Color code	R	G	B
E1	33	100	0
E2	33	100	33
E3	33	100	8
E4	33	100	100
E5	8	0	0
E6	8	0	33
E7	8	0	8
E8	8	0	100
F1	8	33	0
F2	8	33	33
F3	8	33	8
F4	8	33	100
F5	8	8	0
F6	8	8	33
F7	8	8	8
F8	8	8	100
G1	8	100	0
G2	8	100	33
G3	8	100	8
G4	8	100	100
G5	100	0	33
G6	100	0	8
G7	100	33	0
G8	100	33	33
H1	100	33	8
H2	100	33	100
H3	100	8	0
H4	100	8	33
H5	100	8	8
H6	100	8	100
H7	100	100	33
H8	100	100	8

3.2 General Layout

The general layout is shown as follows;

B J L M

B989

When TMS is loading from/to MT, the layout is shown as follows;

B J L M

B988

3.2.1 Title bar

In all screen excluding warming-up screen and display check screen, the title bar have the following information available to the train operator;

-MTRC logo(touch key) :To make the brightness control window on
-Screen name
-Date :Day. Month. Year(2 digit each)
-Time :Hour: Minute: Second(2 digit each)
-Train number :3 digit number
-Destination :Standard station symbol
-Current station :Standard station symbol
-FAULT(Touch key) :To go to Current faults screen.
~~-DEPOT~~ B ~~:Depot mode~~ B
-HELP (touch key) :To make the help window on

In all screen excluding warming-up screen and display check screen, the title bar have the following information available to the train operator;

-Loading symbol(touch key) :To make the brightness control window on
-Screen name
-Date :Day. Month. Year(2 digit each)
-Time :Hour: Minute: Second(2 digit each)
-Train number :3 digit number
-Destination :Standard station symbol
-Current station :Standard station symbol
-FAULT(Touch key) :To go to Current faults screen.
~~-DEPOT~~ B ~~:Depot mode~~ B
-HELP (touch key) :To make the help window on

out in each mode screens

The touch key area locates the bottom in the screen mainly.
The touch key layout is changeable corresponding to each mode.
The touch key layout in each mode are shown as follows;

(1)Fault detection not operational
-Start-up complete screen

B J

(2)Fault detection operational

B J M

(3)Fault detected

B J M

3.2.2 Train configuration

This display supports the following train configurations

(1) .A - .C - B. + .B1 - C1. + .B - C. - A.
(2) .A - .C - B. + .B1 - C1.
(3) .B1 - C1. + .B - C. - A.
(4) .A - .C - B. + .B - C. - A.
(5).A - .C - B.
(6) .B - C. - A.

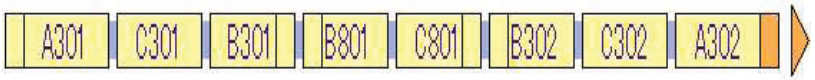
A: Trailer car (with driving cab)
B, B1, C, C1: Motor car
+indicates position of auto coupler.
- indicates position of semi-permanent coupler.
. indicates position of no.1 end.

[note] When less than 8 car, The unit which doesn't exist should indicate Unknown.

3.2.3 Train orientation

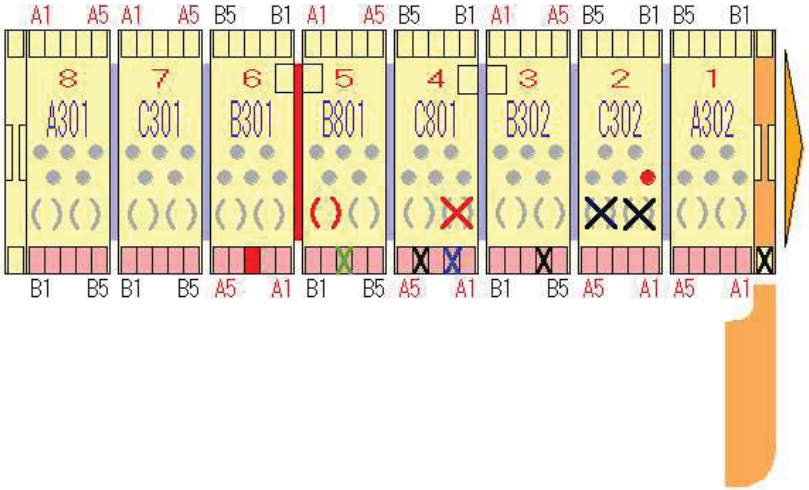
Some screens include the graphical train layout.
The train layout displayed in the own cab is always oriented to right side.
Example of train layout are shown as follows;

(1) “A302” is own cab and leading cab



a. General train layout

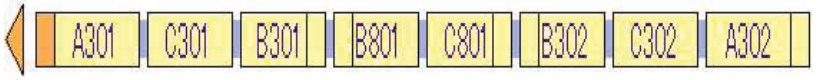
b. Doors, Brakes information



B E J K L

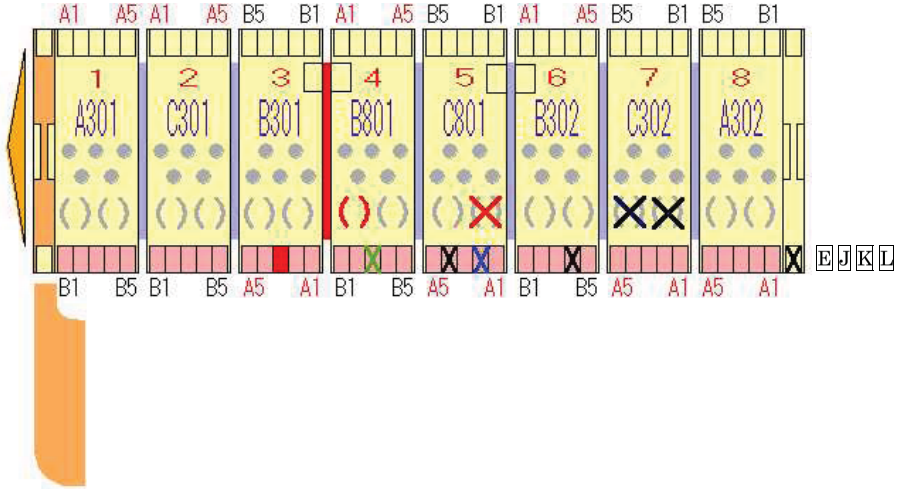
B7500

(2) “A302” is own cab and rear cab



a. General train layout

b. Doors, Brakes information

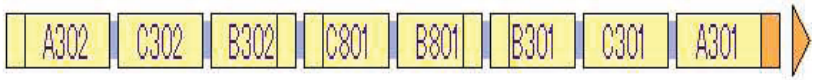


E J K L

B7501

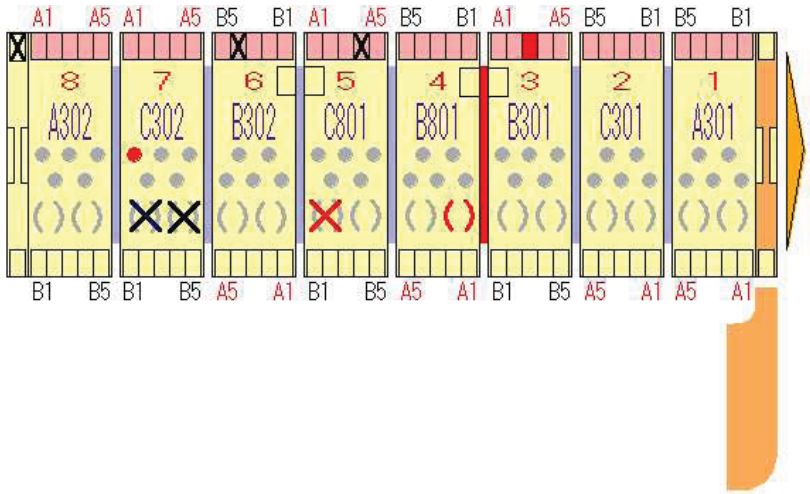
[note]
-The triangle beside the A-car means train direction determined by the forward signal in the train set.
-The colored cab means the occupied cab(Cab/Hostler cab status=1).

(3)"A301" is own cab and leading cab



a. General train layout

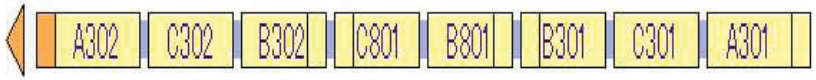
b. Doors, Brakes information



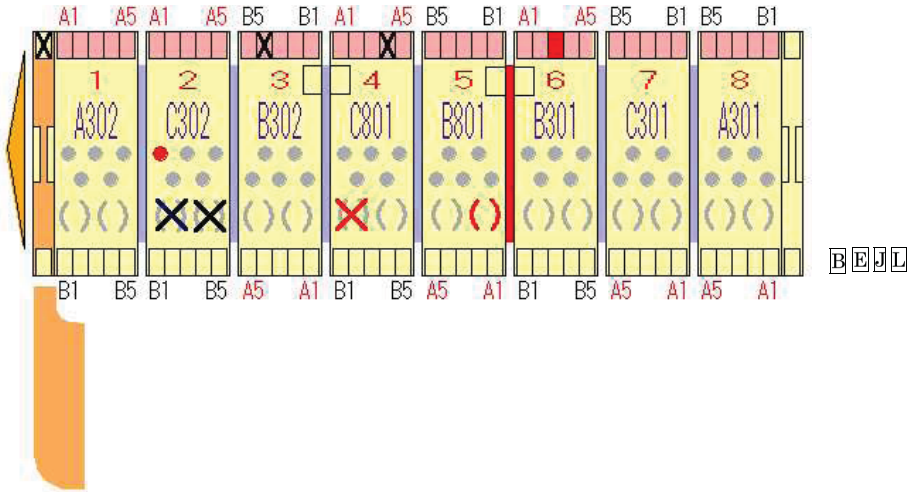
B7503

(4)"A301" is own cab and rear cab

a. General train layout



b. Doors, Brakes information



B7505

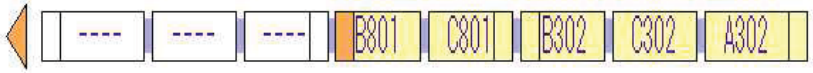
[note]

-The triangle beside the A-car means train direction determined by the forward signal in the train set.

-The colored cab means the occupied cab(Cab/Hostler cab status=1).

(5)"A302" is own cab and rear cab. "B801" hostler master switch is forward.

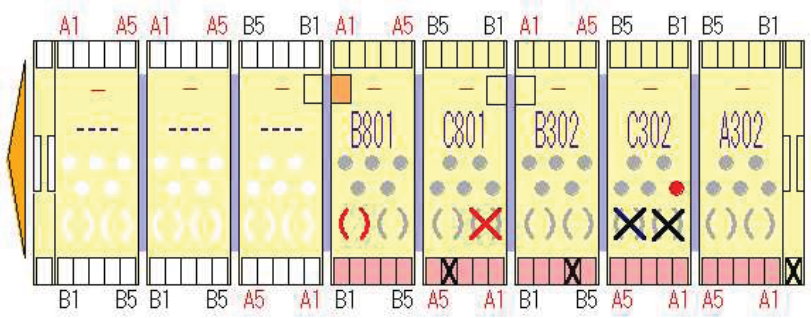
a. General train layout



D

B7536

b. Doors, Brakes information

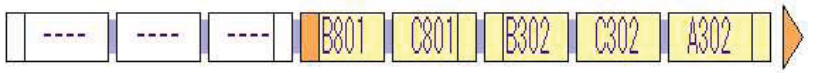


B E L

B7506

(6) "A302" is own cab and leading cab. "B801" hostler master switch is reverse.

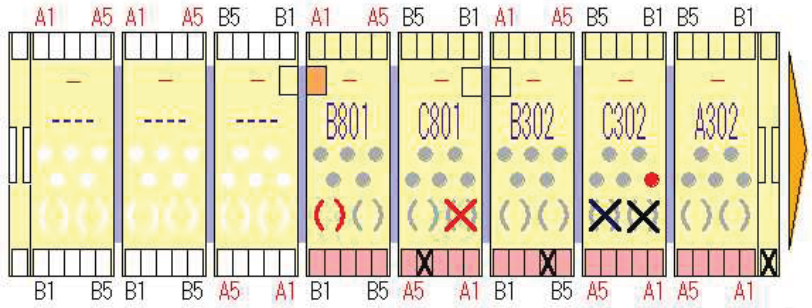
a. General train layout



D

B7537

b. Doors, Brakes information

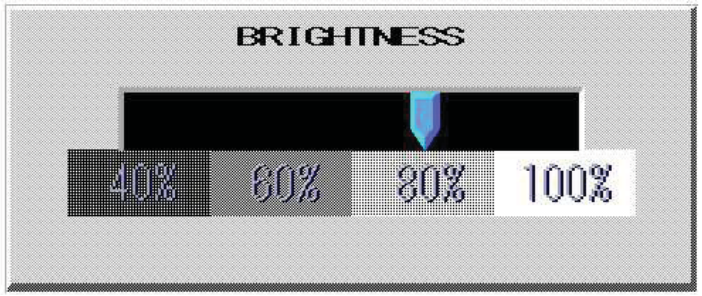


B E L M

B7507

3.2.4 Brightness control window

When the “MTRC logo key” or “Loading mark key” in the title bar is pressed, the following window is displayed on the center of screen.
The brightness control window allows the train operator to manually adjust the brightness of the screen in 4-level brightness control.



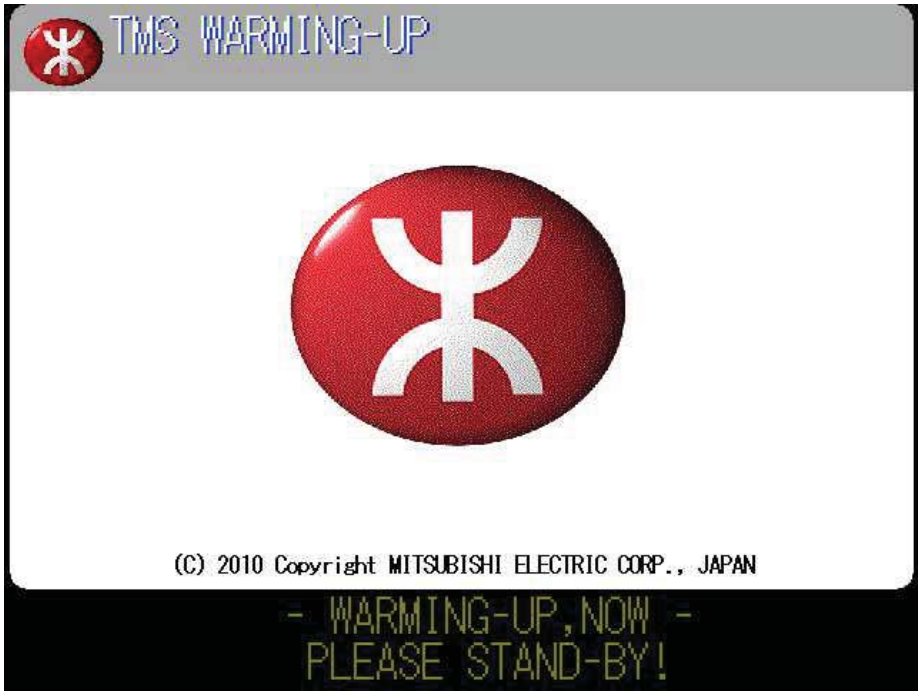
B J

B353

3.3 Screen Display

3.3.1 Warming-up screen

This is the first screen when the TMS is powered.
Flashing text indicates that the TMS is establishing itself.
The screen goes to the next screen when the software initialization is complete.



B

B4

3.3.2 Initialize completed window

This window indicates to the train operator that software initialization is complete.
The screen goes to the next screen when automatic configuration is complete.

B F

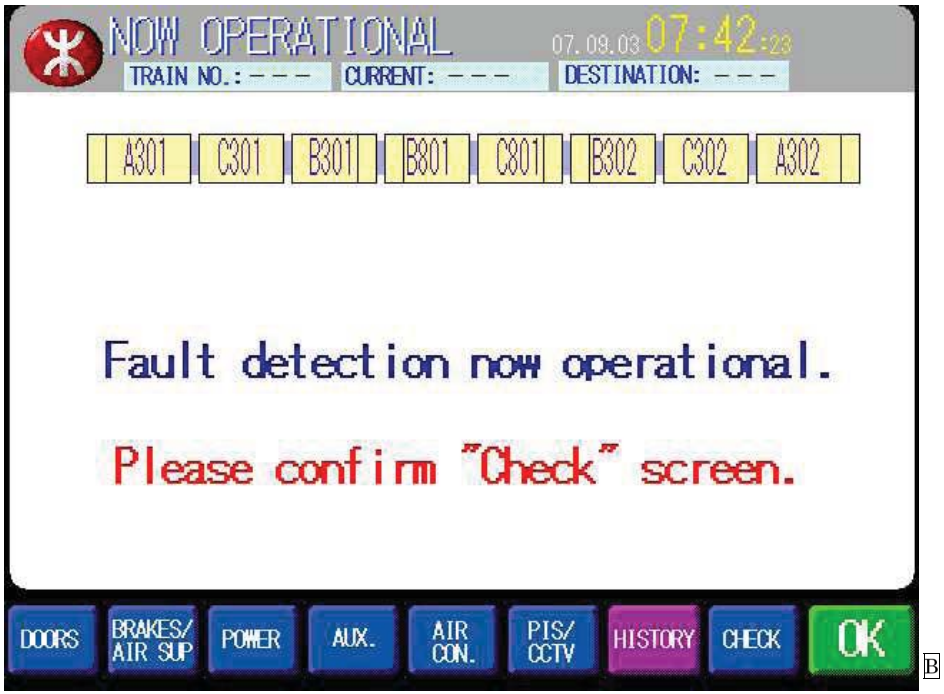
B5

3.3.3 Now operational screen

This screen indicates that TMS enter into the fault detection operational mode and necessary to confirm the “Check information screen”.

.

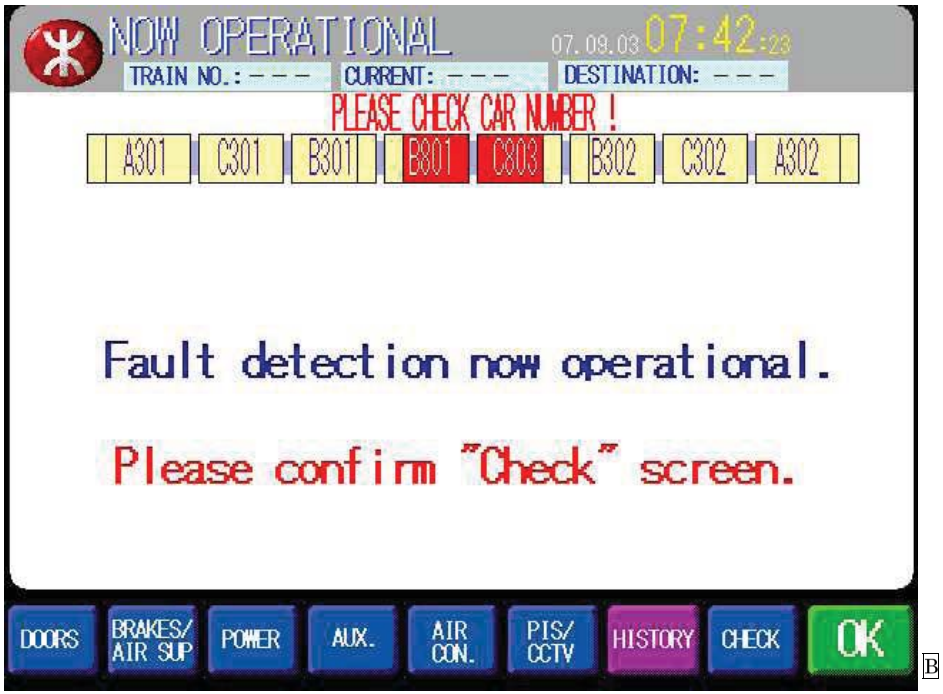
If TMS detects any fault, it reports and all faults detected.



B J L M

B121

If the TMS detects a car number setting error, the following message is displayed.

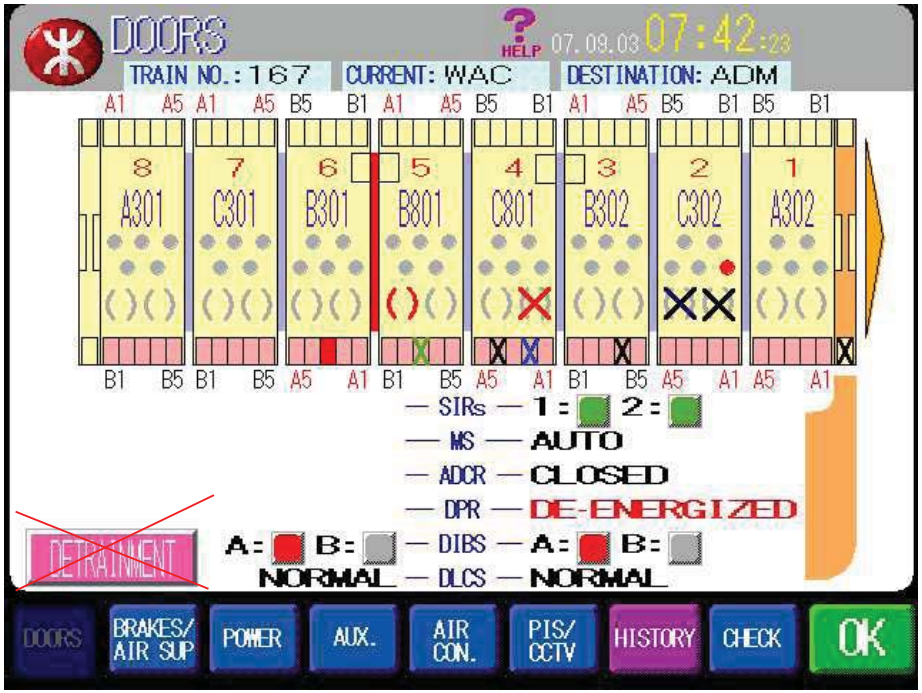


B J L M

B127

3.3.4 Doors information screen

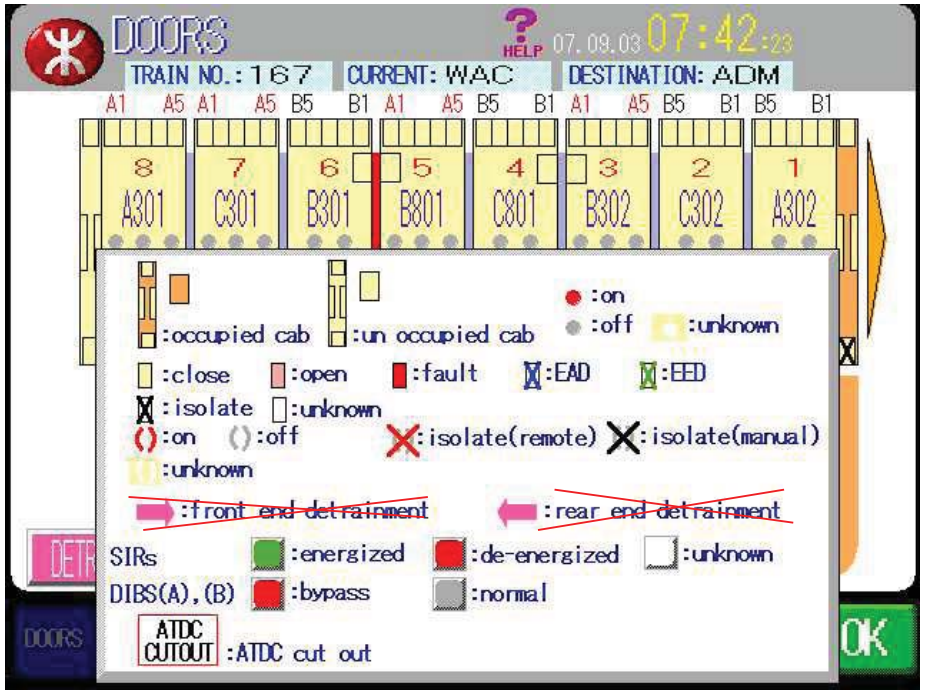
This screen provides the information of particular relevance to the doors system.
This is the default screen, once the TMS is activated from the screen OFF state, or any other mode.



B E F J
K L M

B201

Example of Help window is shown as follows;

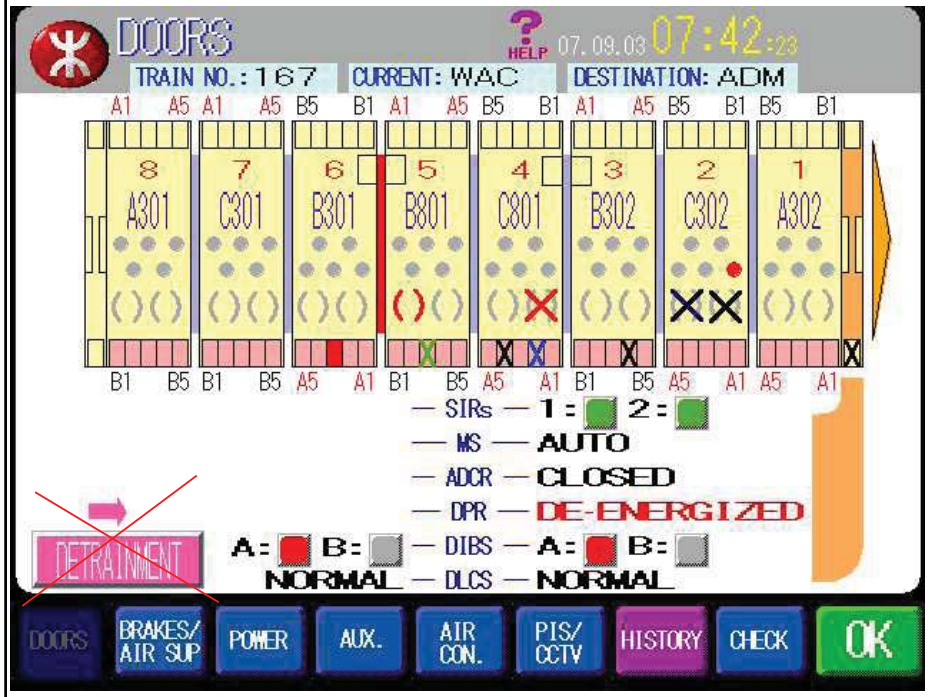


B E F J
K L P Q

B7508

			MITSUBISHI ELECTRIC CORPORATION., JAPAN								
			CHANGE								DOCUMENT NO.
			Q	14. May 10	F	27. Oct. 09	K	17. Dec. 09	M	28. Jan. 10	JHAV438
					J	04. Dec. 09	L	05. Jan.. 10	P	28. Apr. 10	

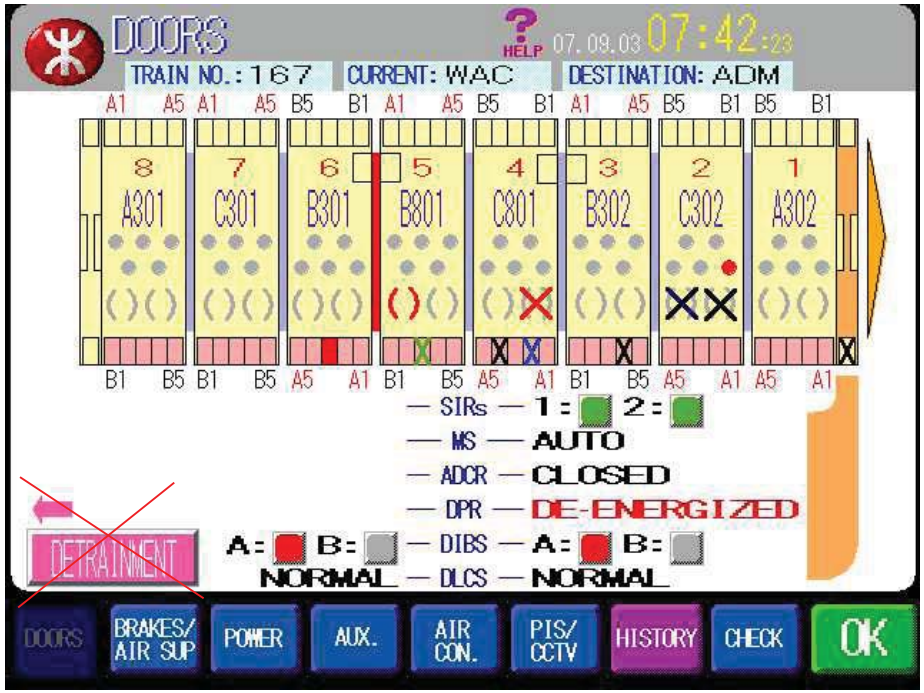
Example of "FRONT END DETRAINMENT was selected".



L M

B7540

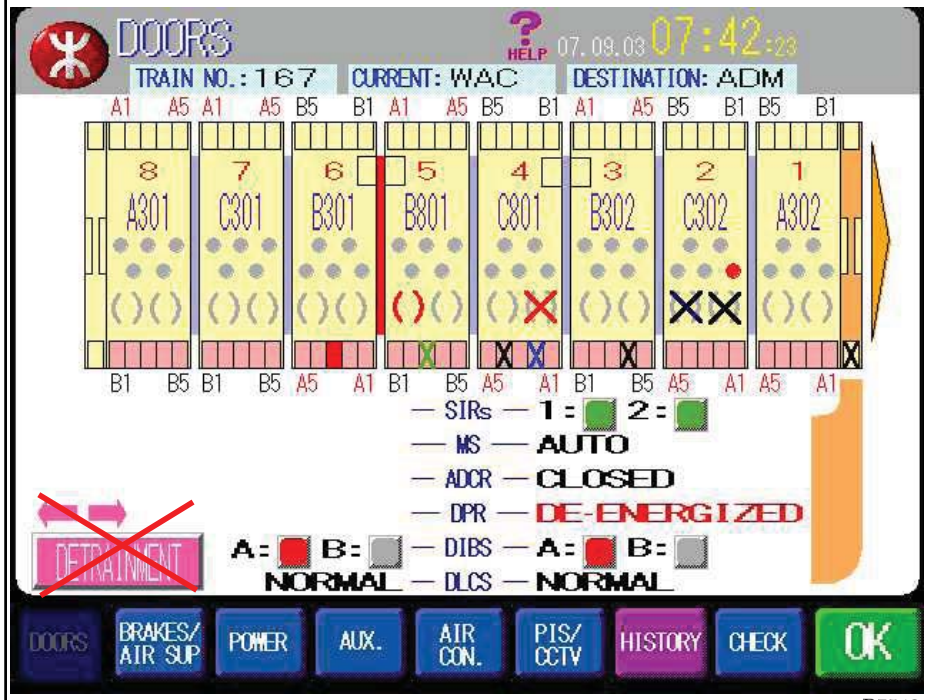
Example of "REAR END DETRAINMENT was selected".



L M

B7541

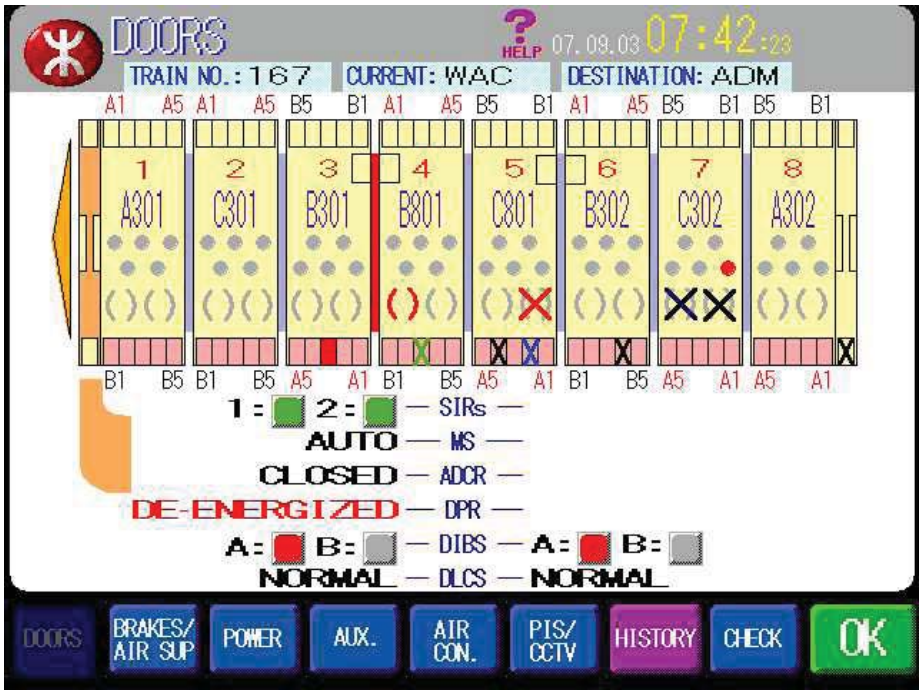
Example of "BOTH ENDS DETRAINMENT was selected".



L M

B7542

In case of unoccupied cab, "DETRAINMENT" key is not displayed.
When both A-car become occupied cab(HCR="ON"), the indication become the same as unoccupied cab.

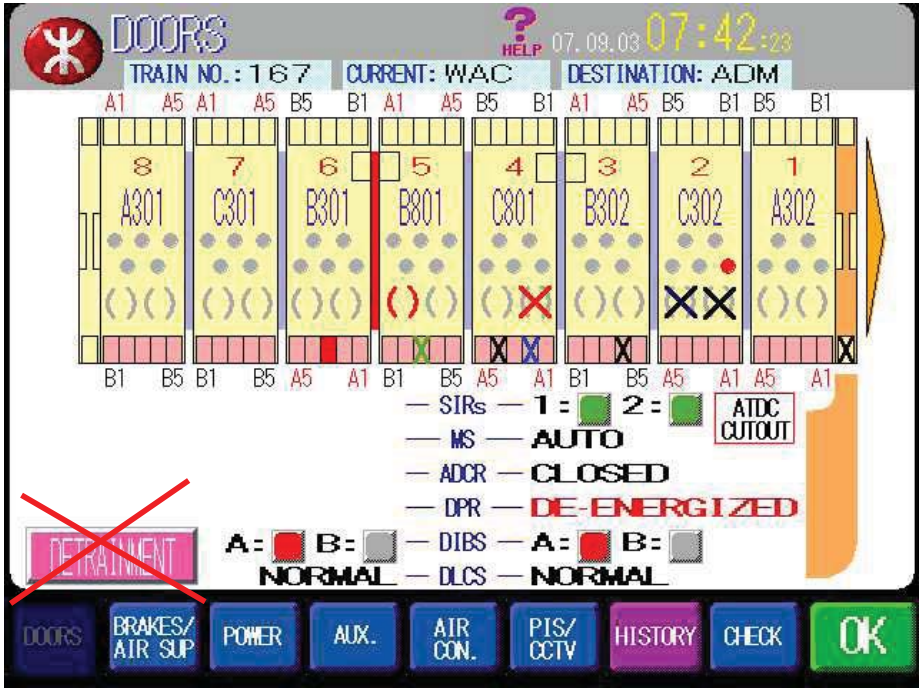


L M

B7539

			MITSUBISHI ELECTRIC CORPORATION., JAPAN								
			CHANGE								DOCUMENT NO.
			K	17. Dec. 09	M	28. Jan. 10					JHAV438
			L	05. Jan.. 10							

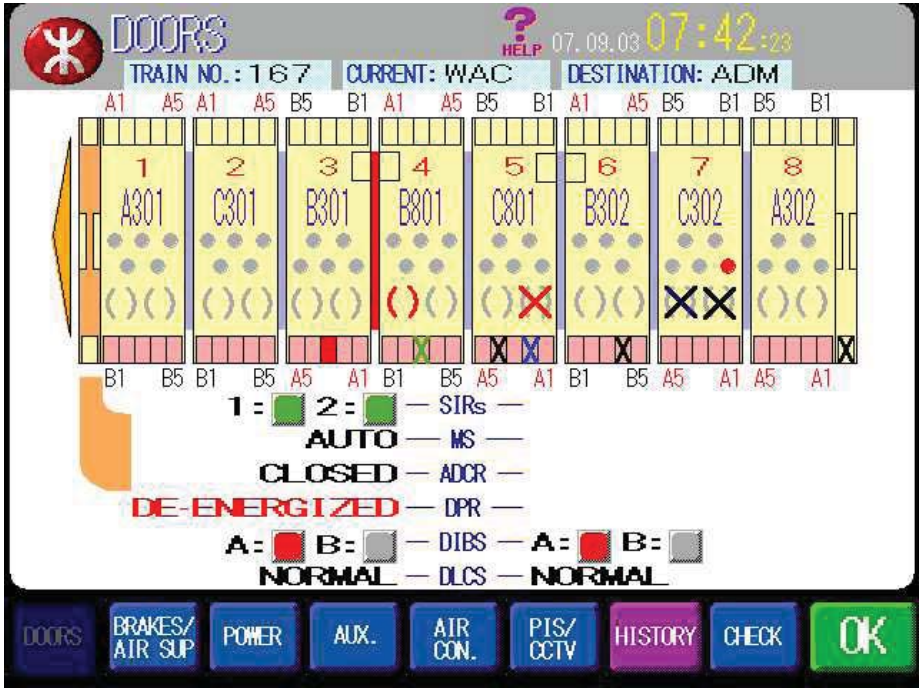
In case of ~~ATDO~~ Q ATDC cut out (occupied cab)".



Q

B7543

In case of ~~ATDO~~ Q ATDC cut out (unoccupied cab)".



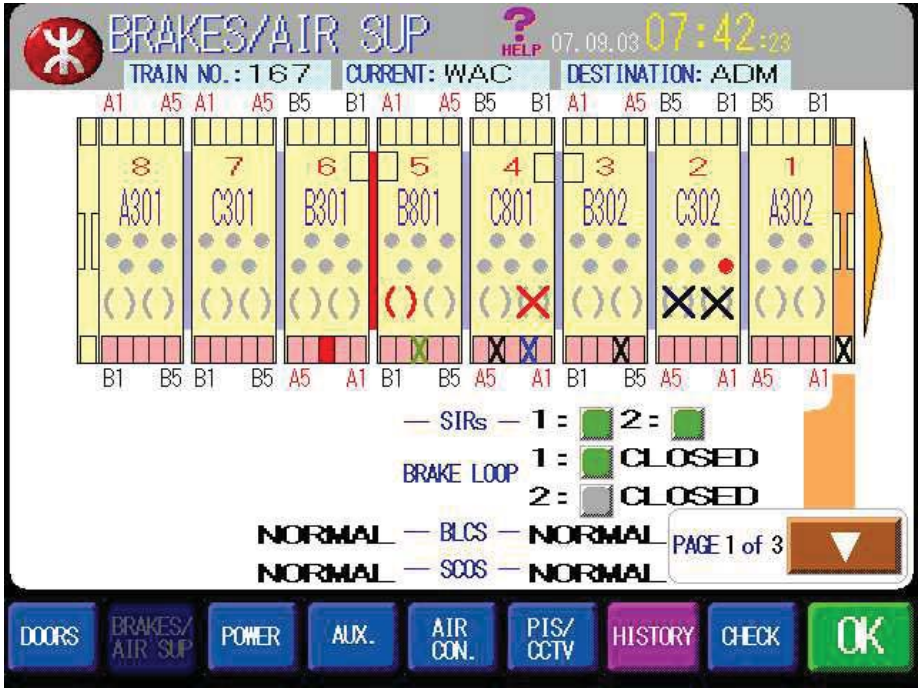
Q

B7544

In case unoccupied cab, ATDC cutout is not displayed. Q

3.3.5 Brakes/Air sup information screen

This screen provides the information of particular relevance to the brakes system.
Example of “Brake/Air sup information screen (Page1)” is shown as follows;.

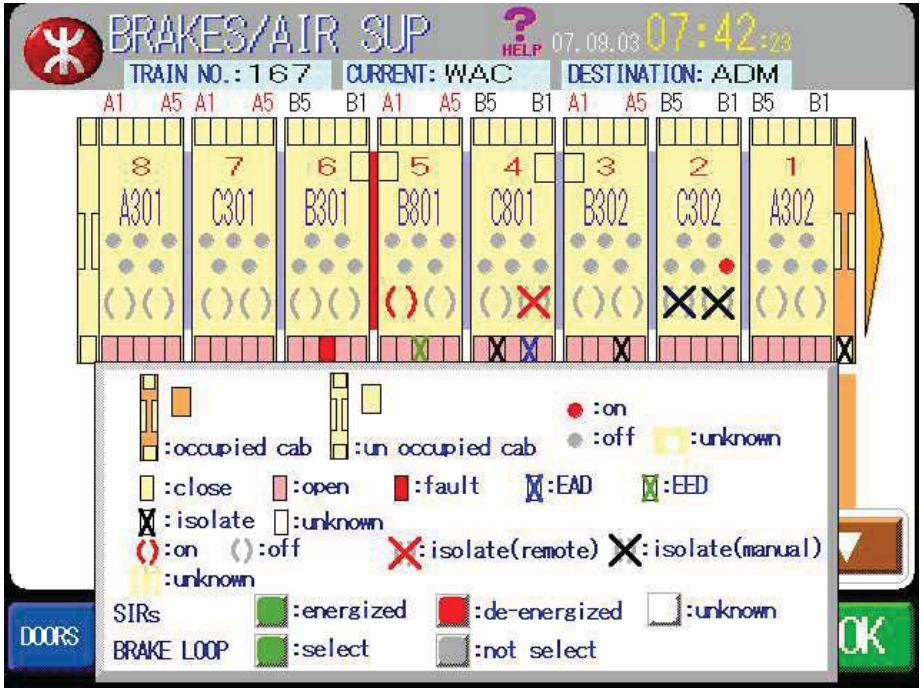


B E F J K L M P

B211

Press the “DOWN” key to call up to the “Brake/Air sup information screen (Page2)”.

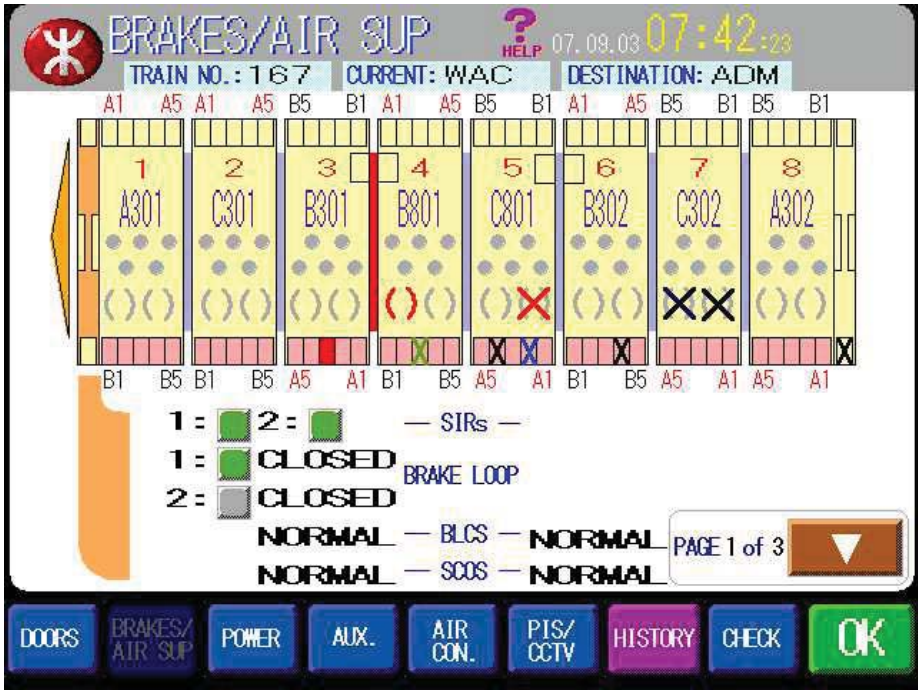
Example of Help window is shown as follows;



B E F J K L

B7509

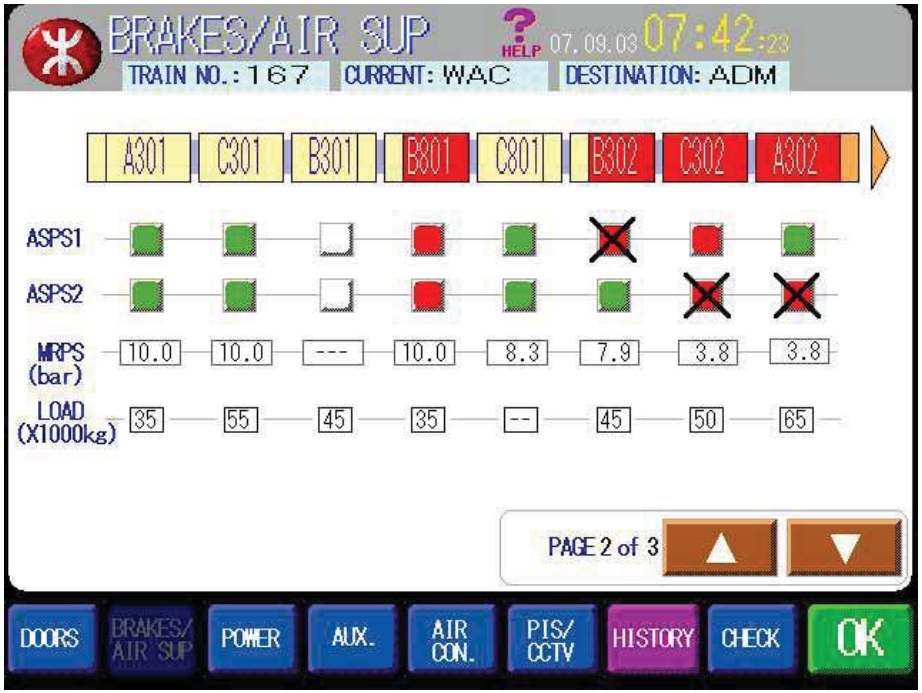
Example of unoccupied cab is shown as follows;



B216

B E F J K L M P

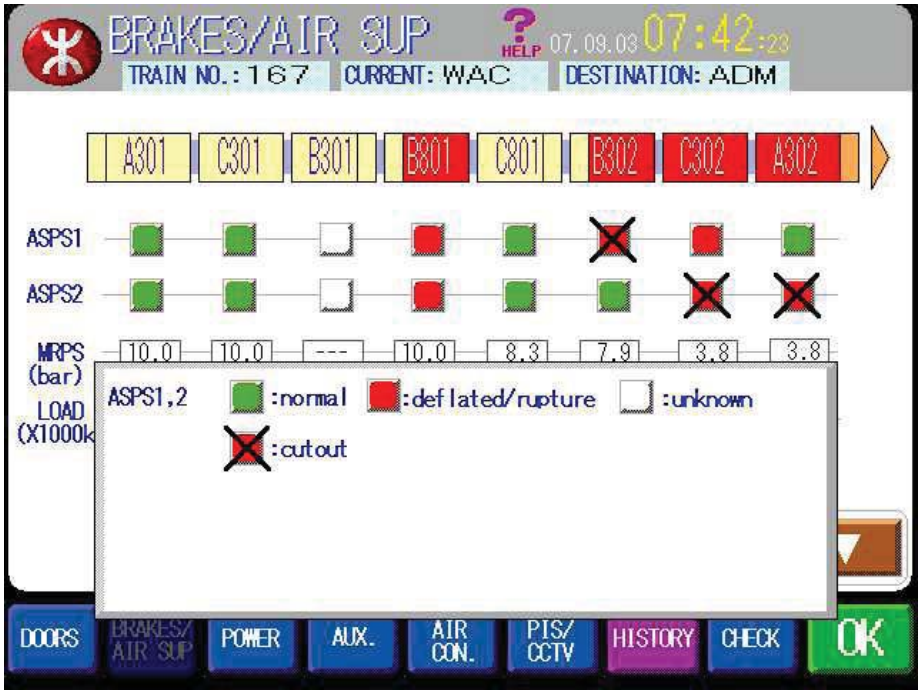
Example of “Brake/Air sup information screen(Page2)” is shown as follows;



B D H J K L M P

B1211

Example of Help window is shown as follows;

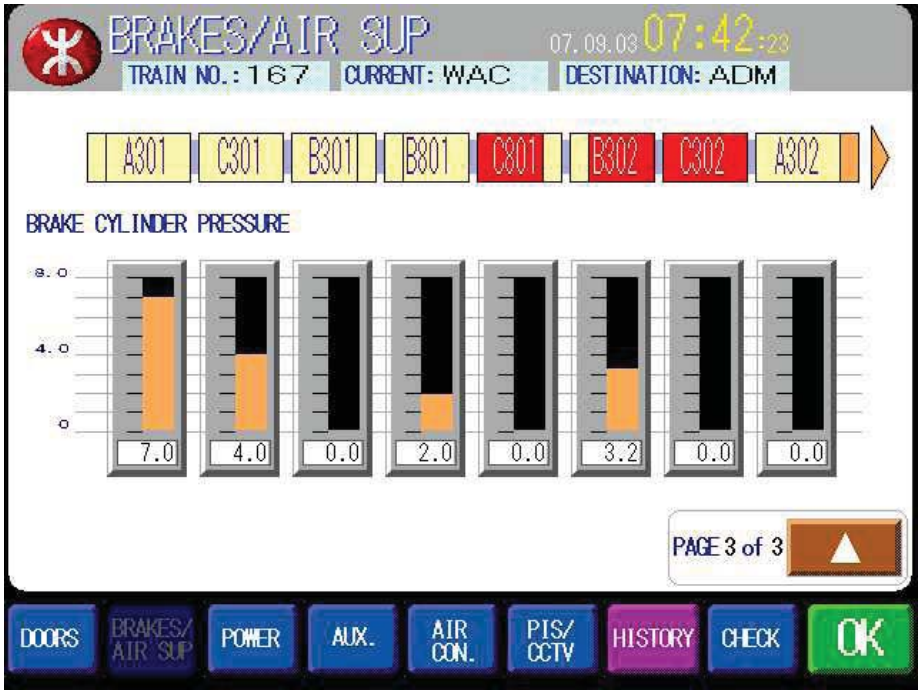


B D H J K L P

B7510

Press the “UP” key to call up to the “Brake/Air sup information screen(Page1)”.
Press the “DOWN” key to call up to the “Brake/Air sup information screen(Page3)”. P

Example of “Brake/Air sup information screen(Page3)” is shown as follows;



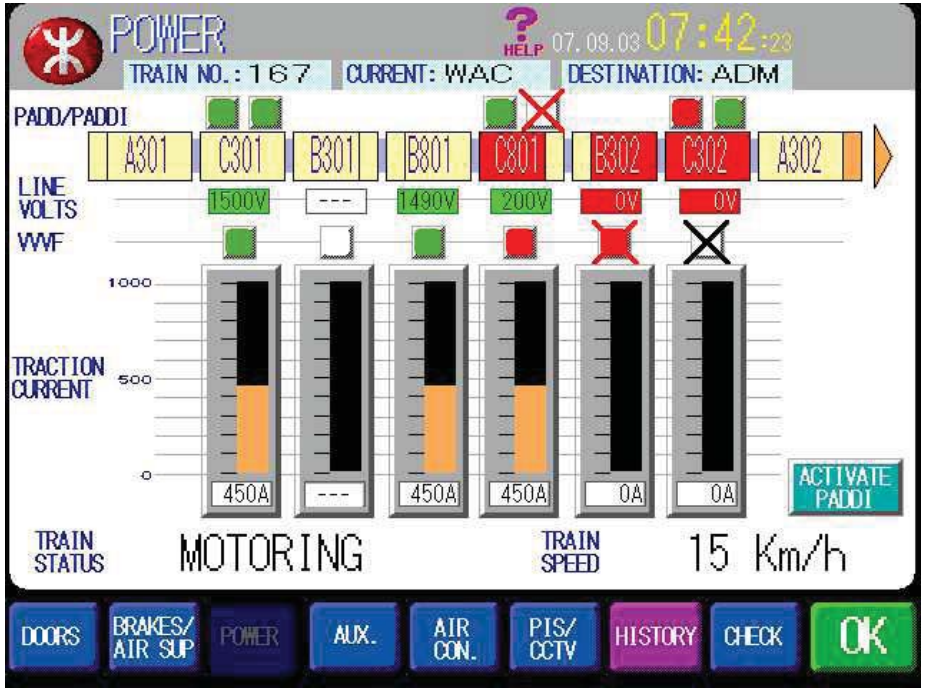
P

B1220

Press the “UP” key to call up to the “Brake/Air sup information screen(Page2)”.

3.3.6 Power information screen

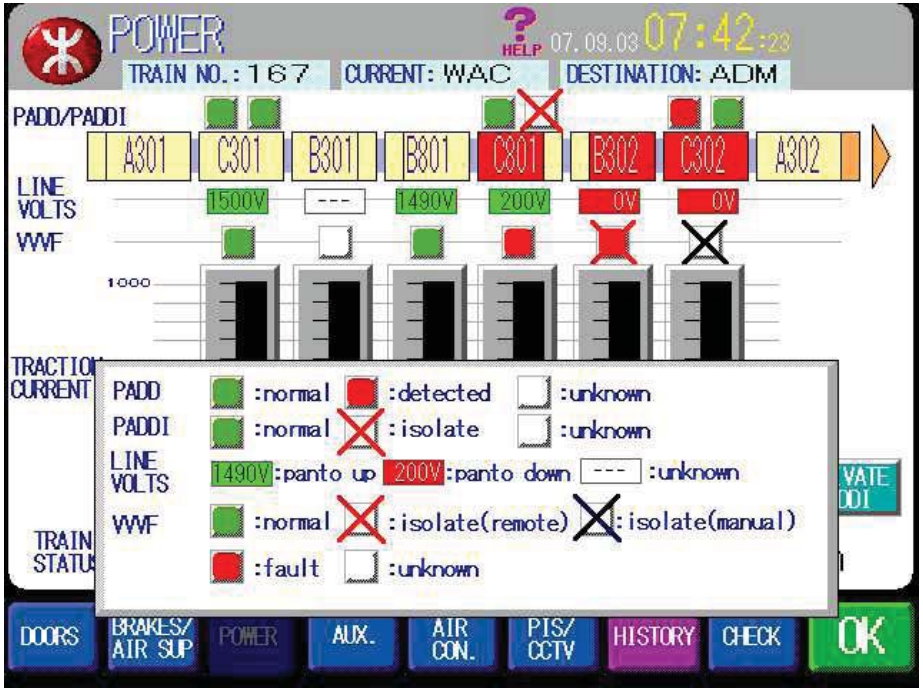
This screen provides the information of particular relevance to the train propulsion system.



B D J L M

B221

Example of Help window is shown as follows;

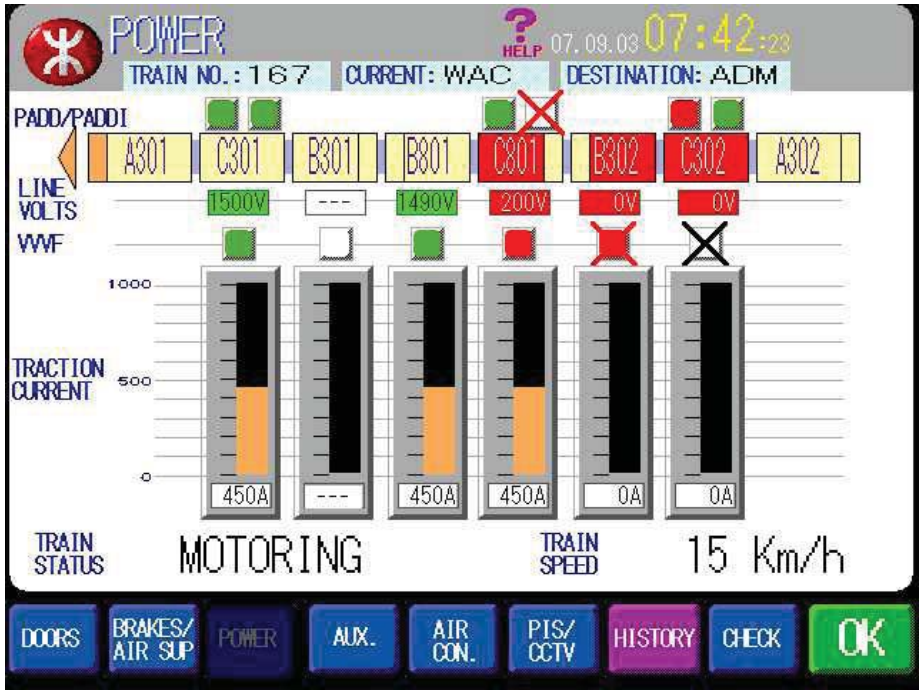


B D J L M

B7511

Press the “PDD ISOLATE” key to call up to the “PADD isolation screen”.

In case of unoccupied cab, “PADD ISOLATE” key is not displayed.



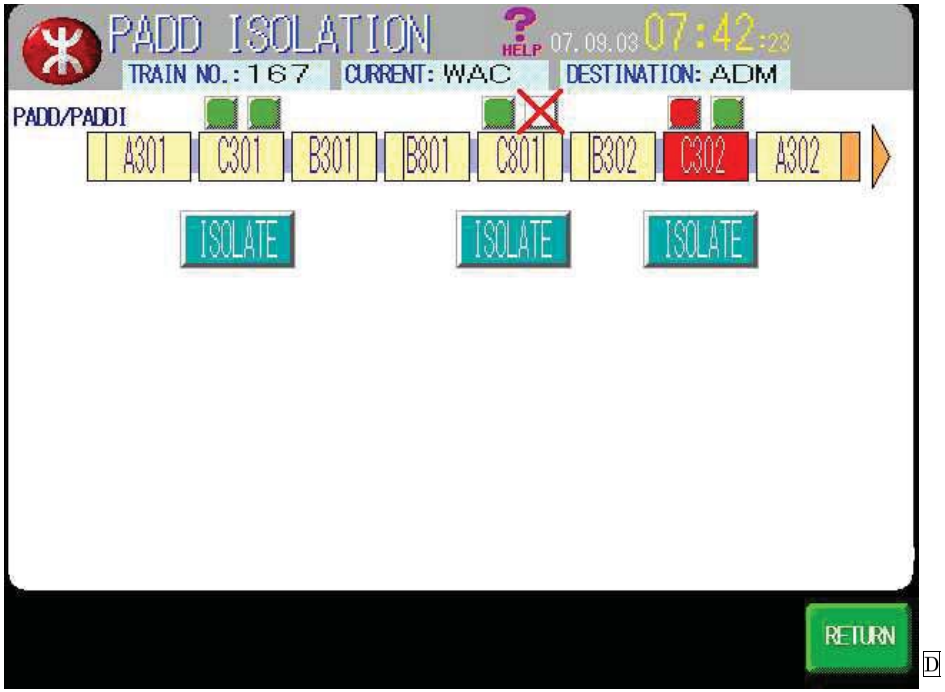
B226

B D F J L M

			MITSUBISHI ELECTRIC CORPORATION., JAPAN									
			CHANGE								DOCUMENT NO.	
			B	22. May. 09	F	27. Oct. 09	L	05. Jan. 10			JHAV438	31
			D	28. Aug. 09	J	04. Dec. 09	M	28. Jan. 10				

3.3.6.1 PADD isolation screen

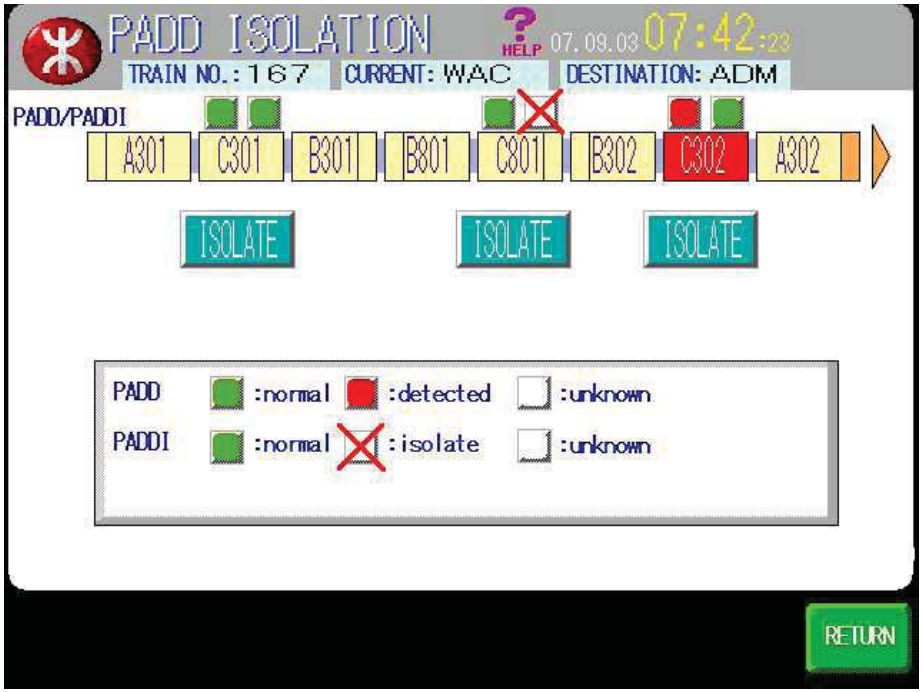
This screen is displayed from "PADD ISOLATE key" of "Power information screen".



D L

B253

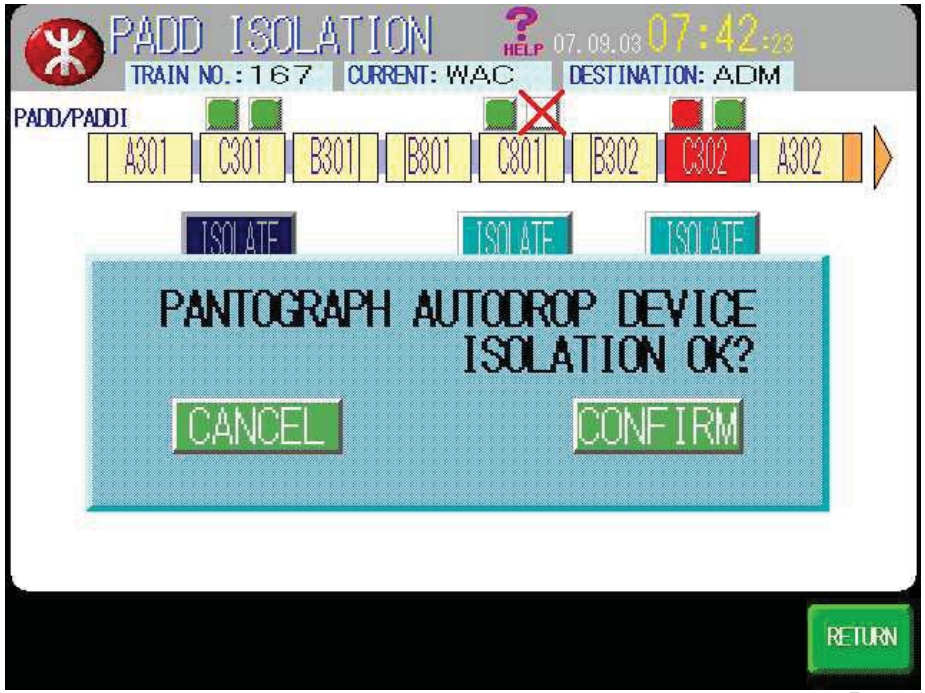
Example of Help window is shown as follows;



D J L

B7538

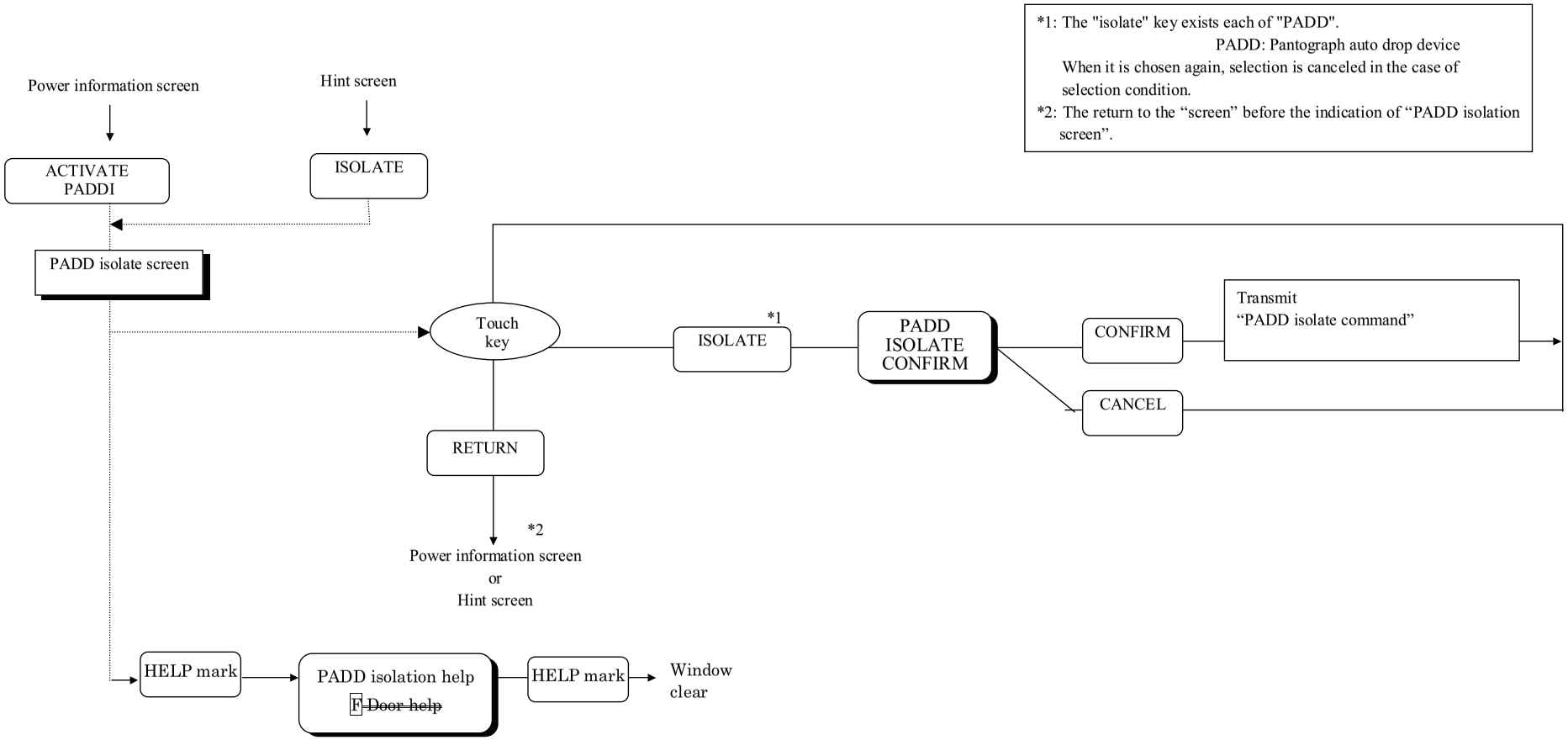
Example of “Pantograph auto drop device isolation confirm window” is shown as follows;



D J L

B254

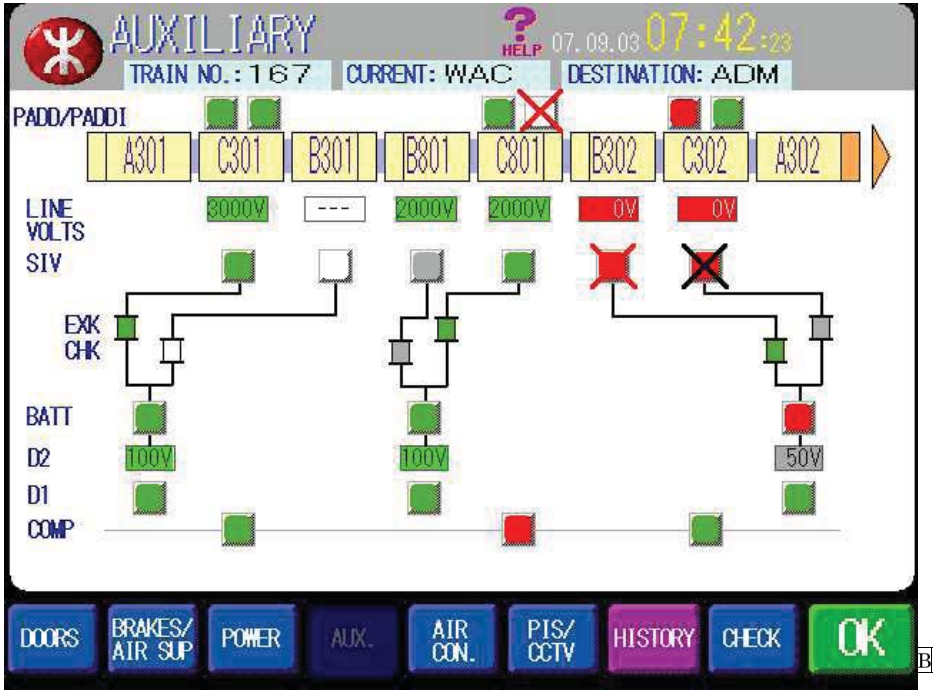
Operation flow of the “PADD isolation” is shown as follows;



			MITSUBISHI ELECTRIC CORPORATION., JAPAN	
			CHANGE	DOCUMENT NO.
			F 27. Oct. 09	JHAV438

3.3.7 Auxiliary information screen

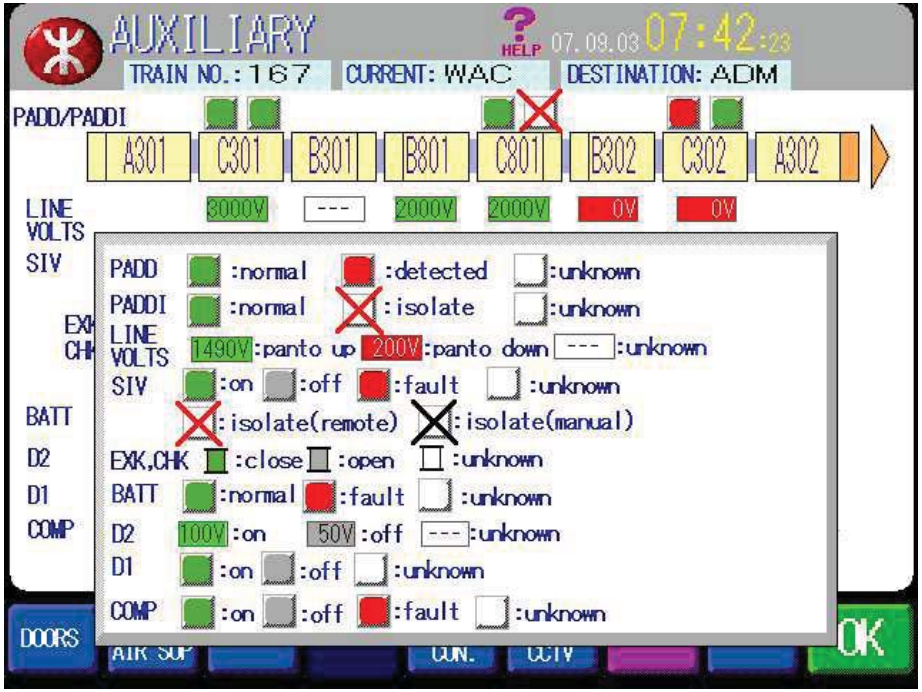
This screen provides the information of particular relevance to the auxiliary power system.



B J L M

B231

Example of Help window is shown as follows;

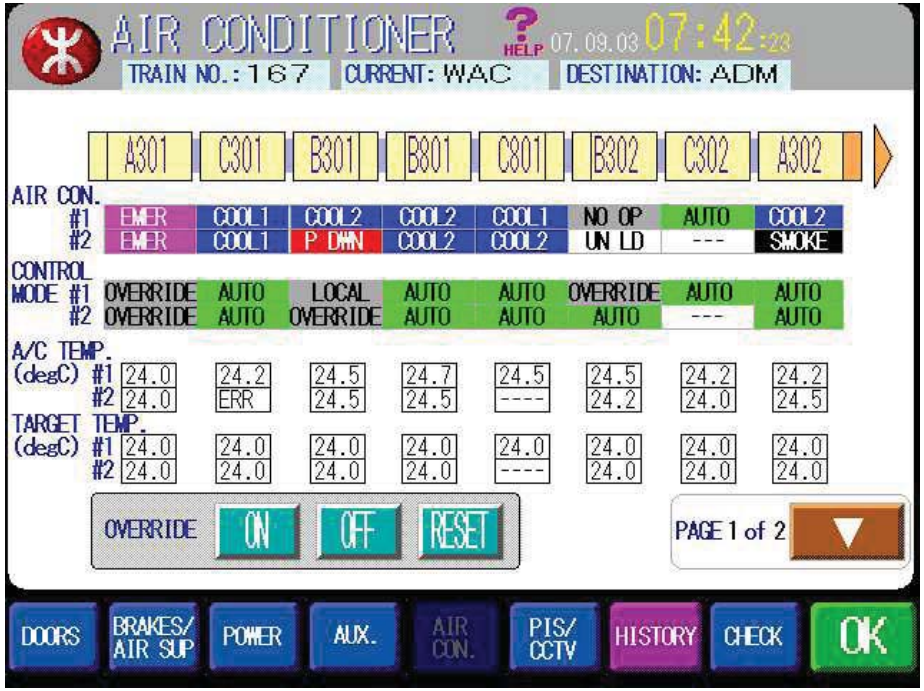


B J L M

B7512

3.3.8 Air conditioner information screen

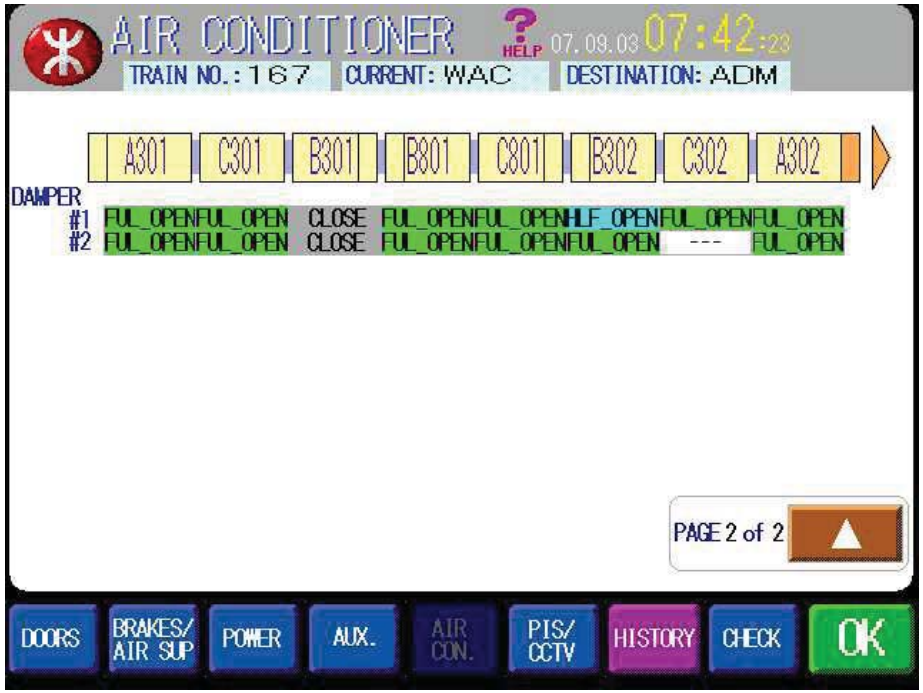
This screen provides the information of particular relevance to the Air conditioner system.



B J L M P Q S

B271

The next page of Air conditioner information screen is shown as follows;

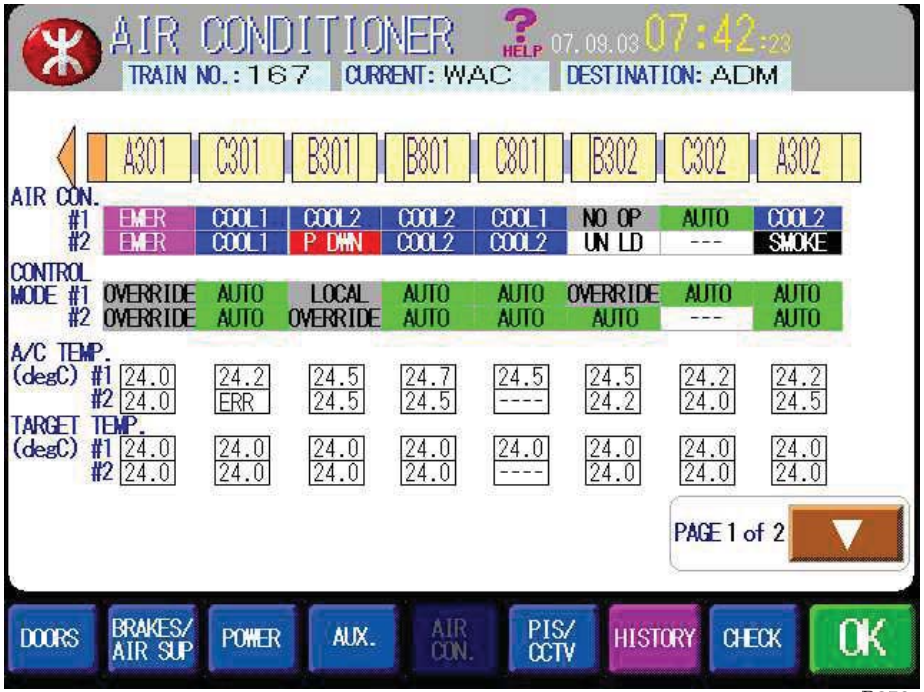


B J L M

Press the DOWN key to call up the next page.

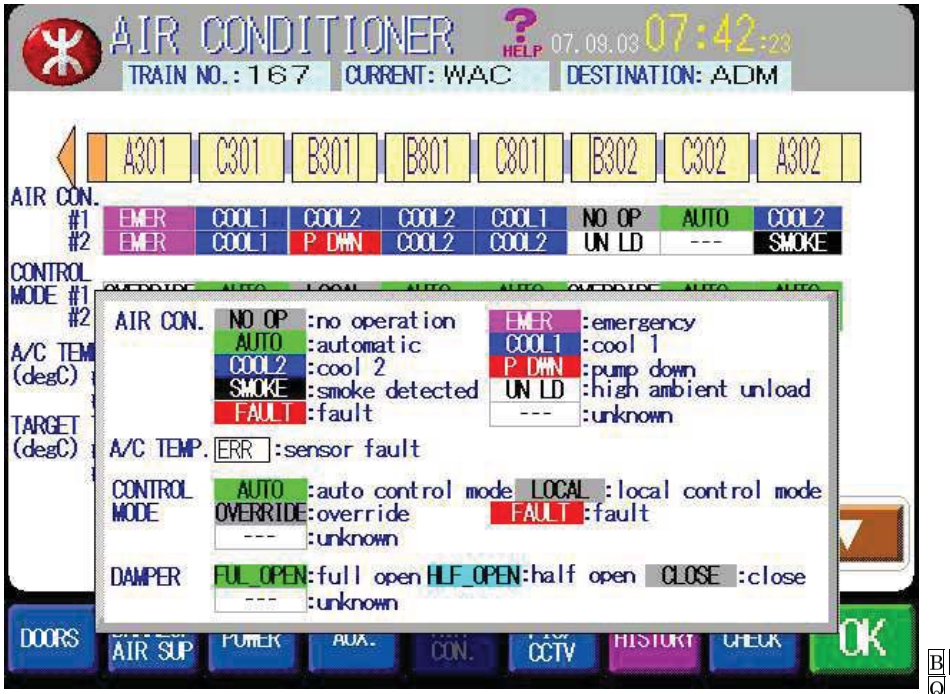
Press the ON, OFF, RESET key to call up the confirm window.

In case of unoccupied cab, “ON”,”OFF ”,”RESET” key are not displayed.
When both A-car become occupied cab (HCR=”ON"), The indication become the same as unoccupied cab.



B276 B J L M P Q S

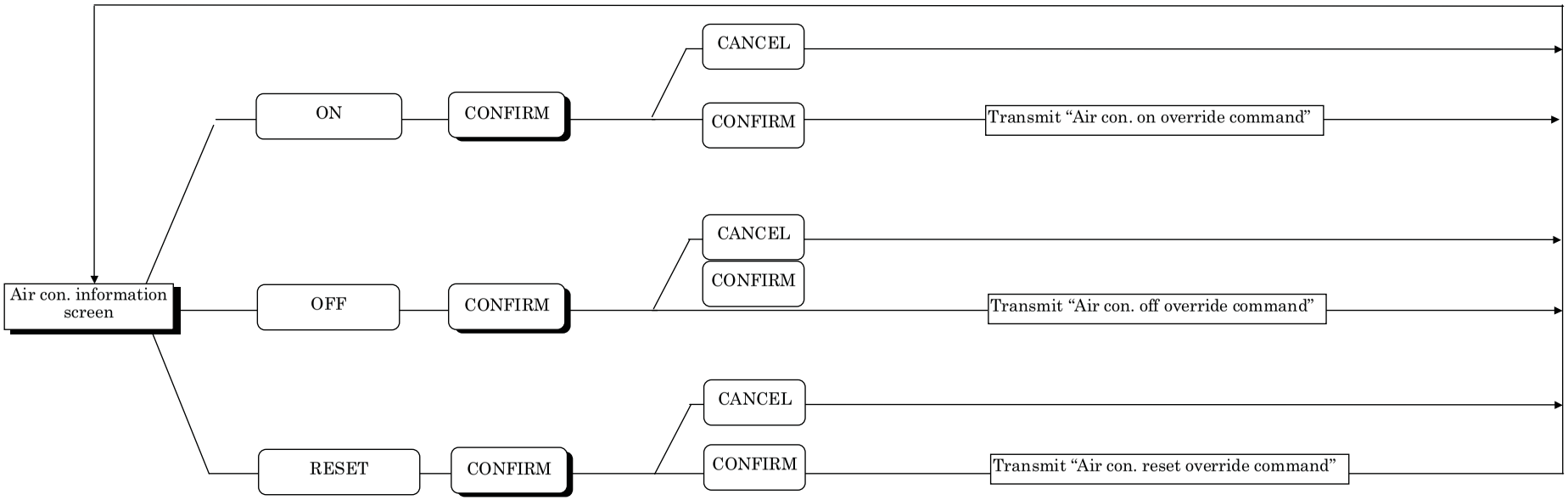
Example of Help window is shown a s follows;



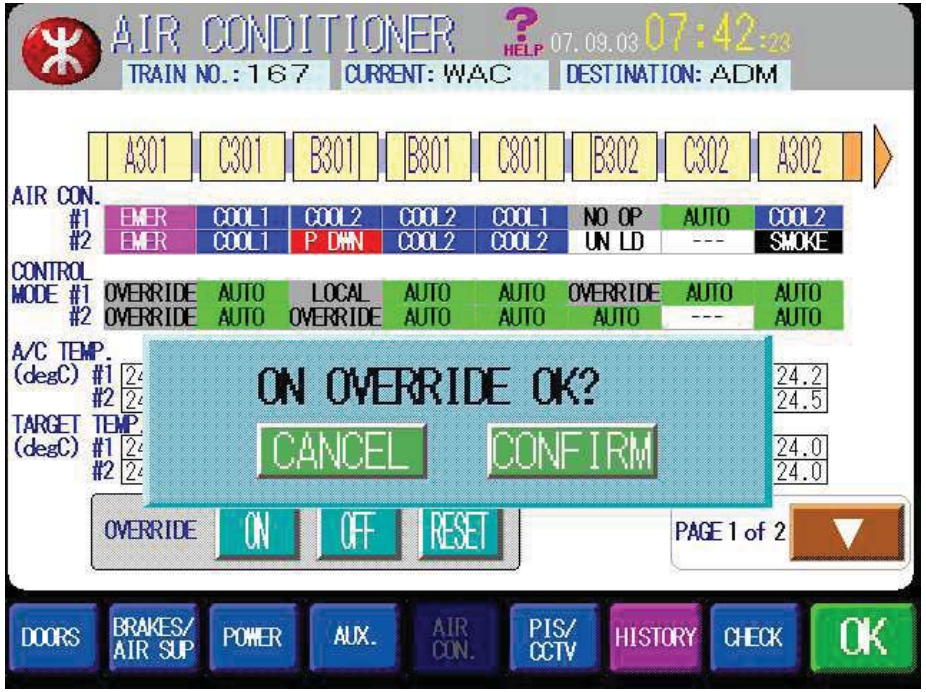
B7513 B F J L M P Q S

			MITSUBISHI ELECTRIC CORPORATION., JAPAN								
			CHANGE								DOCUMENT NO.
			B	22. May. 09	J	04. Dec. 09	M	28. Jan. 10	Q	14. May 10	JHAV438
			F	27. Oct. 09	L	05. Jan.. 10	P	28. Apr. 10	S	04. Aug. 10	37

Operation flow of the override is shown as follows;



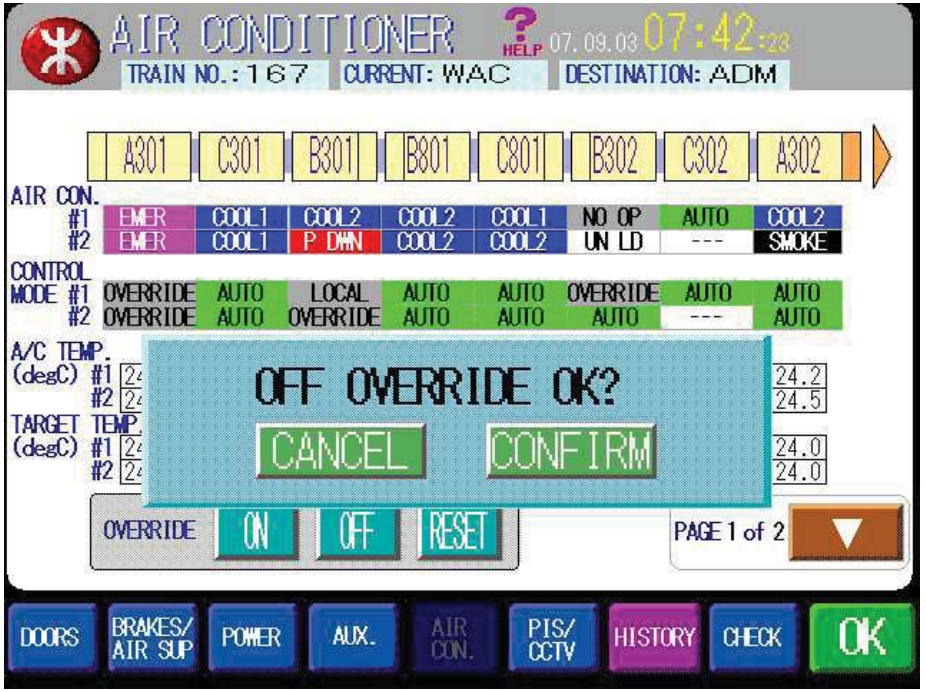
The override confirm window is shown as follows;
Example of "ON OVERRIDE ".



B J L M P Q S

B7514

The override confirm window is shown as follows;
Example of "OFF OVERRIDE ".

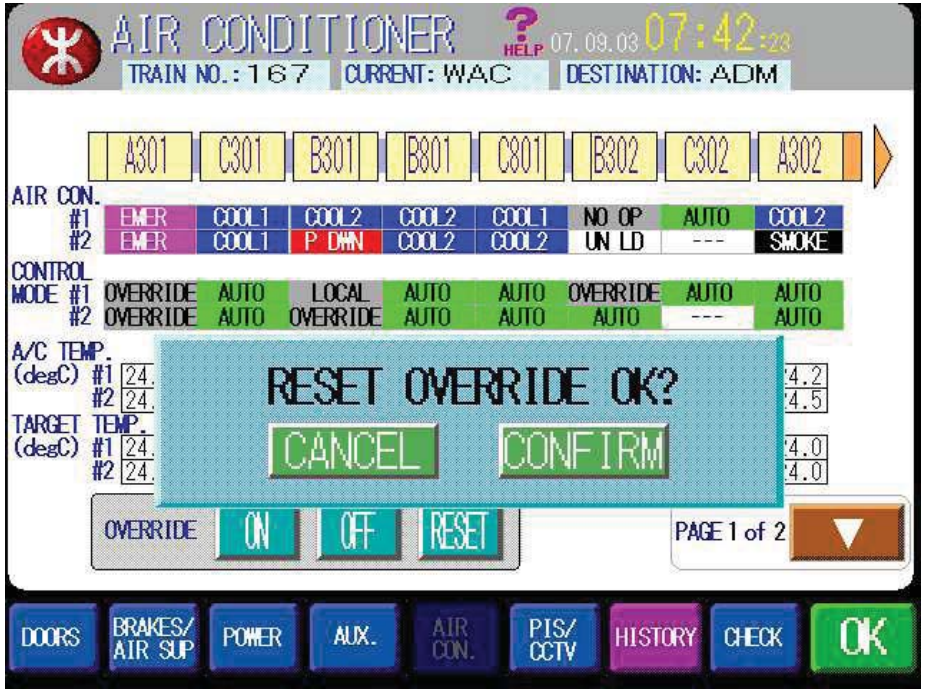


B J L M P Q S

B7515

			MITSUBISHI ELECTRIC CORPORATION., JAPAN								
			CHANGE							DOCUMENT NO.	
			B	22. May. 09	L	05. Jan.. 10	P	28. Apr. 10		JHAV438	39
			J	04. Dec. 09	M	05. Jan.. 10	S	04. Aug. 10			

The override confirm window is shown as follows;
Example of "RESET OVERRIDE ".

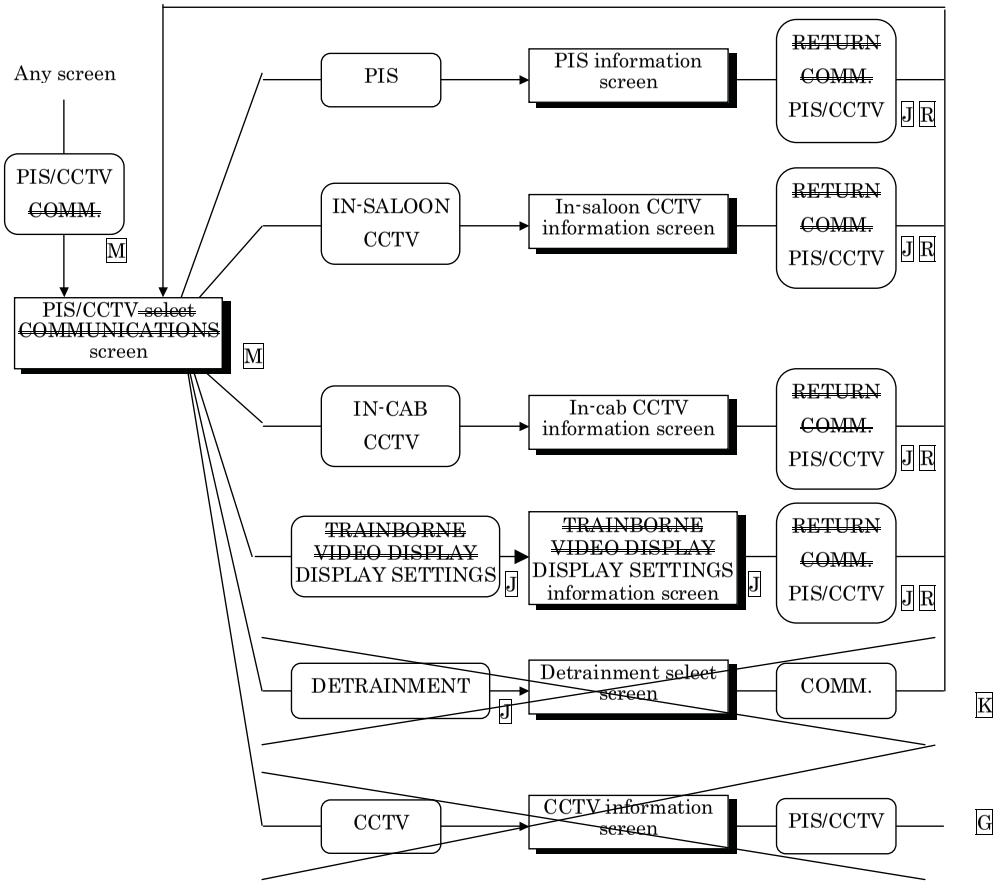


B J L M P Q S

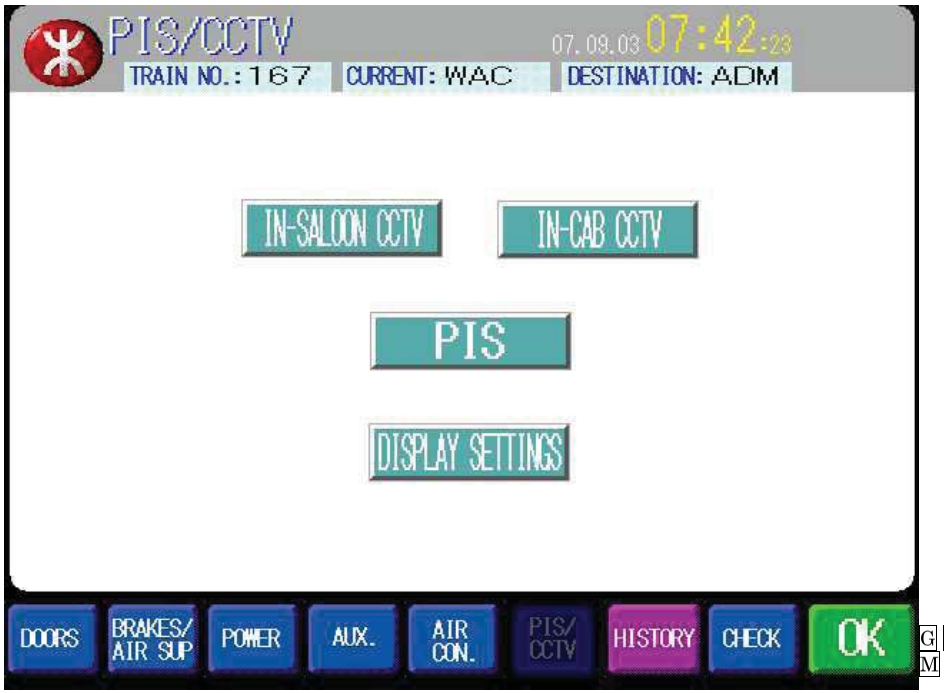
B7516

			MITSUBISHI ELECTRIC CORPORATION., JAPAN									
			CHANGE								DOCUMENT NO.	
			B	22. May. 09	L	05. Jan.. 10	P	28. Apr. 10			JHAV438	40
			J	04. Dec. 09	M	05. Jan.. 10	S	04. Aug. 10				

3.3.9. PIS/CCTV screen M ~~select~~ J ~~COMMUNICATIONS~~



This screen select the PIS information or CCTV information or Detrainment select. J



G J K L M

B489

			MITSUBISHI ELECTRIC CORPORATION., JAPAN								
			CHANGE							DOCUMENT NO.	
			B	22. May. 09	J	04. Dec. 09	L	05.Jan.10	R	10. Jun. 10	JHAV438 41-1
			G	05. Nov. 09	K	17. Dec. 09	M	28.Jan.10			

In case of unoccupied cab, “IN-SALOON CCTV key ”,”IN-CAB CCTV key” , ~~“DETRAINMENT key ”~~J K
” ~~TRAINBORNE VIDEO DISPLAY~~ J DISPLAY SETTING key” , is not displayed.
When both A-car become occupied cab(HCR="ON"), the indication become the same as unoccupied cab.

G J K L M

B494

3.3.~~9~~ B 10 PIS information screen

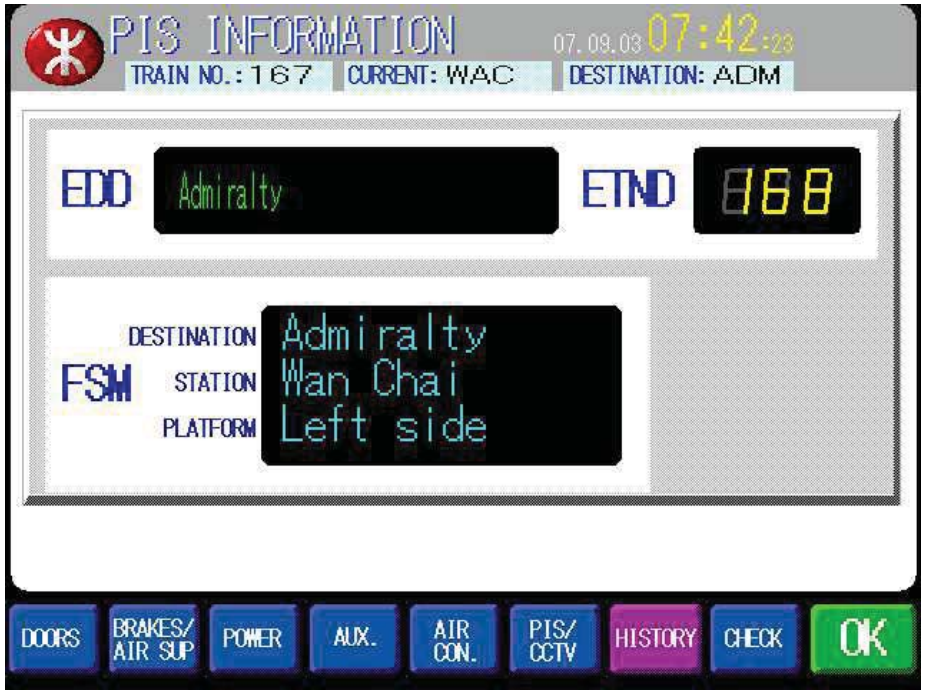
This screen provides the information of display contents of passenger information system.

B C D G J L M

B7517

The EDD, ETND and FSMs can be controlled by this screen with ON/OFF operation and testing.
Press the Journey setting key to call up the Journey setting screen.

In case of unoccupied cab, “JOURNEY SETTING key”, “PIS CONTROL key ” , D ” LED TEST key” are not displayed.
When both A-car become occupied cab(HCR="ON"), the indication become the same as unoccupied cab.



B C D G J L M

B7518

When the EDD LED is OFF, the display area of EDD is cleared.

B C D
G J L M

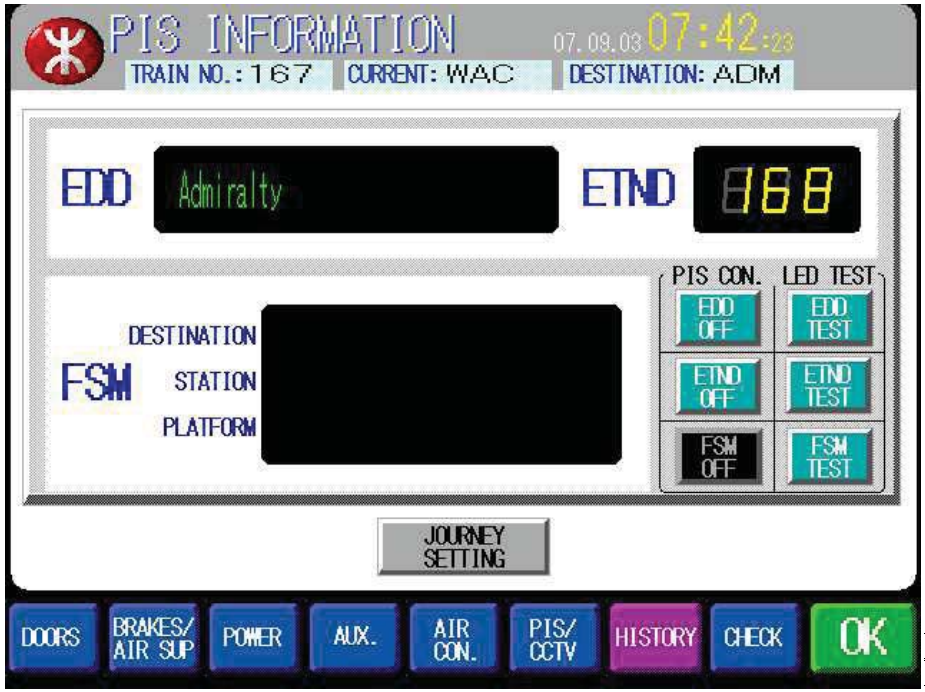
B7519

When the ETND LED is OFF, the display area of ETND is cleared.

B C D
G J L M

B7520

When the FSMs LED is OFF, the display area of FSM is cleared.



B C D
G J L M

B7521

When the EDD's C LED is testing, the following screen is displayed.

B C D
G J L M

B7522

			MITSUBISHI ELECTRIC CORPORATION., JAPAN								
			CHANGE								DOCUMENT NO.
			B	22. May. 09	D	28. Aug. 09	J	04. Dec. 09	M	28.Jan.10	JHAV438 44-1
			C	08. Jul. 09	G	05. Nov. 09	L	05.Jan.10			

C This page added

When the ETND's LED is testing, the following screen is displayed.

D G J L M

B7531

When the FSM's LED is testing, the following screen is displayed.

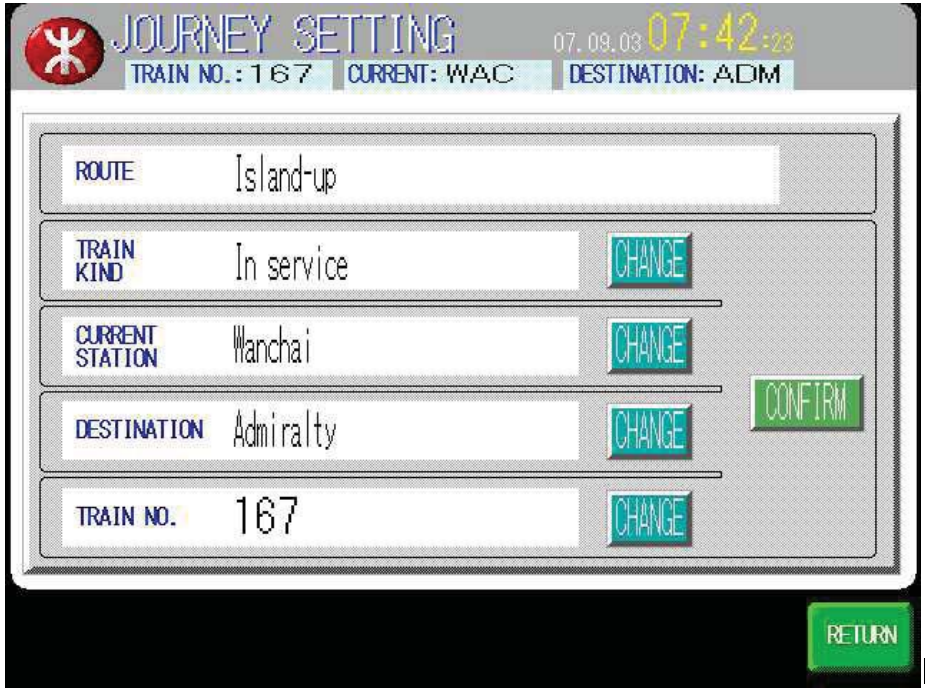
D G J L M

B7532

			MITSUBISHI ELECTRIC CORPORATION., JAPAN									
			CHANGE								DOCUMENT NO.	
			C	08. Jul. 09	G	05. Nov. 09	L	05.Jan.10			JHAV438	44-2E
			D	28. Aug. 09	J	04. Dec. 09	M	28.Jan.10				

3.3.~~10~~ B 11 Journey setting screen

This screen allows the train operator to input the information for the passenger information system control.
The route can be set by four routes. C
(ROUTE : Kwun Tong Line, Tsuen Wan Line, Island line, Tseung Kwan O Line) C
When CURRENT STATION and DESTINATION are set, the route is set first. Afterwards, the station is selected. C



L

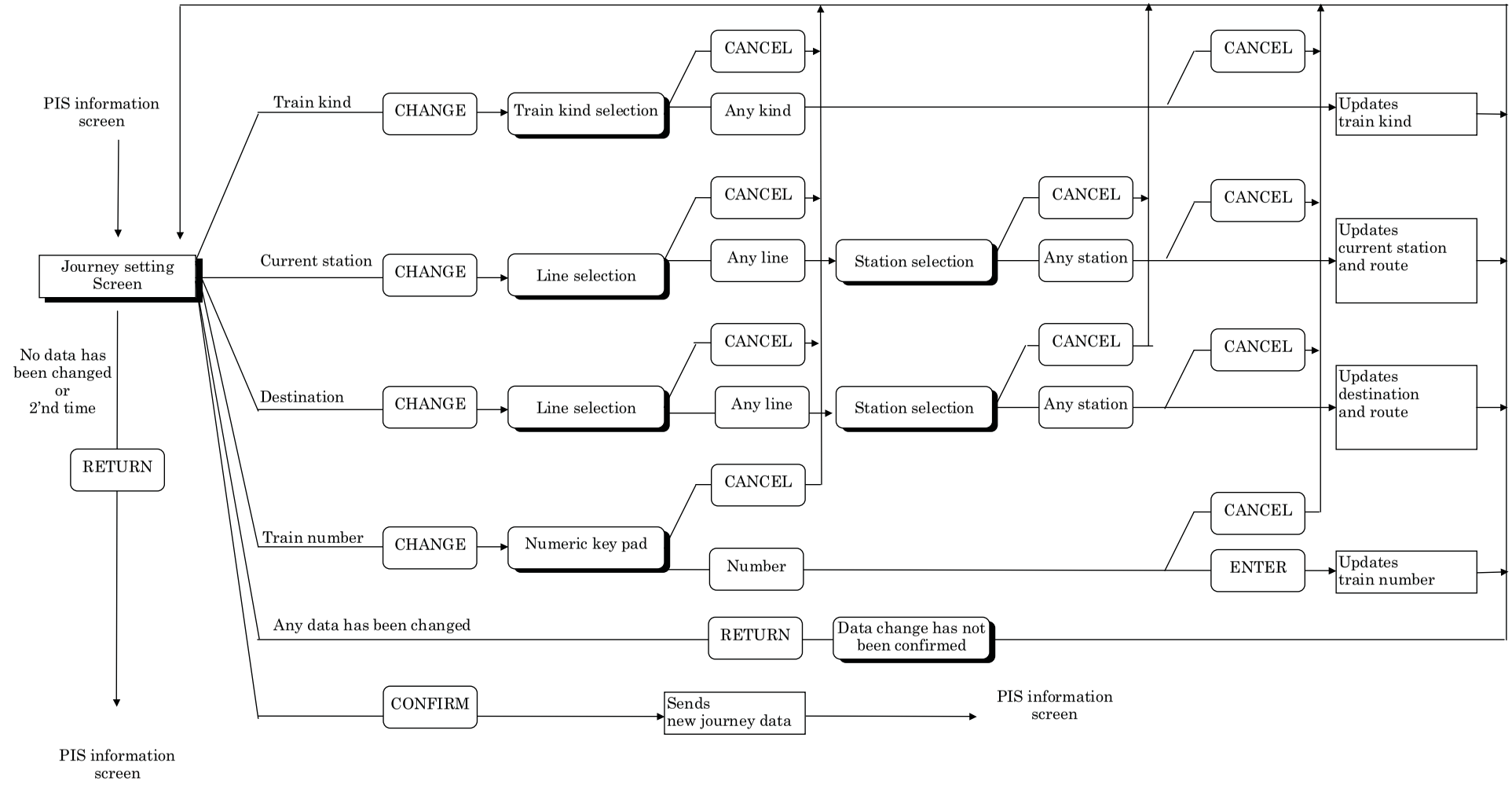
B50

The following information are changed by pressing by the CHANGE key in the corresponding position;

(1)The train kind
(2)The current station
(3)The destination
(4)The train number

The route code is updated by TMS automatically

Operation flow of the journey setting is shown as follows;



(1) Train kind setting

The train kind selection window is shown as follows;

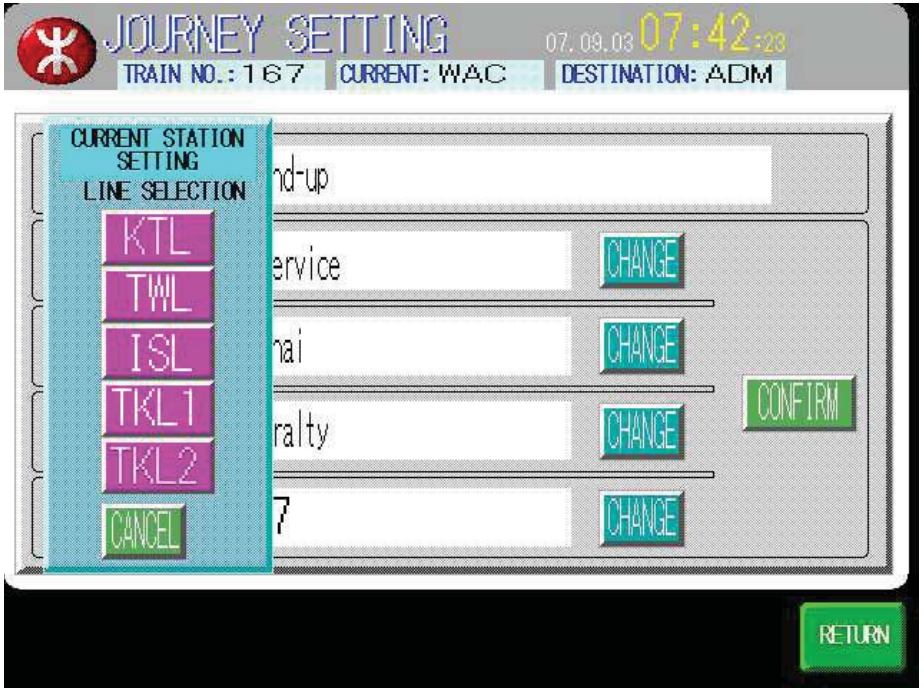
J K L

B 7525

			MITSUBISHI ELECTRIC CORPORATION., JAPAN									
			CHANGE								DOCUMENT NO.	
			J	04. Dec. 09	L	05. Jan.10					JHAV438	47
			K	17. Dec. 09								

(2) Current station setting

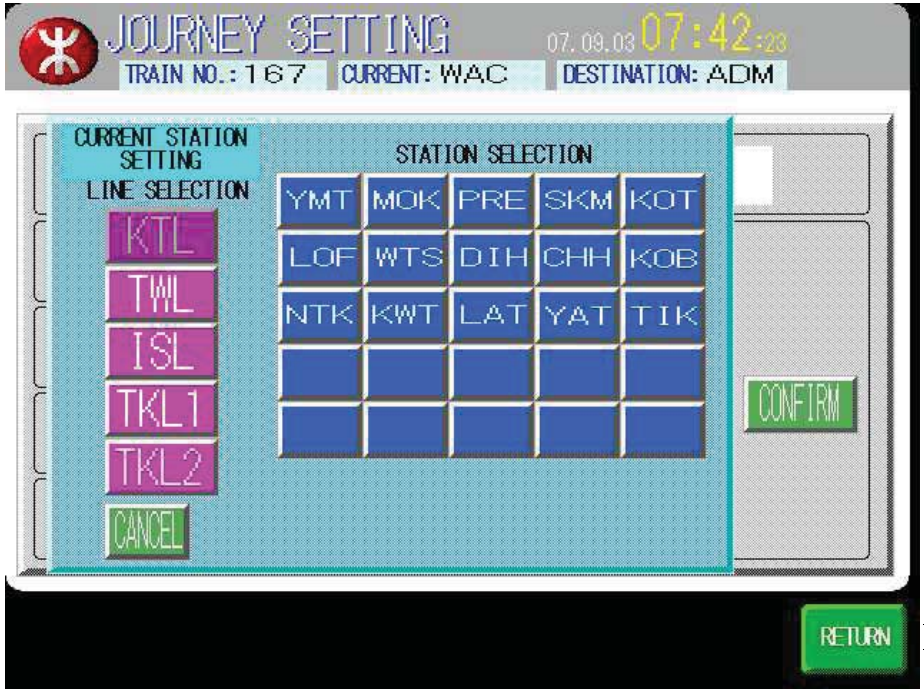
The line selection window is shown as follows;



B7526

L

The example of the station selection windows is shown as follows;
(in case of the KTL line)



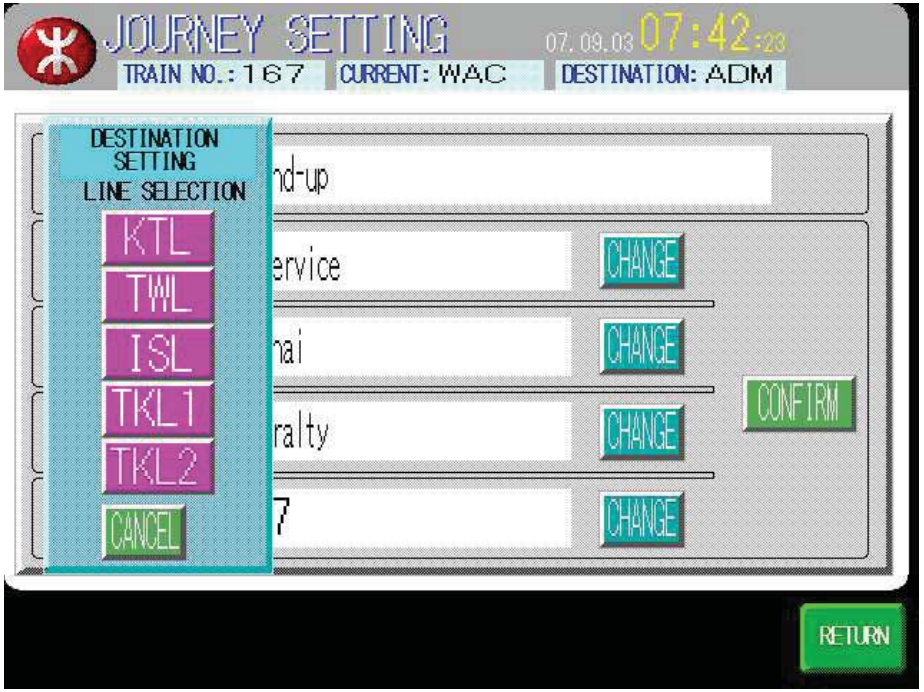
B7527

D J K L

			MITSUBISHI ELECTRIC CORPORATION., JAPAN								
			CHANGE								DOCUMENT NO.
			D	28. Aug. 09	K	17. Dec. 09					JHAV438 48
			J	04. Dec. 09	L	05. Jan.10					

(3) Destination setting

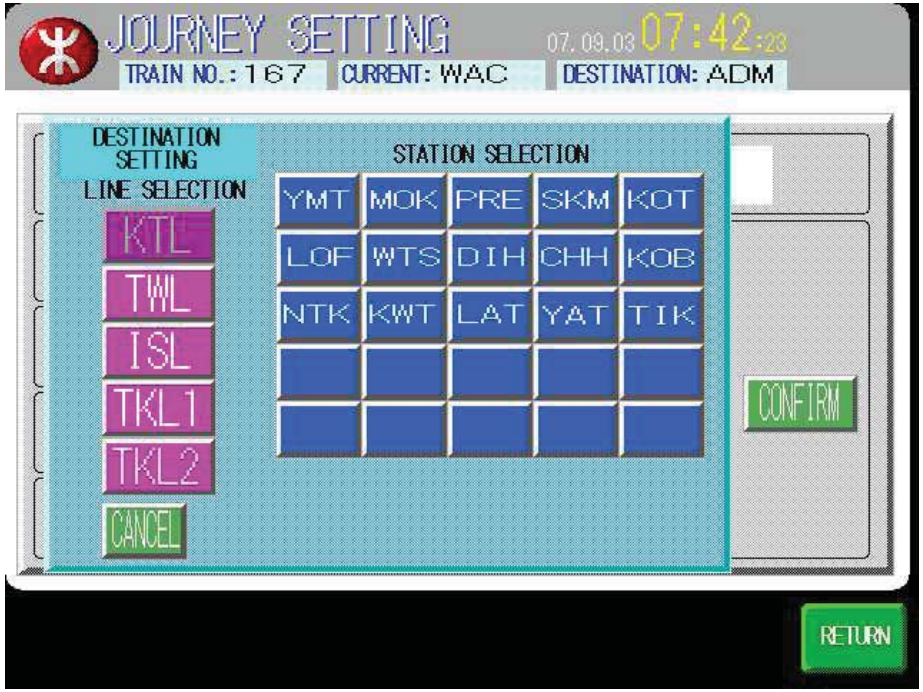
The line selection window is shown as follows;



L

B7528

The example of the station selection window is shown as follows;
(in case of the KTL line)



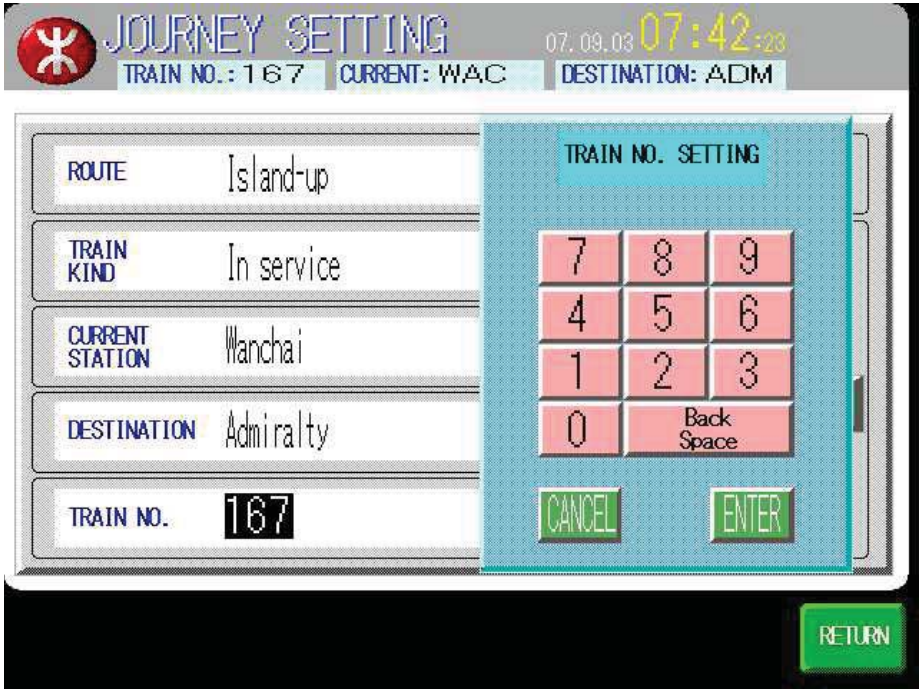
D J K L

B7529

MITSUBISHI ELECTRIC CORPORATION., JAPAN								
CHANGE								DOCUMENT NO.
D	28. Aug. 09	K	17. Dec. 09					JHAV438 49
J	04. Dec. 09	L	05. Jan.10					

(4) Train number setting

The train number setting window is shown as follows;

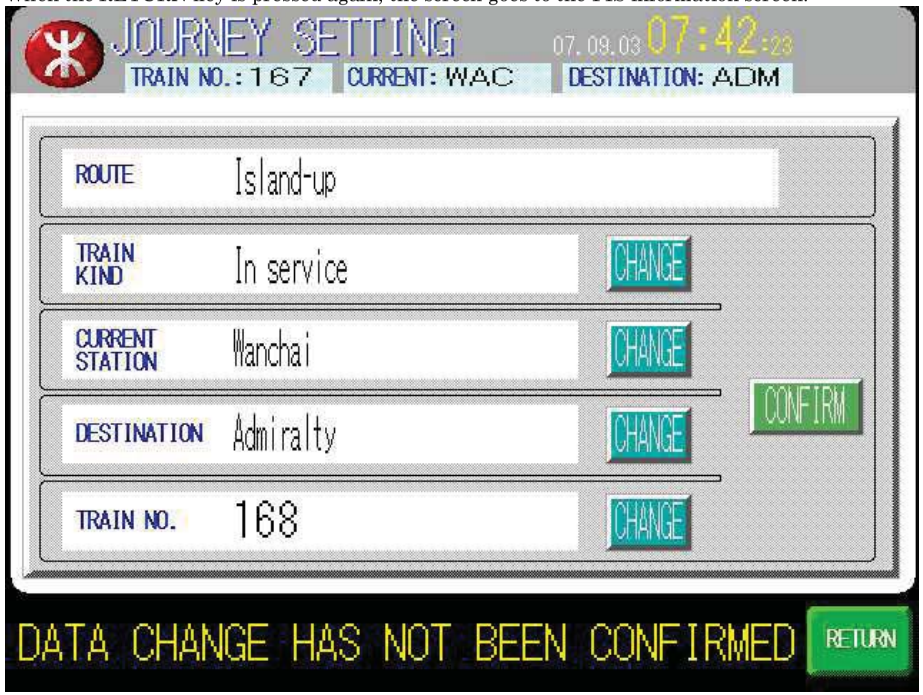


L

B7530

(5) Warning message

If the RETURN key is pressed when any data has been changed, the following warning message is displayed.
When the RETURN key is pressed again, the screen goes to the PIS information screen.

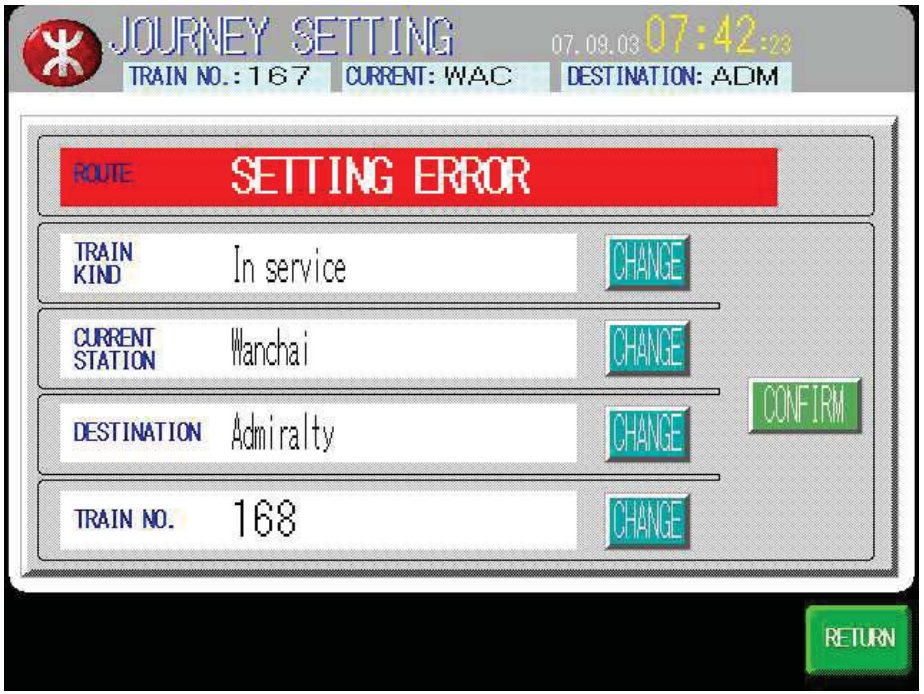


L

B54

(6) Setting error

If TMS detects a setting error, the following message is displayed.



B55

3.3.~~11~~ B 12 New Journey received screen

Whenever TMS receives the different journey information from ATC, the screen is displayed automatically for the train operator to confirm the new journey setting.

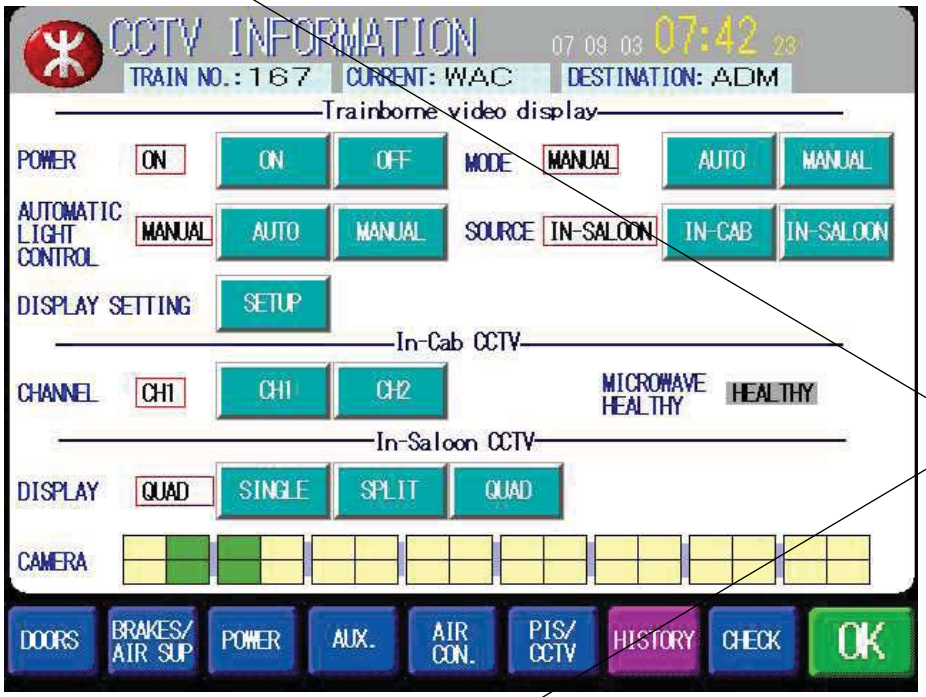
L

B330

The green box indicates new data received from ATC.

3.3. 13 CCTV information screen

This screen allows the train operator to input the information for the CCTV information system control.



C D E

B480

The following information are changed by pressing by the key in the corresponding position;

・Trainborne video display
(1) POWER
(2) ~~DISPLAY SETTING~~ C AUTOMATIC LIGHT CONTROL
(3) DISPLAY SETTING C
(4) MODE
(5) SOURCE

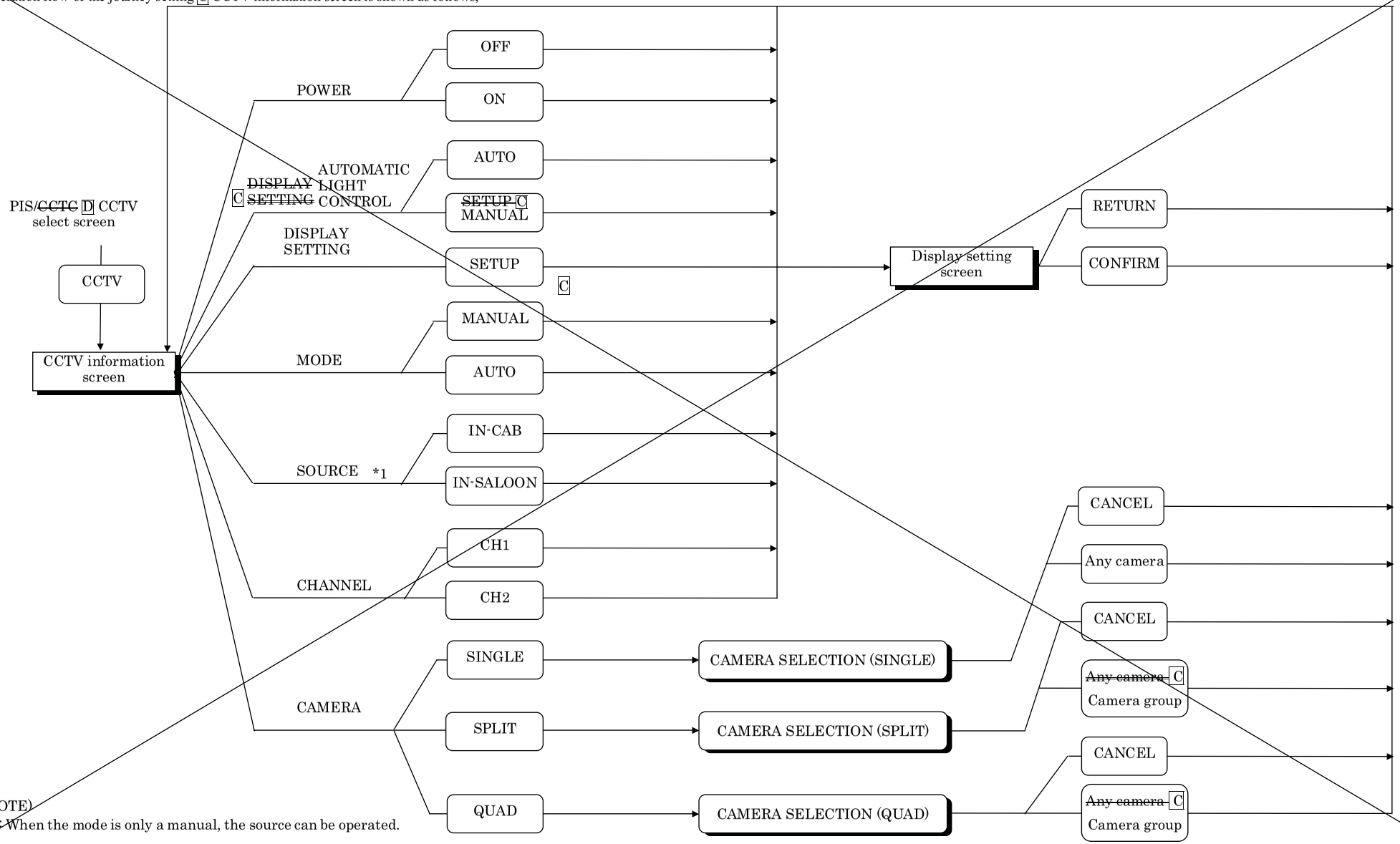
・In-Cab CCTV
(6) CHANNEL

・In- Saloon CCTV
(7) DISPLAY

			MITSUBISHI ELECTRIC CORPORATION., JAPAN							
			CHANGE						DOCUMENT NO.	
			B	22. May. 09	D	28. Aug. 09	G	05. Nov. 09	JHAV438	52-2
			C	08. Jul. 09	E	24. Sep. 09				

B This page added
G This page deleted

Operation flow of the ~~journey setting~~ C CCTV information screen is shown as follows;



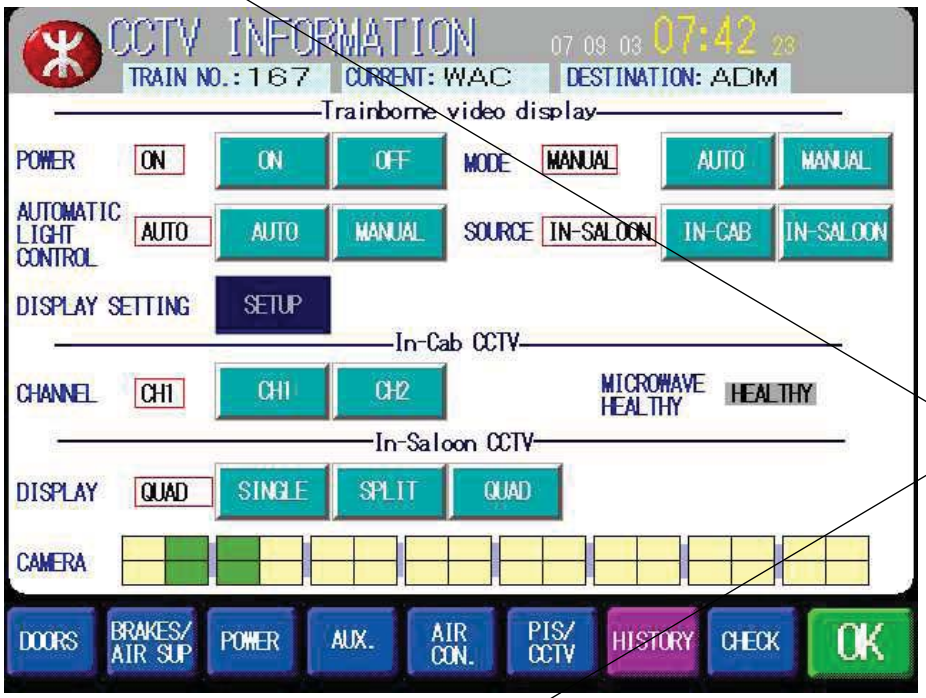
(NOTE)
*1 : When the mode is only a manual, the source can be operated.

MITSUBISHI ELECTRIC CORPORATION., JAPAN

CHANGE								DOCUMENT NO.
B	22. May. 09	D	28. Aug. 09					JHAV438
C	08. Jul. 09	G	05. Nov. 09					

(1) Display setting

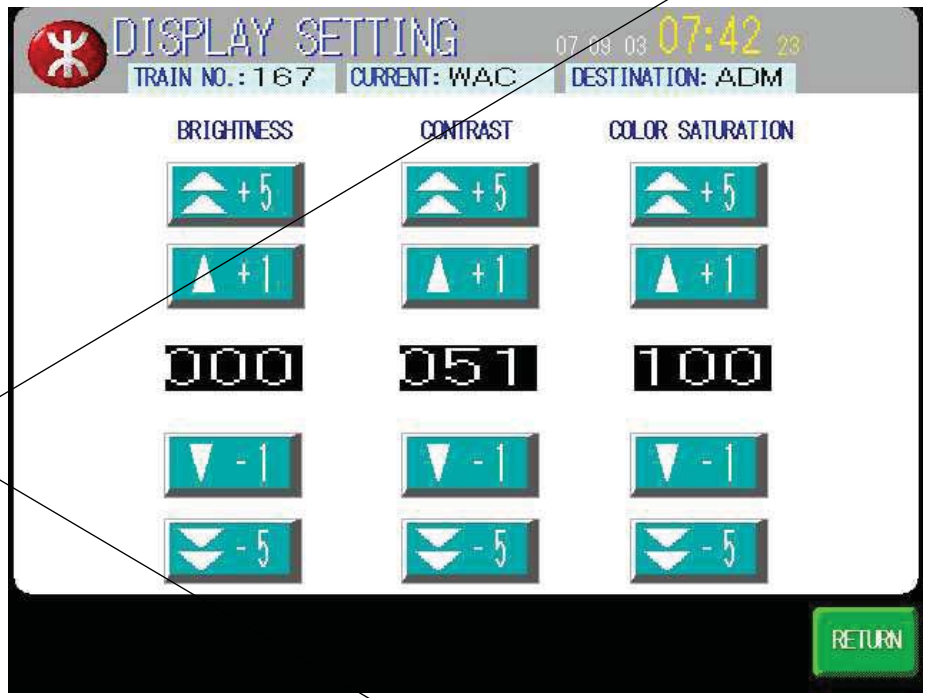
The Display setting is shown as follows;



B491

C D E

The Display setting is shown as follows;
The Display setting screen is displayed when touching SETTING key of Display setting.



B493

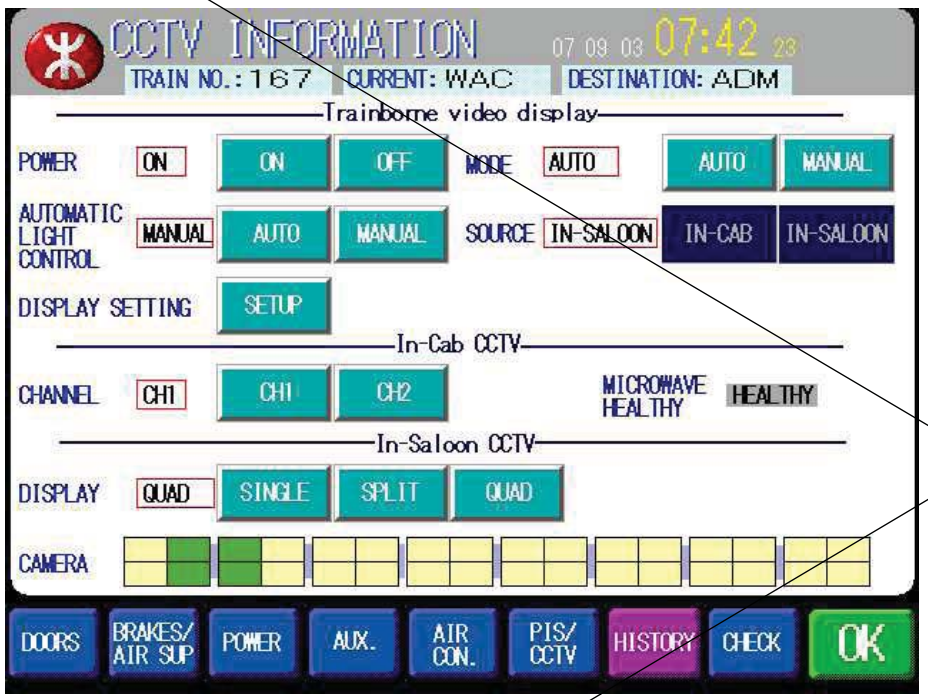
D F

When the automatic light control is only a manual, the display setting can be operated.
If automatic light control is an auto, the " SETTING " key are invalid.

in case of the automatic light control = AUTO:

(2) Source

The Source setting is shown as follows;



C D E

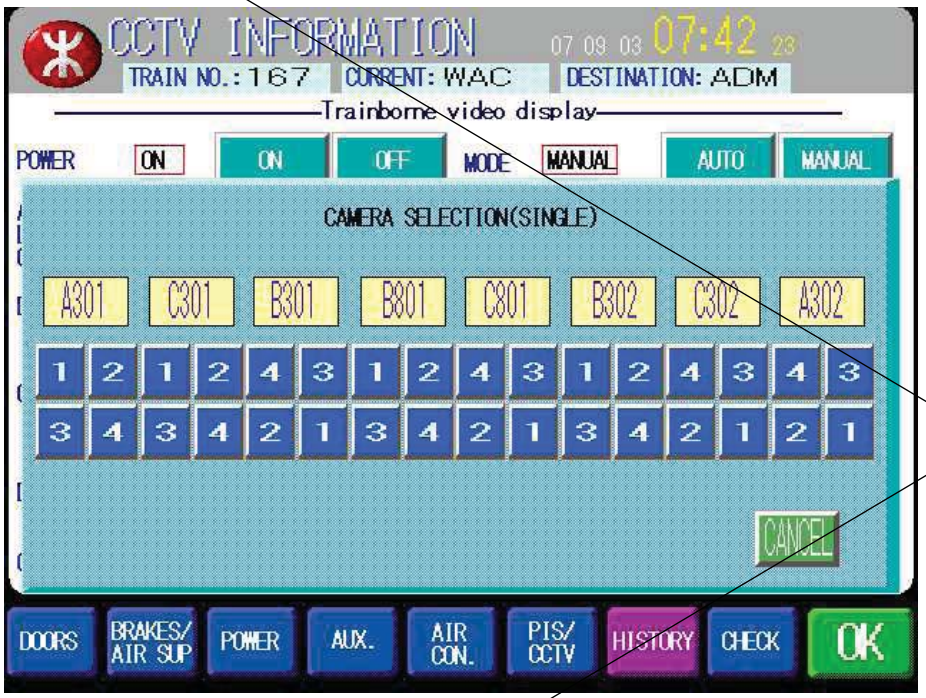
B492

When the mode is only a manual, the source can be operated.
If mode is an auto, the " IN-CAB " key and " IN-SALOON " key are invalid.

in case of the Mode= AUTO:

(3) DISPLAY

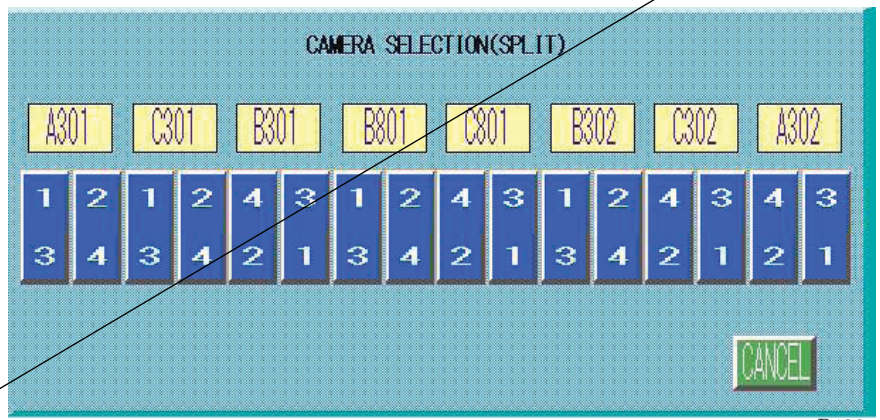
The camera selection (SINGLE) window is shown as follows;



C D E

B484

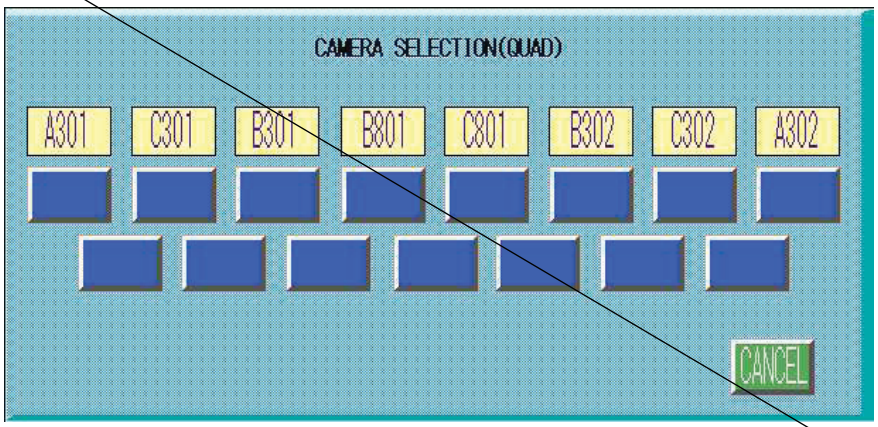
The camera selection (SPLIT) window is shown as follows;



C D

B486

The camera selection (QUAD) window is shown as follows;



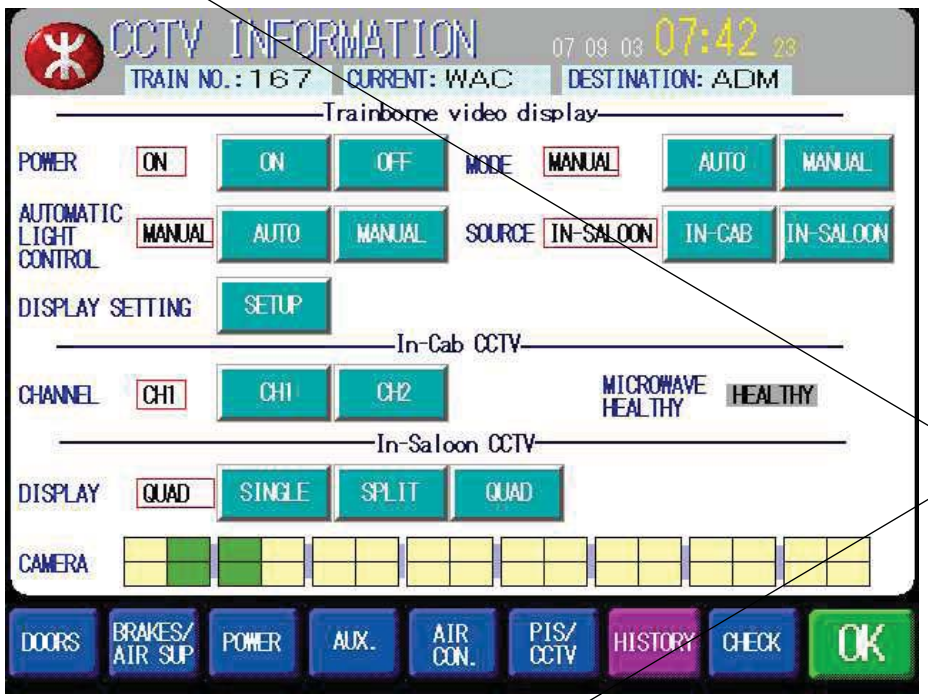
D

B485

			MITSUBISHI ELECTRIC CORPORATION., JAPAN								
			CHANGE								DOCUMENT NO.
			B	22. May. 09	D	28. Aug. 09	G	05. Nov. 09			JHAV438
			C	08. Jul. 09	E	24. Sep. 09					52-6

(4) MICROWAVE HEALTHY

The Display setting is shown as follows:



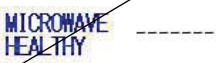
C D

B480

in case of the HEALTY:

in case of the FAIL:

in case of the Off line



3.3. 13 CCTV function

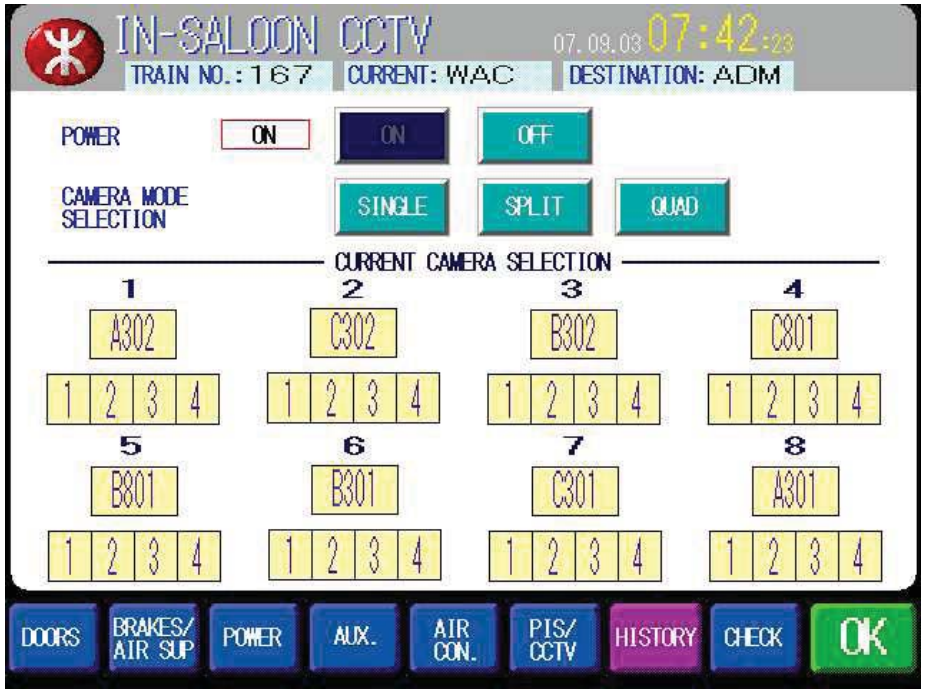
(1) In-Saloon CCTV screen

This screen allows the train operator to input the information for the In-Saloon CCTV information system control.

The following information are changed by pressing by the key in the corresponding position;

(1) POWER
(2) CAMERA MODE SELECTION
(3) CURRENT CAMERA SELECTION (information only)

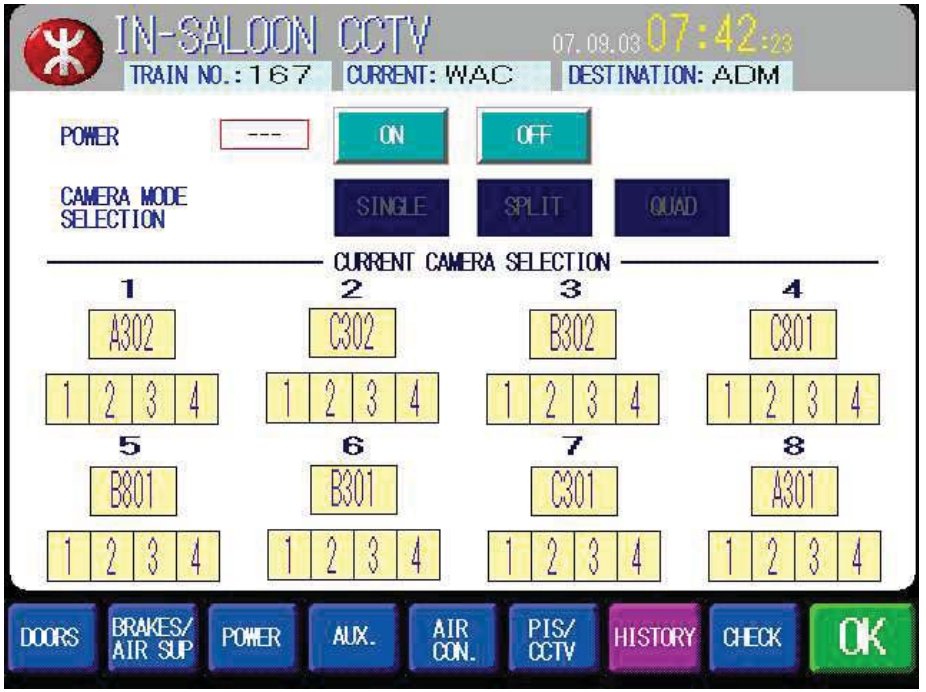
The DVAS On-line is shown as follows;



J L M

B500

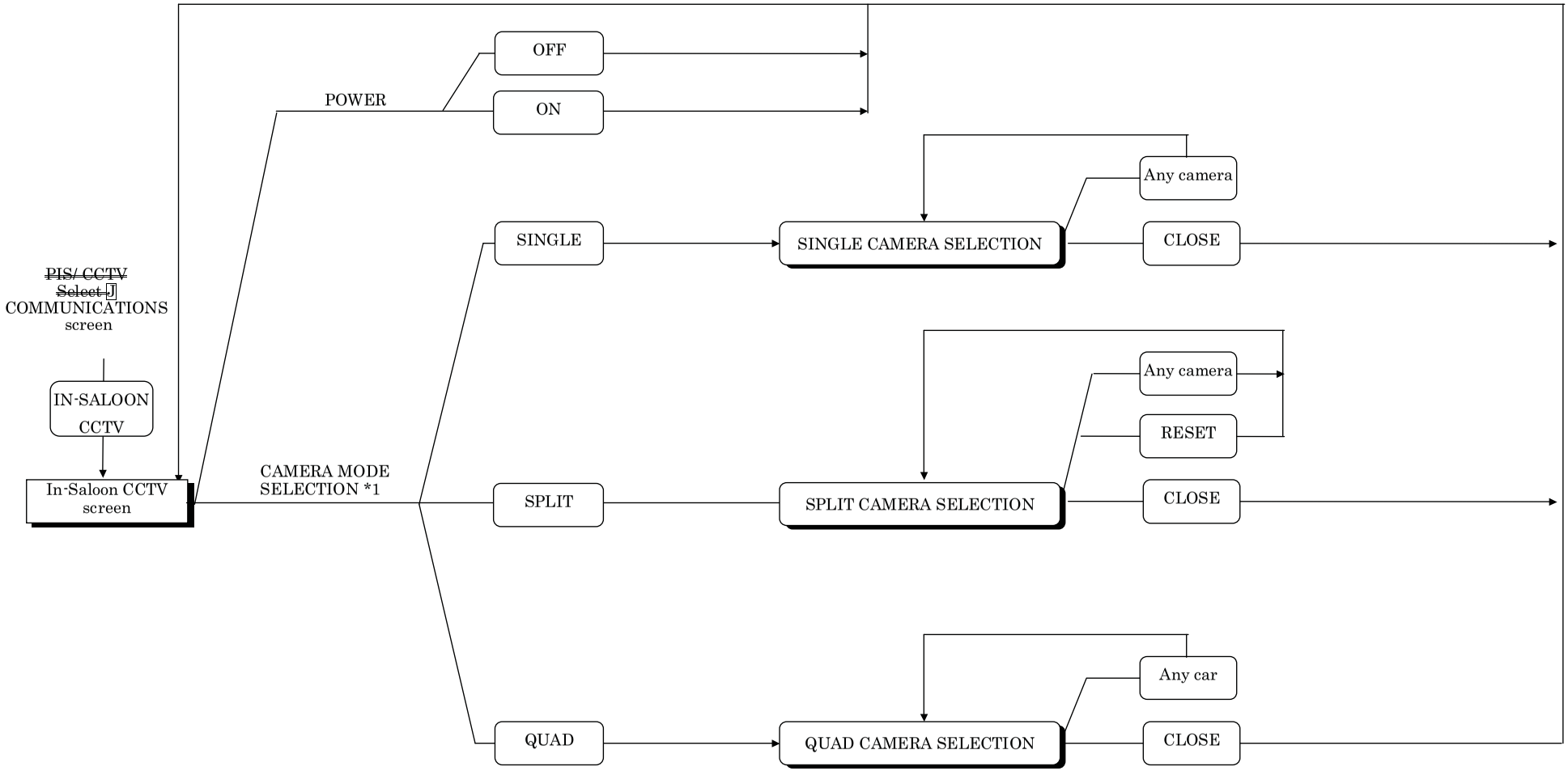
The DVAS Off-line is shown as follows;



J K L M

B528

Operation flow of In-Saloon CCTV information screen is shown as follows;



(NOTE)

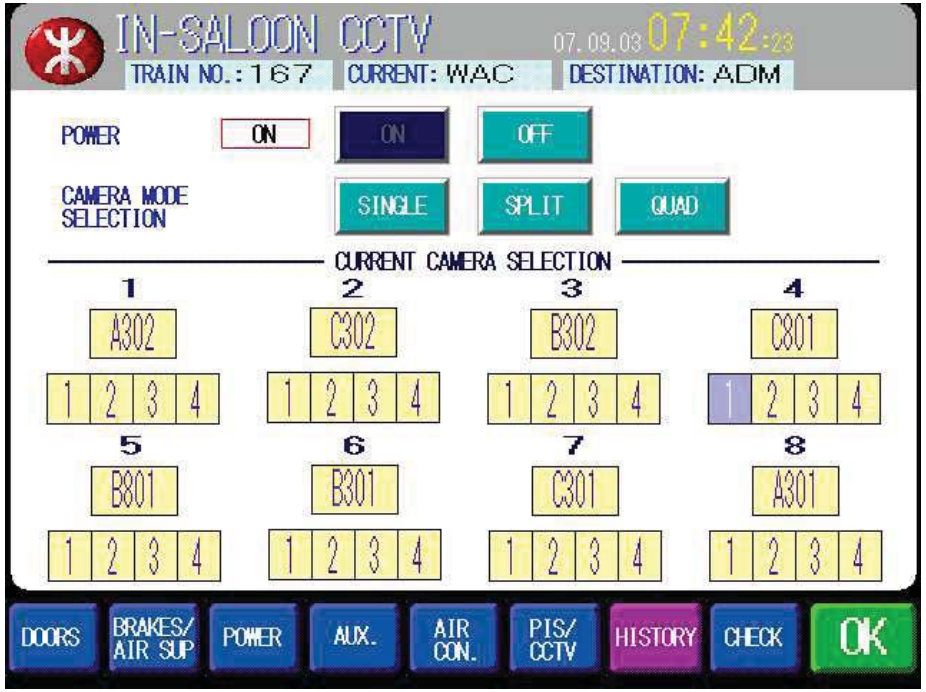
*1 : Only when power of In-Saloon is ON, a camera mode selection can be operated.

1. Power

POWER ON
- CAMERA MODE SELECTION can be selected.
- Selected Camera of CURRENT CAMERA SELECTION is highlighted in purple.
- ~~When the "ON" key of the power of In-Saloon CCTV is touched, the power of In-Cab CCTV is set to OFF.~~ J

POWER OFF
- CAMERA MODE SELECTION cannot be selected.
- Camera of CURRENT CAMERA SELECTION selected is not highlighted in purple.
- When the "OFF" key of the power of In-Saloon CCTV is touched, the ~~power~~ J mode of In-Cab CCTV is set to AUTO J ~~ON~~.

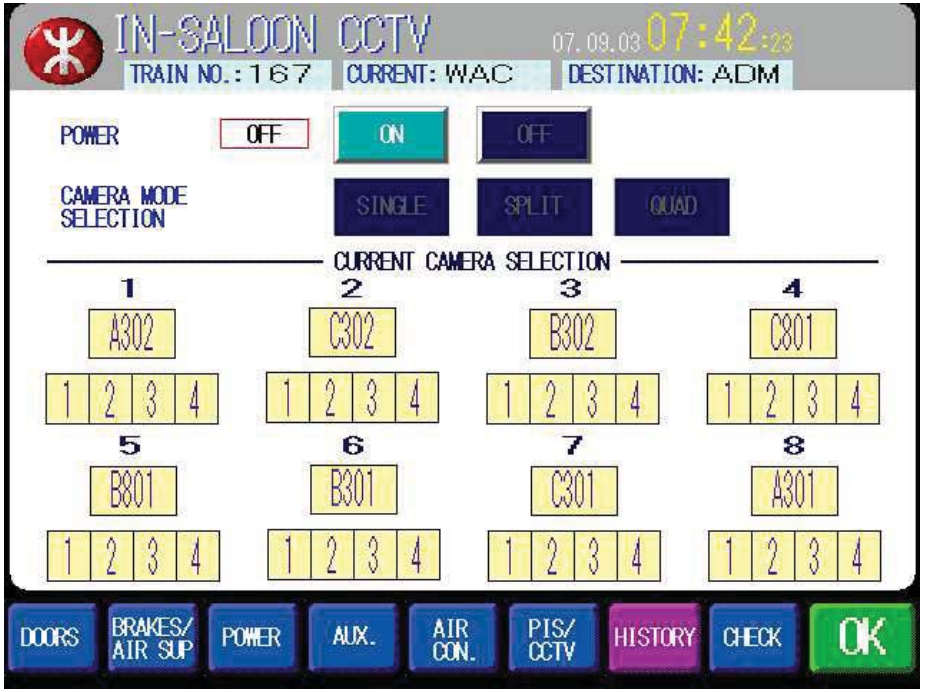
The POWER ON is shown as follows;



J L M

B521

The POWER OFF is shown as follows;



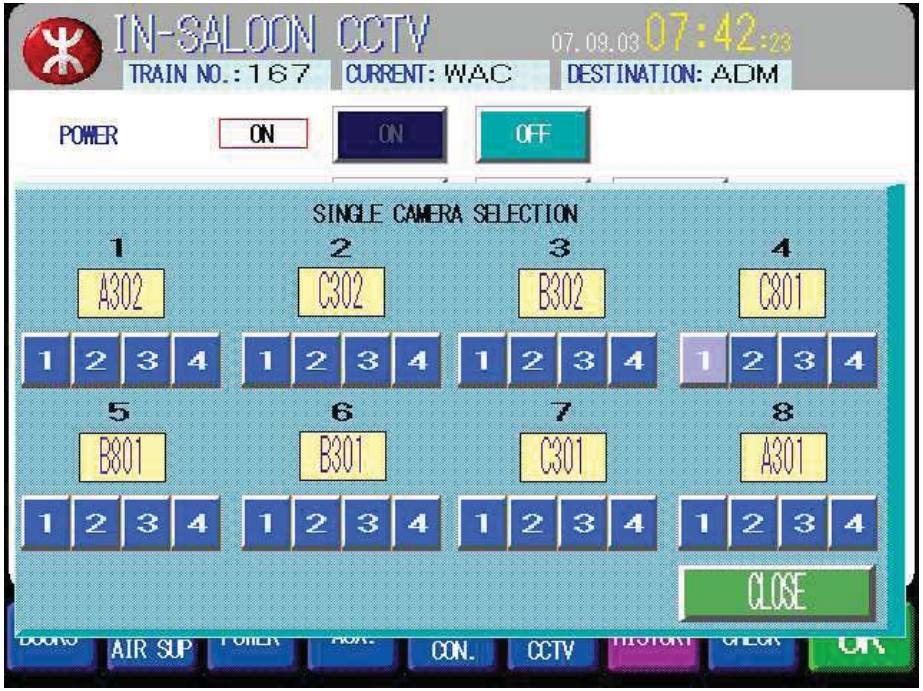
L M

B501

2. Camera Mode Selection

- When the key of Camera Mode Selection is selected, it is not highlighted.
- Camera Mode Selection is available only when the power of In-Saloon is ON.
- The kind of Camera Mode is three, "SINGLE" , "SPLIT" and "QUAD".
- As for the Car of Window, occupied cab is displayed first.
- The SINGLE and SPLIT of Camera Selection window is displayed at camera section.(not a camera number.) Ref to 3.CURRENT CAMERA SELECTION.
- When touched in the key in the same mode as the current mode, the already selected camera is highlighted when window opened. J

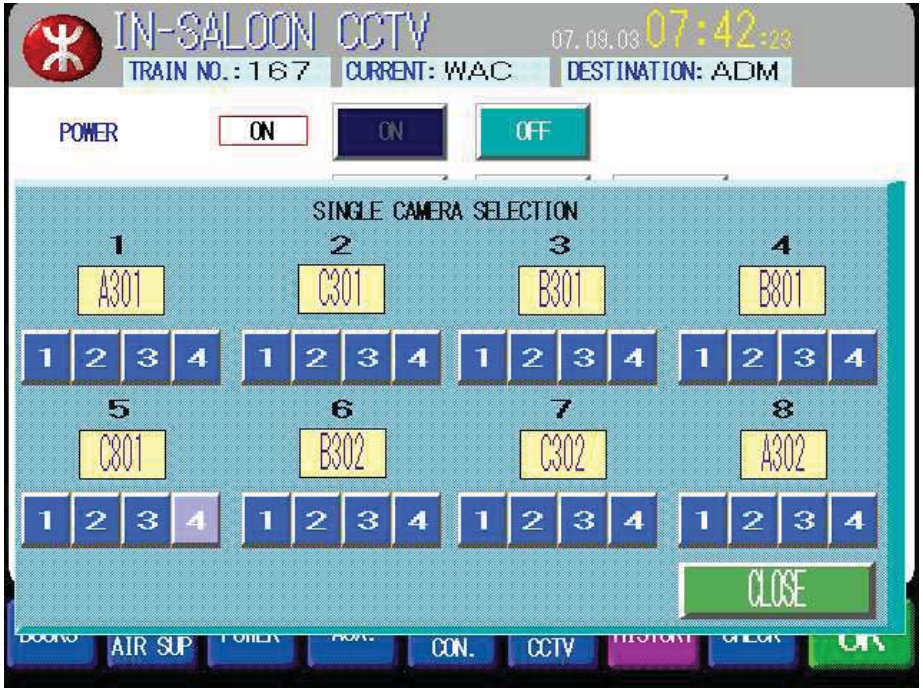
When A302 is occupied cab, it is shown as follows;



J L M

B505

When A301 is occupied cab, it is shown as follows;

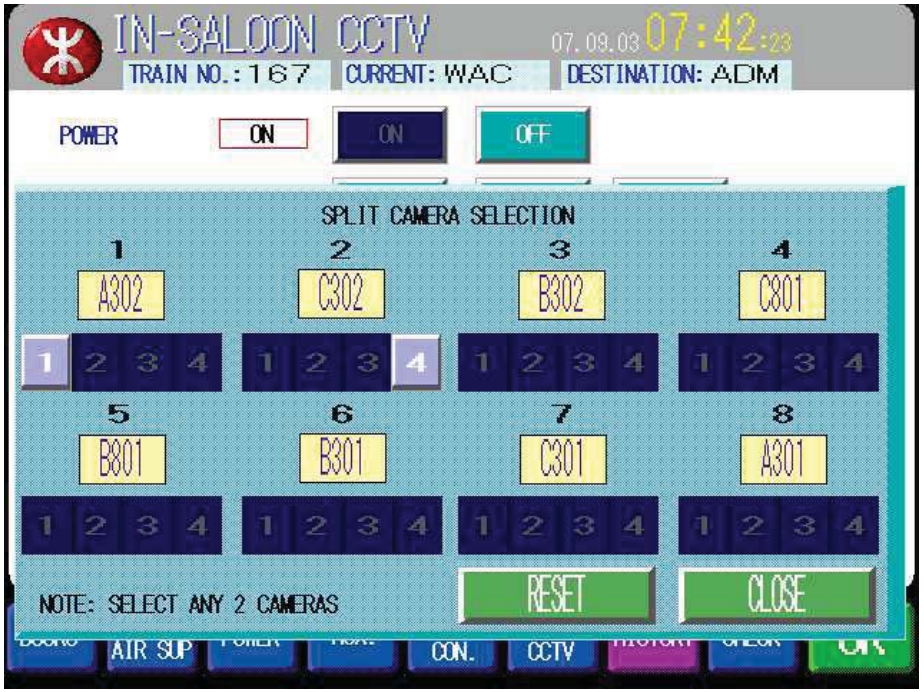


J L M

B527

G This page added

When touched in the key in the same mode as the current mode, the already selected camera is highlighted when window opened. J
(ex. Camera mode : SPLIT, Camera : Camera Number1of A302 and Number4 of C302 is selected)



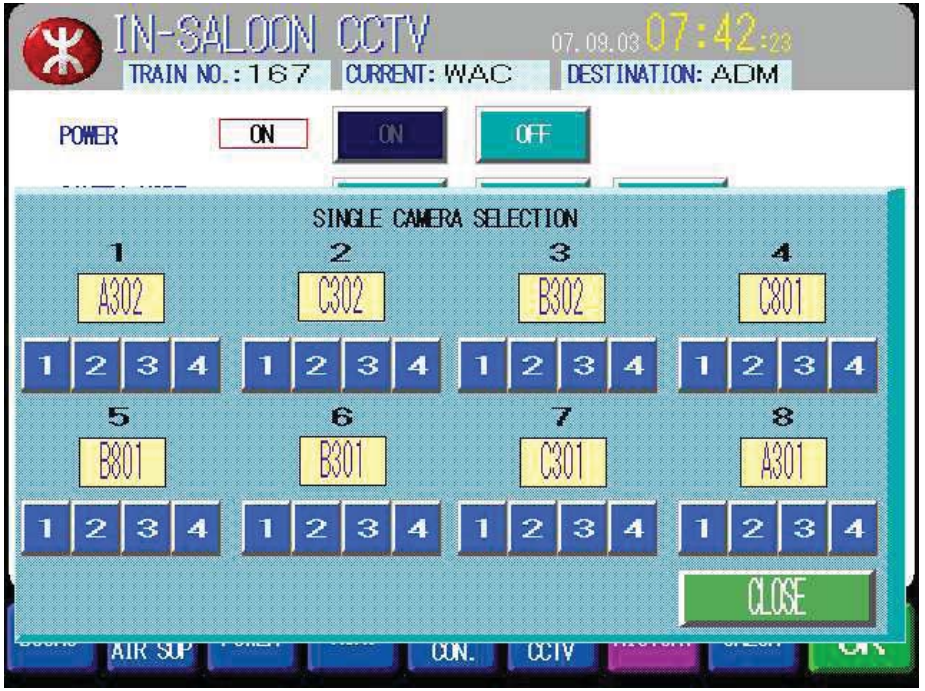
L M

B509

If a SINGLE key or QUAD key are being pushed, the currently selected cameras will not be highlighted in the camera selection window.

・SINGLE Camera Selection
- Only one camera can be selected
- ~~If a camera has already been selected in single camera mode, it will be highlighted in purple.~~ J
- When the key of Camera Section was selected, it is highlighted.
- CLOSE key is touched for clearing a window.
  (Window is not cleared even if it selected a camera.)

The SINGLE Camera Selection window is shown as follows;



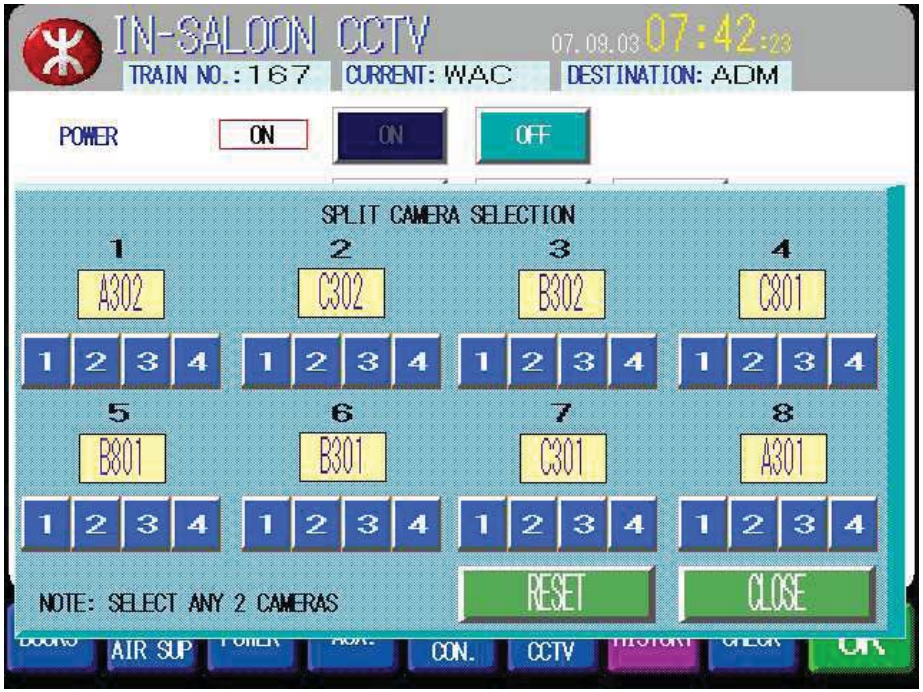
J L M

B504

			MITSUBISHI ELECTRIC CORPORATION., JAPAN									
			CHANGE								DOCUMENT NO.	
			G	05. Nov. 09	L	05. Jan. 10					JHAV438	52 -12
			J	04. Dec. 09	M	28. Jan. 10						

・SPLIT Camera Selection
- Two cameras can be selected. Selection of only one camera is also possible.
- ~~When a Camera Selection window is opened, it is not highlighted even if the camera was set.~~ J
- When the key of Camera Section was selected, it is highlighted.
- If two cameras are selected, it becomes impossible to select the camera which has not been selected.
- The camera selected when RESET key was touched is cleared.
- CLOSE key is touched for clearing a window
  .(Window is not cleared even if it selected a camera.)

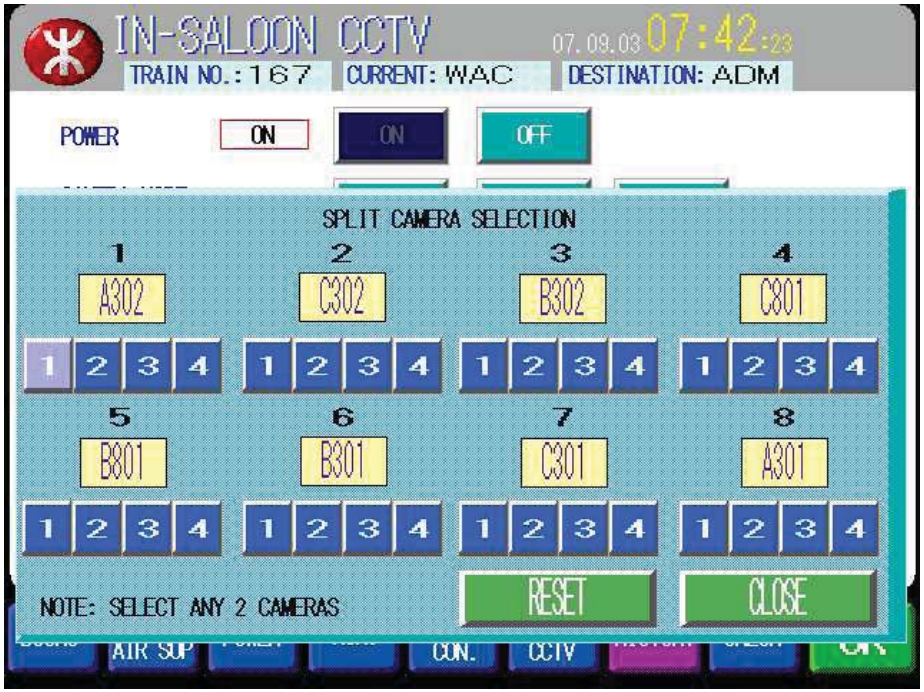
The SPLIT Camera Selection window is shown as follows;



J L M

B507

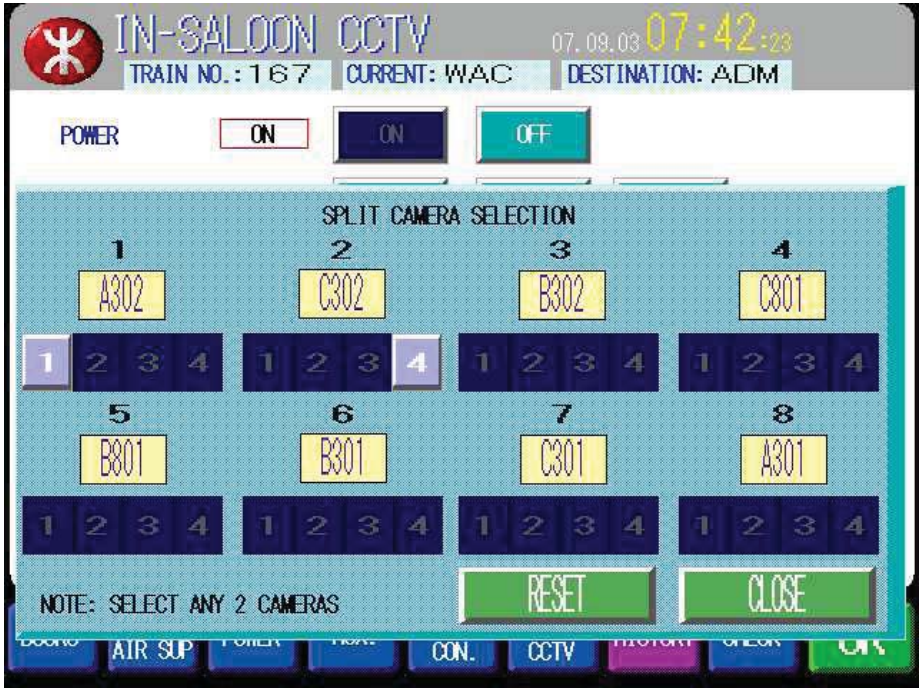
The One camera is selected. is shown as follows;



J L M

B508

The Two camera is selected. is shown as follows;



J L M

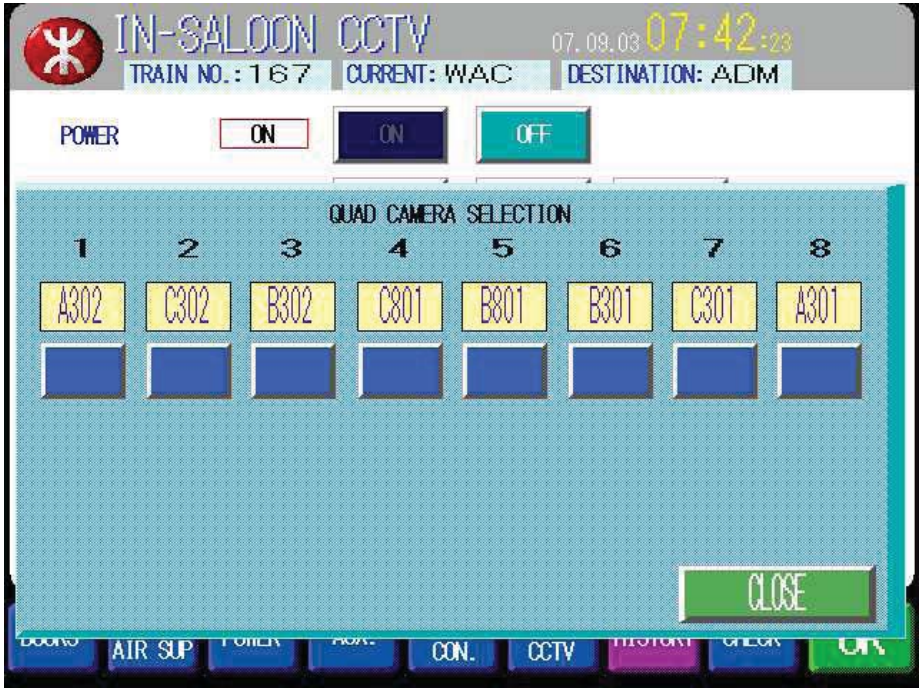
B509

If two cameras are selected, it becomes impossible to choose the camera which has not been selected.
The camera selected when RESET key was touched is cleared.

・QUAD Camera Selection

- Only one Car can be selected
- ~~When a Camera Selection window is opened, it is not highlighted even if the camera was set.~~ J
- When the key of Camera section was selected, it is highlighted.
- key is touched for clearing a window.(Window is not cleared even if it selected a car.)

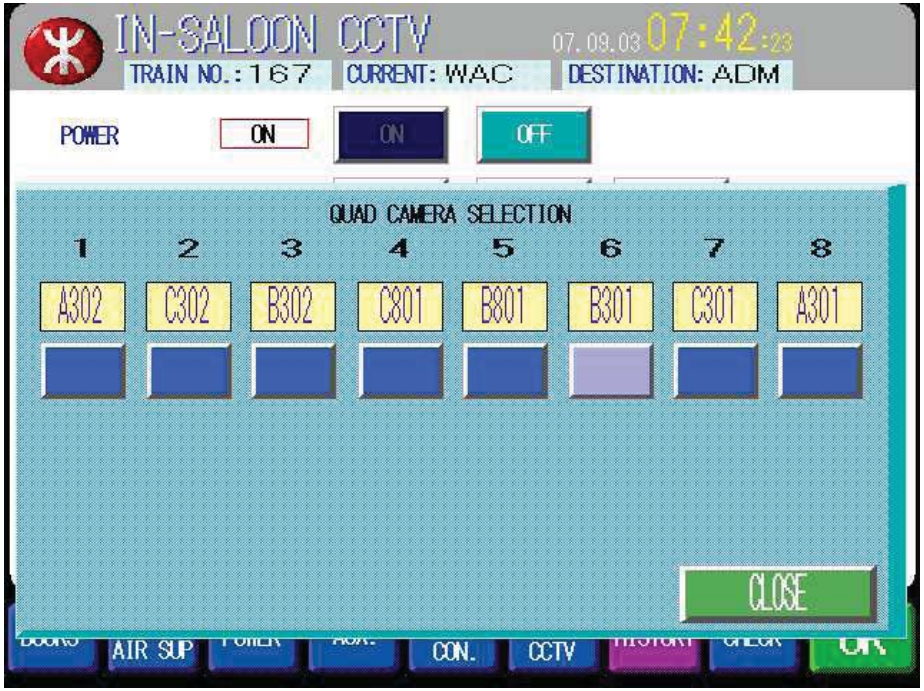
The QUAD Camera Selection window is shown as follows;



J L M

B511

The B301 is selected. is shown as follows;



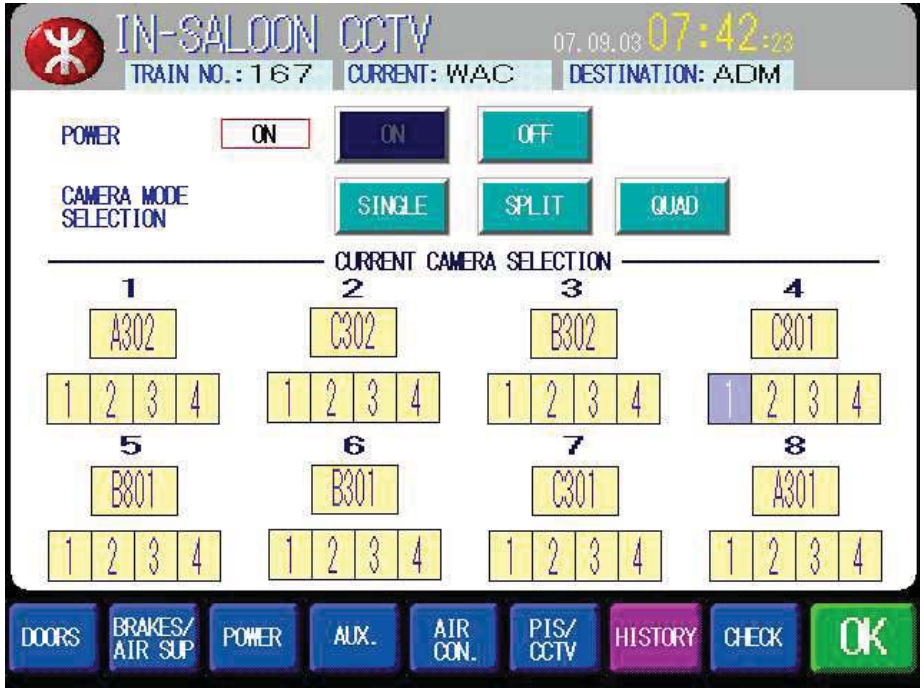
J L M

B522

3. CURRENT CAMERA SELECTION

- The selected camera of CURRENT CAMERA SELECTION is highlighted in purple, only when the power of In-saloon is ON.
- As for the Car of CURRENT CAMERA SELECTION, occupied cab is displayed first.
- The "Current Camera Selection" is displayed at camera section.(not a camera number.)

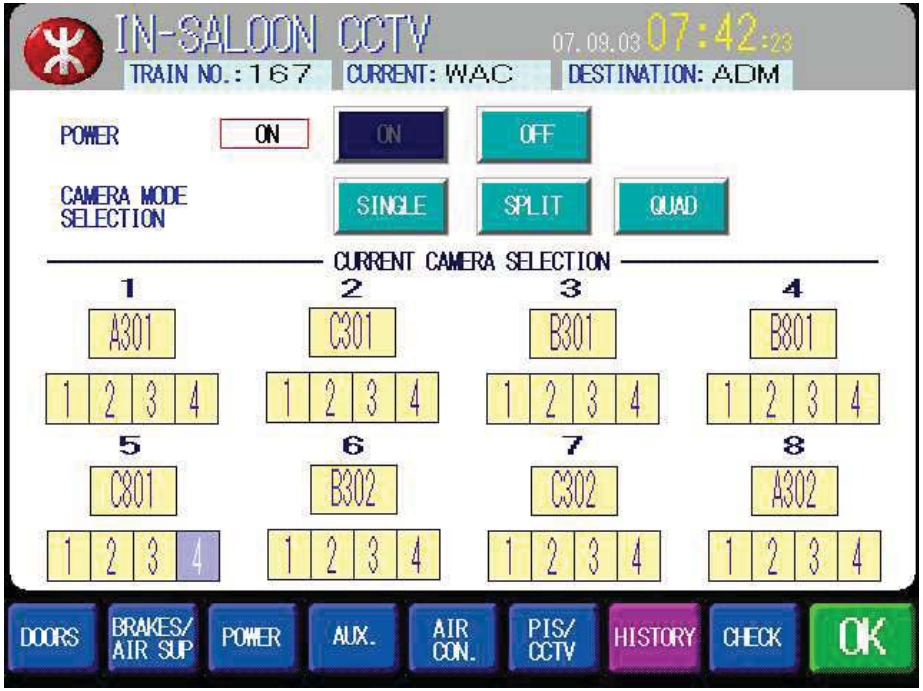
When A302 is occupied cab, it is shown as follows;



J L M

B521

When A301 is occupied cab, it is shown as follows;

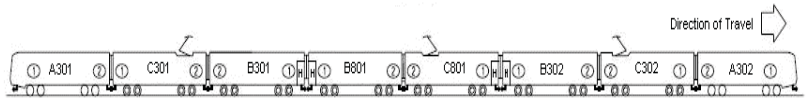


J L M

B523

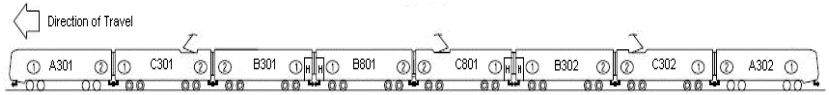
・ Camera Number and Camera section Mapping

A302 occupied



Car position	Car Number	Camera Section	Car Number (SDR/SD)	Camera Number (SDR/SD)
1	A302	1	8	1
		2		3
		3		2
		4		4
2	C302	1	7	1
		2		3
		3		2
		4		4
3	B302	1	6	4
		2		2
		3		3
		4		1
4	C801	1	5	1
		2		3
		3		2
		4		4
5	B801	1	4	4
		2		2
		3		3
		4		1
6	B301	1	3	1
		2		3
		3		2
		4		4
7	C301	1	2	4
		2		2
		3		3
		4		1
8	A301	1	1	4
		2		2
		3		3
		4		1

A301 occupied



Car position	Car Number	Camera Section	Car Number (SDR/SD)	Camera Number (SDR/SD)
1	A301	1	1	1
		2		3
		3		2
		4		4
2	C301	1	2	1
		2		3
		3		2
		4		4
3	B301	1	3	4
		2		2
		3		3
		4		1
4	B801	1	4	1
		2		3
		3		2
		4		4
5	C801	1	5	4
		2		2
		3		3
		4		1
6	B302	1	6	1
		2		3
		3		2
		4		4
7	C302	1	7	4
		2		2
		3		3
		4		1
8	A302	1	8	4
		2		2
		3		3
		4		1

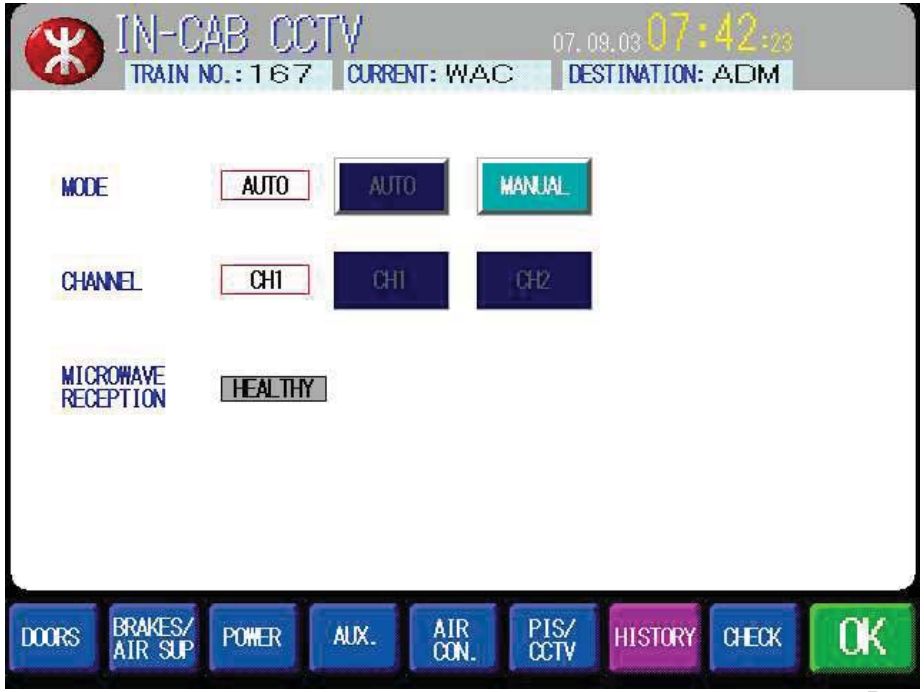
(2) In-Cab CCTV screen

This screen allows the train operator to input the information for the In-Cab CCTV information system control.

The following information are changed by pressing by the key in the corresponding position;

~~(1) POWER~~ J
(1) MODE
(2) CHANNEL
(3) MICROWAVE RECEPTION (information only)

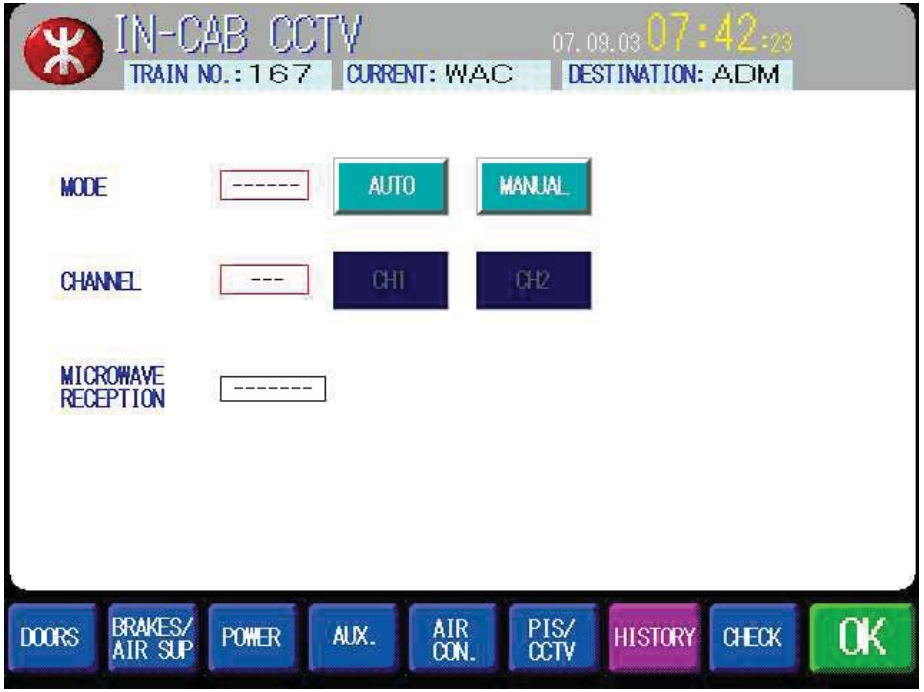
The DVAS On-line is shown as follows;



J L M

B514

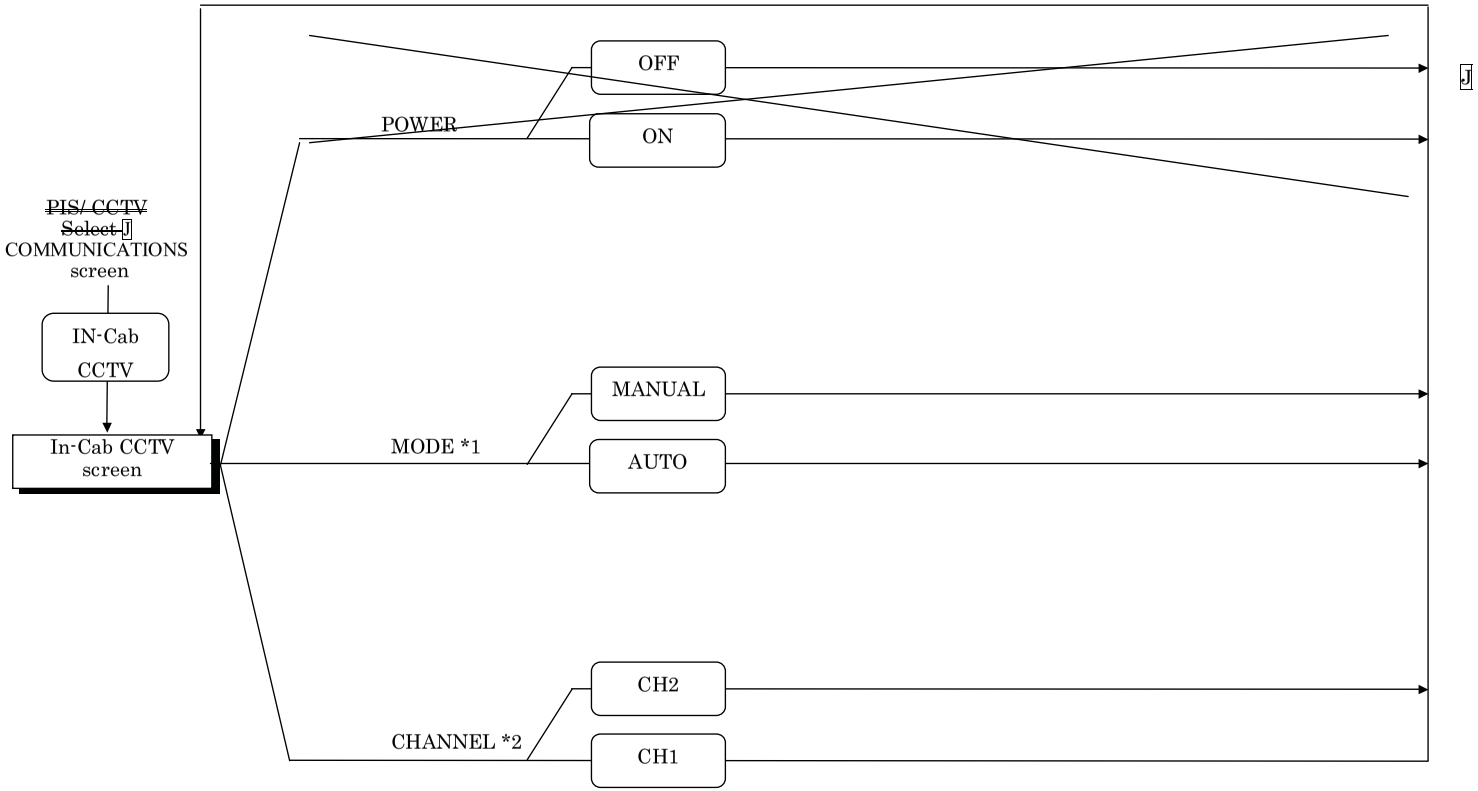
The DVAS Off-line is shown as follows;



J L M

B529

Operation flow of In-Cab CCTV information screen is shown as follows;



(NOTE)

*1 : Only when power of In-Cab is ON, a MODE can be operated.

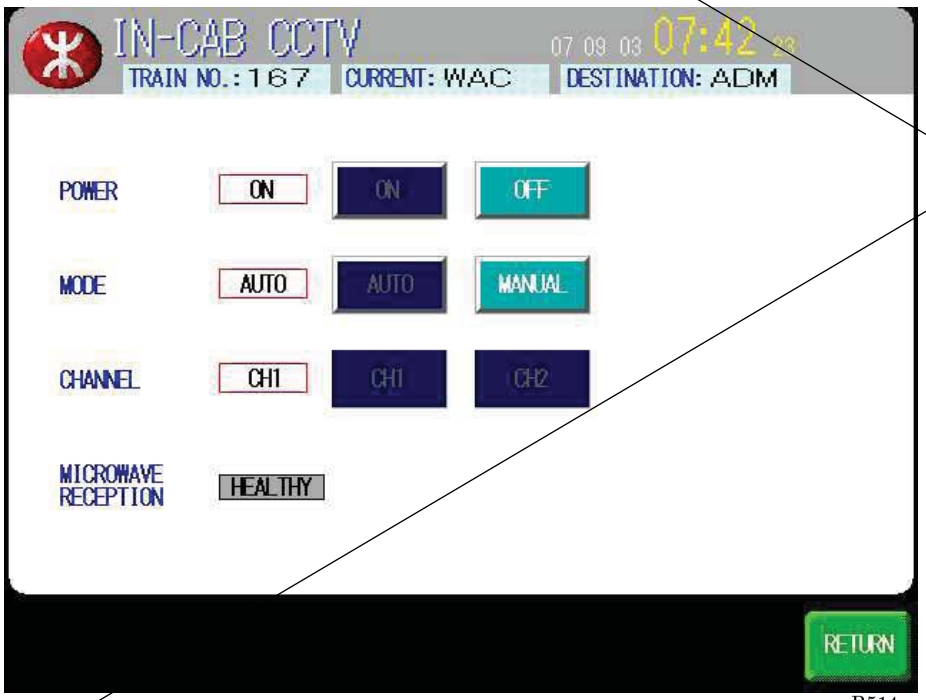
*2 : Only when power of In-Cab is ON and mode of In-Cab is MANUAL, a CHANNEL can be operated.

1. Power

POWER ON
- MODE can be selected.(CHANNEL can also be selected when MODE is MANUAL.)
- When the "ON" key of the power of In-Cab CCTV is touched, the MODE of In-Cab CCTV is set to AUTO.
  And power of In-Saloon CCTV is set to OFF.

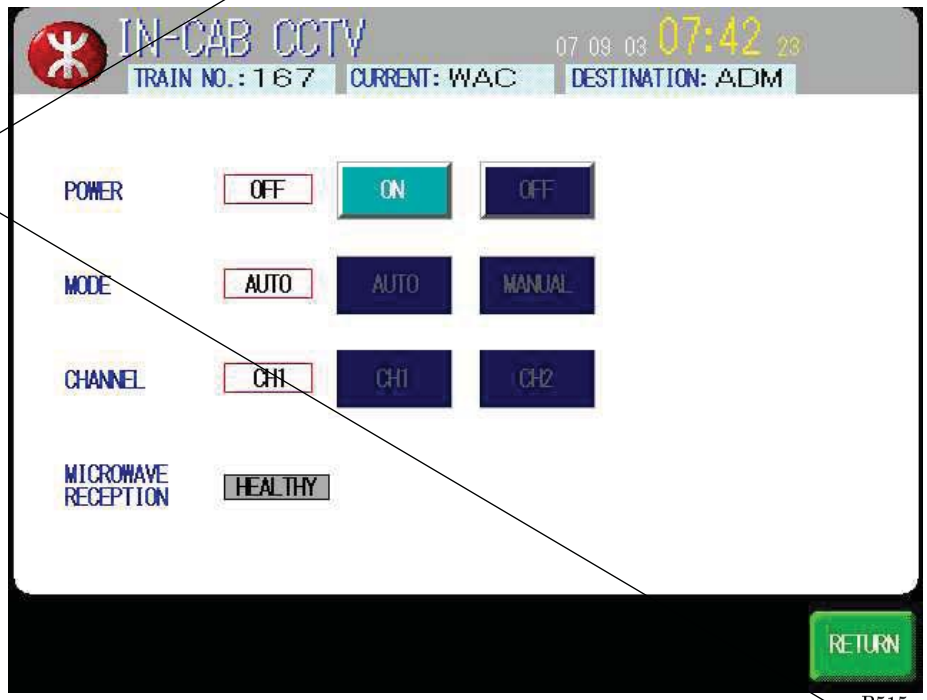
POWER OFF
- MODE and CHANNEL cannot be selected.
- When the "OFF" key of the power of In-Cab CCTV is touched, the power of Trainborne video display is set to OFF.

The POWER ON is shown as follows;



B514

The POWER OFF is shown as follows;



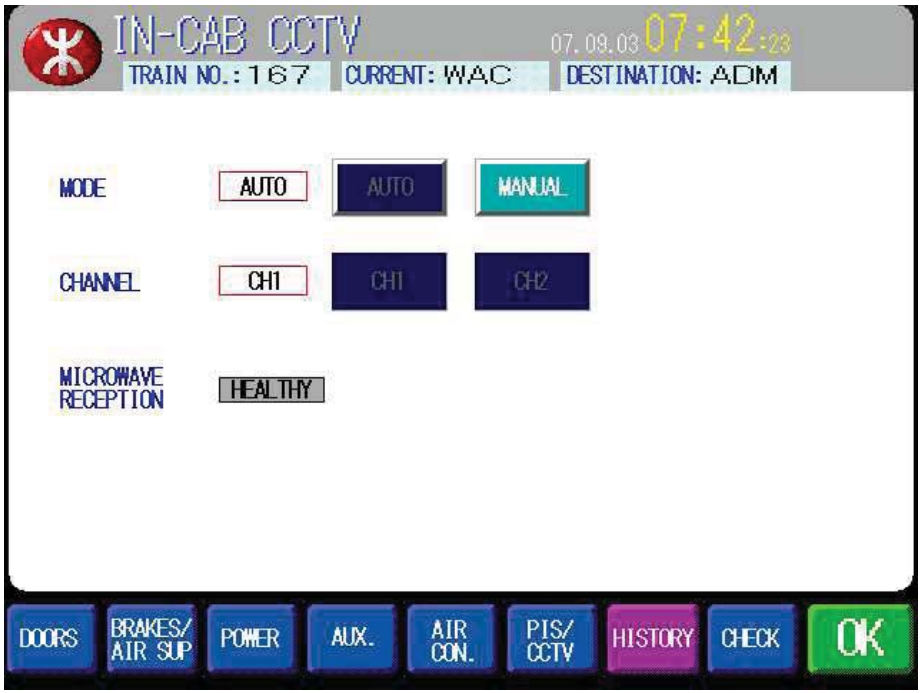
B515

2. Mode

AUTO
- CHANNEL cannot be selected.

MANUAL
- CHANNEL can be selected.

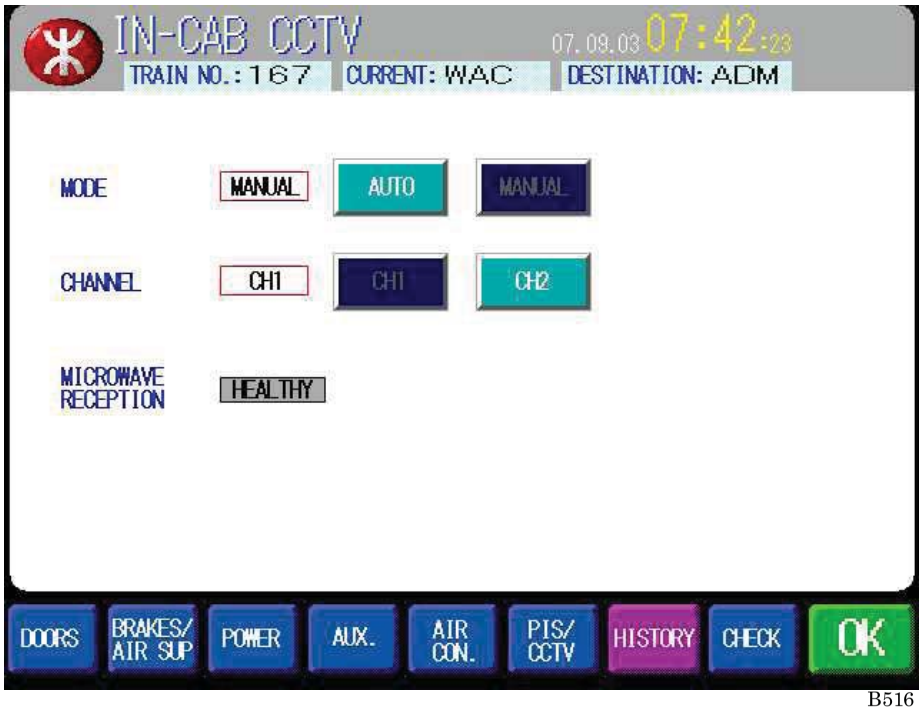
The AUTO is shown as follows;



J L M

B514

The MANUAL is shown as follows;



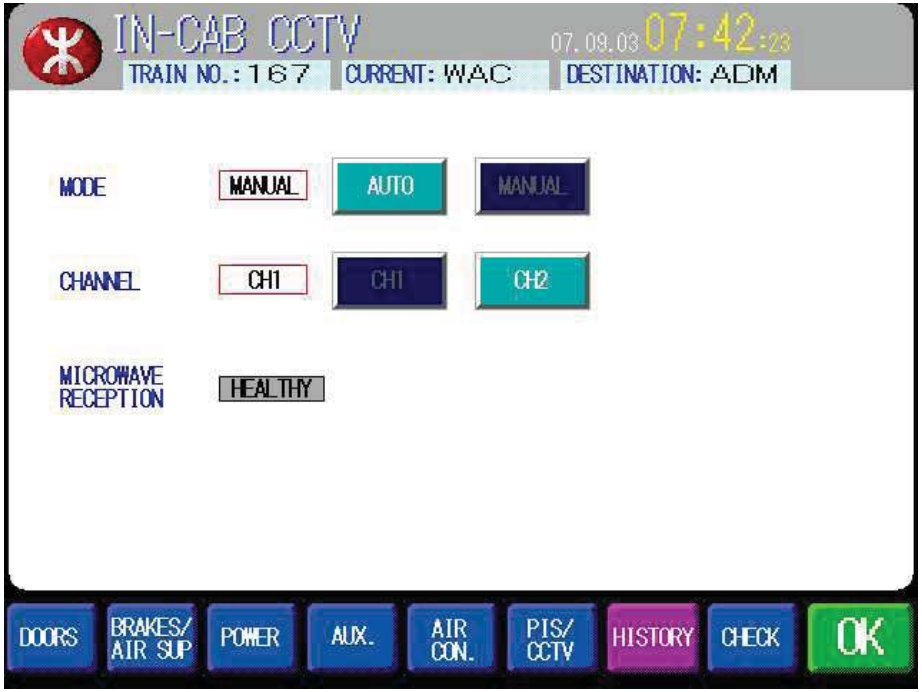
J L M

B516

3. Channel

Only when power of In-Cab is ON and mode of In-Cab is MANUAL, a CHANNEL can be operated.

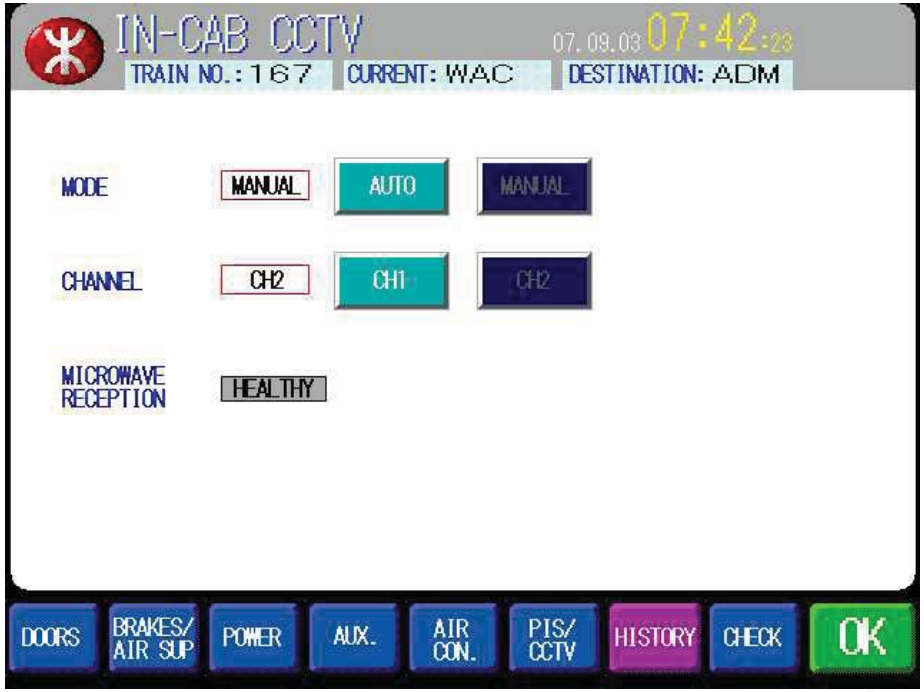
The CH1 is shown as follows;



J L M

B516

The CH2 is shown as follows;

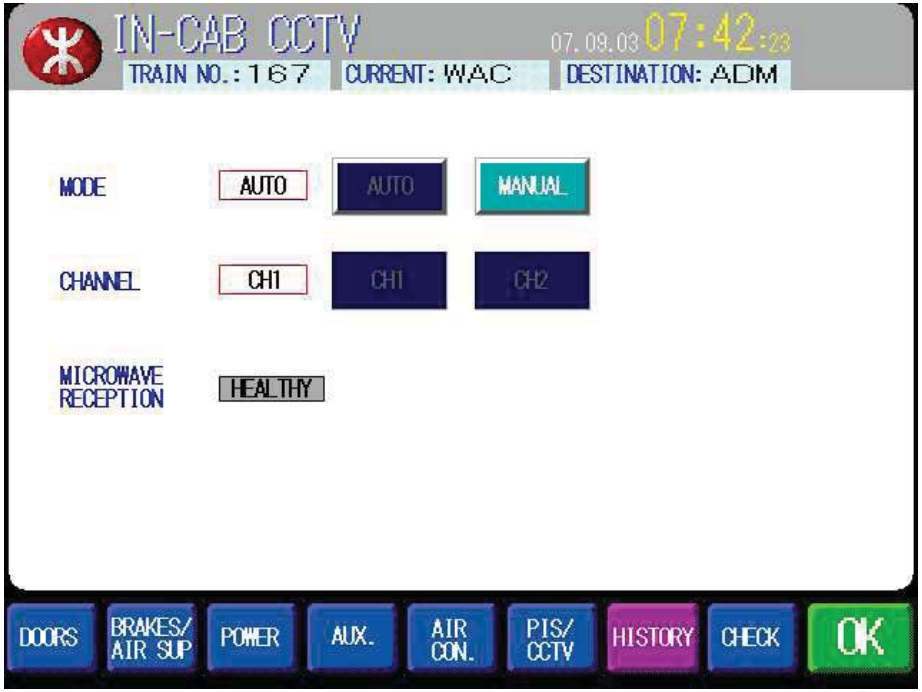


J L M

B524

4. Microwave Reception

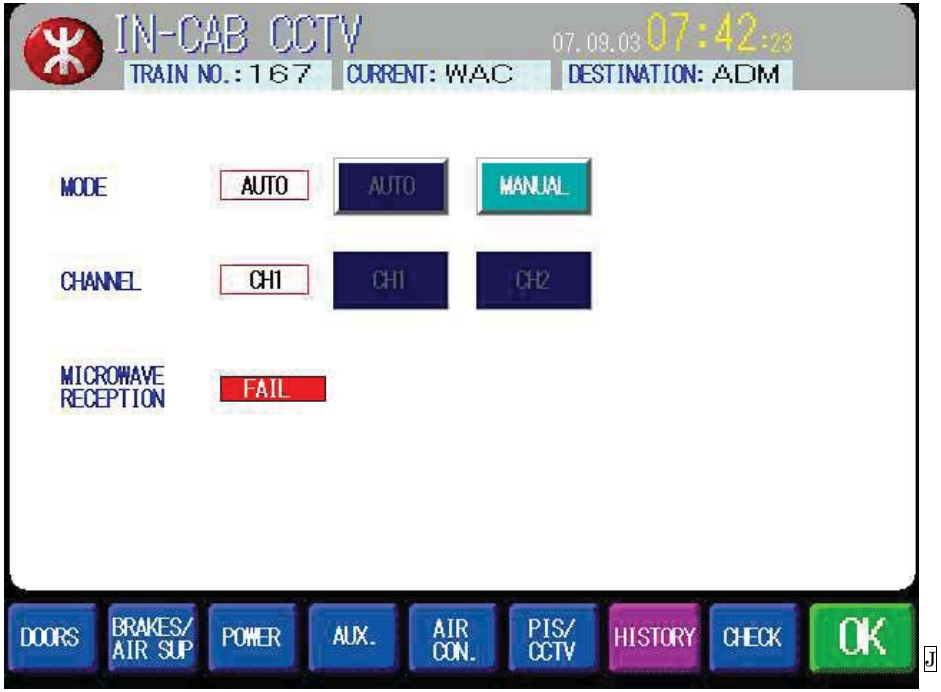
The HEALTHY is shown as follows;



J L M

B514

The FAIL is shown as follows;



J L M

B517

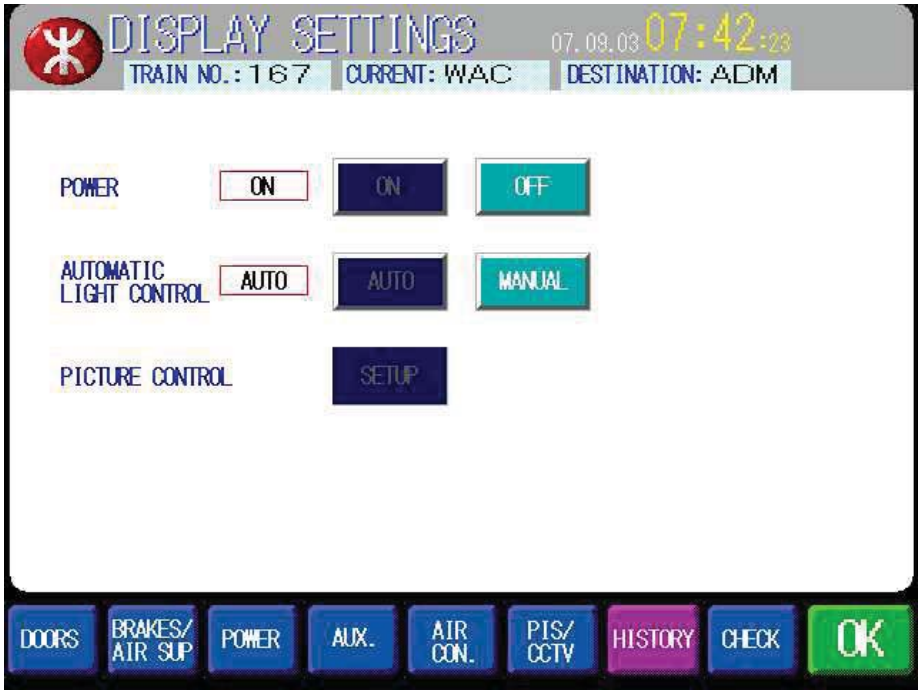
(3) ~~Trainborne video display screen~~ J DISPLAY SETTINGS screen

This screen allows the train operator to input the information for the Trainborne video display control.

The following information are changed by pressing by the key in the corresponding position;

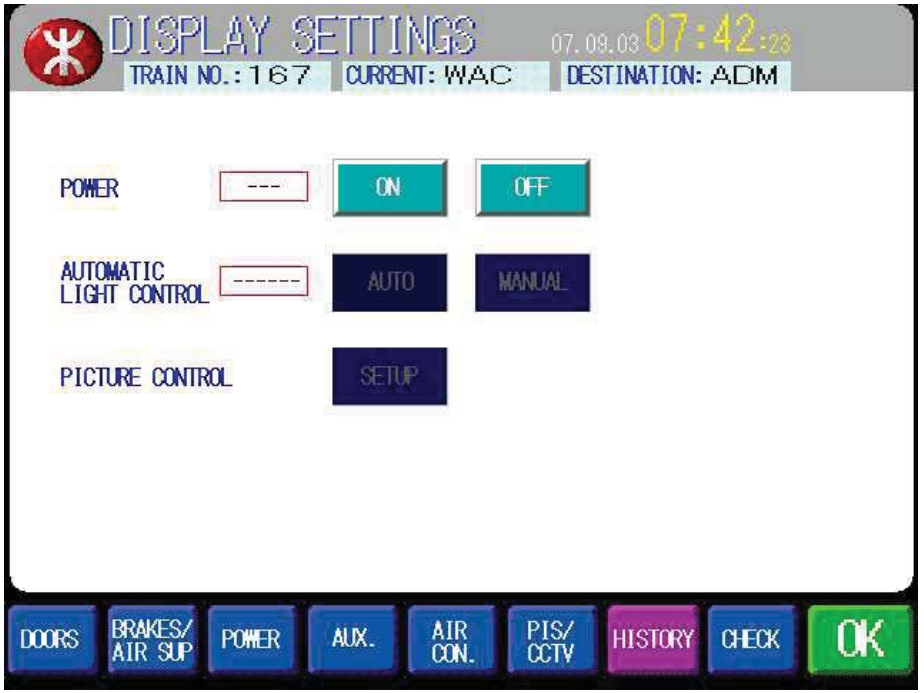
(1) POWER
(2) AUTOMATIC LIGHT CONTROL
(3) ~~DISPLAY SETTING~~ J PICTURE CONTROL

The DVAS On-line is shown as follows;



J L M

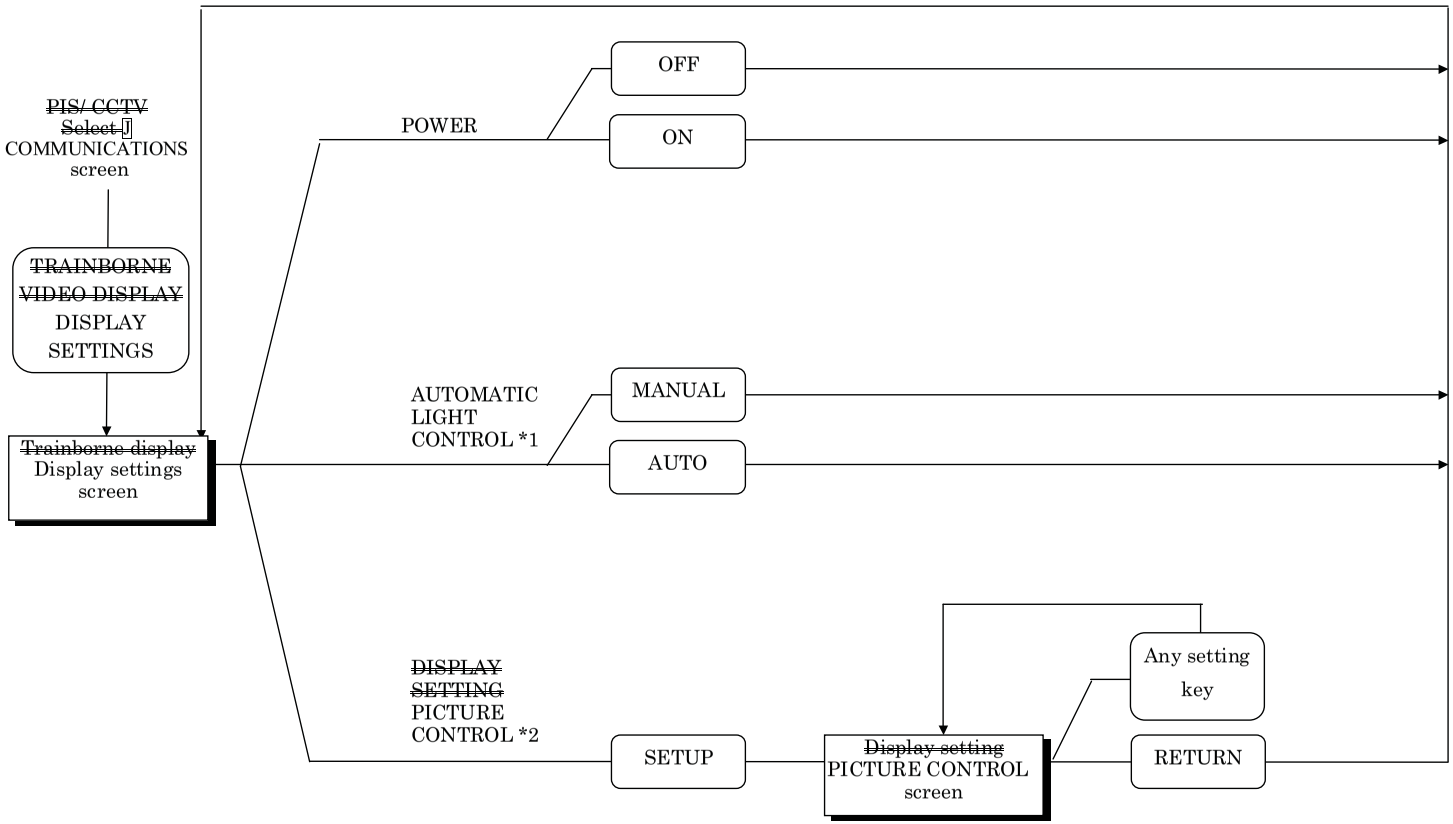
B518



J L M

B530

Operation flow ~~of In-Cab CCTV information~~ J Display Settings screen is shown as follows;



(NOTE)

*1 : Only when power of ~~Trainborne video display~~ J Display Settings is ON, a AUTOMATIC LIGHT CONTROL can be operated.

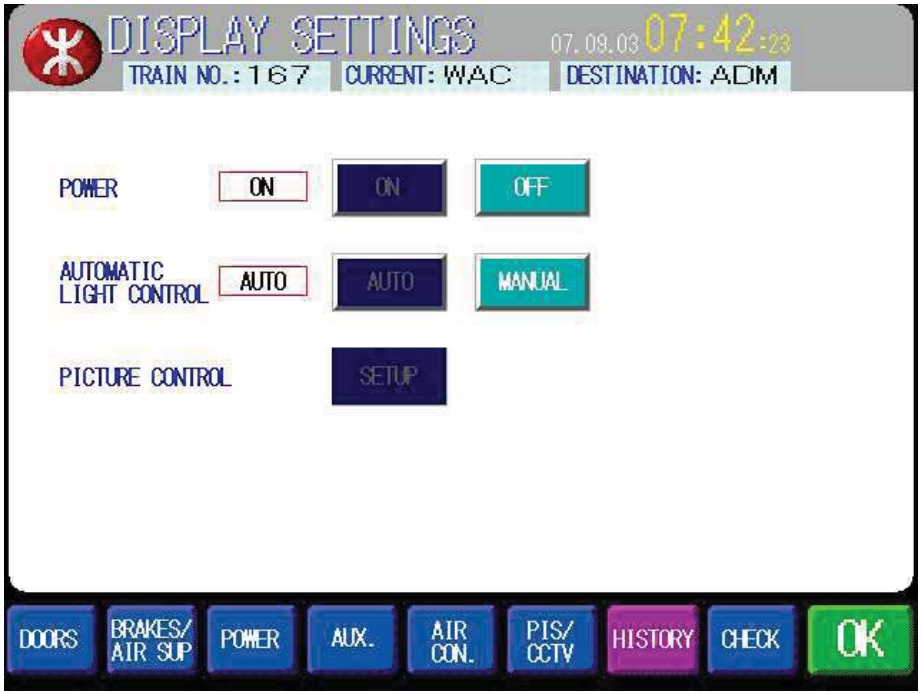
*2 : Only when power of ~~Trainborne video display~~ J Display Settings is ON and AUTOMATIC LIGHT CONTROL of ~~Trainborne video display~~ J Display Settings is MANUAL, a ~~DISPLAY SETTING~~ L PICTURE CONTROL can be operated.

1. Power

POWER ON
- AUTOMATIC LIGHT CONTROL can be selected.
  (~~DISPLAY SETTING~~ J PICTURE CONTROL can also be selected when AUTOMATIC LIGHT CONTROL is MANUAL.)
- When the "ON" key of the power ~~of Trainborne video display~~ is touched, the ~~POWER of In-Cab CCTV is set to ON and the~~ MODE of In-Cab CCTV is set to AUTO.
  And AUTOMATIC LIGHT CONTROL of ~~In-Cab CCTV~~ J DISPLAY SETTING is set to AUTO.

POWER OFF
- AUTOMATIC LIGHT CONTROL and ~~DISPLAY SETTING~~ J PICTURE CONTROL cannot be selected.
- When the "OFF" key of the power ~~of Trainborne video display~~ J is touched, the power of In-Saloon CCTV ~~and In-Cab CCTV~~ J is set to OFF.

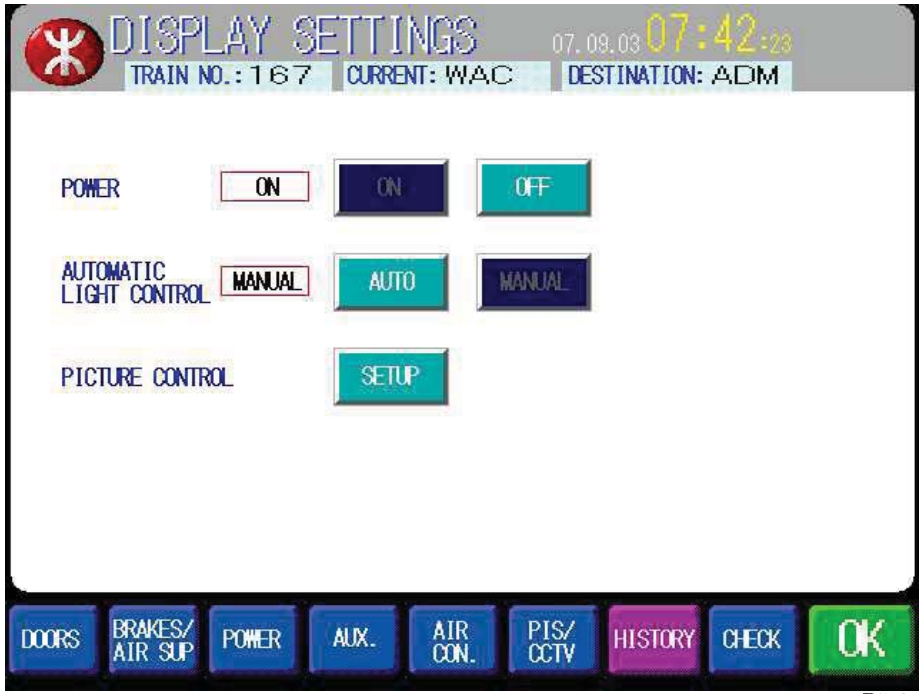
The POWER ON is shown as follows;



J L M

B518

The POWER OFF is shown as follows;



J L M

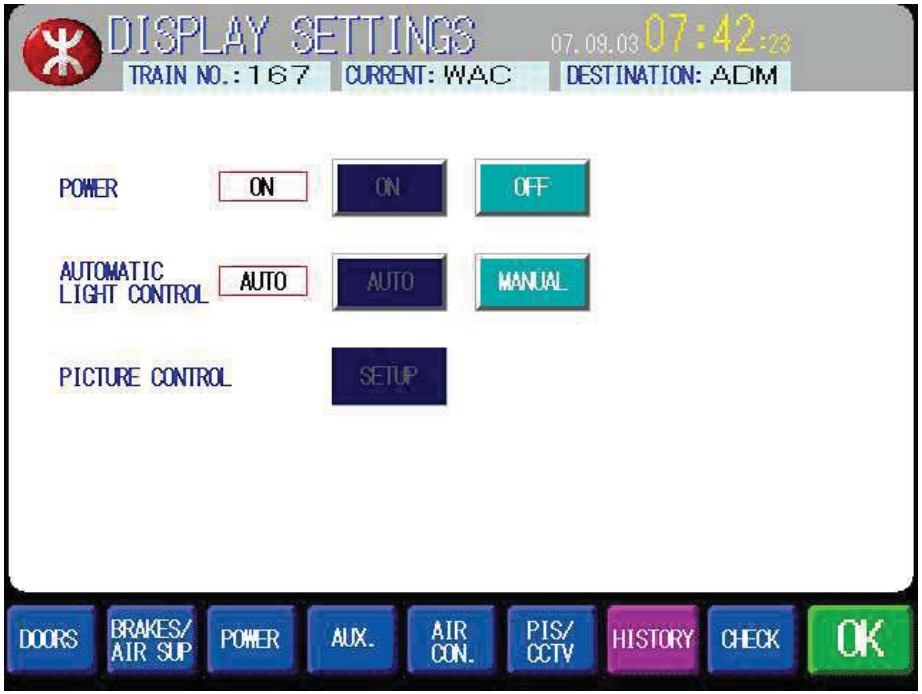
B519

2. Automatic Light Control

AUTO
- ~~DISPLAY SETTING~~ J PICTURE CONTROL cannot be selected.

MANUAL
- ~~DISPLAY SETTING~~ J PICTURE CONTROL can be selected.

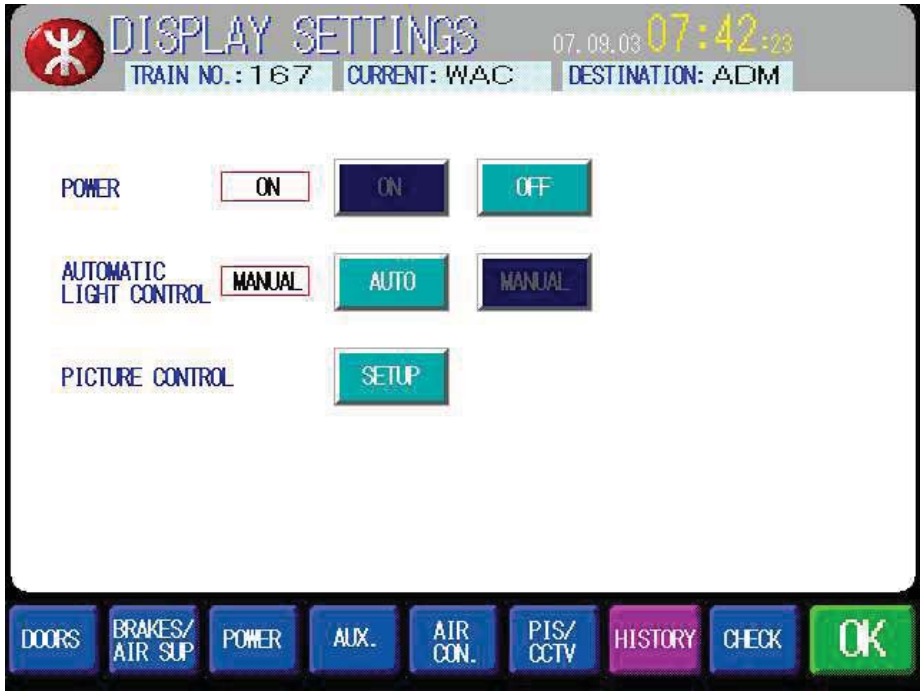
The AUTO is shown as follows;



J L M

B518

The MANUAL is shown as follows;



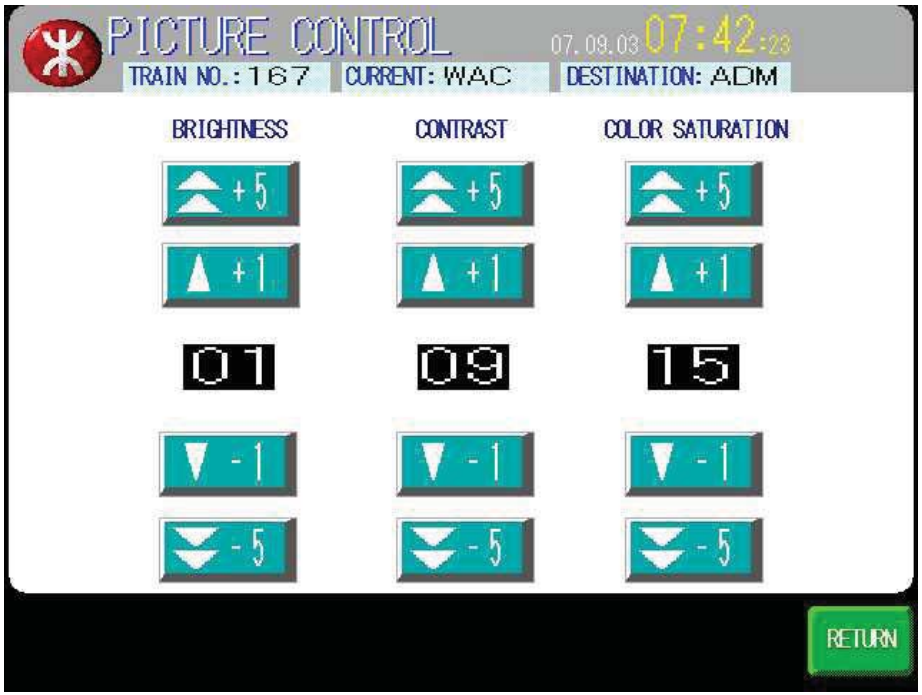
J L M

B520

3. ~~Display Setting~~ J Picture Control

- Only when AUTOMATIC LIGHT CONTROL of ~~Trainborne video display~~ J Display Settings is MANUAL, a ~~DISPLAY SETTING~~ J Picture Control can be operated.
- The Display setting screen is displayed when touching SETUP key.

The ~~Display Setting~~ J Picture Control screen is shown as follows;



J L

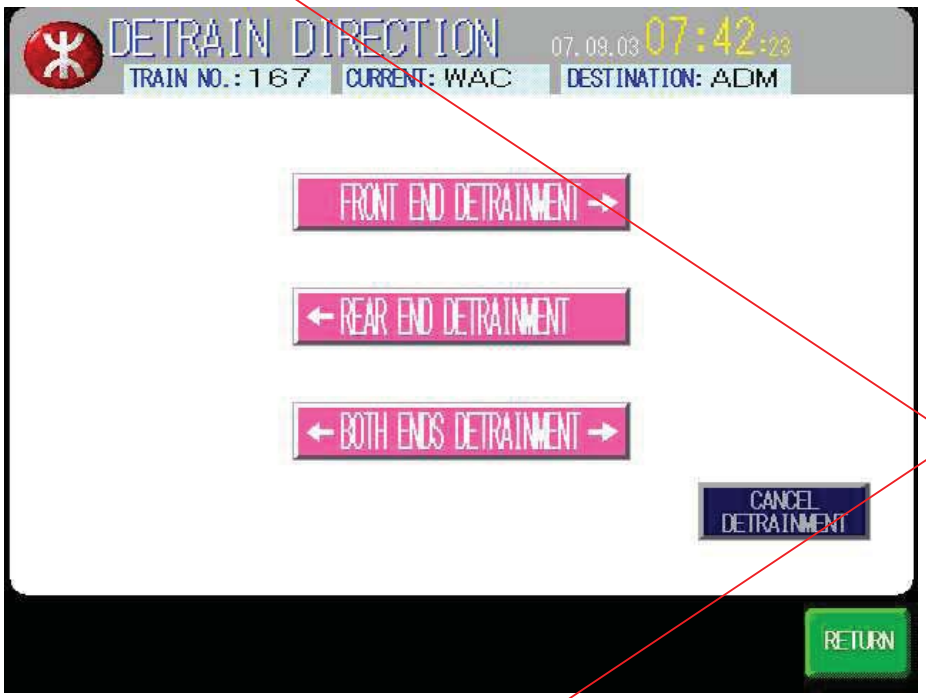
B493

When touching in each key, adjustment of the following of the Trainborne video display is possible.

- Brightness
- Contrast
- Color Saturation

3.3. 14 Detrain direction screen P ~~Dtrain direction screen~~ M ~~Detrainment select screen~~

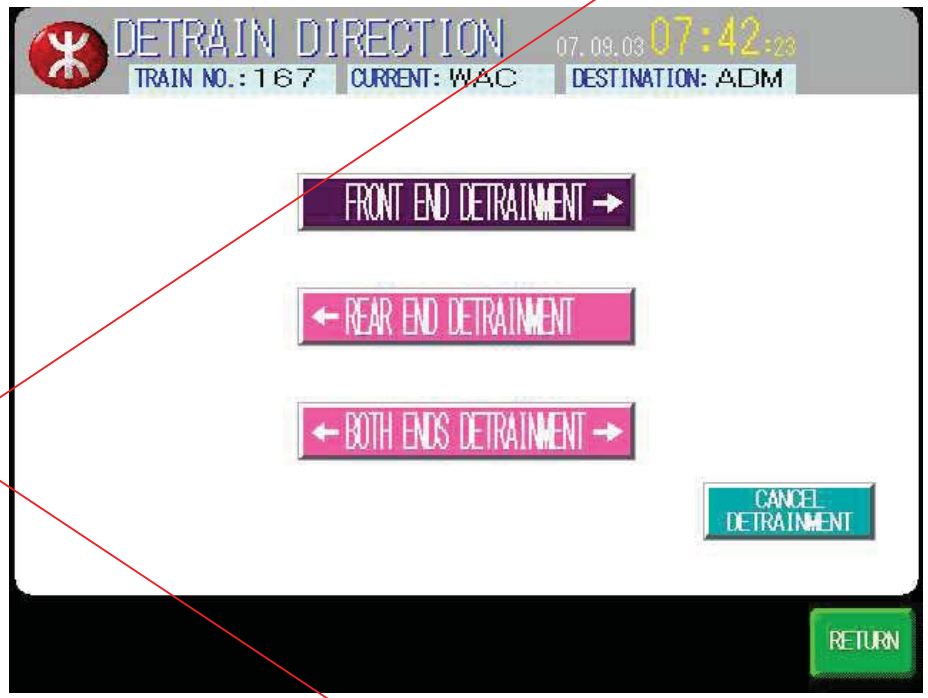
This screen allows the train operator to select the Detrainment.



K L M P

B550

Example of "FRONT END DETRAINMENT was selected".

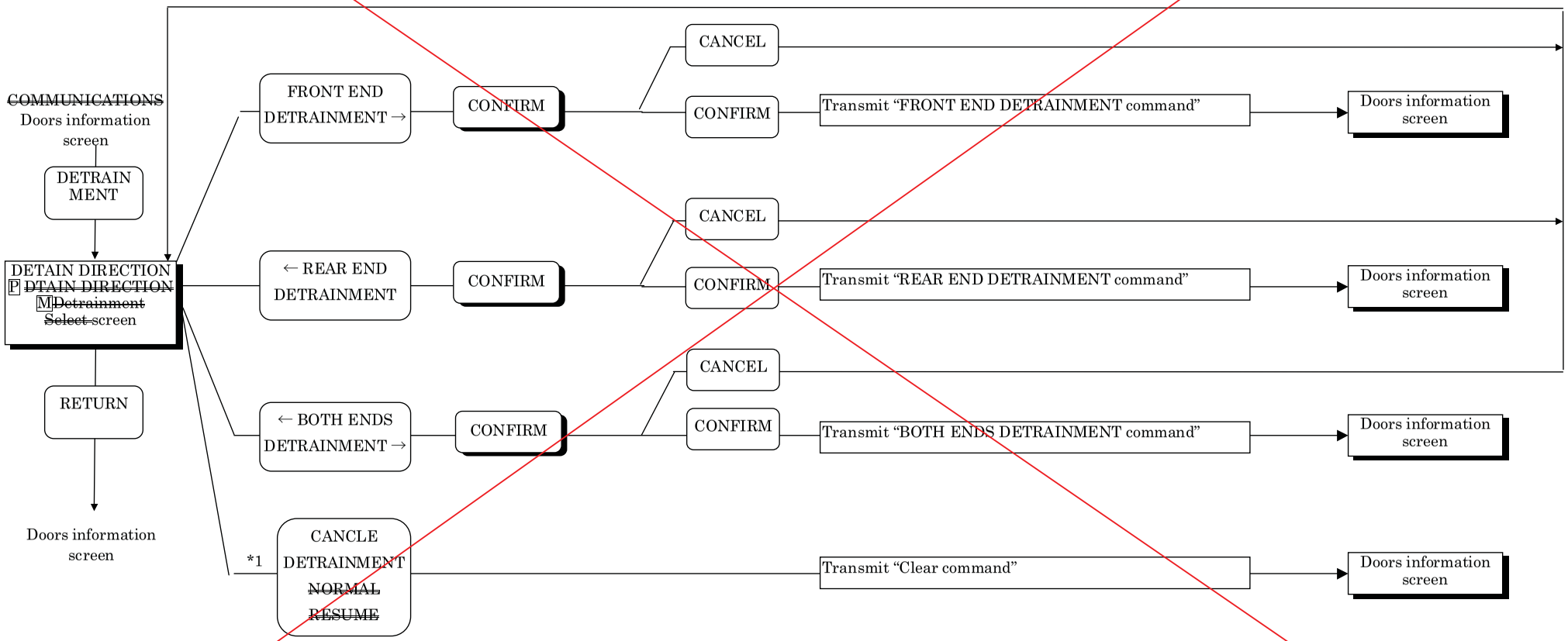


K L M P

B557

J This page added

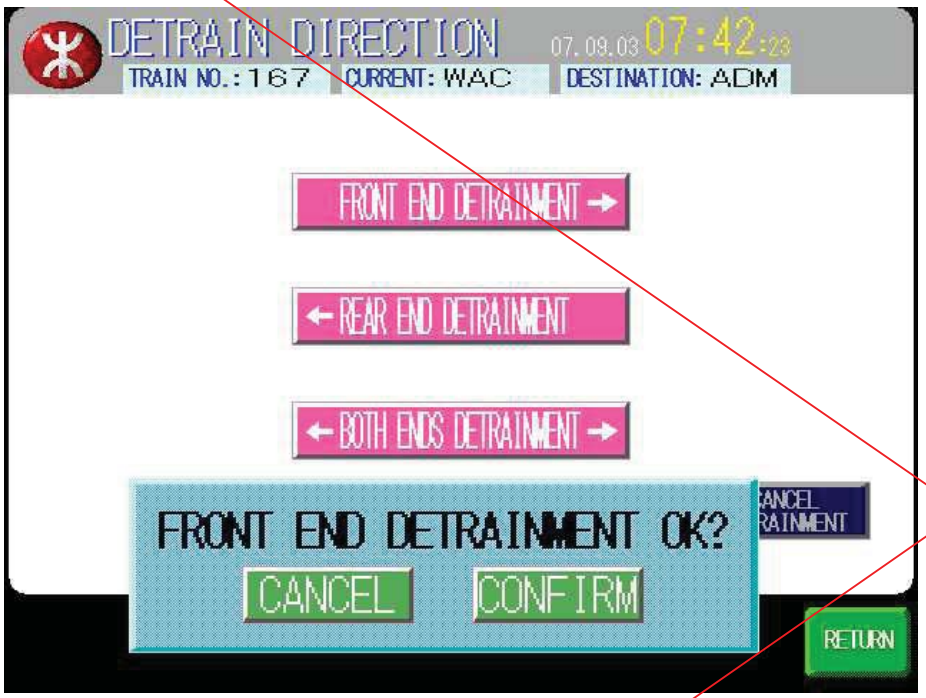
Operation flow of Detrainment select screen is shown as follows; K



*1 CANCEL DETRAINMENT key is valid only when "FRONT END DETRAINMENT → key" , "← REAR END DETRAINMENT key " or "← BOTH ENDS DETRAINMENT →" is selected.

MITSUBISHI ELECTRIC CORPORATION., JAPAN										
CHANGE									DOCUMENT NO.	
J	04. Dec. 09	M	28. Jan. 10						JHAV438	52 ~~30~~
K	17. Dec. 09	P	28. Apr. 10							

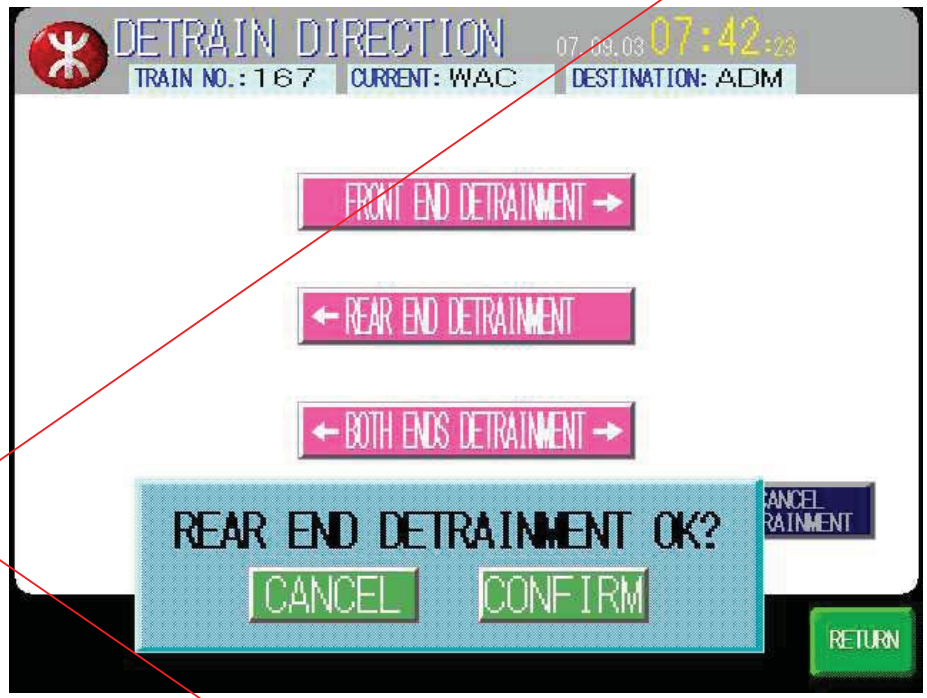
The detrainment confirm window is shown as follows;
Example of "FRONT END DETRAINMENT ".



K L M P

B551

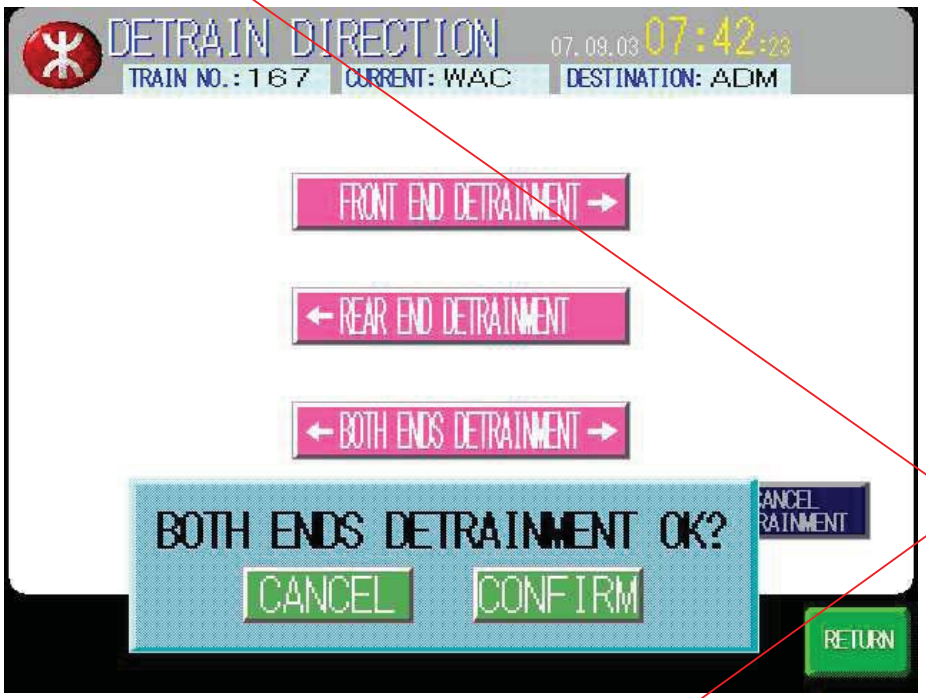
The detrainment confirm window is shown as follows;
Example of "REAR END DETRAINMENT ".



K L M P

B552

The detrainment confirm window is shown as follows;
Example of "BOTH ENDS DETRAINMENT ".



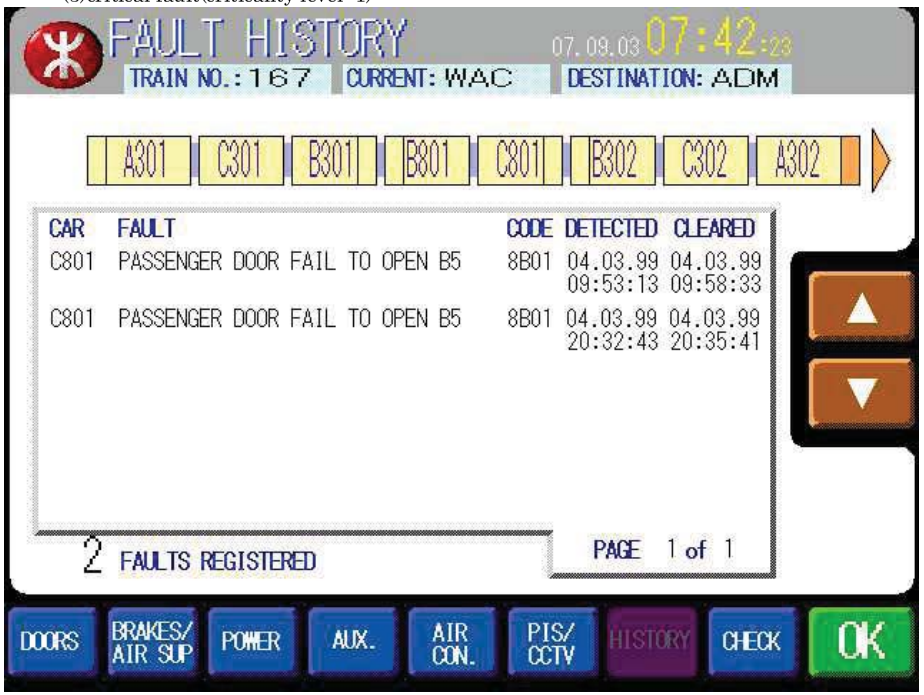
K L M P

B553

3.3.~~12~~ B ~~14~~ J 15Fault history screen

This screen displays information on past recorded faults include the car number where the faults occurred, the fault codes, the fault names, the time when faults were detected and the time when the

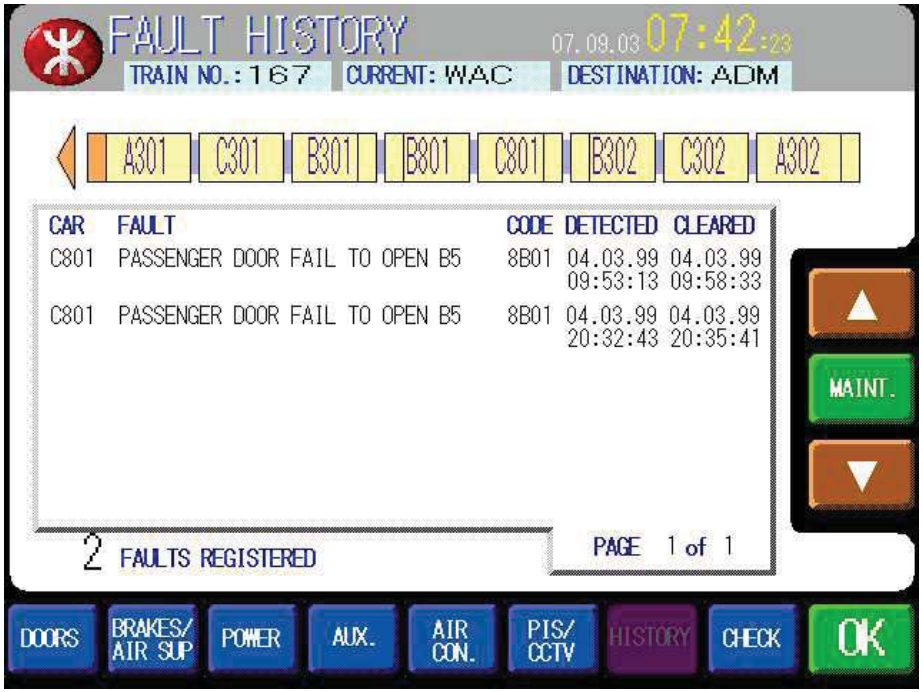
faults were cleared.
Possibilities are;
(1)since the TMS powered.
(2)in the last 24 hours.
(3)critical fault(criticality level=1)



B J L M

B241

In case of unoccupied cab, MAINT. Key is displayed.



B J L M

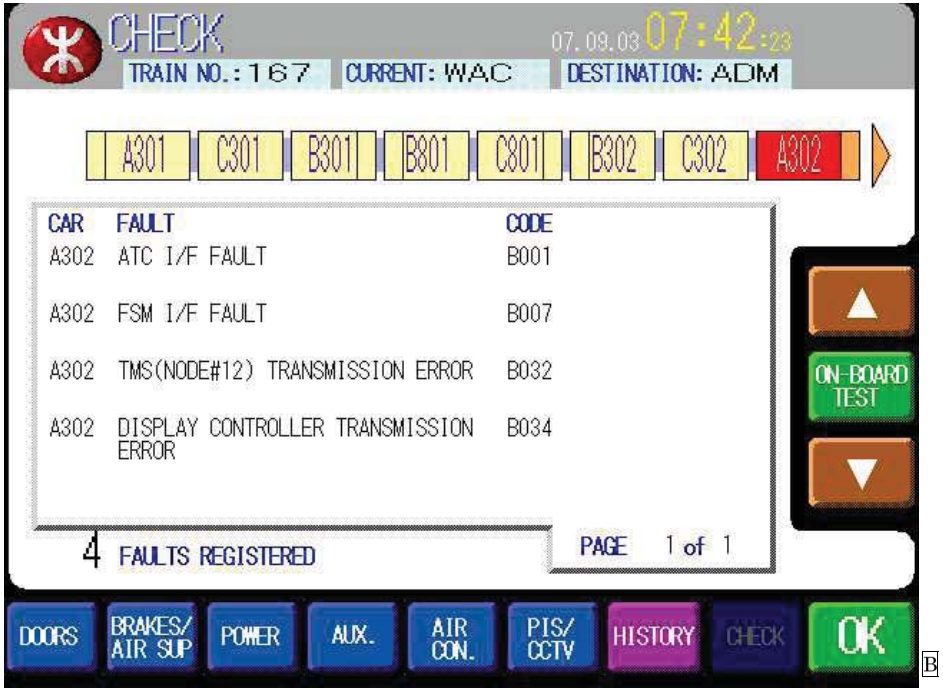
B246

Press the up and down key to scroll the fault record pages.

3.3.~~13~~ B ~~15~~ J 16 Check information screen

The screen provides the information of particular relevance to the condition check.

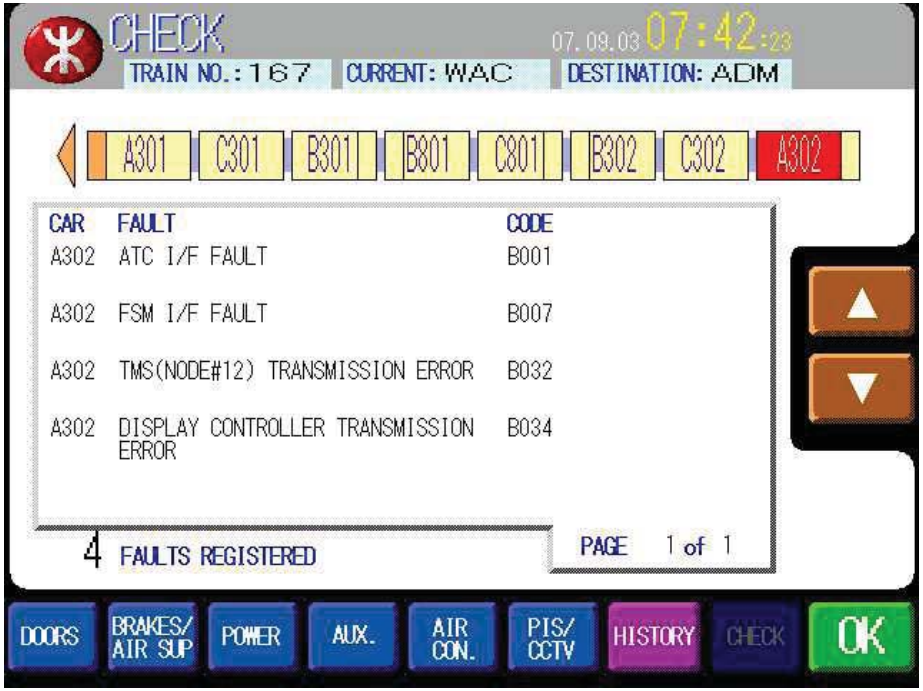
When occupied cab and TMS is in ~~depot mode or~~ B maintenance mode, ON-BOARD TEST Key is displayed.



B J L M

B2111

When unoccupied cab or TMS is not in ~~depot mode or~~ B maintenance mode, ON-BOARD TEST Key is not displayed.



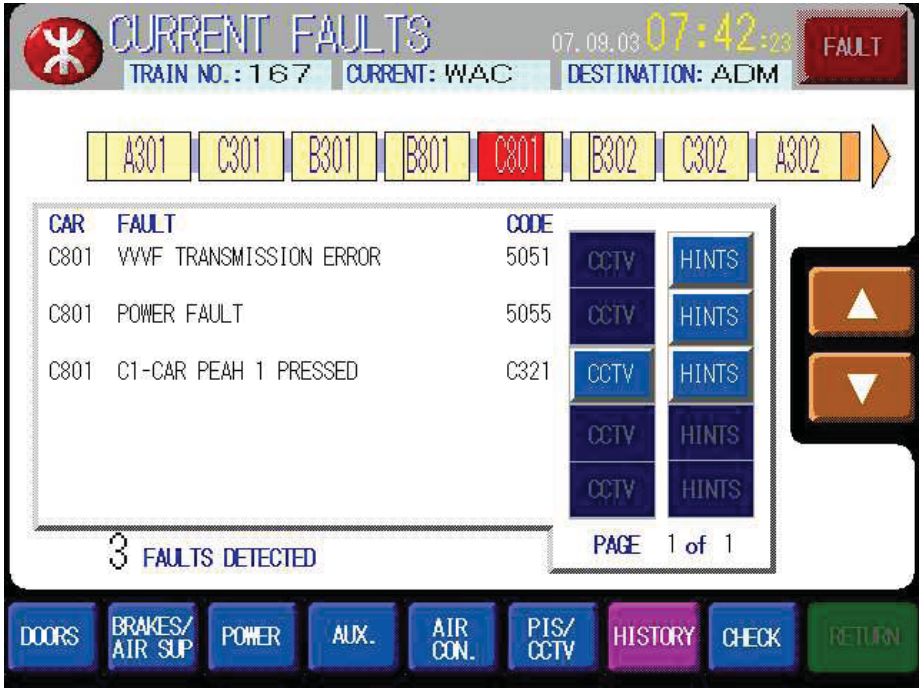
B J L M

B2116

Press the ON-BOARD TEST Key to enter into the On-board test menu screen.

3.3.~~14~~ B ~~16~~ J 17 Current faults screen

This screen displays a listing of all the faults of criticality level 1 or 2 as defined.
Once all the faults are cleared, this screen is no longer available.



B J L M

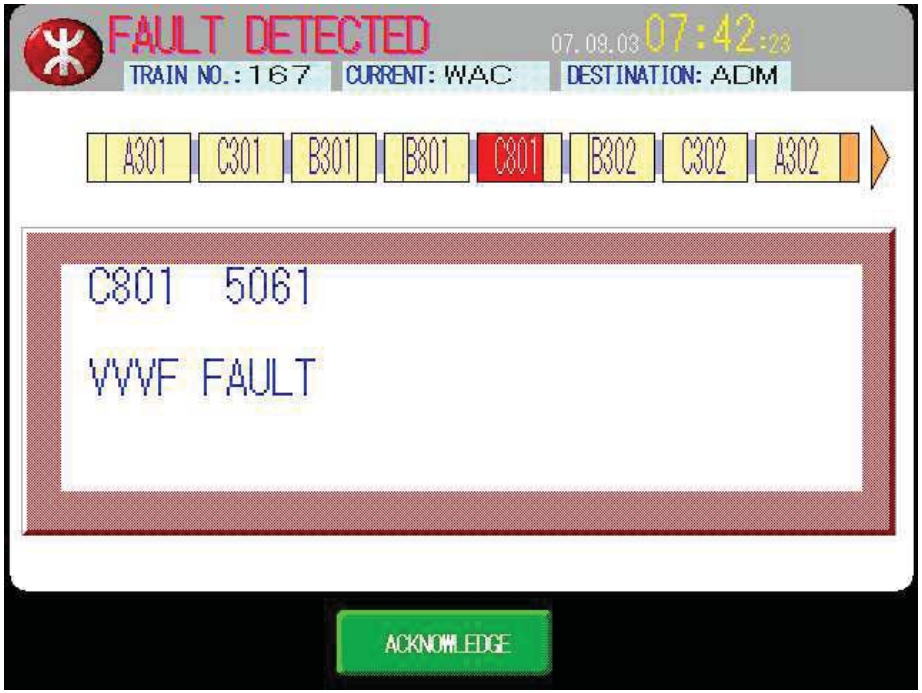
B251

Press the up and down key to scroll the fault pages.
Press the HINTS key to go to TO hints screen in the corresponding position.
Press the CCTV key will transmit bit applicable to DVAS. J

3.3.~~15~~ B ~~17~~ J 18 Fault alert screen

When a criticality level 1 fault is detected by TMS, this screen comes and a buzzer alarm the train operator to acknowledge the fault.
The fault alert screen displays only in the occupied cab.

Example of the fault alert screen is shown as follows;



L

B801

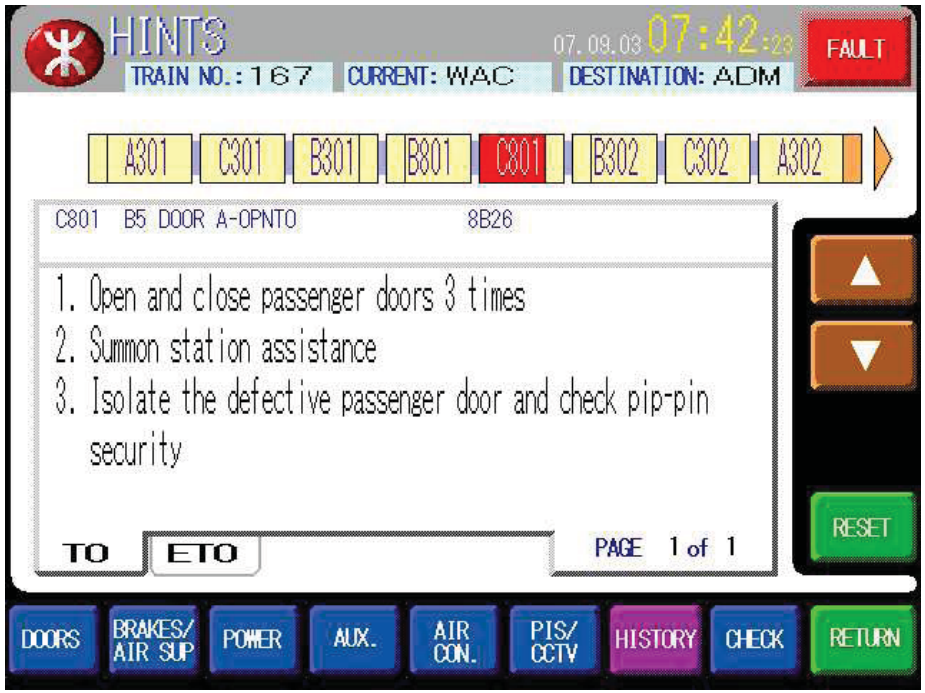
Press the ACKNOWLEDGE key to deactivate the buzzer and the screen to go to Current faults screen.
(In case of criticality level=5, The screen to go to Original screen before fault detection)

In the following faults, in order to project an image on Trainborne video display, bit applicable to DVAS is transmitted. Ref. to Software Design Specification (JHAX334) G
・Passenger alarm pressed (Fault No. C301-C340)
・Train Divided (Fault No. 4002)
・Smoke detector detection (Fault No. D001-D004)

3.3.~~16~~ B ~~18~~ J 19 Hints screen

This screen provides the hints for the train operator and emergency train operator to deal with particular fault.
TO hints is displayed first.

Isolate/reset key is displayed when isolate/reset is required hints.

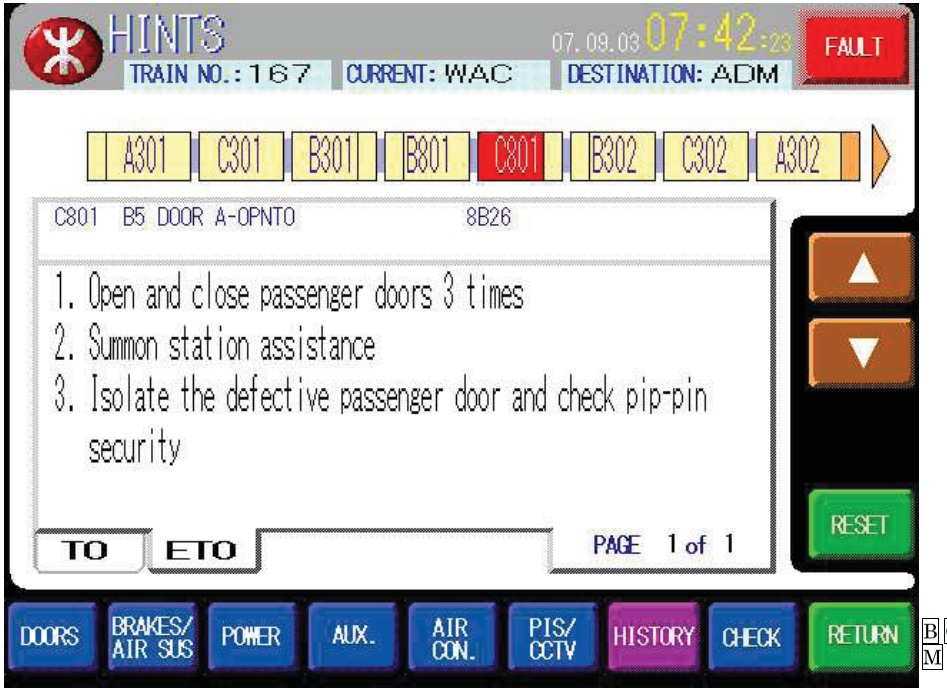


B C J L M

B7523

Press the up and down key to scroll the hints pages.
Press the ETO tag to display the ETO hints window.
Press the ISOLATE,RESET key to call up the isolation/reset confirm window.

PA talk back~~/CCTV~~ [J] key is displayed when PA talk back~~/CCTV~~ [J] ~~PA bypass~~ is required hints. [G]



[B] [C] [F] [G] [J] [L] [M]

B7524

Press the up and down key to scroll the hints pages.
Press the ETO tag to display the ETO hints window.
Press the PA TALKBACK key to call up the PA talk back confirm window.
~~Press the CCTV key, to display In-Saloon CCTV screen.~~
~~And, to project an image on Trainborne video display, bit applicable to DVAS is transmitted.~~ [G] [J]

Press the up and down key to scroll the hints pages.
Press the TO tag to display the TO hints window.
Press the ISOLATE,RESET key to call up the isolation/reset confirm window.

ETO hints window is shown as follows;

[B] [C] [J] [L] [M]

B2268

			MITSUBISHI ELECTRIC CORPORATION., JAPAN								
			CHANGE							DOCUMENT NO.	
			B	22. May. 09	F	27. Oct. 09	J	04. Dec. 09	M	28. Jan. 10	JHAV438 57
			C	08. Jul. 09	G	05. Nov. 09	L	05. jan. 10			

In case of unoccupied cab, “ISOLATE”,”RESET”,”PA TALK BACK”,~~”CCTV”~~ J G ,~~”PA BYPASS”~~ F key are not displayed.
When both A-car become occupied cab (HCR=”ON"), the indication become the same as unoccupied cab.

ETO hints window is shown as follows;

B C J L M

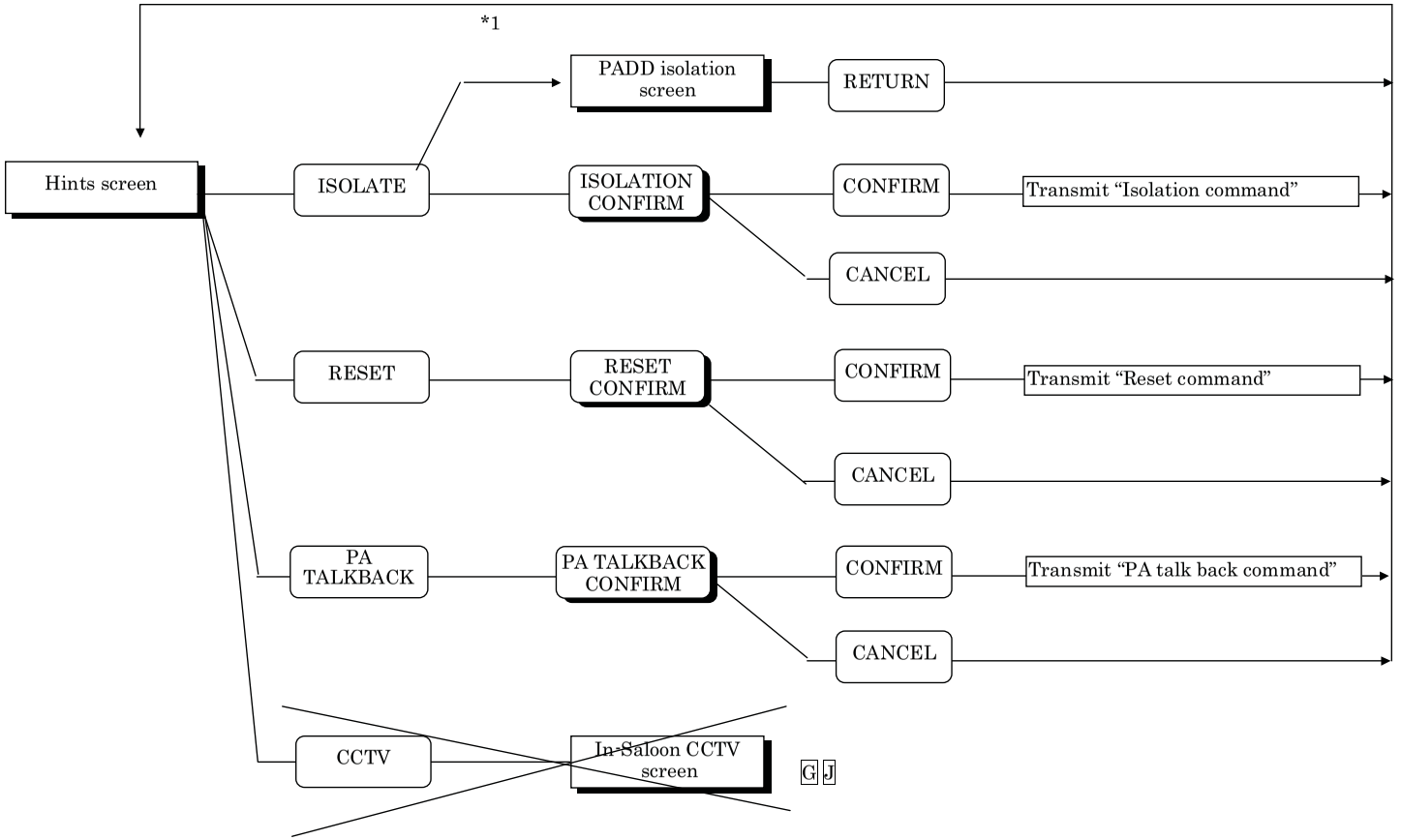
B261

B C J L M

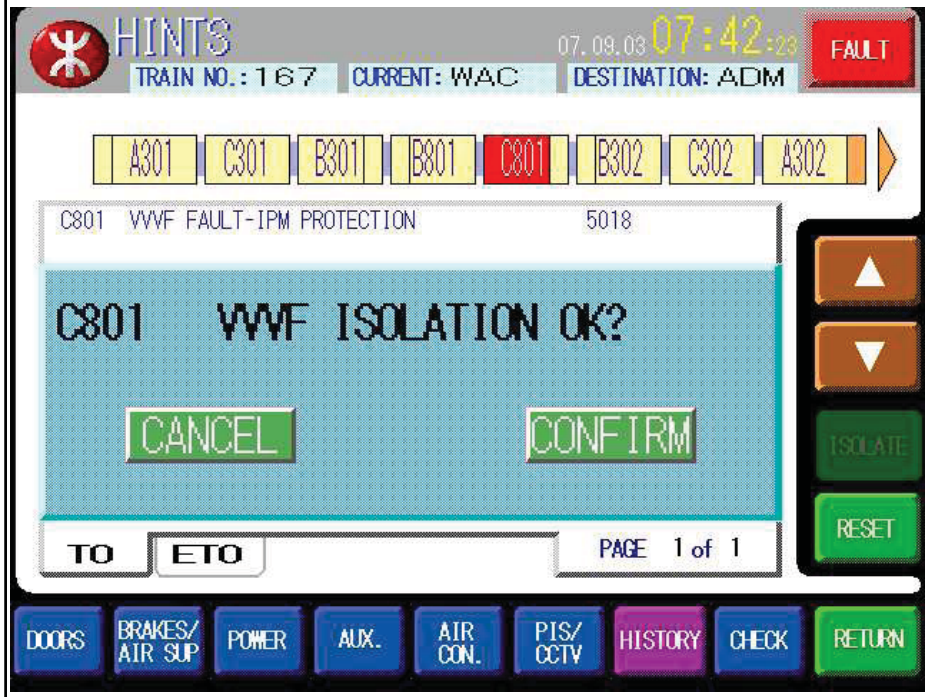
B262

Flow of instruction and operation is shown as follows;

(NOTE)
*1: Only Pantograph auto drop device detected.
(refer to 3.3.7.1 PADD isolation screen)



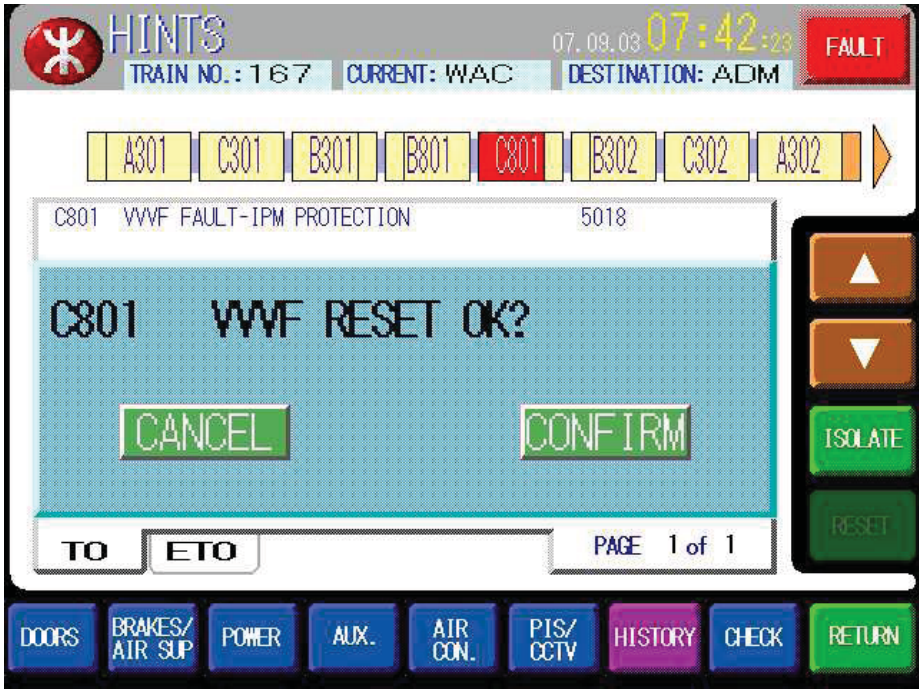
The “VVVF isolation confirm window” is shown as follow;



B C F J K L M

B2280

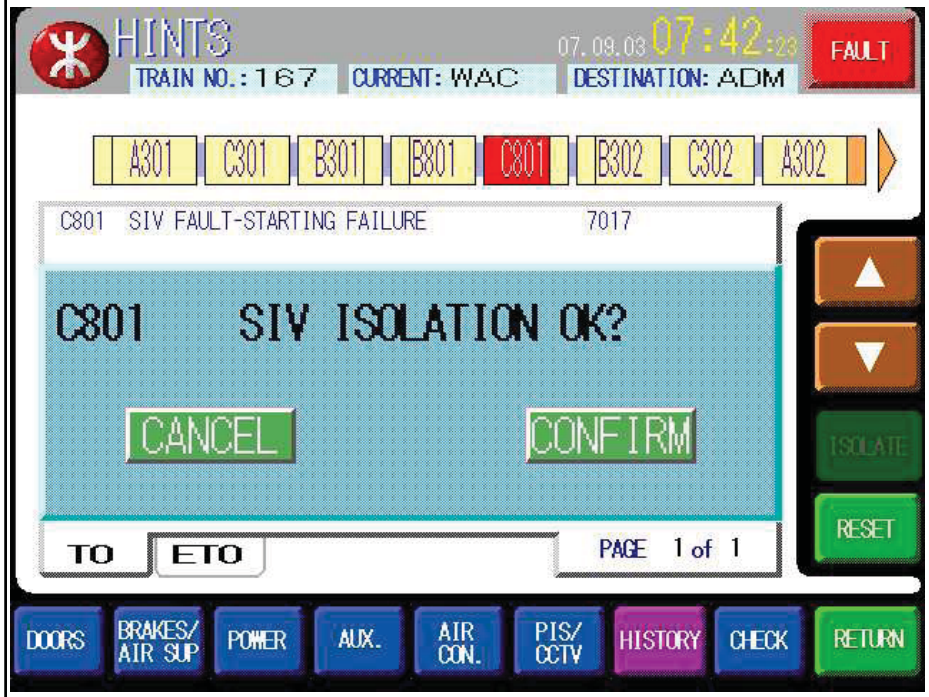
The “VVVF reset confirm window” is shown as follow;



B C F J K L M

B2281

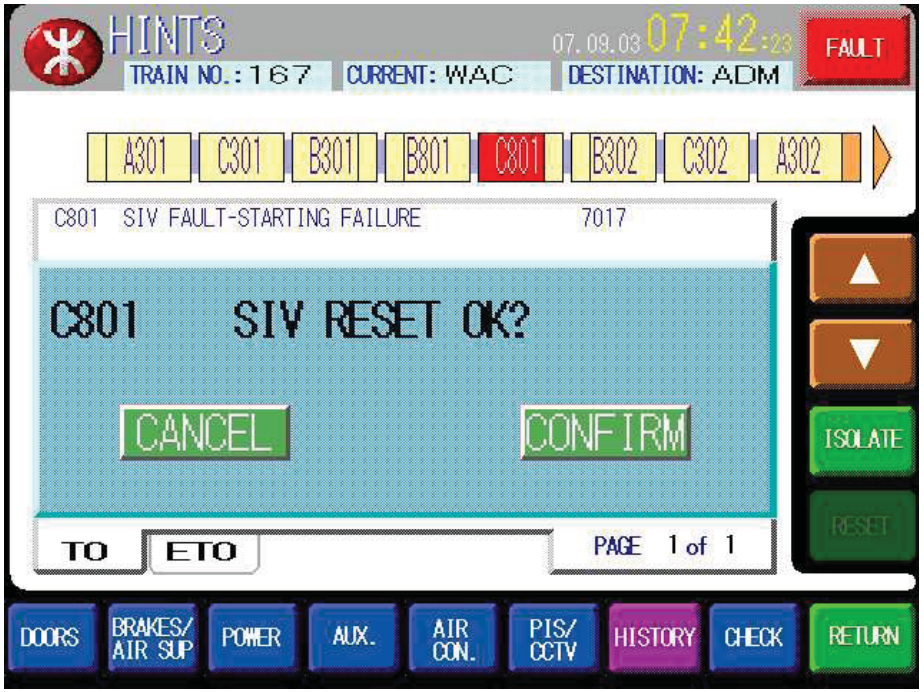
The “SIV isolation confirm window” is shown as follow;



B C F J K L M

B2282

The “SIV reset confirm window” is shown as follow;

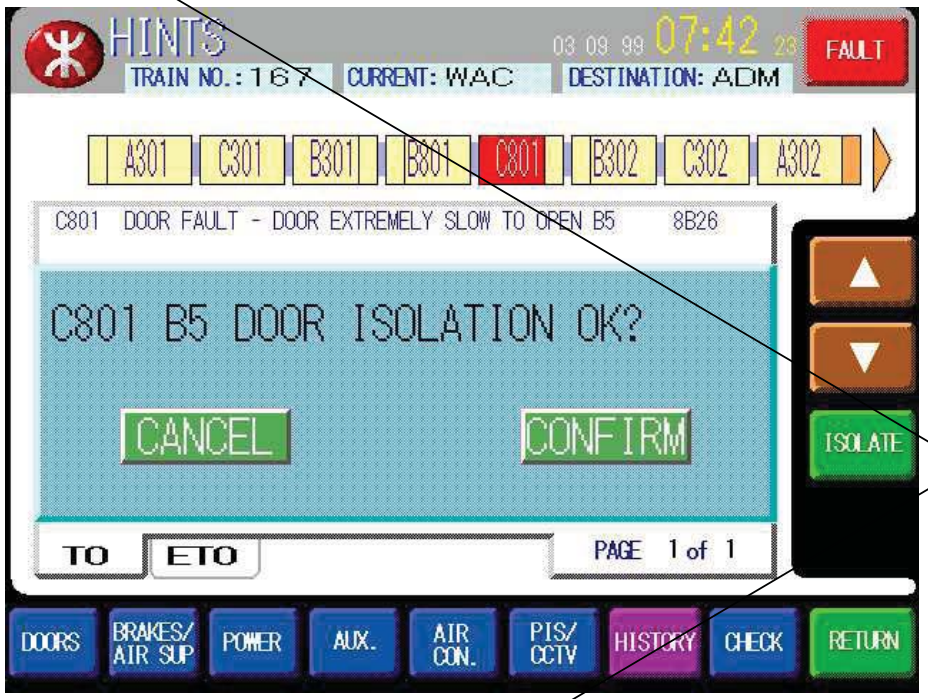


B C F J K L M

B2283

E This page deleted

The “DOOR isolation confirm window” is shown as follow;

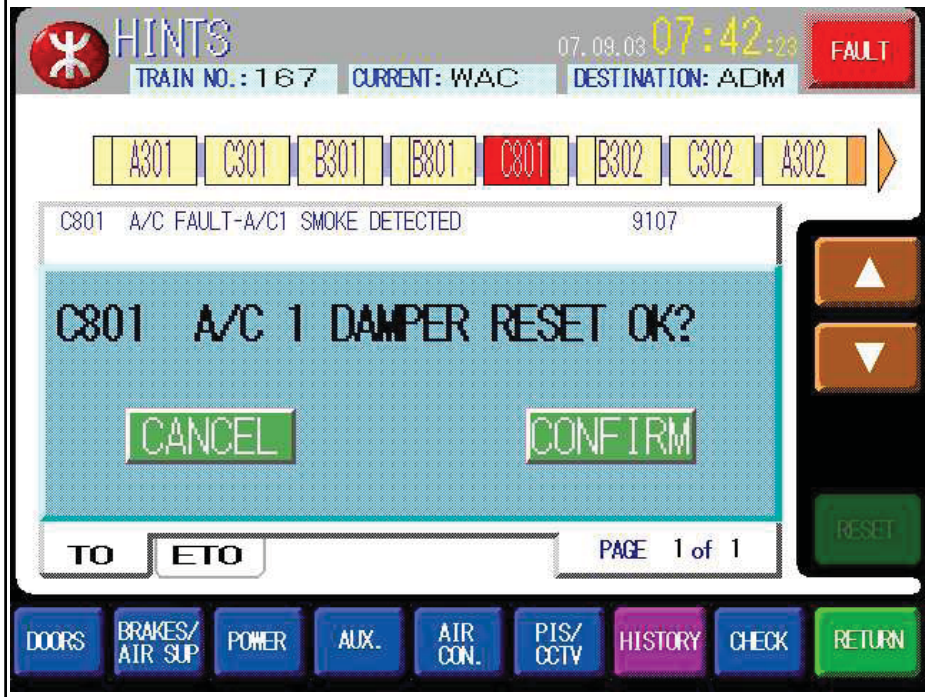


B C

B2285

			MITSUBISHI ELECTRIC CORPORATION., JAPAN								
			CHANGE							DOCUMENT NO.	
			B	22. May. 09	E	24. Sep. 09				JHAV438	62
			C	08. Jul. 09							

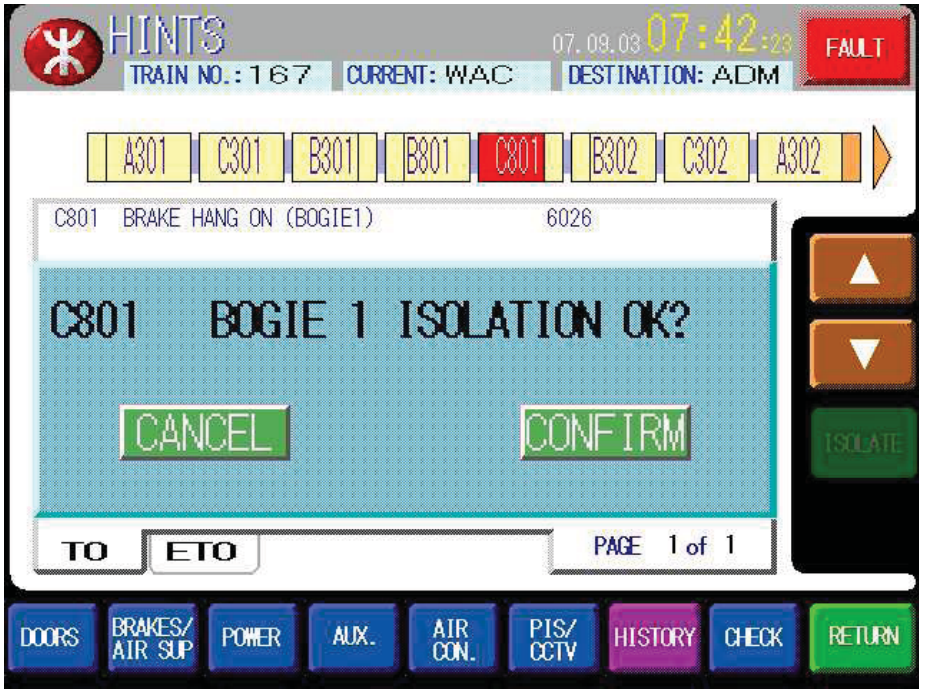
The “DAMPER reset confirm window” is shown as follow;



B C F J K L M

B2287

The “BRAKE isolation confirm window” is shown as follow;

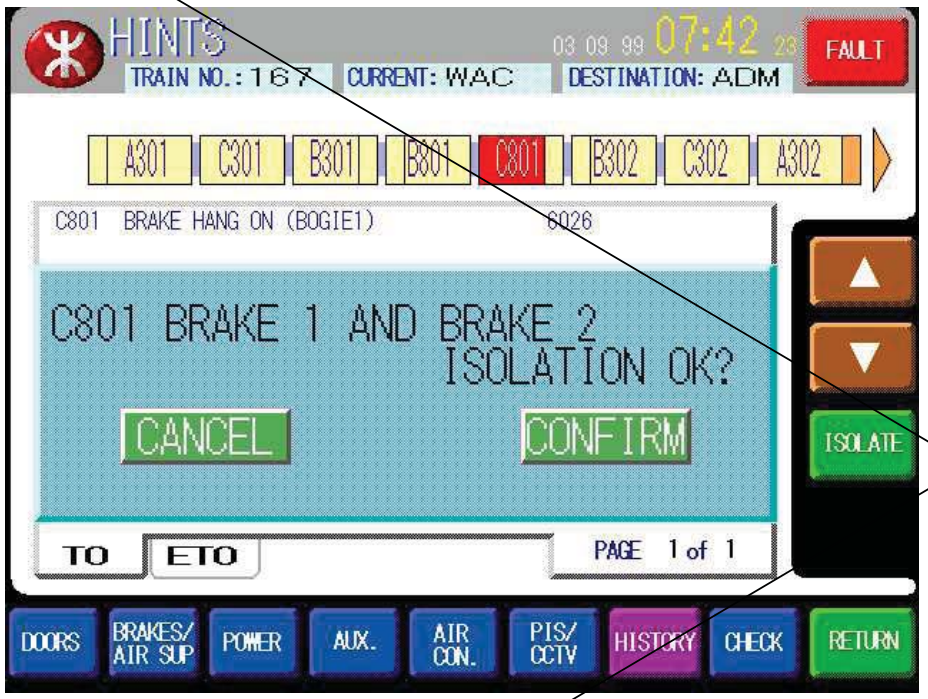


B C F J K L M

B2284

F This page deleted

The “BRAKE isolation confirm window” for Brake 1 and Brake 2 is shown as follow;

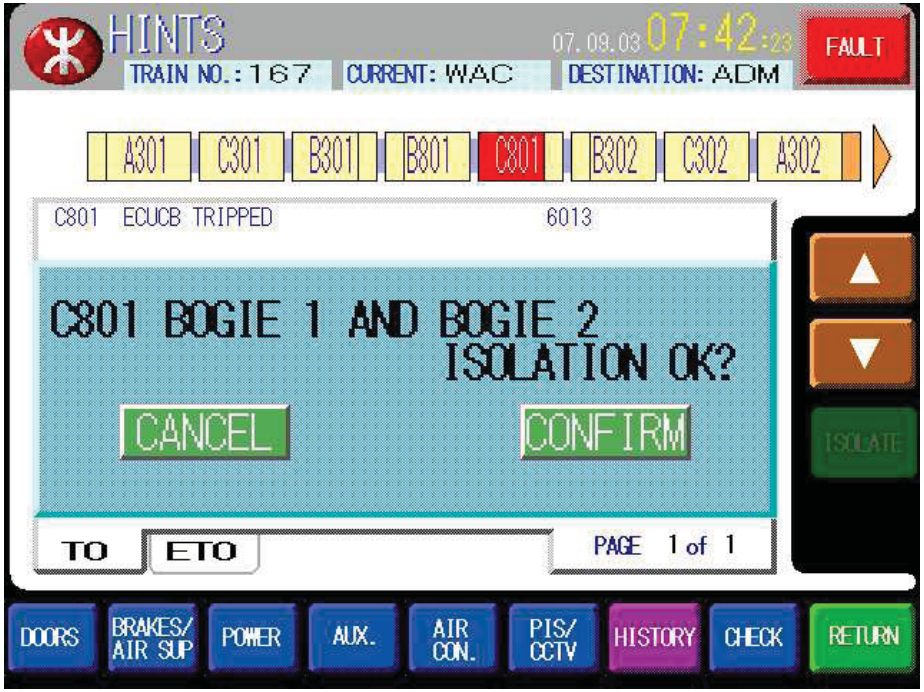


B2290

B C

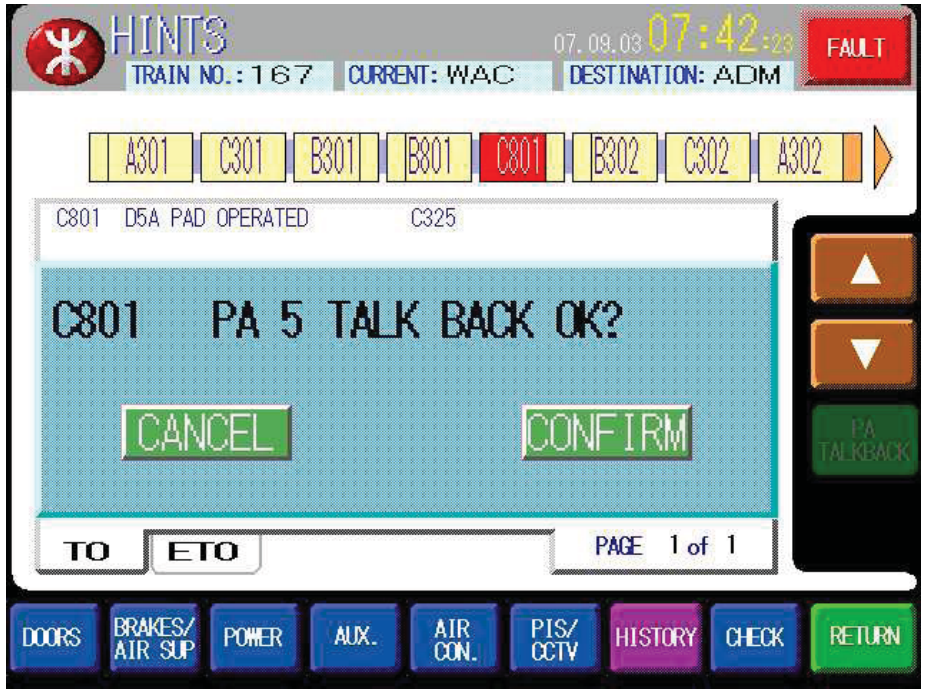
			MITSUBISHI ELECTRIC CORPORATION., JAPAN								
			CHANGE								DOCUMENT NO.
			B	22. May. 09	F	27. Oct. 09					JHAV438
			C	08. Jul. 09							

The “BRAKE isolation confirm window” for Brake 1 and Brake 2 is shown as follow;



B2290

The PA talk back confirm window is shown as follow;

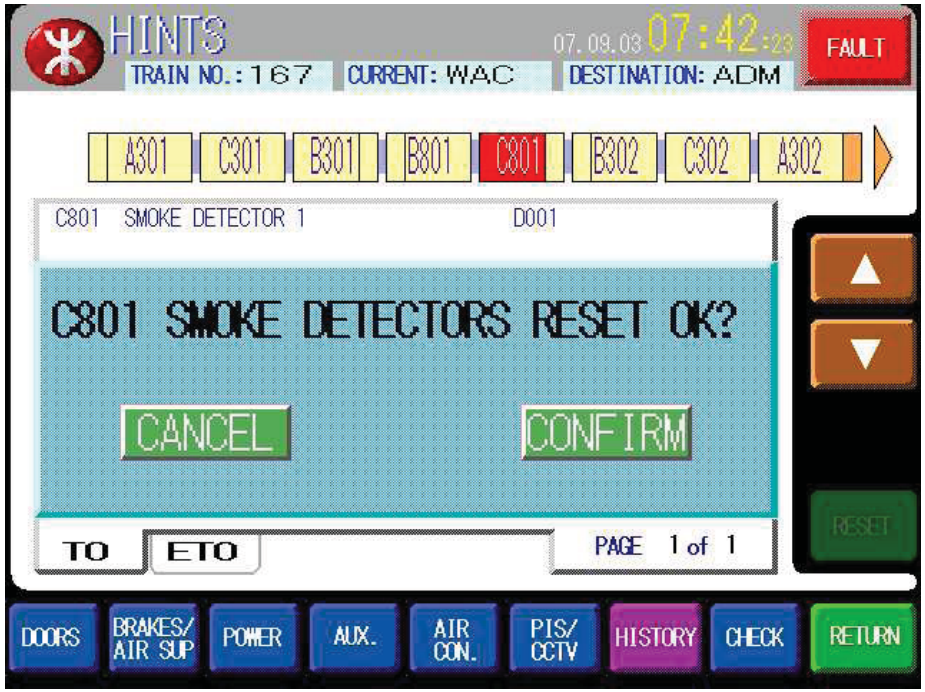


B C F G J K L M

B2288

			MITSUBISHI ELECTRIC CORPORATION., JAPAN									
			CHANGE								DOCUMENT NO.	
			B	22. May. 09	F	27. Oct. 09	J	04. Dec. 09	L	05. jan . 10	JHAV438	65-1
			C	08. Jul. 09	G	05. Nov. 09	K	17. Dec. 09	M	28. Jan. 10		

The smoke detector confirm window is shown as follow;

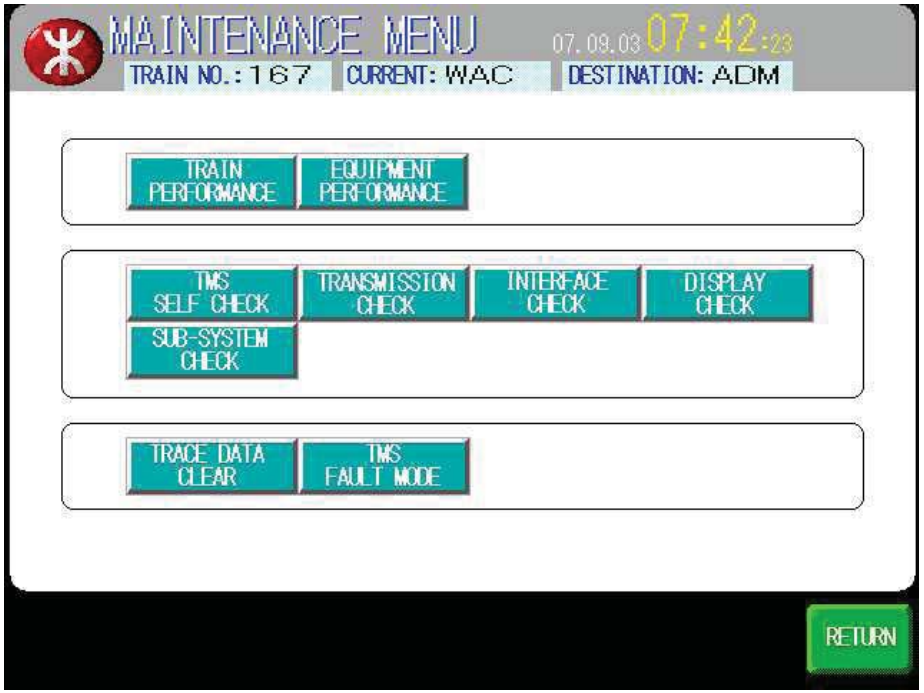


F G J L M

B2291

3.3.~~17~~ B ~~19~~ J 20 Maintenance menu screen

This screen is first screen of the maintenance screens.

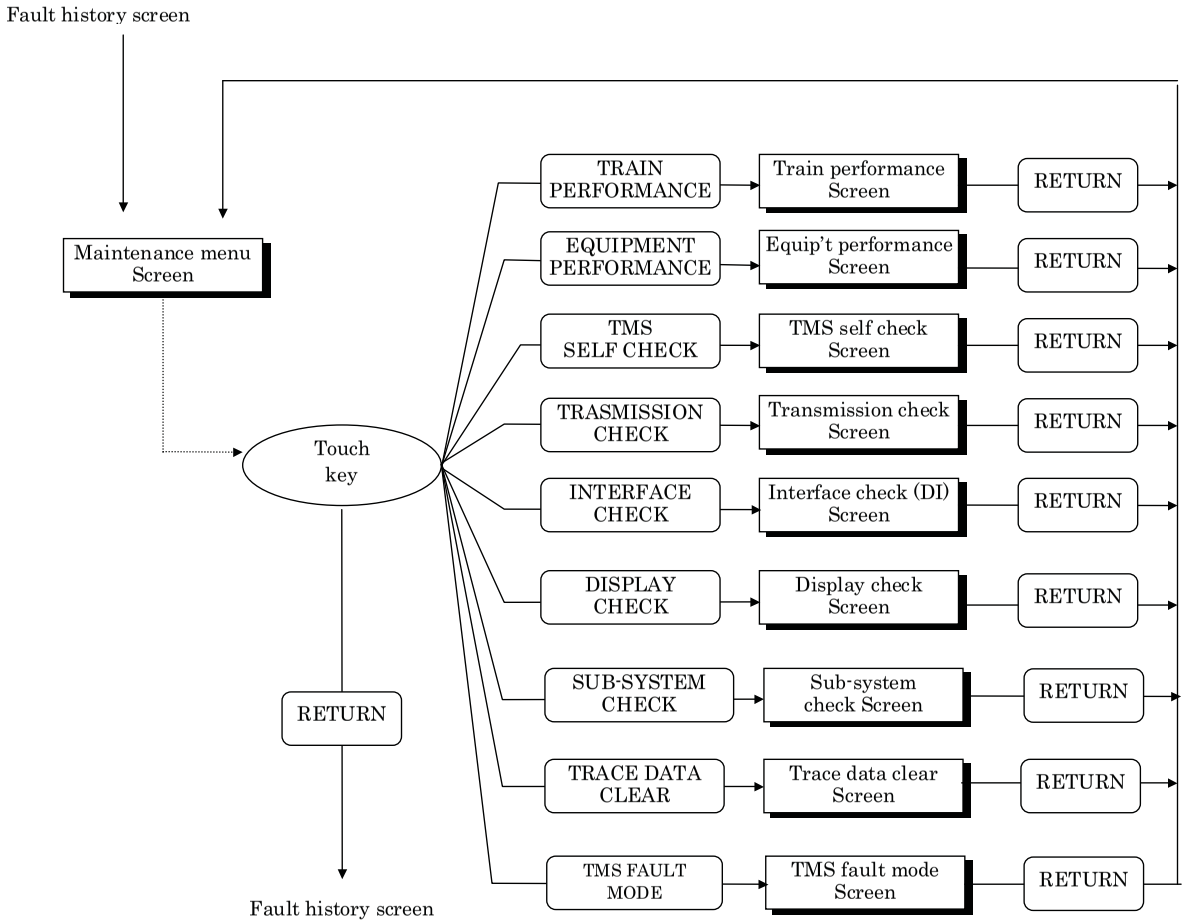


L

B402

Press the each menu key to go to the maintenance screen corresponding pressed key.

Flow of instruction and operation is shown as follows;



3.3.~~18~~ B ~~20~~ J 21 Train performance screen

This screen provides the information relevance to the train propulsion / braking performance.

L M

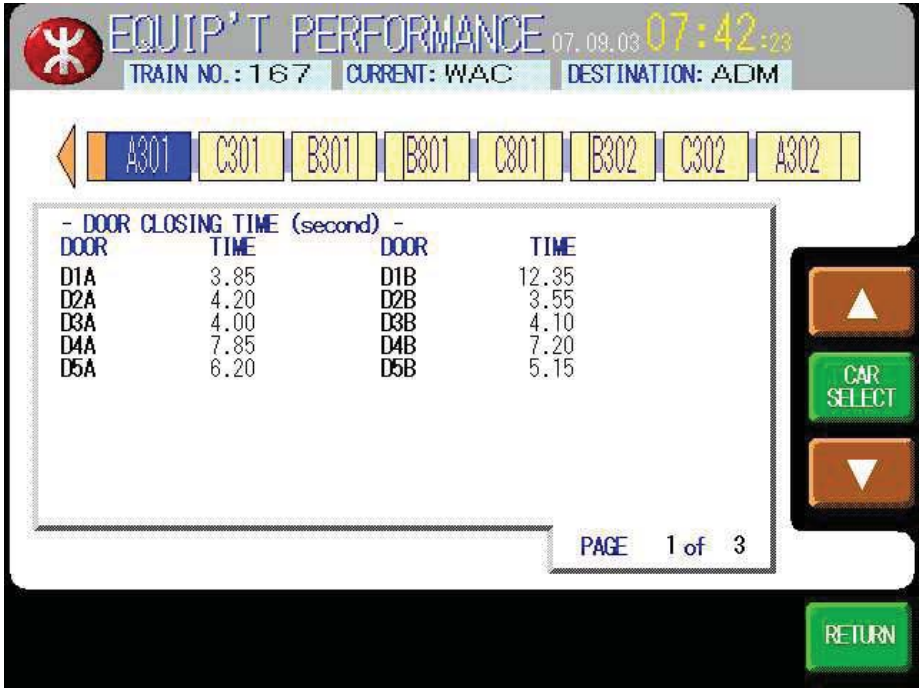
B412

			MITSUBISHI ELECTRIC CORPORATION., JAPAN									
			CHANGE								DOCUMENT NO.	
			J	04. Dec. 09	M	28. Jan. 10					JHAV438	68
			L	05. Jan . 10								

3.3.~~19~~ B ~~21~~ J 22 Equipment performance screen

This screen displays the latest measurement value of the equipment performance data.

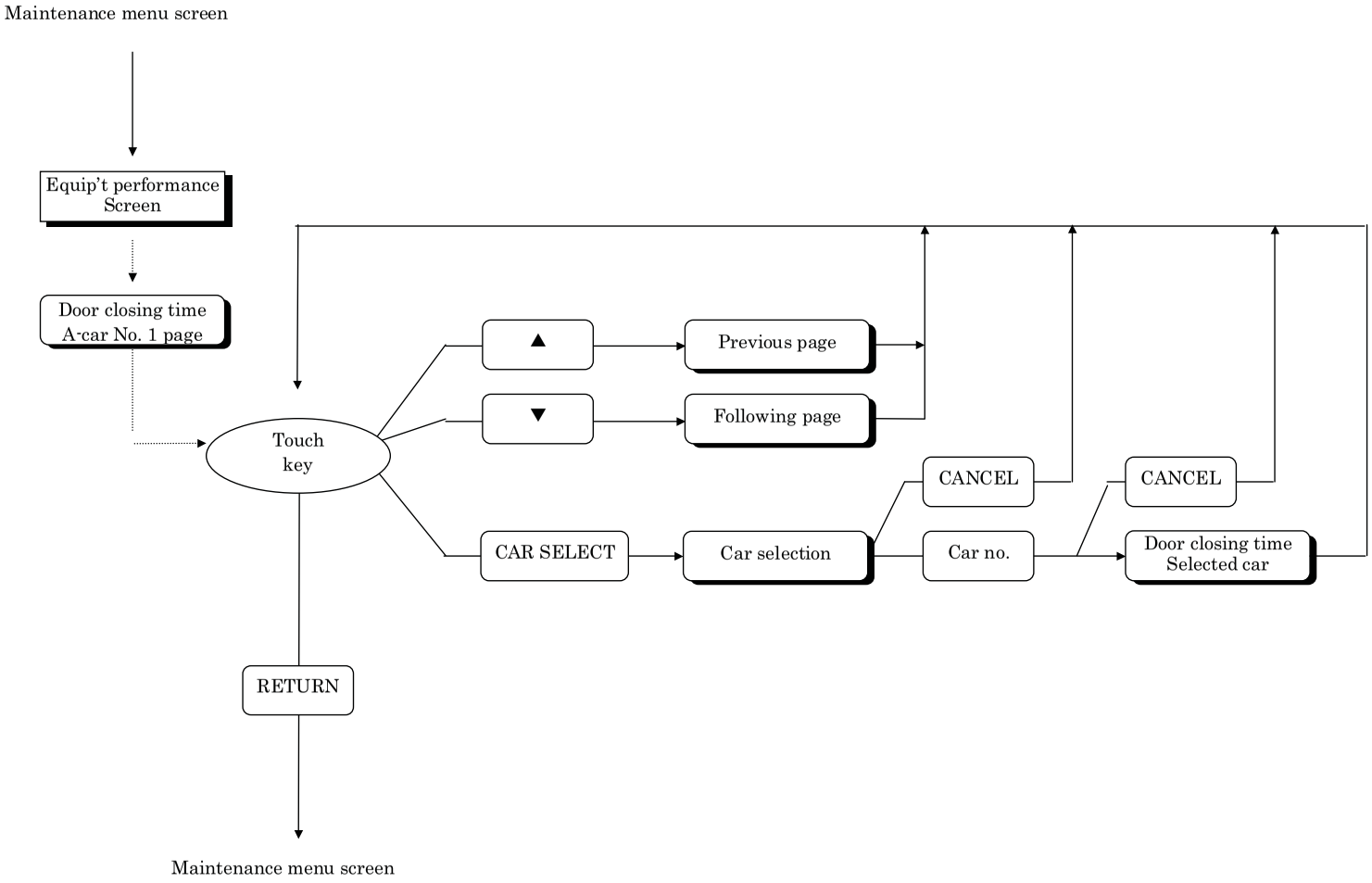
Door closing time of A-car is the first screen of the equipment performance screen.



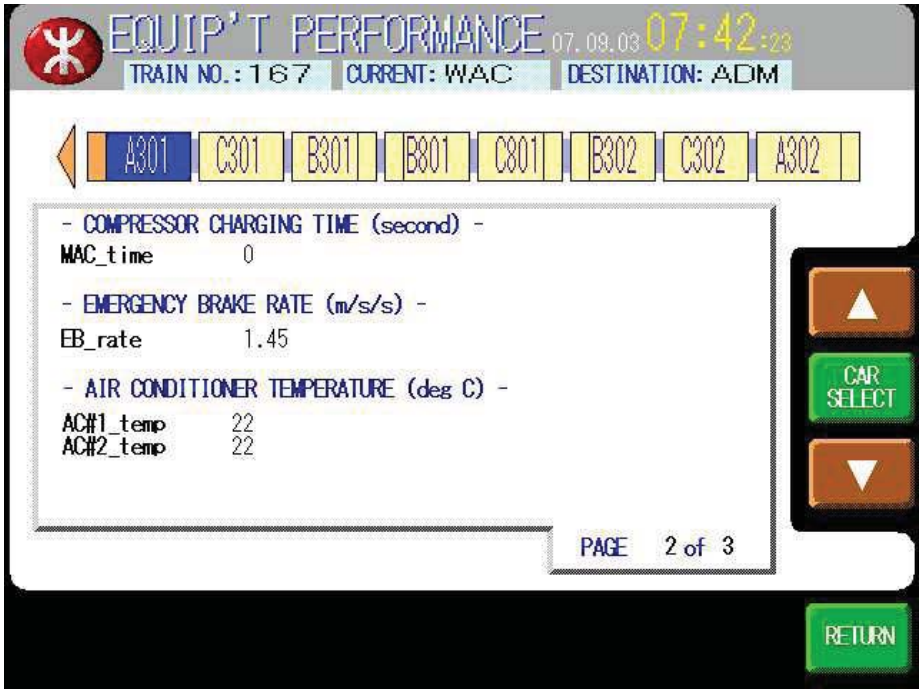
L

B7404

Flow of instruction and operation is shown as follows;



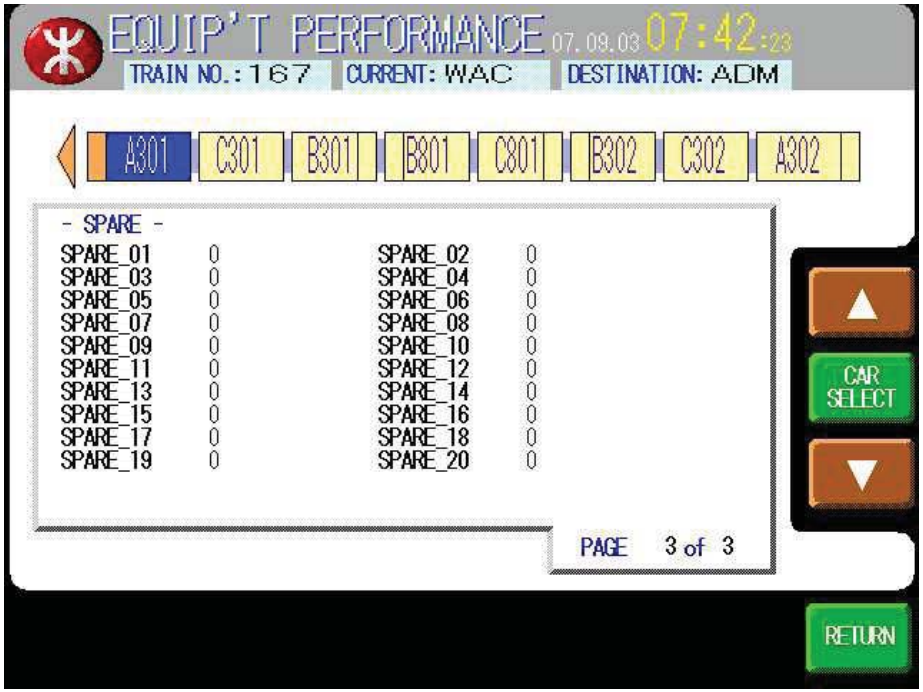
Second page (others) is shown as follows;



L

B7406

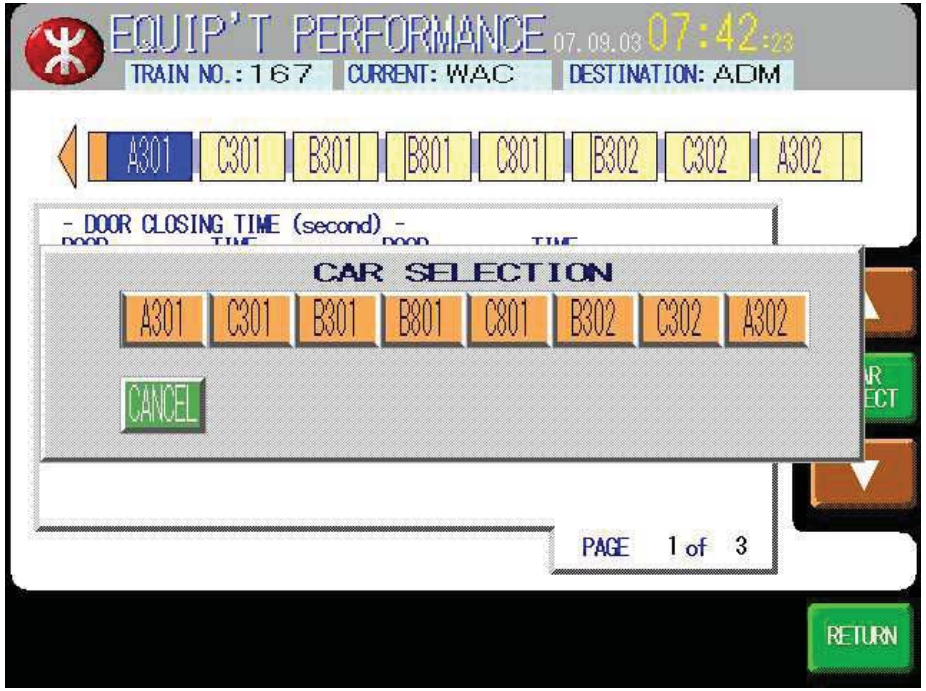
Third page (spare) is shown as follows;



L

B78

The car selection window is shown as follows;



L

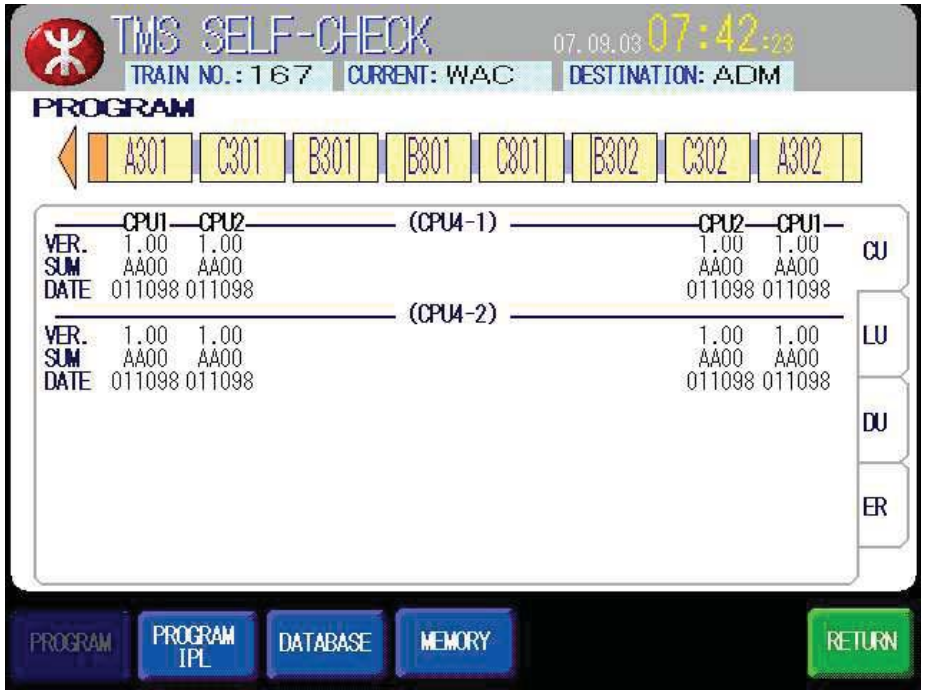
B7413

3.3.~~20~~ B ~~22~~ J 23 TMS self check screen

This screen displays the following information as the TMS self check information.

1)Program identification
2)Program(IPL) identification
3)Database identification
4)Memory check result

This is the first screen of the TMS self check screen. This screen displays the program identification of the CU.

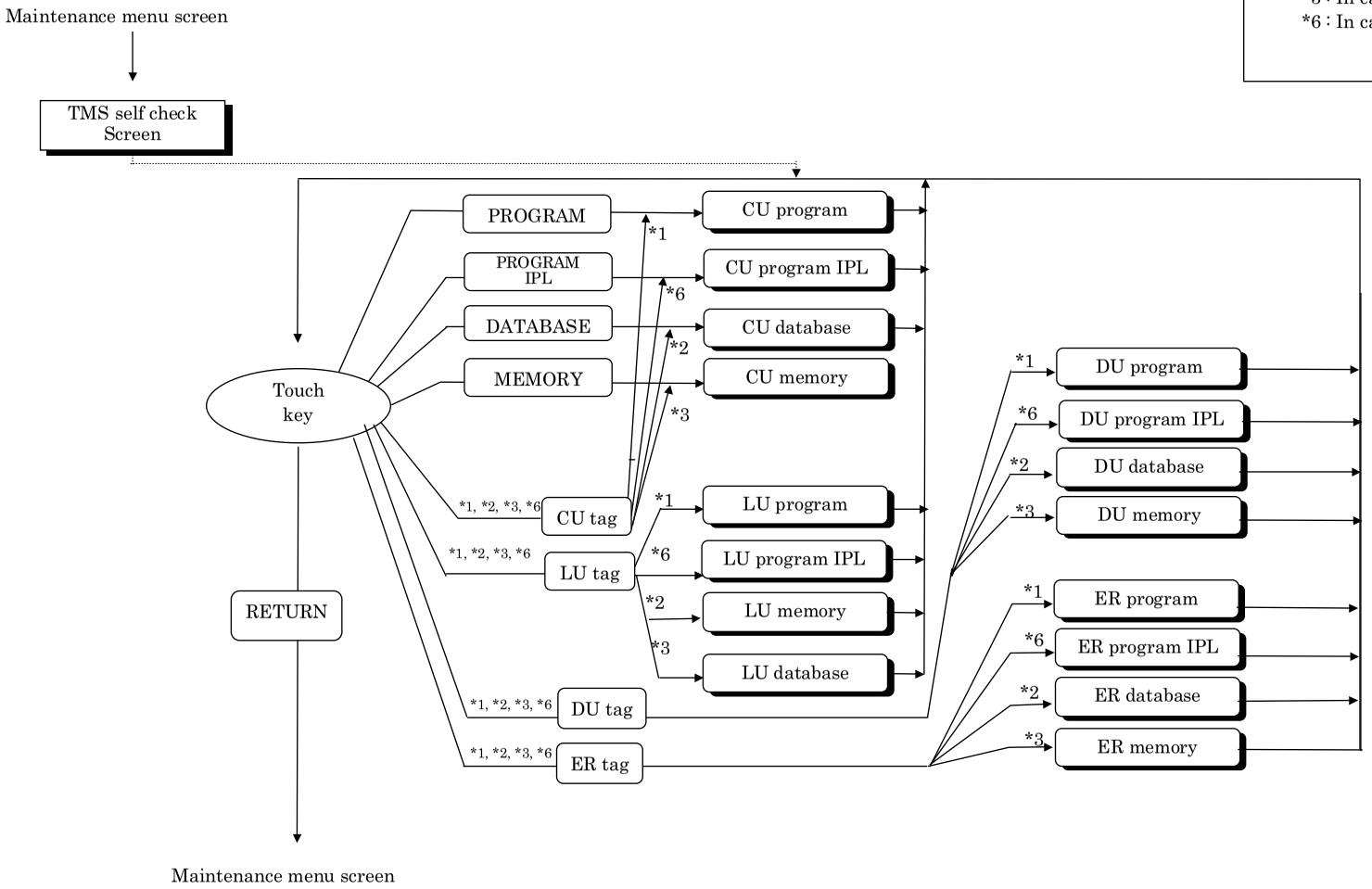


B J L

B6630

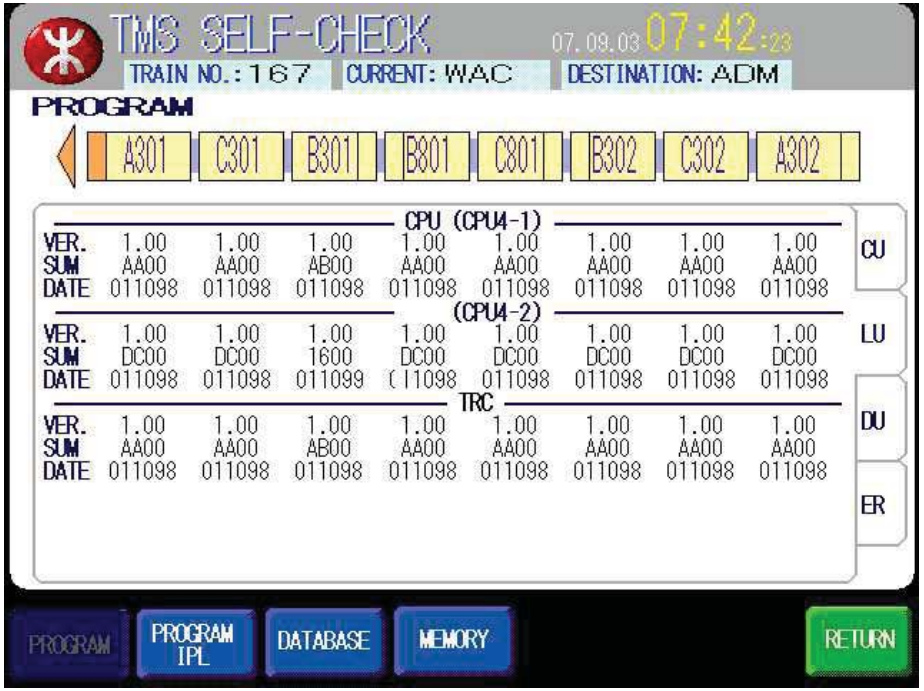
(NOTE)
*1 : In case of program windows
*2 : In case of database windows
*3 : In case of memory check windows
*6 : In case of program IPL windows

Flow of instruction and operation is shown as follows;



			MITSUBISHI ELECTRIC CORPORATION., JAPAN	
			CHANGE	DOCUMENT NO.
				JHAV438

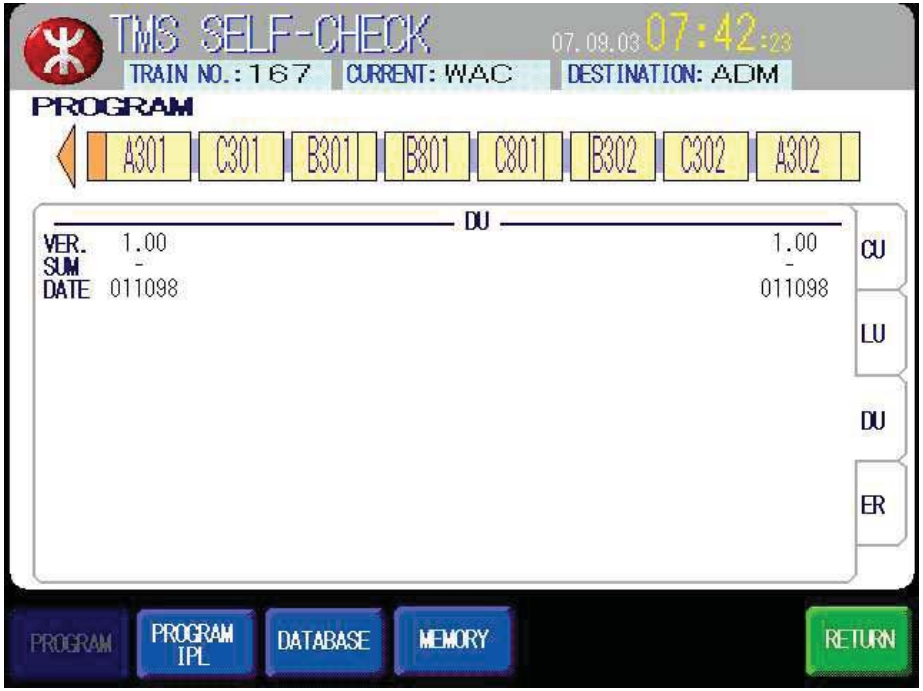
The LU program identification screen is shown as follows;



J L

B6631

The DU program identification screen is shown as follows;

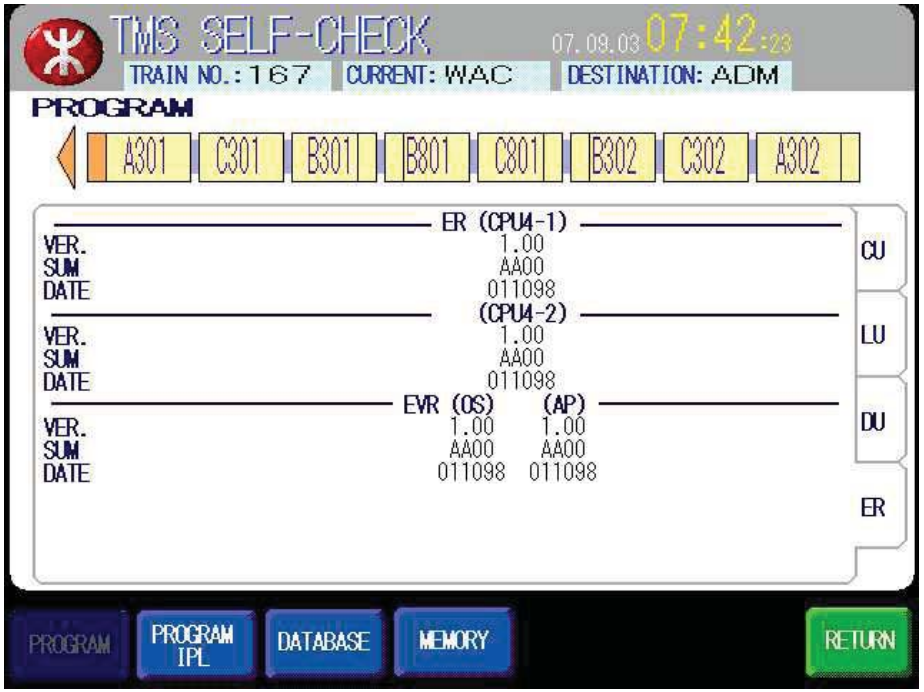


J K L

B6632

			MITSUBISHI ELECTRIC CORPORATION., JAPAN								
			CHANGE								DOCUMENT NO.
			J	04. Dec. 09	L	05. Jan. 10					JHAV438
			K	17. Dec. 09							

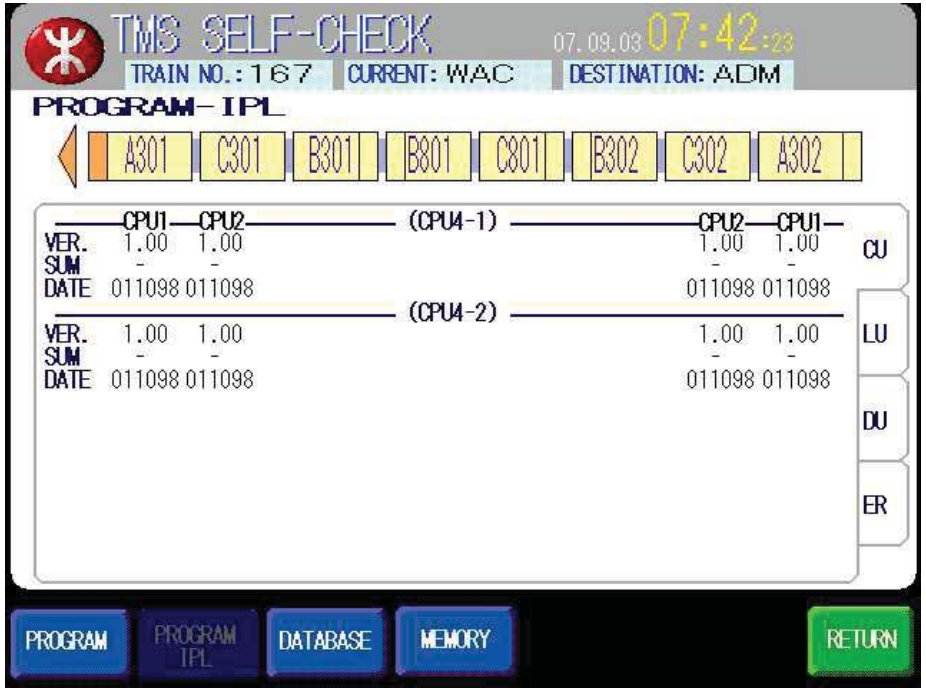
The ER program identification screen is shown as follows;



FJL

B6633

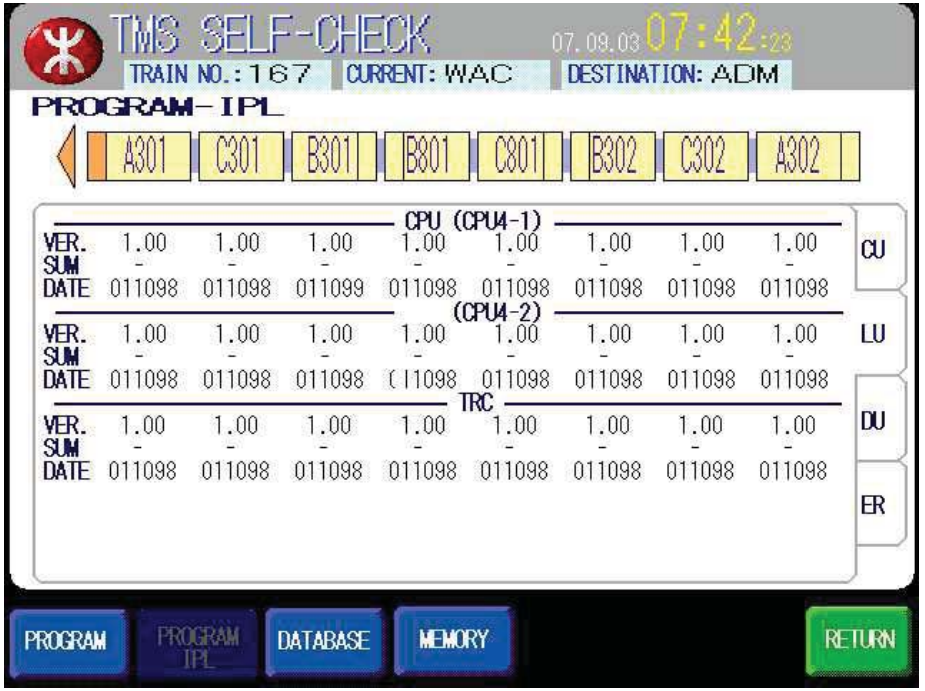
The CU program IPL identification screen is shown as follows;



J L

B6690

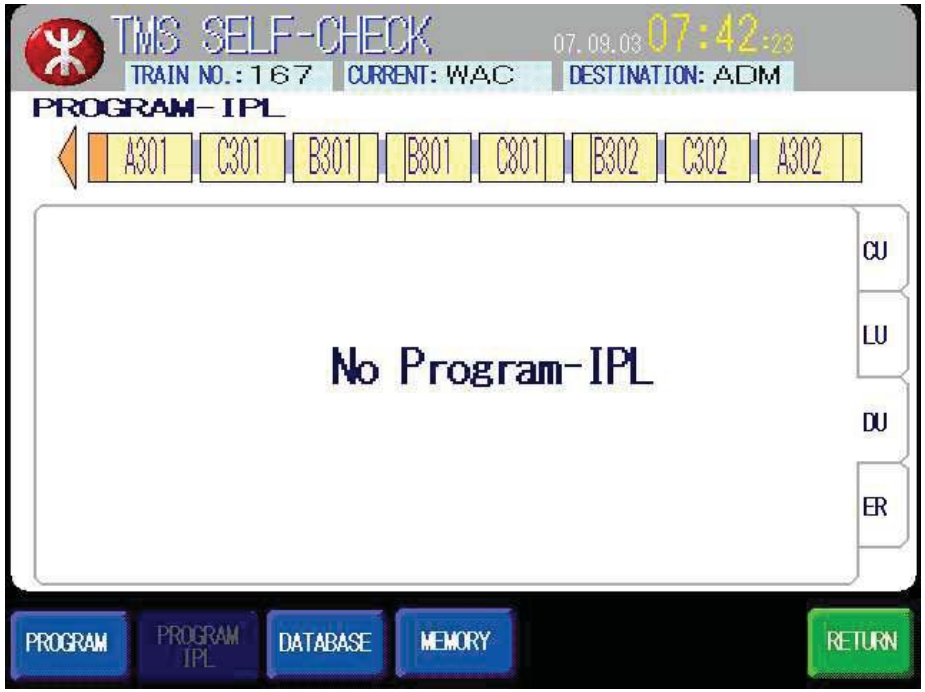
The LU program IPL identification screen is shown as follows;



J L

B6691

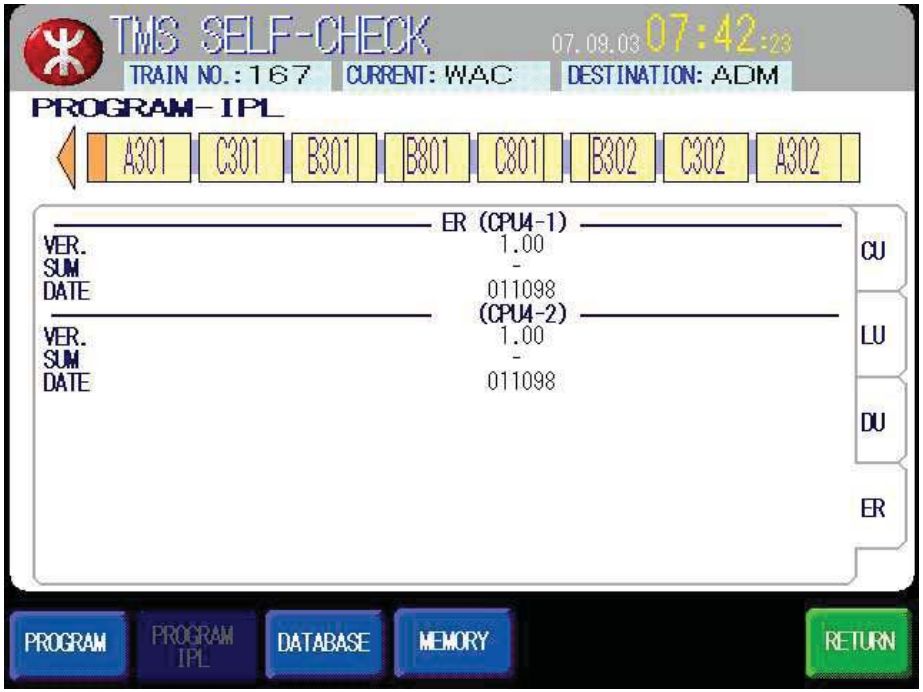
The DU program IPL identification screen is shown as follows;



JL

B6692

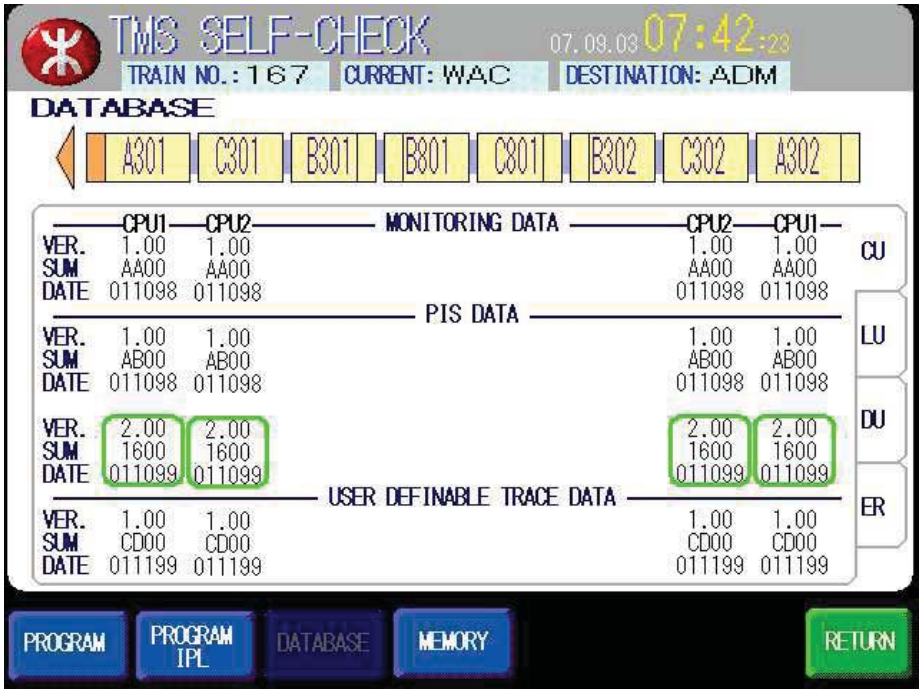
The ER program IPL identification screen is shown as follows;



FJL

B6634

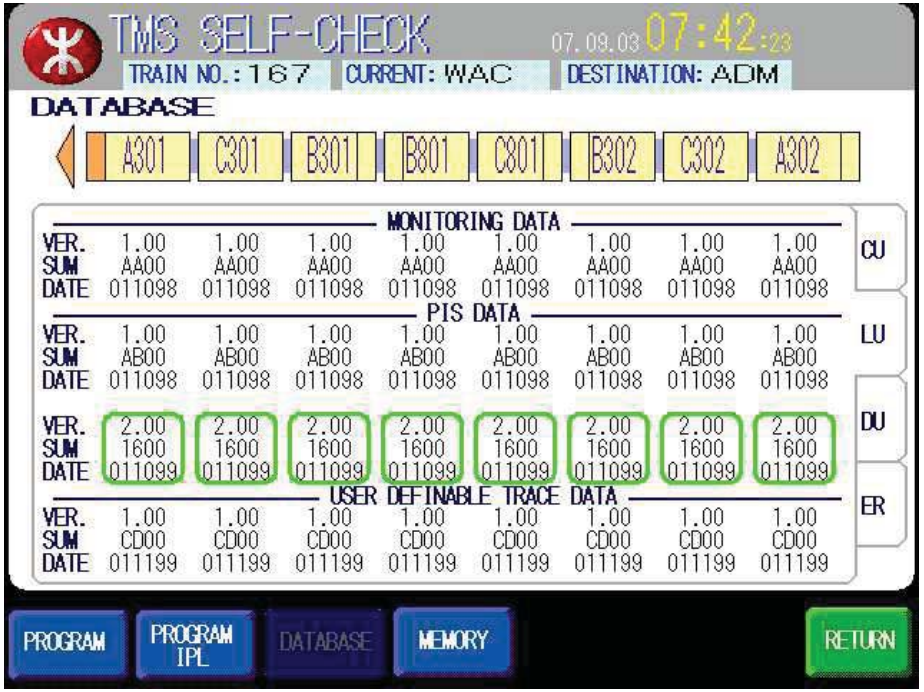
The CU database identification screen is shown as follows:



J L

B6640

The LU database identification screen is shown as follows;

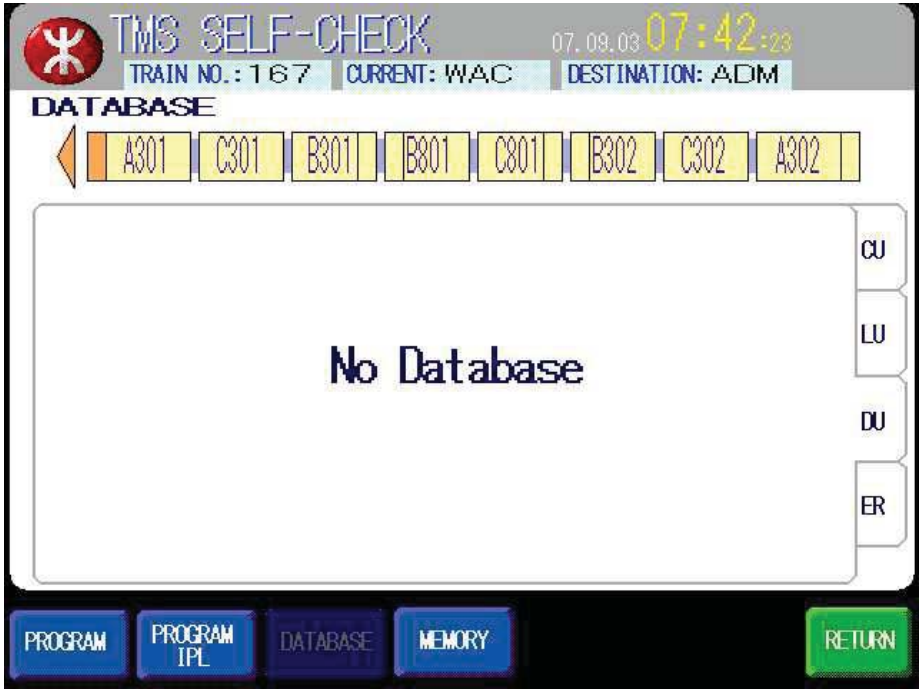


J L

B6641

There is no database in the DU.
In these case “No Database” is displayed on the window.

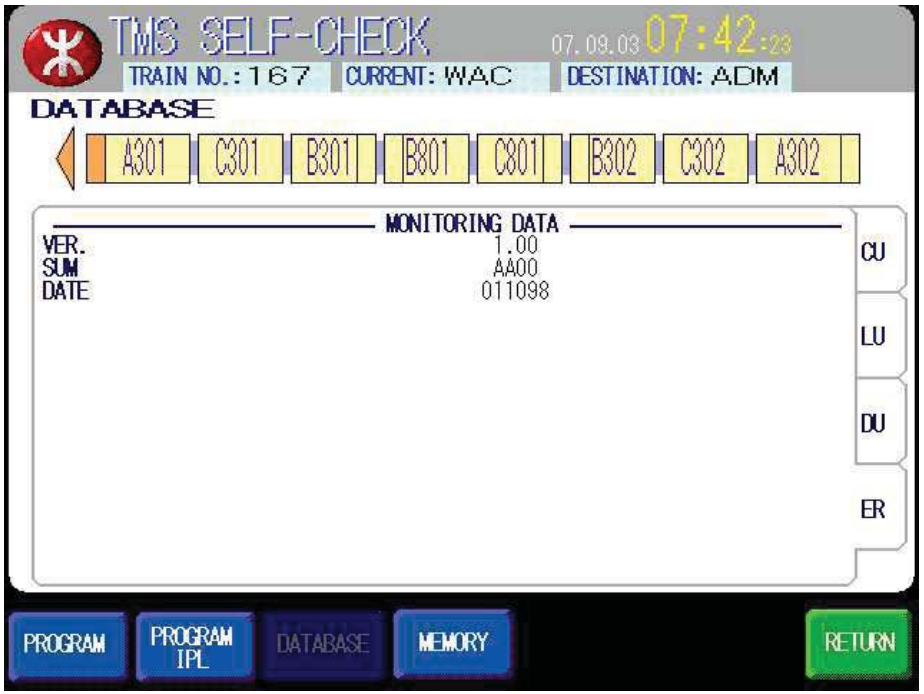
The DU database identification screen is shown as follows;



J L

B6642

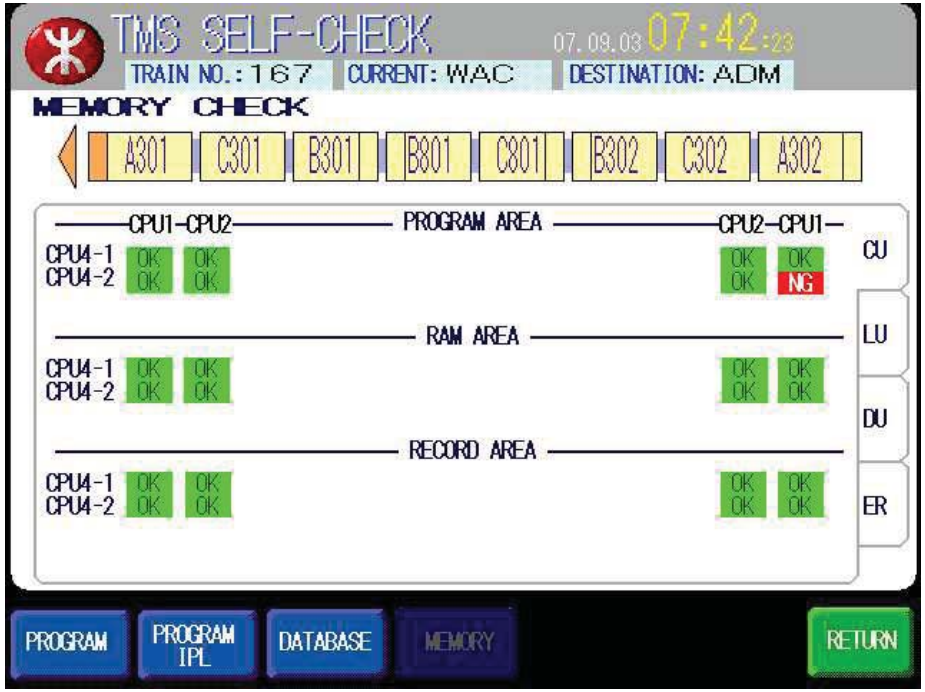
The ER database identification screen is shown as follows:



JL

B6643

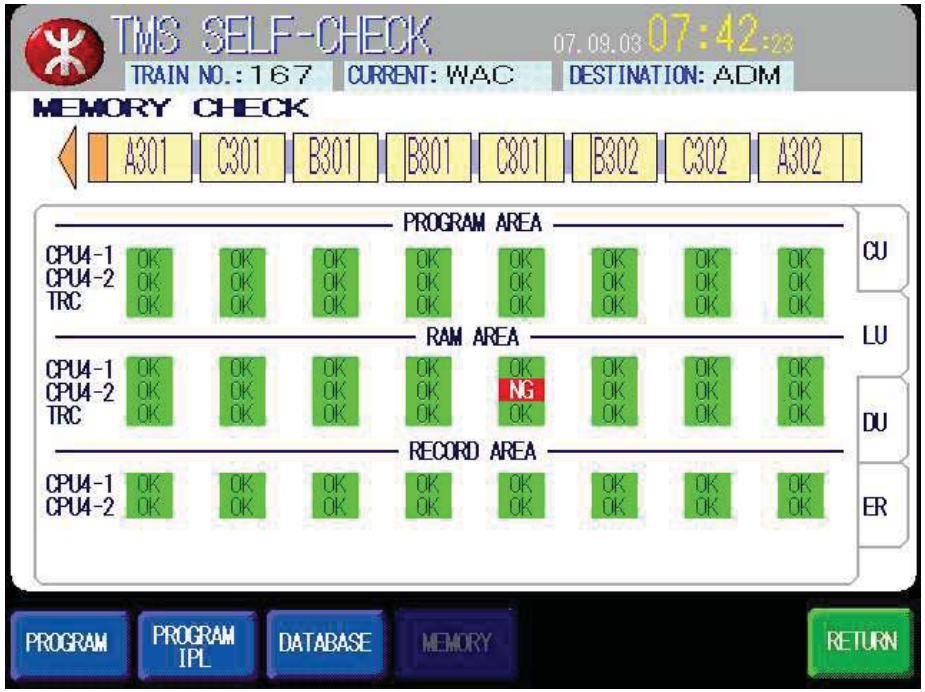
The CU memory check screen is shown as follows;



B J L

B6650

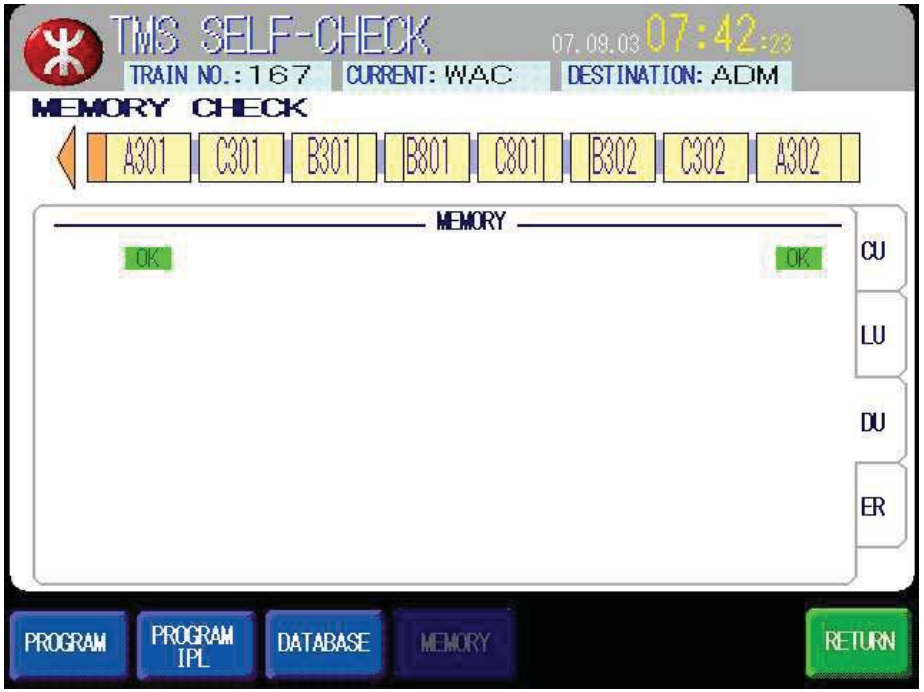
The LU memory check screen is shown as follows;



JL

B6651

The DU memory check screen is shown as follows;

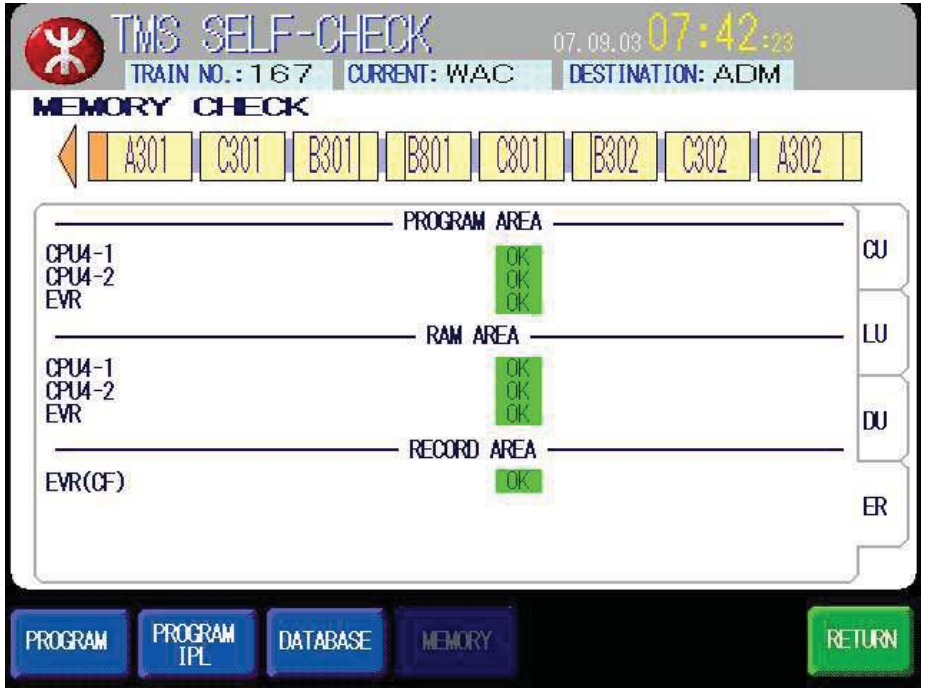


JL

B6652

			MITSUBISHI ELECTRIC CORPORATION., JAPAN									
			CHANGE								DOCUMENT NO.	
			J	04. Dec. 09							JHAV438	83
			L	05. Jan. 10								

The ER memory check screen is shown as follows;



F J L

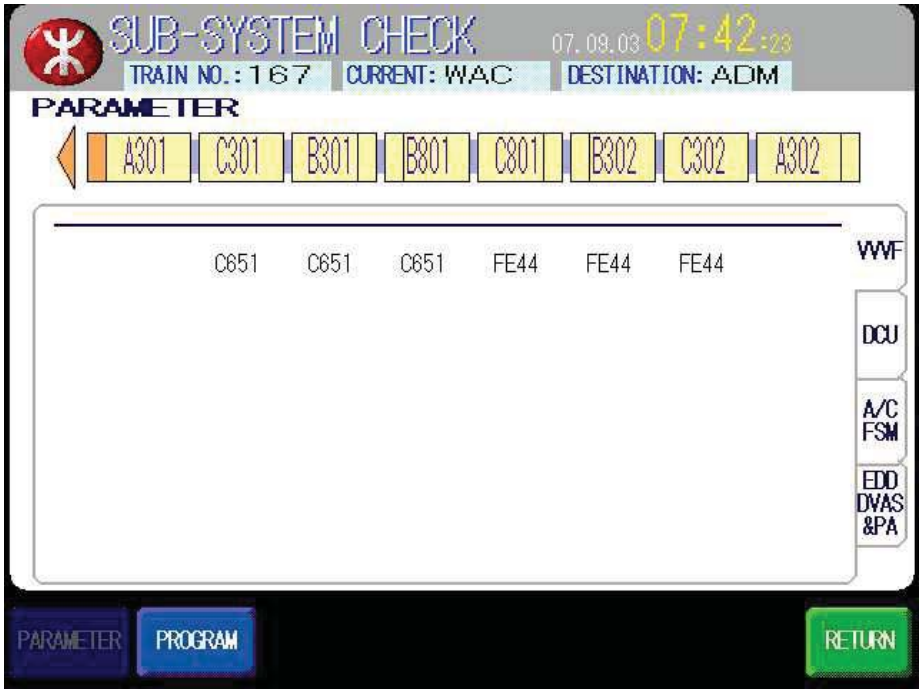
B6653

3.3.~~21~~ B ~~23~~ J 24 Sub-system check screen

This screen displays the following information as the Sub-system check information.

1)Parameter identification
2)Program identification

This is the first screen of the Sub-system check screen. This screen displays the parameter version identification of the VVVF F ~~DCU~~.

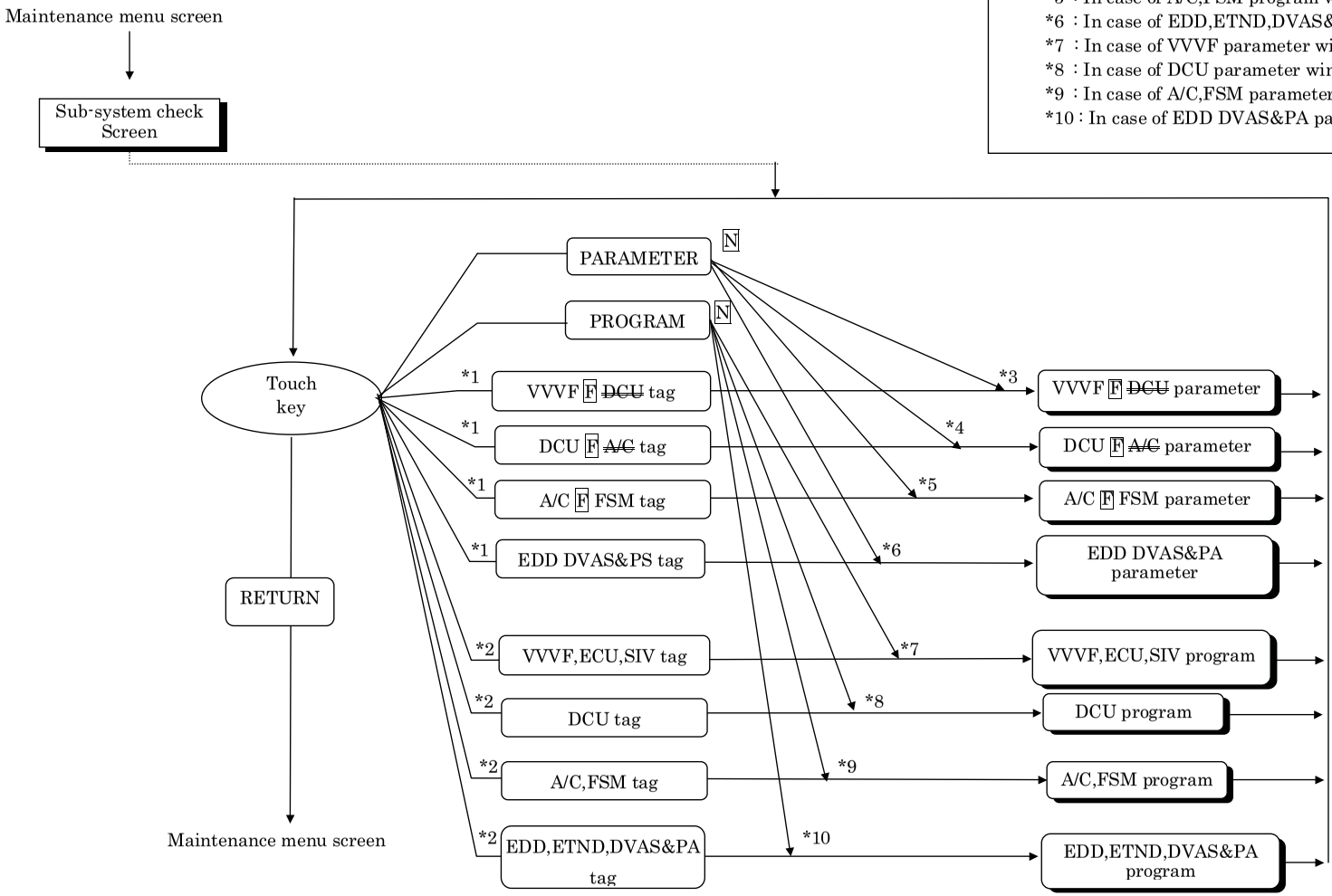


F K L

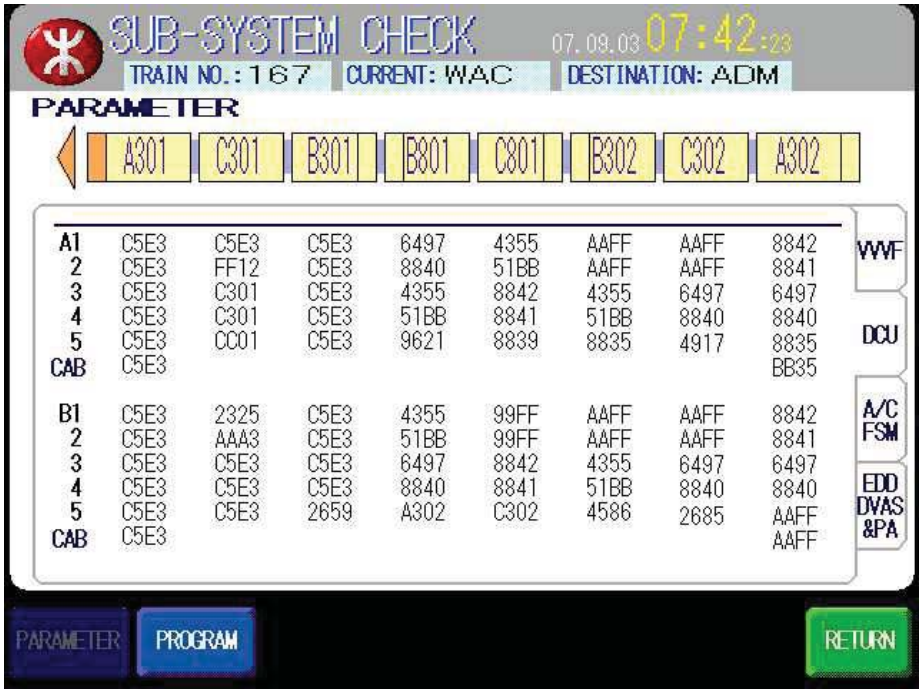
B6662

Flow of instruction and operation is shown as follows;

(NOTE)
*1 : In case of parameter windows
*2 : In case of subsystem windows
*3 : In case of VVVF,ECU,SIV program windows N
*4 : In case of DCU program windows N
*5 : In case of A/C,FSM program windows N
*6 : In case of EDD,ETND,DVAS&PA program windows N
*7 : In case of VVVF parameter windows N
*8 : In case of DCU parameter windows N
*9 : In case of A/C,FSM parameter windows N
*10 : In case of EDD DVAS&PA parameter windows N



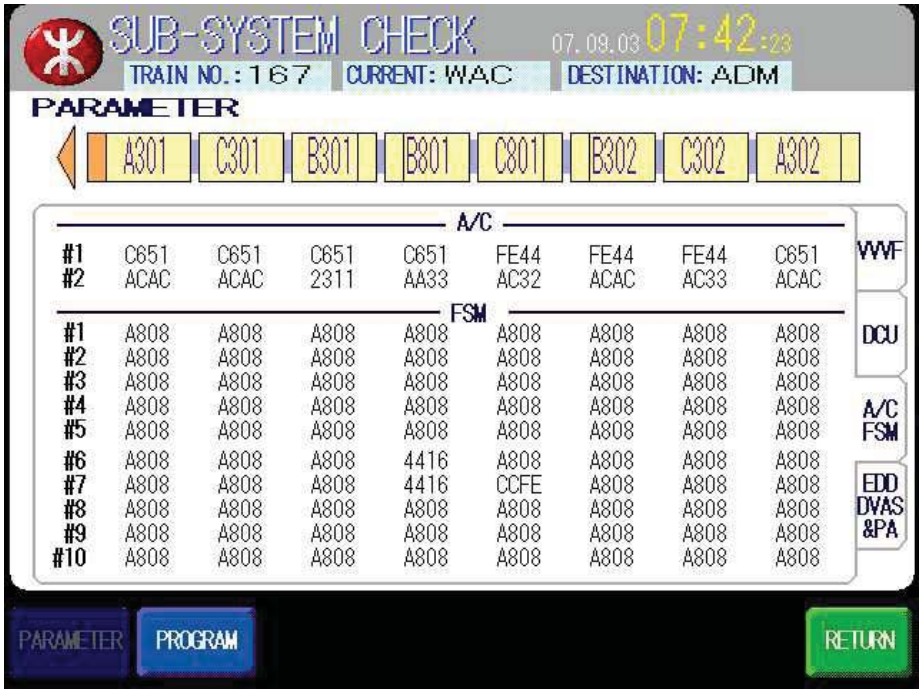
Example the DCU [F] ~~AIR CON.~~ parameter window is shown as follows;



[F] [J] [K] [L]

B6660

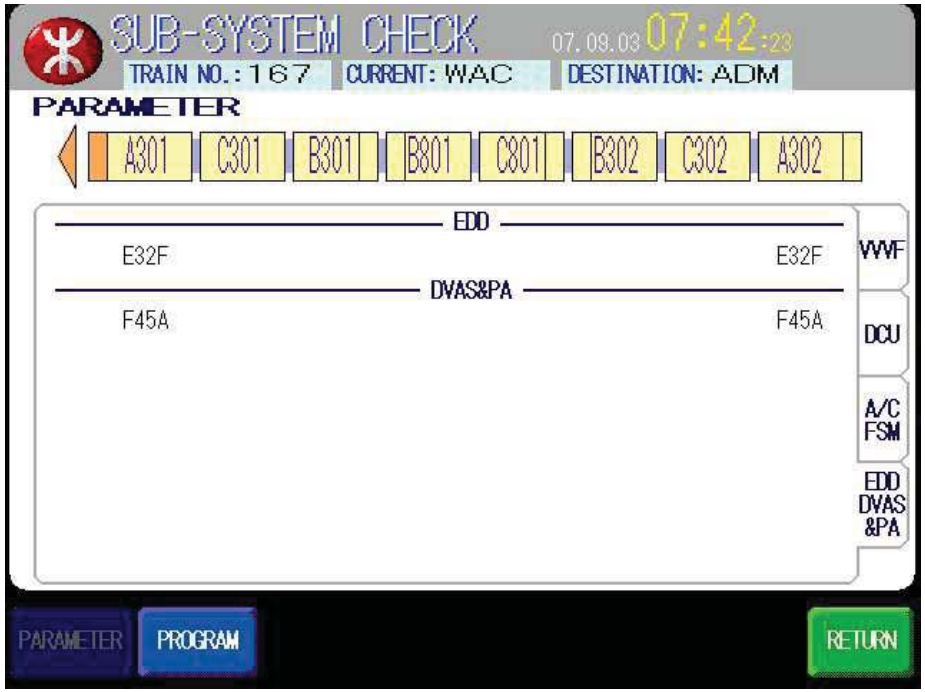
Example the AIR CON. [F] ~~FSM~~ parameter window is shown as follows;



[F] [J] [K] [L]

B6661

Example the EDD parameter window is shown as follows;

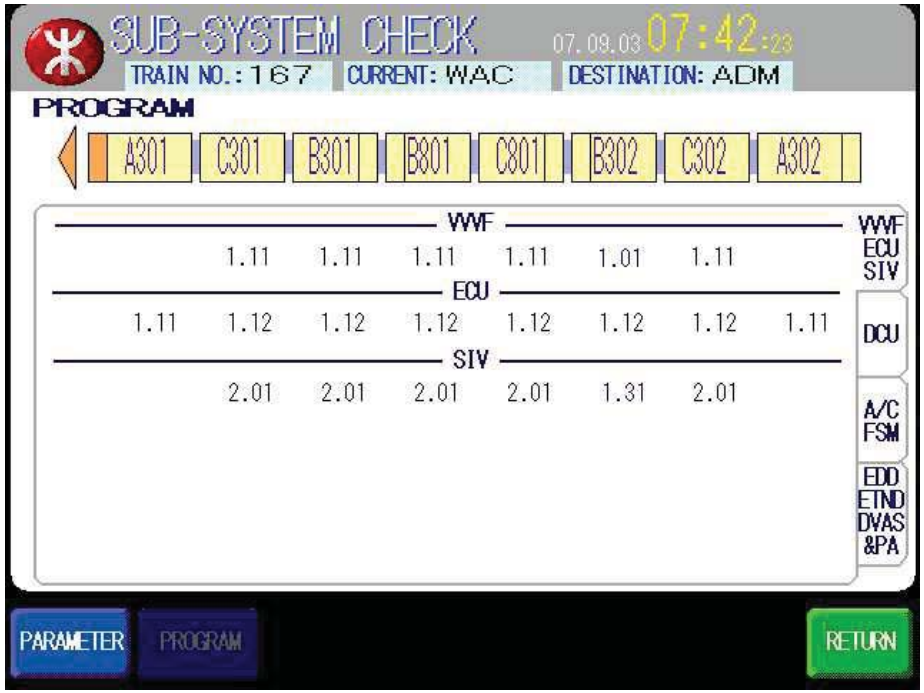


F K L

B6663

MITSUBISHI ELECTRIC CORPORATION., JAPAN									
CHANGE								DOCUMENT NO.	
F	27. Oct. 09	L	05. Jan. 10					JHAV438	88
K	17. Dec. 09								

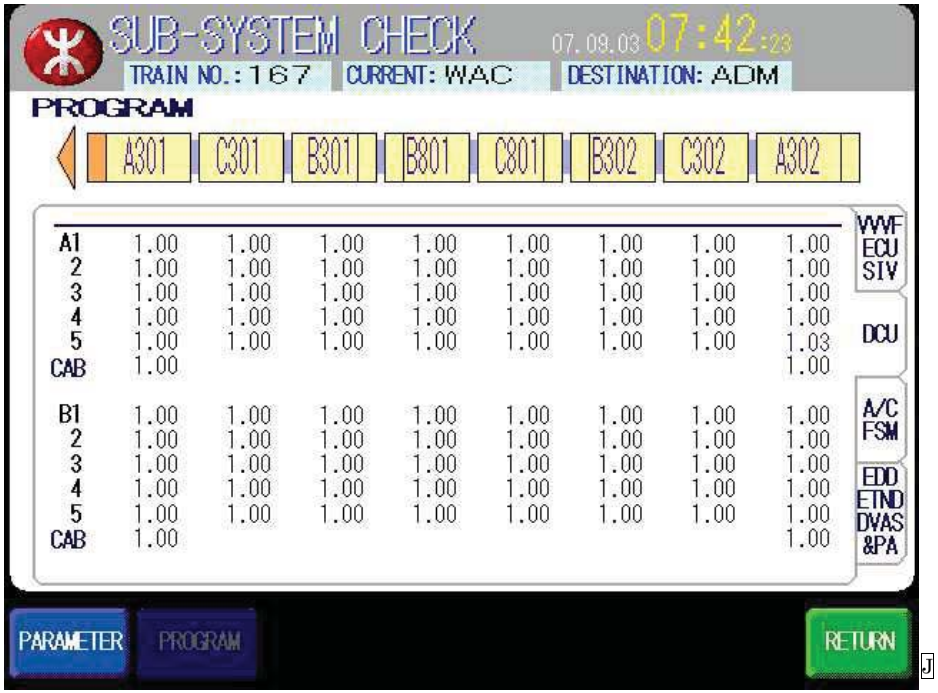
The VVVF, ECU, SIV subsystem program version identification screen is shown as follows;



K L

B6670

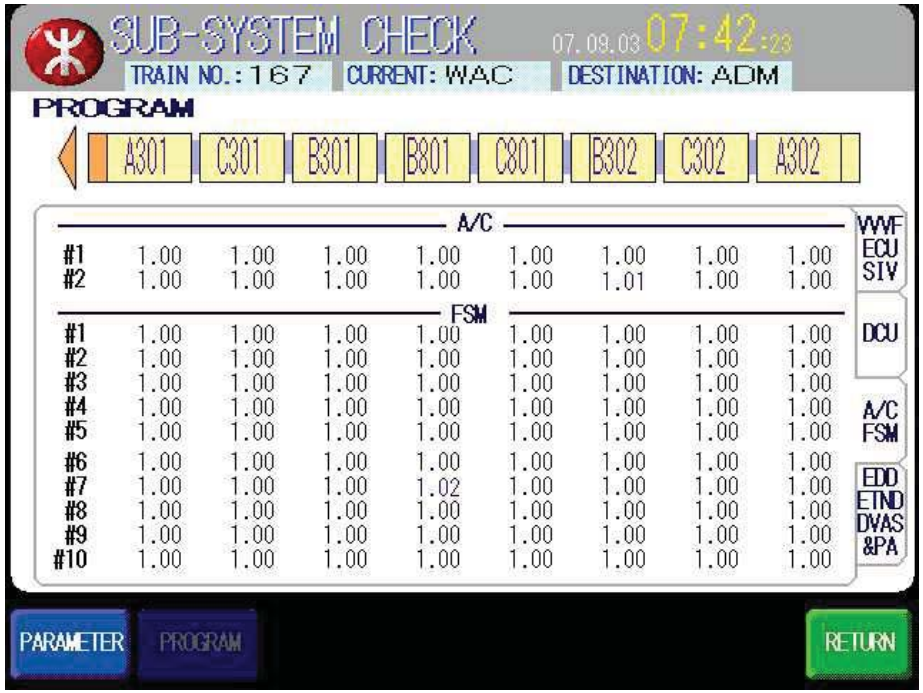
The DCU subsystem program version identification screen is shown as follows;



J K L M

B6671

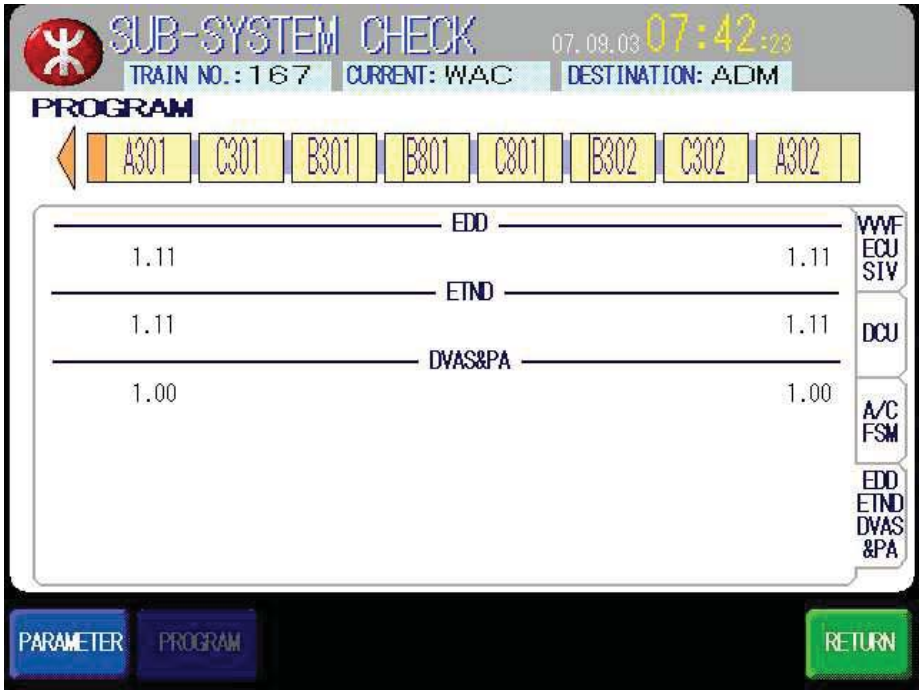
Example the A/C, FSM subsystem program window is shown as follows;



J K L

B6672

Example the EDD, ETND, DVAS&PA subsystem program window is shown as follows;



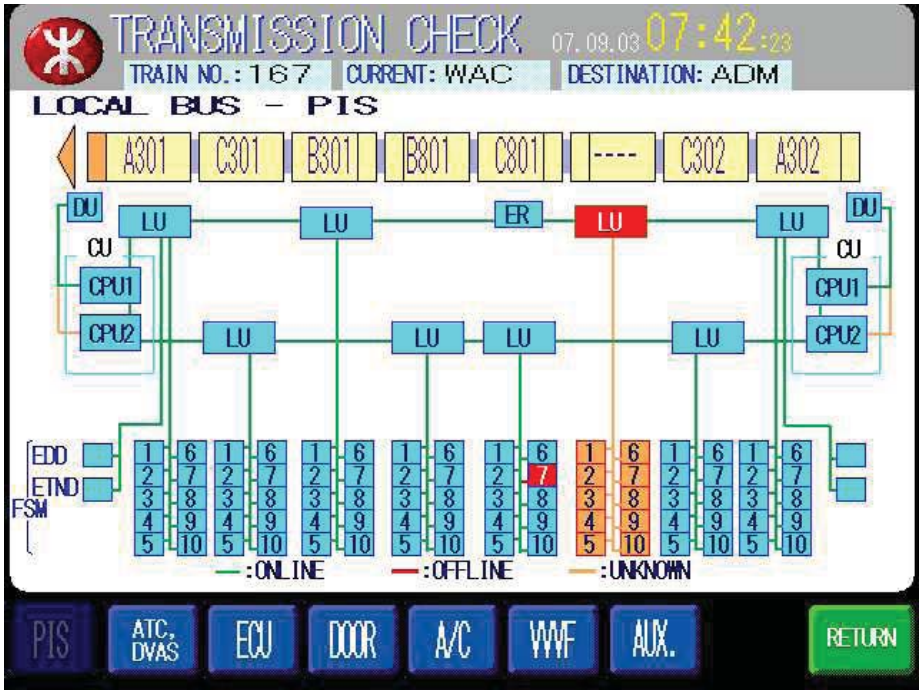
K L

B6673

3.3.~~22~~ B ~~24~~ J 25 Transmission check screen

This screen displays the status of the transmission to the TMS.

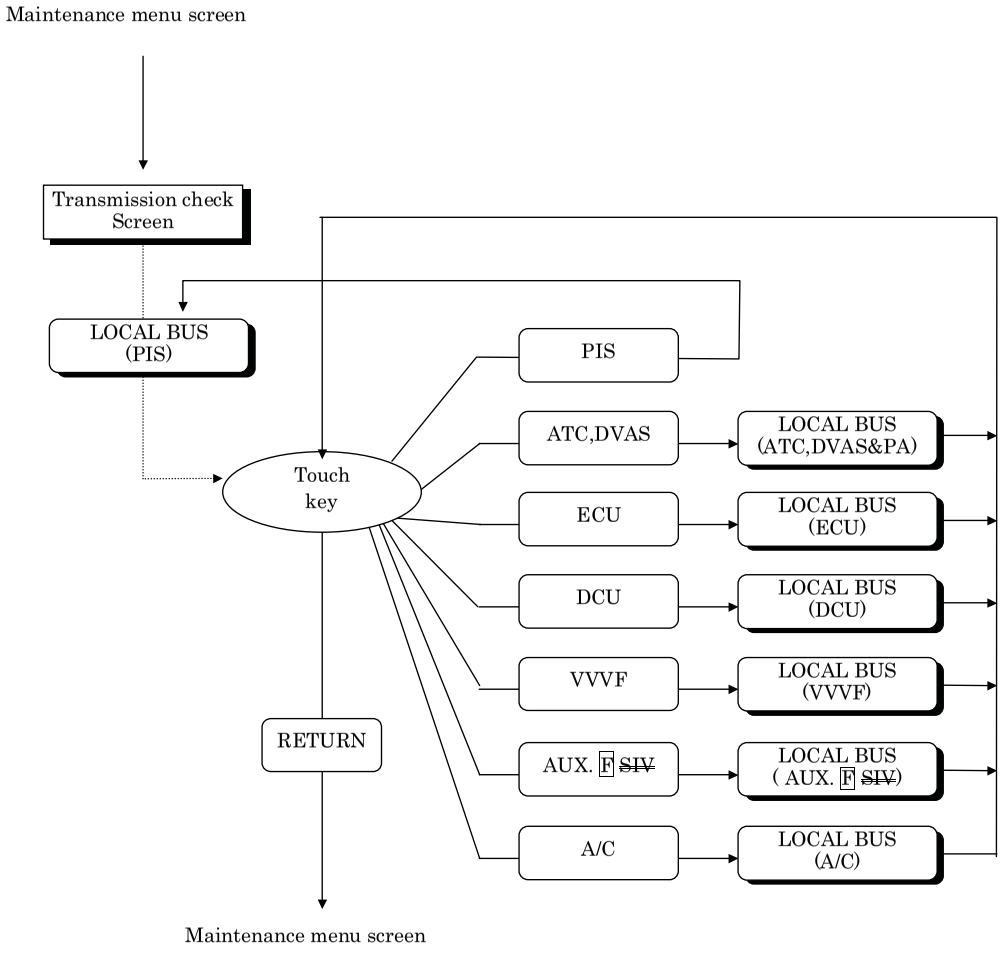
This is the first screen of the transmission check screen.
This screen displays the status of the train bus and local bus for the PIS.
(The status of the train bus is included all transmission check screens.)



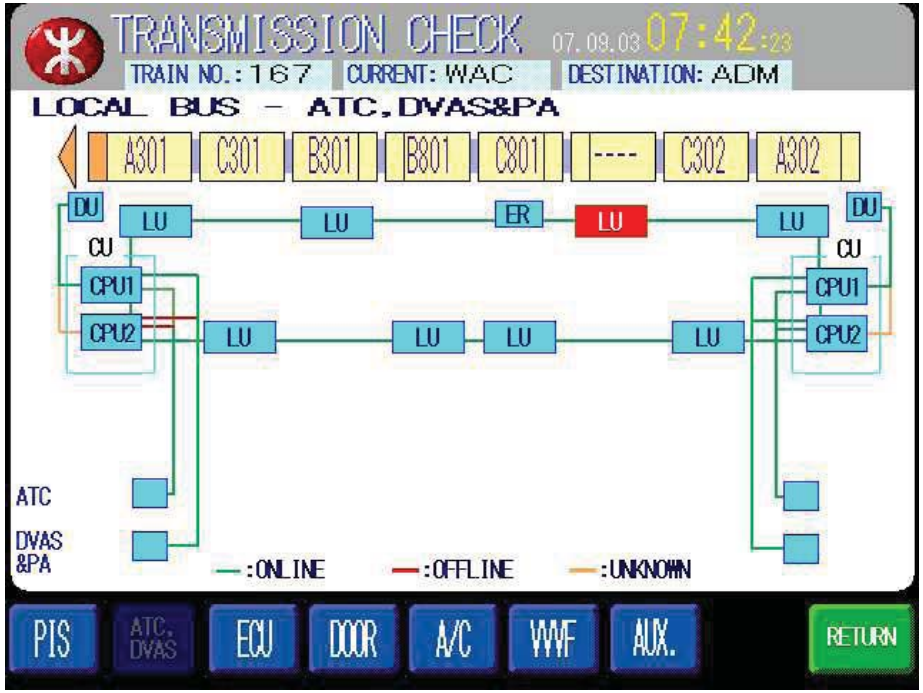
B F J L

B661

Flow of instruction and operation is shown as follows;



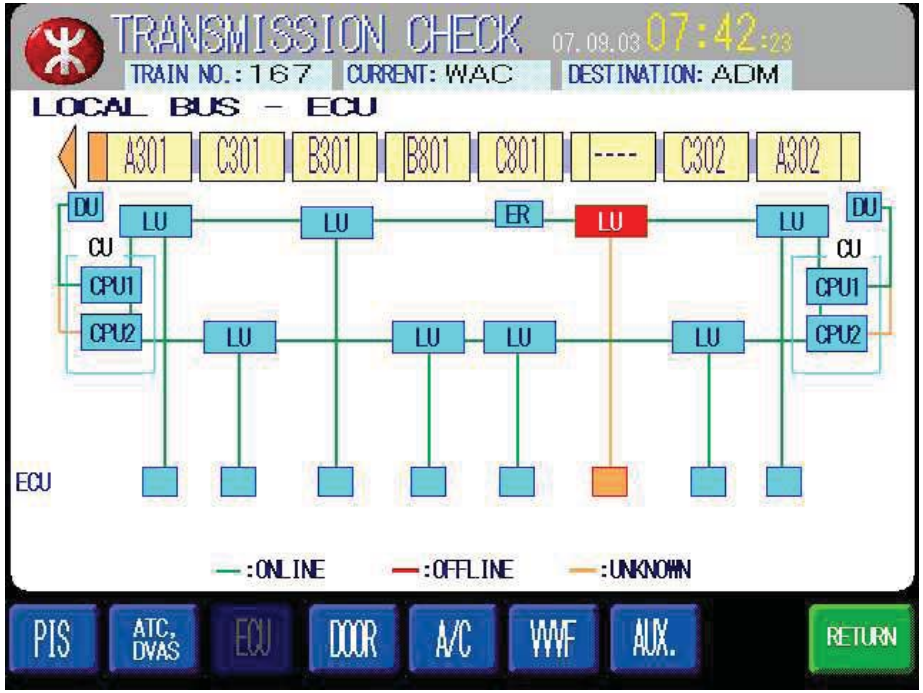
The transmission check screen of the local bus for the ATC and DVAS is shown as follows;



B662

B F J K L M

The transmission check screen of the local bus for the ECU is shown as follows;

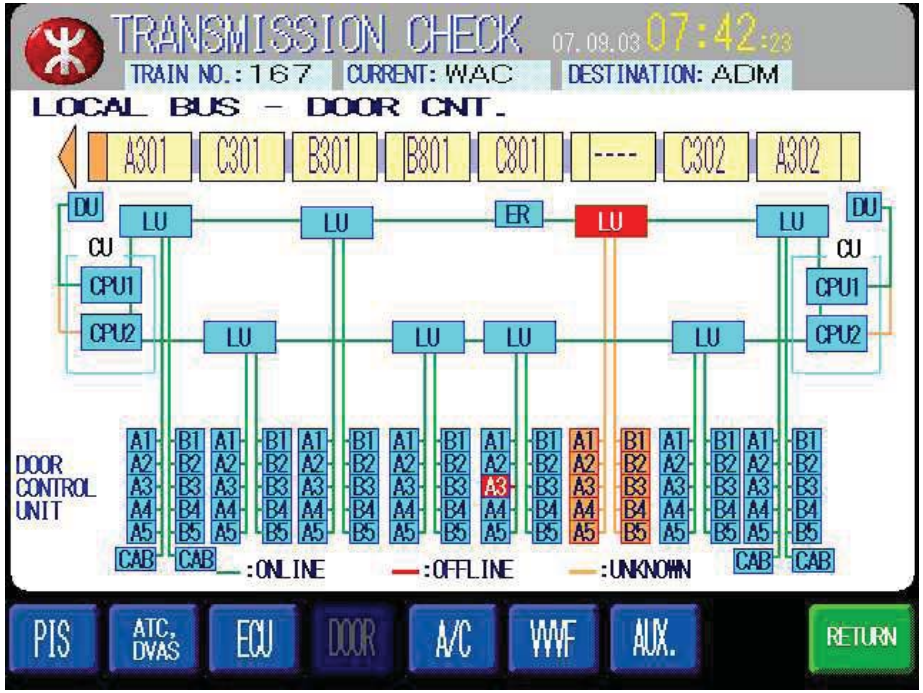


B663

B F J L

			MITSUBISHI ELECTRIC CORPORATION., JAPAN									
			CHANGE								DOCUMENT NO.	
			B	22. May. 09	J	04. Dec. 09	L	05. Jan. 10			JHAV438	93
			F	27. Oct. 09	K	17. Dec. 09	M	28. Jan. 10				

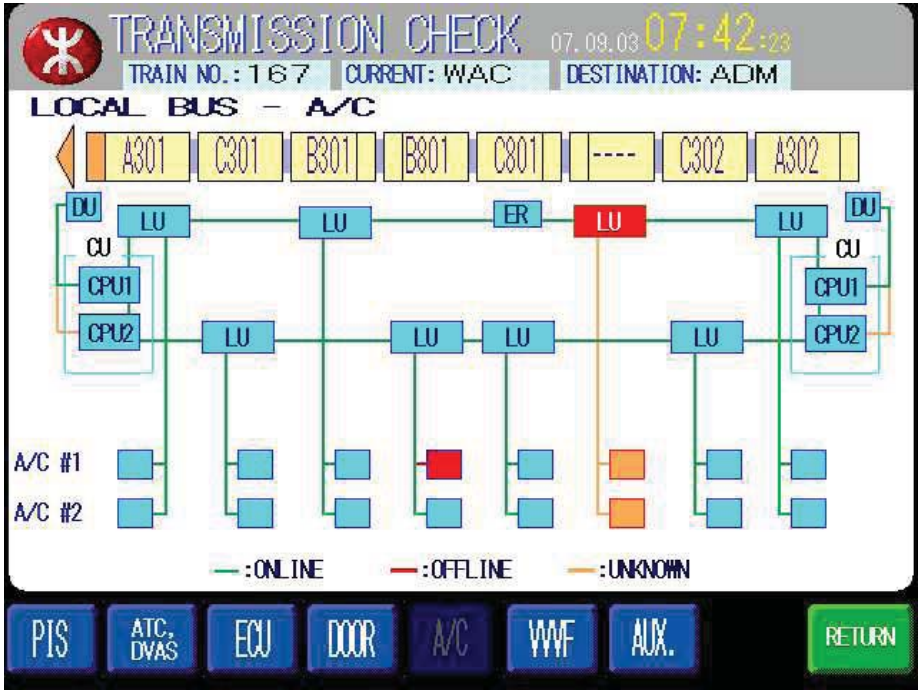
The transmission check screen of the local bus for the DCU is shown as follows;



B F J K L

B664

The transmission check screen of the local bus for the A/C is shown as follows;

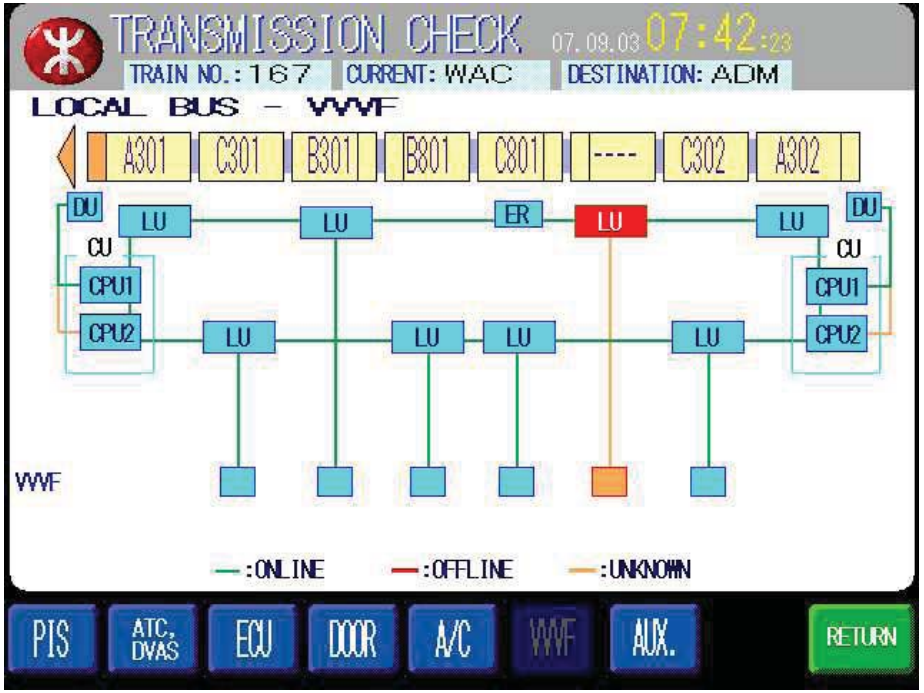


B F J K L

B665

			MITSUBISHI ELECTRIC CORPORATION., JAPAN								
			CHANGE								DOCUMENT NO.
			B	22. May. 09	J	04. Dec. 09	L	05. Jan. 10			JHAV438 94
			F	27. Oct. 09	K	17. Dec. 09					

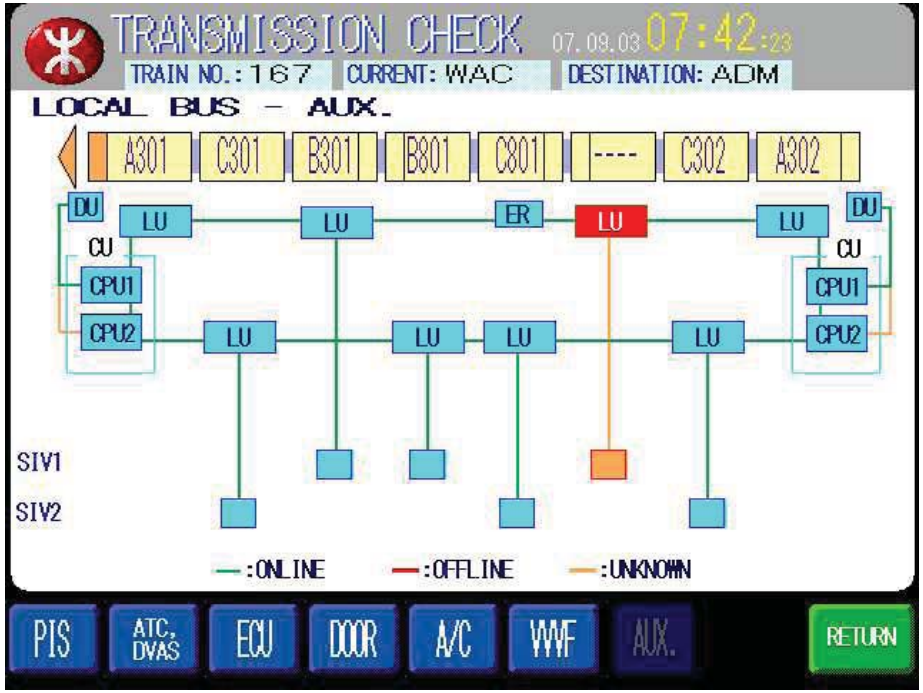
The transmission check screen of the local bus for the VVVF is shown as follows;



B F J L M N

B666

The transmission check screen of the local bus for the AUX. F ~~SIV~~ is shown as follows;



B F J L

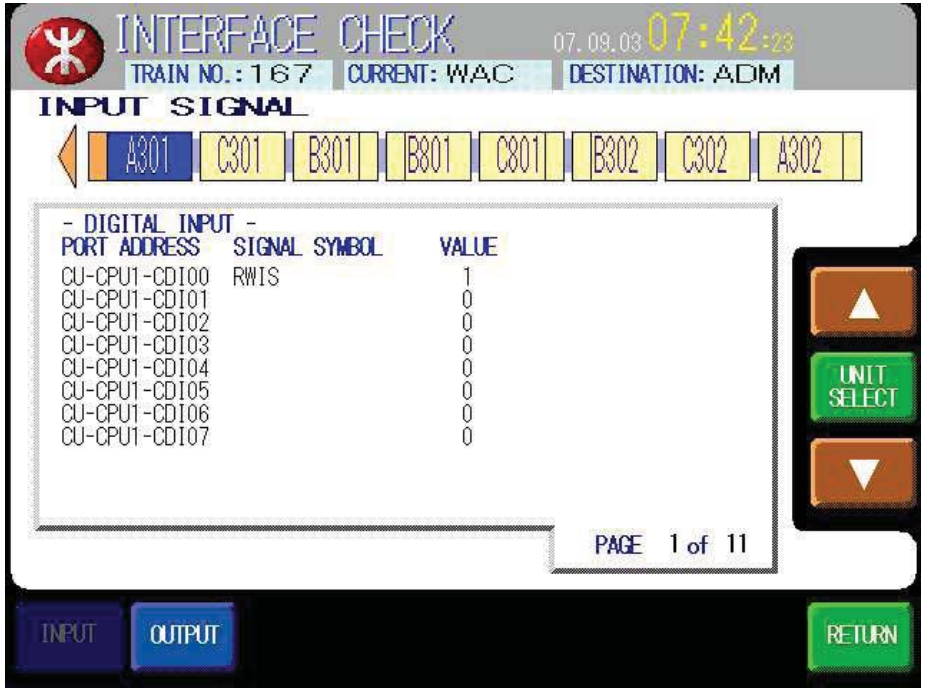
B667

			MITSUBISHI ELECTRIC CORPORATION., JAPAN									
			CHANGE								DOCUMENT NO.	
			B	22. May. 09	J	04. Dec. 09	M	28. Jan. 10			JHAV438	95
			F	27. Oct. 09	L	05. Jan. 10	N	23. Mar. 10				

3.3.~~23~~ B ~~25~~ J 26 Interface check screen

This screen displays the status of the hardware interface of the TMS.

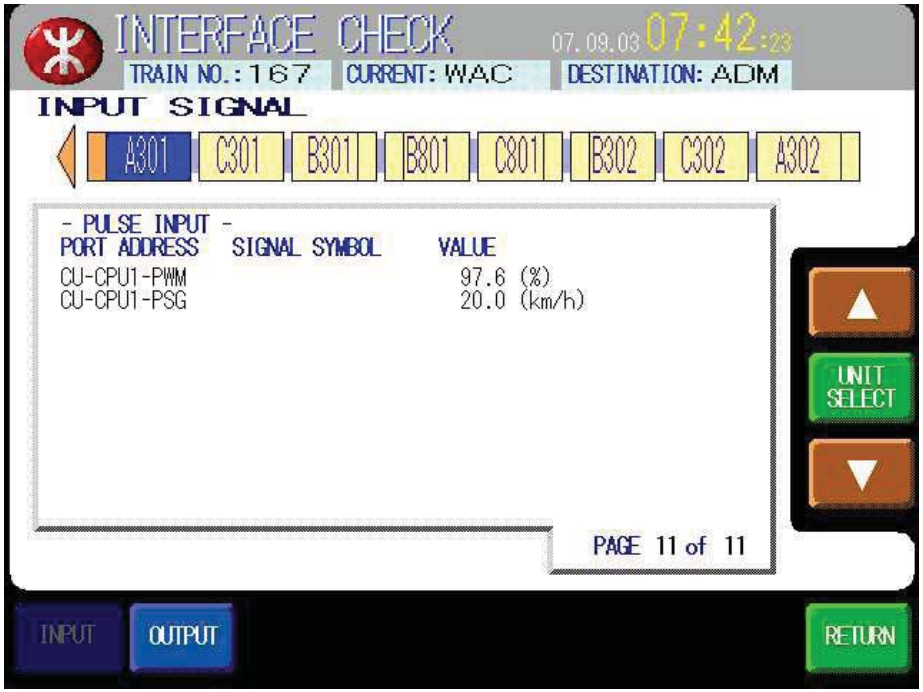
Digital input screen is the first screen of the interface check screen.
Example of the digital input screen is shown as follows;



L

B670

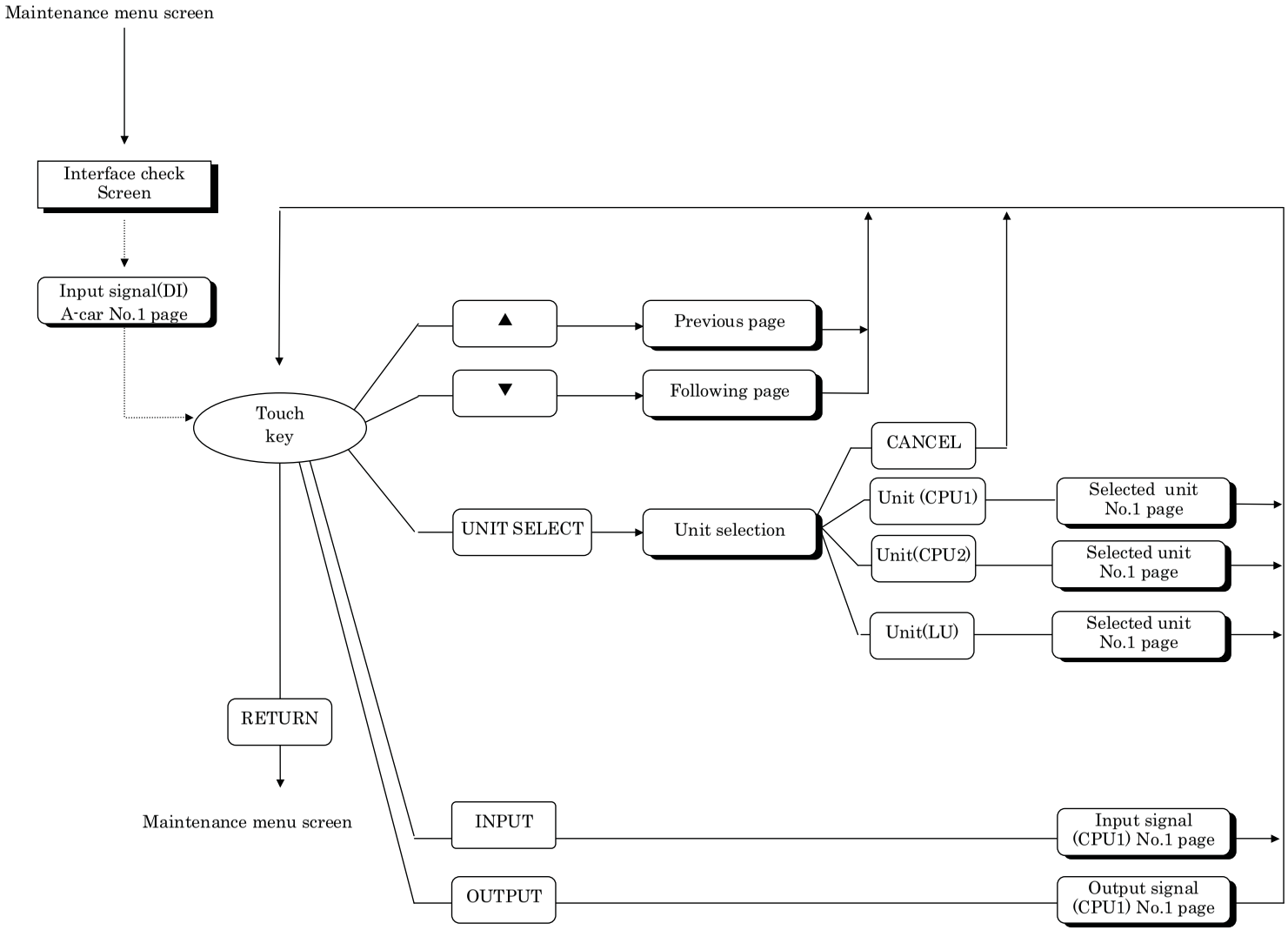
Example of pulse input screen is shown as follows;



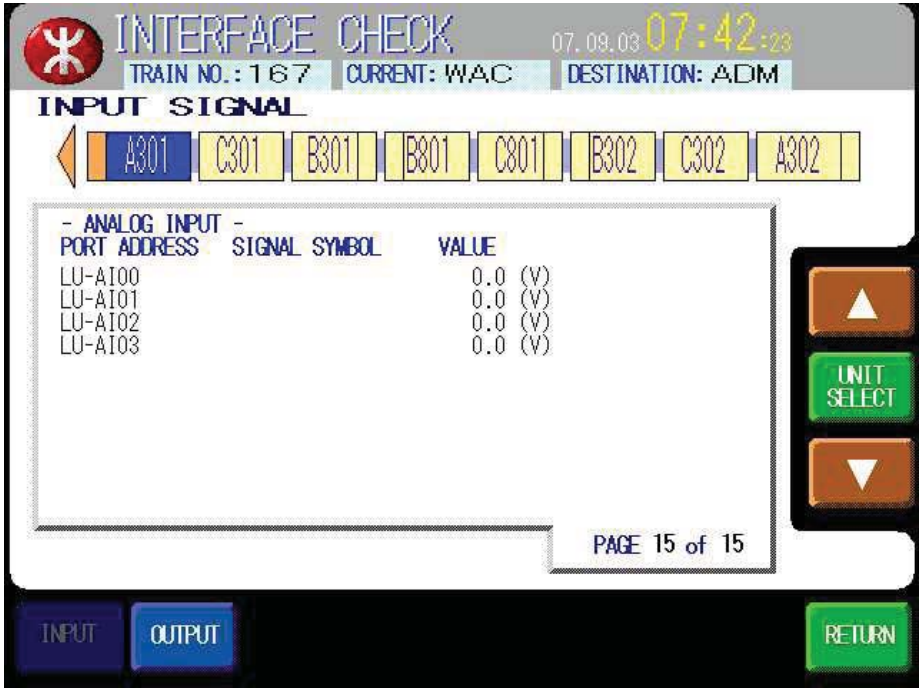
L

B1111

Flow of instruction and operation is shown as follows;

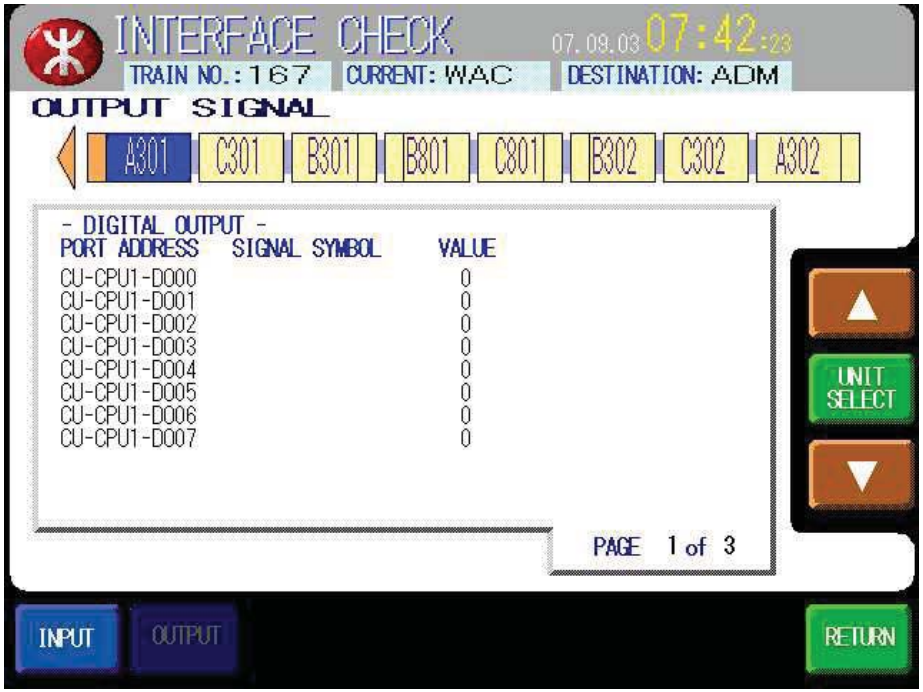


Example of the analog input screen is shown as follows;



B671

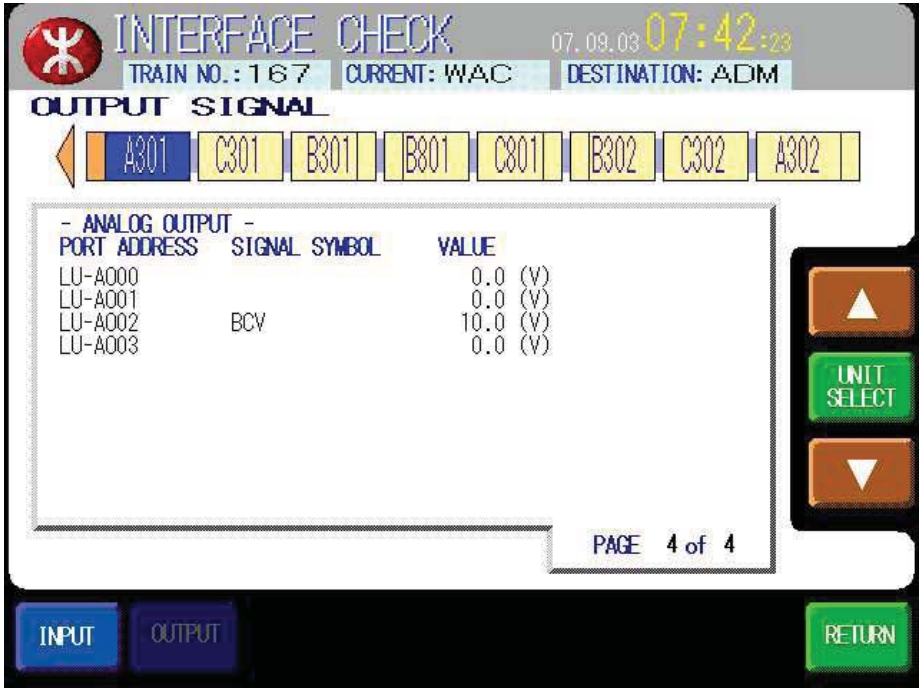
Example of the digital output screen is shown as follows;



B673

			MITSUBISHI ELECTRIC CORPORATION., JAPAN	
			CHANGE	DOCUMENT NO.
			L 05. Jan. 10	JHAV438

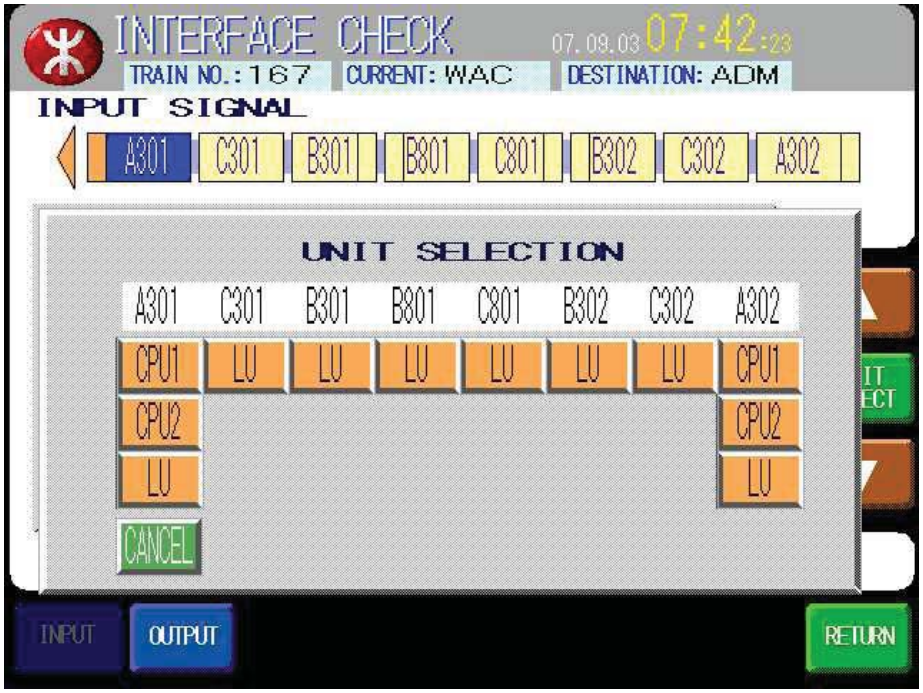
Example of the analog output screen is shown as follows;



L

B674

The unit selection window is shown as follows;



L

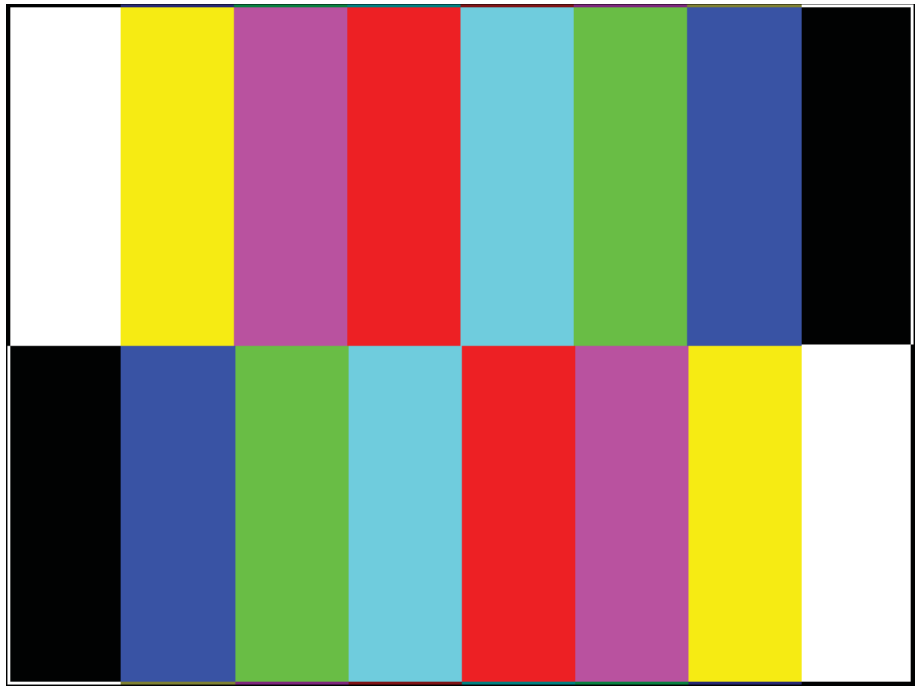
B675

			MITSUBISHI ELECTRIC CORPORATION., JAPAN									
			CHANGE								DOCUMENT NO.	
			L	05. Jan. 10							JHAV438	99

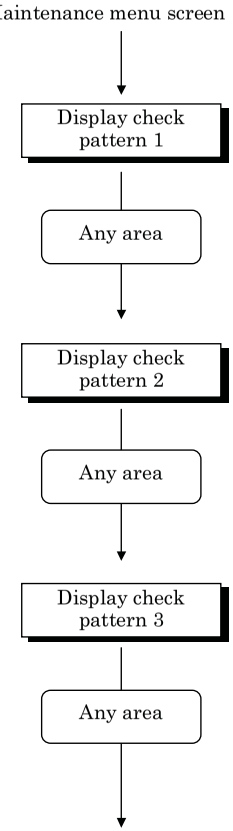
3.3.~~24~~ B ~~26~~ J 27 Display check screen

These display pattern are used for the display check.

This screen is the first screen (display check pattern 1).



Flow of instruction and operation is shown as follows;

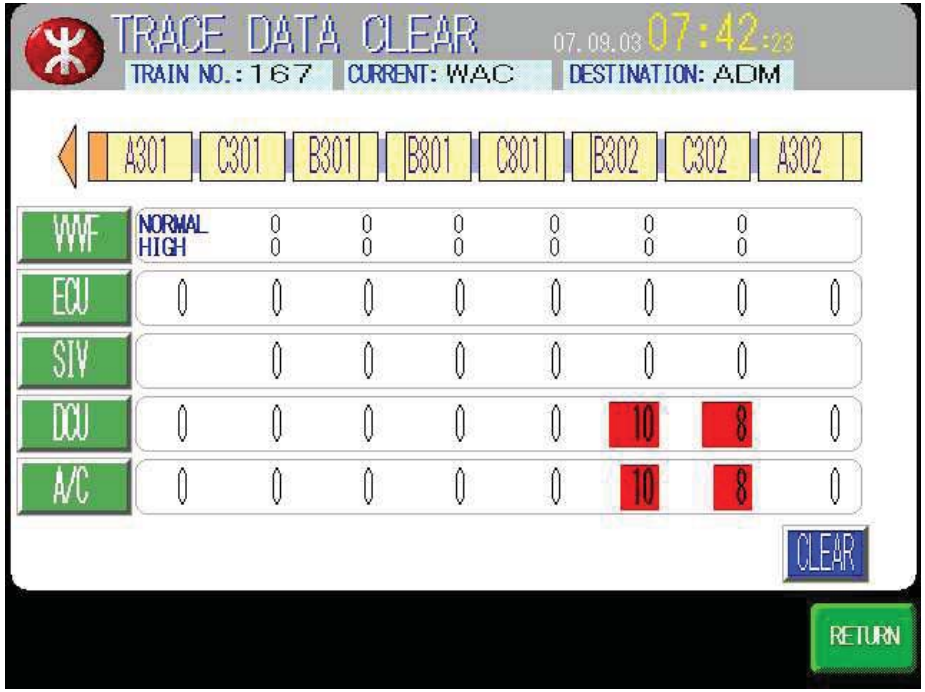


The display check pattern 2 is shown as follows;

The display check pattern 3 is shown as follows;

3.3.~~25~~ B ~~27~~ J 28 Trace data clear screen

This screen displays the status of the trace data each of the sub-system.
Trace data is able to delete each of the sub-system in this screen operation.



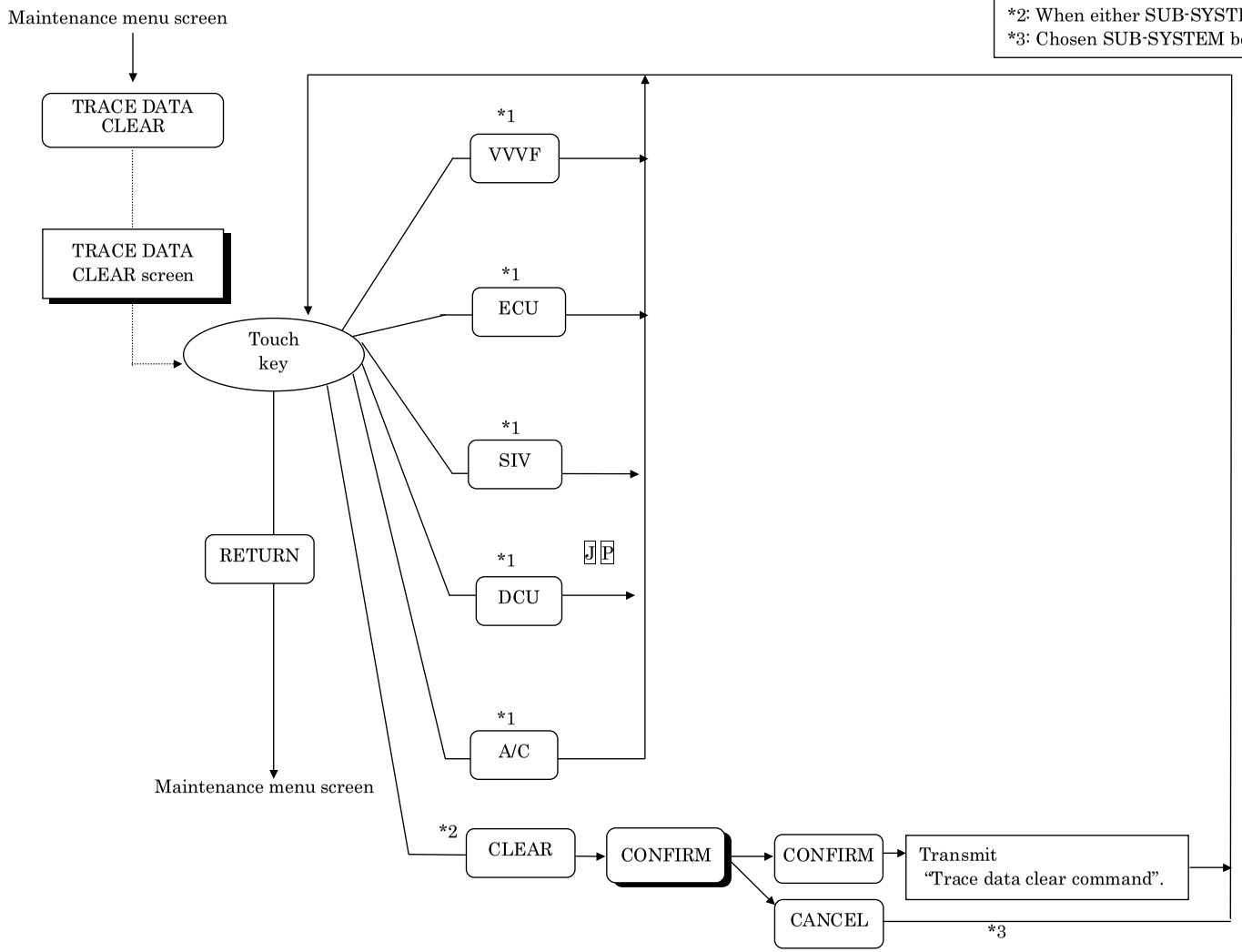
J L P R

B1413

			MITSUBISHI ELECTRIC CORPORATION., JAPAN									
			CHANGE								DOCUMENT NO.	
			B	22. May. 09	L	05. Jan. 10	R	10. Jun. 10			JHAV438	102
			J	04. Dec. 09	P	28. Apr. 10						

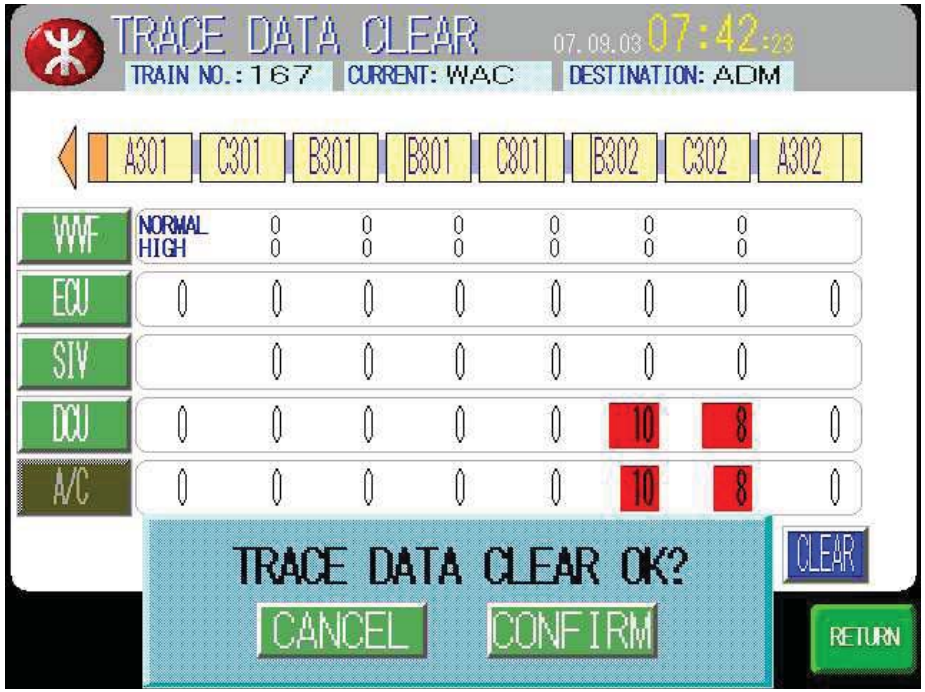
*1: Multiple selections are possible.
When it is chosen again, selection is canceled in the case of the selection condition.
*2: When either SUB-SYSTEM is selected, the “CLEAR” key is valid.
*3: Chosen SUB-SYSTEM become invalid.

Flow of instruction and operation is shown as follows;



			MITSUBISHI ELECTRIC CORPORATION., JAPAN									
			CHANGE								DOCUMENT NO.	
			J	04. Dec. 09							JHAV438	103
			P	28. Apr. 10								

Example of the Trace data clear window is shown as follows;

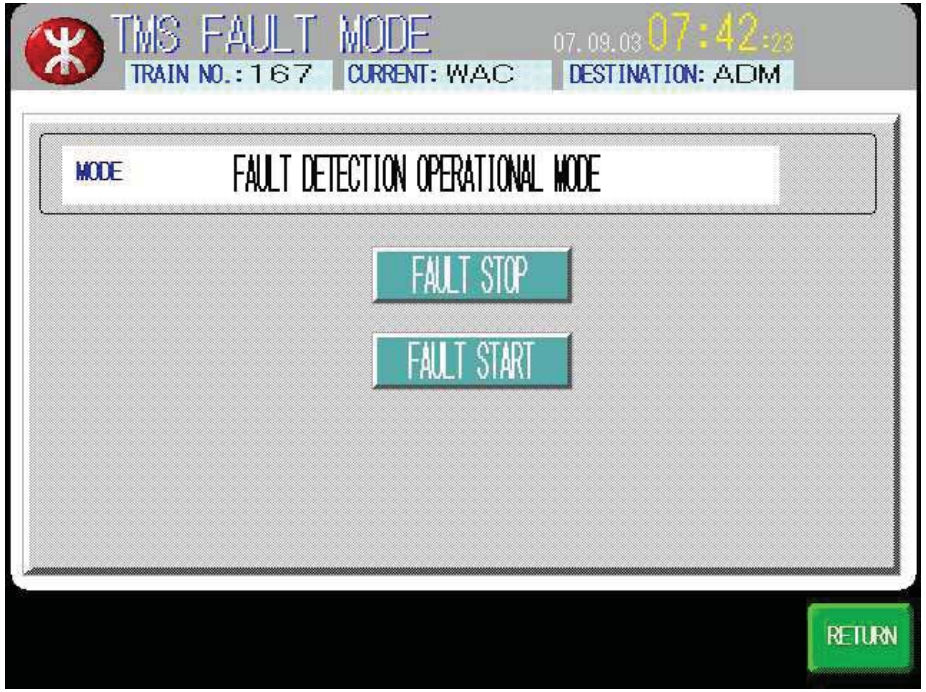


J L N P R

B1414

3.3.~~26~~ B ~~28~~ J 29 TMS fault mode screen

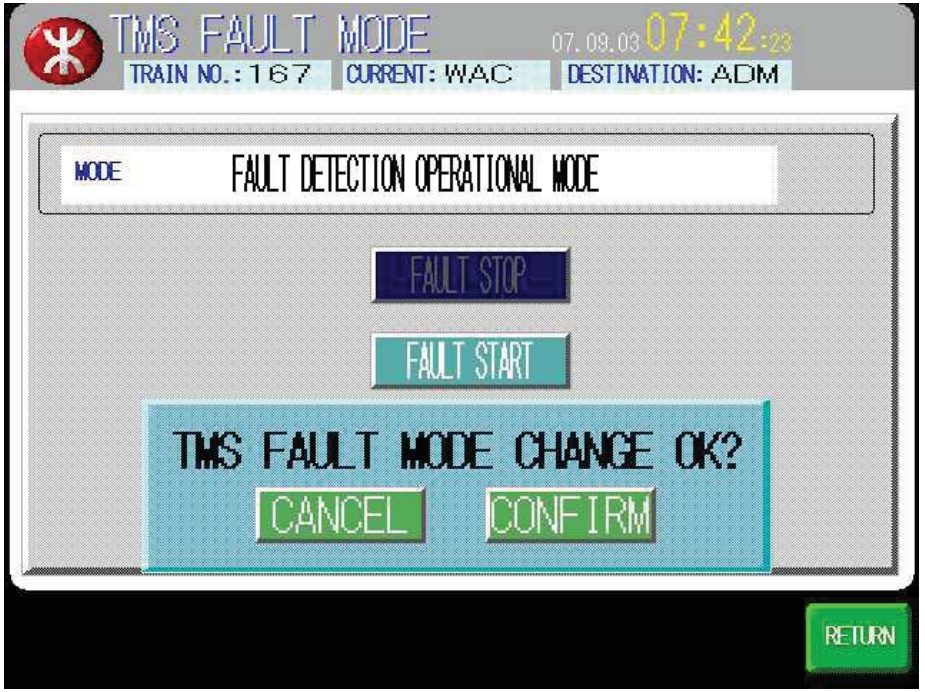
This screen displays the fault mode of TMS.
The fault mode is able to change in this screen operation.



L

B51

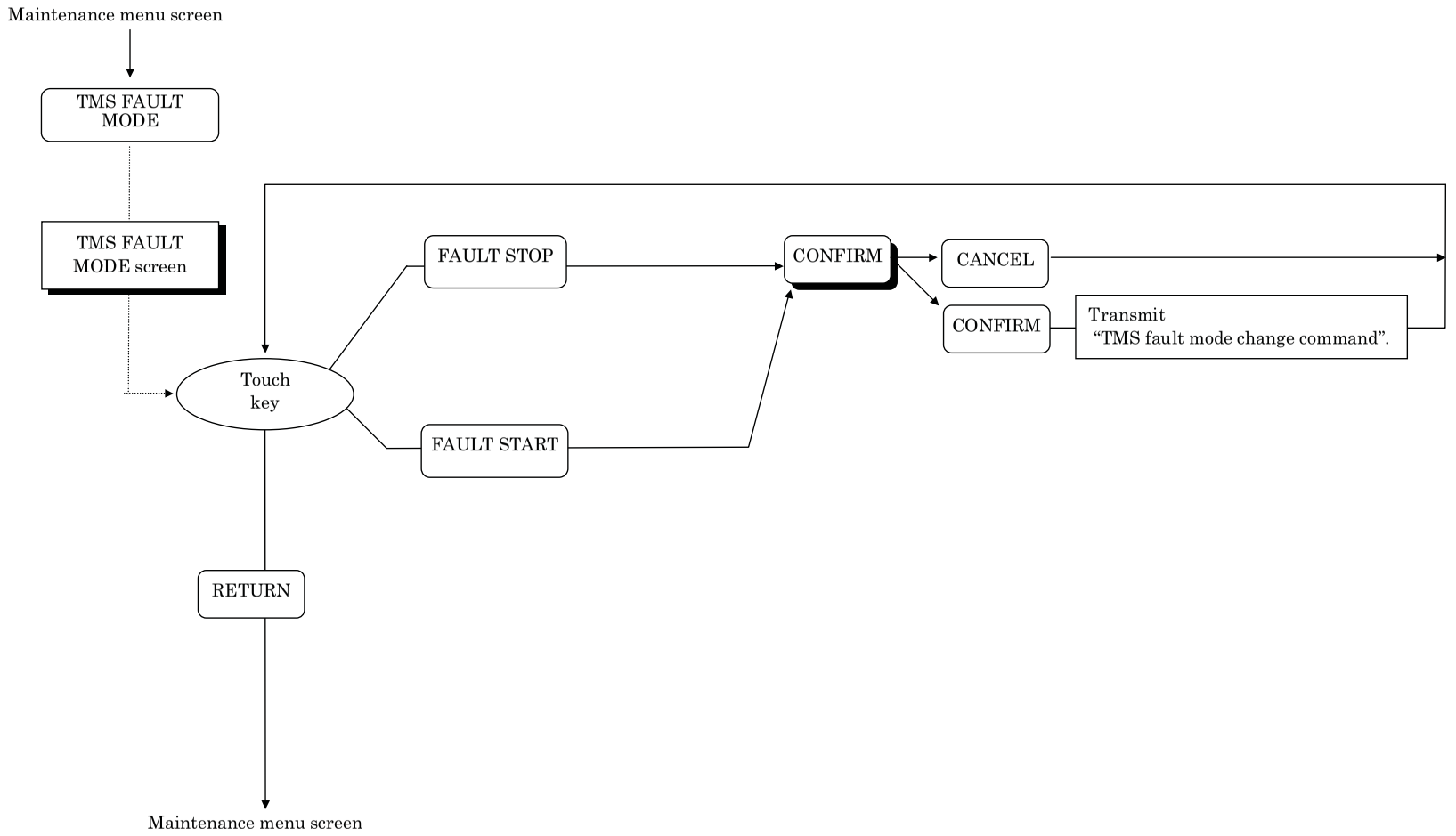
Example of the confirm window is shown as follows;



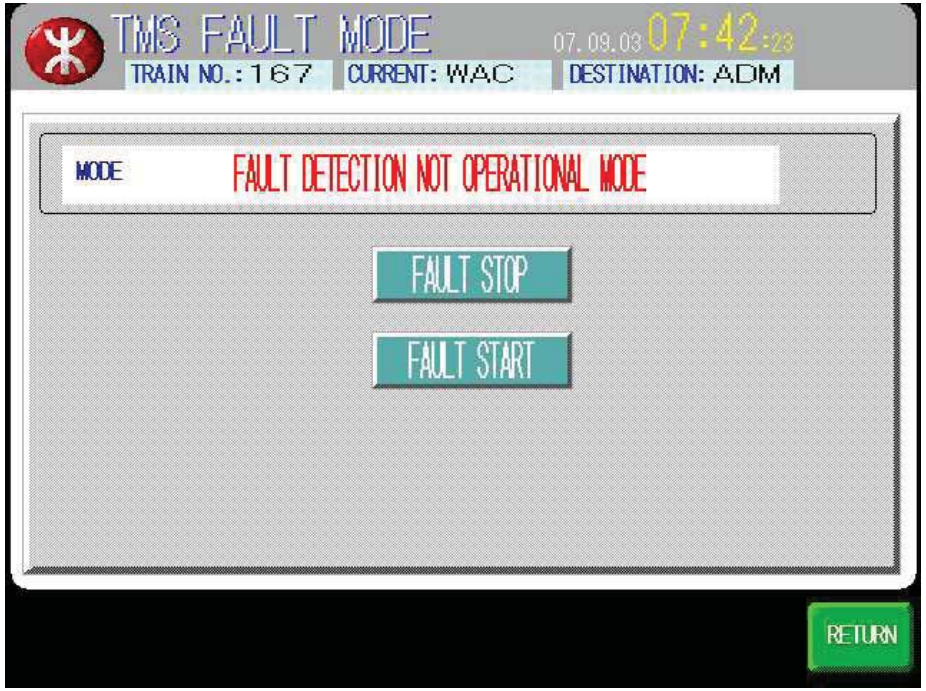
L

B56

Flow of instruction and operation is shown as follows;



Example of the “FAULT DETECTION NOT OPERATIONAL MODE” is shown as follows;

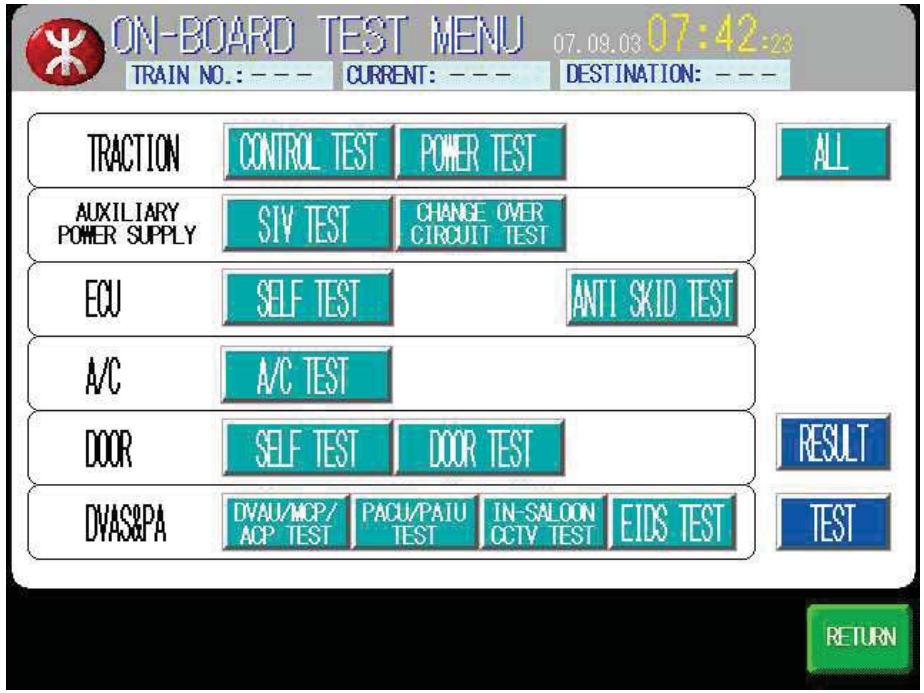


L

B53

3.3.~~27~~ B ~~29~~ J 30 On-board test menu screen

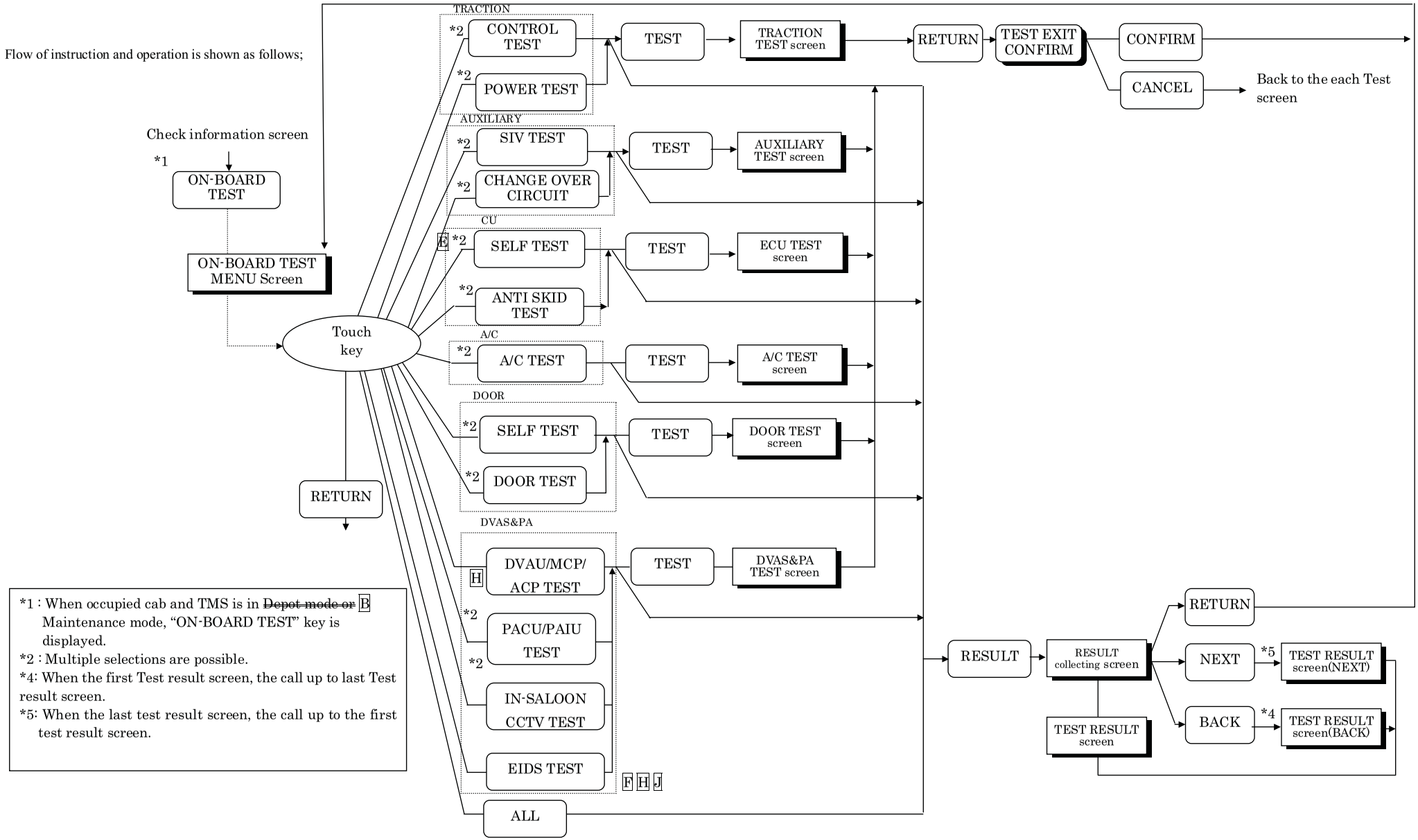
This screen is first screen of the on-board test screens.



E F H J K L

B7120

Press the each test key to go to the test screen corresponding pressed key.



MITSUBISHI ELECTRIC CORPORATION., JAPAN

CHANGE								DOCUMENT NO.
B	22. May. 09	F	27. Oct. 09	J	01. Dec. 09			JHAV438
E	24. Sep. 09	H	19. Nov. 09					

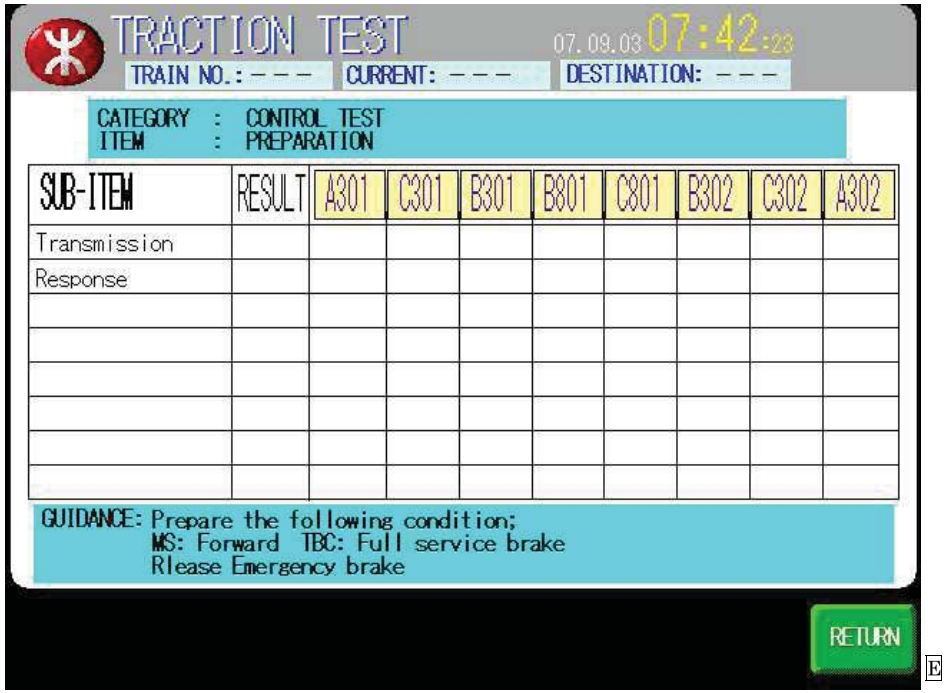
After “RESULT” on the “On-board test menu screen” is pressed, the “RESULT collecting screen” is indicated during collecting result data.
The “RESULT collecting screen” is shown as follow;

L

B8600

3.3.~~28~~ B 30 On-board test screen

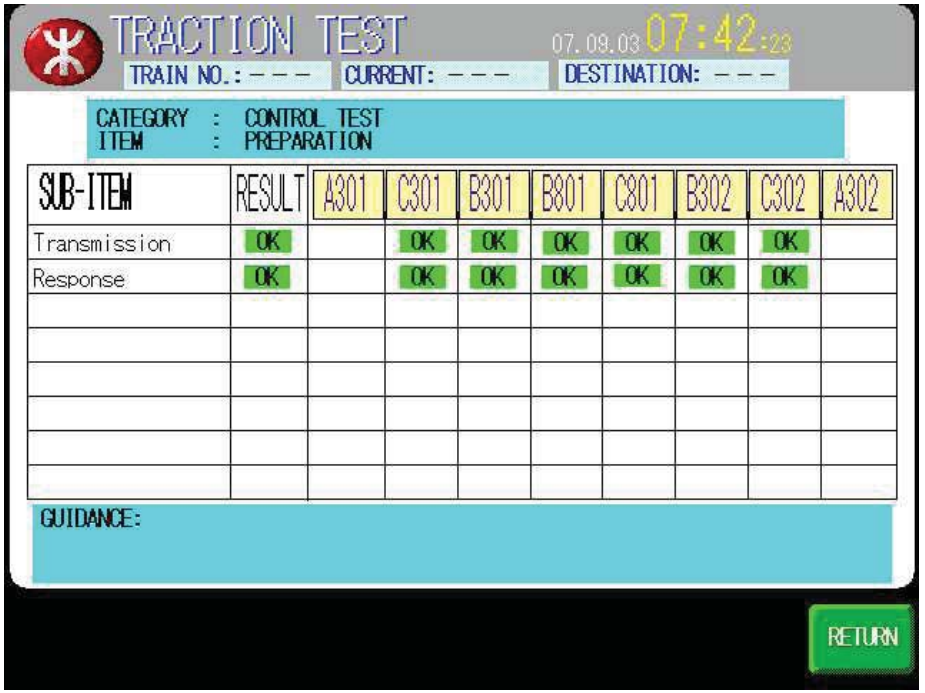
Example of the traction test(control test) screen is shown as follows;



E J K L

B8892

Example of the result screen of the traction test(control test) .



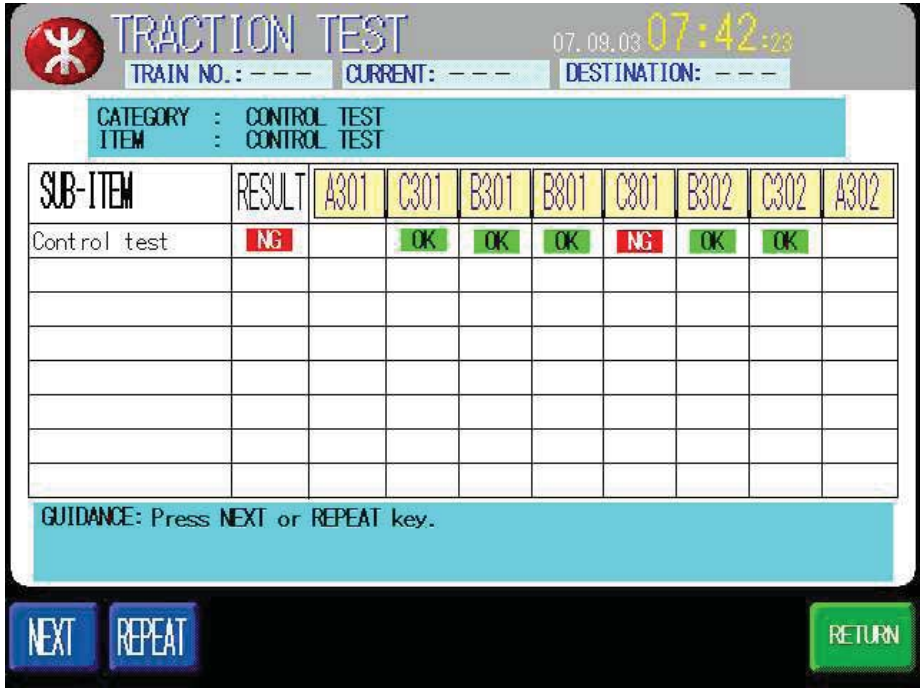
J L

B7347

TMS goes to next item automatically.

			MITSUBISHI ELECTRIC CORPORATION., JAPAN									
			CHANGE								DOCUMENT NO.	
			B	22. May. 09	J	04. Dec. 09	L	05. Jan. 10			JHAV438	111
			E	24. Sep. 09	K	17. Dec. 09						

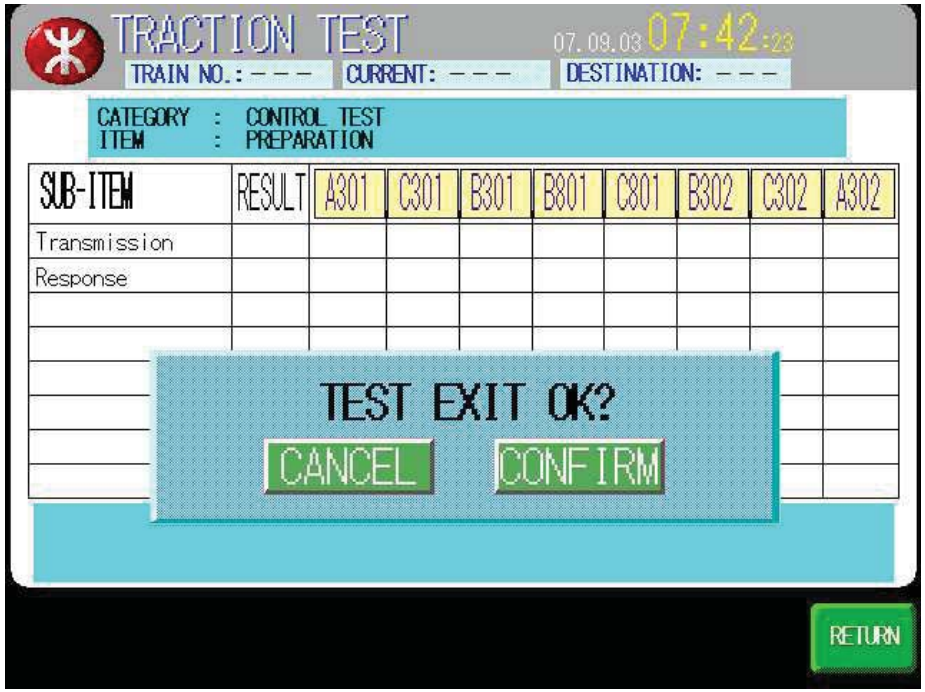
Example of the NG in the test result is shown as follows;



J L M

B7336

Press the NEXT key, the next category is executed.
press the REPEAT key, the same category is executed.

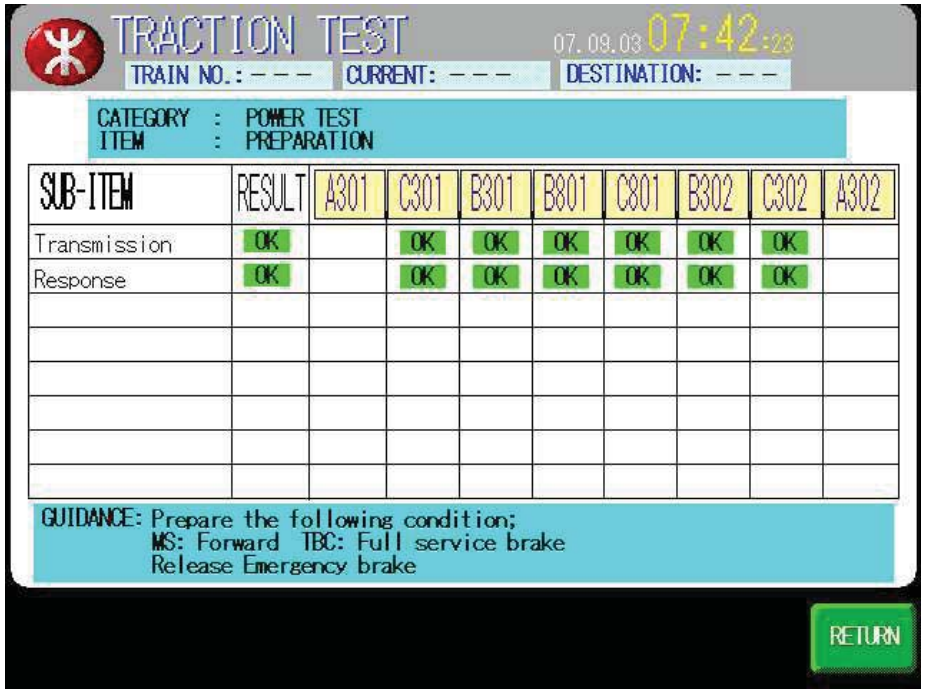


J L

B7348

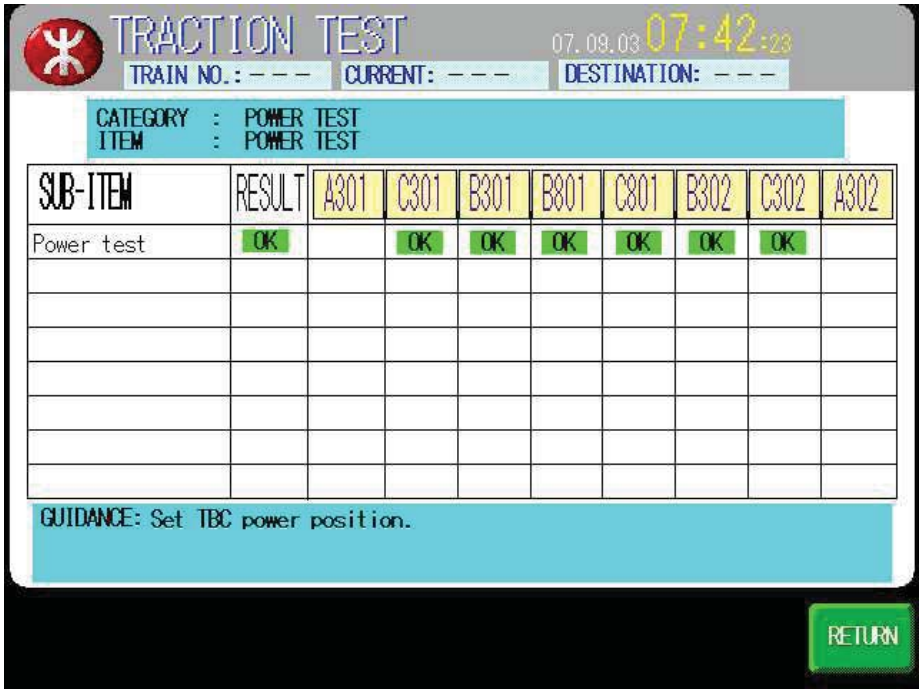
Press the “RETURN” key, the test is exited.
Test exit confirm window is shown as follows;

Example of the traction test(power test) is shown as follows;



E J K L

B8903



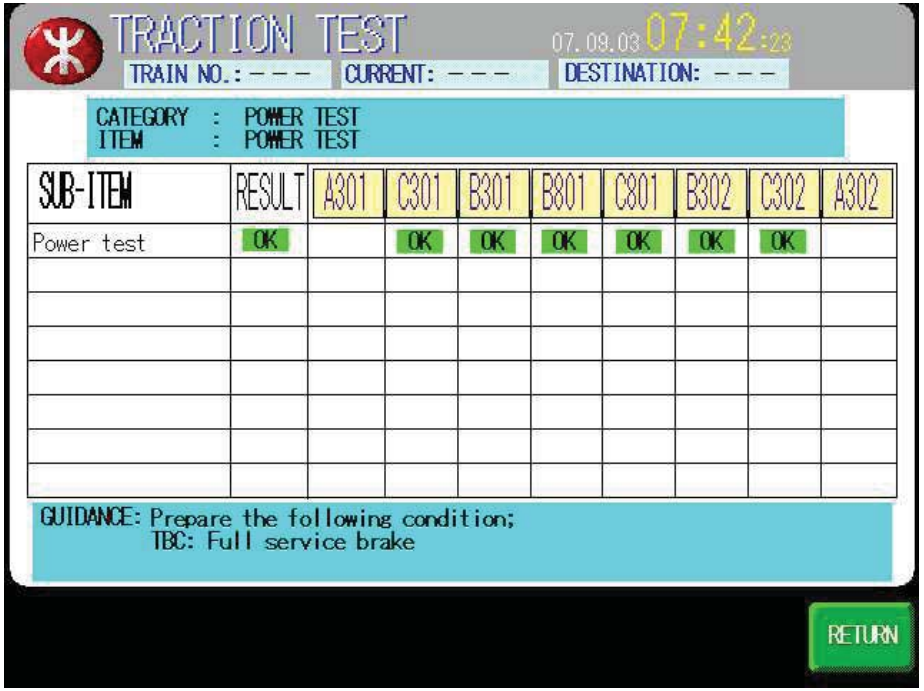
E J L

B8906

TMS goes to next item automatically.

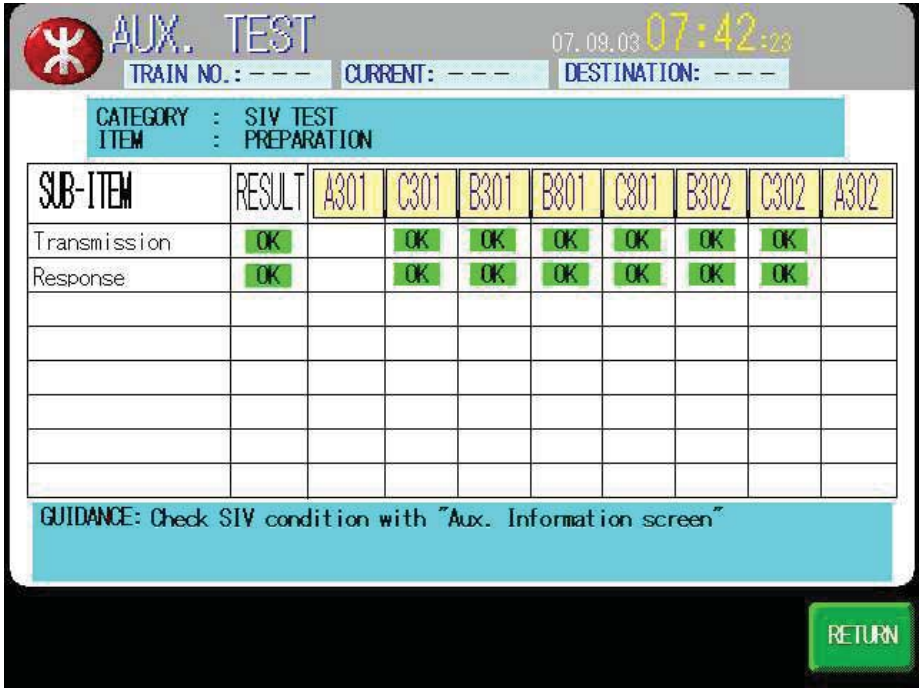
E This page added

Example of the auxiliary power supply test (SIV TEST: preparation) is shown as follows;



K L

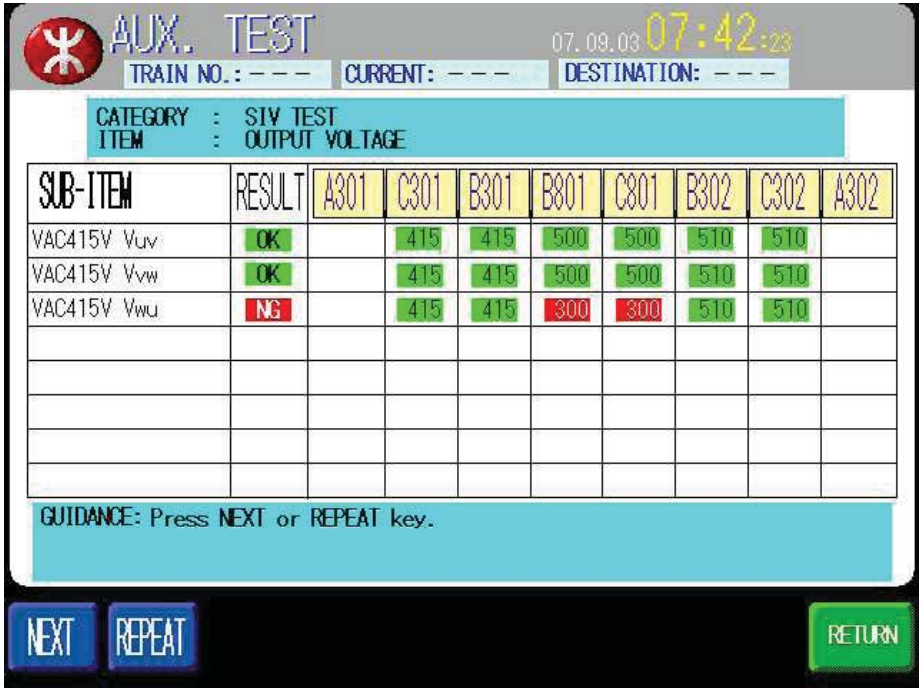
B8908



J K L

B8957

Example of the auxiliary power supply test (SIV TEST: output voltage) is shown as follows;

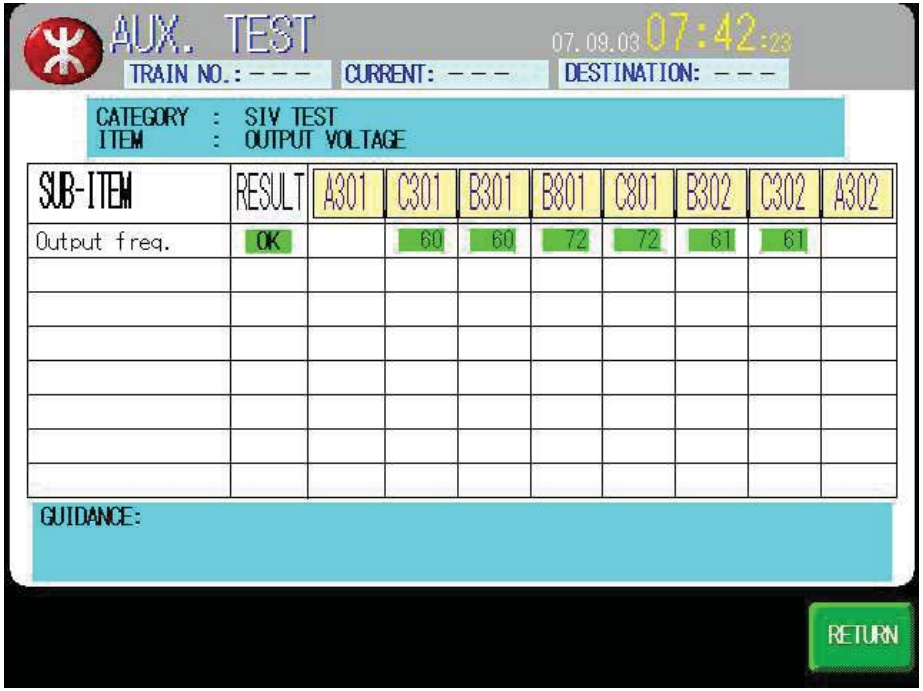


K L

B8958

Press the NEXT key, the next category is executed.
press the REPEAT key, the same category is executed.

Example of the auxiliary power supply test (SIV TEST: output frequency check) is shown as follows;



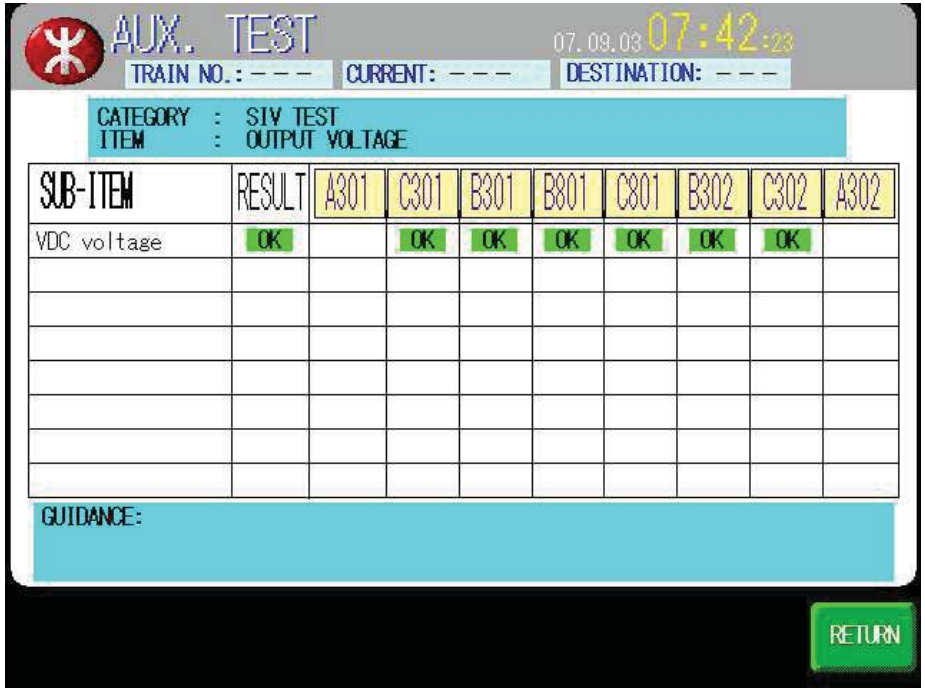
J L

B8959

TMS goes to next item automatically

			MITSUBISHI ELECTRIC CORPORATION., JAPAN									
			CHANGE								DOCUMENT NO.	
			J	01. Dec. 09	L	05. Jan. 10					JHAV438	114
			K	17. Dec. 09								

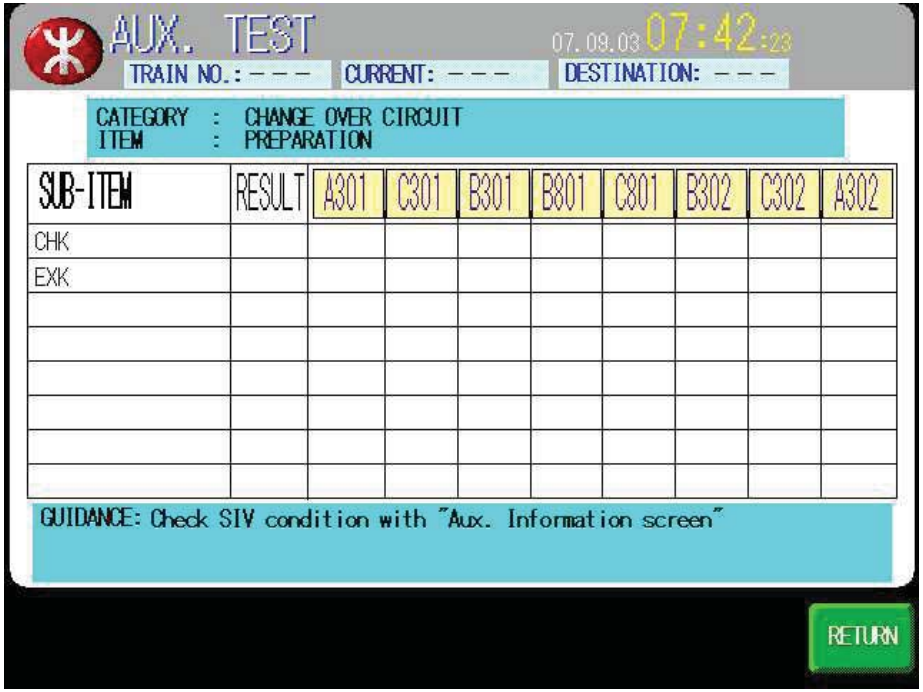
Example of the auxiliary power supply test (SIV TEST: battery charger output voltage) is shown as follows;



J L

B8960

Example of the auxiliary power supply test (Change over circuit) is shown as follows;

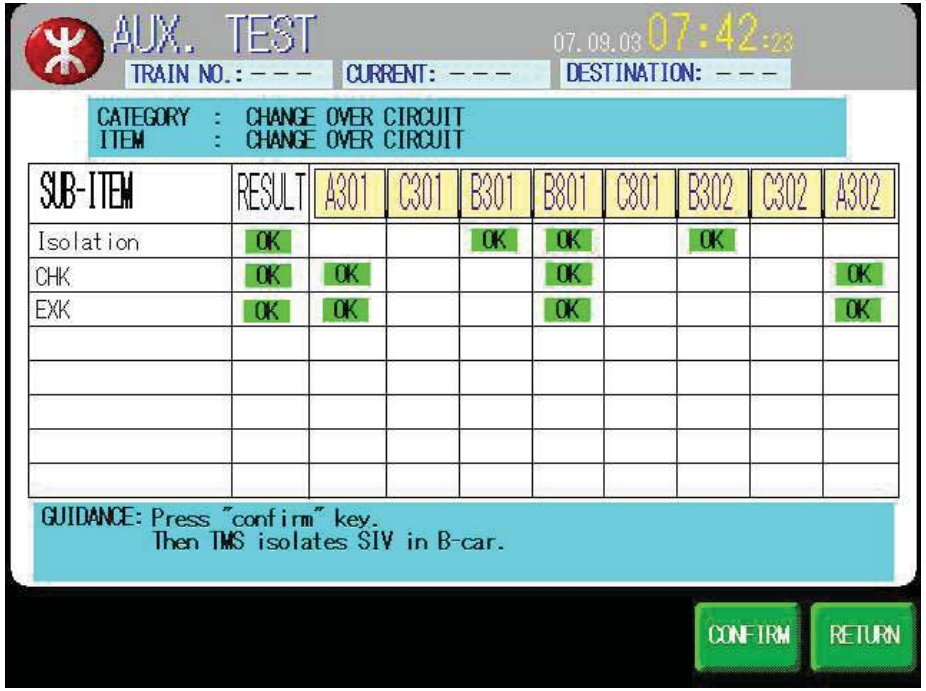


E J K L

B7208

MITSUBISHI ELECTRIC CORPORATION., JAPAN									
CHANGE								DOCUMENT NO.	
E	24. Sep. 09	K	17. Dec. 09					JHAV438	115
J	04. Dec. 09	L	05. Jan. 10						

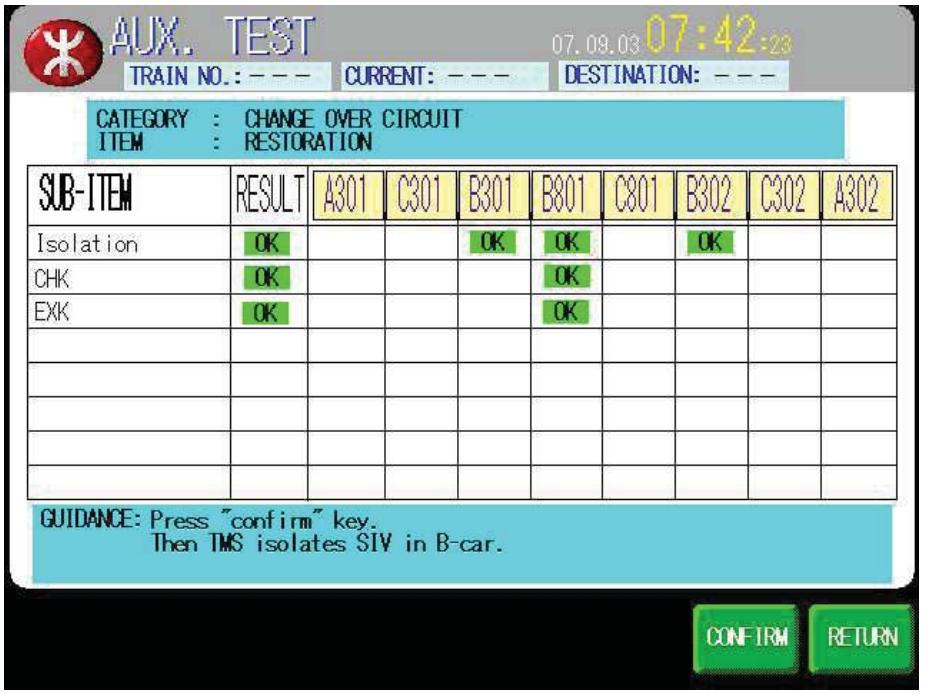
Example of the auxiliary power supply test (CHANGE OVER CIRCUIT: CHANGE OVER CIRCUIT) is shown as follows;



E J L

B7209

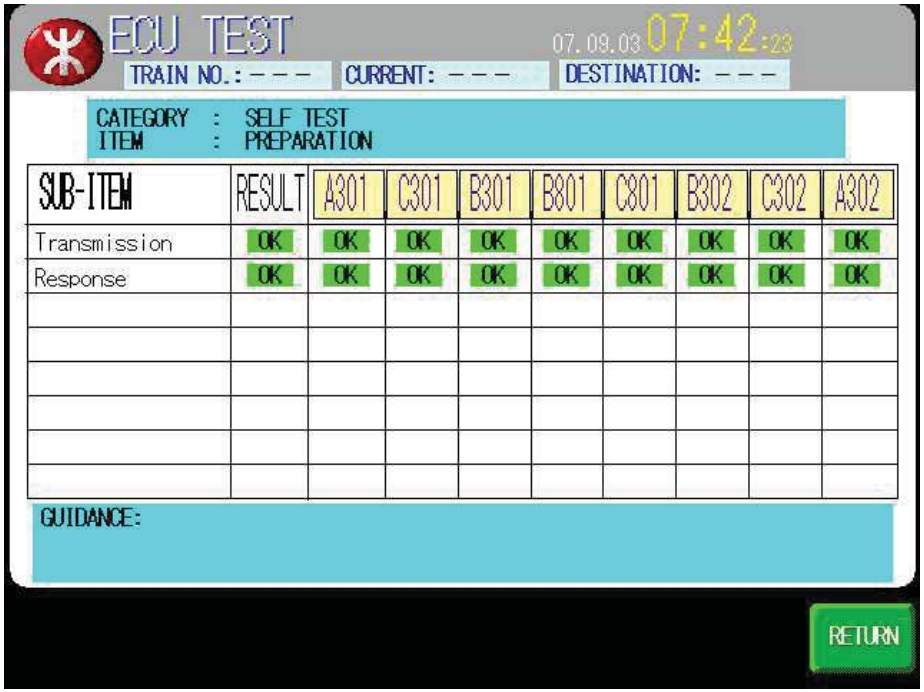
Example of the auxiliary power supply test (CHANGE OVER CIRCUIT: RESTORATION) is shown as follows;



E J L

B7210

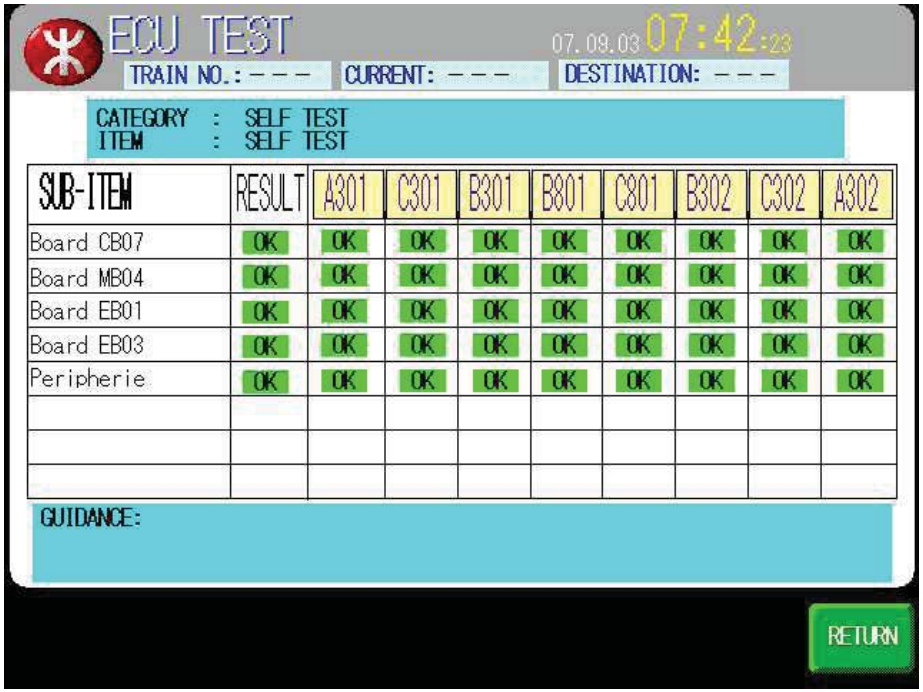
Example of the ECU test(self test) is shown as follows;



J L

B8913

TMS goes to next item automatically.

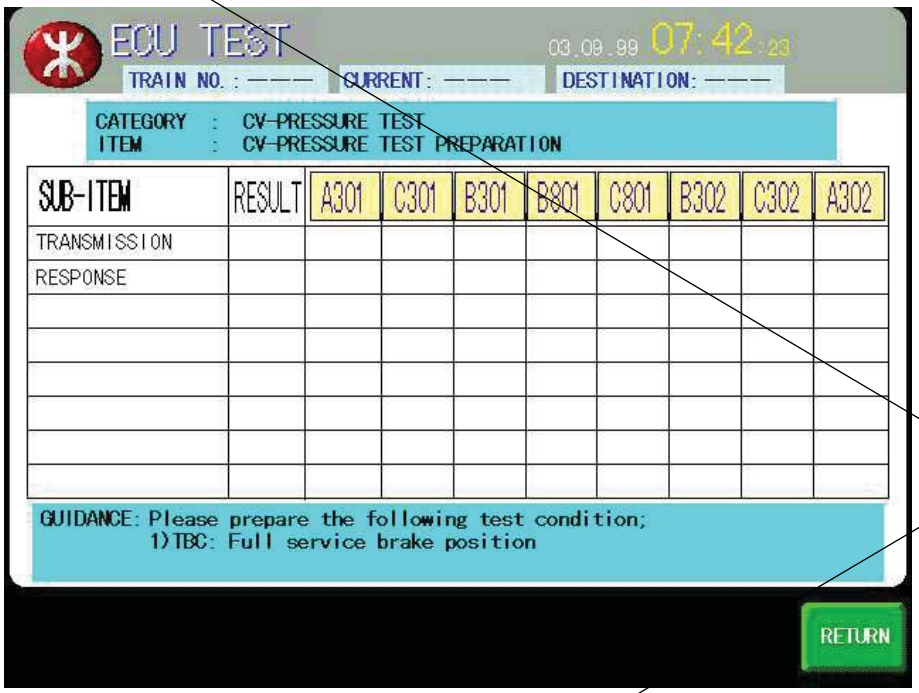


E J L

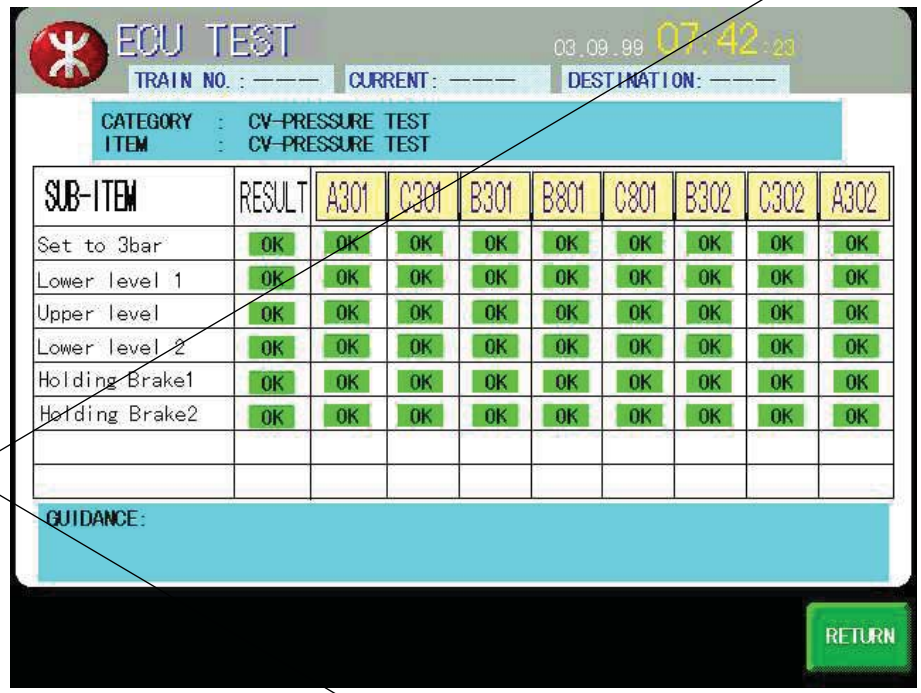
B8921

TMS goes to next item automatically.

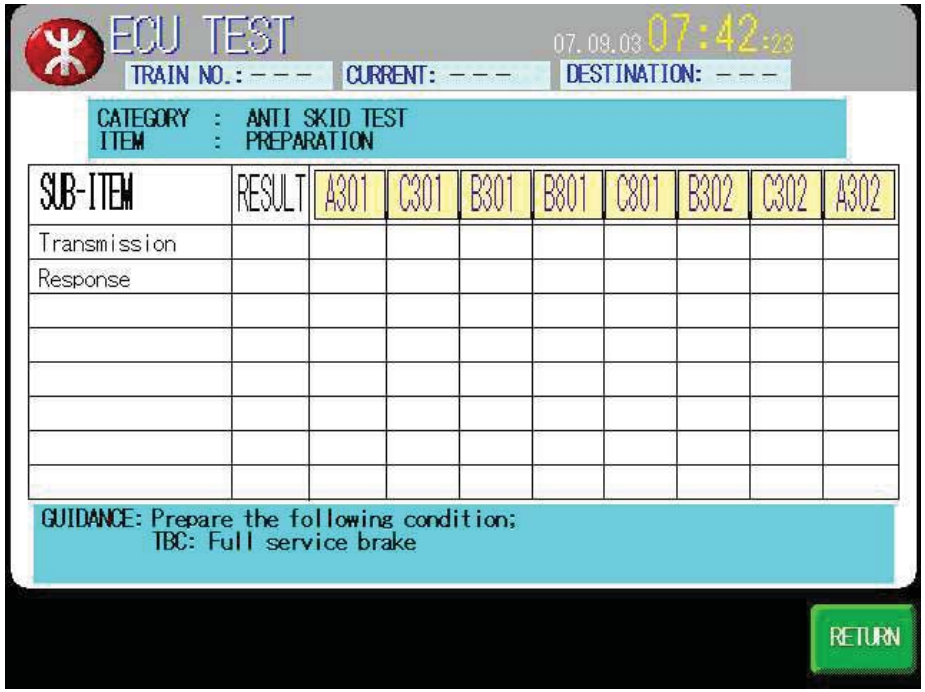
Example of the ECU test(cv-pressure switch test) is shown as follows;



TMS goes to next item automatically.



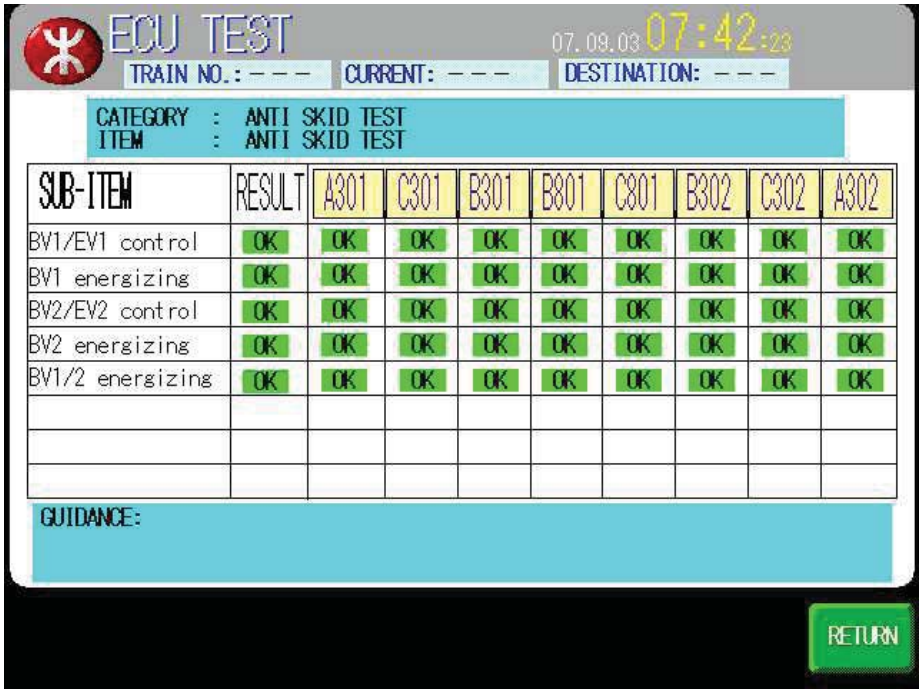
Example of the ECU test(anti skid test) is shown as follows;



E J K L

B8917

TMS goes to next item automatically.

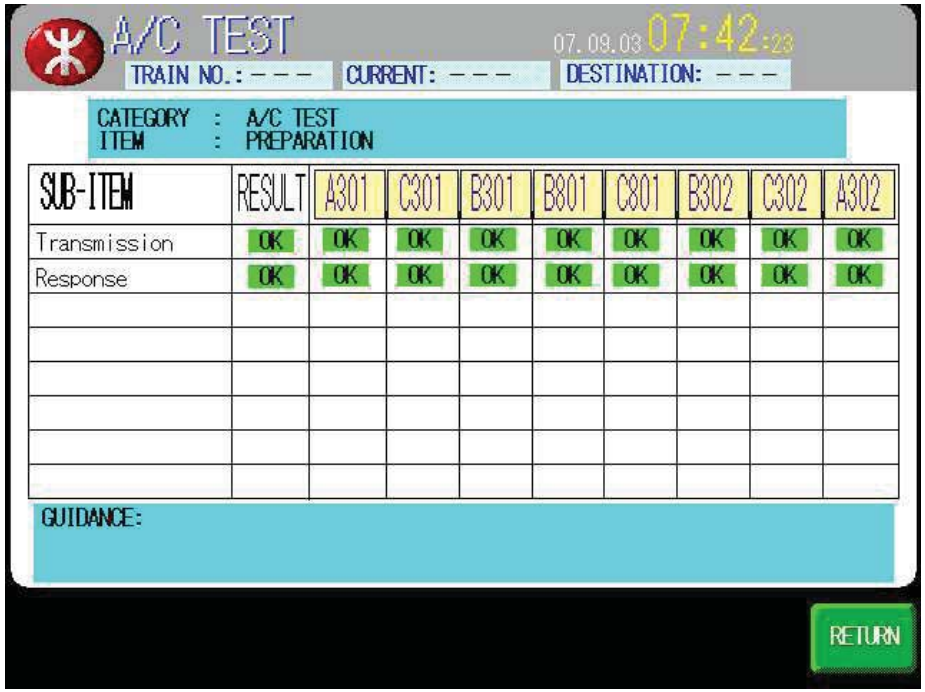


L

B8942

			MITSUBISHI ELECTRIC CORPORATION., JAPAN									
			CHANGE								DOCUMENT NO.	
			E	24. Sep. 09	K	17. Dec. 09					JHAV438	119
			J	04. Dec. 09	L	05. Jan. 10						

Example of the A/C test(A/C Test) is shown as follows;

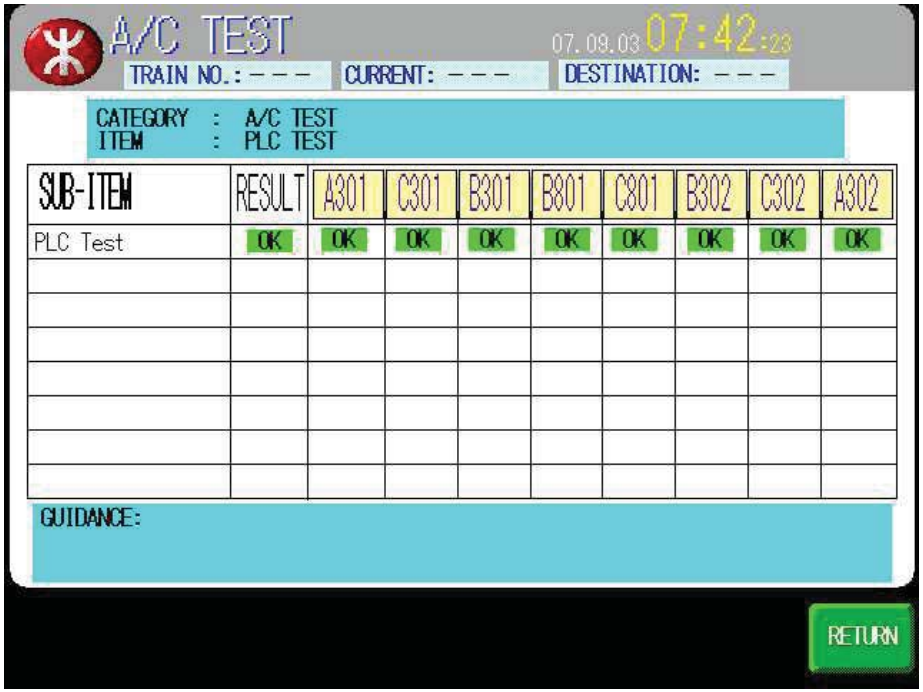


J L

B8996

A/C number is displayed by the side of ITEM.
A/C number(A/C1, A/C2) L

Example of the A/C test(PLC Test) is shown as follows;

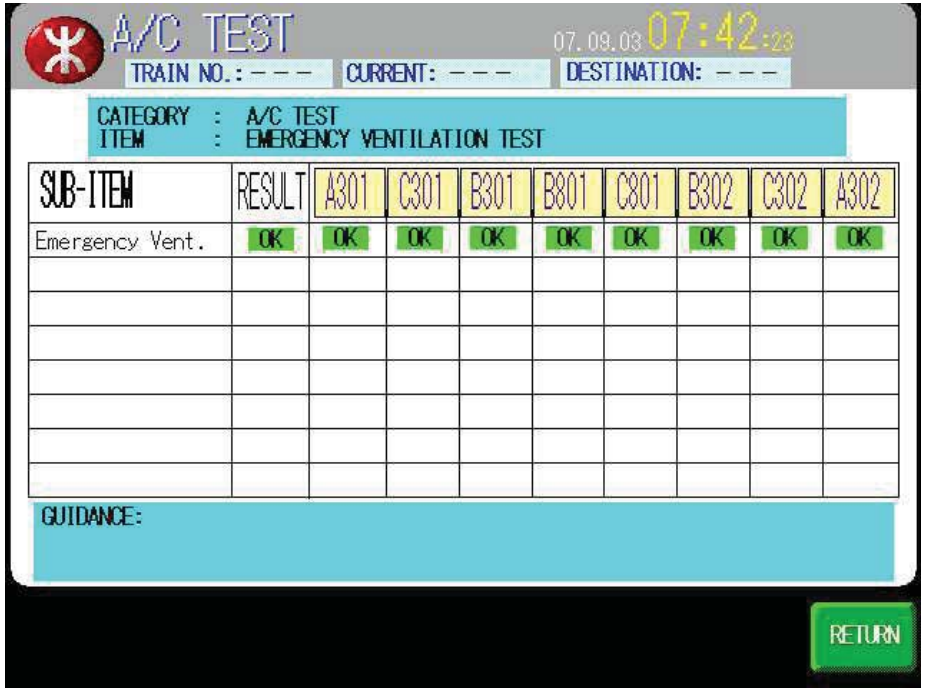


E J L

B8997

A/C number is displayed by the side of ITEM.
A/C number(A/C1, A/C2) L

Example of the A/C test (emergency Vent. test) is shown as follows;

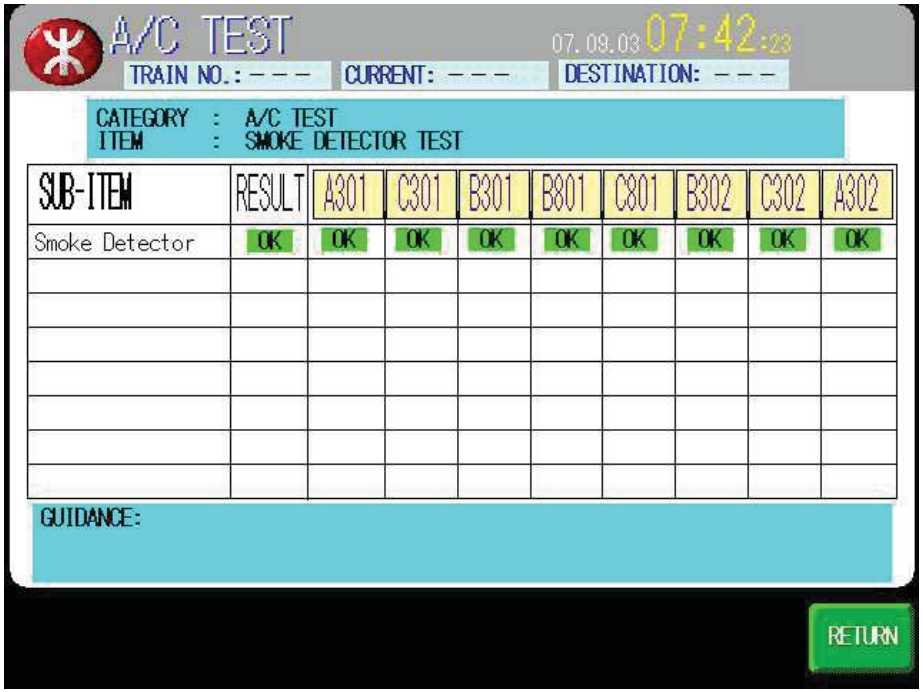


E J L

B8801

~~Door~~ M A/C number is displayed by the side of ITEM.
~~Door~~ M A/C number(A/C1, A/C2) L

Example of the A/C test (Smoke Detector test) is shown as follows;

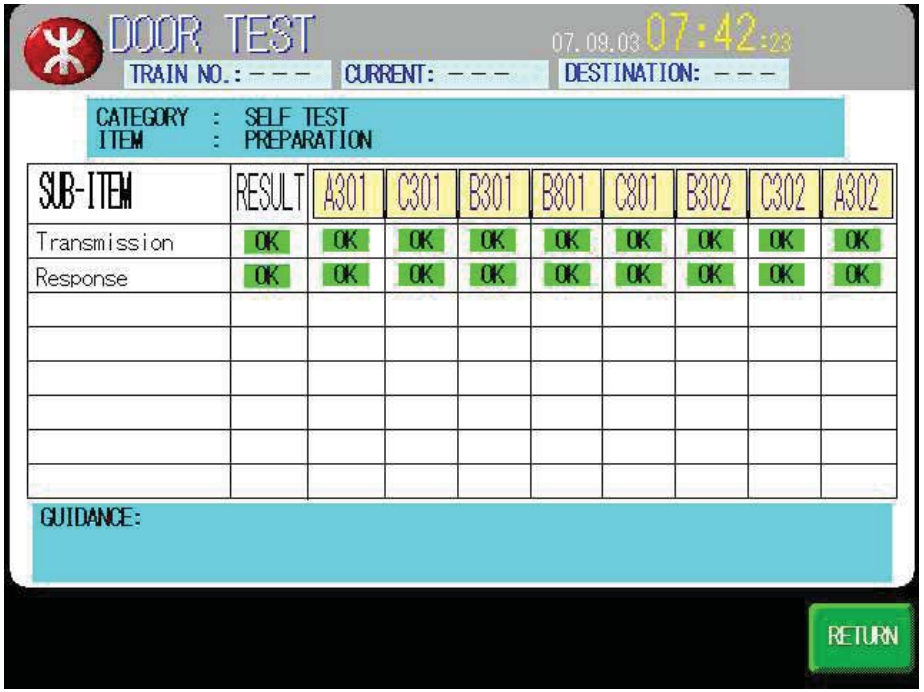


E J L

B8802

~~Door~~ M A/C number is displayed by the side of ITEM.
~~Door~~ M A/C number(A/C1, A/C2) L

Example of the door test (self test) is shown as follows;



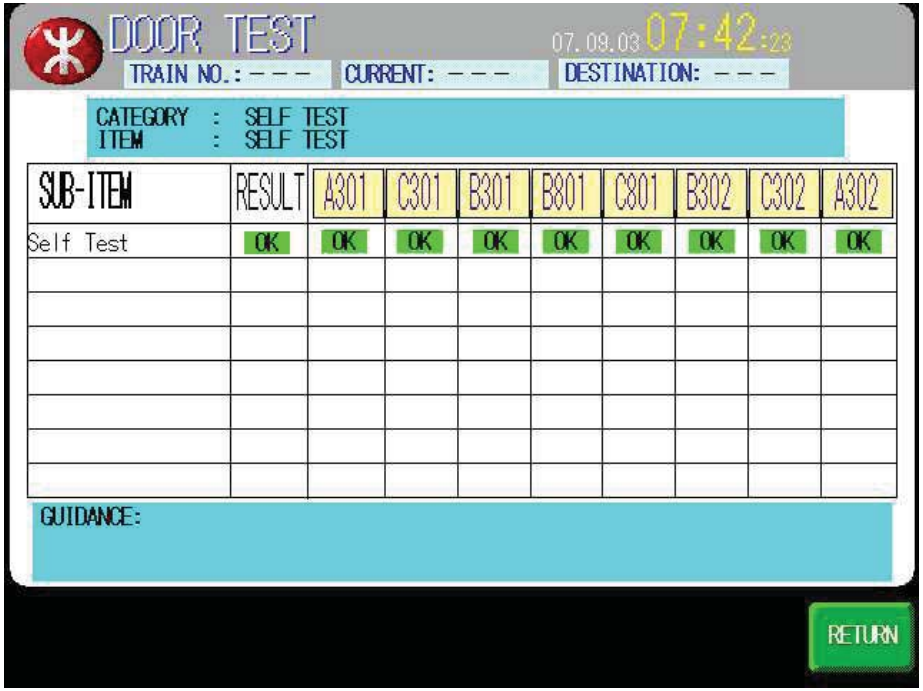
J L

B8976

TMS goes to next item automatically.

Door number is displayed by the side of ITEM.
Door number(DOOR A1～DOOR A6, DOOR B1～DOOR B6) L

TMS goes to next item automatically.

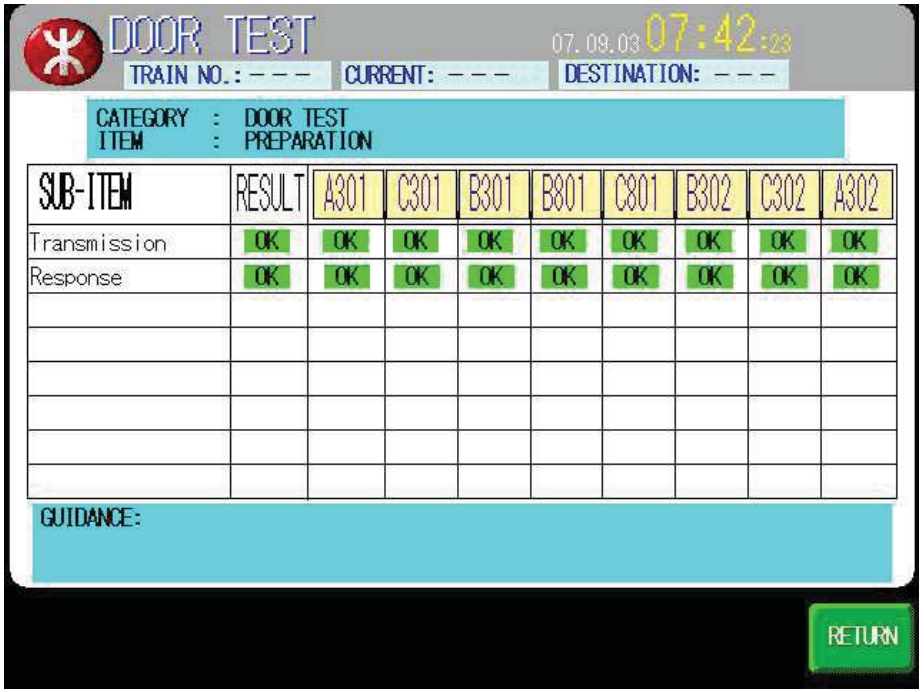


E J L

B7202

Door number is displayed by the side of ITEM.
Door number(DOOR A1～DOOR A6, DOOR B1～DOOR B6) L

Example of the door test (door test preparetion) is shown as follows;



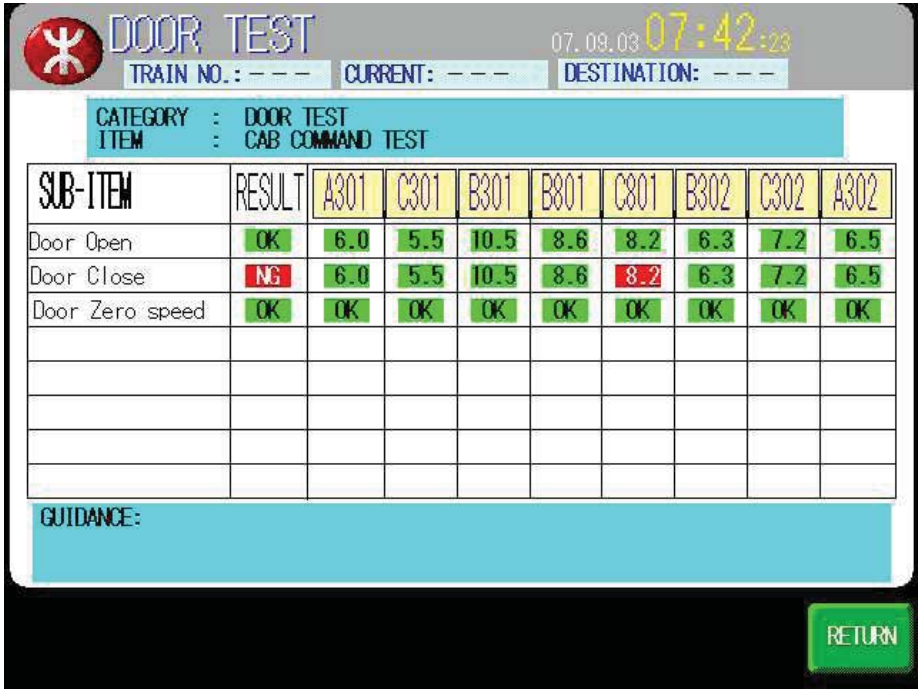
E J L

B7345

MS goes to next item automatically.

Door number is displayed by the side of ITEM.
Door number(DOOR A1～DOOR A5, DOOR B1～DOOR B5) L

Example of the door test (cab) is shown as follows;



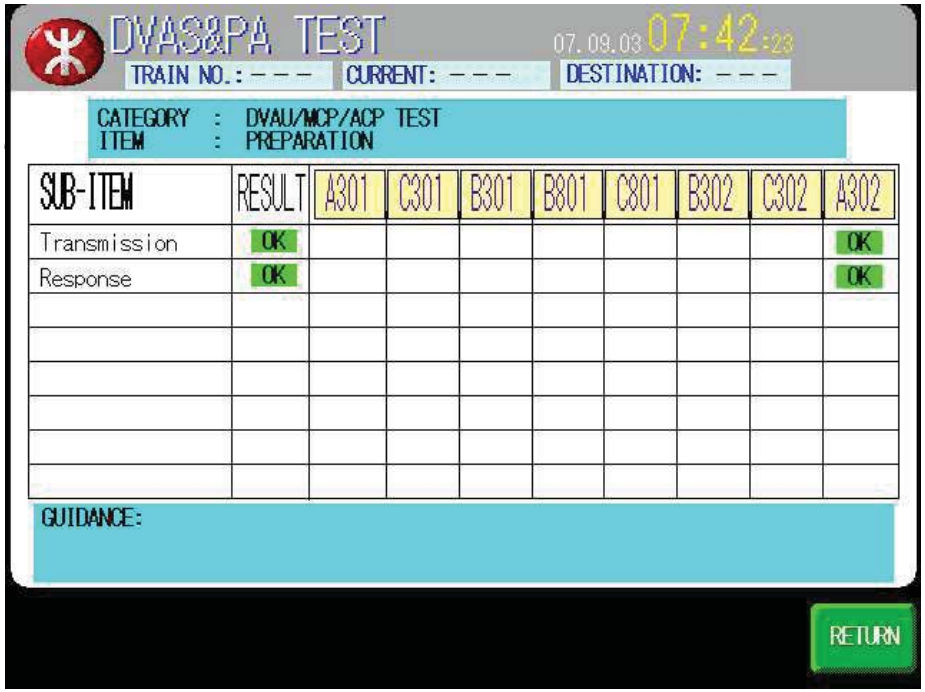
E J L P

B7346

Door open/close time : 0-25.5s P

Door number is displayed by the side of ITEM.
Door number(DOOR A1～DOOR A5, DOOR B1～DOOR B5) L

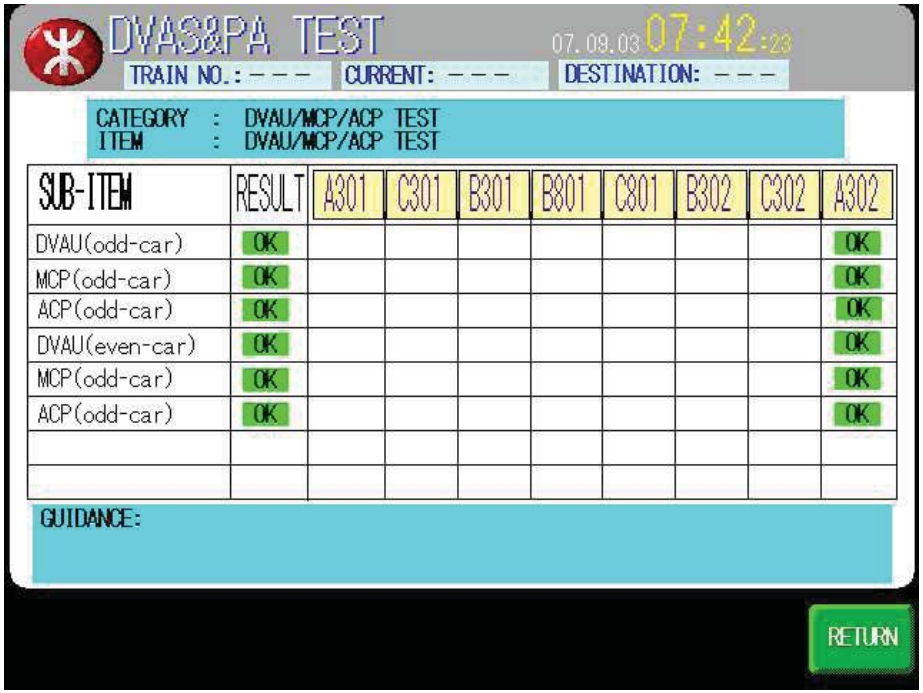
Example of the DVAS&PA test (DVAU/MCP/ACP) is shown as follows;



H J L

B7203

TMS goes to next item automatically.

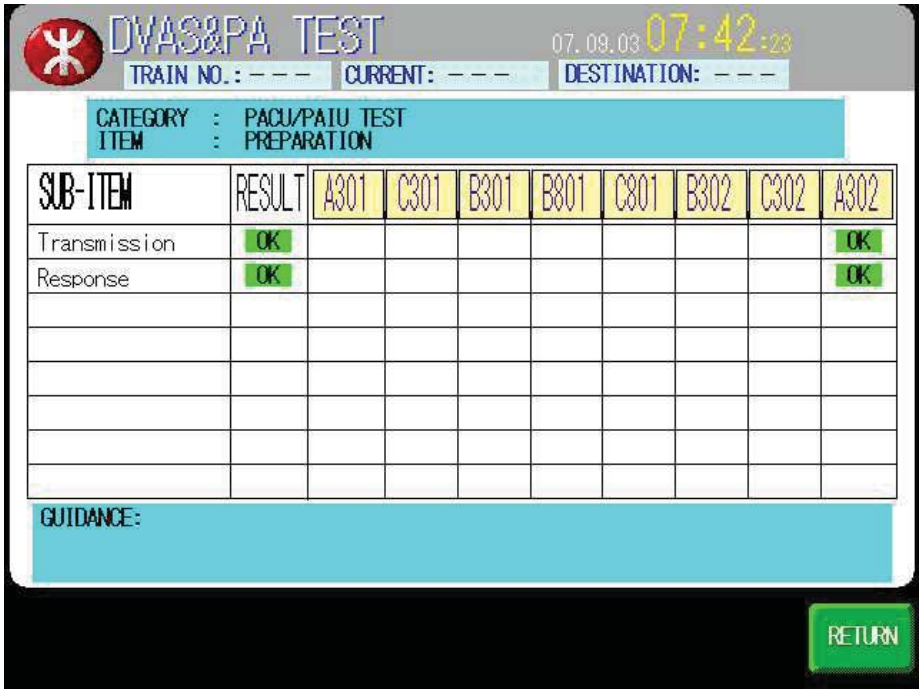


H J L

B7205

TMS goes to next item automatically.

Example of the DVAS&PA test (PACU/PAIU [H] ~~AMP/PIAU~~ [F] ~~SPEAKER~~ TEST PREPERATION) is shown as follows;

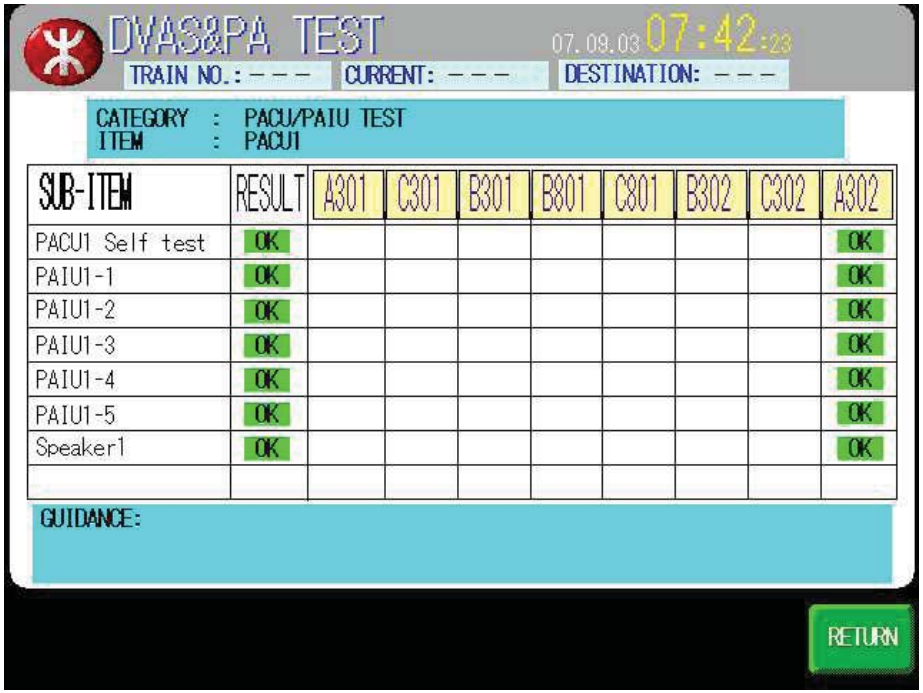


[F] [H] [J] [L]

B7204

TMS goes to next item automatically.

Example of the DVAS&PA test (PACU1 [H] ~~AMP1~~) is shown as follows;

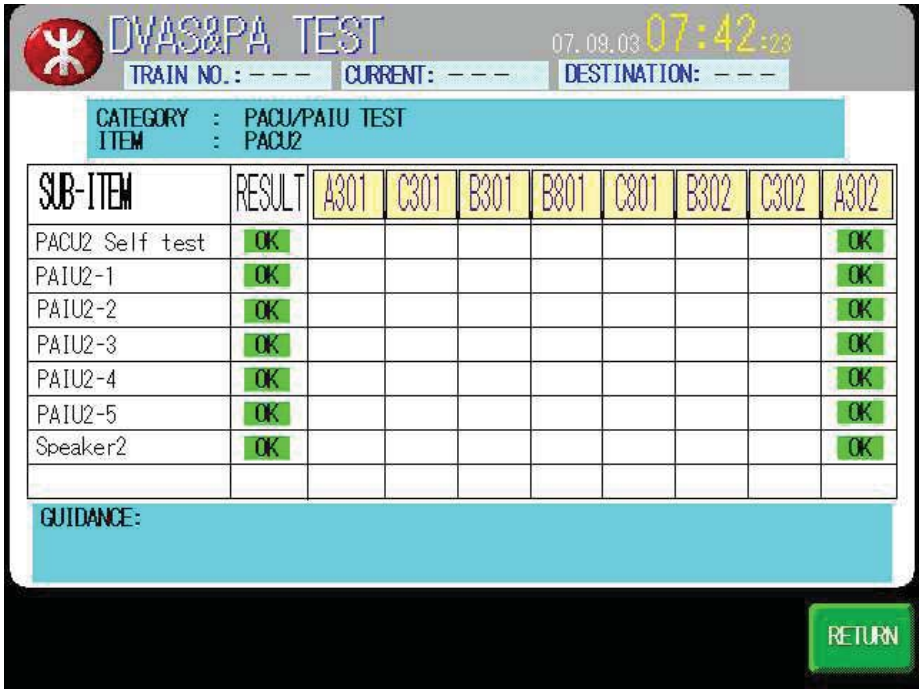


[E] [F] [H] [J] [K] [L]

B7206

TMS goes to next item automatically.

Example of the DVAS&PA test (PACU2 [H] ~~AMP2~~) is shown as follows:

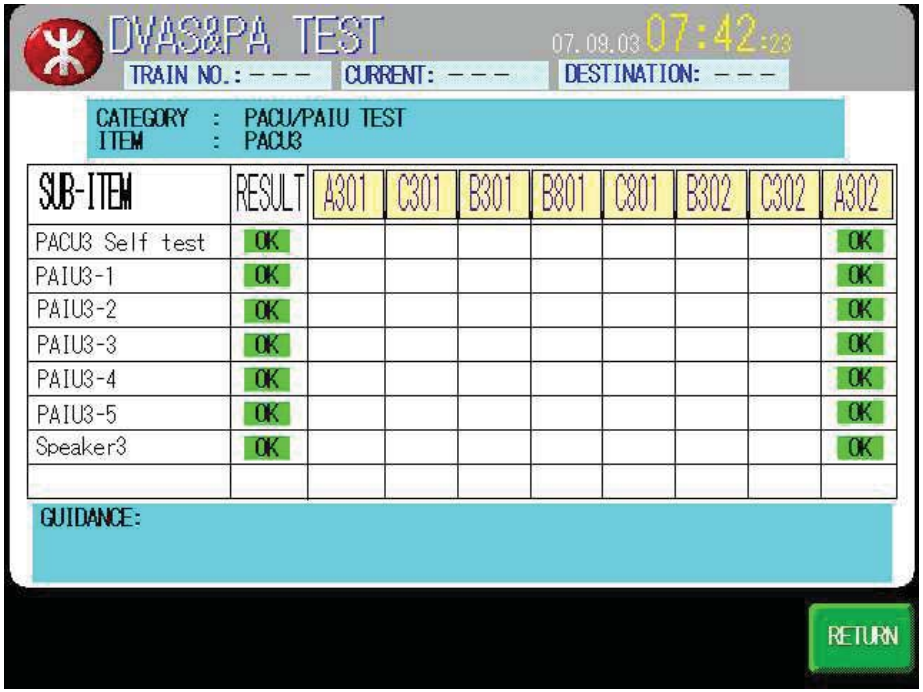


[F] [H] [J] [L]

B7211

TMS goes to next item automatically.

Example of the DVAS&PA test (PACU3 [H] ~~AMP2~~) is shown as follows:

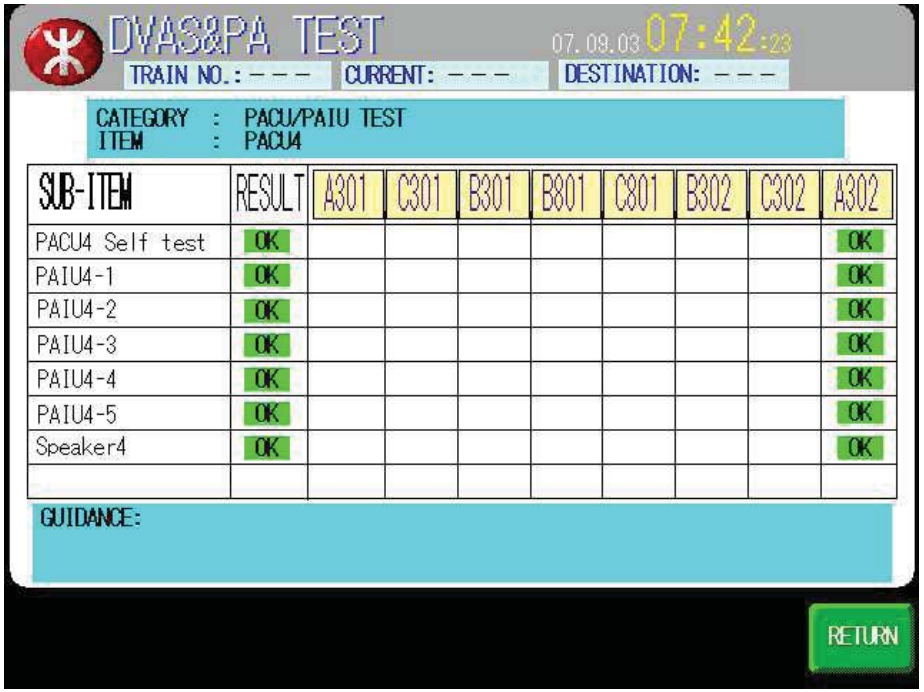


[F] [H] [J] [L]

B7212

TMS goes to next item automatically.

Example of the DVAS&PA test (PACU4 H ~~AMP4~~) is shown as follows:

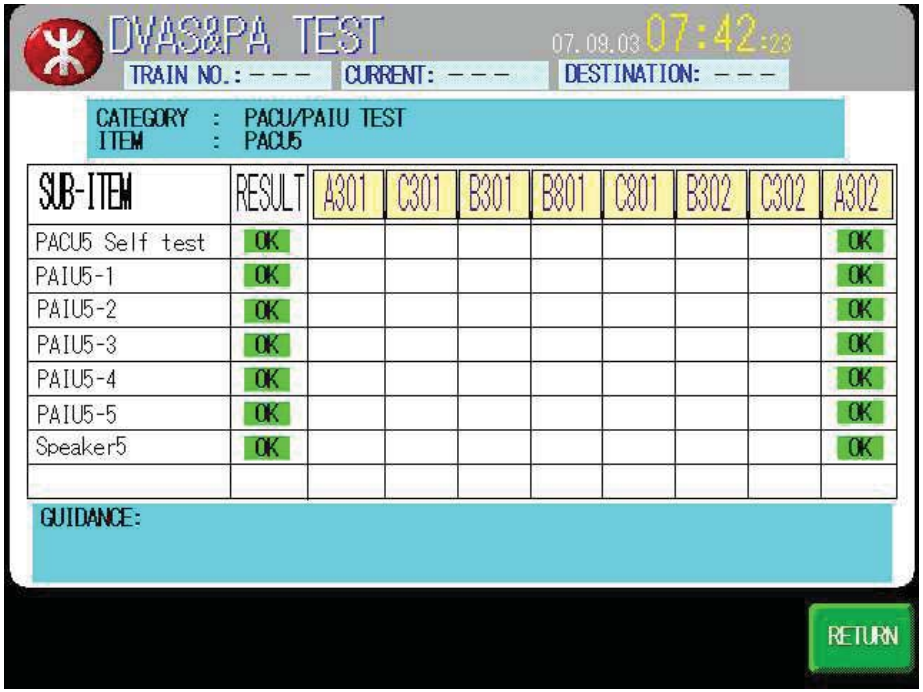


F H J K L

B7213

TMS goes to next item automatically.

Example of the DVAS&PA test (PACU5 H ~~AMP5~~) is shown as follows:

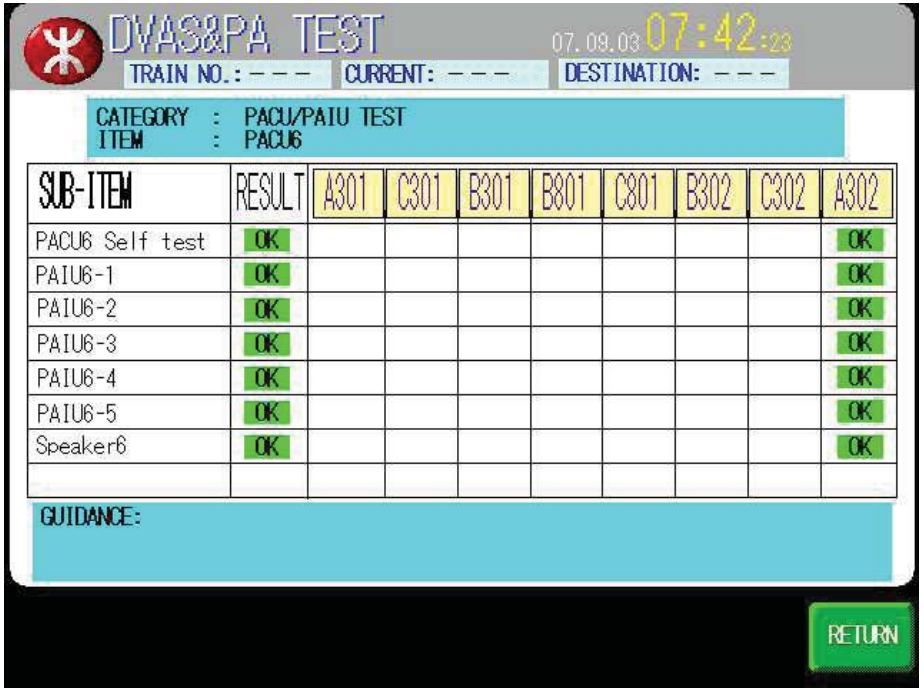


F H J K L

B7214

TMS goes to next item automatically.

Example of the DVAS&PA test (PACU6 H ~~AMP6~~) is shown as follows:

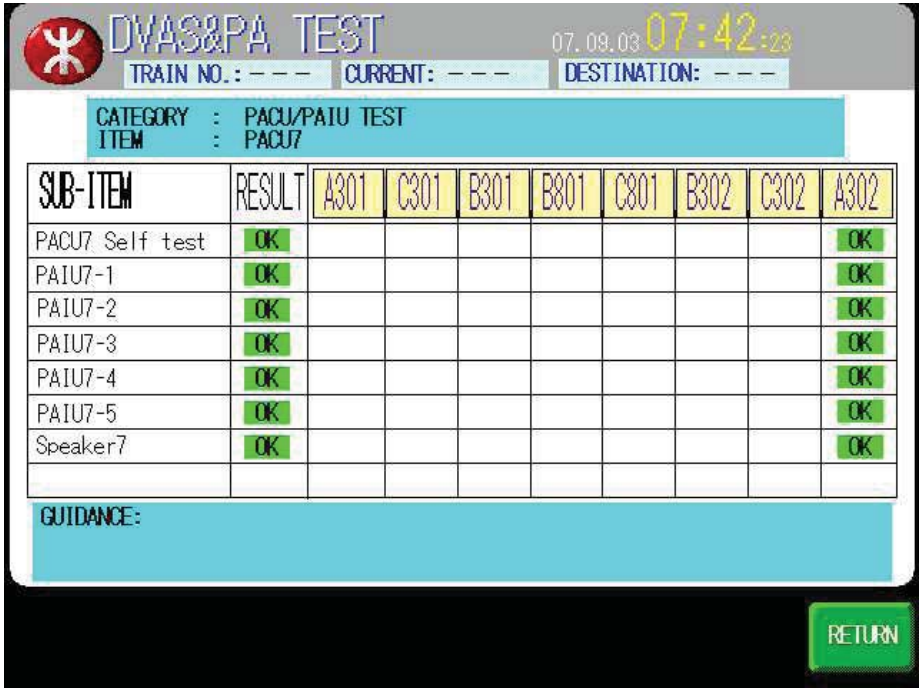


F H J K L

B7215

TMS goes to next item automatically.

Example of the DVAS&PA test (PACU7 H ~~AMP7~~) is shown as follows:

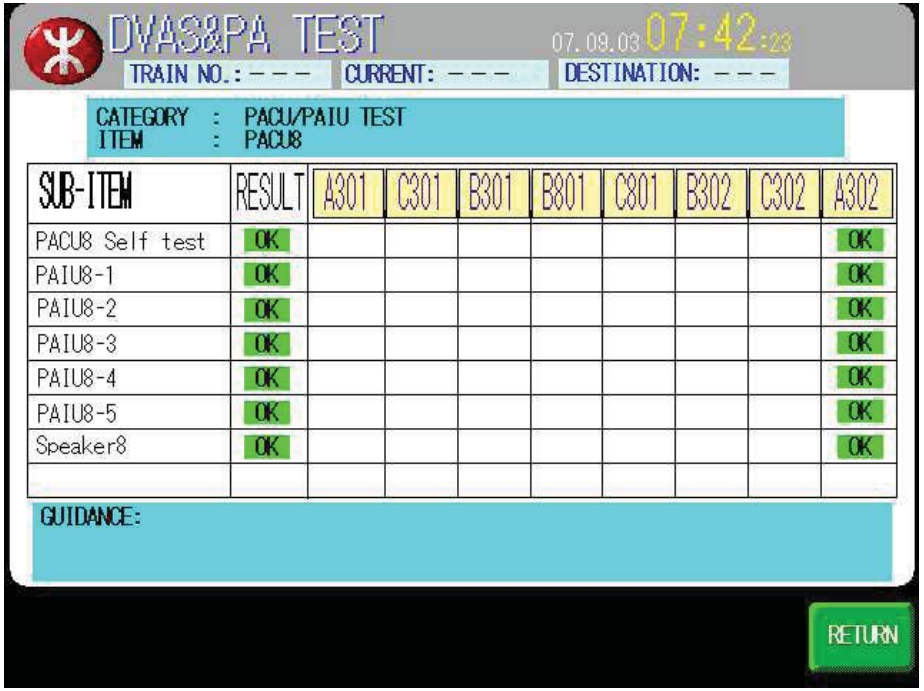


F H J K L

B7216

TMS goes to next item automatically.

Example of the DVAS&PA test (PACU8 H ~~AMP8~~) is shown as follows:

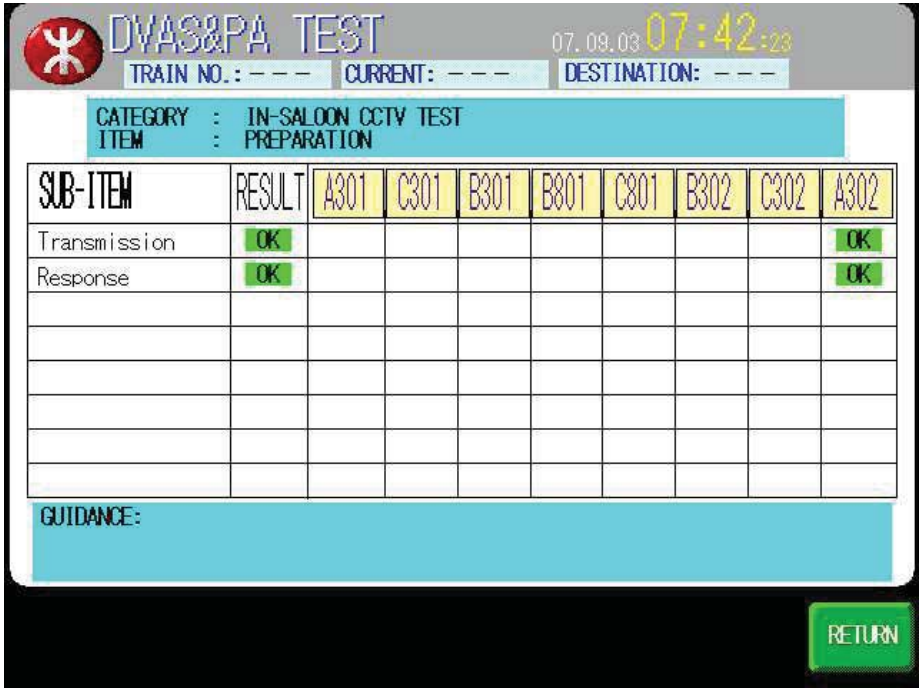


F H J K L

B7217

TMS goes to next item automatically.

Example of the DVAS&PA test (IN-SALOON CCTV TEST PREPARATION K ~~PREPERATION~~) is shown as follows;

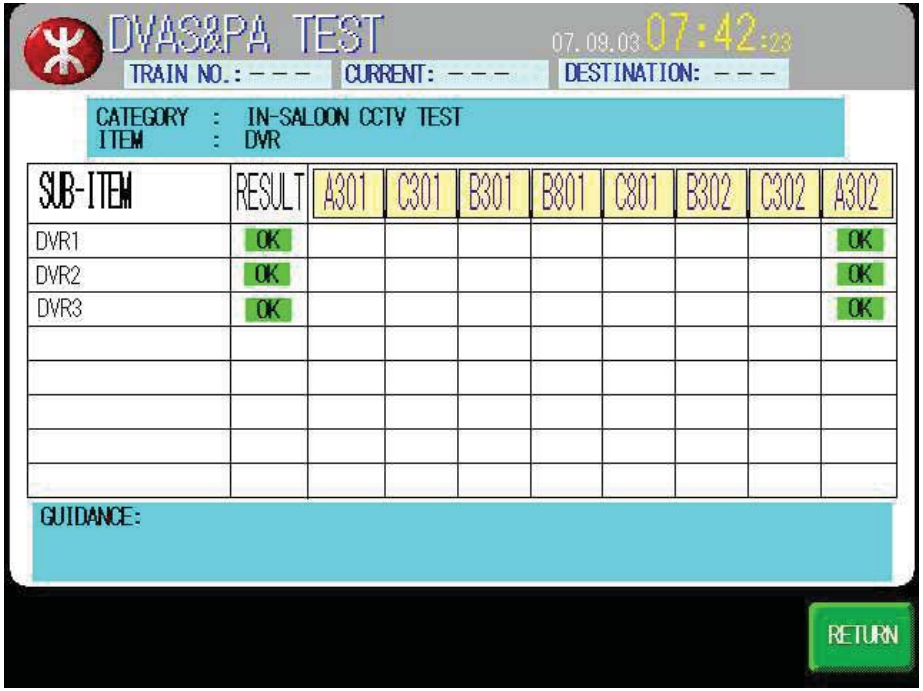


L

B7230

TMS goes to next item automatically.

Example of the DVAS&PA test (DVR) is shown as follows;

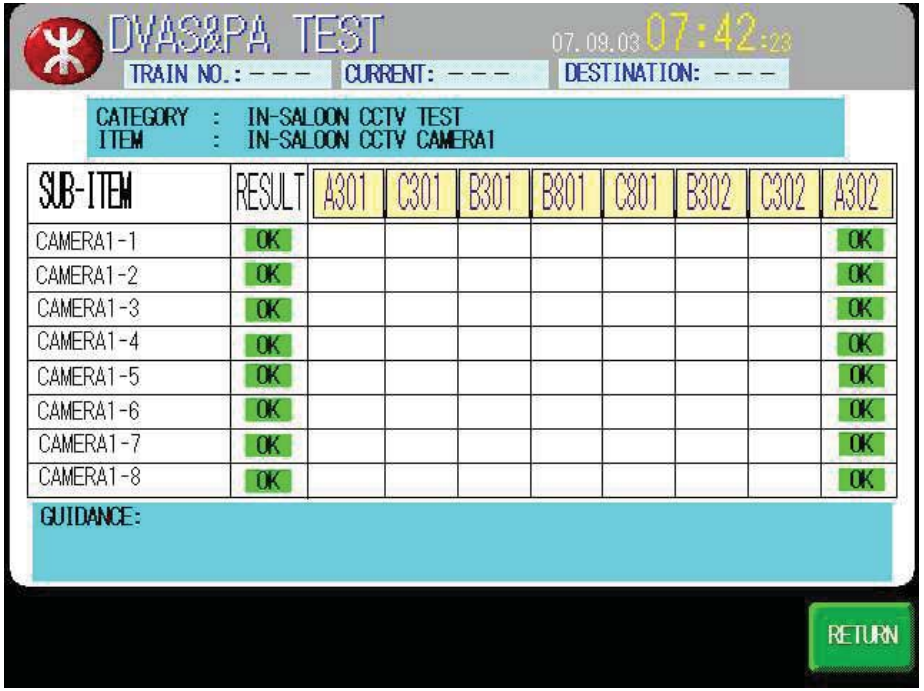


L

B7218

TMS goes to next item automatically.

Example of the DVAS&PA test (IN-SALOON CCTV CAMERA1) is shown as follows;

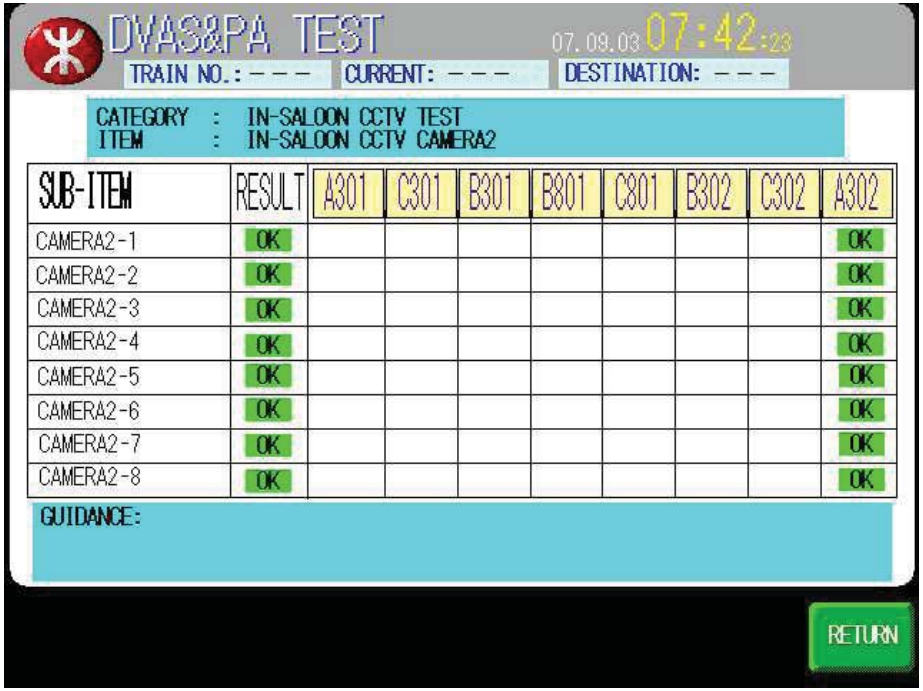


[L]

B7219

TMS goes to next item automatically.

Example of the DVAS&PA test (IN-SALOON CCTV CAMERA2) is shown as follows;

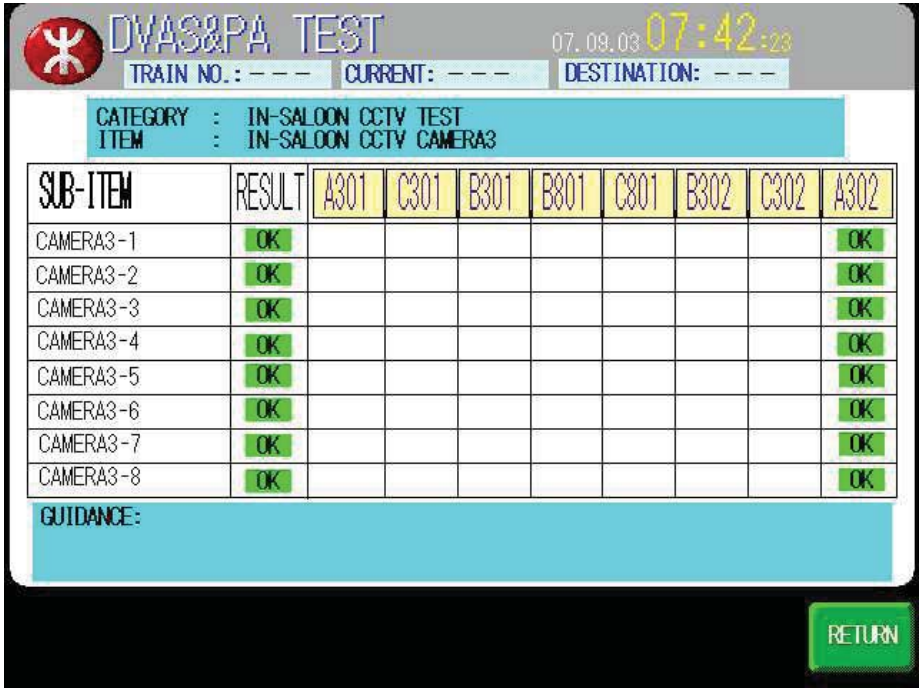


[L]

B7220

TMS goes to next item automatically.

Example of the DVAS&PA test (IN-SALOON CCTV CAMERA3) is shown as follows;

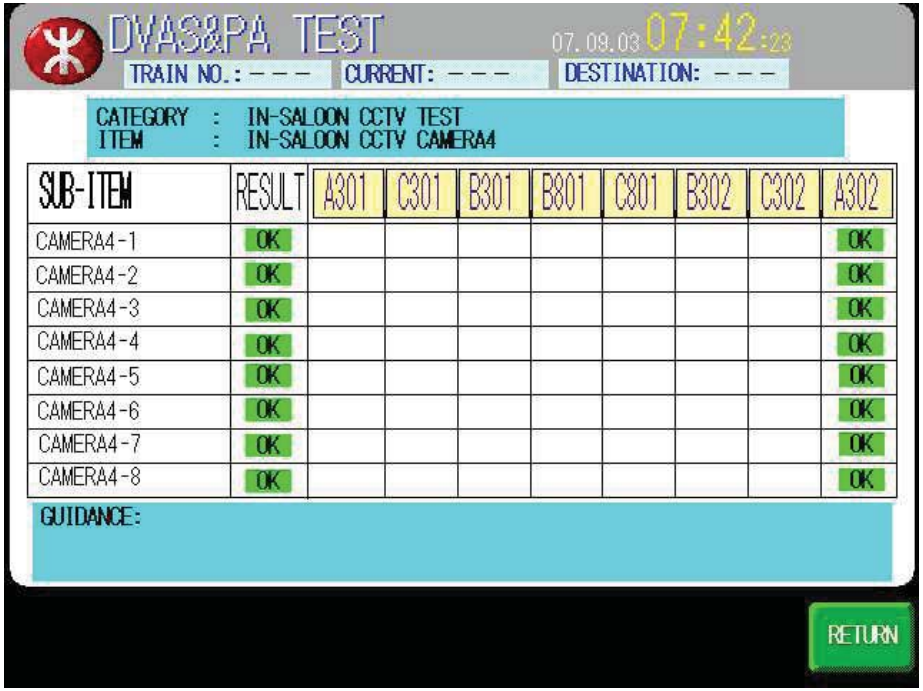


L

B7221

TMS goes to next item automatically.

Example of the DVAS&PA test (IN-SALOON CCTV CAMERA4) is shown as follows;

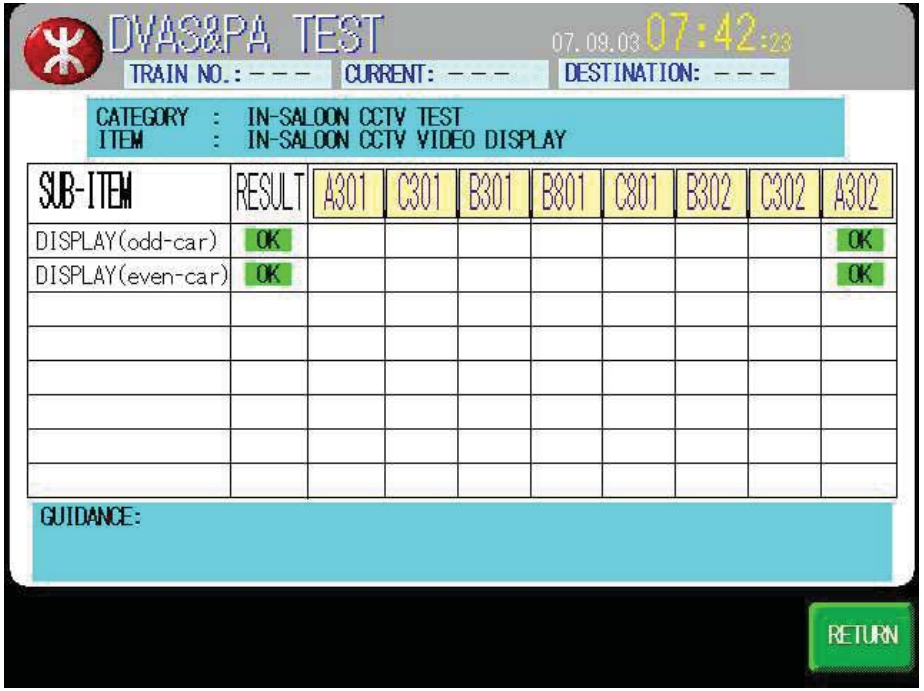


L

B7222

TMS goes to next item automatically.

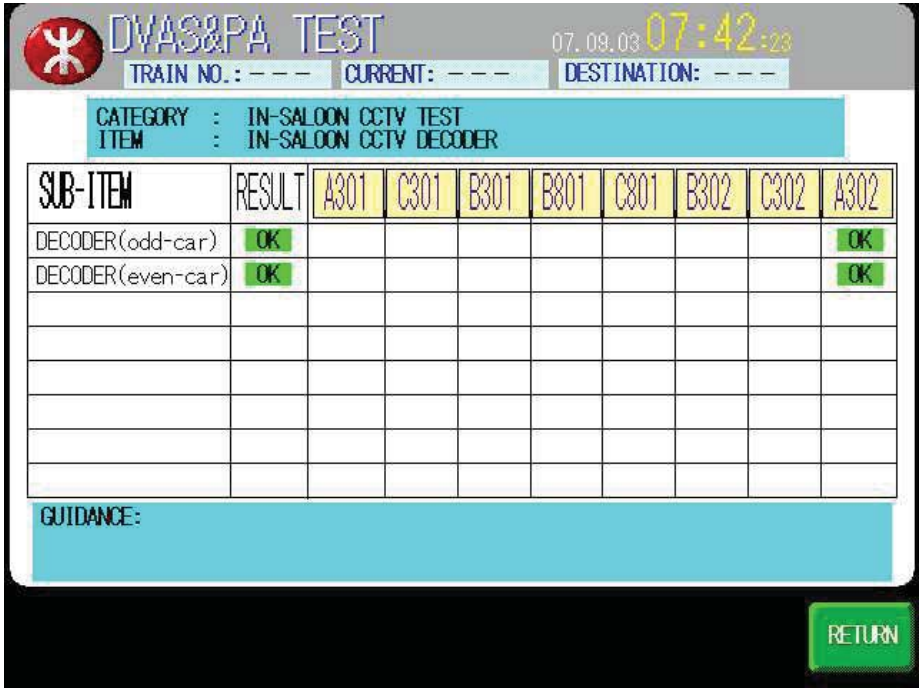
Example of the DVAS&PA test (IN-SALOON CCTV VIDEO DISPLAY) is shown as follows;



[L]

B7223

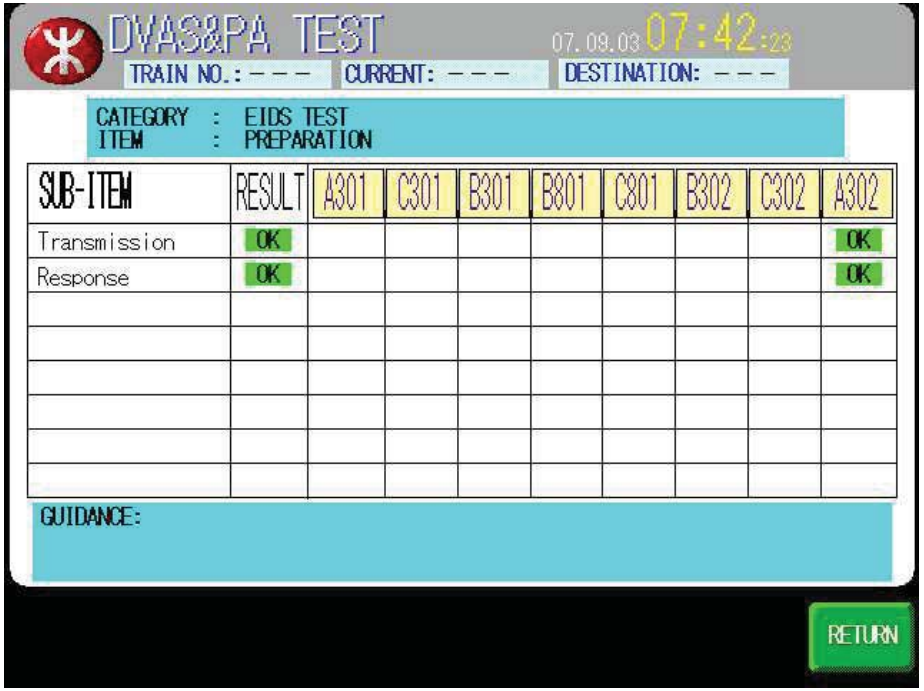
Example of the DVAS&PA test (IN-SALOON CCTV DECODER) is shown as follows;



[K] [L]

B7232

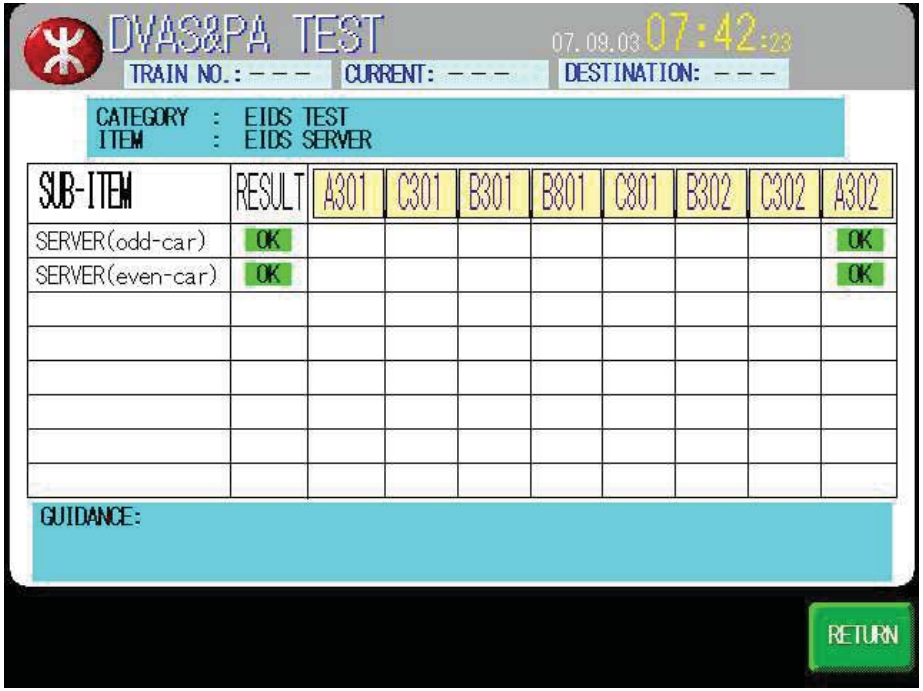
Example of the DVAS&PA test (EIDS TEST PREPARATION K ~~PREPERATION~~) is shown as follows;



L

B7231

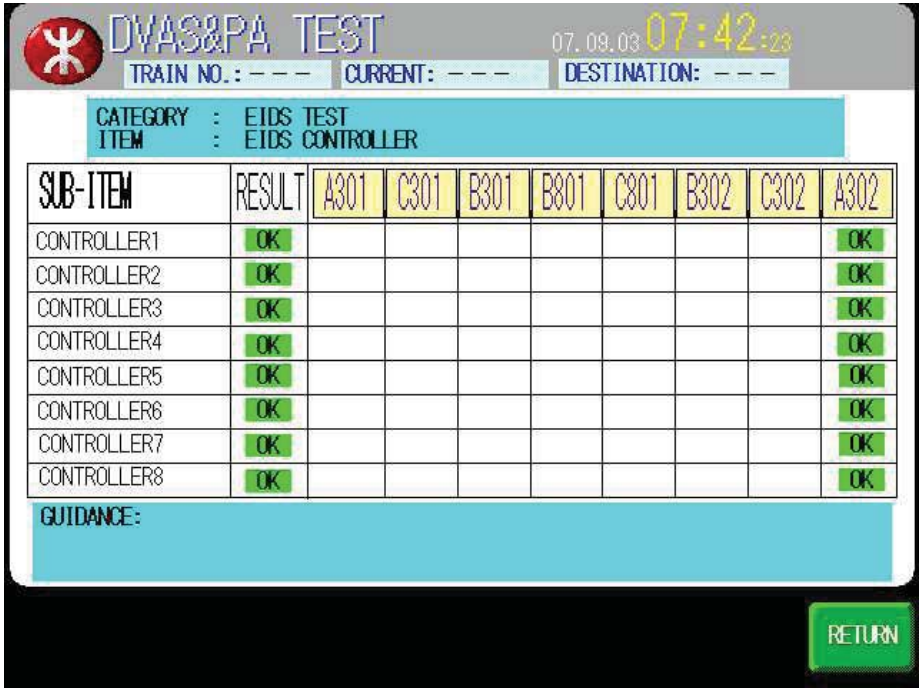
Example of the DVAS&PA test (EIDS SERVER) is shown as follows;



K L

B7224

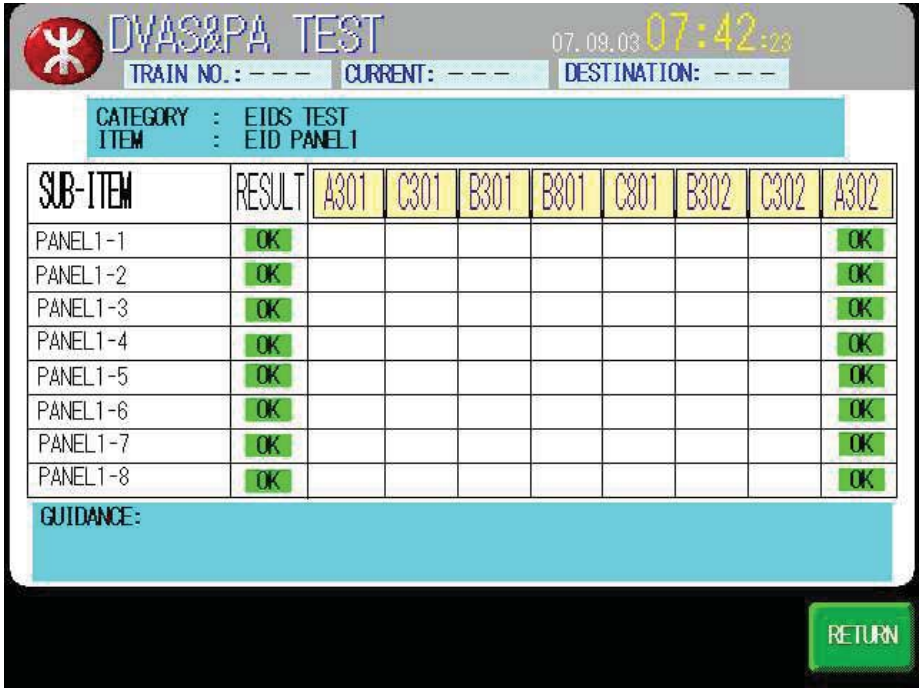
Example of the DVAS&PA test (CONTROLER) is shown as follows;



[L]

B7225

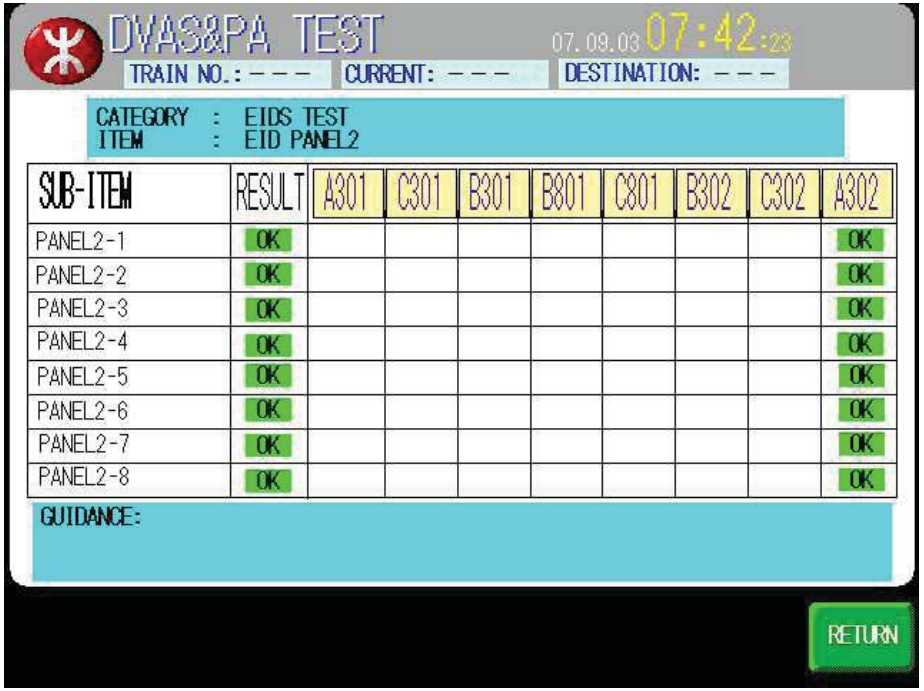
Example of the DVAS&PA test (EID PANEL1) is shown as follows;



[L]

B7226

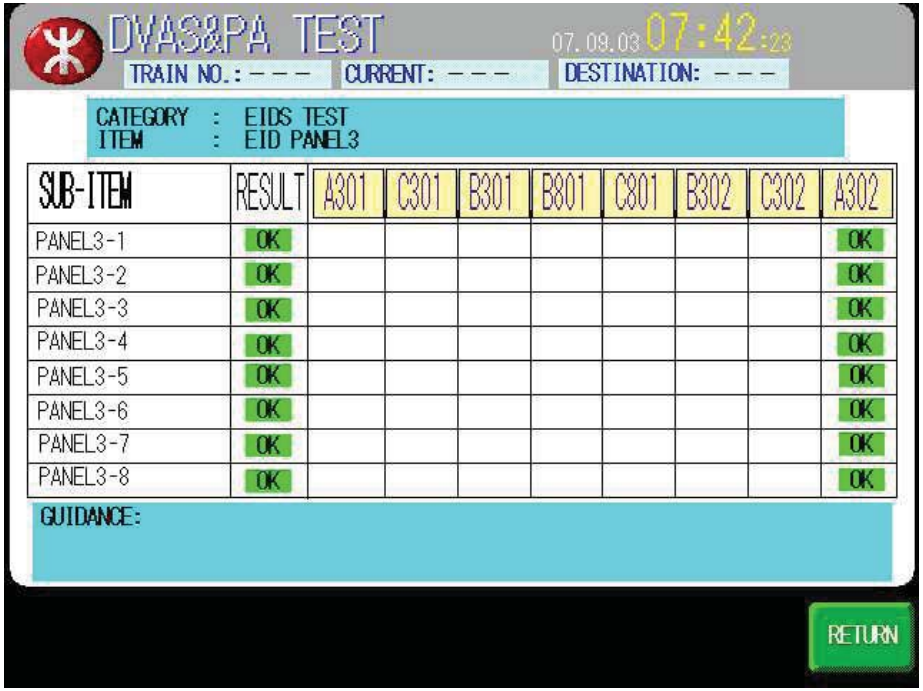
Example of the DVAS&PA test (EID PANEL2) is shown as follows:



L

B7227

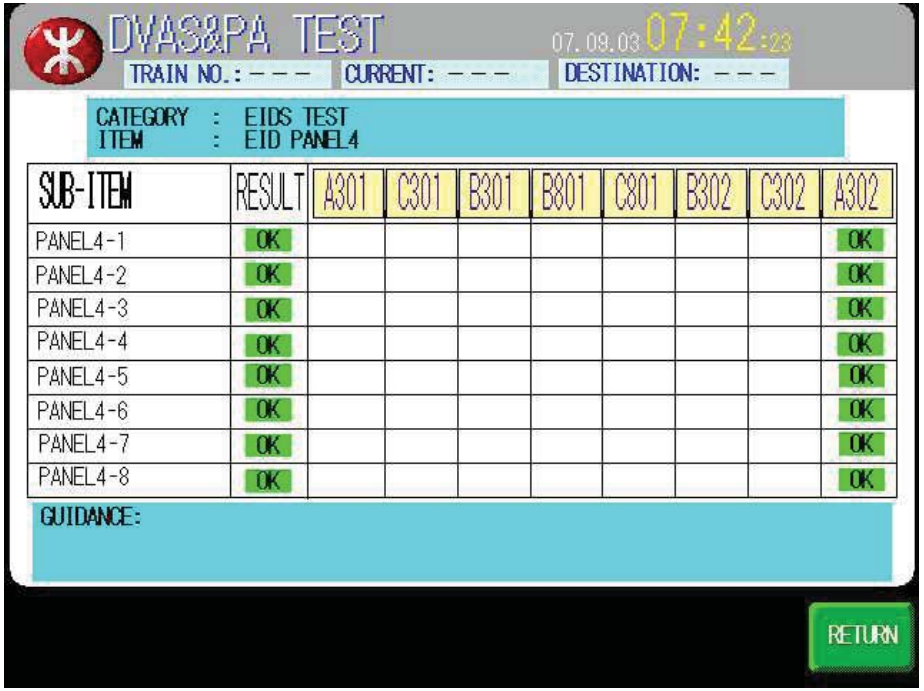
Example of the DVAS&PA test (EID PANEL3) is shown as follows:



L

B7228

Example of the DVAS&PA test (EID PANEL4) is shown as follows;



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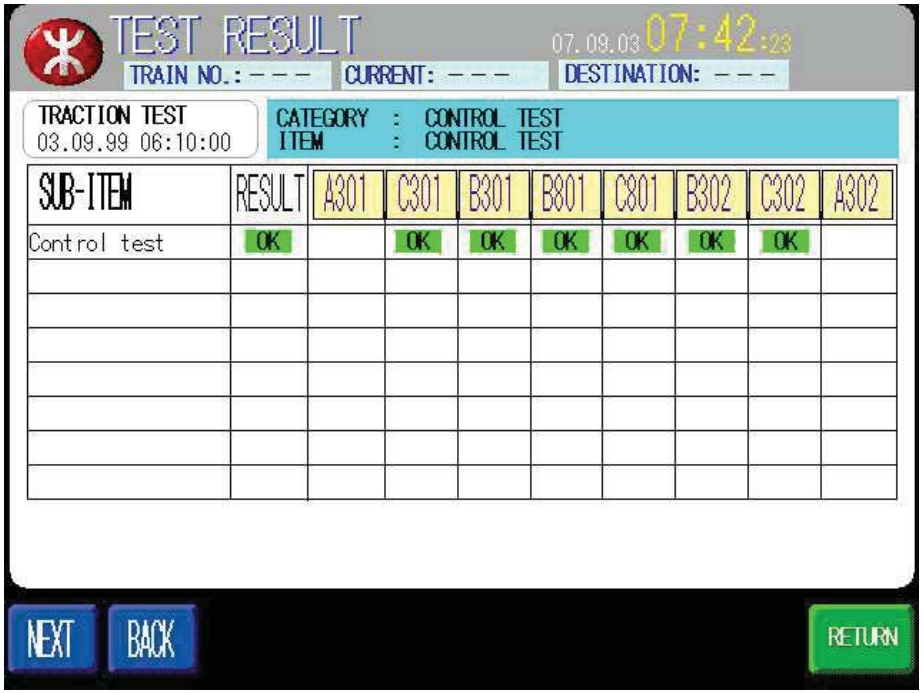
B7229

			MITSUBISHI ELECTRIC CORPORATION., JAPAN								
			CHANGE								DOCUMENT NO.
			J	04. Dec. 09							JHAV438
			L	05. Jan. 10							

3.3.~~29~~ B ~~31~~ J 32 Test result screen

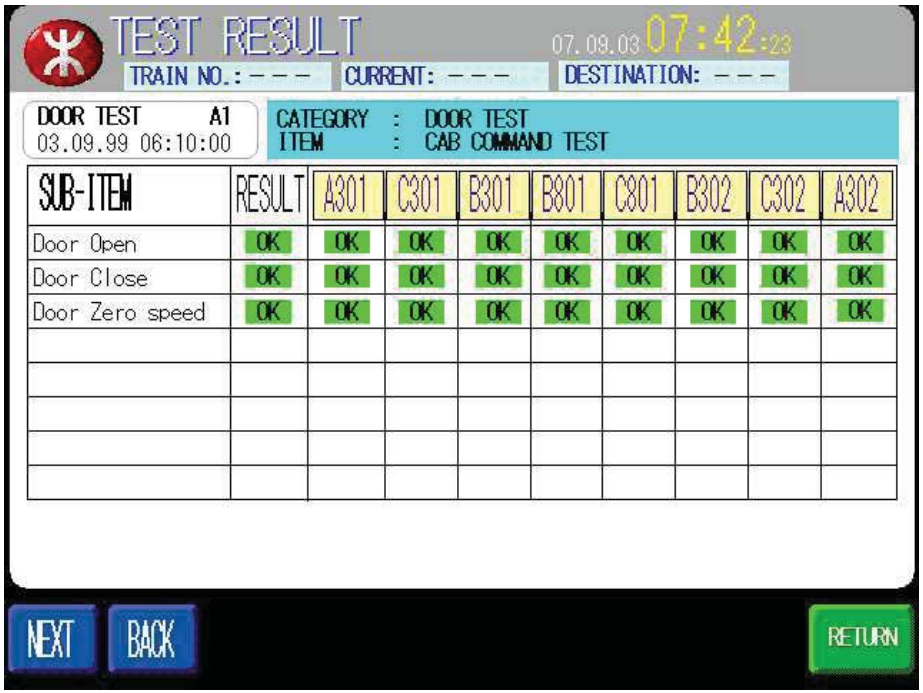
e of the traction test(control test) result screen is shown as follows;



L

B8101

Example of the Door test(Door test) result screen is shown as follows;



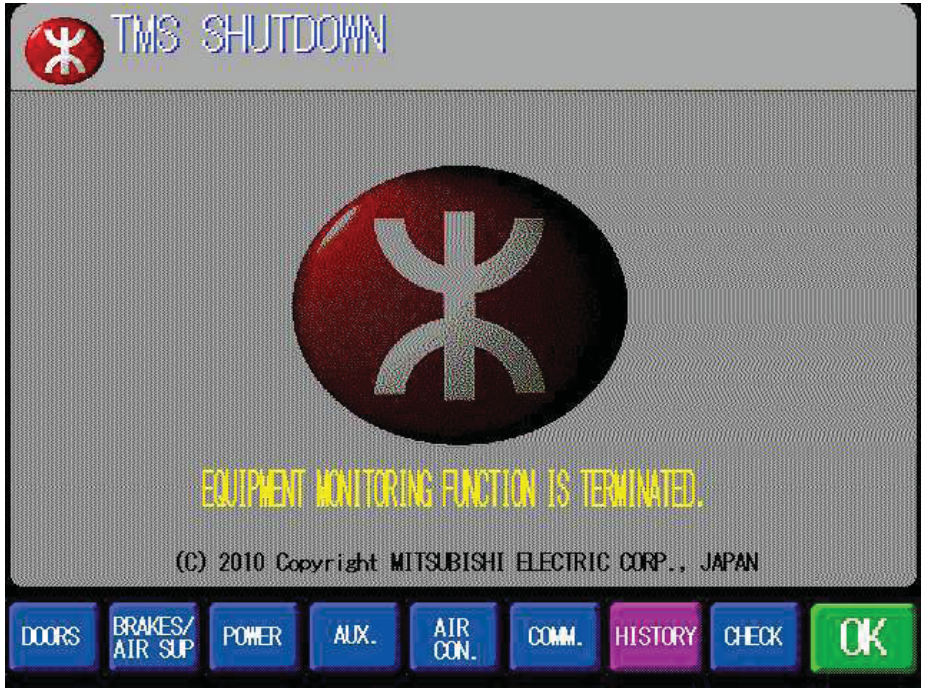
E J L

B8111

Door number and A/C number is displayed by the side of TEST NAME. M
Door number(DOOR A1～DOOR A6 N ~~5~~, DOOR B1～DOOR B6 N ~~5~~)
A/C number(A/C 1, A/C 2)

3.3.~~30~~ B ~~32~~ J 33 TMS shutdown screen

When TMS received the shutdown command, this screen is displayed automatically.



B J

B8

SECTION 11

TRACTION AND BRAKING EQUIPMENT

August 2015

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11 TRACTION AND BRAKING EQUIPMENT

11.1 General

11.2 System Configuration

11.3 Control Interface

11.4 Mode of Operation

11.5 Power Contactors Control

11.6 High Tension Circuit

11.7 Electro-Magnetic Compatibility (EMC) Requirements

11.8 Dynamic Braking Requirements

11.9 Friction Brake

11.10 Brake Response Times

11.11 Combined Brake Control Principles

11.12 Brake Blending

11.13 Wheel Slip and Slide Protection

11.14 Rate of Deceleration

11.15 Friction Brake Isolation

11.16 Parking Brake

11.17 Friction Braking Materials

11.18 Brake Hose

11.19 Drive System Analysis

11.20 Fine Tuning of Traction and Braking Characteristics

Figure 11-1 Traction and Dynamic Brake Characteristics of C Trains

11 TRACTION AND BRAKING EQUIPMENT

11.1 General

11.1.1 The traction and braking system proposed shall be of proven design suitable for the specified performance levels. The design of the power converter shall comply with IEC 61287-1:2005 and IEC 61287-2:2001 and shall be tested to IEC 61377-1:2006.

11.1.2 An AC traction motor system shall be utilised. The AC traction motors and associated drive system proposed shall be designed to perform all normal and emergency duties as specified in PS 4, without damage or deterioration to the motors or their associated connections which may lead to subsequent premature failure.

11.1.3 The system shall be designed for optimum performance in terms of reliability and maintainability and with minimum energy consumption.

11.1.4 The specific energy consumption shall be guaranteed and verified during the testing stage. Requirements for the verification and validation of the energy consumption shall be as specified in Appendix C and Appendix M.

11.1.5 The trains will be required to operate at all-out condition for service regulation purpose. The Contractor shall ensure the traction and brake equipment is designed such that the equipment will not be overloaded and will not be damaged under these conditions.

11.1.6 The existing C Trains with AC Traction system are compatible with the existing Urban Lines trackside ATC signalling systems and trainborne ATC signalling system. The Contractor shall ensure the traction and brake characteristics of the trains are fully compatible with the existing Urban Lines trackside ATC signalling systems and trainborne ATC signalling system. Details of ATC interface requirements are included in Appendix I Annex 3. Traction and dynamic brake characteristics of C Trains are shown in Figure 11-1.

11.1.7 Adjustment facilities on traction and brake control characteristics shall be provided to ensure station stopping accuracy requirements are met when the Trains are operating in Auto Mode. Detailed requirements are described in PS 11.20.

11.2 System Configuration

The traction and braking equipment shall have the following characteristics:

11.2.1 Two bogie frame mounted 3-phase AC induction motors per bogie.

11.2.2 A 3-phase self-ventilated traction converter control system with dynamic braking (both regenerative and rheostatic) capability, each powering the four parallel connected motors of one motor car. All traction converters shall be identical, interchangeable and underframe mounted.

11.2.3 Separate and independent slip/slide control for each car and detection for each axle.

11.2.4 Separate friction brake interface and brake blending control for each car.

11.2.5 An energise-to-release, fail-safe, pneumatic friction emergency braking system.

11.2.6 The electro-pneumatic service and emergency brakes shall operate the same brake actuators.

11.2.7 An automatic spring-applied, air-released parking brake.

11.2.8 Holding brake function which will ensure no roll-back of the train in case it is started at gradient.

11.3 Control Interface

11.3.1 The modes of operation shall be as defined in PS 9.5. No change of travelling direction shall be allowed unless the train speed is less than 1 km/h.

11.3.2 A screened twist pairs train line shall be provided to transmit the tractive effort/braking effort demand in the form of pulse width modulation to the traction and braking equipment. The signal transmission of the above tractive effort/braking effort demand shall be independent with the TMS operation.

11.3.3 The above demand shall be generated in the form of a pulse width modulated by either the ATC system (refer to Appendix I Annex 3), the traction brake controller or the pendant controller (refer to PS 9.6). The circuit shall be designed in a manner that only the PWM signal of the tractive effort/braking effort command shall be available from the ATO unit of the selected active cab

11.3.4 The demand level received by all the traction and braking equipment on the train shall be identical.

11.3.5 The tractive effort/braking effort output from the traction and braking equipment shall be according to the demand level received either from the ATC system in Auto mode or the traction brake controller in manual modes and within the normal working range of the control signal as shown in the following table:

	Traction					Brake				
Effort level (%)	error	0	0 to 100 (linear)	100	error	error	0	0 to 100 (linear)	100	error
PWM rate (%)	0 to 3	3 to 10	10 to 90	90 to 97	97 to 100	0 to 3	3 to 10	10 to 90	90 to 97	97 to 100

11.3.6 In the event of an abnormal demand signal, default traction effort which is equal to zero effort, and default braking effort which is equal to maximum effort, shall be applied.

11.3.7 A load weighing signal which is proportional to car mass and passenger load, shall be provided. This signal shall be suitably damped and provide the mean value of air suspension pressures from the air springs on the two sides of a bogie over the full working range of the air spring pressure.

11.3.8 The tractive effort/braking effort demand signal shall be adjusted by the load weighing signal individually at the related car and assure the appropriate train acceleration/deceleration levels.

11.3.9 In the event that the load weighing signal is lost, the tractive effort/braking effort demand signal shall be modulated assuming the fully laden condition (refer to PS 4.5.4).

11.3.10 During normal operation, the dynamic braking shall be the default braking system and the friction brake system shall be capable of continuous blending to ensure a full service brake rate.

11.3.11 The control response time which is defined as the time elapsed between initiation of the control command signal (for example, motoring, coasting and braking) and on-set of the change of state of the traction/braking circuit, shall be within 0.5 secs.

11.3.12 A failure within the traction and braking equipment shall not cause a failure of friction brake operation.

11.3.13 When the Safety Cut-Out Switch (SCOS) is operated to the Traction Fall-Back position (refer to PS 9.12.4), an overspeed protection shall be provided by the traction and braking system which shall monitor the train speed and ensure that it does not exceed the 22km/h target speed limit. The emergency brake shall be applied when the target speed limit is exceeded.

11.3.14 When the train is operated through the pendant controller, an overspeed protection shall be provided by the traction and braking system which shall monitor the train speed and ensure that it does not exceed the 22km/h target speed limit. The emergency brake shall be applied when the target speed limit is exceeded.

11.3.15 In order to minimise the speed errors caused by the slip/slide problem which will adversely affect the normal operation of the Automatic Train Control (ATC) system, the following arrangements shall be provided to ensure the integrity and availability of the speed feedback to the speed sensors of the ATC system:

(a) The bogie which the axle mounted tachogenerators are installed (refer to Appendix I Annex 3) shall be a non-service brake and non-powered one; and

(b) The design, construction, configuration, emergency braking performance and brake response time of the above bogie shall be identical with the other bogie of the trailer cab car (refer to PS 4.5.1(d)).

11.3.16 For the purpose of accelerating the fault recovery, the location of the faulty traction and braking system shall be identified and reported by the train management system. In addition, a remote traction and braking system isolation function on a car basis shall be provided to isolate the above identified faulty traction and braking system via the train management system.

11.3.17 The integrity of all speed sensing devices shall be continuously monitored. Any abnormality detected shall be reported to the train operator via the TMS and this event shall be logged in the event recorder.

11.3.18 Diagnostic and Fault Logging Facility

(a) The traction converter shall provide self diagnostic and fault logging facilities, to facilitate maintenance and identification of the faulty part down to the LRU level (refer to PS 26.2.5).

(b) A control interface shall be provided between the traction converter and the Train Management System to enable status monitoring of the unit.

11.4 Mode of Operation

11.4.1 The traction equipment shall be capable of operation in the following three modes: Auto, Coded Manual and Restricted Manual. Details of the modes of operation shall be referred to PS 9.5.

11.4.2 Auto Mode

The traction equipment shall respond to the ATC system.

11.4.3 Coded Manual Mode

The traction equipment shall respond to the traction brake controller handle positions. The characteristics of the tractive effort/braking effort output versus the traction brake controller position shall be referred to PS 9.6.

11.4.4 Restricted Manual Mode

The traction equipment shall respond to the traction brake controller handle positions or to the pendant controller according to the driving position chosen.

11.5 Power Contactors Control

For safety purpose, the following arrangements for initiating the traction or braking circuit shall be provided:

11.5.1 The initial setting-up of the traction circuit for motoring or dynamic braking shall be controlled in all cases by two separate train lines.

11.5.2 Whenever zero tractive or braking effort is demanded, the current in the traction motors shall be ramped to zero under jerk rate control and if necessary the power contactors shall open after a time delay.

11.5.3 The time delay shall be provided to prevent the switching of the power contactors in the event of changing mode of operation from motoring to braking and vice versa.

11.5.4 De-energising either of the appropriate two master train lines for a duration longer than the time delay shall cause the traction equipment to be disconnected from the supply.

11.5.5 A stray feed onto any one control wire, not necessarily a train line, shall not prevent the traction equipment from being disconnected from the supply.

11.5.6 To avoid any contact tip wear due to arcing, the motor current shall be ramped to zero before the power contactors open under normal conditions.

11.5.7 Any of the following events shall cause the traction converter to switch off immediately without jerk limit control and the power contactors to open immediately:

(a) emergency brake is demanded;

(b) motoring or braking circuit overload; and

(c) overvoltage or undervoltage in regenerative brake.

11.5.8 The motor/brake and forward/reverse commands shall be provided by means of a dedicated hardwired trainlines to configure the power circuit according to the selected mode of operation.

11.5.9 Changes of state of forward/reverse commands shall only be allowed when zero velocity is proved (refer to PS 9.5.5).

11.5.10 Except emergency brake demand, the jerk rate limit of $0.8 m/s^3$ (refer to PS 4.4.2(d)) shall be applied to all changes of state of motor/brake including coasting commands under manual operations.

11.6 High Tension Circuit

11.6.1 Current Collector Equipment

(a) The traction power supply shall be collected from the overhead contact wire with the running rails utilised for traction return. The detailed interface requirements for the high tension power collection and the traction supply system shall comply with Appendix I Annex 2. The detailed requirement for the pantograph shall refer to RS/C6014/10.

(b) The Contractor shall ensure that the current collector system shall not radiate excessive radio frequency interference (RFI) or cause excessive

RFI to be generated by the overhead catenary system with respect to the limits specified in RS/C6014/04. If necessary, a RFI filter shall be provided.

11.6.2 Surge Arrester

(a) A surge arrester shall be provided for each pantograph and shall be mounted adjacent to the pantograph.

(b) The surge arrester shall have characteristics generally as follows:

Type	Non-linear metal oxide varistor	
Rated voltage	kV	2
Maximum continuous voltage	kV	2
Rated discharge current (wave 8/20μs)	kA	10
Long duration discharge current class		4
Long duration discharge current	kA	1200
Energy capability single pulse	kJ	11
Thermal energy capability	kJ	20
High impulse current (wave 4/10μs)	kA	100
Maximum residual voltages for discharge currents: 10kA, wave 1/2μs 1kA, wave 8/20μs 5kA, wave 8/20μs 10kA, wave 8/20μs 20kA, wave 8/20μs 0.5kA, wave 30/60μs 1kA, wave 30/60μs 2kA, wave 30/60μs	kV	 5.1 4 4.5 4.8 5.3 3.8 4.0 4.2

(c) The surge arrester shall be free from moisture ingress, vandal proof, suitable for installation in polluted environments, high cantilever and torsional strength, non-explosive failure mode, low weight, small size and easy to install.

(d) A means of indication shall be provided for easy identification by visual inspection of a failed surge arrester without dismantling it.

(e) The surge arrester shall not require any maintenance included cleaning for less than six (6) monthly interval.

(f) Under normal service duty, the minimum service life of the surge arrester shall not be less than ten (10) years.

(g) The surge arrester shall be tested to IEC 60099-4:2006.

11.6.3 High Voltage Fuses and Cabling

(a) The use of high tension fuses in the power circuit is not permitted except for the air compressor if it is supplied from the 1,500VDC supply (refer to PS 13) and the auxiliary converters (refer to PS 17).

(b) The cabling to the pantograph shall be correctly sized so that a train can operate continuously without electrical or thermal distress to the pantograph or the associated cabling during the worst case operating condition.

(c) An earthed continuous steel conduit which shall be run externally on the car body, shall be provided to protect the 1,500VDC cable between the pantograph and the high speed circuit breaker (refer to PS 11.6.4). The length of this section of high tension cable shall be kept to minimum.

(d) No intercar cable routing of the 1,500Vdc pantograph cable is allowed except those under the protection of the high speed circuit breaker or high tension fuses for the air compressor (if any) and the auxiliary converters.

11.6.4 Power Contactors

(a) A high speed circuit breaker shall be used for the following purposes:

(i) fault rupturing;

(ii) fault isolation; and

(iii) protect the traction equipment against circuit faults, such as, traction power supply short circuit during regenerative braking.

(b) In the event that the fault is proved to be cleared, the high speed contact shall be either automatically reset or by the intervention of the train operator to re-close it.

(c) A second contactor in series with the high speed contactor shall be provided to satisfy the two wire start and stop requirement as detailed in PS 11.5.

11.6.5 Earth and Isolation Switch

(a) A manually operated earth and isolation switch shall be provided to facilitate the maintenance personnel with a simple means of isolating the traction equipment, discharging all high voltage capacitors to a safe voltage of 50V within 5 minutes and earthing all high voltage equipment.

(b) The earth and isolation switch shall be operable from outside the equipment case

(c) A means for locking the earth and isolation switch in the isolated position shall be provided.

11.6.6 Protection

(a) Protection shall be included in the power circuit to ensure that circulating currents through motor bearings or pinion cannot occur under any condition, for example, motoring, braking, coasting, wheel slip or towing a defective unit. Additionally, the Contractor shall ensure that circulating currents cannot occur between phases of an equipment or between equipments.

(b) Electronic and mechanical overload protection shall be provided in both motoring and braking. The overload protection shall also be capable of protecting the semiconductor devices against all foreseeable faults.

(c) The misfiring of a traction converter or short-circuit failure of a semiconductor device shall not cause consequential damage to other equipment.

(d) Over and under voltage protection shall be provided such that the power circuit ceases to operate outside the limits.

(e) Protection shall be provided to ensure that the equipment cannot be damaged in the event of line voltage transients.

(f) A system shall be provided for detecting an earth fault. The design shall be of high integrity so as not to affect the availability of the train by nuisance tripping.

(g) All high voltage capacitors shall be equipped with a separate discharge paths to ensure they are discharged to 50V within 15 minutes, even without operating the earth and isolation switch (refer to PS 11.6.5(a)).

11.6.7 Input Filter

(a) An input filter shall be provided in the propulsion unit for the following purposes:

(i) To attenuate train generated harmonics to a safe level, particular attention shall be pay to ensure no excessive train generated harmonics shall occur at the signalling frequencies as specified in the Appendix I Annex 3; and

(ii) To prevent damage to solid state equipment due to possible large transient voltages from the traction power supply system.

(b) The Contractor shall ensure the distortion factor of motor ripple current due to traction converter operation for all conditions of motoring and braking has no adverse effect on the traction and braking equipment.

(c) The use of fuses in the filter capacitor or inductor circuit is not permitted.

(d) If an iron cored inductor is used, the Contractor shall provide an impedance versus current curve, up to a current of:

$$1800\sqrt{(C/L)}$$

or full load current, whichever is greater. In the above expression, L and C are the inductance and capacitance of the input filter respectively.

(e) The filter initial charging current shall be limited to a safe level.

11.6.8 Power Component

(a) Power semiconductors shall be arranged in modules complete with snubbing and protection components.

(b) The Contractor shall demonstrate that the limits of electrical and thermal rating for all power components under all conditions of motoring and braking will not be exceeded.

(c) Accurate and detailed computer simulations of single power component failures shall be provided at an early stage in the design of the equipment. These shall show the consequences of every predictable single power component failure and demonstrate the system's ability to adequately clear the fault.

(d) Semiconductor Temperatures and Cooling

(i) The maximum air temperature within any equipment case shall not exceed 65℃ under all conditions of normal and emergency duties specified in PS 4.

(ii) In order to ensure sufficient safety margin is provided, all semiconductors shall not exceed 90 % of the following limits according to the manufacturer's data sheet in all modes of operation including emergency duties: - safe operation area; and - maximum junction temperature.

(iii) Semiconductor cooling shall use natural air convection and earthed heatsinks with all insulating surfaces enclosed in clean conditions. Alternatively, if liquid or phase change cooling is employed for the power semiconductors, a non-immersion type cooling system shall be provided.

(iv) Forced air cooling shall not be used.

(v) The designed life of the cooling system shall not be less than 20 years and cleaning and other maintenance shall not be required at periods of less than 5 years.

(e) The use of electrolytic capacitors in the power circuit is not permitted.

(f) Unless otherwise specified in the manufacturer’s data sheet, the maximum instantaneous temperature of any power resistor element when performing the normal traction and braking duties shall not exceed 470℃. The maximum instantaneous element temperature shall not exceed 550℃ when operating under any of the emergency duties as specified in PS 4.

11.6.9 Braking Resistors

(a) The braking resistors shall comply with IEC 60322: 2001.

(b) The resistors shall be provided with over-temperature protection.

(c) The resistor groups shall be double insulated and adequately protected against wheel splash, flying ballast/debris.

(d) The braking resistor shall be installed so as to prevent over-heating of adjacent equipment, wiring or underframe structure.

(e) An earthed cover shall be provided for the braking resistor bank.

(f) Thermal insulation shall be provided between the resistor enclosure and the underframe.

11.6.10 Traction Motor and Associated Drive System

(a) The traction motors and associated drive system shall be designed for all normal and emergency duties as specified in PS 4, without damage or deterioration to the motors or their associated connections which may lead to subsequent premature failure.

(b) The traction motor shall be mounted on the bogie frame.

(c) The traction motor shall be of robust construction and proven in the railway environment. The motor shall comply with the requirements of IEC 60349-2: 2002.

(d) The motor shall be adequately rated such that its operating temperature will not exceed 90% of the maximum operating temperature permitted by the class of insulation employed whilst fully meeting all specified performance requirements.

(e) The stator windings shall have an insulation life of more than 40 years and be rated Class 200 or better.

(f) The rotor construction shall be robust and be capable of withstanding all foreseeable high vibration and impact loads.

(g) Protection shall be provided to prevent the motor from dropping onto the track should the motor become disconnected mechanically from the frame.

(h) The motor should be self-ventilated or totally enclosed.

(i) If self-ventilated the motor draws the ventilating air from underneath the car, careful consideration shall be given to the positioning of the air inlet to the motor so as to minimise pick-up of dust.

(j) A simple means of excluding dirt and rain water from the machines shall be provided.

(k) Air filters shall not be used.

(l) The insulation system shall be carefully designed to enable the motor to operate with the uncleaned air which will be used to cool it.

(m) Any inspection covers shall be robust and designed for quick and easy removal/replacement and have secondary retention to prevent loss.

Inspection openings shall be as large as possible to facilitate inspection and maintenance.

(n) All grease lubricated bearings shall run between overhauls without replacement. Appropriate thermal sensor shall be provided to monitor the temperature of the traction motor bearings and report to the train management system if any abnormal rise of temperature is detected (refer to PS 10).

(o) Insulated bearings shall be used to prevent current flow through the bearings in normal and under fault conditions.

(p) The coupling of the gearbox shall accommodate all relative movements between the motor and the gearbox, including that caused by a free standing bogie, without damage to the coupling.

(q) The gearbox case design shall give due consideration to minimising weight.

(r) The design of the motor installation shall permit the motor to be removed from, and refitted to, the bogie from above, without any need to disturb the axle and any bogie mounted equipment.

(s) Means shall be provided, by using a wheelskate or similar device, to quickly and safely remove a train with a seized motor, gearbox, or axle, from any point of the main running line back to the depot. To facilitate such operations, jacking points shall be provided beneath the axleboxes.

(t) Where cables pass through holes in the traction motor frame, oil resistant resilient bushes suitably clamped shall be provided to prevent chafing of cables and to seal against the ingress of oil and water.

(u) There shall not be any permanent flying lead attached to the motor. All connections to the motor shall be bolted, torque tightened and marked.

(v) Clearly marked terminals at the junction boxes on the motor frame and on the car underframe adjacent to the motor shall be provided to ensure the motor is electrically connected to the car wiring correctly. Connection or disconnection of the cable terminal shall take not more than ten minutes for one person.

(w) The junction boxes shall be arranged for easy accessibility and colour coded for easy identification. They shall include strain relief provision to ensure that connections are not mechanically stressed.

(x) The cables shall be secured to prevent chafing with other equipment or connections and have sufficient freedom of movement to prevent stressing or fouling of other equipment during the full envelope movement of the bogie.

(y) If speed sensors are fitted to motors, these shall:

(i) be the same for all motor mounting positions; and

(ii) be capable of being replaced with the motor in-situ on the train.

11.6.11 Earthing Equipment

(a) It is a safety requirement that on each car, all power and auxiliary circuits shall be capable of being isolated and all capacitors discharged to allow maintenance access in complete safety. Means shall be incorporated to positively prevent the associated circuits from being made 'live' during the maintenance activity.

(b) Each circuit negative or neutral shall be earthed at one discrete point only on the train in order to prevent the passage of traction current through negative train or unit wires.

(c) Under no circumstances shall circuits be earthed to equipment cases.

(d) Each car shall be provided with two independent earthing brush groups on a bogie basis. Each axle of a bogie shall be provided with an earthing brush box.

(e) Each brush box shall be provided with a protective cover which can be easily removed for inspection and replacement of brushes. An axle end earthing brush box is preferred.

(f) One earthing brush group shall be rated to carry all the 1,500VDC high tension return current with adequate redundancy while the other shall be used for earthing of the carbody, auxiliary negative and neutral bus bar.

(g) The high tension negative return busbar beneath the car shall be fully insulated from other low tension earthing components particularly the carbody.

(h) The high tension earthing bus bar shall consist of a short bus bar with a separate terminal bolt for each connection, and one spare, all mounted accessibly on 1,500VDC insulators on the underframe.

(i) The Contractor shall ensure that there are no extraneous return current paths through any motor gear or axle bearing and that each current return brush group is adequately rated to carry the entire traction return current drawn by that car.

(j) Two low tension earth bus bars shall be provided on each car. Each shall consist of an insulated bus bar solidly connected to the car structure by two cables in parallel to separate terminals. All low tension negative circuits shall be wired to separate terminals on this bus bar, with one spare terminal.

(k) In order to meet the single point earthing requirement as specified in RS/C6014/03, for the low tension earth bus bars on each train unit (refer to PS 4.5.1), there shall be only one earthing point for all earth screens of screened cables and the 110VDC negative return. This earthing connection shall be as close to the 110VDC battery as practicable.

11.6.12 Energy Measurement

(a) The Contractor shall provide means to record usage of energy with an accuracy of ± 5% for motoring, regeneration and auxiliaries separately and independently.

(b) The record of cumulative energy shall be in units of kilowatt-hours.

(c) The energy data shall be non-volatile, easily accessible and monitored by the train management system.

11.6.13 Traction Tests

(a) Traction Control Test

(i) The equipment shall be capable of a train operator initiated static test which shall detect incorrect operation of all major semiconductors, all electronics racks, the input filter, all power protection devices and all contactors.

(ii) During the test, a default friction brake shall be applied and power shall only be applied to the traction motors when the line contactors are proven to be opened.

(iii) Charging of the filter capacitor and gating of the main devices will be permitted provided the power contactors are proven to be opened before any power devices are gated.

(iv) Any fault detected shall be logged and reported to the train management system.

(b) Traction Power Test

(i) The equipment shall be capable of a train operator initiated power test which shall cause the train to motor against its brakes.

(ii) During the test, a default friction brake shall be applied and the traction equipment shall operate according to the demand signal. If wheel rotation is detected, the power shall be shut off on the car concerned.

(iii) The results of this test shall be reported to the train management system.

11.7 Electro-Magnetic Compatibility (EMC) Requirements

11.7.1 The traction and braking system shall comply with the EMC requirements stipulated in RS/C6014/04.

11.7.2 The switching frequencies selected for the traction converter shall be so as to preclude any possibility of electromagnetic interference adversely affecting the functioning of other train borne and trackside equipment particularly the signalling and communications equipment.

11.7.3 The Contractor shall design and install the wiring for all underframe mounted equipment in a manner such that it will minimise conducted or radiated magnetic fields.

11.8 Dynamic Braking Requirements

11.8.1 The dynamic brake shall be continuously available from 85km/h down to 5 km/h or less for the purpose of minimising the brake pad or block wear and maximising the regeneration of energy within the limits of adhesion.

11.8.2 The dynamic braking shall consist of regenerative and rheostatic braking, which shall complement each other, depending on the overhead line receptivity and braking priorities as specified below:

(a) Under normal circumstances, regenerative braking shall have the first priority in the braking process.

(b) In case the line voltage transiently increases up to 1,800VDC, regenerative braking shall be transferred to rheostatic braking without

noticeable change of brake effort, i.e. the blending of regenerative and rheostatic brake shall be smooth, continuous and reversible. A short term rated resistor shall be used to ensure smooth braking transition from the above transient over-voltage conditions. The regenerative and rheostatic brakes transferring process shall be continuously reversible provided the rating of the braking resistor is not exceeded.

(c) Should the overhead line system continue to be either partially or totally non-receptive, dynamic braking shall still be maximised by a smooth transition of regenerative/friction brake blending or revert totally to pneumatic service brake respectively without loss of brake effort until the receptivity of the overhead line system is resumed. The short term braking resistor may be used to ensure smooth braking transition from receptive to non receptive conditions and vice versa.

(d) When there is no dynamic brake available, the total required brake force shall be provided by the friction brake.

(e) Any increase in receptivity during blended brake application shall result in a reduction in the level of friction or rheostatic braking and a resultant increase in the regenerated energy. For detailed requirements of brake blending shall refer to PS 11.12.

11.8.3 The motor unit associated with the trailer car shall provide the dynamic brake for the combination of motor and trailer cars such that the regeneration is maximised and the wear of the friction brake equipment is minimised.

11.8.4 The braking effort shall be regulated among the combination of motor and trailer cars such that the maximum use of the available adhesion is achieved in meeting the demanded braking effort.

11.8.5 Due consideration shall be given to avoid excessive stress build up in the mechanical structure particularly the coupler between the trailer and motor cars caused by the above combination of braking efforts.

11.8.6 Response times during brake blending shall be minimised to facilitate a smooth and non jerky operation.

11.8.7 Within the jerk limits specified, the electric brake shall be built up as rapidly as possible to maximise regeneration and minimise wear of the friction brake.

11.8.8 The regenerative braking shall not cause the line voltage to exceed 1,800VDC.

11.8.9 The Contractor shall submit for Approval a system study indicating the effect of regenerative braking on the overhead line fault level at the design stage. This shall confirm that the regenerative brake shall not cause the fault rupturing capacity of the protective equipment of the cars to be exceeded.

11.9 Friction Brake

11.9.1 The friction braking shall be achieved by means of a friction brake and shall be rated to meet the specified braking performance without assistance from the electrical brake.

11.9.2 The Contractor shall demonstrate by theoretical study, such as, finite element analysis, that the thermal stress built up on the wheel and braking equipment, for example, the brake pad or block, due to frequent friction braking operation according to the conditions specified in PS 11.9.3 below shall not exceed the recommended values given by the suppliers.

11.9.3 The friction brake pad or block shall be capable of a series of 3 consecutive emergency brake applications from maximum speed down to standstill on a crush laden vehicle. The vehicle shall accelerate at its maximum rate up to maximum speed after each stop then immediately undergo an emergency brake application down to a standstill whereupon the train shall be immediately restarted. This shall not cause the pad or block material to change its friction or wear characteristics and shall not cause excessive wear of the friction material.

11.9.4 The friction brake actuation system shall be in accordance with the following general requirements:

(a) It shall be capable of reliable operation in service without the need for any routine attention between overhaul periods.

(b) It shall be capable of functioning satisfactorily without the need for routine lubrication between the overhaul periods.

(c) The design of the friction brake equipment shall permit the equipment to be removed from, and refitted to, the bogie from above (by crane) or below (using a lift table), without any need to disturb the axle or bogie.

(d) An automatic slack adjustment system shall be provided to compensate for the wear of the friction braking material.

11.9.5 In addition to the load weighing signal specified in PS 11.3.7, a pneumatic load compensating device which shall be able to regulate the emergency braking effort on a car basis according to the associated car mass and passenger load, shall be provided. This load compensating device shall be remained operative even the train is in a shutdown mode and auxiliary off state. Also, it shall require no additional power input other than the available pneumatic supply.

11.9.6 In the event that the load weighing feedback signal for the above pneumatic load compensating device is lost, the emergency braking effort shall be regulated assuming the fully laden condition (refer to PS 4.5.4).

11.10 Brake Response Times

11.10.1 The brake response time is defined by the following equation:

$$t_R = t_0 + t_1$$

where
t_R = brake response time

t_0 = dead time (time elapsed between initiation of the brake actuating signal either by the ATO system or by the train operator and the brake cylinder pressure starts to built up)

t_1 = brake built-up time (until the required brake cylinder pressure or braking force have been reached whichever gives the greater braking energy response)

11.10.2 The following brake response times shall be achieved on any single car of a train:

(a) Service brake application: 2.0 secs
(b) Emergency application: 1.6 secs

11.11 Combined Brake Control Principles

11.11.1 The combined braking between the dynamic and friction brake shall be carried out smoothly and within the jerk limits in normal operation. Build up and fade out of dynamic brake and friction brake shall be coordinated to avoid any excessive jerk, in particular at the start and end of a brake application.

11.11.2 The friction brake shall be used to supplement the difference between the required brake demand and dynamic brake achieved.

11.12 Brake Blending

11.12.1 Dynamic braking and friction braking shall be continuously blended to provide the required deceleration rates defined in PS 11.14.

11.12.2 Throughout dynamic braking process, the friction brake shall be such that the brake pad or block is just touching the wheel disc or tread for the purpose of improving the adhesion between the wheel tread and rail and reducing the brake response time.

11.12.3 The dynamic braking shall be preferential and the friction braking shall be applied only under the conditions specified in PS 11.8.2.

11.12.4 The blending control between dynamic brake and friction brakes shall be continuously reversible and carried out automatically.

11.12.5 The blending control between dynamic and friction braking shall not cause any loss of braking effort.

11.12.6 Prior to the final stop, the brake control system shall provide a brake fade out function to facilitate a smooth and non jerky stop. Friction brake blending control during dynamic brake fade, shall ensure no more than a ±5% change of total braking effort relative to the demanded braking effort.

11.12.7 The brake blending at some lower speed when the electric brake fades out shall be smooth.

11.12.8 Fade shall occur at the lowest practical speed applicable to the above requirement. The speed at which electric brake fade occurs shall not be more than 5 km/h.

11.12.9 The Contractor shall ensure that effective wheel slide protection is adequately provided throughout the brake blending process.

11.12.10 If wheel slide is detected then electric brake effort shall be smoothly ramped down and smoothly reapplied as soon as wheel slide has been corrected. At the same time, the friction brake shall also be suitably controlled to prevent excessive braking during the correction process.

11.13 Wheel Slip and Slide Protection

11.13.1 A wheel slip/slide protection system shall be provided to minimise damage to the wheel sets and prevent damage to the traction motors/transmissions during wheel slip or slide.

11.13.2 The wheel slip/slide protection, if not an integral part of the traction and braking equipment, shall provide the signals, for example the slide signal, needed by the traction equipment and other systems.

11.13.3 The wheel slip/slide protection shall incorporate a means of detecting and indicating the health status of the speed sensing devices and any regulating valves. The fault status shall be reported to the train management system (refer to PS 10).

11.13.4 Monitoring device shall be provided to identify a permanently locked axle and report this to the train management system (refer to PS 10).

11.13.5 Wheel Slip Protection

(a) The wheel slip protection shall enable the optimum use of the available adhesion level during motoring and prevent any damage to the wheel sets, traction motors and transmissions, during wheel slip. The system shall be capable of detecting both individual axle slip and synchronous slip of all axles.

(b) If wheel slip is detected then tractive effort shall be smoothly ramped down and smoothly reapplied as soon as wheel slip has been corrected. The system shall be fully adaptive to varying adhesion conditions.

(c) The wheel slip correction shall act independently on each motor car.

(d) The Contractor shall demonstrate that the correction process causes no infringements of the signalling compatibility requirements.

11.13.6 Wheel Slide Protection

(a) The performance of the wheel slide protection equipment shall satisfy the relevant requirements of UIC 541-05: 2005 but need not necessarily be Approved by the UIC.

(b) Testing shall be carried out in accordance with section 2 of the UIC specification.

(c) It is required that the tests specified in PS 11.13.6(b) above shall be repeated on the Engineer's premises.

(d) The above testing shall be carried out both in the open and in tunnel. The tests shall be conducted from a maximum speed of 80 km/h.

(e) The wheel slide protection shall enable the maximum use to be made of the available adhesion level at every axle during braking, at all times, such that the maximum braking effort, achievable with wheel slide, is obtained.

(f) The correction of slide shall act independently on each car.

(g) The system should be fully adaptive to varying adhesion conditions.

(h) An independent circuit, not software based, is required to check the integrity of the wheel slide signal such that it will not continuously energise the correction system when a false continuous wheel slide signal is present.

(i) Additional requirements of the wheel slide protection for the friction braking system specified below shall be fulfilled:

(i) Digital wheel slide protection with gradable slide correction shall be provided in all applications of friction brake for the following purposes:

(1) to minimise damage to the wheel sets; and
(2) to maximise the utilisation of the available adhesion.

(ii) Slide detection shall be on a per axle basis with correction on the following manners:

(1) on a per bogie basis for friction brakes; and
(2) on a per car basis for dynamic brakes.

(iii) The slide protection scheme provided shall be capable of detecting the severity of the slides and provide the appropriate level of slide correction.

(iv) Automatic wheel wear compensation shall be incorporated in the wheel slide protection scheme.

(v) The wheel slide protection system shall be designed for operation during emergency braking. The Contractor shall ensure that the required safety integrity level specified in PS 25 is met under the worst case slide scenario during emergency braking. The emergency brake rate with brake equipment on one car failed and worst case wheel slide shall not be lower than the ATP minimum emergency brake rate for open section as stipulated in Appendix I Annex 3.

(vi) The Contractor shall demonstrate that in the event of a single failure or malfunction of any component in the wheel slide protection system, sustained loss of braking effort shall be limited to one bogie per train.

(vii) The Contractor shall demonstrate that the actual distance travelled by the train under the worst wheel slide scenario shall not be longer than 15% of the distance measured by the ATP system via the tachogenerators (refer to Appendix I Annex 3).

11.14 Rate of Deceleration

The following rates of decelerations excluding the brake response time shall be achieved for all speeds through the full range of wheel diameters with all loadings as specified in PS 4.5.4:

(a) The average service brake when braking into station stops under ATO control will be 0.8 m/s^2 which shall be achievable on all gradients up to ± 3.0% and on both tracks of tunnel and open section;

(b) The maximum service brake rate on level tangent track shall be 1.35 m/s^2; and

(c) The minimum emergency brake rate on level tangent track shall be 1.40 m/s^2 applied with no jerk limit restriction (refer to PS 4.4.2). This shall be achieved by friction braking alone without the assistance of the electric braking.

11.15 Friction Brake Isolation

11.15.1 Friction brake cylinder isolation devices shall be provided in the saloon area and underframe for brake isolation.

11.15.2 Operation of the device shall release the friction brake on an individual car only. The operation status of the friction brake cylinder isolation devices shall be reported to the train management system (refer to PS 10.5.3).

11.15.3 The devices shall be properly locked with breakable seal, such that it shall not be possible to release the brake without breaking the seal.

11.15.4 The appearance of the devices shall be distinguished from other similar devices and shall be painted in red.

11.15.5 The device located inside saloon shall be inaccessible to passengers but accessible to the train operator/maintainer by using an Approved key (refer to RS/C6014/15).

11.15.6 The exhaust of the device located inside saloon shall be directed to the underframe.

11.15.7 The device on the underframe shall be located so that it is operable from the side of the car.

11.15.8 For the purpose of accelerating the fault recovery, the faulty brake system location shall be identified and reported by the train management system. In addition, a remote friction brake isolation function on a bogie basis shall be provided to isolate the above identified faulty brake system via the train management system.

11.15.9 The Contractor shall demonstrate that in the event of a single failure or malfunction of any component in the remote friction brake isolation system, sustained loss of braking effort shall be limited to one bogie per train.

11.16 Parking Brake

11.16.1 Parking Brake Performance

(a) The parking brake force shall be adequate to hold a fully laden train on a 3% gradient.

(b) The parking brake force on individual axles shall not be so large as to inhibit emergency train recovery (refer to PS 4.4.11) or to give rise to locked wheels during recovery.

(c) In the case where the parking brake application is demanded by the train operator (refer to PS 9.12.2(c)) the time for parking brake application shall not exceed 15 seconds.

11.16.2 The parking brake shall be an integral part of the friction brake actuation system.

11.16.3 Parking brake actuators shall incorporate automatic anti-compounding devices to prevent applied braking forces from exceeding the larger of the individual force produced by parking or full service brake applications.

11.16.4 The parking brake shall not give any additional frictional braking force when full service brake is applied.

11.16.5 Progressive application of the parking brake shall occur when the main reservoir air pressure falls below a specific pressure.

11.16.6 Automatic parking brake application shall follow an initial friction brake application with the parking brake applying as the air brake cylinder pressure leaks off. The design shall be such that the parking brakes will take effect prior to fade off of friction brake and shall ensure that the combined brake effort of the friction brake and parking brake is never less than the full brake effort of the parking brake alone.

11.16.7 Subsequent application of air pressure shall automatically release, and reinstate normal operation of the parking brake.

11.16.8 Application and release of the parking brake shall also be controllable from the driving cab (refer to PS 9.12.2(c)).

11.16.9 A means for manual release of each parking brake which can be accessed from track level without the need to reach underneath the car shall be provided.

11.16.10 Under conditions of a dragging parking brake no damage shall be caused to the braking system or any bogie component, with the exception of abnormal pad or block wear.

11.17 Friction Braking Materials

11.17.1 The choice of friction braking material shall ensure the following requirements are met:

(a) The required braking power is provided under all influential factors, such as, temperature, moisture, dirt and grease;

(b) The wear life shall be maximised to demand minimum maintenance.

(c) Only asbestos-free brake materials shall be used.

(d) The performance of the friction braking material shall be consistent throughout its life.

11.17.2 Due consideration shall be given to minimising life costs of brake equipment and the generation of noise and odour when selecting friction braking material.

11.17.3 The friction braking materials shall be able to be easily, quickly and safely changed by unskilled personnel without the need for special tools.

11.17.4 It shall be possible to easily inspect pads or blocks "in situ" without the need to remove or dismantle any components.

11.17.5 The life of the friction braking material in normal service shall not be less than 6 months.

11.17.6 A common friction braking material shall be used for all bogie types and shall be interchangeable between all car types.

11.18 Brake Hose

11.18.1 The material requirements of the brake hose shall comply with RS/C6014/07.

11.19 Drive System Analysis

11.19.1 By the end of SEMP stage 3 (refer to PS 21.3.4), the Contractor shall perform an analysis of the traction and drive system, using well accepted modelling techniques, which shall demonstrate that the system does not contain any resonances, or similar undesirable features, which would cause noise, vibrations or structural damage to the drive, the vehicle or any part of the vehicle. The analysis shall include all relevant components from rail level up to the vehicle body, all component and structural stiffness and all excitation forces and frequencies which could excite the system. The track irregularities input shall be based on Employer’s axlebox acceleration measurement on existing Urban Lines Trains (refer to PS 12.2.2 (e)).

11.19.2 The analysis, together with details of the modelling system and the mathematical model of the drive system shall be submitted for Approval.

11.19.3 During SEMP stage 4, the model shall be updated as design information (refer to Appendix N Clause 2) becomes available until final verification can be confirmed during testing of the vehicles at SEMP stage 5.

11.20 Fine Tuning of Traction and Braking Characteristics

11.20.1 The trainborne ATC signalling system will be used on the trains. In order to achieve the required station stopping accuracy performance as specified in Appendix I Annex 3 Clause 4.4, facilities for fine tuning of the traction and brake characteristics shall be provided.

11.20.2 The fine tuning shall be achieved by adjustment of a set of traction/brake control parameters. The Contractor shall propose for Approval the control parameters which are adjustable by the end of SEMP stage 2.

11.20.3 All adjustable traction/brake parameters shall be stored in non-volatile memories. All parameters shall be reverted to the default values, in case of a failure in the non-volatile memory, or in case of new equipment in which no values have been set.

11.20.4 The traction/brake control parameter adjustment for a complete train shall be performed with a portable notebook computer connected to TMS. Access to the traction/brake control parameter adjustment facilities shall be password protected to prevent unauthorised adjustment. Current values of the parameters shall be available in the TMS display unit in the driving cabs.

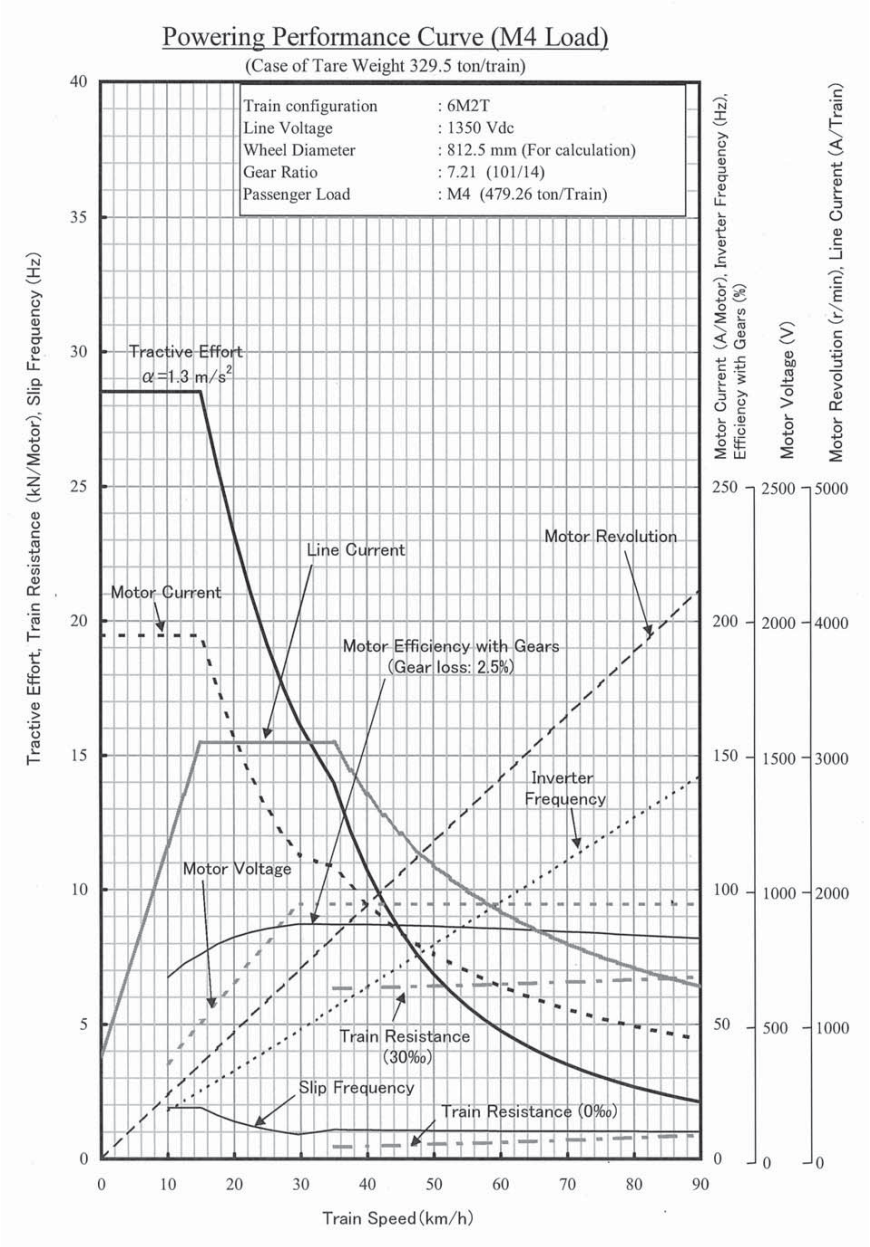
11.20.5 The adjustable range of all traction/brake control parameters shall be preset and fixed. The range shall be selected to ensure no combinations of allowed parameter values will cause:

(i) a failure to meet the brake performance requirements in PS 11.10 and PS 11.14; or

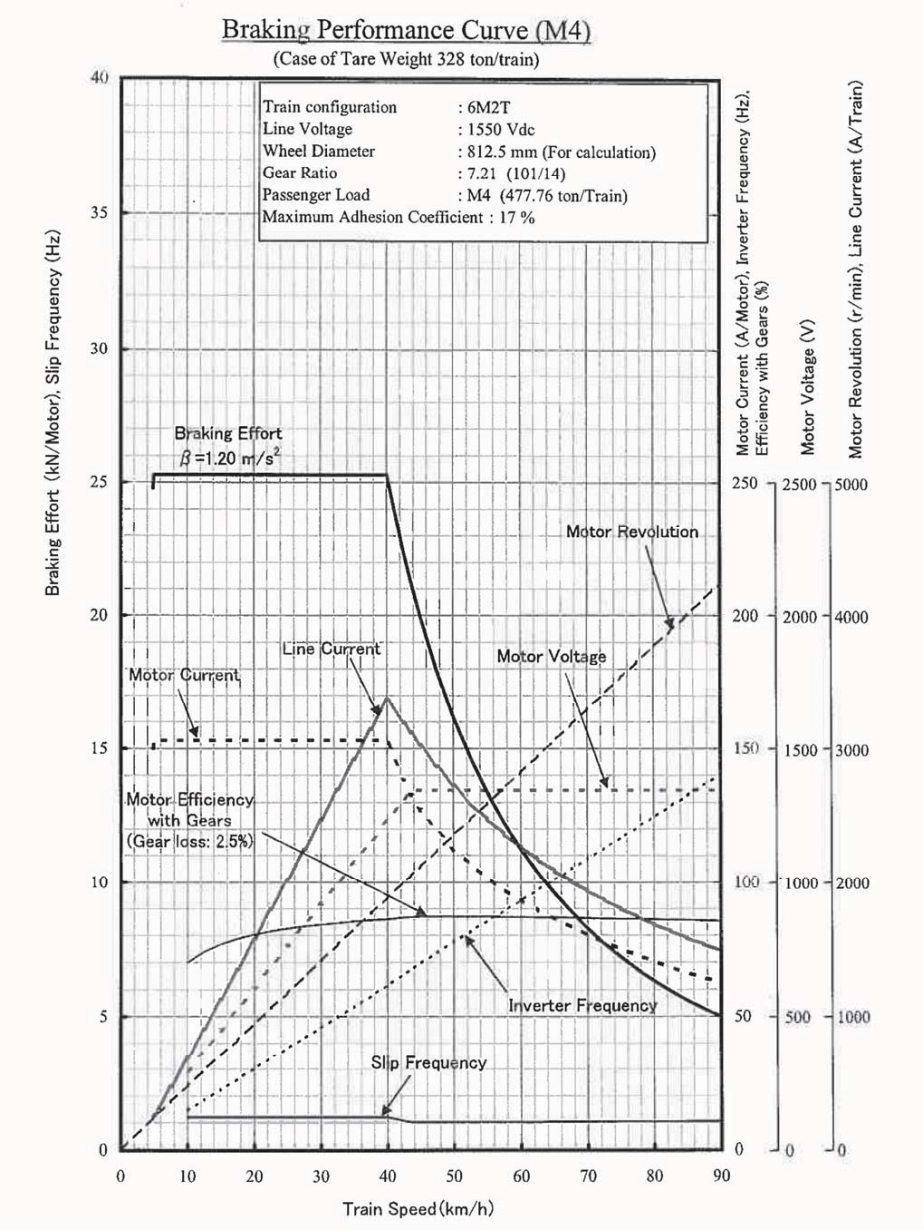
(ii) any adverse effects on wheel slide protection performance.

Figure 11-1
Traction and Dynamic Brake Characteristics of C Trains

RC-B308


Powering Performance Curve (M4 Load)
(Case of Tare Weight 329.5 ton/train)
Train configuration : 6M2T
Line Voltage : 1350 Vdc
Wheel Diameter : 812.5 mm (For calculation)
Gear Ratio : 7.21 (101/14)
Passenger Load : M4 (479.26 ton/Train)
Tractive Effort, Train Resistance (kN/Motor), Slip Frequency (Hz)
Motor Current (A/Motor), Inverter Frequency (Hz), Efficiency with Gears (%)
Motor Voltage (V)
Motor Revolution (r/min), Line Current (A/Train)
Tractive Effort
α=1.3 m/s²
Line Current
Motor Revolution
Motor Current
Motor Efficiency with Gears
(Gear loss: 2.5%)
Inverter
Frequency
Motor Voltage
Train Resistance
(30‰)
Slip Frequency
Train Resistance (0‰)
Train Speed (km/h)

RC-A354


Braking Performance Curve (M4)
(Case of Tare Weight 328 ton/train)
Train configuration : 6M2T
Line Voltage : 1550 Vdc
Wheel Diameter : 812.5 mm (For calculation)
Gear Ratio : 7.21 (101/14)
Passenger Load : M4 (477.76 ton/Train)
Maximum Adhesion Coefficient : 17 %
Braking Effort (kN/Motor), Slip Frequency (Hz)
Motor Current (A/Motor), Inverter Frequency (Hz), Efficiency with Gears (%)
Motor Voltage (V)
Motor Revolution (r/min), Line Current (A/Train)
Braking Effort
β =1.20 m/s²
Motor Revolution
Line Current
Motor Voltage
Motor Current
Motor Efficiency with Gears (Gear loss: 2.5%)
Inverter Frequency
Slip Frequency
Train Speed (km/h)

SECTION 12

BOGIES AND SUSPENSIONS

August 2015

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12 BOGIES AND SUSPENSIONS

12.1 General

12.2 Ride Performance

12.3 Wheel Wear

12.4 Stability Against Overturning and Derailment

12.5 Wheel Off-loading on Twisted Track

12.6 Bogie Rotational Resistance (X-factor)

12.7 Suspension Heights

12.8 Maintainability

12.9 Bogie Structure

12.10 Wheelsets

12.11 Air Suspension

12.12 Pipework and Hoses

Figure 12-1 Wear Limits of Flange Height, Thickness and Slope

12 BOGIES AND SUSPENSIONS

12.1 General

12.1.1 The bogies shall be designed for a life as defined in PS 4.5.5 without rebuilding, repair or strengthening of structural members. The bogie suspension rubber components shall have a life for a minimum of two car overhaul intervals as defined in PS 26.3.3(b) without replacement.

12.1.2 The bogies shall be of a design well proven in a similar service environment.

12.1.3 The characteristics of the suspension shall give a low transmissibility of vibration to the car body and minimise both impact and vibration noise. The suspension frequencies shall be sufficiently separated from the fundamental body frequencies to ensure that resonance does not occur. A minimum frequency separation ratio of 1.4 shall be required.

12.1.4 The Contractor shall ensure that as many parts as possible are identical and interchangeable between the various bogie types.

12.1.5 All bogies types shall have an identical wheel base.

12.1.6 All bogies shall be subjected to Type and Routine testing in accordance with the requirements of PS 22.

12.1.7 The unsprung mass of any bogie shall not exceed 1750 kg.

12.2 Ride Performance

12.2.1 Stability

(a) The car shall be dynamically stable under all operating conditions.

(b) The Contractor shall submit calculations for Approval to demonstrate that the car will achieve a minimum of 5% of critical damping under all combinations of the following conditions:

(i) Velocity from 25 km/h to 90 km/h.

(ii) Conicity from 0.05 to 0.45.

(iii) 0.5, 0.75 and full creep.

(iv) Suspension parameters at the most disadvantageous limits of their tolerance bands, taking into account manufacturing variations, ageing effects, temperature, and deterioration due to normal wear as far as the maintenance limits.

12.2.2 Ride Quality

(a) The cars shall not exceed the following ride performance levels which shall be weighted with the vehicle ride acceleration weighting characteristics shown on Drg. No. C6014-14E/TSEG/010/006:-

Vertical journey average	0.006 g
Lateral journey average	0.008 g
Longitudinal journey average	0.004 g
Vertical 99th percentile	0.012 g
Lateral 99th percentile	0.016 g

(b) The ride performance shall be achieved under all loading conditions when travelling throughout the range of operating speeds and cant deficiencies prevailing in normal passenger service.

(c) Journey average shall be the arithmetic mean of the weighted r.m.s. accelerations evaluated at 10 second intervals over the full length of the running lines in Urban Lines. Accelerations shall only be measured when the car is travelling at speeds above 25 km/h.

(d) The track characteristics over which the cars will operate are given in Appendix I Annex 1.

(e) The track quality shall be as good, or better than, the good quality main line track represented by TRACK225.DAT (track irregularity) and TR225SP.DAT (track spectrum) available in VAMPIRE®.

(f) The Contractor shall submit for Approval calculations to demonstrate that the requirements of PS 12.2.2 are achieved under all track and suspension conditions from new until reaching the maintenance limits

12.3 Wheel Wear

12.3.1 The cars shall achieve a minimum of seven hundred thousand kilometres before reprofiling of the wheels is necessary, which is equivalent to an average flange wear rate of not exceeding 0.011mm per 1000km for the wheel, whilst operating on the routes as specified in Appendix I Annex 1.

12.3.2 A flange lubrication system which applies dry solid lubricant on the wheel flange surface shall be fitted on the trains. Comprehensive details of the proposed system shall be submitted for Approval including but not be limited to design drawings and evidence to show that the system has been well proven under similar conditions on other railways.

12.3.3 The Contractor shall submit for Approval curving calculations to demonstrate that the requirements of PS 12.3.1 will be achieved.

12.3.4 Wear limits before reprofiling of the wheels shall refer to Figure 12-1.

12.3.5 The Contractor shall note that a wheel tread friction modifier system would be retrofitted after the trains will be handed over to the Employer for rail corrugation control. The Contractor shall provide mechanical mounting provision on bogie frame ends for this wheel tread friction modifier system equipment to be installed on a minimum of 25% of train wheels. The Contractor shall integrate this mechanical mounting provision to allow fitting of the wheel tread friction modifier applicator (refer to Drg. No. C6014-14E/TSEG/687/001) with the flange lubrication system.

12.4 Stability Against Overturning and Derailment

12.4.1 The car shall be designed to operate safely under the worst combinations of cant excess or deficiency and wind loading as defined in PS 5.2 and PS 5.4.

12.4.2 The Contractor shall submit calculations for Approval to demonstrate that the requirements of PS 12.4.1 have been achieved.

12.5 Wheel Off-loading on Twisted Track

12.5.1 The off-loading of any wheel shall not exceed 60% of the nominal static load of any wheel on the car when negotiating the track specified in Drg. No. C6014-14E/TSEG/010/005. The nominal static wheel load is defined as each individual wheel load with the car standing on straight and level track. This shall be achieved for all operating conditions, including deflated air suspension and over inflated air suspension.

12.5.2 The Contractor shall demonstrate, by calculation, that the wheel offloading performance shall be achieved with the suspension components at the extreme limits of the manufacturing tolerance and taking into account changes in stiffness due to ageing and temperature effects.

12.5.3 The Contractor shall submit calculations for Approval to demonstrate that the requirements of PS 12.5 have been achieved.

12.6 Bogie Rotational Resistance (X-factor)

12.6.1 The bogie rotational resistance (X-factor) shall be equal to or less than 0.08 when the car is negotiating the minimum radius curve. This requirement shall be achieved for a bogie rotational speed of 0.2 degrees per second, under all loading conditions, and for all suspension conditions, excluding deflation and over inflation of the air suspension. In case of air suspension over-inflated or deflated, the X-factor shall be equal to or less than 0.1. However, the contractor shall set X-factor of equal to or less than 0.08 as a target during the design of the bogie under these abnormal conditions.

12.6.2 X-factor is given by the following formula:-

$$\text{X} - \text{factor} = \frac{T}{2Q \times 2a}$$

Where T = *Torque to rotate the bogie*
$2Q$ = *Average axleload on the bogie being rotated*
$2a$ = *Bogie wheelbase*
in a consistent set of units.

12.6.3 The Contractor shall submit calculations for Approval to demonstrate that the requirements of PS 12.6.1 have been achieved.

12.7 Suspension Heights

12.7.1 The nominal floor height of the car shall be 1110 mm above rail level. This shall be achieved under normal operation with the car in the tare (M1) loading condition.

12.7.2 The car floor height shall not fall below the nominal height of the platform (refer to Drg. No. C6014-14E/TSEG/077/001) under all loading conditions up to fully laden (M4), with the air suspension operating normally, and with the car standing in a station.

12.7.3 Packing of the suspension to accommodate wheel wear shall be achieved by packing at the secondary suspension and shall not be necessary at a period of less than that of half wheel life.

12.7.4 The Contractor shall submit for Approval his detailed procedure for setting vehicle heights together with calculations to demonstrate that the requirements of PS 12.7.1 and PS 12.7.2 have been achieved.

12.8 Maintainability

12.8.1 General

Maintenance of the bogie shall be consistent with the car maintenance philosophy given in PS 26. In particular bogie components shall have a minimum life equal to the maintenance period of the bogie and preferably a multiple of the maintenance period.

12.8.2 Bogie Changing

Bogies shall be capable of being disconnected and reconnected easily and with a minimum of operations by personnel working in pits or alongside the bogies. It shall be possible to easily inspect for correct reconnection without the need for special tools or instruments.

12.8.3 Inspection

It shall be possible for personnel working in pits or alongside the bogie to visually inspect the condition of bogie components, such as brakes and wheel treads, easily and without the use of special tools.

12.8.4 Cleaning

(a) The bogies shall be capable of being cleaned using high pressure hot water and steam jet cleaning equipment, with and without high efficiency detergents. All closed sections and pockets shall be self draining or sealed against water intrusion.

(b) Lubricated bearings shall be adequately sealed to ensure that water and cleaning fluids shall not enter during the cleaning process.

12.8.5 Wheel Turning

(a) To permit wheel turning, axleboxes shall be designed to accommodate a holding down device when wheel turning on an under-floor wheel lathe as specified in Appendix I Annex 6 Clause 5.

(b) The bogie shall be provided with towing eyes which shall be sufficiently strong to allow the Train Unit to be positioned over the underfloor wheel lathe using ropes and a capstan as specified in Appendix I Annex 6 Clause 3.6.

12.8.6 Handling

(a) Lifting attachments shall be provided for handling a complete bogie or a bogie frame alone.

(b) The attachments between the body and the bogie shall be such that if the car is lifted without disconnecting the bogies, the bogies, traction drives and wheelsets shall be retained captive to the car without the need for additional restraints at the time of lifting. No damage shall result to any of the connections as a result of this action.

12.9 Bogie Structure

12.9.1 General

The bogie structure is defined as the bogie frame and all other bogie mounted structural components with the exception of wheelsets.

12.9.2 Manufacture

(a) All machined surfaces and cut plate edges shall be finished to a standard to be defined by the Contractor in accordance with the requirements of PS 20.

(b) After fabrication the bogie frame shall be stress relieved to ensure dimensional stability.

12.9.3 Loads

(a) Proof

The bogie structure shall withstand the following static load cases without permanent deformation or any form of damage or deterioration.

(i) *Vertical* : Twice the sum of the maximum crush laden (M5) static pivot load and the bogie sprung mass. The load shall be applied vertically in equal parts at the secondary suspension points and reacted at the axles.

(ii) *Lateral* : The load equal to that applied to a bogie when the car is subjected to a load, applied at the car centre of gravity, which is sufficient to cause overturning of the car. The car shall be assumed to be in the condition of loading and air suspension inflation/deflation which requires the greatest lateral load to cause overturning.

(iii) *Longitudinal* : 5g times the total bogie mass applied longitudinally in equal parts at the axles and reacted at the body/bogie connection. The maximum static pivot load shall be applied at the same time.

(iv) *Twist* : Diagonally opposite wheels of the bogie shall be unloaded by 60% of the maximum crush laden (M5) static wheel load. The maximum static pivot load shall be applied at the same time.

(b) Fatigue

Assessment of fatigue for fabricated steel structures shall be in accordance with BS 7608:1993 using the mean minus 2 standard deviation S-N data (i.e. a probability of survival better than 97.7%). For materials not covered by BS 7608:1993 the method of fatigue assessment shall be submitted for Approval.
The fatigue damage shall be assessed separately for each of the vertical, lateral and twist load cases given below, and also for any load cases arising from the requirements of the additional loads in PS 12.9.3(c). The total damage resulting from the combination of the individual damages, in accordance with Miners Rule (ref. BS 7608:1993), shall be less than unity.

(i) *Vertical* : ±25% of the fully laden (M4) car body weight applied vertically for 10 million cycles.

(ii) *Lateral* : ±15% of the fully laden (M4) car body weight applied laterally for 10 million cycles.

(iii) *Twist* : 10 million complete reversals of the wheel off-loading which results when a car with the air suspension normally inflated and in the fully laden (M4) loading condition passes over the track twist defined in PS 12.5.

(iv) *Traction/Braking* : 10 million complete reversals of the loads applied to the bogie when a fully laden (M4) vehicle accelerates and decelerates under its maximum tractive effort and decelerates at emergency brake rate.

(c) Additional Loads

The Contractor shall ensure that any other loads that may arise on the bogie due to the particular configuration chosen are adequately taken into account. These additional loads shall include, but not be confined to those caused by the effects of motor inertia, equipment inertia loads, damper loads, and the effects of passenger loading and unloading.

(d) Bogie Mounted Equipment

Items of equipment mounted on the bogie frame, including their mountings shall be designed to withstand the forces associated with the following accelerations:-

(i) Proof

Vertical	±20.0g
Transverse	± 3.0g
Longitudinal	± 5.0g

(ii) Fatigue

10^7 cycles of

Vertical	±5.0g
Transverse	± 1.5g
Longitudinal	± 0.5g

(iii) Impact

The Contractor shall ensure leading bogie mounted equipment and their mountings for ATC equipment as specified in Appendix I Annex 3 so designed to mitigate the risk of derailment due to complete failure as a result of impacting by small animal. The leading bogie mounted equipment and their mountings shall :-

(1) be made of steel.

(2) be able to resist a sustained concentrated proof load of at least 20 kN applied at the middle section of the mounting structure along its bottom edge with 200 mm width and height from the lowest bottom edge up to 1/3 of the mounting structure vertical dimension.

(e) Axlebox Mounted Equipment

Items of equipment mounted to axleboxes, including their mountings, shall be designed to withstand the forces associated with the following accelerations:-

(i) Proof

Vertical	±50.0g
Transverse	± 5.0g

Longitudinal ± 5.0g

(ii) Fatigue

10^7 cycles of

Vertical	±25.0g
Transverse	± 3.0g
Longitudinal	± 3.0g

(f) The accelerations and loads given in PS 12.9.3 do not include the effects of locally generated loads or accelerations caused by the configuration of equipment or resonances. The Contractor shall ensure that any such conditions are adequately considered.

(g) The Contractor shall submit detailed finite element calculations for Approval to demonstrate that the requirements of PS 12.9.3 have been achieved.

12.10 Wheelsets

12.10.1 General

Wheelsets shall be manufactured in accordance with RS/C6014/09. The wheel tread profile shall be as shown on Drg. No. C6014-14E/TSEG/010/003. The wheelset back to back distance shall be 1360 +2/-0 mm.

12.10.2 Axles

Axles shall be designed in accordance with BS EN 13103: 2001 and BS EN 13104: 2001 for non-powered axles and powered axles respectively to meet the requirements of the specification for the full life of the vehicle, without attention, other than routine maintenance and nondestructive testing.

12.10.3 Wheels

(a) Wheels shall be of monobloc type. The wheel mechanical design shall be assessed by BS EN 13979 Part 1: 2003 Clause 7. The wheel thermal mechanical design shall be assessed by the requirements as specified in PS 11.9.2.

(b) Wheels shall have a minimum radial wear allowance of 37.5mm. The nominal new wheel diameter shall be 850 mm.

(c) The wheel shall not cause squealing in curves.

12.10.4 Wheelsets Assemblies

(a) Wheelsets shall be protected using a paint system which will protect the wheelset from damage by corrosion for at least the period between bogie overhauls without maintenance. The paint shall additionally show good resistance to mechanical damage and exhibit self healing properties, be easily maintainable to allow repair of damage and be ultrasonically transparent to allow ultrasonic testing of the axles without removal of the paint.

(b) The cavities formed by wheel and gear hubs overhanging their respective seats, shall be protected by a rust inhibitor which shall protect the axle against corrosion for at least the interval between bogie overhauls.

(c) The Contractor shall submit for Approval comprehensive details of his wheelset design. The submission shall include, as a minimum, axle detail drawings, axle design calculations, wheel detail drawings, wheel design calculations, details and description of any noise damping measures and wheelset assembly drawings and procedures.

(d) Noise damping device shall be provided and fitted to the wheel to achieve the requirements of PS12.10.3 (c) and RS/6014/13. Comprehensive details of the proposed device shall be submitted for Approval including but not be limited to noise calculations to demonstrate the effectiveness of the device, design drawings and evidence to show that the device has been well proven under similar conditions on other railways.

12.10.5 Non-destructive Testing

(a) Easy access shall be provided to both ends of all axles to allow ultrasonic testing of the axles. It shall be possible to carry out ultrasonic testing with the wheelset in situ under the vehicles.

(b) The Contractor shall submit for Approval separate non-destructive testing procedures for testing of a free-standing assembled wheelset and for testing of a wheelset in situ under a vehicle. Additionally, the Contractor shall define appropriate inspection periods based on critical defect sizes and crack growth rates for all areas of the axle where cracking is possible. Calculations and data shall be provided to support this information.

12.10.6 Axlebox bearings

(a) Grease lubricated cartridge bearings shall be used. The bearing shall be such that no attention is required between bogie overhauls.

(b) The front and rear seal shall prevent the ingress of water and/or cleaning fluids to the bearing both during normal running and during cleaning.

(c) The Contractor shall carry out bearing life calculations to demonstrate that the selected size of bearing is adequate for the required duties.

(d) The Contractor shall carry out bearing rig performance test and sealing test in accordance with BS EN 12082: 1998 to demonstrate that the requirements in PS 12.10.6 have been achieved.

12.11 Air Suspension

12.11.1 The bogie shall be fitted with air suspension which shall maintain a constant floor height in the car under all conditions of loading (excluding primary suspension deflection).

12.11.2 In the event of a fault resulting in over inflation or deflation of the airsprings, the car shall be able to operate safely at its normal operating speeds. Under these conditions the weighted journey average ride for vertical, lateral and longitudinal direction shall not be more than 0.004 g worse than that with the air suspension normally inflated. This shall be achieved without the use of extra features, e.g. dampers, which would not be required to achieve the ride requirements in the normally inflated condition.

12.11.3 Pressure switch shall be fitted to monitor any fault with deflated airsprings on each bogie. The status of the air suspension shall be reported to the TMS as specified in PS 10.5.7.

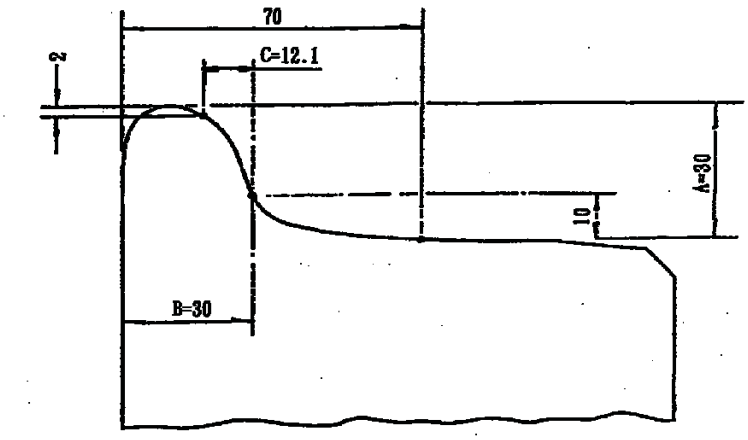
12.11.4 Air suspension isolation cock shall be provided for each bogie to enable the car levelling operation. The operation status of the air suspension isolation cock shall be reported to the TMS as specified in PS 10.5.7.

12.12 Pipework and Hoses

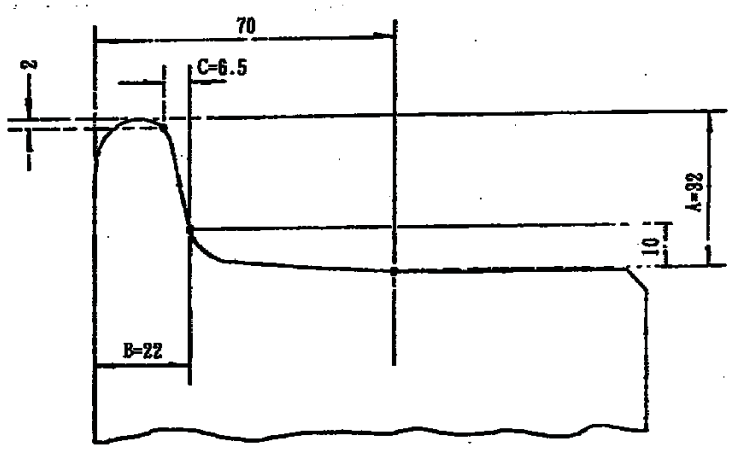
12.12.1 Pipework and hoses shall be manufactured in accordance with RS/C6014/07.

12.12.2 Brake-pipes, hoses and conduits shall be installed such that risk of damage such as from flying ballast is minimised.

12.12.3 Brake-pipes and conduits shall be supported with suitable cleats at intervals of not greater than 300 mm. Cleats shall be positioned so as to avoid high stressed areas of the bogie frame.



NEW CONDITION.



FULLY WORN CONDITION

	Wear Limits
	< 32 mm
	> 22 mm
	< 6.5 mm

Figure 12-1 Wear Limits of Flange Height, Thickness and Slope

SECTION 13

PNEUMATICS AND AIR DISTRIBUTION SYSTEMS

August 2015

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13 PNEUMATICS AND AIR DISTRIBUTION SYSTEMS

13.1 System Requirements

13.2 General Requirements

13.3 Main Air Compressor

13.4 Construction of the Compressor

13.5 Compressor Control

13.6 Air Drying System

13.7 Auxiliary Supply for Pantograph Control

13.8 Air Reservoirs

13.9 Piping

13.10 Safety Valves

13.11 Pressure Indication

13.12 Brake Isolation

13.13 Pressure Governors

13.14 Horn

13 PNEUMATICS AND AIR DISTRIBUTION SYSTEMS

13.1 System Requirements

13.1.1 The train shall provide a compressed air supply system which shall comprise a self-contained air supply system for each Train Unit (refer to PS 4.5) in the train consist.

13.1.2 The system for each Train Unit shall comprise at least one compressor (refer to PS 13.3) and a through Main Reservoir Pipe of sufficient capacity.

13.1.3 All pneumatic sub-systems shall be adequately supplied from the Main Reservoir Pipe.

13.1.4 Automatic connection of the through Main Reservoir Pipe shall be provided following the coupling of Train Units (refer to PS 13.9.4).

13.1.5 The compressed air shall be treated by an air drying system (refer to PS 13.6).

13.1.6 The Contractor shall propose and submit for Approval the system design with schematic layout and air flow consumptions for the pneumatic system.

13.1.7 The nominal Main Reservoir Pipe air pressure shall be 10 bar.

13.1.8 The nominal air pressure for all pneumatic air controls shall be 5.5 bar.

13.2 General Requirements

13.2.1 Details of pipe work, standards and general constructional features of pneumatic equipment shall meet the requirements specified in RS/C6014/07.

13.2.2 Arrangements shall be provided for individual isolation of the compressed air supply to each sub-system and including the main air compressor with facilities to vent the residual air.

13.2.3 Consideration shall be given to group the relevant components on a module basis for easy replacement.

13.2.4 Exhaust of compressed air into either the passenger saloon area or Train Operator's cab will not be accepted.

13.2.5 The Contractor shall carry out type and routine tests in accordance with the requirements specified in PS 22 and Appendix C to demonstrate the quantity, quality and control of the delivery air meets the pneumatic system requirements.

13.3 Main Air Compressor

13.3.1 The type of compressor used shall be proven for railway application and shall be submitted for Approval.

13.3.2 Consideration shall be given to optimise the performance of the compressor type being selected to meet the system requirements as specified in PS 13.1.

13.3.3 The compressors shall be adequately sized and shall be submitted for Approval, taking into account the consumption of various sub-systems, charging up time and recovery requirements (refer to PS 4.4.3(a)).

13.3.4 The Contractor shall propose the duty cycle of the compressor and submit for Approval.

13.3.5 The time required for charging up the train from empty (i.e. all reservoirs and equipment at zero pressure) to full Main Reservoir Pipe pressure with all compressors working normally shall be less than 30 minutes.

13.3.6 The system shall be maintained within its service working pressure range when there is only one compressor working normally in a train. In this case, PS 13.3.4 and PS 13.3.5 are not applicable.

13.4 Construction of the Compressor

13.4.1 The compressor shall be directly driven from the associated motor.

13.4.2 The compressor shall be AC driven and be powered by the Auxiliary Converter (refer to PS 17.3.1).

13.4.3 Consideration shall be given to motor selection to match the auxiliary power supply load distribution and stability (refer to PS 17.1 and PS 17.3.1).

13.4.4 The compressor motor shall comply with the requirements of RS/C6014/02.

13.4.5 A sight glass shall be provided to check oil levels.

13.4.6 The design of the compressor and the associated equipment shall minimise the transmission of vibration to the saloon floor.

13.4.7 Means shall be provided to identify correct wiring connection and motor rotating direction of the compressor.

13.4.8 The system shall be designed to minimise oil carrying over from the compressor to the system.

13.5 Compressor Control

13.5.1 Each compressor on the train shall be equipped with an associated air pressure governor to regulate the Main Reservoir Pipe air pressure on the whole train.

13.5.2 Synchronous control shall be provided to ensure all compressors to operate simultaneously.

13.5.3 The compressor shall start automatically to maintain the main reservoir air pressure as specified in PS 13.1.7 and PS 13.1.8.

13.5.4 All compressor controls on the train shall be powered by the auxiliary control supply from the appropriate controlling cab or gangway cubicle and protected by an independent MCB.

13.5.5 The compressor control circuit shall be designed to ensure that batteries cannot be coupled together.

13.5.6 Each compressor control circuit shall remain fully operational for at least 60 minutes following the failure of the normal supply.

13.5.7 Isolation controls shall be provided for each compressor system, to enable electrical isolation under fault conditions whilst not affecting the operation of the remainder of the train compressor system. The isolation controls shall not be accessible to passengers.

13.5.8 The run time and healthy status of each compressor shall be monitored by the TMS (refer to PS 10.5.8).

13.6 Air Drying System

13.6.1 An air drying system shall be provided to ensure delivery of high quality compressed air, of class 3 to ISO 7183-2: 1996 or better, to the main air reservoir.

13.6.2 An air dryer shall be provided for each compressed air system and the air dryer shall be manufactured and tested to ISO 7183: 1986.

13.6.3 The air dryer shall be a self-contained unit mounted in the vicinity of the main compressor.

13.6.4 The air dryer shall be re-generative type with automatic change-over feature.

13.6.5 The air dryer shall be coordinated with the compressor control system in order to achieve the requirements as specified in PS 13.6.4.

13.6.6 Indication shall be provided to indicate the degree of dryness of the desiccants.

13.6.7 The life of desiccant shall not be less than the time between the planned air dryer overhaul period.

13.6.8 Silencer shall be provided if purging is used for re-generation to meet the requirements of RS/C6014/13.

13.7 Auxiliary Supply for Pantograph Control

13.7.1 In addition to the normal regulated supply from the Main Reservoir Pipe, an auxiliary compressed air supply shall be provided for each pantograph to maintain the normal pantograph control pressure in the event of insufficient normal supply.

13.7.2 The time required to raise the pantograph after the auxiliary compressor has been started shall be less than one minute.

13.7.3 The auxiliary compressor shall be powered from the battery.

13.7.4 A safety pressure relief valve shall be provided with the settings to be submitted for Approval.

13.7.5 An air reservoir shall be provided to ensure that the pantograph maintains steady contact with the overhead wire, refer to RS/C6014/10.

13.7.6 Padlock isolating cock shall be provided to isolate and vent the pantograph cylinder with the following handle positions:

(a) Vertical up for the pantograph to be connected to compressed air supply.

(b) Horizontal for the pantograph to be lowered with compressed air supply to be isolated and pantograph cylinder to be vented.

13.7.7 Provision shall be made to fit a padlock onto the isolation cock to secure the pantograph in the lowered position as specified in PS 13.7.6(b).

13.8 Air Reservoirs

13.8.1 All reservoirs shall be designed, manufactured and tested in accordance with RS/C6014/07.

13.8.2 All test certificates shall be submitted for Approval.

13.8.3 The capacity of the Main Reservoir shall be designed to achieve the following requirements when the reservoir is at minimum Main Reservoir Pipe air pressure without any compressor running except (d) below:

(a) It shall enable all pneumatic equipment to be operable.

(b) It shall account for normal leakage of the system.

(c) It shall enable the train running safely from one station and stop accurately at the next station with friction brake only.

(d) It shall enable the train to assist a defective Urban Lines Train for recovery to charge up from 5 bar within 20 minutes.

13.8.4 Brake supply reservoir shall be fitted on each car to provide a protected supply to the friction brake equipment of that car.

13.8.5 The brake supply reservoir installation shall meet the following requirements:

(a) When the pressure in the brake supply reservoir is at maximum Main Reservoir Pipe air pressure and the Main Reservoir Pipe is at zero

pressure, the brake supply reservoir pressure drop shall not be more than 0.1 bar within 5 minutes due to normal leakage.

(b) With the brake supply reservoir is at minimum operating Main Reservoir Pipe air pressure and the Main Reservoir Pipe is at zero pressure, it shall be possible to make two Emergency Brake applications at crush laden (M5) condition.

13.9 Piping

13.9.1 Quick release test points for measuring system pressures shall be provided in readily accessible positions.

13.9.2 The positions for the test points specified in PS 13.9.1 shall be submitted for Approval.

13.9.3 Protective covers shall be provided for the quick release test points when they are not in use.

13.9.4 Automatic connection of the Main Reservoir Pipe air through the automatic coupler shall be provided as required by PS 14.3.

13.9.5 Individual manual isolation of the Main Reservoir Pipe shall be provided at each automatic coupler end (refer to PS 14.3.1(e)) and each bar coupler end (refer to PS 14.4.4). The operation of isolation shall be easily accessible to the train operator from the underframe.

13.9.6 Check valves at all compressor flexible hoses shall be provided to minimise the effect of a burst flexible hose.

13.9.7 Flow restricting devices shall be located in the Main Reservoir Pipe adjacent to branch connections, to avoid excessive air flow in the event that a piping failure or equipment malfunction occurs.

13.9.8 A drain point shall be provided at the lowest point of the system in each car to enable manual drainage of condensate, if any.

13.9.9 All intercar and cab end flexible pneumatic hoses shall be duplicated and fitted with a suitable valve such that, in the event of damage which causes air leakage from any one of the hoses, air supply to the damaged hose will be cut off whilst allowing air to be supplied to the Main Reservoir Pipe via the other hose.

13.9.10 A Main Reservoir Pipe isolation cock shall be provided to isolate and vent the Main Reservoir Pipe for parking brake application during recovery operation (refer to PS 4.4.3(c)). The operation of the isolation shall be easily accessible to the train operator from the hostler position (refer to PS 7.17.1 (e)). The cock shall be properly locked with breakable seal in the opened position.

13.9.11 The Main Reservoir Pipe isolation cock (refer to PS 13.9.10) shall be constructed with large venting capacity. Under the condition of no main air supply, the time required to vent the whole train compressed air from the nominal Main Reservoir Pipe pressure to the pressure with parking brake fully applied on the whole train with one Main Reservoir Pipe isolation cock shall be less than 8 minutes. The Contractor shall submit the calculation for Approval to demonstrate this time can be achieved.

13.9.12 The exhaust of the Main Reservoir Pipe isolation cock (refer to PS 13.9.10) shall be directed to the underframe.

13.9.13 A cab end Main Reservoir Pipe isolation cock shall be provided to isolate the Main Reservoir Pipe for train coupling during recovery operation (refer to PS 4.4.3). The operation of the isolation shall be easily accessible to the train operator from the cab position (refer to PS 8.9.5 (a)). The default position of the cab end Main Reservoir Pipe isolation cock shall be in the isolated position.

13.9.14 The operation status of the Main Reservoir Pipe isolation cock (refer to PS 13.9.10) and the cab end Main Reservoir Pipe isolation cock (refer to PS 13.9.13) shall be reported to the TMS (refer to PS 10.5.8).

13.9.15 A provisional facility shall be provided to release the parking brake of Urban Lines Train to satisfy the emergency push out requirements (refer to PS 4.4.3 (d)). A connection point to the Main Reservoir Pipe shall be provided at each train cab front. This Main Reservoir Pipe connection will be used to supply air to a defective Urban Lines Train in order to permit successful emergency push out. This connection facility to the Main Reservoir Pipe shall be provided by an Approved quick release connection and shall be isolated from the Main Reservoir Pipe by an isolation cock. The quick release connector shall be located in a readily accessible position to be agreed with the Engineer.

13.10 Safety Valves

13.10.1 The Contractor shall provide safety valve to be installed in each compressed air supply system to protect the associated main reservoirs against over pressure.

13.10.2 The safety valve capacity shall be at least 50% greater than the compressor delivery.

13.10.3 The safety valve shall operate at a pressure not less than 0.5 bar and not more than 1.0 bar above the maximum operating system air pressure.

13.10.4 The safety valve setting shall be submitted for Approval.

13.11 Pressure Indication

13.11.1 A duplex pressure gauge shall be provided in each cab (refer to PS 8.8.4(b)) to indicate the pressure of Main Reservoir Pipe and Local Brake Cylinder. The pointer for Main Reservoir Pipe pressure indication shall be painted in yellow and the pointer for Local Brake Cylinder pressure indication shall be painted in red.

13.11.2 The Main Reservoir Pipe pressure and brake cylinder pressure of each car shall also be recorded by Event Recorder (refer to PS 10.7) through the TMS.

13.11.3 The duplex pressure gauge shall be operable at all times and shall not require the presence of an electrical control signal to indicate the correct pressure.

13.11.4 A pressure gauge shall be provided at each hostler cubicle to indicate local brake cylinder pressure.

13.11.5 The pressure indication shall be taken from a point upstream from the brake cylinders.

13.11.6 No pneumatic devices shall be mounted between the pressure indicator and the brake cylinders.

13.11.7 A pressure gauge shall be installed in the pantograph control cubicle inside the saloon to indicate the pressure connected to the pantograph.

13.11.8 Electrical signal of a pressure senor for measuring the brake cylinder pressure of the leading bogie shall be transmitted to the trainborne ATC equipment, refer to Appendix I Annex 3.

13.12 Brake Isolation

Brake isolation device shall be provided in accordance with PS 11.16.

13.13 Pressure Governors

13.13.1 All pressure governors shall be of an Approved type.

13.13.2 The pressure governors shall be able to withstand a pressure not less than the 'open' pressure of the main safety valve without causing any damage or deterioration.

13.13.3 The Contractor shall submit all pressure governors settings for Approval.

13.13.4 The pressure governors shall meet the requirements of RS/C6014/07.

13.14 Horn

13.14.1 Pneumatic horn shall be fitted in accordance with PS 6.9.4.

13.14.2 The horn shall generate an audible warning, measuring at 1.6 m above rail top level along the car centreline to achieve a minimum sound pressure level of 80 dB(A) at a distance of 150 m from the car end but not to exceed 130 dB(A) at a distance of 1 m from the car end.

13.14.3 The horn shall emit a sound with the fundamental frequencies in the range of 1 to 2 kHz, either in a single frequency or combination of frequencies.

13.14.4 The horn controls shall be located as specified in PS 8.8.7 for that in the cab and PS 7.17.3 for that in the hostler cubicle.

13.14.5 Operation of the horn control shall be in accordance with PS 9.6.3.

SECTION 14

GANGWAYS AND COUPLERS

August 2015

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14 GANGWAYS AND COUPLERS

14.1 General

14.2 Operation Requirements

14.3 Automatic Coupler

14.4 Bar Coupler

14.5 Coupler and Draftgear

14.6 Intercar Gangway

14 GANGWAYS AND COUPLERS

14.1 General

14.1.1 The cab end shall be fitted with an automatic coupler.

14.1.2 The non-cab ends of each Train Unit shall be fitted with automatic couplers and gangways.

14.1.3 The intermediate ends between the cars of a Train Unitshall be fitted with semi-permanent bar couplers and semi-permanent gangways.

14.1.4 The coupler shall be compatible with the gangway fitted to that end of the car in all aspects including coupling/uncoupling and normal operations, taking into account the gangway guidance, gangway and passenger load.

14.1.5 The autocoupler, together with the electrical head, shall be compatible with the existing Urban Lines BSI couplers. The lubricant used for the coupler surface shall be Gleitmo 805.

14.1.6 The couplers and gangways shall be designed to meet the door pitch requirements as specified in Drg. No. C6014-14E/TSEG/010/012.

14.1.7 An additional secondary coupling device shall be provided at the noncab end automatic coupler to maintain the mechanical integrity of the couplers and gangways in the event of a failure in the coupler engagement mechanism (refer to PS 14.3.3).

14.1.8 An adequately rated flexible earth bond shall be provided across the moving joints of the inter-car gangways/couplers in order to ensure that the earthing circuits of all car bodies are continuously connected.

14.2 Operation Requirements

14.2.1 The automatic coupler shall, in conjunction with any associated gangways be capable of coupling with another on any track layout as specified in Appendix I Annex 1.

14.2.2 Under these track conditions coupling shall be achieved with the most adverse mismatch of car heights caused by wheel wear, passenger loading, air spring deflation and tolerances.

14.2.3 Other than the operation of the secondary coupling device (refer to PS 14.3.3), the coupling/uncoupling of automatic coupler and the associated gangway shall be achieved by a maximum of two actions inside the saloon by one operator without any additional manual locking/unlocking required.

14.2.4 The Contractor shall ensure that the uncoupling of the autocoupler shall not be allowed unless the associated gangway has been uncoupled.

14.2.5 The secondary coupling device (refer to PS 14.3.3) shall be unlocked manually from the saloon prior to the uncoupling operation as specified in PS 14.2.3.

14.2.6 The secondary coupling device shall be locked manually from the saloon after the coupling operation as specified in PS 14.2.3 in order to complete the whole coupling process.

14.2.7 Emergency Push-out Requirements

(a) A cab end coupler shall be capable of

(i) mechanical, pneumatic and electrical coupling to the cab end of other train, and

(ii) mechanical, pneumatic and electrical coupling (refer to PS 9.11.1) to the cab end coupler of the Urban Lines Train (refer to Drg. Nos. OD2/301/00015/0001, OD4/361/00715/0003 and C6014-14E/TSEG/115/001 for emergency push out operation (refer to PS 4.4.3).

(b) In order to accelerate the recovery process, a cab end Main Reservoir Pipe isolation cock (refer to PS 13.9.13) and a sealed autocoupler electrical isolation switch shall be provided on the driving cab for selectively isolating the pneumatic and/or electrical coupling connection (refer to PS 9.7). The default position of the cab end Main Reservoir Pipe isolation cock and the autocoupler electrical isolation switch shall be in the isolated position.

(c) The cab end coupler and all inter-car couplings shall be capable of transmitting the forces necessary to pull or push an unpowered train with fully laden passenger load and all parking brakes applied or not applied up or down a 3% gradient at any speed up to 10 km/h under all track layout as specified in PS 4.4.

14.2.8 Coupling with Locomotives

(a) The cab end automatic coupler shall be capable of mechanical and pneumatic coupling to the Urban Lines locomotives (refer to Drg. Nos. OD4/311/00001/0012, OD4/311/00001/0014, OD4/312/00001/0008 and OD4/312/00001/0051).

(b) When coupled to a locomotive it shall be possible for a Train Unit coupled at either a cab end or an intermediate end to be moved both in the depot and on the main line. Main line air pressure will be supplied to the Train Unit from the locomotive, via the centre main reservoir pipe port on the automatic coupler face, and the locomotive will provide the braking effort.

14.3 Automatic Coupler

14.3.1 General

(a) The automatic coupler shall incorporate the following connections.

(i) Mechanical connection

(ii) Electrical connection

(iii) Pneumatic connection

(b) The automatic coupler shall automatically effect mechanical, electrical and pneumatic coupling as specified and permit separation of the Train Units either manually from track side or remotely from the train operator cab or the hostler position.

(c) When uncoupled, the electrical contacts and pneumatic connection shall be automatically protected against physical and mechanical damage and shall be sealed against the ingress of water from rain and from washing plant, and general dirt and detritus from the environment.

(d) The automatic couplers shall provide positive indication to the TMS to prove that they are correctly and fully coupled (refer to PS 9.7.6).

(e) An autocoupler pneumatic isolation cock shall be provided to isolate and vent the automatic coupler from the main line air supply. The operation of the isolation shall be easily accessible to the train operator from the underframe. The default position of the autocoupler pneumatic isolation cock shall be in the opened position.

(f) Equipment to centralise the automatic coupler to allow ease of coupling shall be fitted.

(g) The design of the automatic coupler and its components shall have no failure to couple, either electrically or mechanically, for a minimum of 2,500 couplings.

(h) A sealed autocoupler electrical isolation switch shall be provided to isolate the electrical connections of the automatic coupler and it shall be easily accessible to the train operator from the cab and the hostler position. The switch shall be sealed in the "isolated" position at the cab and in the "engaged" position at the hostler position.

(i) The non-cab end automatic coupler shall be designed so that coupling/uncoupling, including gangway connection/disconnection, can be performed at the hostler position to the following requirements:

(i) by one person within 5 minutes on straight level track.

(ii) by two persons within 5 minutes on tracks as stated in PS 14.2.1 other than (i) above.

(j) The coupling requirement in PS 14.2.1 shall be achieved under the following minimum coupler misalignment conditions:

(i) parallel and vertically misaligned only,
+90 ± 5 mm and -90 ± 5 mm

(ii) parallel and horizontally misaligned only,
+170 ± 10 mm and -170 ± 10 mm

(k) The autocoupler shall provide mounting provision for duplicated flexible pneumatic hose connection arrangement as required in PS 13.9.9.

14.3.2 Automatic Coupler Electrical Head Requirements

The electrical connections shall be made by an electrical head attached to the coupler and satisfy the following requirements:

(a) It shall not require any power source to couple/uncouple the electrical head.

(b) During coupling process, the electrical head shall be coupled automatically together with the mechanical head.

(c) During uncoupling process, the electrical head shall be separated automatically with the mechanical head.

(d) A manual uncoupling device shall be provided to uncouple the electrical connection to prevent the electrical connections from being made during coupling operation, without the use of any additional tool.

(e) When coupled, all contacts shall be accurately aligned and maintained in contact with adequate compressive force.

(f) In addition to providing the electrical contacts for control signals, provision shall be made to automatically effect coaxial connections.

(g) All contacts shall be adequately rated for all train consists in terms of voltage and current capacity.

(h) The number of contacts and their ratings shall be submitted for Approval.

(i) The contacts shall be contained in a block which shall be removable from the coupler without cutting of the cables.

(j) Individual contacts shall be capable of being replaced in the block.

(k) Electrical connections shall comply with RS/C6014/02.

(l) A junction box shall be mounted at the body end to allow replacement of the electrical head by one person within 30 minutes.

(m) Jumper cables between the coupler head and the junction box shall be arranged to prevent them from being damaged under all operating conditions.

(n) Inspection covers fitted to the coupler head and disconnection boxes shall also be sealed. All sealing shall be to BS EN 60529: 1992 IP 65.

14.3.3 Secondary Coupling Device

(a) A secondary coupling device shall be provided for each pair of automatic couplers at intercar gangways.

(b) The device shall provide additional mechanical lock of the automatic couplers and ensure that the gangway above the automatic couplers remains engaged in the event of mechanical failure of the automatic

coupler engagement mechanism or in the event of any uncommanded automatic coupler disengagement.

(c) Strength

(i) The strength of the mechanical lock shall be sufficient to operate on its own under normal condition.

(ii) The strength calculation shall be submitted for Approval.

(d) Constructional Features

(i) It shall be a mechanical device.

(ii) It shall be operated from within the saloon at the hostler position.

(iii) It shall prevent the automatic coupler release mechanism from operating unless the secondary coupling device is in the unlocked position.

(iv) It shall prevent the automatic couplers from coupling together unless the secondary coupling device is in the unlocked position.

(v) It shall not engage until the automatic couplers are fully engaged.

(vi) It shall positively indicate inside the car if the secondary coupling device is in the unlocked or a partially engaged position.

14.4 Bar Couplers

14.4.1 The connection and disconnection of bar couplers will take place in depot only.

14.4.2 The bar coupler shall incorporate all necessary pneumatic connections including the duplicated flexible pneumatic hose connection arrangement as required in PS 13.9.9.

14.4.3 The bar coupler, shall be designed so that assembly/disassembly, including gangway separation and necessary jumper connection/ disconnection, can be completed in 45 minutes by two persons.

14.4.4 A bar coupler pneumatic isolation cock shall be provided to isolate and vent the bar coupler from the main line air supply. The operation of the isolation shall be easily accessible to the train operator from the

underframe. The default position of the bar coupler pneumatic isolation cock shall be in the opened position.

14.5 Coupler and Draftgear

14.5.1 Draftgear

Coupler draftgear shall be suitably damped, and be designed to prevent the occurrence of unduly large dynamic deflections and associated forces in all normal and specified emergency train operating conditions.

14.5.2 Coupler and Draftgear Mounting Requirements

(a) The couplers shall be mounted so that the coupler is free to move and not be impeded by body structure under any operating condition including the emergency push out condition with Urban Lines Train as specified in PS 14.2.7.

(b) The coupler and draftgear shall incorporate a form of adjustment to ensure compliance in accordance with PS 14.2.1 and 14.2.2 as necessary.

(c) Coupler fasteners and fastener security devices used to connect the couplers shall be positioned so that they can be easily inspected as well as enabling the tooling, required to install and secure the fasteners, to be easily operated.

(d) The height of the centre of the autocoupler locking pin shall be 790 +0 15mm from the rail head level in order to enable coupling with the Urban Lines Train (refer to Drg. Nos. OD2/301/00015/0001, Drg. No. OD4/361/00715/0003 and C6014-14E/TSEG/115/001) under the specified coupler misalignment conditions in PS 14.3.1(j).

14.5.3 Coupler and Draftgear Strength Requirements

(a) The coupler and draftgear shall be designed to accommodate all forces generated under normal operating conditions at all track layout and to withstand all steady state and dynamic forces generated under the specified emergency push out/pull out conditions for all coupler angles.

(b) There shall be no in service failure of any coupling, automatic or bar type, throughout the life of the train, when subjected to the forces mentioned in PS 14.5.3(a).

(c) Compliance with this strength requirement shall be demonstrated by analysis during the design phase and subsequently verified by type test.

(d) The coupler and draftgear shall be suitable for repeated coupling/uncoupling between trains with impact speeds not exceeding 5 km/h and for the emergency train recovery operation as specified in PS 4.4.3.

(e) In the event of adverse service conditions imposing excessively high tensile forces on the automatic coupler, the design shall be such that failure shall ensure a positive interruption of electrical and pneumatic continuity.

(f) The bar couplers shall be designed to ensure that they do not fail before the automatic couplers.

(g) The system shall be designed to ensure that, in the event of a burst hose or similar malfunction, uncoupling of the coupler cannot occur.

14.5.4 Energy Absorption

(a) In addition to the draftgear for normal service operation, the couplers shall incorporate an emergency energy absorption feature which shall operate only when the buffing load exceeds a predetermined level.

(b) The energy absorption capacity and the load at which the emergency energy absorption device begins to operate shall be as high as practicable commensurate with the requirements of PS 6.4.3.

(c) The design of the energy absorption element shall be such that it shall not be caused to operate or to deteriorate in any way under normal train operating conditions.

14.6 Inter-car Gangway

14.6.1 General

(a) Inter-car gangways shall be provided at all car ends except the cab end.

(b) The minimum dimensions of the internal passageway shall be 1500 mm wide and 1800 mm high. The minimum width dimension 1500 mm shall be achieved at any height of the internal passageway.

(c) The gangways shall provide a safe means of passage between cars for standing passengers and staff under all depot and running line operating conditions.

(d) The gangway interior shall be free of any protrusions and devoid of any gaps that may be exposed during gangway movements and which would be a danger to passengers or staff.

(e) The gangway shall be fully weatherproofed.

(f) All gangways shall meet the requirements of the interior design, as specified in PS 7.

(g) The gangway shall withstand the loads and aerodynamic effects encountered in service up to the maximum operating speed without permanent deformation or premature fatigue failure and without any deflection of the gangway internal lining surfaces.

(h) The gangway shall be sufficiently thermally and acoustically insulated to ensure that the overall air conditioning performance (refer to PS 15) and noise performance (refer to RS/C6014/13) of the train are achieved.

(i) The time required to separate a gangway shall be in accordance with the requirements specified in PS 14.3.1(i) and 14.4.3.

(j) The splitting arrangement of the gangway shall be at the middle such that each half gangway is the same.

(k) The gangway shall not interfere with the carbody end structure under normal operations.

(l) If clamping devices are fitted to the gangway at the bar coupler end, they shall be inaccessible to passengers and shall be easily and quickly operable by authorised personnel, without the aid of tools, from track level.

(m) All gangway materials shall meet the fire performance requirements as specified in RS/C6014/08.

(n) The gangway interior design shall be flat along the vertical surface from the ceiling down to the floor level in order to avoid any protrusion from obstructing the standing passengers.

14.6.2 Gangway Floor

(a) The interior and the floor surface shall match with that of the saloon as far as possible.

(b) When the train is in service there shall not be any interruption of the walking floor level which would present a hazard to passengers or staff.

(c) The flooring shall be provided with an anti-slip surface.

(d) If there is any movement between floor sheets, easily replaceable wear pads shall be incorporated to take up any abrasion wear.

(e) The standing floor shall be strong enough to hold a load of 8 passengers/m^2. The strength calculation shall be submitted for Approval.

14.6.3 Gangway Panel

(a) Gangway panels are required at the gangway internal vertical surfaces and the ceiling.

(b) The gangway panels shall meet the following requirements:

(i) The surface of the panel shall match to the saloon panel surface and the styling shall be in accordance with Interior and Exterior Styling Schedule (Appendix L).

(ii) The panel surface shall be easily clean.

(iii) It shall not obstruct the operator's view when coupling from the hostler position.

(iv) It shall not cause any injury to the passenger when the train is in motion.

14.6.4 Flexible Rubber Element

(a) The stiffness of any flexible rubber elements used on the floor and the passage sides shall provide sufficient support to passengers under all operating conditions.

(b) The design shall not allow any water accumulated inside.

(c) The life of the flexible rubber element shall not be less than the mid-life period of the train

SECTION 15

AIR CONDITIONING AND VENTILATION

August 2015

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15 AIR CONDITIONING AND VENTILATION

15.1 System Requirements

15.2 Saloon Air Conditioning System Requirements

15.3 General Requirements

15.4 Design Conditions

15.5 Cooling Load Estimate

15.6 Supply Air Distribution

15.7 Emergency Mechanical Ventilation System

15.8 Equipment Ventilation

15.9 Smoke Detection

15.10 Control

15.11 Temperature Settings and Control

15.12 Control Equipment and Pressure Control Panel

15.13 Constructional Requirements and Mounting Details

15.14 Compressor

15.15 Refrigerant Circuit

15.16 Condensate Drainage

15.17 Ventilation and Condenser Fans

15.18 Ducting

15.19 Air Filter

15.20 Noise and Vibration

15.21 Cab Air Conditioning System Requirements

15.22 Car End Ventilation Fans

15 AIR CONDITIONING AND VENTILATION

15.1 System Requirements

15.1.1 The system shall comprise saloon air conditioning, emergency mechanical ventilation, equipment ventilation and cab air conditioning.

15.1.2 The Contractor shall propose and submit the type and number of air conditioning units per car for Approval taking into account, but not be limited to, the requirements of cooling performance, noise, RAM requirements, space and saloon ceiling heights.

15.1.3 The Contractor shall submit the system design supported by schematic layouts, equipment sizing and selection, air flow distributions, cooling load estimation and psychometric charts to meet the saloon environmental requirements including, but not be limited to, temperature, relative humidity and noise requirements.

15.1.4 The air conditioning system shall be powered from the auxiliary electrical supplies (refer to PS 17) including normal and emergency operations. In order to reduce the inrush current required from the auxiliary electrical supplies during compressor operation, the Contractor shall submit the staggering start arrangement of the air conditioning units of the train (refer to PS 10.5.5 (f)) for Approval. The staggering start design shall allow only one out of all air conditioning units powered from the same auxiliary electrical supply to be started at specified time window. The inrush current of the air conditioning unit shall return back to nominal current value before the next air conditioning unit shall allow to be started.

15.1.5 Start up and shut down of the system shall be in accordance with PS 9.2 and PS 9.3.

15.1.6 The Contractor shall carry out the Type and Routine tests in accordance with the requirements of PS 22 and Appendix C.

15.2 Saloon Air Conditioning System Requirements

15.2.1 The system shall be capable to achieve the saloon design condition as specified in PS 15.4.2 throughout the life of the car.

15.2.2 The minimum cooling capacity shall not less than 84 kW per car.

15.2.3 The air conditioning unit shall be capable of operation at maximum rated capacity with external ambient temperatures up to 46°C.

15.2.4 The capacity of the air conditioning unit shall not drop by more than 50% with an ambient temperature rise of up to 56 °C.

15.2.5 Unloading facility shall be provided to meet the part load and high pressure unloading conditions (refer to PS 15.10.1 and PS 15.10.5).

15.2.6 The system shall have automatic temperature control via the TMS (refer to PS 15.11.1).

15.2.7 The system shall report the saloon temperature to the TMS (refer to PS 10.3.5 and PS 10.5.5).

15.3 General Requirements

15.3.1 The units shall not infringe the Kinematic Envelope as specified in PS 5.1 under any combinations of operation conditions.

15.3.2 Minimum number of fixings shall be used for installation without requiring any gaskets or sealing compounds between the roof-mounted unit and the car roof.

15.3.3 The system shall be driven by AC motor to the requirements of RS/C6014/02.

15.3.4 Integral modular construction shall be used to facilitate easy and efficient replacement for maintenance (refer to PS 26) within the time specified in PS 25.9.1.

15.3.5 The Contractor shall co-ordinate the supply air outlets and return air grille with the interior fittings to optimise the air conditioning performance while maintaining the train styling.

15.4 Design Conditions

15.4.1 The environmental data shall refer to Section 2 of the GS except as modified in PS 15.4.2 and PS 15.4.3.

15.4.2 Saloon Conditions

(a) The saloon condition of 25 °C 65% RH shall be achieved for the trains operating under conditions specified in PS 15.4.3(a) and PS 15.4.3(b).

(b) The Contractor shall submit the saloon condition for the trains operating under the congested tunnel condition specified in PS 15.4.3(c).

15.4.3 Ambient Conditions

(a) The outside condition for open section shall be 32 °C 75% RH. °

(b) The normal tunnel condition shall be 35 °C 65% RH.

(c) For congested tunnel, the condition for the bulk air surrounding the train shall be 40 °C 40% RH while local to condenser of the air ° conditioning unit shall be 46 °C 40% RH.

15.5 Cooling Load Estimate

15.5.1 The Contractor shall carry out cooling load estimates for all conditions with the use of internationally recognised reference data.

15.5.2 The air conditioning units shall be sized to cater for fully laden (M4) condition as specified in PS 4.5.4 with all equipment being operated.

15.5.3 The Contractor shall take into consideration to allow the effects of door opening and closing at stations and the piston and infiltration effects for the train moving in tunnel.

15.5.4 The sensible and latent thermal emission per person shall be taken as 70 W and 60 W respectively.

15.6 Supply Air Distribution

15.6.1 The Contractor shall carry out the air flow rate and distribution analysis to achieve even distribution of conditioned air throughout the whole length of the saloon including the extreme car ends.

15.6.2 The air distribution shall not produce any dead zone in the saloon.

15.6.3 The saloon shall have a minimum air circulation rate of 3.2 m^3/s within a car.

15.6.4 The saloon fresh air intake rate shall not be less than 0.83 m^3/s per car under all normal modes of operation.

15.6.5 Return air shall be filtered, refer to PS 15.19.

15.6.6 The Contractor shall submit an air flow distribution schematic for Approval.

15.6.7 The Contractor shall submit the air flow measurement procedure for Approval which shall be in accordance with CIBSE or ASHRAE standards or equivalent.

15.6.8 The Contractor shall carry out air flow type and routine tests in accordance with Appendix C.

15.7 Emergency Mechanical Ventilation System

The mechanical ventilation shall be provided in accordance with PS 15.7.1, PS 15.7.2 and PS 15.7.3 which are summarised as the following matrix:

Mode	Cooling	Fresh Air	Return
Ventilation	Not Required	Available	Available
Emergency	Not Required	Full	Not Required
Smoke	Available	Not Required	Full

15.7.1 Ventilation Mode

(a) In the event of failure of an air conditioning unit to provide cooling, the system shall provide mechanical ventilation with normal fresh air intake and return air circulation.

(b) The failure shall be reported to and recorded by the TMS (refer to PS 10.3.6 and PS 10.5.5).

15.7.2 Emergency Mode

(a) In the event of normal supply failure, emergency ventilation (refer to PS 17.1.4) shall be provided and powered from battery (refer to PS 17.4.2).

(b) The emergency ventilation shall inhibit cooling and deliver full (100%) fresh air to the saloon without any recirculation.

(c) The fresh air intake rate per car shall not be less than 2.5 m^3/s.

(d) The air conditioning system shall automatically restore normal operation if power supply returns to normal.

(e) Operation of the emergency mode ventilation shall be reported to and recorded by the TMS (refer to PS 10.3.6 and PS 10.5.5).

15.7.3 Smoke Mode

(a) In the event of smoke being detected intake into saloon by the system, the system shall shut off the fresh air intake and provide a full (100%) recirculation of return air within the saloon.

(b) The system shall maintain supply of cooling to the saloon.

(c) The smoke detection system shall meet the requirements of PS 15.9.

(d) In the event of a loss of the normal power supply or emergency power supply, the dampers system shall default to the mode specified in PS 15.7.3.

(e) Indication for smoke alarm and trigger of dampers shall be provided on local control panel which shall not be visible to the passenger.

(f) The dampers shall be reset by the train operator via the TMS if the system resumes normal (refer to PS 10.5.5).

(g) The dampers shall be capable of being reset locally from the saloon if remote reset has failed.

(h) Operation of the smoke mode ventilation shall be reported to the TMS (refer to PS 10.3.6 and PS 10.5.5).

15.8 Equipment Ventilation

15.8.1 Equipment ventilation shall make use of exhaust air and shall not degrade the air conditioning performance.

15.8.2 The Contractor shall provide ventilation to the ATC cabinet for sufficient cooling of trainborne ATC equipment.

15.8.3 Equipment ventilation shall meet the requirements of RS/C6014/08.

15.9 Smoke Detection

15.9.1 The Contractor shall propose a smoke detection system suitable for railway application.

15.9.2 The detection system shall be designed to give a fast and accurate response with minimised nuisance activation.

15.9.3 The detection system shall be able to distinguish between dusty tunnel environment and other smoke/fume sources such as diesel fumes from smoke being caused by tunnel fire.

15.9.4 Faulty or dirty detector shall be reported to the TMS (refer to PS 10.5.5).

15.9.5 The detection system shall be able to be checked, calibrated and replaced from the saloon including the sensitivity test.

15.9.6 The detection system shall be designed to require no maintenance or adjustment between overhauls of the air conditioning unit.

15.10 Control

15.10.1 High and low pressure cut-out devices shall be provided to shut down operation if the refrigerant pressure exceeds the preset limits.

15.10.2 In the event of high pressure cut-out being activated by malfunction of the air conditioner, means shall be provided to inhibit further operation of the compressor and prevent self-reset of the cut-out device.

15.10.3 In the event of the high pressure being built up due to temporary abnormal high ambient temperature, the system shall unload in accordance with PS 15.10.5 without tripping the compressor MCB and permit the high-cut device to be self reset when conditions resume normal.

15.10.4 The Contractor shall submit all pressure switch settings with the associated conditions.

15.10.5 Compressor unloading device shall be provided to cater for part load conditions and relief of high refrigerant pressure due to the ambient temperature exceeding the tunnel congested temperature as specified in PS 15.4.3.

15.10.6 The Contractor shall submit the unloading arrangement to demonstrate compliance with PS 15.2.3 and PS 15.2.4.

15.10.7 In the event that all conditions revert to normal without malfunction in the system, the unloading device shall be reset and the system shall load up automatically.

15.10.8 The operation of high pressure cut-out device, low pressure cut-out device and compressor unloading device shall be reported to TMS (refer to PS 10.5.5).

15.11 Temperature Settings and Control

15.11.1 The saloon temperature setting shall be controllable through both the TMS (refer to PS 10.5.5) or the local communicating port to the control unit.

15.11.2 Under normal operation, two-stages cooling will be preferred for the saloon air conditioning unit with an on/off differential between each stage shall be approximately 0.5-1 ^{o}C.

15.11.3 High precision type digital thermal probe shall be provided in the return air inlet of each saloon air conditioning unit to sense the saloon temperature.

15.11.4 The thermal probe shall be easily accessible from saloon to facilitate maintenance.

15.11.5 The temperature control shall provide quick and accurate response to achieve the saloon conditions specified in PS 15.4.2 within 30 minutes.

15.11.6 The temperature control shall make full use of the available saloon temperature information to achieve convergent and stable saloon temperature. The Contractor shall submit the temperature control coordination arrangement between two air conditioning units within the same vehicle to achieve PS 15.11.5 for Approval.

15.12 Control Equipment and Pressure Control Panel

15.12.1 The Contractor shall propose the location to contain the control equipment for each air conditioner without affecting the interior styling of the saloon.

15.12.2 The control equipment shall be arranged to prevent overheating and ingress of water and dirt to meet the requirements of RS/C6014/02.

15.12.3 Faults shall be reported to the TMS (refer to PS 10.3.6 and PS 10.5.5) to enable diagnosis via the TMS or locally through a portable PC.

15.12.4 The control shall be achieved by means of modular programmable electronic controller to enable changing of parameters to be downloaded from a portable PC.

15.12.5 The software shall meet the requirements as specified in RS/C6014/05.

15.12.6 All control equipment including the MCB's shall have modular arrangement and shall be able to be accessed from the front panel.

15.12.7 A pressure control panel shall be provided for each air conditioning unit which shall be located for easy maintenance and containing pressure switches and gauges (refer to PS 15.10.1) with refrigerant shut off valves to enable easy replacement.

15.13 Constructional Requirements and Mounting Details

15.13.1 Construction and installation of the system shall meet the requirements of RS/C6014/02.

15.13.2 The air conditioning unit shall be designed and constructed to meet the noise and vibration requirements specified in PS 15.20.

15.13.3 The compressor, emergency ventilation equipment, unloading device, motors and pressure switches shall be weatherproof to BS EN 60529: 1992 IP65.

15.13.4 The emergency ventilation equipment, if required to be installed near the condenser area, the equipment shall require to operate under hot ambient temperature encountered near the condenser area. The reliability of the emergency ventilation equipment would not be affected by the hot ambient conditions.

15.13.5 Connections for electrical and compressed air, if any, shall be designed for quick disconnection.

15.13.6 The connectors shall be arranged to be protected from damage during removal and permit placement on a flat surface, without sacrificing ease of access.

15.13.7 The condenser coil and evaporator coil shall be located so that it can be cleaned using water from the outside by removing the external covers only.

15.13.8 The condenser and evaporator coils, including tubes and fins, shall be constructed from copper.

15.13.9 All external grille shall be designed to prevent water ingress resulting from adverse weather or train washing.

15.13.10 Exhaust grille shall be designed to prevent external outside air to be diffused into the saloon when the train is moving up to the maximum speed.

15.13.11 All mounting rails used inside the control cubicle shall be DIN type to RS/C6014/03.

15.13.12 Lifting lugs shall be provided at suitable positions to achieve balanced lifting.

15.14 Compressor

15.14.1 The compressor shall be semi-hermetic type.

15.14.2 The Contractor shall propose the overheating and overloading protection arrangement for the compressor motors and submit for Approval. The operation of compressor motor overheating and overloading protection device shall be reported to TMS (refer to PS 10.5.5).

15.14.3 Arrangements shall be made to recover any oil lost from, and automatically return it to, the compressor.

15.14.4 Sight glass shall be provided to check the oil level with maximum and minimum levels clearly marked and visible without removing any other components.

15.14.5 The compressor shall not suffer from any damage due to restarting after previously having shut down without carry out pumping down cycle. In the event that the compressor had shut down without carry out pumping down due to loss of auxiliary electrical supplies, the compressor control shall carry out pumping down when auxiliary electrical supplies resumed before the compressor shall be restarted.

15.14.6 Unloading device shall be provided to achieve the requirements as specified in PS 15.11.2 and PS 15.10.5.

15.15 Refrigerant Circuit

15.15.1 A refrigerant of zero ozone depletion potential index in accordance with Montreal Protocol shall be used and the Contractor shall submit details of the proposed refrigerant for Approval.

15.15.2 A sight glass shall be fitted in the refrigerant liquid line to show the refrigerant flow and be visible from the saloon area through an inspection hole.

15.15.3 Non-ferrous and corrosion resistant material shall be used for the associated piping and fittings in the refrigerant circuit.

15.15.4 Screw couplings shall be used for components to be disconnected from the refrigerant circuit for maintenance. Automatic shut off facilities shall be provided with the couplings to prevent loss of refrigerant for the disconnection. The components required screw couplings and automatic shut off facilities shall include pressure switches and gauges at the pressure control panel (refer to PS 15.12.7), dehydration device (refer to

PS 15.15.6) and thermal expansion valves. All other connections shall be of a permanent type.

15.15.5 The refrigeration piping system shall be effectively dehydrated prior to charging.

15.15.6 A dehydration device shall be installed in the refrigerant circuit and shall have sufficient capacity to absorb any moisture entering the system during overhaul. The dehydrator shall not require servicing between overhauls. The dehydration device shall be positioned at easy accessible location with refrigerant shut off valves to enable easy replacement.

15.15.7 High sensitivity moisture indicator shall be provided with colour change to indicate the status.

15.15.8 Means shall be provided to avoid loss of refrigerant to atmosphere during charging and extraction.

15.15.9 Facilities shall be provided to allow the refrigerant to be pumped down to the liquid receiver before shut down of the system (refer to PS 9.3.2).

15.16 Condensate Drainage

15.16.1 The Contractor shall submit the sizing and arrangement of condensate drainage to adequately collect and drain condensate without spillage.

15.16.2 Outlets of the condensate drain shall be arranged to avoid dipping on the running rails.

15.16.3 The Contractor shall take into consideration the drainage arrangement in depot as specified in Clause 2.3 of Appendix I Annex 6.

15.16.4 The roof-mounted unit shall seat on a sealed pan on the roof with cutouts for access from the saloon for maintenance purposes. The cutouts shall be designed to avoid any water getting into the saloon area.

15.16.5 The floors of any wells shall be flat, and without obstruction which could lead to the collection of pools of water. The floors and sides of the wells shall be completely sealed against penetration of water into the saloon.

15.16.6 The exterior of the drain pan and drain pipes shall be insulated to prevent condensation on the cold surface.

15.16.7 The use of flexible hose to connect the drainage pipes from the air conditioning unit to the carbody is not permitted.

15.16.8 The drainage arrangement shall be integrated with the sealed pan design as specified in PS 15.16.4 and shall avoid any blockage by debris.

15.17 Ventilation and Condenser Fans

15.17.1 Fan and motor shall be directly coupled.

15.17.2 No greasing shall be required for any part of the motor and fan coupling.

15.17.3 Each fan and motor assembly shall be dynamically balanced. The supply fan and motor assembly shall comply with balance quality grade G2.5 according to BS ISO 1940 Part 1: 2003.

15.17.4 The assembly shall be tested to BS 848: Part 1: 1997.

15.18 Ducting

15.18.1 The saloon ducting shall be designed to achieve uniform discharge along the whole length of the car as specified in PS 15.6.

15.18.2 The supply air speed shall not exceed 0.5 m/s measured at a level 1600 mm above floor level to avoid discomfort due to direct draughts.

15.18.3 The ducts shall be thermally and acoustically insulated. No condensation shall occur on the duct exterior surfaces, ceiling panel or air supply outlets. The insulation arrangement shall be submitted for Approval.

15.18.4 The ducting installation shall be in accordance with CIBSE or ASHRAE or equivalent in particular the duct leakage requirements.

15.18.5 The Contractor shall carry out type tests to demonstrate compliance with the performance requirements specified in PS 15.18.1, PS 15.18.2 and PS 15.18.4.

15.19 Air Filter

15.19.1 The air filter element shall be non-combustible and manufactured to BS EN 779: 2002 class F8 or better.

15.19.2 The air filter shall provide effective filtering between scheduled maintenance without causing significant increase to air flow resistance.

15.19.3 The air filter element shall be washable type. Disposable filters are not permitted.

15.19.4 Air filters shall be replaceable from inside the saloon without accessing from the roof.

15.19.5 Means shall be provided to avoid soiling of interiors during replacement of air filters.

15.19.6 The air filter shall not be accessible to passengers.

15.19.7 There shall not be any shrinkage of the air filter due to washing or normal use.

15.19.8 Air filters to clean both fresh and recirculated air, shall be provided and located in such a manner that it (they) may be easily replaced/installed from within the saloon or cab by maintenance staff (refer to PS 15.3.4).

15.20 Noise and Vibration

15.20.1 The noise levels of the system shall meet the requirements specified in RS/C6014/13

15.20.2 The system shall be acoustic and vibration isolated to prevent emission of perceptible or objectionable hum, noise or vibration.

15.20.3 In addition to the requirements as specified in PS 15.18.3, in the event that the Contractor considers that acoustic internal duct lining is necessary in order to achieve the noise levels requirements of PS 15.20.1, the Contractor shall provide the duct lining at no extra cost to the Employer to meet the following requirements:

(a) The acoustic internal duct lining, if fitted, shall be mat-faced duct liner with anti-fungus treated and firmly bonded to the duct with a fire resistant adhesive compliance to RS/C6014/08.

(b) The acoustic lining shall not delaminate or be loosened by the air stream or release any fibre to the air stream under normal operating conditions or impart any odour to the supply air even if wet.

(c) The leading edge of the lining exposed directly to the air stream shall be sufficiently protected to prevent erosion, de-lamination and leakage.

15.20.4 The Contractor shall demonstrate that consideration has been given to prevent the acoustic panel, if fitted, for the air conditioning unit from

damage such as accumulation of condensate and ingress of water during in situ cleaning of the unit.

15.20.5 The Contractor shall demonstrate to pass mechanical endurance, vibration and shock type tests to the air conditioning unit.

15.21 Cab Air Conditioning System Requirements

15.21.1 An air conditioning system shall be provided for each cab to achieve the same conditions as specified for the saloon in PS 15.4.2(a).

15.21.2 The system shall have back up from the adjacent saloon air conditioning unit in the event of cab air conditioning unit failure. The arrangement shall be submitted for Approval.

15.21.3 The Contractor shall carry out cooling estimates for the cab in accordance with PS 15.5 except modifying PS 15.5.2 to 2 persons per cab.

15.21.4 The minimum fresh air intake rate shall be taken as 60 m^3/h during all operation modes including emergency. Consideration may be taken to admit fresh air intake to the cab from the treated saloon supply air.

15.21.5 The Contractor shall take into account the heat generated from equipment inside the cab and provide ventilation to the equipment in accordance with PS 15.8.

15.21.6 The exhaust of the equipment ventilation discharging to the cab or saloon areas shall not be allowed.

15.21.7 Emergency ventilation and smoke detection as specified in PS 15.7.2, PS 15.7.3 and PS 15.9 are not required for cab air conditioning.

15.21.8 Charging ports shall be provided for charging and pressure gauge connection purposes.

15.21.9 The supply air outlet shall co-ordinate with the cab interior layout (refer to PS 8.12).

15.21.10 Adjustable louvres, temperature control and air flow control shall be provided as specified in PS 8.12.1 and PS 8.12.2.

15.21.11 Apart from the cab, the supply air shall be delivered to the train extreme end ventilation fans (refer to PS 15.22).

15.22 Car End Ventilation Fans

15.22.1 In order to improve the air flow distribution at the car ends, the Contractor shall provide ventilation fans at train extreme ends and gangway ends. The ventilation fans shall be equipped with swing mechanism to deliver air flow evenly to ensure draught free environment.

15.22.2 The air circulation rate of the ventilation fans shall be not less than $0.2m^3/s$ per car.

15.22.3 The Contractor shall co-ordinate the ventilation fan grille outlet with the interior fittings to optimise the circulation performance while maintaining the train styling (refer to PS 7.5). Train end ceiling panels and gangway ceiling panels shall be provided for maintenance access (refer to PS 7.5.16).

15.22.4 Integral modular construction shall be used to facilitate easy and efficient replacement for maintenance. The design shall allow the car end ventilation fan assembly be removed and installed by one competent maintenance staff within 20 minutes.

15.22.5 The ventilation fans shall be designed to minimise both airborne and structure borne noise. The noise levels shall meet the requirements specified in RS/C6014/13.

15.22.6 The ventilation fans shall meet the requirements of RS/C6014/02 and PS 15.17.

SECTION 16

DOORS

August 2015

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16 DOORS

16.1 General

16.2 Passenger Bodyside Door

16.3 Cab Bodyside Door

16.4 Emergency Door

16.5 Cab/Saloon Partition Door

16.6 Life Expectancy and Maintenance

16.7 Prototypes and Testing

16 DOORS

16.1 General

16.1.1 Layout and Arrangement

(a) Five pairs of electrically powered passenger external sliding doors shall be provided on each side of each car.

(b) One electrically powered single leaf driving cab bodyside door shall be provided on each side of the cab car.

(c) An emergency detrainment door shall be provided at the front of each driving cab (refer to PS 8.16).

(d) A partition door shall be provided between each driving cab and the saloon.

(e) The passenger doors shall be designed to the door pitch specified in Drg. No. C6014-14E/TSEG/010/013.

16.1.2 Construction

(a) Reference in this Section to power supplies means the electrical supply required for door power operation and control functions.

(b) The doors shall be of robust design and construction, capable of withstanding the specified design loadings, and be impact resistant and durable with minimal maintenance requirements.

(c) All components and equipment that are accessible to the passengers during any part of the door operating cycle shall be vandal resistant.

(d) The doors shall be designed to prevent ingress of water in tropical storm conditions and during washing in an automated wash plant.

(e) Gutters shall be provided above all cab bodyside and passenger bodyside doors to protect staff, passengers, saloon and cab interiors, and door operating mechanisms, from water running off the roof.

(f) Under no circumstance shall it be possible for the doors to become jammed or fail to close under any condition of car loading.

16.1.3 Safety

(a) The design of the door system as a whole, together with the interfaces with carbody, shall not cause any injury to the passengers, train operator or station operator under any normal operating conditions. Due consideration shall be given to minimising the possibility of human error causing injury due to mis-operation.

(b) Door control and operating arrangements shall be designed to fail to a safe condition with no hidden failure.

(c) No single component failure shall result in an unsafe failure mode, such as a door being powered open in the absence of a valid "open" command.

(d) The Contractor shall demonstrate, by a combination of attention to the design detail of the leading edge of the door and appropriate actuation and control facilities, the ability of the door systems to reduce the risk of entrapment to a minimum and eliminate the risk of a train being released to start with an obstruction between any door leaves.

(e) The Contractor shall ensure that the doors will be operated within the specified kinematic envelope under all normal operating conditions.

(f) The status of each door shall be monitored by the TMS which shall detect and report emerging door problems (refer to PS 10.5.4).

(g) The door system, in particularly the carbody/ door leaf interface, shall be designed to prevent passenger injury due to the entrapment of body during the movement of the doors.

16.1.4 Acoustic and Vibration

(a) Consideration shall be given in the design of the doors to the overall acoustic performance of the train as specified in RS/C6014/13.

(b) The doors installation shall be quiet in operation and shall be free of all "rattle", "squeak", "whistle", "slamming" and other inappropriate operationally generated noise, or train movement induced noise.

(c) All elements of the doors installation (fixed and moving) shall be sufficiently rigid to avoid generation of noise by panel excitation as a result of train or air movement.

(d) All arrangements for movement shall incorporate noise and vibration control wherever practicable. Details of the proposed noise and vibration

control measures shall be submitted for Approval prior to commencement of fabrication.

16.1.5 The design and operating features of all types of doors shall be submitted for Approval.

16.2 Passenger Bodyside Door

16.2.1 Spatial Arrangement

A clear opening of not less than 1 400 mm wide and 1 920 mm high, shall be provided on each passenger door of each car.

16.2.2 Door Panel Construction

(a) The exterior and interior surfaces of the doors shall be finished in accordance with the agreed external livery and interior design (refer to PS 6 and Appendix L).

(b) The door panel shall be resistant to normal detergents and chemicals such as dilute phosphoric and oxalic acids or similar, used for internal and external car cleaning.

(c) The doors shall be free from surface defects such as dimples, warping, spot welding depressions and blemishes.

(d) The doors shall be provided with fixed flush fitted double glazed windows to the colour specified in PS 6.11 positioned as described in Drg. No. C6014-14E/TSEG/010/013.

(e) The door panel shall be designed to avoid the possibility of any ingress of water into, and the formation of condensate within, the door structure.

(f) No electrical equipment shall be located on any door panel.

(g) The maximum weight of a saloon door panel shall not exceed 50 kg.

(h) The door panel shall be designed to last for the life of the train without major refurbishment required. In designing to achieve this, the Contractor shall give due consideration to the climatic conditions in Hong Kong as described in GS Section 2.

16.2.3 Sealing Arrangement

(a) The sealing arrangement between the door leaves and the carbody shall avoid any finger trapping or causing any injury to passengers during door opening or closing operations.

(b) The doors shall be fully sealed when closed to meet the acoustic requirements as stated in RS/C6014/13 and the water tightness requirement as stated in PS 16.1.2 (d).

(c) The door panel seals shall be designed to avoid excessive wear and tear when the door is moving.

(d) The seals shall not impede operation of the door and they shall have adequate operating clearances and adjustment to ensure that scuffing of the bodyside and panels of the doors does not occur in operation.

(e) The seals shall be securely fixed by an approved means, avoiding the use of loose fasteners or adhesive. They shall be easily replaceable and adjustable and shall not allow the build up of dirt or moisture. All fixings to door seals shall be concealed.

16.2.4 Door Operating Mechanism Construction

(a) All components and systems, such as rollers, racks, gears and pinions, not intended for passengers use, shall be inaccessible to passengers at all times, including during the door operating cycle.

(b) The mechanism shall be simple with the number of moving parts kept to a minimum. The use of driving belt design is not encouraged unless it is proved to be very reliable and with minimal maintenance.

(c) The door mechanism including guides shall be arranged so that no objects can become trapped and prevent door operation.

(d) For all operating modes and under all power supply conditions, door movements shall be smooth, controlled and without jerks or any violent motion.

(e) No part of the doors, door installation, door control systems or any other door system components shall be damaged, or have their service life shortened by repeated or continuous stalling by obstructions, or pushing back of the doors by passengers.

(f) Each mechanism shall be mounted on a rigid frame that can be adjusted for alignment in situ, and removed from the car as an integral unit.

(g) The operating mechanism shall be housed inside the car and the design shall provide for ease of access for maintenance.

16.2.5 Strength

(a) Each door panel, associated mountings and structural support shall, with the door correctly mounted and in the closed position, be capable of meeting the following requirements without permanent deformation, damage or failure:

(i) An inward or an outward force of 3 500 N applied separately at waist level, top and bottom normal to the surface of the panel over a maximum vertical width of 300 mm.

(ii) The maximum deflection resulting from the test (i) above shall not exceed 10 mm at any point on the frame.

(iii) After test (i) above, the door shall be immediately capable of normal operation.

(iv) A downward vertical force of 2 000 N distributed across and applied onto the lower edge of the window aperture.

(v) During test (iv) above, there shall be no apparent damage or displacement of the window and the glazed parts of the door shall remain intact and in position throughout application and removal of load.

(vi) The effect of pressure pulses as specified in PS 6.11.3.

(b) Each door panel, associated mountings and structural support shall, with the door correctly mounted and in the closed position, be capable of withstanding a uniformly distributed load of 8.5 kN/m2 over the door panel area without failure.

(c) Displacement of door panel from the door suspension and door panel delamination shall not occur in the above conditions.

16.2.6 Door Control Unit

(a) Each door shall be provided with a door control unit for local control and monitoring. The purpose of the door control unit is to provide the local control for door operation and a central connection point for door sensors and door drive.

(b) The door control unit shall provide all the logic and operational control upon receipt of:

EITHER the hardwired command signals from the door controls in the active cab.

OR the coded command signals from the TMS communication link

(c) The hardwired command signals to the door control unit shall include:

(i) DOORS OPEN
A hardwired signal from the active cab door controls to initiate the door open procedure in accordance with the PS 16.2.6(e). The open signal from the active cab shall be initiated from the door open pushbutton in conjunction with the ATC DOOR ENABLE SIGNAL (refer to Appendix I Annex 3 and PS 9.8). The DOORS OPEN signal shall be latched until DOORS CLOSE signal is received.

(ii) DOORS CLOSE
A hardwired signal from the active cab door controls to initiate the door close procedure in accordance with the PS 16.2.6(e). The close signal from the active cab shall be initiated from the door close pushbutton (refer to PS 9.8.8). The DOORS CLOSE signal shall be latched until DOORS OPEN signal is received.

(iii) ZERO VELOCITY
This signal will be initiated from the ATC system under the train conditions as specified in PS 9.8.13.

(d) The coded command signals from the TMS communication link to the door control unit shall include the maintenance of door operational parameters (refer to PS 16.2.12 and PS 16.2.13).

(e) Assuming that the doorset has not been isolated and the Door Bypass Switch has not been operated, the door control unit shall open or close the corresponding doorset in accordance with the following conditions:

Hardwire Commands			Next Door State
ZERO VELOCITY	OPEN (Active Cab)	CLOSE (Active Cab)	
1	1	0	OPEN
1	0	1	CLOSE
0	X	X	CLOSE

"1" means the corresponding command is requested.
"0" means the corresponding command is forbidden. "X" means don't care.

(f) The door control unit shall validate the logic of various command signals and report any fault to the TMS. For example:

Commands		Door State	Remark
OPEN	CLOSE		
1	1	As previous state	Report fault to the TMS
0	0	As previous state	

"1" means the corresponding command is requested. "0" means the corresponding command is forbidden.

(g) The Contractor shall provide all the alarm and condition monitoring of all applicable system components in order to observe system performance, and fault diagnostics and aid the timely provision of preventive maintenance as necessary to comply with the door system performance requirements described in the PS. The Contractor shall submit the monitoring parameters for Approval.

(h) The Contractor shall provide the facility for local interrogation via a serial link at each doorset, by the use of portable computer. Details and performance of the serial link shall refer to RS/C6014/01.

(i) Each door control unit shall process and transmit the operational monitoring signals to the TMS via the communication link (refer to RS/C6014/01).

(j) Each doorset shall send a door FULLY CLOSED signal to the Door Proving Loop as specified in PS 16.2.9(f) under all conditions irrespective of the door isolation device status (refer to PS 16.2.8).

(k) The door control unit shall have a self test function on power up that can check the system healthiness (refer to PS 16.2.13(b)). It shall be able to provide indication of alarm status should any irregularities be detected. The results of the self test (including the alarm status if there are irregularities detected from the door control units) shall be reported to the TMS via the communication link.

(l) The door control unit shall command the door to be powered closed when the door is opened illegally whilst the train is in motion. A fault signal shall be sent to the TMS (refer to PS 16.2.13(f)).

16.2.7 Mechanical Lock

(a) Each door shall incorporate a heavy duty lock which engages automatically when the door is fully closed, irrespective of the availability of power.

(b) The lock shall positively engage both door leaves and be able to release automatically when the door open controls are legitimately operated or when the manual release device is operated (refer to PS 16.2.10).

(c) The operation of the lock relative to the door opening cycle shall ensure release before the commencement of the cycle and engagement on closure, with or without the availability of power.

(d) When the lock is released, it shall be possible to manual push/slide open the door from inside or outside the saloon.

(e) The door leading edge seals shall be configured in such a way, utilizing interlocking mating arrangements, that the locking devices shall not engage in the presence of small obstruction of minimum thickness 10 mm at any height of application using the measurement gauge as shown in the Drg. No. C6014-14E/TSEG/100/026.

(f) Mechanical lock shall be fitted with a sensor to prove that the door is locked. The status of the mechanical lock shall be monitored by the TMS, irrespective of the door isolation device status (refer to PS 16.2.8(e)).

(g) The mechanical lock shall not require lubrication between overhauls.

(h) The mechanical lock shall be spring loaded in the engaged position.

16.2.8 Door Isolation Device

(a) Each door shall be fitted with a manual door isolation device which shall isolate the door drive from the power supply when operated with an approved key.

(b) Operation of the door isolation device shall isolate the corresponding door such that the door control unit shall not respond to any door open or close control commands.

(c) Operation of the door isolation device shall disrupt the communication between the door control unit and the TMS.

(d) The door isolation device shall be accessible from inside the saloon without removing or opening any interior panels.

(e) Irrespective of the door isolation device status, the status of the door isolation device and the mechanical lock shall be monitored by the TMS.

16.2.9 Door Sensors

(a) Door close sensor shall be provided for door leaf which shall provide a positive door closed indication only when the gap between the door leaves is less than 10 mm. This requirement shall be verified by using the measurement gauge as shown in the Drg. No. C6014-14E/TSEG/100/026.

(b) Door encoder shall be provided to provide the positioning of the door leaves from the fully opened position up to the fully closed position.

(c) The sensors shall be positioned such that they are not affected by lateral or longitudinal displacement of the door by normal wear of any part of the door in service.

(d) A doorset shall be defined FULLY CLOSED when:

(i) both door leaves are proved closed as indicated by the door close sensor, and

(ii) the mechanical lock is engaged as indicated by the mechanical lock sensor (refer to PS 16.2.7(f)).

(e) A doorset shall be defined FULLY OPENED when both door leaves are proved fully opened as indicated by the door encoder.

(f) The doorset shall send a door FULLY CLOSED signal to the Door Proving Loop (refer to PS 9.9.7) when the door is FULLY CLOSED as defined in PS 16.2.9(d) under all conditions irrespective of the door isolation device status (refer to PS 16.2.8).

(g) The reliability of the door sensors shall ensure that no more than one incident occurred (refer to PS 25.7.1) as a result of door sensor failure per year for the whole fleet.

16.2.10 Manual Release

(a) An interior manual release device shall be fitted to each door gear and shall comply with the following requirements:

(i) It shall be operable from inside the car.

(ii) It shall not be accessible by passengers.

(iii) The device shall be flush mounted at the door pillar with a panel cover to be opened using an approved key.

(iv) When the device is operated, it shall release the mechanical lock. The Door Proving Loop (refer to PS 9.9.7) shall be interrupted as a result of the release of the mechanical lock (refer to PS 16.2.9(f)).

(v) When the device is reset, it shall send a close command to the corresponding door control unit to close the door automatically.

(vi) Operation of the device shall enable the door to be manually opened or closed easily by a normal 5th percentile Hong Kong Chinese female.

(vii) The status of the device shall be monitored by the TMS via the door control unit.

(b) An exterior manual release device shall be fitted to control the middle door on each side of the carbody and shall meet the following requirements:

(i) It shall not be operated or damaged by automated train washing plant.

(ii) It shall be operable manually without the necessity to use any key or tools.

(iii) The device shall be positioned on the carbody beyond the opened middle passenger door such that it is safe to operate from track level (refer to Drg. No. C6014-14E/TSEG/010/013).

(iv) The operation of the device shall achieve the same functions as stated in PS 16.2.10 (a) (iv), (v), (vi) and (vii).

16.2.11 Bodyside Indicator Light

(a) On each side of each car, a lamp of tamper proof design shall be provided which shall lit or flash (refer to PS 9.9.7(e)(iv)) when:

(i) any door is not proved fully closed (refer to PS 16.2.9(d) on that car, or

(ii) any internal/ external manual release device is operated on that car, or

(iii) any passenger alarm device is operated on that car.

(b) The sealing of the indicator shall be protected to BS EN 60529: 1992 IP65.

(c) The brightness, size and location of the illuminated bodyside indicator light shall ensure clear visibility, through the Platform Screen Doors, from any position on the platform.

(d) All the lights on one side shall be visible down the length of the train, on straight track, when viewed from either cab side door position on that side of the train.

16.2.12 Door Opening and Closing Profiles

(a) Door Open/ Close Speed

(i) The two door panels at each doorway shall be synchronously controlled to give equal distance of opening from the door centre line throughout the operation.

(ii) All timings specified relate to the open and close times for the door system as a whole, the times being measured from the activation of the door actuation device to the completion of the movement of the door panel.

(iii) The passenger doors shall open fully within 2.5 seconds. The opening shall be programmable between 2.0 to 3.5 seconds. The door shall close fully within 3.5 seconds. The closing shall be programmable between 2.5 to 4.0 seconds. The velocity and the panel mass shall be limited by dynamic safety considerations.

(iv) The limiting maximum velocity shall be 0.5 m/s for the door leaf open/ close speed. Final value shall be dependent on the Contractor's design for dynamic safety.

(v) The design parameters, including the speeds, acceleration or deceleration, shall be easily adjustable by the maintenance staff

through the TMS remotely from the driver's console via the Train Communication Network, and through the door control unit via the serial link.

(vi) Door opening and closing parameters shall not be drifted and shall be maintained at the preset values between overhaul periods.

(b) Door Closing Force

(i) The end of the door opening and closing strokes shall be safely damped.

(ii) The maximum door closing force shall be less than 150 N at a shoulder breath of 95th percentile Hong Kong Chinese male till the end of door travel. The door closing force shall be measured by a device and method according to BS EN 14752: 2005.

(iii) The door closing force during the movement shall be carefully designed to ensure that the door can be fully closed under crush laden conditions whilst not introduce excessive force onto the passengers.

(iv) The design parameters mentioned in PS 6.2.12(b)(ii) above, including the normal force, the reduced force and the location where it is applied, shall be easily adjustable by the maintenance staff through the TMS remotely from the driver's console via the Train Communication Network, and through the door control unit via the serial link.

(v) The door closing force shall be removed when an obstacle is detected and shall be rebuilt after a predetermined time or once the obstacle is removed (refer to PS 16.2.13(e)).

(c) Door Open/ Close Delay

(i) Door open and door close delay times shall be provided as DCU parameters in additional to the door open/ close speed adjustment mentioned in PS 16.2.12(a).

(ii) The adjustable door open time delay shall be programmable in steps of 0.1s from 0 to 5 seconds. The default door open time delay shall be 0 second. This door open time delay shall only be applicable when the doors open from a fully closed and locked condition (refer to PS 9.8.7).

(iii) The adjustable door close time delay shall be programmable in steps of 0.1s from 0 to 5 seconds. The default door close time delay shall be 3 second (refer to PS 9.8.8).

(d) The Contractor shall demonstrate the following:

(i) The effectiveness and safety of the opening and closing cycles;

(ii) Appropriate diagrams, supported by tests results, to detail the relationship between the door velocity, acceleration, deceleration, kinetic energy, force and the door position in the operating cycles.

(iii) Particular attention shall be paid to zones of acceleration in terms of dynamic loadings to the door operating equipment and the kinetic energy to be dissipated in the event of a door leaf meeting an obstruction.

16.2.13 Protection Logic

(a) The door system shall be provided with protective systems to cater for probable faults or failures. This Section provides details of the primary protective systems that shall be inherently part of the operational procedure.

(b) Startup /Shutdown Logic

(i) The door system shall shutdown in response to designed trips or equipment failure in a safe and orderly fashion so as to ensure minimum disruption to the system operation.

(ii) Automatic startup equipment check shall be conducted to ensure that the door system returns to service in an orderly fashion.

(iii) The door system shall be returned to the DOOR CLOSED state during startup.

(iv) Any failure found in the automatic startup test shall be reported to the TMS.

(c) Failure to Close

In the event that the ALL DOORS CLOSED signal is not confirmed for a predetermined time period after the initiation of the DOOR CLOSE command signal by the train operator, a fault signal shall be reported to

the TMS. The train shall be prevented from leaving unless the Door Proving Loop Cut Out Switch is operated (refer to PS 8.10.2).

(d) Failure to Open

In the event that the DOOR OPENED signal (refer to PS 16.2.9(e)) is not confirmed for a predetermined time period after the initiation of the DOOR OPEN signal by the train operator, a warning signal shall be sent to the TMS.

(e) Obstruction Detection

(i) Upon encountering an obstruction, the corresponding door shall stop and back off by a predetermined amount and allow a push back by personnel to occur of up to full open width with reduced opposing force and reclose automatically after a predetermined period of time. Restoration of the closing force shall not result in a slamming action of the doors. This action shall be repeated until the obstruction is removed or a predetermined number of re-closing attempts has been reached, after which the door(s) which have not proved FULLY CLOSED (refer to PS 16.2.9(d)) shall remain in stalled position and a fault signal shall be reported to the TMS. The train shall be prevented from leaving and thus attracting the attention of the train operator to take appropriate action.

(ii) The obstruction detection function as specified in PS 16.2.13(e)(i) shall be operative upon the presence of small obstruction of thickness 10 mm or greater at any height of application using the measurement gauge as shown in the Drg. No. C6014-14E/TSEG/100/026.

(iii) The method proposed for preclusion of entrapment shall be drive resistive sensing. Leading edge design is not encouraged unless it is proved to be very reliable and maintenance free.

(iv) The design parameters mentioned in PS 16.2.13 (e) (i) above, including the back off distance, reduced closing force, waiting time and the number of re-closing attempts, shall be easily adjustable by the maintenance staff through the TMS remotely from the Train Operator Console via the Train Communication Network, and through the door control unit via the serial link. The default number of re-closing attempt shall be zero.

(f) Door Opened Illegally

If the DOOR CLOSED signal is removed when the door system is not in the open procedure in accordance with the PS 16.2.6(e) under the situation that the door is opened illegally whilst the train is in motion, the door control unit shall command the door to be powered closed. A fault signal shall be sent to the TMS.

(g) System Failure

Under a full system failure due to loss of power, or control failure, any open doors shall return safely to the closed position without the need for staff intervention. Manual release device as specified in PS 16.2.10 shall be operated to open the door.

16.2.14 Obstacle Removal Force

An obstacle with maximum dimensions of 10 mm x 50 mm (refer to Drg. No. C6014-14E/TSEG/100/027) trapped with its long edge vertically between the leading door edge shall be withdrawn slowly in outward direction with a force not higher than 150 N, measured perpendicularly to the door surface. Alternatively, the door shall not be indicated closed and locked. The requirement shall be verified at the middle position of the door only.

16.3 Cab Bodyside Door

16.3.1 A single leaf driving cab door of a similar mechanism (e.g. sliding door or sliding plug door) to the passenger bodyside doors shall be provided, with at least 600mm clear width and 1950 mm clear height, for each side of the cab.

16.3.2 Other than the size requirements, the construction method and features of the cab bodyside door shall be the same as those specified for the passenger bodyside doors in PS 16.2.2 to PS 16.2.9 inclusive.

16.3.3 Control

(a) Interior Control

The cab door control push-buttons shall be provided inside the driving cab (refer to PS 8.10.4 and PS 8.11.3).

(b) Exterior Control

(i) A device shall be provided adjacent to each cab door on the car exterior, at a position that is accessible from the platform, the track or from the depressed floor in the depot.

(ii) The operation of the device shall achieve the same functions as stated in PS 16.2.10(b).

16.3.4 A manual release device shall be fitted inside the cab for each cab door and fulfils the following requirements:

(a) It shall not require any key to operate.

(b) The operation of the device shall achieve the same functions as stated in PS 16.2.10(a)(iv), (v), (vi) and (vii).

(c) No component failure shall inhibit manual opening of any individual door when the release mechanism is operated.

16.4 Emergency Door

An emergency door shall be fitted to the front of the cab as specified in PS 8.16.

16.5 Cab/Saloon Partition Door

16.5.1 General Arrangement

(a) The cab to saloon door is a double door located in the centre of the cab rear bulkhead to permit access between the cab and the saloon.

(b) The doorway shall have a clear width of 960 mm with the door leaves opening into the cab.

(c) The door shall not be forced open or prevented from opening due to pressure of passengers.

16.5.2 Opening

(a) One door leaf (the master leaf) shall normally be kept closed with the other leaf (the secondary leaf) secured to it by a suitable arrangement.

(b) The secondary leaf shall be opened into the cab by the operation of a handle on the secondary leaf from the cab side or by an approved key from the saloon side.

(c) Provision shall be made to permit a passenger to open both door leaves from the saloon, in the event of emergency, by the pulling out of an emergency access panel on the master leaf and operate a door handle through the opening.

(d) The door handle shall be visible to the passenger after the emergency access panel was pulled out. Proper signage shall be provided on the master leaf (saloon side) to give opening instruction of the cab/ saloon partition door.

(e) The emergency access panel shall be pulled out by a force of 80 - 200 N.

(f) Refitting of the emergency access panel shall be done in 5 minutes by one competent maintenance staff.

16.5.3 The cab main light shall be turned on automatically when the cab/ saloon partition door is opened.

16.6 Life Expectancy and Maintenance

16.6.1 The doors shall not require maintenance, adjustment or resetting between overhauls (refer to PS 27).

16.6.2 The design life of the doors system as a whole shall be equal to the life of the train.

16.7 Prototypes and Testing

16.7.1 Fully operational prototype for two passenger bodyside doors, two cab bodyside doors, one cab/ saloon partition door and one emergency door shall be constructed in the cab and saloon mock-up (refer to PS 7.2 and PS 8.2).

16.7.2 The prototypes shall be constructed to demonstrate the appearance and operation of complete door installations. In this respect the trial installation is required to reflect, as far as possible, the conditions and support arrangements in the train. The prototypes shall incorporate all fixings, ironmongery, seals, finishes attachments, details and appurtenances to fully reflect the "as-installed" condition.

16.7.3 Testing shall be conducted in accordance with Appendix C Clause 2.11.

16.7.4 Testing procedures submitted shall demonstrate all the safety related facilities of the doors installation,

SECTION 17

AUXILIARY ELECTRICAL SUPPLY

August 2015

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17 AUXILIARY ELECTRICAL SUPPLY

17.1 General

17.2 Auxiliary Converters

17.3 Alternating Current (AC) Circuit

17.4 Direct Current (DC) Circuit

17 AUXILIARY ELECTRICAL SUPPLY

17.1 General

17.1.1 Apart from the traction equipment (refer to PS 11), the electrical power supplies of the other electrical equipment, such as the auxiliary converters (refer to PS 17.2) and air compressor, if it is not driven by an alternating current (AC) motor (refer to PS 13.4.2), utilised by the train shall be derived from the traction supply.

17.1.2 The auxiliary converters and air compressor (if appropriate) shall be independently supplied from the traction supply, via the line contactors. The requirements as stipulated in PS 17.2.3 shall apply to both auxiliary converters and air compressors.

17.1.3 All the auxiliary electrical equipments that are not supplied directly from the traction supply, shall be powered from the low voltage auxiliary power supplies provided by the auxiliary converters during normal operation (refer to PS 17.2.1(a)).

17.1.4 All emergency systems which shall include but not be limited to the following systems/equipment:

- friction brake system (refer to PS 11.9),
- communications system (refer to PS 18.1.4),
- interior emergency lighting (refer to PS 7.9),
- saloon smoke detection system (refer to PS 7.18),
- door equipment (refer to PS 16.2.6),
- emergency ventilation (refer to PS 15.7),
- train management system except the EDD and ETND (refer to PS 10.4), and
- DC supplied operation and control circuits (refer to PS 9) including the head and tail lights (refer to PS 9.9.11).

shall continue to operate for at least 1 hour after a power failure due to loss of traction or auxiliary power supply. The proposed list of equipment of the emergency systems shall be submitted for Approval.

17.1.5 Final circuits for the above emergency systems shall be electrically separate from one another and from other circuits.

17.2 Auxiliary Converters

17.2.1 General Requirements

(a) The auxiliary converter shall provide an alternating current (AC) three phase output for supplying the AC circuit (refer to PS 17.3) and a direct current (DC) output through a battery charger (refer to PS 17.4.2(d)) for supplying the DC circuit (refer to PS 17.4).

(b) The AC output provided by the auxiliary converters, shall be such that in the event of one auxiliary converter failure, it shall not cause the loss of more than 1/3 of the saloon lighting and 1/2 of the air conditioning system, in any one car.

(c) The DC output provided by the auxiliary converters, shall be arranged to ensure that neither the control or battery charging supplies are not lost in the event of a failure of an auxiliary converter.

(d) The auxiliary converters shall be adequately rated to enable the supply of an additional load imposed by the trailer car (refer to PS 4.5.1).

(e) All auxiliary converters shall be identical, interchangeable and underframe mounted.

(f) All internal items of the equipment shall be easily accessible and detachable, with the converter "in situ", to facilitate maintenance.

(g) Equipment cases shall be sealed to IP 65 as defined in IEC 60529 : 2001.

(h) The efficiency of the auxiliary converter shall be higher than 80 % for all combinations of load over the full load range except when the total load is less than 10 % of full load.

(i) The auxiliary converter shall be capable of withstanding the full voltage range of the traction supply, as specified in GS Clause 3.1, and still maintain the outputs as specified.

(j) High voltage spikes or transients on the traction supply shall not be transmitted to the auxiliary converter outputs. The auxiliary converter shall not suffer any damage or malfunction, when subjected to surges and transients as specified in BS EN 50155: 2007 and the worst case surges, such as, the surge produced by the traction high speed circuit breaker when rupturing fault currents.

(k) In the event of a failure of the DC output (refer to PS 17.2.1) from the auxiliary converters, the DC circuit (refer to PS 17.4) shall still continue to operate correctly by power automatically supplied from the battery.

(l) The design of the auxiliary converter shall comply with the IEC 61287 Part 1: 2005.

17.2.2 Control Requirements

The starting, stopping and fault resetting control requirements of the auxiliary converters are specified in PS 9.2 and 9.3.

17.2.3 Protection and Cooling

(a) The Contractor shall demonstrate to the satisfaction of the Engineer that adequate protection is provided by the auxiliary converters against fault conditions, such as, overloads, surges and transients.

(b) Cooling System

(i) Semiconductor cooling shall use natural air convection and earthed heatsinks with all surfaces that require insulation enclosed in clean conditions.

(ii) The design life of the cooling system shall not be less than 20 years.

(iii) Cleaning and other maintenance shall not be required at periods of less than 5 years.

17.2.4 Operation Under Fault Conditions

(a) The auxiliary converter shall be automatically isolated from the traction supply line by tripping a line contactor (refer to PS 17.2.6(a)) in the event of general fault conditions, such as current overloads, output over voltage and output frequency out of range.

(b) Only in the event of critical fault conditions, such as, short circuit fault, shall the auxiliary converter be automatically isolated from the traction supply line by rupturing of the fuse (refer to PS 17.2.6(b)).

(c) A reset facility (refer to PS 17.2.2) shall be provided, to enable the auxiliary converter to be re-started after a trip of the line contactor. Repeatedly operating this reset facility shall not cause any damage to the auxiliary converter.

(d) In the event of one auxiliary converter not operating, the DC output shall prevent discharging of the battery (refer to PS 17.2.1(c)).

(e) Failure of an auxiliary converter shall be visually indicated to the train operator in the controlling cab.

17.2.5 Control Electronic Equipment and Software

The generic requirements of control electronic equipment and software for the auxiliary converters are specified in RS/C6014/03 and RS/C6014/05 respectively.

17.2.6 Power Circuit

(a) Line Contactor

(i) Individual line contactors shall be provided to connect each auxiliary converter to the traction supply.

(ii) The line contactors shall be able to operate frequently at the maximum breaking capacity without abnormal or premature deterioration.

(iii) Activation of the individual contactor shall only isolate the associated auxiliary converter.

(b) Fuses

(i) Adequately rated fuses at the traction supply side shall be provided to the auxiliary converters for critical fault isolation.

(ii) These fuses shall be located in a position where the inter-car connections can also be protected.

(c) A manually operated earth and isolation switch shall be provided to facilitate the maintenance personnel with a simple means of isolating the power circuit, discharging all high voltage capacitors to a safe voltage of 50V within 5 minutes and earthing all high voltage equipment.

(d) All high voltage capacitors shall be equipped with a separate discharge paths to ensure they are discharged to 50V within 15 minutes, even without operating the earth and isolation switch (refer to PS 17.2.6(c)).

(e) An isolation transformer shall be provided to isolate the auxiliary converter output and the AC circuits (refer to PS 17.3). The primary and secondary windings of the isolation transformers shall be separated by an earthed screen.

17.2.7 Diagnostic and Fault Logging Facility

(a) The auxiliary converter shall provide self diagnostic and fault logging facilities, to facilitate maintenance for identification of the faulty part down to the LRU level (refer to PS 26.2.5).

(b) A control interface shall be provided between the auxiliary converter and the Train Management System to enable status monitoring of the Train Unit.

17.3 Alternating Current (AC) Circuit

17.3.1 General

(a) The AC output shall be three-phase 50 Hz, 415 V r.m.s. line-line supply regulated to within ± 5 % of the nominal voltage and frequency over the full load range shall be adopted on the AC circuit. Alternatively, three phase AC output of 60 Hz, 440 V r.m.s. line-line supply regulated to within ± 5 % of the nominal voltage and frequency over the full load range will be considered if it is so required for the major AC auxiliary equipment, such as, the air conditioning units.

(b) The linear ratio of voltage and frequency shall be kept constant in order to cater for the load voltage regulation.

(c) The total harmonic distortion shall not exceed 8 % for a balanced full load, with a lagging power factor of 0.85.

(d) The output shall be sinusoidal under all conditions of load.

(e) Each auxiliary converter shall supply half the main lights and one air conditioning unit on each of the 2 or 3 cars.

(f) One of the car auxiliary converter shall normally supply the battery charger.

(g) In the event of a loss of supply from one auxiliary converter, the battery charger supply shall automatically change over to the other auxiliary converter of the Train Unit of train. Definition of Train Unit of train is specified in PS 4.5.1(b).

(h) A similar automatic changeover system shall be provided for any essential loads, such as, the passenger information systems (refer to PS

10.4.2(e), 10.4.3(d), 10.4.4(d) and 10.4.5(d)). The proposed list of equipment of the essential loads shall be submitted for Approval.

(i) The equipment shall be interlocked and controlled to avoid paralleling the outputs of the auxiliary converters, so that the above change over functions are automatically performed.

(j) Fault protection on any equipment fed from the auxiliary converter shall have adequate discrimination to ensure that a fault cannot cause shutdown of one auxiliary converter, followed by shutdown of the second auxiliary converter after the above automatic changeover.

(k) Single phase loads with three phase supply shall be evenly and reasonably distributed among the phases.

(l) The neutral conductor of a single phase circuit shall not be shared with any other circuit.

17.3.2 AC Socket Outlet

(a) To enable the use of portable electrically operated equipment within each driving cab and saloon, each car shall be equipped with a single phase AC switched socket outlet.

(b) The socket outlet shall be mounted within each saloon in a position that is easily accessible to maintenance staff but inaccessible to passengers.

(c) The supply to the AC outlet shall be the regulated and isolated single phase voltage of 220VAC with a rating of 13 A. Detailed requirements of the power socket shall refer to PS 8.10.7.

17.3.3 AC Shore Supply Inlet

(a) To enable the equipment functional test in the depot where no traction supply will be provided, an adequately rated 3 phase AC socket inlet to IEC 60309-1: 2005 with IP 67 shall be provided for each auxiliary converter AC output point to accept the shore supply obtained from a mobile power supply unit (refer to Appendix I Annex 6 Clause 6.3).

(b) One shore supply socket fitted with a full compliment of male contact pins (5 pins: 3PN + E) shall be provided adjacent to the auxiliary converter.

(c) The Contractor shall also supply the mating half of the connector, which shall include a full compliment of female contacts. The minimum quantity shall be 4.

(d) The shore supply shall be electrically interlocked with the auxiliary supply system to ensure that the supply from one system to the other system at the same time will not be possible.

17.4 Direct Current (DC) Circuit

17.4.1 General

(a) The DC output of the auxiliary converter or associated battery charger shall be 110 VDC (nominal) for providing the control supply to the DC circuits and battery charging supply to the battery set (refer to PS 17.4.2(a)).

(b) The DC supply shall be regulated to within ± 5 % of the nominal rated value over the full load range, including no-load.

(c) The ripple voltage content shall not exceed 2% peak to peak under all load conditions.

(d) The DC output of the auxiliary converter shall directly supply a primary DC circuit via a dedicated wire D2 for starting up or back up purpose.

(e) In addition to PS 17.4.1(d) above, the DC output of the auxiliary converter shall also supply a secondary DC circuit which shall be fed by wire D2 via a dedicated wire D1 through a Battery Isolating Contactor.

(f) The Battery Isolating Contactor shall be controlled by a battery voltage monitoring device which shall cause it to drop out and pull in at the voltages as specified below:

The Battery Isolating Contactor shall drop out at 76 V ± 2 V and pick up at 95 V, and these values shall be adjustable over a range of not less than ± 5 V.

(g) The battery charger output shall be monitored by the Train Management System. The voltage of the battery shall be monitored and this signal shall be sent to OCC if the voltage falls below a predefined level.

(h) The DC negative and the neutral of the AC supply shall be separately earthed. The earthing requirements are specified in PS 11.6.11.

17.4.2 Battery Equipment

(a) Battery

(i) The battery shall provide standby power to the equipment of the emergency system (refer to PS 17.1.4).

(ii) The battery shall meet the emergency duties (refer to PS 17.1.4) for a period of 1 hour before its voltage falls below 76 V. The ATC equipment draws 200W permanently from the battery in the shutdown state when the train is parked in the stabling track or without 110V supply from the battery charger. The maximum number of hours for stabling trains is 48 hours. Therefore the capacity of the battery shall be properly sized to meet this requirement.

(iii) The Contractor shall demonstrate that at the end of the declared battery life-time and with the charging system provided, the above emergency duty requirement can still be fulfilled.

(iv) The maximum charging and discharging current that the battery shall withstand without endangering its life and reliability shall not be less than 100 A.

(v) The configuration and arrangement of the battery shall be compatible with the battery box and tray as specified in PS 17.4.2(b).

(b) Battery Box

Design of the battery box shall be complied with RS/C6014/02.

(c) Battery Protection and Isolation

(i) Protection of the battery shall be provided, with adequately rated fuses placed in both the positive and negative poles.

(ii) Battery fuses shall be fitted in a separate box located adjacent to one of the battery boxes and shall enable easy access from track level.

(iii) Back connected fuse holders shall be provided and the battery fuse enclosure shall be sealed to IP 65 in accordance with IEC 60529 : 2001.

(iv) An isolation switch shall be provided inside the battery fuse box to manually disconnect the battery from any car wiring electrically when required.

(v) Facility shall be provided to lock the isolation switch actuator in the isolated position, and also be clearly identifiable when it is operated.

(vi) A low voltage earth bar (refer to PS 11.6.11) shall be provided and located outside the box close to the negative fuse.

(d) Battery Charger

A battery charger shall be provided if it is not an integral part of the auxiliary converter and shall comply with the following requirements:

(i) The battery charger shall be 110 VDC constant voltage type without current limiting function.

(ii) The battery charger shall be simple and robust in design and it shall not require any maintenance at a periods of less than 5 years.

(iii) The battery charger shall be mounted adjacent to the battery boxes (refer to PS 17.4.2(b)).

(iv) The battery charger shall be protected by a 3-phase MCB on the input side and a fuse on the positive output lead.

(v) The battery charger fuse, MCB and diodes and other equipment associated with the circuit shall be mounted within the same equipment case and be easy to access for maintenance.

SECTION 18

COMMUNICATIONS

August 2015

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18 COMMUNICATIONS

18.1 General

18.2 Trainborne Radio

18.3 In-Cab CCTV

18.4 Digital Voice Announcement System and Public Address (DVAS and PA)

18.5 Electronic Information Display System (EIDS)

18.6 Door Chime System

18.7 In-Saloon CCTV

18.8 Provision for Public WiFi Access

18.9 RFID for Trainborne Radio

18.10 RFID Axle Box Temperature Detection System

18 COMMUNICATIONS

18.1 General

18.1.1 Communications equipment shall be provided on train which shall provide an integrated system of audio and data communication between the passengers, train operator, operations control centre (OCC), depot train controller (DTC) and depot control centre (DCC). The way to use the existing communications equipment in the Urban Lines Train is described in the Engineer's Communications Manual which is available for Contractor's reference. Due consideration shall be given to achieve similar way of operation for the various communications equipment.

18.1.2 The following communications equipment shall be provided :

(a) Trainborne Radio to be purchased from the Named Supplier, installed, interfaced, tested and commissioned as stipulated in PS 18.2 and Appendix I Annex 4.

(b) In-Cab CCTV to be purchased from the Named Supplier, installed, interfaced, tested and commissioned as stipulated in PS 18.3 and Appendix I Annex 4.

(c) Digital Voice Announcement System and Public Address including Cabto-Cab Intercom and Passenger Alarm System to be designed, installed, interfaced, tested and commissioned as stipulated in PS 18.4.

(d) Electronic Information Display System (EIDS) Equipment to be free issued (except, EID panels and inter-car connections) by the Employer and to be installed, interfaced, tested and commissioned as stipulated in PS 18.5 and Appendix I Annex 4.

(e) Door Chime System (DCS) to be free issued by the Employer and to be installed, interfaced, tested and commissioned as stipulated in PS 18.6 and Appendix I Annex 4.

(f) In-saloon CCTV to be designed, installed, interfaced, tested and commissioned as stipulated in PS 18.7 and Appendix I Annex 4.

(g) The infrastructure of Pubic WiFi Access to be designed, installed, interfaced, tested and commissioned as stipulated in PS 18.8.

(h) RFID for Trainborne Radio to be purchased from the Named Supplier, installed, interfaced, tested and commissioned as stipulated in PS 18.9 and Appendix I Annex 4.

(i) Trainborne RFID Axle Box Temperature Detection System to be purchased from the Named Supplier, installed, interfaced, tested and commissioned as stipulated in PS 18.10 and Appendix I Annex 4.

18.1.3 All the communications equipment, except the Trainborne Radio, the InCab CCTV, the Door Chime System, the RFID Axle Box Temperature Detection System and the provision of Public WiFi Access, shall include a self test facility that allows automatic checking of the equipment healthiness. The self test facility shall be able to be initiated either by the train operator or by the Train Management System (TMS, refer to PS 10). The result of the self test shall be able to be transmitted to the TMS as described in the automatic train preparation process (refer to PS 10.3.2).

18.1.4 All communications equipment as stipulated in PS 18.1.2, except InCab CCTV, RFID Axle Box Temperature Detection System and the provision of Public WiFi Access, shall remain fully operational in accordance with PS 4.4.5(a) following the loss of traction or auxiliary power supply.

18.2 Trainborne Radio

18.2.1 General

(a) The Contractor shall purchase from the Named Supplier of Trainborne Radio of the Terrestrial Trunked Radio (TETRA) system and install the Trainborne Radio Set (including mobile unit, power supply, control head, interface unit, loudspeakers, handset, and antenna) and associated interconnection cables as stipulated in Appendix I Annex 4.

(b) The Contractor shall ensure that the Trainborne Radio Sets are the same as those operating on the Urban Line Train in terms of functions, operation, performance and interfaces with the trainborne equipment.

(c) The Contractor shall liaise with the Named Supplier of Trainborne Radio to purchase / provide and install all connectors, interfacing plugs and sockets, earthing connections and all associated equipment housings and mounting materials.

(d) The Contractor shall provide accommodation including mountings, equipment cabinets and cable access for installation of all the trainborne radio equipment. Typical dimensions and location of the equipment are detailed in Appendix I Annex 4.

(e) The Contractor shall provide the appropriate d.c. power supplies including the power supply interface and the protection device to the Trainborne Radio Set in accordance with RS/C6014/02. The Contractor shall ensure that the power supply arrangement can fulfill the emergency power supply requirement as stipulated in PS 18.1.4. A time delay off (6 seconds to 60 seconds adjustable) power supply circuit shall be incorporated to maintain the power supply of the Trainborne Radio Set during shutdown and open up operation by the train operator.

(f) The Contractor shall ensure and demonstrate that all the interface requirements as stipulated in Appendix I Annex 4 are satisfied.

(g) The Contractor shall liaise with the Named Supplier of Trainborne Radio for the configuration of the Trainborne Radio Set and shall be responsible for the test and commissioning of all the installed Trainborne Radio Set and associated interconnection cables. Testing shall be conducted to confirm compliance with the Urban Lines, Tung Chung Line and future Kwun Tong Line Extension.

18.2.2 Each driving cab shall be fitted with the Trainborne Radio Set which allows two way communications between the train operator and the Operation Control Centre (OCC) and with the depot controller. The coverage area shall include the Urban Lines, Tung Chung Line, West Island Line, Kwun Tong Line Extension and the four Urban Lines depots (CWD, KBD, TWD and TKD).

18.2.3 The Trainborne Radio Set shall be a closed selective call system that enables a two-way communication between OCC and an individual train or a group of trains.

18.2.4 The Trainborne Radio Set shall enable communication between different trains with OCC acting as the central dispatch, i.e. train operators need to establish call with OCC and then be enabled by OCC to talk to each other.

18.2.5 The Trainborne Radio Set shall enable train-to-portable calls through OCC authorization or patching.

18.2.6 The Trainborne Radio Set shall provide emergency call between OCC and an individual train.

18.2.7 The Trainborne Radio Set shall enable communication with the Employer’s PABX system.

18.2.8 The Trainborne Radio Set shall be able to send and receive status messages and text messages using Short Data Services (SDS) with both English and Chinese characters from OCC to an individual train or a group of trains. A minimum of 100 most recent messages shall be able to be stored on the Trainborne Radio Set.

18.2.9 The Trainborne Radio Set shall be able to receive Centralized Public Announcement (CPA) from OCC and relay the received audio message to the DVAS and PA system for broadcasting to all passengers.

18.2.10 The Trainborne Radio Set shall allow automatic switching of talk groups when trains runs from depots to running lines and vice versa or from running lines to running lines, without intervention of OCC/Depot Operators or train operators.

18.2.11 The Trainborne Radio Set shall allow automatic switching to talk groups created for Fallback Operation Mode of the TETRA System without intervention of train operators, and a message shall be shown on the display of the concerned Trainborne Radio Set to inform the train operators about this talk group switching.

18.2.12 The Trainborne Radio Set shall allow communication with handportable radio units of station operators when the base-station providing radio coverage has changed to operate in local trunking mode.

18.2.13 The Mobile Unit shall use the same system clock as the Central Equipment of the TETRA System.

18.2.14 Once power is available from the train to a Trainborne Radio Set, it shall automatically start-up, register with the Central Equipment and then ready to support radio communication. The Trainborne Radio Sets shall provide air interface encryption (AIE) using the TETRA Encryption Algorithm TEA1 so that they are able to communicate with the existing radio equipment with the same encryption.

18.2.15 The screen of the Trainborne Radio Sets shall have a backlight function for use under conditions with insufficient ambient lighting. Moreover, all information shown on the display of the Trainborne Radio Set shall be visible under direct sunlight.

18.2.16 In case of switching to operate in the Fallback Operation Mode by authorized OCC Operators, all Mobile Units in the railway lines shall automatically switch to the Fallback Operation Mode talk group of the respective lines without manual intervention by the train operators. Passenger trains and Engineering Trains leaving depots to running lines during Fallback Operation Mode shall also automatically switch to the Fallback Operation Mode talk groups.

18.2.17 Each Trainborne Radio Set shall be equipped with an external reset button. On pressing and holding this reset button for 2 seconds, the Trainborne Radio Set shall turn off, restart, and then register with the Central Equipment and successfully pass the authentication of the Central Equipment.

18.2.18 Each Trainborne Radio Set shall have a dedicated call button. Upon pressing this button once by the operator, a call request shall be sent to the concerned OCC Operators, and the call request shall be shown in the Call Queue of the corresponding Dispatcher Workstations.

18.2.19 Each Trainborne Radio Set shall have a dedicated button which enables the user to make emergency call in the current home talk group as well as to the concerned OCC Operators by pressing and holding the button for 2 consecutive seconds.

18.2.20 When the Mobile Units detect no valid radio signal of the Delivered System, they shall give out audio alerts to the operators and an alert sign shall be displayed on the screen.

18.2.21 Separate volume control shall be provided for each handset and the loudspeaker of each Mobile Unit.

The audio shall be outputted to handset and loudspeaker according to the following table:

	Audio output at Handset	Audio output at Loudspeaker
a) Before the handset is lifted	Mute	Yes
b) After the handset is lif ted	Yes	Yes
c) After the handset is r eplaced back to the c radle	Mute	Yes

The volume control shall be provided to handset and loudspeaker according to the following table:

	Volume Control at Handset	Volume Control at Loudspeaker
a) Before the handset is lifted	Volume Control of Handset is not available	Volume Control Button (Control Head)
b) After the handset is lif ted	Volume Control Button (Handset)	Volume Control Button (Loudspeaker)
c) After the handset is r eplaced back to the c radle	Volume Control of Handset is not available	Volume Control Button (Control Head)

Each volume level setting shall be stored in non-volatile memory (e.g. flash memory) such that the setting remains the same when the Trainborne Radio Set is powered down and re-powered up, or reset.

18.2.22 Each Trainborne Radio Set shall accept a “Cab Occupied” signal from the associated train cab of the train. When the “Cab Occupied” signal changes status, the Trainborne Radio Set sends the status change back to the Central Equipment. The Central Equipment shall then use this information to update all relevant databases, including the determination of front and rear cabs of trains.

18.2.23 Three RS-422 data ports shall be provided at each Trainborne Radio Set as shown in the Drawing in Appendix I Annex 4 to support the transmission of SDS messages and packet data from the Trainborne Radio Set to the Central Equipment and vice versa. When conducting commissioning, the notebook computer shall be connected to the Central Equipment via the Employer’s Corporate Data Network (CDN) to demonstrate operation of the data protocol and complete data path from the notebook computer to Trainborne Radio Sets.

18.2.24 Through the TETRA-PABX interface, a user shall be able to use any PABX handset of the Employer to initiate a call to a Mobile Unit using a unique equipment ID assigned to that Mobile Unit. The call shall be fully duplex and can be terminated by either party.

18.2.25 The following items shall be shown on the display of the Trainborne Radio Set:

(a) the TETRA system in which the Trainborne Radio Set is currently subscribed to;

(b) either the Trainborne Radio Set is operating in trunked mode or Direct Mode Operation (DMO);

(c) name of home talk group;

(d) own identity/alias of the Trainborne Radio Set when it is idle or transmitting; and

(e) the identity/alias of the party transmitting when this Trainborne Radio Set is receiving a call.

18.2.26 Through the TETRA-PABX interface, a user shall be able to use a Mobile Unit to initiate a call to a PABX handset using the Employer's PABX dialing plan. The call shall be fully duplex and can be terminated by either party. Such PABX-TETRA calls shall be subject to the following constraints:

(a) A Mobile Unit shall only be allowed to initiate calls to pre-defined PABX extensions;

(b) Only calls initiated by pre-defined PABX extensions shall be accepted by the Delivered System; and

(c) This TETRA-PABX call feature shall be enabled by the concerned TCs prior to call initiation.

18.2.27 Through the TETRA-PABX interface, a user shall be able to use any PABX handset of the Employer to initiate a call to talk groups created for the TETRA system. The call shall be half duplex. Such PABXTETRA talk group calls shall be subject to the following constraints:

(a) Only calls initiated by pre-defined PABX extensions shall be accepted by the Delivered System; and

(b) This TETRA-PABX talk group call feature shall be enabled by the concerned TCs prior to call initiation.

18.2.28 The unique equipment ID of each Trainborne Radio Set shall be directly related to the Car Consist Number (CCN) of the train cab where the Trainborne Radio Set shall be installed. The CCN of each train cab will be assigned by the Engineer.

18.2.29 For all TETRA-PABX calls, the caller identity of PABX telephone set shall be shown on the display of the Mobile Unit and the unique equipment identity of the concerned Train Radio Set/talk group name shall be shown

on the display of the PABX telephone set. This feature shall be applicable to calls initiated by either party.

18.2.30 Each Trainborne Radio Set shall be equipped with a programming port for data updates and configuration changes. Such programming port shall be accessible from the front panel without dismantling of any trainborne equipment / components. Authorized personnel with the programming kit shall be able to modify the configuration as well as load updated data to the Trainborne Radio Set through the programming port.

18.2.31 The Contractor shall install an antenna on the roof of train for each Trainborne Radio Set. The antenna shall be installed according to proper Radio Frequency practice. The antenna specification and installation design shall be submitted to the Engineer for approval.

18.2.32 The Contractor shall ensure that the radio transceiver inside Trainborne Radio Set shall be Type Approved for use in Hong Kong by the Office of the Communications Authority (OFCA) and the relevant type approval certificate shall be submitted to the Engineer for Approval. Manufacturing of equipment of the Trainborne Radio Sets shall only be commenced after type approval is obtained from OFCA.

18.2.33 The Contractor shall apply Radio Licenses from the OFCA and pay the first year License fee for each Trainborne Radio Set supplied.

18.2.34 If the TRS handset is already put off-hook before the call, TRS shall provide a ringing tone upon receiving an Individual Call. The ringing tone shall stop when the Individual Call is established (ready for conversation). The ringing tone sound and level produced shall be the same as that when the handset is placed on-hook.

18.2.35 The Trainborne Radio Sets (except trainborne radio control head) shall be designed for an operating life of 15 years, starting from the date of Certificate of Completion of the Whole of the Works. The trainborne Radio control heads shall be designed for an operating life of 8 years.

18.2.36 The Power-up time of the Trainborne Radio Sets (from power on to fully available for all relevant radio operation specified under the Contract) shall be less than 30 seconds.

18.2.37 The Contractor shall ensure that the Trainborne Radio set has a Mean Time Between Failure (MTBF) figure of not less than the following figures and the logistic failure rate not greater than the figure given in below table.

Item	Equipment	MTBF (hours)	Maximum Logistic Failure Rate (failures per 10,000 hours)
1	Mobile Unit with Control Head & Handset	46,000	0.21739
2	Mobile Unit with Control Head, Handset, Loudspeaker and Train Control Interface Unit	31,000	0.32258
3	Trainborne Antenna	150,000	0.06667

18.2.38 All parts of the Trainborne Radio Sets shall be properly protected from ingress of dust and water according to the following enclosure standards of IEC 60529:

Equip. & Location	IP rating
Equipment outside Train compartments	IP 65
Equipment inside Train compartments except control head of Trainborne Radio Set	IP 55
Control head of Trainborne Radio Set	IP 54

18.3 In-Cab CCTV

18.3.1 General

(a) The Contractor shall purchase from the Named Supplier of In-Cab CCTV and shall provide an industrial graded colour trainborne video display for the In-Cab CCTV System. The Contractor shall install the trainborne video display, trainborne wireless video receiver unit, picture auto on/off control and trainborne power supply unit as stipulated in Appendix I Annex 4.

(b) The Contractor shall liaise with the Named Supplier of In-Cab CCTV to purchase / provide and install all video, control and power cables, all connectors, interfacing plugs and sockets, earthing connections and all associated equipment housings and mounting materials.

(c) The Contractor shall provide accommodation including mountings and cable access for installation of all the trainborne In-Cab CCTV equipment. Typical dimensions and location of the equipment are detailed in Appendix I Annex 4.

(d) The Contractor shall provide the appropriate d.c. power supplies including the power supply interface and the protection device to the trainborne In-Cab CCTV equipment in accordance with RS/C6014/02.

(e) The Contractor shall ensure and demonstrate that all the interface requirements as stipulated in Appendix I Annex 4 are satisfied.

(f) The Contractor shall be responsible for the test and commissioning of all the installed In-Cab CCTV equipment. Testing shall be conducted to confirm compliance in the Urban Lines.

18.3.2 Each driving cab shall be fitted with the In-Cab CCTV system that shall clearly show alighting, boarding and waiting passengers at the platform and the passengers loading and unloading conditions.

18.3.3 Wireless Video Receiver

(a) A wireless video receiver shall be installed in each driving cab which shall be capable of receiving a composite video signal transmitted from the station wireless video transmitter. The composite video signal will be :

(i) Video signal : CCIR (The International Radio Consultative Committee) 625 lines, 2:1 interlace, 50 fields per second

(ii) Colour system : PAL

(iii) Signal voltage : 1 V p-p composite video, composed of 0.3 V sync and 0.7 V peak white

(iv) Impedance : 75 Ω source, termination and line characteristics

(v) Line frequency : 15625 ± 300 Hz

(vi) Colour subcarrier frequency : 4433618.75 ± 5 Hz

(vii) The video modulation will be Frequency Modulation with 6 dB signal bandwidth not less than 24 MHz.

(b) The trainborne wireless video receiver sensitivity shall be adjusted such that the signal margin between the receiving signal level and the receiver

sensitivity shall be maintained at not less than 20 dB for the whole signal coverage area (refer to PS 18.3.4(b)).

(c) The trainborne wireless video receiver shall not be saturated by the transmitting signal even when the train moves to a point such that the distance between the receiver and the transmitter becomes the shortest

(d) The trainborne wireless video receiver shall be able to receive platform picture for both stopped and moving train without visible degradation of picture quality along the signal coverage area. The speed of train at the signal coverage area will be 40 km/h maximum.

(e) The trainborne wireless video receiver shall be directional and facing the normal running direction of train. The reception angle and sensitivity shall be designed to avoid unwanted signal pick up from adjacent tracks and opposite end of platform with reverse coverage but shall be able to cater for curvature of platforms with a typical radius of 1000 m and a minimum radius of 400 m. However, the reception angle shall not be less than 20°, with the sensitivity degraded by 6 dB.

18.3.4 Trainborne Video Display

(a) The trainborne video display shall be viewed clearly by the train operator at both the sitting and standing positions in front of the train operator console.

(b) The trainborne video display shall be automatically blanked to dark level when the train moves out of the signal coverage area by the picture auto on/off control equipment. During the cab is unoccupied, the In-Cab CCTV shall keep to display the platform image if the train is still in the signal coverage area. The signal coverage will be 10 m on the approach to the platform stopping mark and 44 m beyond the headwall. For stations requiring tailwall end coverage (for train movement in reverse direction), an additional signal coverage of 13 m before the tailwall in the platform track section and 44 m beyond the tailwall will be provided. The accuracy of the position control of the picture auto on/off control equipment shall be in accordance with PS 18.3.5(b).

(c) The trainborne video display shall provide fallback control for bypassing the picture auto on/off control equipment to show the picture of the received signal regardless of the location of the train via TMS on-screen commands :

(i) Display Picture On/Off – turn on and off the picture display.

(ii) Auto/Manual Picture Control Selection – toggle between automatic control and manual control of picture display.

(d) The trainborne video display shall be integrated into the driving console (refer to PS 8) and shall also be used to display the In-saloon CCTV images.

(e) The trainborne video display interfaces shall conform to the following requirements :

(i) Displaying the colour picture of the full platform received by the trainborne wireless video receiver.

(ii) Picture controls of the display such as brightness, contrast, and colour balance shall be interfaced with TMS on screen display.

(iii) Automatic Light Control function shall be provided to allow the brightness and contrast of the display to be automatically adapted to different lighting conditions of the driving cab. An indication light showing the current status of the Automatic Light Control function shall be provided.

(iv) The Automatic Light Control function shall be disabled and overridden by the control buttons via TMS on-screen commands.

(v) The warm up time and thus the total display latency shall be less than 1 second for the display to re-display the platform picture when the train moves into a desired coverage area in the platform.

(vi) Configuration of the display shall be able to be performed on site by the built-in On-Screen-Display features or by a portable terminal via a configuration port at the back panel of the display.

(vii) All configuration data shall be stored in non-volatile memory in the display and shall be preserved even after power interruption.

(viii) The performance of the display shall refer to PS 18.7.9 (k) (viii).

(ix) The status of the In-cab CCTV equipment shall be displayed on the TMS screen. The status shall include the light control, microwave reception and equipment self-test.

18.3.5 Picture Auto On/Off Control

(a) The screen of the trainborne video display shall be blanked to dark level by the picture auto on/off control equipment when the train moves out of

the specified signal coverage area. Platform picture shall be shown on the display unit within 1 second when the train moves into the specified signal coverage area.

(b) The accuracy of the position control of the picture auto on/off control equipment shall be +5/-5 m with reference to the specified signal coverage area, provided that the receiving signal is sufficient to allow the platform picture to be always available when the automatic control sets the display on.

(c) A latching mechanism shall be provided to prevent oscillation of the display on/off control switch at the boundary of the signal coverage area.

18.3.6 The overall performance of the trainborne In-Cab CCTV equipment (wireless video receiver, picture auto on/off control and power supply) shall ensure that the input signal to the trainborne video display, both when trains are in motion or stationary within the signal coverage area, shall be :

(a) Picture signal : 0.7 ± 0.1 V

(b) Sync signal : 0.3 ± 0.05 V

(c) Picture-to-Sync ratio : 70 / 30 ± 10%

(d) Pulse-to-Bar ratio :< 5%

(e) 2T pulse response : < 5%

(f) Bar response :< 4%

(g) Frequency response : 50 Hz to 5.5 MHz ± 2 dB with respect to 100 kHz

(h) Signal-to-Noise ratio : 45 dB, weighted in accordance with CCIR 567

(i) Hum : 50 dB below wanted signal

(j) Luminance-to-Chrominance gain inequality : ± 6%

(k) Luminance-to-Chrominance delay inequality : ± 40 ns

(l) Differential gain : < 6%

(m) Differential phase : < 6 degree

(n) Luminance non-linearity : < 6%

18.3.7 The picture quality, stability and operation of the trainborne video display and the operation of the trainborne In-Cab CCTV equipment shall not be affected by the driving cab EMI environment. All In-Cab CCTV equipment shall conform to the EMC requirements as stipulated in RS/C6014/04.

18.3.8 The Contractor shall liaise with the Named Supplier of In-Cab CCTV to obtain the electrical performance and wiring details of all the video and control cables.

18.3.9 Operating Description

(a) Startup

The trainborne In-Cab CCTV equipment and trainborne video display will start to operate as soon as power is available and no initialization process is required.

(b) Normal Operation

(i) Platform pictures will be automatically displayed on the trainborne video display when the train moves into the signal coverage area. The In-saloon CCTV images shall be displayed when the train is out of the signal coverage area.

(ii) Automatic Light Control will be automatically activated to adjust the brightness and contrast of the trainborne video display to adapt to the different lighting conditions in the driving cab. The train operator can manually adjust the picture brightness and contrast by using the manual picture controls via TMS on-screen commands.

(c) Abnormal Operation

(i) In case of failure of the picture auto on/off control equipment, flickering pictures or no picture will be displayed in the coverage area or the display will not be turned off outside the coverage area. The train operator shall be able to override the picture auto on/off control equipment via TMS on-screen commands.

(ii) The display of pictures will be controlled by the train operator via TMS on-screen commands.

18.4 Digital Voice Announcement System and Public Address (DVAS and PA)

18.4.1 General

(a) The Contractor shall provide the DVAS and PA equipment including Cab-to-Cab Intercom and Passenger Alarm system.

(b) All cables, connectors, interfacing plugs and sockets, earthing connections and all associated mounting materials shall be provided by the Contractor.

(c) The Contractor shall provide accommodation including mountings, equipment cabinets and cable access for installation of all the DVAS and PA equipment in accordance with the requirements as stipulated in PS 7 and 8.

(d) The Contractor shall ensure and demonstrate that all the interface requirements as stipulated in Appendix I Annex 4 are satisfied.

(e) The Contractor shall include in his supply, a maintenance terminal and a portable maintenance terminal able to modify / add any pre-recorded announcements in the Digital Voice Announcement Unit.

(f) The Contractor shall ensure and demonstrate that all the interface requirements as stipulated in Appendix I Annex 4 are satisfied.

(g) The Contractor shall be responsible for the test and commissioning of all the installed DVAS and PA equipment. Testing shall be conducted to confirm compliance in the Urban Lines.

18.4.2 The DVAS and PA system shall consist of:

(a) The following equipment, as a minimum, in each driving cab :

(i) A Digital Voice Announcement Unit (DVAU) including the Door Chime Tone Generator;

(ii) A Master Control Panel (MCP) with loudspeaker and microphone;

(iii) An Auxiliary Control Panel (ACP) with loudspeaker and microphone;

(iv) A Public Address Unit with Public Address amplifier;

(v) A D.C. Voltage Regulator Unit; and

(vi) An Interface Unit.

(b) The following equipment, as a minimum, in each car :

(i) Public Address amplifier(s);

(ii) Coving panel mounted loudspeakers; and

(iii) Passenger alarm emergency handles (PAEH) and passenger alarm microphones (number and location refer to PS 7).

18.4.3 The following modes of communication shall be provided by the DVAS and PA:

(a) Public Address (PA) to passengers including :

(i) Manual Broadcasting in which train operator can make live announcements to all passengers.

(ii) Radio Broadcasting in which traffic controller in OCC can made live announcements to all passengers via Trainborne Radio.

(iii) Broadcasting of pre-recorded announcements initiated by the train operator (including the door message and door chime).

(iv) Broadcasting of pre-recorded announcements based on real time information received via the interface with TMS.

(b) Cab-to-Cab Intercom which provides intercom function between the two driving cabs.

(c) Passenger Alarm system which enable half duplex communication between the train operator and passenger who has operated the PAEH(s) via the coving panel mounted loudspeakers and passenger alarm microphone situated adjacent to the activated PAEH(s).

18.4.4 The availability of the different modes of communication in the active and non-active cab shall be :

Communication mode Driving Cab	Public Address *Clause 18.4.3(a) refers*	Cab-to-Cab Intercom *Clause 18.4.3(a) refers*	Passenger Alarm System *Clause 18.4.3(a) refers*
Active Cab	✓	✓	✓
Non-active Cab	✓	✓	×

18.4.5 The different modes of communication (Public Address, Cab-to-Cab Intercom and Passenger Alarm System) shall have different priority as tabulated below :

Priority	Communication Mode	Condition	Response Loudspeakers	
1	Cab-to-Cab Intercom	'Cab/Cab' button pressed on MCP or ACP and 'PTT' button pressed on either microphone	All saloon loudspeakers inactive	
			Active cab	Non-active cab
			MCP loudspeaker active ACP loudspeaker active	MCP loudspeaker active ACP loudspeaker active
2	PA – Manual Broadcasting by train operator	'PTT' button pressed on either microphone on the MCP or ACP	All saloon loudspeakers active	
			Active cab	Non-active cab
			MCP loudspeaker inactive ACP loudspeaker inactive	MCP loudspeaker inactive ACP loudspeaker inactive
3	PA – Broadcasting of pre-recorded	Broadcast the selected pre-recorded emergency	All saloon loudspeakers active	

	emergency announcements initiated by train operator	announcement via MCP or ACP	Active cab	Non-active cab
			MCP loudspeaker active ACP loudspeaker active	MCP loudspeaker inactive ACP loudspeaker inactive
4	Passenger Alarm system	PAEH activated	Only the selected loudspeaker near to the activated PAEH active	
			Active cab	Non-active cab
			MCP loudspeaker active ACP loudspeaker active	MCP loudspeaker inactive ACP loudspeaker inactive
5	CPA – Radio Broadcasting by Communication Coordinator	PA message (individual CPA or group CPA) received via rear cab Train Radio	All saloon loudspeakers active	
			Active cab	Non-active cab
			MCP loudspeaker inactive ACP loudspeaker active	MCP loudspeaker inactive ACP loudspeaker active
6	PA – Broadcasting of pre-recorded special announcements initiated by train operator	Broadcast the selected pre-recorded announcement via MCP or ACP	All saloon loudspeakers active	
			Active cab	Non-active cab
			MCP loudspeaker active ACP loudspeaker active	MCP loudspeaker inactive ACP loudspeaker inactive
7	PA – Broadcasting of pre-recorded announcements based on real time information	Broadcast the appropriate prerecorded announcement	All saloon loudspeakers active	
			Active cab	Non-active cab

	received via interface with TMS		MCP loudspeaker active ACP loudspeaker active	MCP loudspeaker inactive ACP loudspeaker inactive

18.4.6 The first priority communication mode has the highest priority while the seventh priority communication mode has the lowest priority. Higher priority communication mode shall interrupt and stop communication modes with lower priorities (except during broadcasting of pre-recorded emergency messages that shall played repeatedly – the broadcast of emergency messages shall be stopped for those higher priority mode and then continue to be played repeatedly).

18.4.7 The DVAS and PA shall be designed and supplied to meet the constructional and workmanship standard and electrical and electronic design standard as stipulated in RS/C6014/02 and RS/C6014/03.

18.4.8 The stability and operation of the DVAS and PA equipment shall not be affected by the driving cab EMI environment. All DVAS and PA equipment shall conform to the EMC requirements as stipulated in RS/C6014/04.

18.4.9 The DVAS and PA shall have a self test function on power up that checks the system healthiness. The self test function shall only be initiated at active cab. Once the self test is activated, the self test announcement shall keep broadcast even the cab switch to unoccupied. The announcement shall broadcast automatically repeat not less than 4 minutes and shall stop after completion of the whole announcement or stop in the event of either cab being occupied. The self test announcement shall also stop in the event of higher priority audio taken effect. Sensing equipment shall be provided for each power amplifier and coving panel mounted loudspeaker which can check its healthiness (i.e. sound can actually be broadcast to the saloon). It shall be able to provide indication of alarm status should any irregularities be detected. The result of the self test (including the alarm status if there are irregularities detected) shall be reported to the TMS via the interface unit.

18.4.10 The DVAS and PA shall be equipped with automatic sensing and adjustment devices to sample and detect the ambient noise in each saloon and automatically adjust the output level of PA amplifiers in order to maintain the threshold sound level of broadcast messages above that of the ambient noise as stipulated in PS 18.4.19(b).

18.4.11 Manual Broadcasting

The train operator shall be able to make live announcements to passengers via either of the microphone on the MCP or ACP. The 'Press-To-Talk' (PTT) switch on the microphone shall be pressed during the announcement to enable the broadcast to passengers. The response time from keying a button on either MCP or ACP to the establishment of a manual broadcast shall be as short as unnoticeable. From cab occupied to unoccupied, manual broadcasting shall be available until the other end is occupied. Ongoing manual broadcasting shall be stop in the event of either cab being occupied. The manual broadcasting shall not be available in the event of higher priority audio taken effect.

18.4.12 Radio Broadcasting

(a) Communication Coordinator in OCC shall be able to make live announcements to passengers via rear cab Trainborne Radio Set and the corresponding DVAS and PA interface. Once a CPA call is established, the audio shall be directly sent from TETRA System to DVAS and be broadcasted to the train saloon. Broadcasting shall not be terminated unless the CPA call ends, or the concerned Trainborne Radio Set is interrupted due to other urgent radio calls. From cab occupied to unoccupied, CPA call shall be available until the other end is occupied. Ongoing CPA call shall be stop in the event of either cab being occupied. The CPA call shall not be available in the event of higher priority audio taken effect.

(b) A separate indicator in the MCP shall be illuminated during the course of radio broadcasting.

(c) The broadcasting priority shall synchronize the audio and visual passenger information with the priority as specified in PS 18.4.5.

(d) The DVAU at rear cab shall co-ordinate with the DVAU at the front cab for the PA announcement. The acknowledgement signal by the DVAU at rear cab shall be transmitted over the radio bus lines to the DVAU at the front cab.

(e) A voltage free contact will shall be provided to Train Radio unit for cab occupied acknowledgement. The voltage free contact shall be rated at 110Vdc 2A.

The logic of the dry contact will depend on whether it is in the firstly opened up cab or not. A summary is as follows:

	Operation Sequence 1	Operation Sequence 2	Operation Sequence 3	Operation Sequence 4
Firstly opened up cab (Cab A) status	Occupied	Not occupied	Not occupied	Occupied
Firstly opened up cab (Cab B) status	Not occupied	Not occupied	Occupied	Occupied
Dry contact status of Cab A	Opened	Opened	Closed	Closed
Dry contact status of Cab A"	Closed	Closed	Opened	Opened
DVAS Status of Cab A	Master	Master	Slave	Slave
DVAS Status of Cab B	Slave	Slave	Master	Master

18.4.13 Broadcasting of Pre-recorded Announcements

(a) All the pre-recorded announcements shall be stored in the DVAU and shall be able to be selected and generated as audio signal to the PA Unit for broadcasting.

(b) The DVAS and PA shall store, select and broadcast all the required messages for the Urban Lines as well as meeting the expansion requirements as stipulated in PS 18.4.16(d).

(c) There shall be four types of pre-recorded announcements in either Cantonese, Putonghua or English or a combination of either two or three languages stored in the DVAU :

(i) Door messages for all stations, for example "Please stand clear of the doors"

(ii) Station messages for particular stations, for example "The next station is Kwun Tong"

(iii) Special messages, for example "Attention please, there will be a short delay because of train service regulation. Please accept our apologies for any inconvenience caused."

(iv) Emergency messages, for example “Attention please. This train is unable to move because of a technical problem. Please walk to the front of the train. The train operator will escort you to the next station. Please accept our apologies for any inconvenience caused.”

(d) The broadcast of pre-recorded announcements shall be able to be triggered by :

(i) reception of real time station information via the TMS interface and messages shall be automatically broadcast.

(ii) manual selection and activation by the train operator via the MCP or ACP.

(iii) the operation of the door close push button for door message for door closing and door closing chime (refers to section (e) below for details).

(iv) the operation of the door open push button for door message for door opening (refers to section (e) below for details).

(v) the operation of the door announcement button for door message and door chime for door closing. Also the activation of the door message and door chime shall be easily configured (active / inactive, triggered by door announcement button, time delay) via the portable maintenance terminal (refer to PS 18.4.16(h)) or the interface with TMS (refer to PS 18.4.20). During door announcement broadcasting, the continuous broadcasting message shall not be interrupted in the event of pressing the door announcement button again.

(e) On operation of the door close push button (refer to PS 8.8, 8.10 and 8.11), the door closing chime shall be automatically broadcast. The activation of automatic broadcast operation shall be configurable via maintenance terminal. Also the activation of the door closing message and door closing chime shall be easily configured (the parameters shall include active / inactive, triggered by door close push button and time delay) via the portable maintenance terminal (refer to PS 18.4.16(h)) or the interface with TMS (refer to PS 18.4.20).

(f) On operation of the door open push button (refer to PS 8.8, 8.10 and 8.11), the door opening message shall be automatically broadcast. The activation of automatic broadcast operation shall be configurable via maintenance terminal. The activation of the door opening message and

door opening chime shall be easily configured (the parameters shall include active / inactive, triggered by door open push button and time delay) via the portable maintenance terminal (refer to PS 18.4.16(h)) or the interface with TMS (refer to PS 18.4.20).

(g) All the special and emergency messages shall be selected and initiated by the train operator via the MCP. Different indicators shall be provided on the MCP to indicate the broadcast of special and emergency messages.

(h) Emergency messages shall be broadcast repeatedly to the passengers. A ‘reset’ button shall be provided in the MCP to terminate the broadcast of emergency messages. The repeating broadcast of emergency message shall also be terminated if a higher priority communication mode is activated (refer to PS 18.4.5).

(i) The EIDS controllers (refer to PS 10.4.3) and DRM controllers (refer to PS 10.4.2) shall be pre-loaded with all four types of pre-recorded announcements in the DVAS and PA (refer to PS 18.4.13 (c)) in the corresponding textual format. The DVAS and PA shall interface with EIDS Server and DRM, such that the synchronization of audio and textual announcements (in both English and Chinese) shall be achieved such that the message broadcast (either triggered by the train operator or by ATC via TMS) by the DVAS and PA is also displayed by all the EID panels and DRM displays in the corresponding textual format at the same time. This shall be applicable to all types of messages i.e. door, station, special and emergency messages except for those emergency messages requiring detrainment via the emergency door (from the front cab or from both the front and rear cab) as described in (j) below. This audio and textual announcement synchronization feature shall be able to be deactivated via the portable maintenance terminal (refer to PS 18.4.16(h)).

(j) In case detrainment of passengers via the front emergency door is required, an emergency message informing such arrangement shall be able to be selected by the train operator and broadcast to passengers. At the same time, a command shall be sent via the TMS interface and EIDS interface and DRM interface to all the EID panels and DRM displays to stop the display of all other information and show a big red arrow directing passengers to detrain via the front cab emergency door. The word “EMERGENCY EXIT” in both Chinese and English shall also be displayed on the top of the arrow. For detrainment via both the front and rear cab emergency doors, the same arrangement shall be applied except that the EID panels and DRM displays shall show big red arrows directing passengers to detrain via either the front or rear cab emergency doors.

(k) On selecting the correct line and starting station message via the 'line/station select, 'forward' and ‘REVERSE’ button on the MCP (refer to

PS 18.4.17), the train operator shall be able to initiate the broadcasting of the correct station message via the 'STATION MESSAGE' button on either the MCP or ACP. The response time from keying a button on either MCP or ACP to the broadcast of a prerecorded message by the DVAU shall be as short as unnoticeable. After the announcement, the selected message shall be automatically switched to the next station message ready for the next station broadcasting. The sequence and control shall take into account of the turn-around of trains at all the terminus stations.

(l) Real time information including the name of the next station, door opening side and the destination of train shall be received via the TMS interface from the trainborne ATC equipment (refer to Appendix I Annex 3). Based on these information received, correct station messages shall be automatically selected and broadcast. A separate control button and indicator shall be provided on the MCP to activate and indicate the automatic broadcast of pre-recorded announcements triggered by trainborne ATC equipment.

(m) In the event of failure of the automatic broadcast of announcements triggered by trainborne ATC equipment, it shall be possible to program a particular sequence of messages with pre-set time intervals between messages and then manually triggered to be broadcast by the train operator.

(n) A separate button on the MCP and ACP shall be provided that allow the train operator to repeat the broadcast of the previous announcement.

(o) In the event of after change end, DVAU shall repeat the same event and shall broadcast "停車位置正確". This shall only happen when the relevant message is received from TMS before change end. Ongoing "停車位置正確" broadcast shall stop in the event of higher priority audio taken effect. It shall keep broadcast even the cab is unoccupied and no "停車位置正確" broadcast when the train stop at correct position at siding.

(p) All the emergency, special and pre-recorded messages shall only be initiated at active cab. Once the emergency, special or pre-recorded message is initiated, the message broadcast shall continue even when both cabs are non-active. The broadcast shall stop in the event of either cab being occupied. All the emergency, special and pre-recorded messages shall stop in the event of higher priority audio taken effect.

(q) In case the door opening and door closing broadcast as described in PS 18.4.13(e) & PS 18.4.13(f) were set to enable, the corresponding door open or door close message shall broadcast and the corresponding events shall send to DRM and EIDS for 2 seconds in case of either door close or door open push button is pressed. The door announcement shall

also broadcast and send the event to DRM and EIDS for 2 seconds in case of door announcement button is pressed. In case the door opening and door closing broadcast were set to disable, the corresponding door open or door close message shall not broadcast and the corresponding events shall still send to DRM and EIDS for 2 seconds in case of either door close or door open push button is pressed. The door announcement shall still also broadcast and still send the event to DRM and EIDS for 2 seconds in case of door announcement button is pressed. During manual PA, Cab-to-Cab, PAEH or CPA, the DRM and EIDS shall receive the same door open or door close event since there are no specific events for these types of broadcast in case the door opening and door closing broadcast were active. For other announcement including special message, emergency message, next station message and non ATC operational message, it shall replace the event sent to DRM and EIDS according to their priority.

18.4.14 Cab-to-Cab Intercom

(a) The Cab-to-Cab Intercom shall enable two way communications between the two driving cabs. The train operator on either driving cab shall be able to initiate the Cab-to-Cab Intercom function via either the MCP or ACP. The response time from keying a button on either MCP or ACP to the establishment of a Cab-to-Cab Intercom shall be as short as unnoticeable.

(b) A separate indicator shall be provided on both the MCP and ACP to indicate the activation of the Cab-to-Cab Intercom function.

(c) The Cab-to-Cab Intercom shall only be established when one of the mode selector (refer to PS 9.5.2) is moved away from the shutdown position.

18.4.15 Passenger Alarm System

(a) A Passenger Alarm system consisting of PAEH(s), passenger alarm microphones and coving panel mounted loudspeakers shall be provided to enable passengers to alert and communicate with the train operator. The number and location of these equipments shall be in accordance with PS 7.

(b) By pulling any one of the PAEH(s) (refer to PS 7.13) in the saloon, passengers can speak to the train operator immediately via the passenger alarm microphone situated near to the PAEH. Only the passenger alarm microphone situated near to the activated PAEH shall be available for communication. An indication adjacent to the PAEH shall be provided to indicate the operation of the handle. The activation of any PAEH shall interface with the In-Saloon CCTV system, such that the images at the concerned areas shall be automatically displayed on the Trainborne Video Display unit of the In-Saloon CCTV system in the

occupied cab after the acknowledgement by the Train Operator on the TMS display terminal.

(c) A separate indicator in the MCP shall be provided to indicate that PAEH(s) has / have been activated and identification(s) of the activated PAEH(s) shall be displayed on the MCP. The train operator can select the PAEH(s) and initiate talk back to the passenger(s). Only the loudspeaker(s) responsible for coverage of the selected PAEH area(s) shall be activated and the voice of the train operator shall only be broadcast to this loudspeaker(s).

(d) The identification(s) of the activated PAEH shall also be displayed on the TMS display terminal and selection of which alarm to talk back shall also be able to be performed via the TMS display terminal.

(e) In case more than one PAEH(s) have been activated, the list of activated handles shall be displayed and the train operator can select a single handle or multiple handles he wants to talk back.

(f) Any operation of the Passenger Alarm system shall interrupt the door proving loop (refer to PS 9.9.7) and report to the Event Recorder (refer to PS 10.7) via the interface with TMS.

18.4.16 Digital Voice Announcement Unit (DVAU) including the Door Chime Tone Generator

(a) The DVAU shall be of the solid state type and capable of storing announcements in Cantonese, Putonghua and English. All messages in memory shall be randomly and instantly available.

The time taken from the confirmation of any selected message to the resultant message being broadcast in saloon shall be 500 ms maximum. This shall be applicable for all four types of messages, i.e. door, station, special and emergency messages. The total silence time for the separation of broadcast between different languages shall not more than 1 second.

(b) The DVAU shall be able to store a minimum of 90 minutes announcements comprising the following four types of accumulated length of messages :

(i) Door and station message : 45 min

(ii) Special message : 30 min

(iii) Emergency message : 15 min

(c) The DVAU shall be able to be expanded, with the addition of hardware / software, to store another 90 minutes of announcements in the memory. The memory shall be configurable for the allocation of new messages via a portable maintenance terminal.

(d) The stored messages of the DVAU shall be delivered naturally in speech tones and shall meet the following performance :

(i) Bandwidth : 300 Hz - 7 kHz (-3 dB)

(ii) Distortion at 1 kHz : < 1%

(iii) Dynamic range : 80 dB minimum

(e) The door chime tone generator shall be an integral part of the DVAU. The duration of the door chime tone shall be around 3 - 5 seconds to be Approved and shall be adjustable via the portable maintenance terminal (refer to PS 18.4.16(h)).

(f) The DVAU shall not at any time generate any incorrect message and shall not interfere with station PA broadcasts under any circumstances.

(g) A portable maintenance terminal in the form of an IBM compatible portable PC shall be provided such that it enables a technician to customize the DVAU and manage the stored messages. The interface to the DVAU shall employ RS 232 serial interface or other standard industrial interface subject to Approval. It shall also enable the upload / download of digitized messages to the trainborne DVAU. The location of the interface port shall be in the driving cab and be readily accessible.

(h) A message maintenance terminal shall be provided that has the following functions, as a minimum :

(i) Ability to create, delete and record any messages in three different languages of Cantonese, Putonghua and English.

(ii) System configuration and programming.

(iii) Fault diagnosis of the DVAU.

(iv) Downloading / uploading of digitised messages to the portable maintenance terminal via standard RS 232 serial interface or other standard industrial interface subject to Approval.

(v) External audio interfaces for digital recording which shall include microphone, handset and recorder inputs.

18.4.17 Master Control Panel (MCP) with Loudspeaker and Microphone

(a) The MCP shall be located on the driving console as stipulated in PS 8. It shall be able to be accommodated in a space envelope of 140 mm (W) x 230 mm (H) x 60 mm (D) maximum.

(b) It shall be equipped with the following, as a minimum :

(i) 'LINE/STATION SELECT' button - for selection of line and starting station.

(ii) 'ENTER' button - for confirmation of selected action.

(iii) 'STATION MESSAGE' button - for broadcast of station message and increment the announcement sequence.

Once a station message announcement is made (either by pressing the 'STATION MESSAGE' button on the MCP / ACP or triggered automatically by TMS), the display shall then show the next station name to the station just announced rather than the current station name. In addition, if journey information is first received from TMS, the station name displayed shall be the next station but not the current station. After the car change end, the MCP shall display the next station (i.e. at YMT(Yau Ma Tei) change end, it shall display MOK(Mongkok)).

(iv) 'REPEAT' button - for repetition of previous announcement.

On pressing this button the previous station message with respect to the station name being displayed will be broadcast (currently on pressing this button the station message with respect to the station name being displayed will be broadcast).

(v) 'SPECIAL MESSAGE' button - initiates and indicates the broadcast of special message.

(vi) 'EMERGENCY MESSAGE' button - initiates and indicates the broadcast of emergency message.

(vii) 'CAB-TO-CAB INTERCOM' button - initiates and indicates a cabto-cab intercom request.

(viii) 'PASSENGER ALARM EMERGENCY HANDLE' indicator - indicates emergency handle(s) operated.

(ix) 'RADIO BROADCASTING' indicator - indicates radio broadcasting is active.

(x) 'ATC TRIGGERED' button - initiates and indicates automatic broadcast of announcements triggered by ATC.

(xi) 'RESET' button - to cancel the selection and stop the broadcast of emergency message.

(xii) 'FORWARD' and 'REVERSE' buttons - for browse and selection. The buttons shall accept a single strobe pressing or continuous pressing.

Activation	Button	Effect on MCP	Remarks
A single strobe pressing	Forward	Increment message selection one by one	Provide cyclic selections whenever the selection reaches the end of message list. Only message selections with sound files shall be displayed
	Reverse	Decrement message selection one by one	
Continuous Pressing	Forward	Increment message selection at a rate of 5 messages per second.	
	Reverse	Decrement message selection at a rate of 5 messages per second.	

The message rate shall be configurable via the maintenance terminal from 1 message per second to 10 messages per second.

(xiii) 'MESSAGE SCROLL LEFT' and 'MESSAGE SCROLL RIGHT' buttons - to allow scrolling of message content for display on the 4 row LED displays.

(xiv) 'SELF TEST' button - initiates and indicates the self test function.

(xv) Display - a 4 row LED displays capable of displaying the selected line/mode code and station/message code together with the

message content (in English only). Only message code with sound files shall be displayed.

(xvi) Loudspeaker with volume adjustment device. The minimum volume level shall set to an audible level.

(xvii) Microphone with removable socket that can be unplugged and replaced easily.

18.4.18 Auxiliary Control Panel (ACP) with loudspeaker and microphone

(a) The ACP shall be located on the auxiliary driving console as stipulated in PS 8. It shall be able to be accommodated in a space envelope of 140 mm (W) x 230 mm (H) x 60 mm (D) maximum.

(b) It shall be equipped with the following, as a minimum :

(i) 'STATION MESSAGE' button - for broadcast of station message and increment the announcement sequence.

(ii) 'REPEAT' button - for repetition of previous announcement.

(iii) 'CAB-TO-CAB INTERCOM' button - initiates and indicates a cabto-cab intercom request.

(iv) Loudspeaker with volume adjustment device. The minimum volume level shall set to an audible level.

(v) Microphone with removable socket that can be unplugged and replaced easily.

18.4.19 Public Address Unit and Public Address Amplifier

(a) The Public Address Unit shall accept the audio signal from either the DVAU or the microphone and broadcast it to the saloon loudspeakers (except for passenger alarm talkback in which it shall only be transmitted to the selected loudspeaker).

(b) The following performance shall be met :

(i) Sound Pressure Level

The sound pressure level measured in all areas where the train operator or passengers can sit or stand in the driving cab or saloon at a height between 1 metre and 2 metres above the floor level shall be 9 dB ± 1 dB above the ambient noise measured at the

same area and height range. This Sound Pressure Level parameter shall be able to be adjusted by means of the portable maintenance terminal.

(ii) Differential Sound Pressure Level

The Sound Pressure Level between maximum and minimum along the length of each saloon measured as in (i) above shall not be greater than 3 dB within each saloon.

(iii) Bandwidth : 50 Hz to 7kHz (-3 dB)

(iv) Total Harmonic Distortion : less than 1% at 1 kHz at rated output

(v) Signal to noise ratio : greater than 60 dB

(vi) Hum level : -80 dB at full rated output

18.4.20 Interface Unit

The Interface Unit shall provide the following interfaces with TMS, EIDS , Train Radio and DRM:

(a) An interface with TMS shall be provided to allow :

(i) the transfer of system status, message displayed in the EIDS display boards

(ii) the receipt of ATC information

(iii) the receipt of door open/close status

(iv) the reporting of activated PAEH as stipulated in PS 18.4.15

The interface shall be in accordance with RS/C6014/01.

(b) An interface with EIDS shall be provided to allow :

(i) the transfer of route, station and message information

(ii) receipt of message displayed in the EID panels and EIDS system fault data

The interface shall be in accordance with RS/C6014/01.

(c) An interface shall be provided with Train Radio for radio broadcasting. A balanced audio output and a dry contact closure will be provided to the DVAS and PA system for broadcasting the PA message to the passengers by the Train Radio.

(d) An interface with DRM shall be provided to allow :

(i) the transfer of route, station and message information

The interface shall be in accordance with Appendix I Annex 9.

18.4.21 Pre-recorded announcements

(a) The messages for the Urban Lines shall be transferred and stored in the DVAS and PA and shall be fully operational. The numbers of messages to be transferred are 200 typical and 500 maximum.

(b) The messages for Kwun Tong Line Extension shall be based on the existing messages with modification / addition. The list of messages shall be submitted for Approval.

18.4.22 Operating Description

(a) Startup

(i) The DVAS and PA will start to operate as soon as power is available.

(ii) The DVAS and PAS will carry out a self test to verify its healthiness and the status will be sent to the TMS. The self test can also be initiated by pressing the ‘SELF TEST’ button on the MCP.

(iii) The train operator will need to select the correct line via the ‘LINE SELECT’, ‘FORWARD’ and ‘REVERSE’ buttons.

(b) Manual Broadcasting

(i) Live announcements can be made via either of the microphone on the MCP or ACP.

(ii) The ‘PRESS-TO-TALK’ switch on the microphone shall be pressed to enable broadcast to passengers.

(c) Radio Broadcasting

(i) Communication Coordinator can make live announcements to passengers via the Train Radio and interface with DVAS and PA.

(ii) The 'radio broadcasting' indicator on the MCP will be illuminated during the course of radio broadcasting.

(iii) The audio signal received from Train Radio will be transmitted to the Public Address amplifiers for broadcast in saloon.

(d) Broadcasting of Pre-recorded Announcements

(i) Not used.

(ii) On pressing the door open push button, the door opening chime will be broadcast automatically.

(iii) Not used.

(iv) On pressing the door close push button, the door closing chime will be broadcast automatically.

(v) The train operator will be able to select the correct line and starting station message by means of the ‘LINE/STATION SELECT’, ‘FORWARD’ and ‘REVERSE’ button on the MCP. The name of the line and station together with the message content (in English) will be displayed on the MCP.

(vi) Having selected the correct line and starting station, the train operator can use the ‘STATION MESSAGE’ button on either the MCP or ACP to broadcast the correct station message. After completion of the message, the next station message will be displayed on the MCP.

(vii) The train operator can use the ‘REPEAT’ button to repeat the previous announcements.

(viii) The train operator can press the ‘ATC TRIGGERED’ button to initiate the automatic broadcast of station messages on reception of real time station information via the TMS interface. If the link with trainborne ATC equipment is healthy, the button will be illuminated otherwise it will be blinking.

(ix) The train operator can select special message by means of the ‘special message’, ‘FORWARD’ and ‘REVERSE’ buttons on the MCP. The message is selected on pressing the 'ENTER' button

and will be broadcast on pressing the ‘special message’ button again.

(x) The train operator can select emergency message by means of the ‘emergency message’, ‘FORWARD’ and ‘REVERSE’ buttons on the MCP. The message is selected on pressing the 'ENTER' button and will be broadcast on pressing the 'emergency message' button again. The broadcast of emergency message will be stopped by pressing the 'reset' button on the MCP.

(e) Cab-to-Cab Intercom

(i) The calling train operator press the 'CAB-TO-CAB INTERCOM' button on either the MCP or ACP and press the press-to-talk button on the microphone.

(ii) The 'CAB-TO-CAB INTERCOM' button on both the active and non-active MCP and ACP will be illuminated.

(iii) The receiving train operator can press the 'CAB-TO-CAB INTERCOM' button on either the receiving MCP or ACP to start the conversation.

(f) Passenger Alarm System

(i) The passenger can pull any one of the PAEH(s) inside saloon and be able to speak to the train operator directly via the corresponding passenger alarm microphone.

(ii) The identification of the PAEH will be displayed on the MCP with the 'PASSENGER ALARM EMERGENCY HANDLE' indicator illuminated.

(iii) The train operator can select the PAEH he wants to talk back and a point-to-point communication with the passenger who has operated the PAEH can be established.

(iv) In case more than one PAEHs have been activated, the train operator shall be fully informed and be able to select which alarm to talk back.

(v) The activated PAEH will trigger the display of saloon images at the concerned areas on the trainborne video display unit of the In-Saloon CCTV system.

18.5 Electronic Information Display System (EIDS)

18.5.1 General

(a) The Employer will free-issue the EIDS equipment, Digital Visual Interface (DVI) cables and accessories, all connectors, interfacing plugs and sockets to the Contractor for installation. The EIDS equipment free-issued by the Employer will include antenna and feeder cable, wireless router and LAN switch, reset button, EIDS Server, EIDS Controller and audio equipment. The Contractor shall provide the GSM Modem Assemblies Interface and install all EIDS equipment, associated cables and power supply as stipulated in Appendix I Annex 4.

(b) The Contractor shall provide and install Electronic Information Display (EID) panels for displaying the electronic information, all inter-car cable connections for the EIDS communications across passenger vehicles, associated cables other than those cables provided by the Employer specified in Attachment App-I-Annex-4, all earthing connections and associated equipment housings and mounting materials. All cables provided by the Employer specified in Attachment App-I-Annex-4 shall also be installed by the Contractor.

(c) The Contractor shall provide accommodation including mountings, equipment cabinets and cable access for installation of all the EIDS equipment. The locations of the equipment shall be submitted to the Employer for Approval.

The Contractor shall provide the appropriate power supplies including the power supply interface and the protection device to the EIDS equipment in accordance with RS/C6014/02. The Contractor shall ensure that the power supply arrangement can fulfill the emergency power supply requirement as stipulated in PS 18.1.4. Suitably rated MCBs shall be separately provided for EID panels with AC power type and DC power type in each car of the train. Suitably rated MCB shall also be separately provided for the EIDS equipment in each car of the train.

(d) EIDS Server will issue instruction to EIDS Controller to invoke the display and broadcast of the message in sequence according to the any pre-determined schedule, time of day or location as stated in the scheduling list (refer to RS/C6014/01). Message being displayed on all display panels will be synchronized. Audio being broadcasted will be interfaced with DVAS/PA. The Contractor shall provide and install all necessary cables and accessories for connecting the EIDS server and DVAS.

(e) For the first train, all the free-issued EIDS equipment as specified in PS 18.5.2 shall be fully installed, tested and commissioned in the

Contractor's premises. For the remaining trains, all the free-issued EIDS equipment as specified in PS 18.5.2 shall be fully installed, tested and commissioned in the Employer's premises. All the free-issued cables and accessories, connectors, interfacing plugs and sockets of all trains shall be installed in the Contractor's premises. The delivery programme and the point of delivery of the free-issued EIDS equipment shall be followed as stipulated in PS 29. The Contractor shall be responsible for the test and commissioning of all the installed EIDS equipment and EID panels. Testing shall be conducted to confirm compliance in the Urban Lines.

18.5.2 Each train shall be fitted with the following EIDS equipment :

(a) The GSM Modem Assemblies Interface (one per cab);

(b) Two WiFi Access Points and Routers (one set per cab) which forms part of the Bulk Data Transmission;

(c) Two EIDS Servers (one per cab) for information updates, controls of network equipment, GSM Modem Assemblies interface and DVAS/PA interface;

(d) Eight EIDS Controllers, audio equipment and accessories (one per car) for DVI controls;

(e) Eight LAN switches and accessories;

(f) 32 EID Panels (4 panels per car) for electronic information display. One of the 4 panels on each car shall be supplied by 110Vdc power source; the other three panels shall be supplied by 240 Vac power source;

(g) Two voltage free contacts signal for Zero-speed Contact Interface (one per cab);

(h) Two voltage signals for Auxiliary Power Source Interface (one per cab); and

(i) Two reset buttons (one per cab);

18.5.3 Performance Requirements

(a) The EID Panels shall be able to display the passenger information of the following types of data, namely, commercial.

18.5.4 Real Time Transmission Facilities

(a) The Real Time Transmission Facilities consist of the existing OCC equipment, GSM Modem Assemblies and GSM Modem Assemblies Interface as stipulated in Appendix I Annex 4. The GSM Modem Assemblies Interface shall provide a transmission mean to send a dry contact signal from OCC to the EIDS Server in a real time manner within 30 seconds in the event of broadcasting emergency message.

(b) When the emergency messages are received from the GSM Modem Assemblies, a dry contact signal shall be sent to the EIDS Servers immediately for blanking the screen or pre-loaded images/video files on the EID panels.

(c) Not used.

(d) The Real Time Transmission Facilities will allow messages to be sent to a selected train or all trains running in the Urban Lines.

(e) The Real Time Transmission Facilities will be available at all times and there is no need to undertake any startup / login process.

(f) Real Time Data Receiver

(i) Two GSM Modem Assemblies shall be installed in each train as the Real Time Data Receivers (Refer to PS 10.4.2(o)).

(ii) The Contractor shall develop the GSM Modem Assemblies Interface as specified in Appendix I Annex 4 to send the dry contact signal to EIDS Server in the event of broadcasting emergency messages.

(iii) Not used.

(iv) The GSM Modem Assemblies and GSM Modem Assemblies Interface shall incorporate appropriate error checking functions to ensure integrity of the received data.

(v) Not used.

18.5.5 Bulk Data Transmission Facilities

(a) The Bulk Data Transmission Facilities will provide a transmission mean to send scheduling list, advertising messages (in graphic files format) and other information generated by the Media Team Workstation (refer to RS/C6014/01) to the trainborne EIDS Server.

(b) The Bulk Data Transmission Facilities will provide wireless and seamless LAN connection from the Media Team Workstation to the trainborne EIDS Server.

(c) The Bulk Data Transmission Facilities will be self-recovery. Every equipment will be able to restart and resume normal operations automatically after power interruption.

(d) The data rate of the Bulk Data Transmission Facilities shall be 40 Mbps minimum in TCP and the throughput shall not be smaller than 40% of the data rate.

(e) Trainborne Transceiver

(i) Two WiFi Access Points and Routers shall be installed in each train, one in each of the two A cars, as the trainborne transceiver.

(ii) The location of the WiFi Access Points shall be properly chosen such that the quasi-peak level field strength measured with 25kHz bandwidth shall be no more than 63dBμV/m at the following locations (regardless train(s) is/are present on the associated track(s) or not) :

- at all locations above the centre line of the track of the adjacent platform(s);

- at all locations in front of the opposite driving cab of the same train; and

- at 600 m from the trainborne transceiver along the track in the reverse direction of travel towards the previous station.

The Contractor shall install the two WiFi Access Points according to the locations as stipulated in the Appendix I Annex 4. Any change in the location shall be submitted to the Engineer for Approval.

(iii) Not used

(iv) Only the rear driving cab, with respect to the normal direction of travel, the WiFi Access Point will be used for bulk data transmission. The front driving cab WiFi Access Point shall always remain switched off.

(v) The rear driving cab WiFi Access Point shall be turned on only when the “door open signal” of the train stopping at the target

platform is received and it shall turn off immediately when the “door close signal” is received.

(vi) The power output of the antenna will conform to HK OFCA requirements and Operations Engineering Standard – S/C&C/DS/007 “Electromagnetic Compatibility and Non-Ionizing Radiation Standard”.

(f) The Bulk Data Transmission Facilities will be available at all times and there is no need to undertake any startup / login process.

(g) Download of scheduling list / advertisements / other information in the Urban Lines.

(i) The Media Team workstation will generate the scheduling list / advertisements / information and these will be transmitted to the Bulk Data Transmission Facilities transceivers situated on certain station platforms of the Urban Lines. When a train is within the coverage area of the transmitter, this information will be automatically downloaded to the EIDS Server

(ii) Upon receipt of the information, the EIDS Server will broadcast the data received to each of the EID panels via EIDS Controllers.

(h) Upload of fault logs / event records to the Station Server

(i) EIDS Server will collect the fault information and event logs form the EIDS equipment and automatically transmit the data messages to the Station Server via the WiFi Access Points when the train is within the coverage area of a station.

(j) The wireless network connection and data transmission between the Bulk Data Transmission Facilities and EIDS Server should be encrypted, and support authentication, E-Cert security and MAC layer filter to ensure WLAN security, and to protect the network from unauthorized access and attacks. The design of WLAN security shall be provided for the Engineer’s review.

18.5.6 EIDS Server

(a) The EIDS Server is the main control part of the whole trainborne EIDS. EIDS Server will control the traffic of its dedicated data network, display sequence of messages, provide the audio control and compensation schemes, interface with different systems and manage all the EID Panels via the EIDS Controllers.

(b) EIDS Server will decode data received from all interfacing systems using an error detection and correction protocol. Data verification shall be conducted by the EIDS server upon completion of downloading message files from station server / media team workstation. The message file / data should be re-downloaded if error is detected in the data verification process.

(c) EIDS Server will check the messages inside the EIDS Controllers and pass the updated messages stored inside its local memory to every EIDS Controller at the beginning of operation.

(d) Only those messages scheduled to be displayed 2 hours later will be transmitted by EIDS Server to the local buffer memory of the EIDS Controllers.

(e) EIDS Server will issue instruction to EIDS Controller to invoke the display and broadcast of the message in sequence according to the any pre-determined schedule, time of day or location as stated in the scheduling list (refer to RS/C6014/01). Message being displayed on all display panels will be synchronised. Audio being broadcasted will be interfaced with DVAS/PA.

(f) EIDS Server will collect the diagnostic results from all EIDS Controller and will transmit the results during the initial power up routine and send to the Station Server.

(g) Diagnostic function will be provided to check the hardware and software status of the EIDS equipment. The Diagnostic function will include two levels checking.

(h) Self Diagnostic Function

The self diagnostic function will be performed automatically by the EIDS Server as shown in the following table.

Items	Diagnostic Details	Frequency
1	Test the functionalities of hardware, such as, interface modules, control module and memory module.	Only at initial power up.
2	Check the version of all control firmware	Only at initial power up.
3	Check the versions of information messages stored in the memory of EIDS Server.	Every two hours.

The diagnostic result will transmit through the Bulk Data Transmission Facility for record (refer to PS 18.5.5).

(i) Polled Diagnostic Function

(i) When Polled Diagnostic Function command is received, the EIDS Server will request all equipment to perform the Self Diagnostic Test again. The EIDS Server will then consolidate all the diagnostic results and then send through the Bulk Data Transmission Facility immediately.

(ii) If there is fault found in the diagnostic test, fault message including the equipment address and fault type will be sent to the EIDS Server. The EIDS Server will consolidate all the equipment fault messages of EIDS and send through the Bulk Data Transmission Facilities.

(iii) EIDS Server will keep all fault messages within one week. All expired fault messages shall be automatically deleted.

(j) Digital Voice Announcement System (DVAS and PA)

(i) EIDS Server will interface with the DVAS and PA to obtain information of door status, next station, pre-recorded DVAS and PA message codes for providing train location to EIDS system and the mute signal from DVAS to mute the audio output at the EIDS in case of the PA message broadcasting is conducted. When the

emergency messages are received from the DVAS, a software control signal shall be sent to the EIDS Servers immediately for blanking the screen or display pre-loaded images/video files on the EID panels in synchronization with PA messages through the interface between DVAS and EIDS as stipulated in RS/C6014/01.

(ii) Not used.

(iii) Not used.

(k) Real time Transmission Facilities

(i) EIDS Server will interface with the Real Time Transmission Facilities (refer to PS 18.5.4) to obtain the dry contact signal in the event of broadcasting emergency messages through the GSM network as specified in Appendix I Annex 4.

(ii) EIDS Server will relay the received dry contract signal to the EIDS Controller. EIDS Controller will interrupt the current displaying message and blank the screen or display pre-loaded images/video files on EID Panels.

(l) Zero-speed Contact

(i) EIDS Server will interface with the Zero-speed Contact to obtain the voltage free relay contact for indicating whether the speed of the train is zero or not.

(ii) EIDS Server will monitor this relay contact to achieve the required audio output level adjustment with respect to whether the train is moving or stationary as stipulated in Appendix I Annex 4.

(m) Auxiliary Power Source

(i) EIDS Server will interface with the Auxiliary Power Source to monitor the power supplied by the auxiliary power source of the train for achieving the required delay shutdown function as stipulated in Appendix I Annex 4.

(ii) The master EIDS Server will check whether any of the two Trainborne Wireless Aps is connected to depot Wireless AP in the event of the detection of loss of power from auxiliary power source. If such a connection is present, the master EIDS Server will terminate all broadcasts and shutdown all EIDS Controllers and all equipment of the audio system on that train. The EIDS Servers and Wireless APs at both ends of the train and all network equipment of the train will remain in their working state for an

adjustable period of time for bulk data download. Otherwise, the whole Trainborne Sub-system will remain in normal working state for another adjustable period of time. Upon expiry of these periods, the master EIDS Server will instruct the graceful shutdown of all equipment.

(n) Reset button

(i) The reset button free-issued by the Employer shall be installed in cab to reset the EIDS Server by the cab driver during abnormal operation as stipulated in Appendix I Annex 4.

(o) Bulk Data Transmission Facilities

(i) EIDS Server will determine the logic of activation of the WiFi Access Point.

(ii) EIDS Server shall interface with the activated WiFi Access Point to communicate with Station Server transceiver, which shall be installed in certain strategic station platform, when the train is within Station Server's coverage area.

(iii) EIDS Server will receive from the Station Server

(1) Messages files

(2) Data files, for example, EIDS Server firmware, EIDS Controller firmware, pre-recorded messages and English/Chinese font files and then relay them to the relevant memory location of all EIDS Server and EIDS Controller at right moment.

(iv) EIDS Server will send to the Station Server

(1) Fault messages of EIDS equipment on train

(2) EIDS Polled Diagnostic and Self Diagnostic results when requested

Station Server will relay the receive data to the depot through the Employer's IDN.

(p) EIDS Server Mastership

(i) Each EIDS Server will have its own logical hardware address.

(ii) One of the EIDS Server swill automatically designate itself the master EIDS Server and will control the entire EIDS when initial power up.

(iii) The master EIDS Server will:

(1) verify the available equipment, including checking to verify if there are other EIDS Server and the number of EIDS Controller, on the Train Data Network.

(2) control the data traffic flow along the its dedicated data network.

(3) scan for and monitor the existence of equipment along its dedicated data network. When there is added or deleted equipment from the dedicated data network, the EIDS Server will:

- Re-initialize to account for the added or deleted elements.

- Scan the dedicated data network for 3 times in a 2-minute interval if there are deleted elements.

- Record the absent elements in the fault log if the deleted elements still absent.

- If there are added elements, the added elements shall be capable of displaying messages as soon as they are received from the master EIDS Server. For those other elements that are already in the dedicated data Network, it will continue to function normally during the updating of the added elements.

(4) show the real-time clock onto all EID Panels when door close signal received from DVAS.

(5) consolidate the fault messages and diagnostic results from all equipment and send through the Bulk Data Transmission facilities.

(6) resolve the priority of transmitting data from EIDS Server to Station Server. The priority of transmitting data will be:

Priority	Data information
1	EIDS fault messages, including address of fault equipment (either EIDS Server, EIDS Controller or other EIDS equipment), time of fault found and fault type.
2	Polled Diagnostic result
3	updated Self Diagnostic result

(q) The slave EIDS Server will:

(i) perform self diagnostic test at initial power up.

(ii) verify data and message received from the master EIDS Server and compared it against data and messages received directly from its own interfaced systems.

(iii) transmit the received messages received from its own interfaced systems to the master EIDS Server.

(iv) store the verified data and messages into its local memory.

(v) change to master EIDS Server if the master EIDS Server failed during operation.

(r) Electrical Requirement

(i) EIDS Server and its associated network equipment shall be supplied by 110VDC +25% -30%, which shall be switched on at 100V and turned off at 77V.

(ii) When there is a loss of AC power on the train, EIDS Server shall not transmit normal messages and invoke the message to display on the panels except those high priority messages.

(s) Internal Architecture of EIDS Server

(i) The EIDS Server will include at least the following configurations:

(1) Microprocessor and controller boards for controlling and scheduling of data and messages received.

(2) Power Supply Module for providing power for the receiver of the Real Time Transmission Facility (refer to PS 18.5.4).

(3) Re-programmable RAM for storage of frequently changed or updated messages such as: news, weather, advertisements and operational messages.

- The memory size will be doubled to the size of RAM memory of the EIDS Controller to hold all messages files, including all message files of one 20-minute display cycle and those files that are not scheduled to be displayed in the next two hours.

- The memory will be sustained by an internal back-up battery to provide long-term storage of the message data.

(4) Re-programmable non-volatile Flash Memory for storage of rare change files like microprocessor boots and control firmware.

- The memory size will only be large enough to store control firmware.

- The files inside the Flash Memory will be reprogrammable through High Speed Data Link.

(5) Real-time clock

(6) Interface Module with Bulk Data Transmission Facilities transceiver to send and receive data to/from Station Server.

(7) Interface Module with Real Time Transmission Facilities receiver.

(8) Interface Module with DVAS/PA.

(9) Interface Module with audio equipment.

(ii) The microprocessor and controller will have watch-dog function to monitor the operation of the processor and will reset the microprocessor in case of processor hang up.

(iii) All electronic cards will be in modular design and will be easily accessible, maintainable and replaceable.

(iv) Each electronic card will have sufficient visual indications for system status to give a clear indication of all on-line activities. This will include LEDs for transmit, receive signal, power available, power on and fault

(t) Mechanical Requirement of EIDS Server

(i) The exact locations for EIDS Server shall be installed according to the layout as stipulated in the Appendix I Annex 4. Any change in the location shall be submitted to the Engineer for Approval.

(ii) A metallic case shall be used as enclosure for all components of the EIDS Server. The enclosure case shall be sealed to IEC 60529 IP54.

18.5.7 EIDS Controller

(a) EIDS Controller will receive instructions from EIDS Server, control the display sequence of messages, send DVI signal to all EID Panels for display, receive status information from all EID Panels and interface with audio equipment for audio broadcast.

(b) EIDS Controller will report the messages stored inside its local memory to the EIDS Controller at the beginning of operation. EIDS Controller will update the messages and store inside its local memory as per the EIDS Server instruction.

(c) EIDS Controller will receive those messages scheduled to be displayed 2 hours later from EIDS Server to its local buffer memory. Upon the reception of EIDS Server instruction, EIDS Controller will synchronously display and broadcast the related messages on all EID Panels and audio equipment.

(d) Diagnostic function will be provided to check the hardware and software status of the EIDS Controller. The Diagnostic function will include two levels checking.

(e) Self Diagnostic Function

The self diagnostic function will be performed automatically by all EIDS Controller as shown in the following table.

Items	Diagnostic Details	Frequency
1	Test the functionalities of hardware, such as, interface modules, control module and memory module.	Only at initial power up.
2	Check the version of all control firmware	Only at initial power up.
3	Check the versions of information messages stored in the memory of EIDS Controller.	Every two hours.

The diagnostic result will send to the EIDS Server and then transmitted through the Bulk Data Transmission Facility for record (refer to PS 18.5.5).

(f) Real time Transmission Facilities

EIDS Controller will receive the dry contact signal from the EIDS Server in the event of broadcasting emergency messages through the Real Time Transmission Facilities. EIDS Controller will then interrupt the current displaying message and will blank the screen or display pre-loaded images/video files on EID Panels.

(g) Bulk Data Transmission Facilities

EIDS Controller will receive the Data files, for example, EIDS Controller firmware, pre-recorded messages and English/Chinese font files from EIDS Server and store them to the relevant memory location inside EIDS Controller at right moment.

(h) EID Panel

EIDS Controller will interface with EID Panels to obtain the status information from EID Panels as stipulated in RS/C6014/01. When the EIDS Controller could not able to monitor the EID Panel during a period of time, the EIDS Controller will determine connection overtime with EID Panel automatically.

(i) Electrical Requirements

(i) All EIDS Controller shall be supplied by 110VDC +25% -30%, which shall be switched on at 100V and turned off at 77V.

(ii) When there is a loss of AC power on the train, EIDS Controller shall not invoke the message to display on EID Panel except those high priority messages.

(j) Internal Architecture of EIDS Controller

(i) The EIDS Controller will include at least the following configuration:

(1) Microprocessor and controller boards for controlling and scheduling of data and messages received.

(2) Re-programmable RAM for storage of frequently changed or updated messages such as: news, weather, advertisements and operational messages.

- The memory size will be able to hold all messages files, including all message files of one 20-minute display cycle and those files that are not scheduled to be displayed in the next two hours.
- The memory will be sustained by an internal back-up battery to provide long-term storage of the message data.

(3) Re-programmable non-volatile Flash Memory for storage of rare change files like microprocessor boots and control firmware.

- The memory size will only be large enough to store control firmware.
- The files inside the Flash Memory will be reprogrammable through High Speed Data Link.

(4) The video interfaces as stipulated in PS 18.5.8.

(5) The audio interfaces.

(ii) The microprocessor and controller will have watch-dog function to monitor the operation of the processor and shall reset the microprocessor in case of processor hang up.

(iii) All electronic cards will be in modular design and shall be easily accessible, maintainable and replaceable.

(iv) Each electronic card will have sufficient visual indications for system status to give a clear indication of all on-line activities. This will include LEDs for transmit, receive signal, power available, power on and fault.

(j) Mechanical Requirement of EIDS Controller

(i) The exact locations for EIDS Controller shall be installed according to the layout as stipulated in Appendix I Annex 4. Any change in the location shall be submitted to the Engineer for Approval.

(ii) A metallic case shall be used as enclosure for all components of the EIDS Controller. The enclosure case shall be sealed to IEC 60529 IP54.

(iii) A metallic case shall be used as enclosure for all audio equipment. The enclosure case shall be sealed to IEC 60529 IP54.

18.5.8 Electronic Information Display Panels (EID Panel)

(a) The Electronic Information Display Panels (EID Panel) shall be able to display the required information in the form of animated graphics and text. The EID panel shall be of LCD type.

(b) Automatic Light Control shall be provided on each EID Panel to cater for the tunnel and overhead section ambient lighting conditions.

(c) Each EID Panel shall provide a DVI interface for the video connection and a RS-485 Serial port for the status communication between EIDS Controllers.

(d) The performance of EID Panel shall be as follows:

Size	Not larger than 500 mm (w) x 320 mm (h) x 80 mm (d)
Weight	Less than 15 kg (including vandalproof protective glass)
Effective display area	At least 474mm (w) x 296 mm (h)
Aspect ratio	16:10
Display format	1680 x 1050 pixels (or higher)
Pixel addressing	Active matrix

Colour rendering	16.7 million colour Simulation of 10 bits/colour with spectral and temporal dithering techniques
Horizontal viewing angle	Minimum 178°
Vertical viewing angle	Minimum 178°
Surface luminance (at peak white)	At least 450 cd/m^{2} (after degraded by protective cover/glass)
Contrast ratio	At least 1000:1 in complete darkness
Response time	Less than 6 ms
Video resolution	Not less than 90 dpi
Signal input	DVI, RS-485 Serial
Sync input impedance	2.2 kΩ
Automatic light control	Dual light sensors (Brightness / Contrast / Saturation shall be corrected with respect to the environmental change)
	The LCD shall be of non-reflective display surface.

(e) Electrical Requirements of EID Panel

(i) Among the four EID Panels installed in each car of the trains, three panels shall be supplied by AC power and one shall be supplied by DC power.

(ii) The one display panel supplied by DC shall be operated satisfactorily at battery supply voltages of 110 VDC (nominal) between 77VDC and 137.5VDC.

(iii) The EID Panel shall be equipped with a highly efficient and reliable internal power supply converter to supply power for control and displaying functions. The noise power level generated by the converter shall be limited below 30dB in the audible frequency ranged from 20Hz to 20kHz.

(iv) Power Management

When there is a loss of AC power on the train, only the panel supplied by DC shall be in operation. Normal messages shall not be displayed and only those priority messages as defined in RS/C6014/01 shall be displayed in order to save the emergency DC power from the battery.

(f) Internal Architecture of EID Panel

(i) The EID Panel shall have a built-in photo sensor which shall automatically adjust the intensity of the display panel. At least two levels of LED illumination shall be provided to cater for the tunnel and overhead section ambient lighting condition. The Contractor shall submit the illumination intensity of the LEDs and the intensity variation between LEDs at the two levels to the Employer for Approval.

(ii) The brightness of the EID Panel shall be automatically diminished to the dimmest mode in case of the failure of the either sensor.

(iii) The EID Panel shall not at any time show blank screen under normal operation condition so that train operators can easily know whether the display panel function normally or not.

(iv) All electronic components shall be water resistance.

(g) Mechanical Requirements of EID Panel

(i) The physical dimension of the display panel together with the enclosure shall not exceed 630 mm (width) x 415 mm (height) x 80 mm (depth). The size of the EID Panel shall be optimized with the interior coving panel. The selection of EID Panel shall be submitted to the Employer for Approval.

(ii) The total weight of one EID panel shall not exceed 15kg.

(iii) The panel shall be designed to make flushed with the coving panels of the saloon interior after installation. The mechanical interface arrangements shall be submitted to the Employer for Approval.

(iv) The design of the panel enclosure shall be tamper resistant, and shall not allow passenger to disassemble the unit from the front.

(v) All equipment of the panel shall be sealed to IEC 60529 IP54.

(vi) The exterior design of the display panel shall blend in with the aesthetics of the vehicle interior finishing and the final product shall be seamlessly integrated into the vehicle's interior design. The aesthetic design shall be submitted to the Employer for Approval.

(vii) The exact locations for the panels inside the saloon shall be determined by the Engineer during the detail design stage.

(viii) The front shield shall be complied with the material requirements in PS 20. It shall also be protected from vandalism by passengers.

(ix) The front shield shall be non-reflective, glareless and with light transmissivity of not less than 85%. The front shield shall not affect the colour quality of the display.

18.6 Door Chime System (DCS)

18.6.1 General

(a) The Employer will free-issue the DCS equipment with accessories as stipulated in Appendix I Annex 4 Clause 5.1. The Contractor shall install, test and commission the DCS. The Contractor shall conduct interface and integrated tests for the DCS against the associated interfaces such as train systems and platform to confirm the correct operation and functions.

(b) Every driving cab of trains shall be installed with Door Chime System (DCS) which provides a set of unified chime/audible announcement on train to alert passengers when passenger doors are opening, about to close, and closing.

(c) The Contractor shall provide all necessary interfaces, accessories, cables, cable harness and mounting brackets other than the equipment stipulated in PS 18.6.2(f)(i) to facilitate the installation of DCS. The interfaces between DCS and interfacing systems shall be designed with proper protection such that the normal operation of any one system shall not be affected by the failure of another system.

(d) The interface requirements of DCS are defined in Appendix I Annex 4 Clause 5. The interfaces are specified according to the application of the DCS in Urban Lines Trains. The Contractor shall comply with the interface requirements specified in this Annex subject to the changes requested by the Engineer. The Contractor shall finalize the design of all interfacing systems by end of SEMP 2.

18.6.2 Contract Demarcations

(a) Based on the interface requirements stipulated in Appendix I Annex 4 Clause 5, a detailed interface specification shall be provided with the liaison of the Engineer (refer to PS 31.3).

(b) The Contractor shall specify in the above detailed interface specification all additional design information required on system interfaces which are not provided in Appendix I Annex 4 Clause 5. A program for the submission of interface design information shall also be submitted for Approval.

(c) For those interface designs that may affect the manufacturing program shall be finalized prior to the commencement of SEMP 4. In the event that the required interface design information are not available from the Engineer by the period specified in the above program, the Contractor shall carry out interface design based on his own judgment and submit for Approval.

(d) Subject to the detailed interface specification, the contract demarcations specified in this Clause shall be complied with. The interface demarcation shall refer to Appendix I Annex 4 Clause 5.5.6.

(e) The Contractor shall provide the following items, as a minimum requirement:

(i) Accommodation of the DCS equipment according to Appendix I Annex 4 Clause 5.5.2.

(ii) The power supply and interfacing signals according to Appendix I Annex 4 Clause 5.5 shall be provided and complied with. All cables together with cable identifications and mating connector for TU between TU and train systems shall be provided and installed.

(iii) Installation, testing and commissioning of DCS equipment on first train in Contractor’s factory and remaining trains in Employer’s premises except the cables and connectors stipulated in PS 18.6.2(iv).

(iv) Installation of interconnection cables and connectors provided by Employer as stipulated in Appendix I Annex 4 Clause 5.1 for DCS equipment for all trains in Contractor’s factory.

(v) All necessary inspections, checks and testing for ensuring the quality of workmanship of the interface installation works.

(vi) Proper delivery of DCS equipment for the first train and cables and connectors for the remaining trains stipulated in Appendix I Annex 4 Clause 5.1 to Contractor's factory at Contractor's own cost.

(vii) Integrated test with the participation of Employer to validate the DCS interface in main running line in Hong Kong.

(f) The Employer will provide and support the following items:

(i) The free-issued DCS equipment with accessories as stipulated in Appendix I Annex 4 Clause 5.1 in Hong Kong.

(ii) Interfacing signals for the DCS equipment according to Appendix I Annex 4 Clause 5.5.3 and 5.5.4.

(iii) Supervision on the installation, testing and commissioning of all DCS equipment.

(iv) A competent testing engineer throughout the period of the tests and commissioning to participate and facilitate all DCS system related interface tests.

(v) All required instructions, drawings and special tools (if necessary) to facilitate the Contractor to perform the installation works.

(vi) Site supervision and training to facilitate the Contractor to perform the works as specified in Clause 18.6.2(e)(iii) in order to ensure the Contractor's workmanship meets the quality of work as required by the Engineer.

18.7 In-Saloon CCTV

18.7.1 General

(a) The Contractor shall provide In-Saloon CCTV System and install cameras, control computer, video recorders, video control unit, video monitor interface and network equipment accessories as stipulated in Appendix I Annex 4.

(b) The Contractor shall provide and install all video, control and power cables, all connectors, interfacing plugs and sockets, earthing

connections and all associated equipment housings and mounting materials.

(c) The Contractor shall provide accommodation including mountings and cable access for installation of all the In-Saloon CCTV equipment.

(d) The Contractor shall provide the appropriate d.c. power supplies including the power supply interface and the protection device to the trainborne In-Saloon CCTV equipment in accordance with RS/C6014/02.

(e) The Contractor shall make provisions on the train for 2-way wireless communication between the In-Saloon CCTV system and the OCC such that upon the reception of OCC request, the In-Saloon CCTV system can be able in future to transfer the required captured video images through the wireless transmission in real time from train to OCC. The Contractor shall not be responsible for making provisions for the wayside equipment to the OCC.

(f) The Contractor shall ensure and demonstrate that all the interface requirements as stipulated in Appendix I Annex 4 are satisfied.

(g) The Contractor shall be responsible for the test and commissioning of all the installed In-Saloon CCTV equipment.

18.7.2 The In-saloon CCTV System shall equip at least 32 cameras installed evenly in the 8 train saloons for surveillance purpose. In the occurrence of train system failure or operational deficiency, the In-Salon CCTV system shall also deliver the monitoring functions to the concerned areas of the saloon.

18.7.3 The In-Saloon CCTV System shall capture and transmit images from the cameras to the active driving cab through an IP-based network. Connections between cars and connections between Train Units shall be made via fixed network.

18.7.4 The Train Operator shall be able to select one or more of the desired images for viewing on the monitor which shall be commonly used by the In-cab CCTV system.

18.7.5 All camera pictures shall also be recorded and stored locally on the train in digital format by the In-Saloon CCTV System. A storage time of 7 days is required and provisions shall be made for subsequent downloading of the stored images for off-site viewing.

18.7.6 The quality of captured images and the replay images

(a) The camera shall clearly capture the image of an 80mm high test character “E” at 8m away from the camera. The captured image shall be clearly seen on the trainborne video display.

(b) The corresponding recorded images shall be clearly seen on the display units for off-site viewing.

18.7.7 Network

(a) The network shall be an IP-based network. The network equipment shall enable the manual assignment of fixed IP addresses.

(b) The network shall be connected to enable the sending of data packets and/or streams between any of the 8 cars of the train.

(c) The network shall provide at least six LAN ports at each passenger car for connection of network devices. Four of them shall be dedicated to the CCTV Cameras and one LAN port shall be the provision of wireless transmission of video images from train to OCC. These ports shall be 10/100 Base-T Ethernet Ports for connection via Cat-5e cables.

(d) For the inter-connections between cars within a single Train Unit, fixed 10/100 Base-T Ethernet connection shall be provided; for the interconnections across Train Units, fixed 10/100 Base-T Ethernet connection with CAT5e cable shall be provided.

(e) The wireless device shall be able to upgrade to the highest data rate model by firmware and/or application software changes through the network, if IEE802.11n is released. For other higher data rate model, hardware and/or application software changes shall be required.

(f) In case power supply to one or more equipment of the network is lost and upon resumption of power supply, the network shall be able to automatically initialize itself to provide full functionality.

(g) When any wireless connection is interrupted or lost, the equipment shall continuously attempt to resume the wireless link, and automatically configure itself to resume normal network connection when the wireless link is resumed.

(h) All network equipments shall support WPA encryption and MAC Layer security filters to protect the network from unauthorized access and attacks and to ensure data integrity.

(i) The network shall be able to be partitioned into different logical or virtual networks. Each logical or virtual network shall have its own data

throughput control, security and Quality of Service (QoS) settings. The data flow of each logical or virtual network shall not interfere with one another.

(j) The In-Saloon CCTV System shall support the assignment of priority levels to the logical or virtual networks as stipulated in (g) above. In the case of competing capacity demands, the network shall assign the capacity to networks with higher priority levels first.

(k) The In-Saloon CCTV System shall be able to configure itself and the network equipments such that any replaced or swapped network equipment shall work as part of the network with manual configuration by operators. The list of IP assignments to each In-Saloon CCTV equipment shall be provided for Engineer's Approval.

(l) Since train cars (or Train Units) may be swapped to become part of another train from time to time, once all train cars are properly coupled together and powered up, the network shall automatically re-configure itself to establish network connections with any newly added network equipments and start functioning as required.

18.7.8 Cameras

(a) The cameras shall be able to capture full colour images with a resolution of 480 Television Lines (TVLs) or 752×582 pixels at PAL. The depth of field shall be at least 10 meters at 70 degrees viewing angle.

(b) The cameras shall be able to capture images with full colour and distinguishable objects at a minimum illumination level of 100 lux.

(c) The cameras shall be IP type cameras or other type of cameras with the related interfaces with the ability to output images as follows:

- Frame rate: 25 frame per second;
- Resolution: 752 × 582 pixels in minimum; and
- MPEG 4 Part 10 / H.264 compression.

(d) The cameras shall be connected to the In-Saloon CCTV System via the network equipment at each passenger car. The cameras shall, upon its connection to the network equipment or power up/reset of either of the devices, obtain a fixed IP address. The list of IP assignment to each CCTV camera shall be provided for Engineer's Approval.

(e) The cameras shall have a sealed, dome-shaped protective cover with a low-profile appearance. The housing shall protect the camera from external damage and vibration.

(f) The Contractor shall propose the location for installation to achieve the full coverage in each train saloon and submit to the Employer for Approval.

(g) The convention of camera numbering shall refer to drawing C6014-14E/TSEG/010/015, in which the locations of cameras are for indicative purpose.

18.7.9 Image Selection and Displaying at Driving Cab

(a) The Contractor shall provide an industrial grade colour trainborne video display which shall be integrated into the driving console (refer to PS 8). The trainborne video display shall interface with both the In-Saloon CCTV an In-cab CCTV systems as stipulated in PS 18.3 and Appendix I Annex 4.

(b) The In-Saloon CCTV System shall interface with the TMS such that the trainborne video display shall display the control selections or video images as per the selections on TMS screen. Platform pictures captured by In-cab CCTV system shall be automatically displayed on the trainborne video display when the train moves into the signal coverage area, unless the automatic display function is overridden by the Train Operator through the TMS on-screen command. The Insaloon CCTV images shall be resumed once the train leaves the signal coverage area of the In-cab CCTV system.

(c) TMS shall report the activation of any PEAH of DVAS and PA, smoke detectors and train divided detection circuits to the Train Operator. TMS shall provide an acknowledgement button for the Train Operator to select the corresponding images to be shown on the trainborne video display. TMS shall send the quad screens information to In-Saloon CCTV for the display of corresponding images. The trainborne video display shall automatically show the saloon images in quad screen arrangement by default. The quad screen image arrangements shall efficiently cover the concerned areas. The Train Operator can select single or dual screen arrangement manually afterwards.

(d) With the activation of a PEAH, the quad screen arrangements shall be as follows:

Car Type	PAEH No.	Quad Screen Arrangements			
		Car	Camera No.	Car	Camera No.
A	A1P	A	C1, C3	A	C2, C4
	B2P	A	C1, C3	A	C2, C4
	A3P	A	C1, C3	A	C2, C4
	B4P	A	C2, C4	A	C1, C3
	A5P	A	C2, C4	C	C1, C3
C	A1P	C	C1, C3	A	C2, C4
	B2P	C	C1, C3	C	C2, C4
	A3P	C	C1, C3	C	C2, C4
	B4P	C	C2, C4	C	C1, C3
	A5P	C	C2, C4	B	C2, C4
B	A5P	B	C2, C4	C	C2, C4
	B4P	B	C2, C4	B	C1, C3
	A3P	B	C1, C3	B	C2, C4
	B2P	B	C1, C3	B	C2, C4
	A1P	B	C1, C3	B1	C1, C3
B1	A1P	B1	C1, C3	B	C1, C3
	B2P	B1	C1, C3	B1	C2, C4
	A3P	B1	C1, C3	B1	C2, C4
	B4P	B1	C2, C4	B1	C1, C3
	A5P	B1	C2, C4	C	C2, C4
C1	A5P	C	C2, C4	B1	C2, C4
	B4P	C	C2, C4	C	C1, C3
	A3P	C	C1, C3	C	C2, C4
	B2P	C	C1, C3	C	C2, C4
	A1P	C	C1, C3	B	C1, C3

(e) With the activation of a smoke detector or a train divided detection circuit, the quad screen arrangements shall be as follows:

Car Type	Smoke Detector.	Quad Screen Arrangements			
		Car	Camera No.	Car	Camera No.
A	No.1 End	A	C1, C3	A	C2, C4
	No.2 End	A	C2, C4	C	C1, C3
C	No.1 End	C	C1, C3	A	C2, C4
	No.2 End	C	C2, C4	B	C2, C4
B	No.2 End	B	C2, C4	C	C2, C4
	No.1 End	B	C1, C3	B1	C1, C3
B1	No.1 End	B1	C1, C3	B	C1, C3
	No.2 End	B1	C2, C4	C1	C2, C4
C1	No.2 End	C1	C2, C4	B1	C2, C4
	No.1 End	C1	C1, C3	B	C1, C3

(f) Software selection buttons shall be provided on TMS screen for the Train Operator to perform the following display control functions:

(i) general function: to power on or off the trainborne video display and to setup the configuration of the trainborne video display;

(ii) system selections: to choose the images to be displayed from either the In-Saloon CCTV System or the In-Cab CCTV System automatically or manually;

(iii) light controls: to override the automatic light control function as stipulated in PS 18.3.4 (e) (iii) and PS 18.7.9 (k) (iv) and to take up the light control locally when the configuration setup of the trainborne video display is chosen;

(iv) picture controls: to adjust brightness, contrast, and colour balance when the configuration setup of the trainborne video display is chosen;

(v) channel selections: to select the operating channel used in InCab CCTV system;

(vi) mode selections: to choose between single, split and quad screen modes for displaying the camera images from the saloons; and

(vii) source selections: to select the camera or groups of camera to be viewed.

(g) The In-Saloon CCTV System shall receive the “cab-occupied” control command from TMS via a hardwire signal to active the trainborne video display. Upon the reception of the control command from the TMS, the In-Saloon CCTV System shall automatically start to display the real time images on the screen.

(h) The In-Saloon CCTV System shall display the current time, source, system selected and identification of the selected cameras on the screen when the mode is selected to be that of the system.

(i) No delay, image retention and discontinuity shall be noticeable during normal operation of the In-Saloon CCTV System.

(j) When power is resumed subsequent to power loss to one or more equipment, the In-Saloon CCTV Controller shall be able to automatically initialize itself to provide full functionality.

(k) The trainborne video display shall conform to the following requirements :

(i) The display unit shall be protected from fraudulent use by a nonreflective, glareless and vandalproof reinforced glass. The light transmissivity of the protective glass shall not be less than 95%. The design, material specification, fixing method and a sample of the protective glass shall be submitted for Approval.

(ii) The backlight module of the display unit shall be field replaceable by maintenance staff with the use of special tools, if applicable.

(iii) No build-up/decay lag or image retention shall be noticeable during the normal operation of the display. The response time of the picture elements shall be less than 50 ms.

(iv) Automatic Light Control function shall be provided to allow the brightness and contrast of the display to be automatically adapted to different lighting conditions of the driving cab. An indication showing the current status of the Automatic Light Control function shall be provided.

(v) The warm up time and thus the total display latency shall be less than 1 second for the display to re-display the images upon the reception video signals.

(vi) Configuration of the display shall be able to be performed on site by the built-in On-Screen-Display features or by a portable terminal via a configuration port at the back panel of the display.

(vii) All configuration data shall be stored in non-volatile memory in the display and shall be preserved even after power interruption.

(viii) The performance of the trainborne video display shall be :

Size	Not larger than 325 mm (w) x 248 mm (h) x 70 mm (d)
Weight	Less than 4 kg (including vandalproof protective glass)
Effective display area	At least 214 mm (w) x 161 mm (h)
Aspect ratio	4:3
Display format	1024 x 768 pixels
Pixel addressing	Active matrix
Colour rendering	8 bits/colour i.e. 16 million colour/256 grey or 6 bits/colour i.e. 262,144 colour/64 grey Simulation of 10 bits/colour with spectral and temporal dithering techniques
Horizontal viewing angle	Minimum $\pm 45^{o}$
Vertical viewing angle	$+30^{o}$ / -10°, optimum at 12 o'clock
Backlight	Dual Cold Cathode Fluorescent Tube (CCFT) in parallel operation
Surface luminance (at peak white)	At least 200 nits (after degraded by protective cover/glass)
Contrast ratio	At least 100:1 in complete darkness At least 20:1 in an ambient lighting of 10,000 lux
Response time	Less than 50 ms
Video resolution	Not less than 480 TVL

Signal input	Analogue (VGA) Composite, PAL, 1 V p-p
Signal input impedance	75 Ω
Sync input impedance	2.2 kΩ
Control functions	Contrast, brightness and colour saturation
Automatic light control	Dual light sensors
Blank control	External by picture auto on/off control equipment

18.7.10 Video Storage and Downloading

(a) The In-Saloon CCTV System shall provide video storages on Train Unit basis. The video storages shall be networked and shall be accessed over any network access point on a train. All video storages on the train shall be protected by RAID technology.

(b) The In-Saloon CCTV System shall record all images captured by all cameras inside the train saloons at all times when power is supplied to the system. The recorded images shall be time-stamped and watermarked.

(c) The recorded images shall be kept in the storage device provided on the train. If the connection of a storage device to one or more cameras is/are lost due to any reason, the storage device shall continue to record the image captured by the still-connected cameras. Upon the resumption of the link, the storage device shall automatically start to record the resumed images.

(d) The recorded images shall be kept in the storage for 7 days, and shall be deleted automatically after 7 days. The freed storage space shall be used for subsequent recordings.

(e) The Contractor shall provide any special software package with necessary licenses required for selecting and downloading of the recorded images. The In-Saloon CCTV System shall allow the selection of portion of recorded video for downloading by specifying the following parameters:

- Start date and time;
- End date and time or duration;
- Car number; and
- Camera source.

(f) The In-Saloon CCTV System shall allow the selected images to be downloaded to a laptop computer via an 802.11 b/g wireless link or the spare LAN port at the switch.

(g) The video files shall be viewable with Windows Media Player and no additional software shall be needed, or the Contractor shall provide any proprietary viewing software for viewing the video files.

(h) In the case of any video storage failure, the In-Saloon CCTV system shall report the fault information to the TMS.

18.7.11 System Configuration and Logging

(a) The In-Saloon CCTV System shall record with timestamps all actions of the user and the selected view(s) of the system in a user-log file.

(b) The In-Saloon CCTV System shall also record with timestamps all system messages and errors, including but not limited to video loss, full storage, attempted intrusion and network link failure, in a system-log file.

(c) The In-Saloon CCTV System shall provide an internal system clock for generating the timestamps required in PS 18.7.10 (b), PS 18.7.11 (a) and PS 18.7.11 (b), as well as for synchronizing the clocks, if present, of all equipments of the System. TMS system clock shall synchronize the system of the In-Saloon CCTV system once TMS is powered up.

(d) The log files shall be viewable by using Microsoft Excel or Word program.

(e) The In-Saloon CCTV System shall allow the log files to be downloaded to a laptop computer via an 802.11 b/g wireless link.

(f) The In-Saloon CCTV System shall provide a user interface for basic configuration of the system parameters and monitoring of status of the system. The interface shall be accessible through the wireless link as

stipulated in PS 18.7.9 (e). The functions to be provided shall include, but not be limited to, the following:

- network link and network component status monitoring and setup;
- security key configuration;
- status of storage capacity;
- camera management; and
- fault viewing and reset.

18.7.12 The network stipulated in PS 18.7.7 shall provide at least 40 Mbps of TCP/IP data throughput between any two LAN ports. Upon the formal publish of the wireless standard 802.11n, the network shall be upgraded to at least 100 Mbps TCP/IP data throughput between any two LAN ports.

18.7.13 Video

(a) The In-Saloon CCTV System shall support the decompression and combining of images captured by the cameras, and smooth viewing of combined or un-combined images.

(b) The total delay induced by the In-Saloon CCTV System on the video images shall not be larger than 500 ms.

(c) The images displayed shall at all times be free from flicker, noise, and incorrect colour saturation

(d) The time from the operator completing a selection of source of video image to the selected image is actually displayed smoothly on the screen shall be less than 1 second.

18.7.14 The delivered system shall achieve an intrinsic availability of 99.9%.

18.7.15 All recording devices of the In-Saloon CCTV system shall be able to, in total, record at least 7 days of images from 32 cameras with the following assumptions:

- 19 hours operation per day;
- 70% movement of image;
- resolution of 795 × 596 pixels;
- MPEG 4 Part 10 / H.264 compression; and
- 15 frames per second.

18.7.16 All equipment installed on the train shall comply with IP55 rating or achieve an equivalent level of protection.

18.7.17 All equipment shall comply with EN50155 (2001). All equipment, the design of mounting and installation shall comply with the shock and vibration requirements to IEC 61373 (1999).

18.7.18 The network shall be an IP-based layer 2 or 3 network.

18.7.19 All network equipment shall conform to IEEE 802.11 standards, and shall be exempted from licensing requirement by OFTA.

18.7.20 Any compression technology used shall conform to MPEG 4 part 10 / H.264 standard.

18.7.21 All cases/enclosures of the trainborne equipment shall be earthed to the vehicle frame.

18.7.22 All equipment shall auto-restart and initializes itself to for normal operating state after a power interruption. Manual intervention for resetting, adjustment or like shall not be required.

18.7.23 The power consumption for the In-Saloon CCTV System shall not be greater than 180W per Train Unit and shall be submitted for Approval.

18.7.24 The Contractor shall not use any frequency bands which have already been occupied by various signalling and communications systems in the MTR environment.

18.7.25 The Contractor shall employ suitable techniques to minimize the effects of electromagnetic interference.

18.7.26 All equipment shall conform to the Electromagnetic Compatibility as stipulated in EN50121-3-2 and the Employer's design standard S/C&C/DS/007 Electromagnetic Compatibility and Non-ionizing Radiation.

18.7.27 All cables used for the In-saloon CCTV System shall comply with RS/C6014/06 Cable Standards.

18.7.28 All network cables employed for data transmission on trains shall be Cat 5-e Shielded Twisted Pair cables.

18.7.29 The details of all cables used in the In-saloon CCTV System shall be submitted for Approval.

18.7.30 The internal system clock shall have an accuracy of less than five seconds of deviation per year.

18.7.31 System Interfaces

(a) The In-saloon CCTV System shall interface with TMS via a serial link for the “Cab Occupied” signal, the operational commands, system status and fault messages. Details refer to Appendix I Annex 4.

(b) The trainborne video display shall interface with In-Cab CCTV video signal as stipulated in Appendix I Annex 4.

(c) The selection of saloon images shall interface with TMS on-screen commands for displaying the concerned areas of the activated PEAH of DVAS and PA, smoke detectors and train divided detection circuits.

18.8 Provision for Public WiFi Access

18.8.1 The Contractor shall make provisions for Public WiFi Access on the train. The trainborne Public WiFi Access equipment which will be provided by the Employer will include:

(a) antenna and wireless router at each driving cab for train to track or track to train continuous data transmission; and

(b) WiFi access points and routers in each saloon for passenger access.

18.8.2 The Contractor shall provide the infrastructure for the connection of the Public WiFi Access equipment, including:

(a) all train network equipment and accessories;

(b) net work cables;

(c) power supply and earth connections;

(d) all connectors, interfacing plugs and sockets;

(e) cable containments; and

(f) mounting interfaces for Public WiFi Access equipment as stipulated in PS 18.8.1.

18.8.3 The Contractor shall provide, design and install all interconnection cables, control and power cables, all connectors, interfacing plugs and sockets, earthing connections and all associated equipment housings, mounting and cable containment for Public WiFi Access devices.

18.8.4 The Contractor shall provide the appropriate d.c. power supplies including the power supply interface and the protection device to the Public WiFi Access devices.

18.8.5 The Contractor shall be responsible for test and commissioning of the infrastructure for connecting Public WiFi Access.

18.8.6 The Contractor shall make provisions for providing appropriate d.c. power supply and a.c. power supply including the power supply interfaces and the protection devices to the Public WiFi Access equipment as stipulated in PS 18.8.1 above.

18.8.7 Antenna and Wireless Router

(a) The mounting locations of the antenna and wireless router shall be in each driving cab.

(b) The antenna shall not be enclosed in any metallic cabinet.

(c) The feeder cable between the antenna and the wireless router shall be less than 5 m such that the location of the antenna and the wireless router shall be optimised.

(d) The power consumption of wireless router shall not exceed 200W.

18.8.8 Train Network

(a) The train network shall be an IP-based network. The network equipment shall enable the automatic assignment of IP addresses by the Dynamic Host Configuration Protocol (DHCP).

(b) The train network shall be connected to enable the sending of data packets and/or streams between any of the 8 cars of the train.

(c) The train network shall provide at least four LAN ports at each passenger car for connection of network devices. The ports shall be 10/100 Base-T Ethernet Ports for connection via Cat-5e cables.

(d) For the inter-connections between cars within a single Train Unit, fixed 10/100 Base-T Ethernet connection shall be provided; for the interconnections across Train Units, fixed 10/100 Base-T Ethernet connection with CAT5e cable shall be provided.

(e) The wireless device shall be able to upgrade to the highest data rate model by firmware and/or application software changes through the network, if the new IEEE 802.11 protocol is released.

(f) The network shall provide at least 40 Mbps of TCP/IP data throughput between any two LAN ports on a train. Upon the formal publish of the wireless standard 802.11n, the network shall be upgraded to at least 100 Mbps TCP/IP data throughput between any two LAN ports.

(g) In case power supply to one or more equipment of the network is lost and upon resumption of power supply, the network shall be able to automatically initialize itself to provide full functionality.

(h) Since train cars (or Train Units) may be swapped to become part of another train from time to time, once all train cars are properly coupled together and powered up, the network shall automatically re-configure itself to establish network connections with any newly added network equipments and start functioning as required.

18.8.9 WiFi access points and routers for passenger access

(a) Each saloon shall be equipped with WiFi access points and routers.

(b) The mounting location shall be line of sight at high level. The aesthetic design shall be submitted to the Engineer for Approval.

18.9 RFID for Trainborne Radio

18.9.1 The Contractor shall purchase from the Named Supplier of 4 Nos. Radio Frequency Identity (RFID) tags for each A-car (leading car) of the supplied trains and install the RFID tags on A-car body..

18.9.2 The Contractor shall ensure that the supplied RFID tags shall be operationally compatible with the existing RFID readers of the radio system and the existing RFID tags installed on the Urban Line Train. The supplied RFID tags shall have the same dimensions as the existing RFID Tags.

18.9.3 The Contractor shall design, supply and install the mounting bracket for the RFID tags.

18.9.4 Four (4) RFID tags shall be installed at the underframe structure of the car body of each A-car at 600 mm above rail level. Two (2) RFID tags shall be installed on A-side and the other 2 tags shall be installed on B-side of the A-car body. The 2 RFID tags on the same side shall be separated for at least 8 meters.

18.9.5 The RFID tags shall meet the "Performance Specification for Radio Frequency Identification Equipment Operating in the 865 – 868 MHz

and/or 920 - 925 MHz Bands" (HKTA 1041, Issue 1, April 2005) of the Office of the Communications Authority (OFCA). It shall also be compliant with all other relevant standards and code of practices issued by the OFCA.

18.9.6 The RFID equipment provided by the Contractor shall be exempted by the OFCA for application of license. The Contractor shall submit formal documents to demonstrate this exemption.

18.9.7 Each RFID tag shall be uniquely assigned with an equipment ID which shall be associated with the Car Consist Number (CCN) of the corresponding train. The Contractor shall program each RFID tag according to the numbering scheme of the RFID tags installed on the Urban Line Train.

18.9.8 The RFID equipment to be installed on train shall be mounted on the underframe structure of trains. No drilling of holes on the train body shall be allowed. The Contractor shall select RFID tag location that is free from blockage (in the direction of RFID Readers) by any metallic parts of the train.

18.9.9 The locations of the RFID tags shall be subject to operating and safety requirements. The Contractor shall submit the proposed mounting locations, mounting design and the associated structural calculations of the RFID tags to the Engineer for approval.

18.9.10 The RFID tags shall be able to withstand the environmental conditions and comply with the requirements as stipulated in below table. In particular, the RFID tags shall have an enclosure protection rating of IP66 as defined in IEC 60529.

Environmental factor	**Range/Requirement**
Temperature	0 to 50°C without air circulation
Humidity (Relative)	5 to 99%
shock and vibration	RIA 20 (Category 1 for equipment mounted on a vehicle body)
Immunity to Environmental	shall not be degraded by sunlight, dust, dirt, grease, heavy rainfall, water droplets, vapour disposition and the above operating conditions.
Wind speed	Up to 117km/h and gust speed of up to 216km/h blowing in the opposite direction of train movement.

18.9.11 The RFID tags shall not generate excessive interference to the existing equipment of the Employer and comply with the EMC requirements as stipulated in Appendix I Annex 4 Clause 1.9. Moreover, the operation of the RFID tags shall not be affected by existing equipment of the Employer.

18.9.12 The RFID tags shall not rely on any power supply source or battery, including internal battery, to support their operation.

18.9.13 The Contractor shall ensure that the RFID tags has a MTBF figure greater than170,000 hours and a logistic failure rate less than 0.025 failures per 10,000 hours.

18.9.14 The RFID tags shall be able to withstand corrosive environment, including the use of commercial acidic wash plant for train exterior cleaning.

18.10 RFID Axle Box Temperature Detection System

18.10.1 The Contractor shall purchase the following trainborne RFID Axle Box Temperature Detection System equipment from the Named Supplier specified in Appendix Q:

(a) Radio Frequency Identity (RFID) tag per bogie axle box
(b) Temperature sensor per bogie axle box

18.10.2 The Contractor shall ensure that the supplied RFID tags shall be operationally compatible with the existing RFID trackside readers, RFID handheld reader and Monitoring Server of the trackside RFID Axle Box Temperature Detection System in URL.

18.10.3 The Contractor shall supply and install the RFID tags and the temperature sensors including equipment mounting and cabling on all bogies. The proposed locations of RFID tag and temperature sensors as well as their mounting arrangements shall be submitted for Engineer’s approval.

18.10.4 The RFID equipment to be installed on train shall be mounted on the bogies of trains as stipulated in Appendix I Annex 4 Clause 9.2. The RFID tag locations on bogie shall be optimized to achieve the wide signal coverage with trackside receivers.

18.10.5 Provision of automatic association system between RFID tag and Axle Box Position. The RFID tags shall be read by existing handheld reader for automatic tag identification system.

18.10.6 Provide necessary amendment to existing automatic tag identification system.

18.10.7 Provision of MMI software amendment or display modification on the RFID system in URL Depots and MMC, so as to ensure the New Trains can also be monitored in other locations if necessary. The existing Employer Monitoring Server shall be used in MMC to display both RFID Axle Box Monitoring systems concurrently.

18.10.8 Provide necessary amendment on the operation and maintenance manual for the whole of RFID system.

18.10.9 Provision of amended as-built drawing for whole of the RFID system.

18.10.10 The Contractor shall be responsible to test and commission the trainborne RFID Axle Box Temperature Detection System and conduct the integrated test in Employer premises in accordance with Appendix C.

SECTION 19

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SECTION 20

MATERIALS AND WORKMANSHIP REQUIREMENTS

August 2015

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20 MATERIALS AND WORKMANSHIP REQUIREMENTS

20.1 General

20.2 Materials

20.3 Materials Testing

20.4 Workmanship

20 MATERIALS AND WORKMANSHIP REQUIREMENTS

20.1 General

20.1.1 All materials and workmanship shall be in every respect in accordance with the proven up-to-date best practice.

20.1.2 Whenever the PS, Drawings or directions/instructions of the Engineer is doubt for about what is permissible and when the required quality of any work is not specified, the interpretation which requires the best quality of work shall be followed.

20.2 Materials

20.2.1 Materials used in the construction of the train shall not constitute a health hazard for passengers, staff or the public. Prohibited materials shall include but shall not be limited to the following:

(a) Asbestos
(b) Lead based pigment paints
(c) Halogens in greater concentrations than those specified in RS/C6014/08.

The use of all materials shall be submitted for Approval.

20.2.2 All materials including painting used on the vehicles shall be of a Limited Fire Hazard type to the requirements of RS/C6014/08 except fuel, transmission oil and lubricants.

20.2.3 The Contractor shall consider at all stages of SEMP, the specification of all materials with regard to their health and safety impact both in handling, use and disposal, and in this regard shall incorporate into the Safety Management Plan according to the GS Section 15.

20.2.4 The Contractor shall consider at all stages of SEMP, the specification of all materials with regard to their environmental impact both in use and upon eventual disposal, and in this regard shall incorporate into the Environmental Management Plan according to GS Section 17

20.2.5 A schedule of all materials used shall be regularly updated and submitted and shall include the following:-

(a) Composition
(b) Quantity (kg)
(c) Life Expectancy

(d) Items that would be re-cycled at mid-life refurbishment and at life expiry
(e) Means of disposal and environmental effect of this disposal
(f) Labelling with regards to composition and hazard

20.2.6 In addition to the materials used during construction the schedule (refer to PS 20.2.5) shall also list materials used in the maintenance and cleaning of the trains, their usage rates and disposal procedures.

20.3 Materials Testing

20.3.1 Fire Performance

(a) The Contractor shall supply and maintain a schedule of non-metallic materials used in the construction of the trains under the Configuration Management requirements (refer to PS 21.3.10(b)).

(b) This schedule shall give information in respect of the fire certification of the materials and groupings of materials in assemblies (copies of which shall be supplied), the national or international standard applicable to the material, its location, the amounts used and its calorific value.

(c) The schedule shall include a fire load calculation for the train. This latter feature will be used to highlight materials with particular fire hazard potential so that special attention can be paid to the fire test results, with a view to ensuring that this potential is not realised.

(d) The schedule shall be audited periodically in line with the Systems Assurance Plan (refer to PS 25).

(e) Triplicate testing, generally to ISO 5660: Part 1, shall be carried out for materials/composites which form major and/or significant surfaces within the saloons.

(f) Where composites are used, eg. seat trim, these shall be tested at the maximum convenient thickness (25mm) and shall be as closely representative of the item concerned as possible.

(g) In addition to the standard test house report, data from each test shall be supplied in an electronic form on CD-ROM/DVD-ROM which shall be compatible with Microsoft Windows XP computers or a later version, which submitted for Engineer's Approval (refer to GS Section 10).

(h) The materials/composites tested shall be representative of the surfaces listed below and shall be tested at the stated input radiation (flux). In each

test the scan time shall be 2.0 s and the test duration shall not be less than 1200 s irrespective of the sample behaviour.

(i) ISO 5660 instruments are available which also record smoke, CO and CO_2 emission. This data shall also be supplied. In addition, video recording an example of each material during testing shall be provided.

Surface	Flux kWm^{-2}
Floor	20
Wall	35
Ceiling	50
Seat Shell Back	35
Seat Shell Base	50
Seat Trim Back	35
Seat Trim Base	20

(j) This additional testing is required for information purposes and there shall be no pass/fail criteria.

20.3.2 Power Output on Flash-Over Fires

(a) The Contractor shall carry out prediction and final evaluation on the power output from flash over fire in accordance with RS/C6014/08.

(b) The maximum power output on flash-over fires shall not exceed 5 MW per car.

20.3.3 Suitability of Materials

(a) Where materials used in the construction of the vehicles are not in accordance with the specified requirement or standards samples of such materials shall, if instructed by the Engineer, be tested at an Approved Laboratory at the Contractor's expense.

(b) All materials or details represented by these samples, which are found not to be in accordance with this Specification, or are unfit for purpose will be rejected. The Contractor shall replace, at his own expense, any materials thus rejected, with a suitable alternative which shall be submitted for Approval.

(c) The Contractor shall submit with his offer a general precis of his procurement and quality assurance procedures. Not later than six months after placement of the order, full details shall be given so that the

Engineer can arrange for an appropriate level of inspection at all stages of manufacture.

20.3.4 Certification

(a) All materials used in the construction of the vehicles shall be procured with a Certificate of Conformity in line with the Contractors Quality Control procedures.

(b) The documentation shall be held by the Contractor or his subcontractor as appropriate and shall be made available to the Engineer at all reasonable times upon demand.

20.4 Workmanship

The constructional and workmanship requirements specified in RS/C6014/02 shall be complied with.

SECTION 21

DESIGN REQUIREMENTS

August 2015

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21 DESIGN REQUIREMENTS

21.1 Purpose

21.2 Policies

21.3 System Engineering Management Plan (SEMP)

21.4 System Assurance Plan

21.5 Operability Plan

21.6 Weight Management Plan

21.7 Electromagnetic Compatibility Plan

21.8 Noise Plan

21.9 Software Management Plan

21.10 Fire Engineering Plan

Figure 21-1 Overview of the Design Life Cycle

Figure 21-2 Overview of the System Engineering Management System

21 DESIGN REQUIREMENTS

21.1 Purpose

21.1.1 The policies and procedures presented in this Section establish a common frame of reference for developing the System Engineering Management System (SEMS).

21.1.2 These policies and procedures establish the basis for integrating the technical efforts of the entire design team of the Contractor to meet programme, quality and performance objectives with an optimal design solution that encompasses the system and its associated manufacturing, test and support processes.

21.1.3 The Contractor shall establish and maintain the SEMS in accordance with the policies and procedures.

21.2 Policies

21.2.1 The Contractor shall nominate a System Engineering Management (SEM) representative with overall responsibility for the SEMS. The SEMS shall be initiated by a series of design plans (refer to PS 21.2.3) which shall identify and establish the required documents detailing policy, organizations, engineering tasks, processes and the necessary documentation to be prepared.

21.2.2 The System Engineering Management shall be applied throughout the design life cycle (refer to Figure 21-1) as a comprehensive, iterative technical management process to:

(a) Translate the operational needs into configured systems through a systematic, concurrent approach to integrated design of the systems and the related manufacturing, test and support processes;

(b) Integrate the technical inputs of the entire design team and all technical disciplines (including the concurrent engineering of manufacturing, logistics and test) into a coordinated effort that meets established programme, quality and performance objectives;

(c) Ensure the compatibility of all functional and physical interfaces (internal and external) and ensure that system definition and design reflect the requirements for all system elements: hardware, software, facilities, people and data;

(d) Characterize technical risks, develop risk abatement approaches and reduce technical risk through early test and demonstration of system elements. The result of the above risk assessment shall be documented in the System Assurance Plan (refer to PS 21.4).

(e) The systems engineering process shall place equal emphasis on system capability, manufacturing processes, test processes and support processes.

21.2.3 The following design plans shall be documented and used in SEMS as System Engineering Management tools or agents to ensure achievement of the required performances:

(a) System Engineering Management Plan (refer to PS 21.3);
(b) System Assurance Plan (refer to PS 21.4);
(c) Operability Plan (refer to PS 21.5);
(d) Weight Management Plan (refer to PS 21.6);
(e) Electromagnetic Compatibility Plan (refer to PS 21.7);
(f) Noise Plan (refer to PS 21.8);
(g) Software Management Plan (refer to PS 21.9); and
(h) Fire Engineering Plan (refer to PS 21.10).

21.2.4 Total system approach shall be used on the System Engineering Management in order to optimise total system performance and minimize the cost of ownership. The total system consists the prime rolling stock equipment, the people who operate and maintain the system, the systems security procedures and practices, the operation of the system in its intended operational environment and the way the system responds to any effects unique to that environment; the compatibility, interoperability and integration of the system with other systems; the operational and support infrastructure (including Control, Communications); training and training devices; any data required by the system in order for it to operate; and the system's potential impact on the environment and environmental compliance.

21.2.5 The Configuration Management shall be used as a supporting function to the System Engineering Management throughout the design life cycle. The Configuration Management provides the means for formal control of the technical aspects of a project and anchors the operational and technical requirements in documentation that is standard for both the Engineer and Contractor (refer to PS 21.3.10).

21.2.6 The SEMS shall be an integral part of the Quality Management System (refer to PS 27) and shall also meet the requirement for Quality Assurance or Management in design in accordance with the ISO 9001 : 2000.

21.2.7 In order to ensure the above SEM requirements are met, a representative from the sub-contractor, manufacturer, supplier or vendor shall be nominated for each major system/equipment (refer to Appendix K) to lead the design management of the associated major system/equipment and to assist the SEM representative (refer to PS 21.2.1) to perform the required SEM tasks.

21.3 System Engineering Management Plan (SEMP)

21.3.1 The System Engineering Management Plan (SEMP) shall establish the plan for the System Engineering Management required to define the system performance parameters and preferred system configuration to satisfy the technical requirements as stipulated in the PS, the planning and control of technical program tasks, integration of the engineering specialities and the management of a totally integrated effort of design engineering, computer software engineering, specialty engineering, test engineering, logistics engineering, quality evaluation and production engineering to meet cost, technical performance, quality and schedule objectives for a specific project or program. Refer to Figure 21-2 for an overview of the System Engineering Management System.

21.3.2 Design Data Submission Plan (DDSP)

The SEMP shall include a Design Data Submission Plan (DDSP) which shall be submitted to the Engineer by the date stated in the PS (refer to Appendix F). The DDSP shall show in detail the timing and sequence of each design submission (refer to GS Section 10.9) in accordance with the SEMP. The DDSP shall contain but not be limited to the following information:

(a) Design Approval Request (DAR) Number
(b) Title of the DAR
(c) Contractor's reference
(d) Contractor's document reference or drawing number
(e) Relevant Clause(s) in the PS
(f) Expected submission date of each DAR
(g) Actual submission date of each DAR
(h) Status

21.3.3 The DDSP shall be reviewed in the Technical Review Meeting (refer to PS 21.3.8). If required by the Engineer, the DDSP shall be revised in order to meet the design requirements.

21.3.4 Five stages of SEMP

The Contractor shall identify five stages of the SEMP in accordance with the following definitions:

SEMP 1: Concept Exploration

SEMP 2: Design Development and Review;

SEMP 3: Design Verification and Validation;

SEMP 4: Engineering and Manufacturing Development Phase;

SEMP 5: Inspection, Testing and Training;

Detailed criteria for the SEMP stages are defined in Appendix N.

21.3.5 SEMP Presentation

(a) At the end of each stage of the SEMP, a SEMP presentation shall be conducted and a SEMP report shall be submitted which shall cover each section of the plans as specified in PS 21.2.3.

(b) Unless otherwise specified, the SEMP presentation shall be conducted at the Engineer's premises.

(c) The SEMP report shall present an integrated approach between the sections of the plan demonstrating that the Contractor is addressing the requirements of each section concurrently.

21.3.6 Each SEMP stage, ends in a milestone, to be identified in the Schedule of Critical Dates (refer to Appendix F).

21.3.7 Monthly SEMS Reports

(a) The Contractor shall prepare Monthly SEMS Reports, which shall be submitted to the Engineer by the first week of the month.

(b) The SEMS Report shall focus on the technical issues, progress of the SEMP and its associated design plans and summary of the design submission status.

21.3.8 Technical Review Meeting

(a) During the execution of the Contract, the Engineer will call technical review meetings as he deems necessary to discuss the progress of the design works in accordance with the above SEMP.

(b) The SEM representative (refer to PS 21.2.1) or his written delegate who shall be responsible for all technical matters, shall attend the technical review meetings.

(c) If required by the Engineer, the responsible sub-contractor, manufacturer, supplier or vendor as nominated for each major system/equipment (refer to PS 21.2.7) shall attend the technical review meetings. In addition, the responsible engineers or designers of the Contractor shall be presented in such meetings if it is deemed necessary by the Engineer.

(d) In general meetings will be held bi-monthly, but can take place more frequently if required.

(e) Unless otherwise specified, the technical review meeting shall be conducted at the Contractor's premises and minutes of these meetings will be issued by the Engineer.

21.3.9 Engineering Audit

(a) Periodically during the life of the Contract the Engineer will conduct compliance audits of the SEMS to ensure the design, procurement, manufacturing and testing works conform to the PS requirements. Not less than 4 weeks notice will be given by the Engineer. The Contractor shall provide suitably qualified staff to accompany the audit team.

(b) The Contractor shall be responsible for ensuring that subcontractors, vendors and suppliers of the major systems/equipment participate in the engineering audits, as appropriate.

(c) Unless otherwise specified, the engineering audits shall be conducted at the Contractor's facility or at a designated subcontractor facility. The Contractor shall provide the necessary equipment, facilities and material to perform the engineering audit effectively.

(d) The Contractor shall:

(i) Ensure that each engineering audit schedule is compatible with the availability of the necessary information and contract documents, for example, system engineering data, trade study results, producibility analysis results, risk analysis results, specifications, manuals, drawings, reports, hardware, software, or mockups.

(ii) Ensure that all subcontractors, vendors and suppliers personnel or those chosen to make presentations of design proposals shall be prepared to discuss in technical detail any of the presented material within the scope of the review.

(iii) Follow up and resolve all action items in the minutes which will be prepared and distributed by the Engineer and identify whether subcontractors, vendors and/or suppliers actions are required for its resolution.

21.3.10 Configuration Management

(a) Objectives

(i) To define material both functionally and physically by drawings, specifications and related documentation identifying the configuration to the lowest level required to assure repeatable performance.

(ii) To perform the technical and administrative functions of identifying, recording, controlling and reporting the functional and physical characteristics of material during its life cycle.

(iii) To allow the maximum degree of design and development latitude, yet to introduce at the appropriate time the degree and depth of configuration control necessary for production, interoperability and logistic support.

(iv) To ensure that the configuration of Configuration Items (refer to PS 21.3.10(b)) is known and the pertinent functional and physical interfaces between systems, equipments and software are established, controlled and recorded throughout their life cycle.

(v) To ensure that specifications, engineering drawings, software documentation and the related technical data are adequate to facilitate the Configuration Control Program (refer to PS 21.3.11).

(b) Configuration Items

(i) The Configuration Items shall be an aggregation of the approved hardware, firmware, software, or any of its discrete portions, which satisfies an end use function and is designated for configuration management.

(ii) Configuration Items may vary widely in complexity, size and type, from a system, assembly or component to a test meter.

(iii) During development and manufacture of the initial production configuration, Configuration Items are those items whose performance parameters and physical characteristics must be separately specified and controlled to provide the management insight needed to achieve the overall end use function and performance.

(c) As an integral part of the SEMP, the Contractor shall submit a pertinent issue of Configuration Identification List which is the summary of all approved Configuration Items at the end of each stage of SEMP. The Configuration Identification List shall also form part of the SEMS Report (refer to PS 21.3.7).

(d) The Contractor shall ensure that the current approved Configuration Documentation is available when needed.

21.3.11 Configuration Control Program

(a) Objective

(i) To attain maximum efficiency in the management of engineering changes by ensuring that Engineering Change Proposals are justified, processed and evaluated promptly and, when Approved, are implemented using approved procedures.

(ii) To ensure that total performance, cost effect and the effect of Engineering Change Proposals, concessions and production permits on the project are known at the time of their Approval.

(b) As part of the SEMP, the Contractor shall submit a Configuration Control Program for preparing and submitting Engineering Change Proposals and related information.

(c) The proposed engineering changes require a complete analysis of the impact of the proposed engineering change.

(d) The detailed requirements of the Configuration Control Program shall be referred to Appendix P.

21.4 System Assurance Plan

21.4.1 It is an essential requirement of the train design that at every stage of SEMP, the requirements of safety, reliability, availability and maintainability are adequately considered and any modifications resulting from these considerations be included in the design. Therefore, the Contractor shall provide a System Assurance Plan which shall detail the Contractor's intended methodology for controlling the system assurance process within his own organisation and cover his subcontractors, vendors and suppliers with an aim to meet the system assurance requirements specified in PS 25.

21.4.2 The detailed requirements of the System Assurance Plan shall be referred to PS 25.2.1.

21.5 Operability Plan

21.5.1 As an integral part of the SEMP, the Contractor shall submit an Operability Plan which shall include a study of the man-machine interface in order to ensure the user friendliness of the train system. Both quantitative and qualitative measures shall be used to determine the user friendliness.

21.5.2 The process of ensuring operability is continuous and consists of the verification of operability by operators and formal determinations of operability whenever a verification or other indication shall be called into question of the system's or component's ability to perform its specified function.

21.5.3 The detailed requirements of the operability plan shall be referred to RS/C6014/14.

21.6 Weight Management Plan

21.6.1 As an integral part of the SEMP, the Contractor shall submit a weight management plan which shall define the way in which the requirements for overall vehicle weight and weight distribution shall be achieved.

21.6.2 The weight management plan shall include, but not be limited to, the following items:

(a) Appointment of a person with the responsibility of developing the overall vehicle weights and weight distribution from the individual component weights.

(b) Allocation of maximum weights for subcontractors equipment during the purchasing phase so that the maximum weight for the equipment can form a part of the contract for that equipment.

(c) Review of weight with a view to weight saving as an integral part of the design review process.

(d) Publication of a weight report, on a monthly basis, in which the emerging weight is updated and any variations from the previous report are explained and justified.

(e) Verification of the weights of individual components during the manufacturing phase.

21.7 Electromagnetic Compatibility Plan

21.7.1 As an integral part of the SEMP, the Contractor shall submit a Electromagnetic Compatibility (EMC) Plan which shall define the overall approach and methodology in achieving the electromagnetic compatibility requirements.

21.7.2 It is essential that the Contractor and all sub-contractor(s) shall conform to the EMC requirements as defined by the EMC Plan.

21.7.3 The detailed requirements of the EMC Plan shall be referred to RS/C6014/04.

21.8 Noise Plan

21.8.1 The Contractor shall submit a detailed Noise Plan and programme to illustrate the manner in which the required exterior and interior noise levels will be achieved and the necessary interfaces between the Contractor and the noise specialist.

21.8.2 The detailed requirements of the Noise Plan shall be referred to RS/C6014/13.

21.9 Software Management Plan

21.9.1 As an integral part of the SEMP, the Contractor shall submit a Software Management Plan consisting of the Software Quality Plan, Software Development Programme, Software Verification and Validation Plan and Software Configuration Management Plan which shall define the planning, design, development, verification, validation, maintenance and configuration management of all software supplied for the Contract. The primary objective of the Software Management Plan is to ensure the quality of all software supplied which form part of the integrated systems to meet the Contract requirements.

21.9.2 It is essential that all software suppliers (the Contractor and all subcontractor(s)) shall conform to the software requirements as defined by the Software Management Plan.

21.9.3 The detailed requirements of the Software Management Plan shall be referred to RS/C6014/05. The events defined by the Software Quality Plan and Software Verification and Validation Plan shall be integrated with the stages of the SEMP.

21.10 Fire Engineering Plan

21.10.1 As an integral part of the SEMP, the Contractor shall submit a Fire Engineering Plan.

21.10.2 The detailed requirements of Fire Engineering Plan shall be referred to RS/C6014/08.

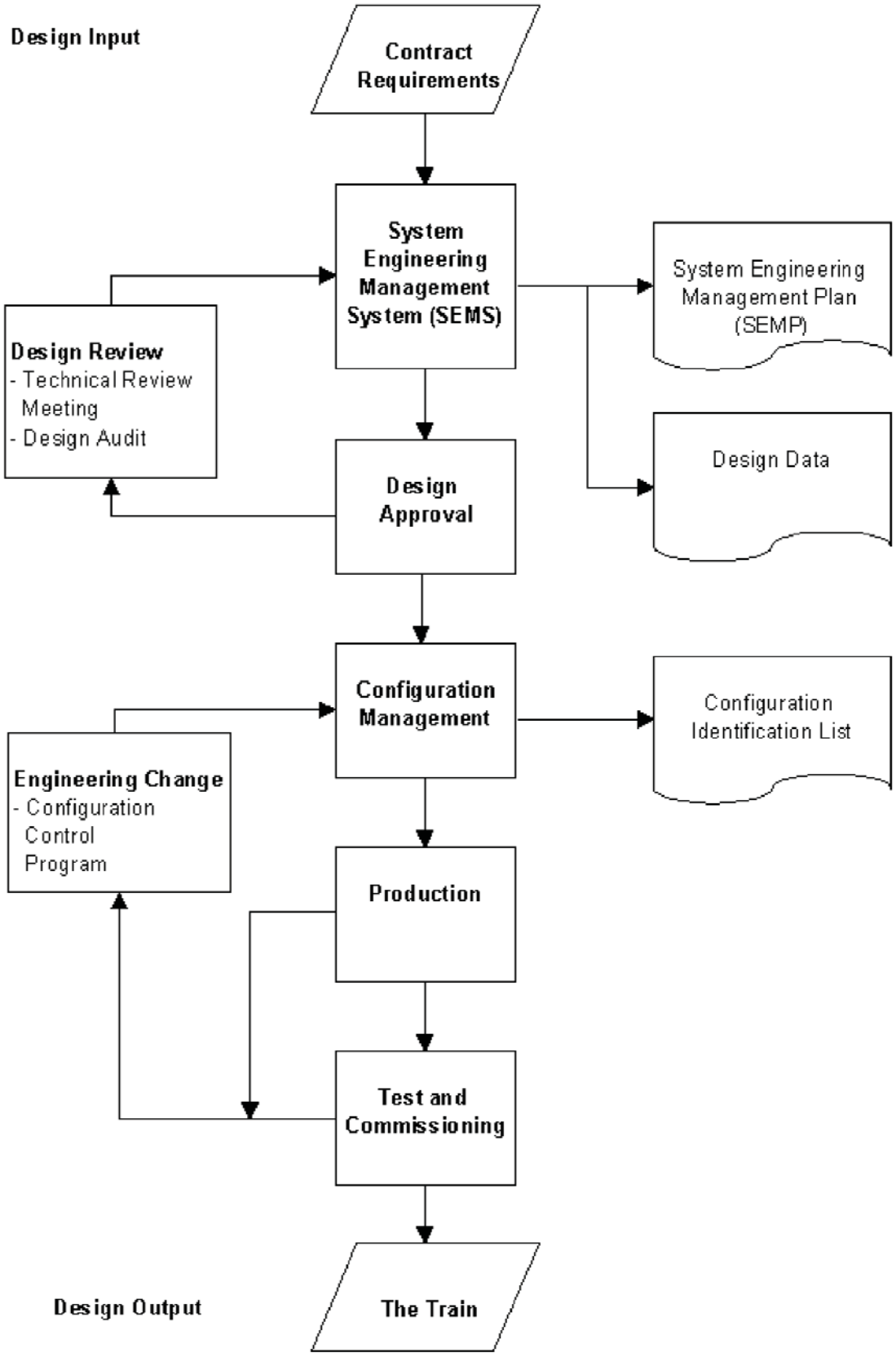

Figure 21-1 Overview of the Design Life Cycle

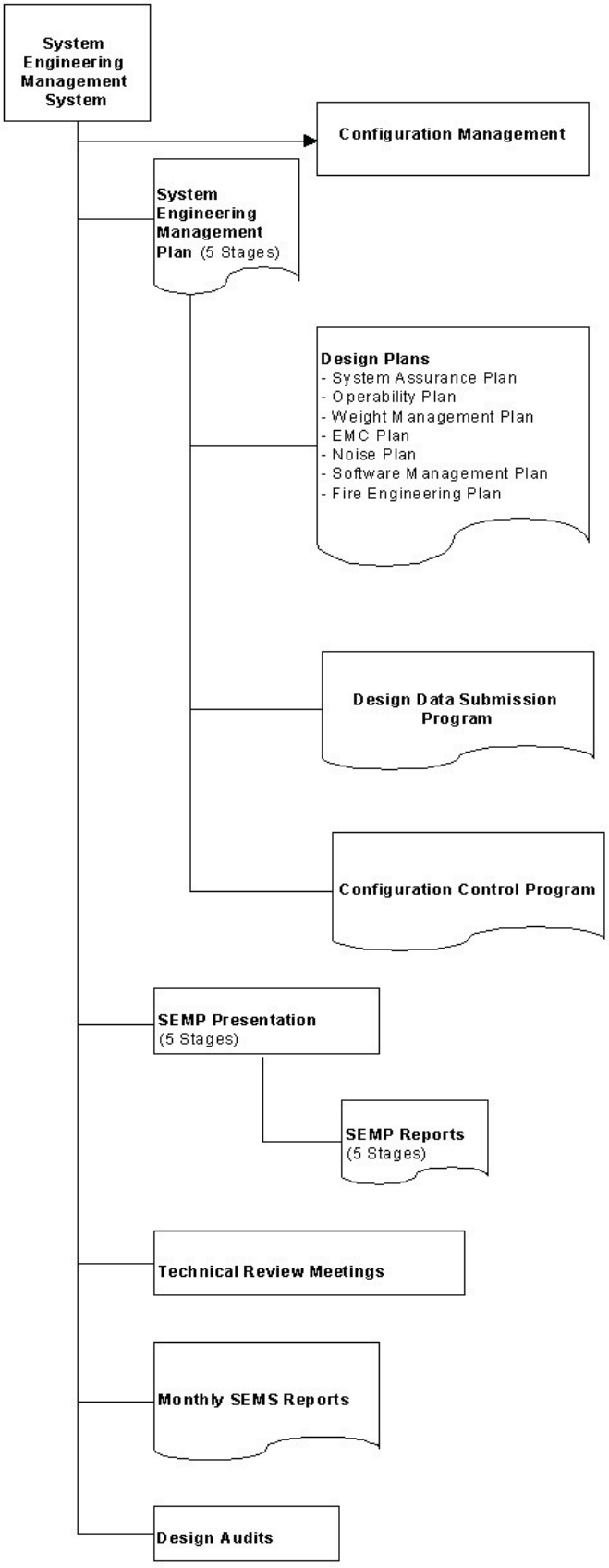

Figure 21-2 Overview of the System Engineering Management System

SECTION 22

TESTING REQUIREMENTS

August 2015

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22 TESTING REQUIREMENTS

22.1 General Requirements

22.2 Format of Specifications

22.3 Approval Process

22.4 Testing Facilities

22.5 Notification of Tests/Inspections

22.6 Nature of Tests/Inspections

22.7 Tests/inspections Process

22.8 Acceptance Procedure

22.9 Works Tests

22.10 Commissioning (Tests in Hong Kong)

22.11 Tests on Completion

22.12 Integrated Test

22.13 Certificate of Completion of Part of the Works

22.14 Not Used

22 TESTING REQUIREMENTS

22.1 General Requirements

22.1.1 The fitness for purpose of all cars, Train Units, trains, systems and items of equipment shall be demonstrated by a combination of tests/inspections including Works Tests (refer to PS 22.9), Commissioning Tests in Hong Kong (refer to PS 22.10), Tests on Completion (refer to PS 22.11) and Integrated Testing (refer to PS 22.12) during the SEMP stage 5 (refer to PS 21.3.4). These tests/inspections shall be performed at the Contractor's works or in the Employer's facilities, or other agreed venue, or as considered relevant. Detailed requirements of the above tests/inspections shall comply with the Tables App-C-1 to App-C-4 in Appendix C.

22.1.2 A Preliminary Testing Plan shall be provided and submitted for Approval by the end of SEMP stage 2. The Preliminary Testing Plan shall include the following items:

(a) Identify the testing requirements for all stages of tests specified in PS 22.1.1.

(b) Identify the Contractor's representative who will be the overall in charge of the testing and commissioning phases.

(c) Provide a preliminary testing programme which shall include staff resources. This programme shall be able to demonstrate that all tests shall be achievable taking into account of time-scales, man-power constrains with regards to the proposed testing work patterns.

(d) Identify any testing instructions and specifications that may be required.

(e) Take into account of any training needs.

(f) Define the limits of the testing, particularly the responsibilities and interfaces.

(g) Highlight the site transport and office accommodation requirements for system/equipment under test and testing staff.

(h) Ensure that occupational safety considerations are adequately addressed.

(i) Define the style and length of tests, commissioning and possessions of the Employer's track.

(j) Identify the required test and communication equipment, such as test instruments, special tools and portable radios.

22.1.3 A Testing Plan shall be provided and submitted for Approval by the end of SEMP stage 3 and the Preliminary Testing Plan specified in PS 22.1.2 shall be used as the baseline of the Testing Plan. The Testing Plan shall include the following items:

(a) Confirm all items specified in the Preliminary Testing Plan are fully covered.

(b) Give a full description of the work and the associated testing.

(c) Establish a firm testing programme, including the proposed commissioning dates.

(d) Define the limits of capabilities and responsibilities for each sections of system, sub-systems and components under test.

(e) Define the interfaces with other systems and disciplines.

(f) Specify the staff resources and competency requirements.

(g) Confirm training requirements.

(h) Identify occupational safety requirements.

(i) List all documentation to be used, including testing instructions, codes of practice and testing specification. The submission dates of these documentations shall also be specified in the testing programme for Approval.

(j) Specify the train movements, if applicable.

22.1.4 Logical and practical divisions of test/inspection items shall be included in the Testing Plan. It shall also allow sections of the system or subsystems to be tested individually and separately if necessary. Any overlap between these sections shall be clearly identified and there shall be no gaps.

22.1.5 Tests/inspections shall be planned in such a manner that all sections of the system or sub-systems shall be successfully tested and proved meeting the PS requirements before installing onto the train. In addition, once a sub-system or its component parts have been taken through a series of tests, they shall not be dismantled to facilitate subsequent tests in order to avoid negating the original tests.

22.1.6 Contingency arrangements shall be included in the Testing Plan to facilitate a planned response to foreseeable problems in order to avoid

affecting the manufacturing, assembling, testing and commissioning programmes. Procedures such as design change control (refer to Appendix P) shall be incorporated.

22.1.7 Testing Plans shall be updated and refined in response to changes in the objectives of the scheme, or to clarify the objectives of each test and its relationship with other tests.

22.1.8 A Commissioning Plan shall be developed from the above Testing Plan and submit for Approval. It shall cover all critical testing activity particularly the interfaces with other systems specified in Appendix I. Any liaison with engineers of other disciplines required from the Employer or other contracts during the test and commissioning phase shall be specified in the Plan. The Commissioning Plan shall include the following items:

(a) Define items from the testing plan in details.

(b) Define interface limits.

(c) Describe the commissioning team and allocate clearly the roles and responsibilities of each team member.

(d) List the sections of system, sub-systems or equipment to be commissioned.

(e) State the documentation control procedures to be used for the commissioning phase.

22.1.9 The tests/inspections shall be carried out to approved national or international standards or as dictated elsewhere in the Specification, and in accordance with the Approved Inspection and Testing Plan (refer to GS Clause 8.2.3).

22.1.10 All components and assemblies shall be subject to a First Article Inspection (FAI) (refer to PS 22.6) at the place of manufacture by the Engineer or his appointed representative prior to be installed onto the train.

22.1.11 Where an item of equipment has been used previously in a similar application then the Type Test (refer to PS 22.6) results may be submitted for Approval in place of conducting a type test for that item of equipment. Approval will be given only where sufficient evidence is provided to show that the equipment successfully passed all type tests required by the PS, or more arduous tests, and that the item is the same as that to be provided under the Contract.

22.1.12 For the micro-processor based systems, sub-systems or equipment shall require strict adherence to the requirements of software and change control specified in RS/C6014/05.

22.1.13 In association with the change of software version during module replacement or modification, the micro-processor based systems, subsystems and equipment shall be provided with the built-in version control and can be accessed by the diagnostic/testing facilities specified in PS 24.3.11. Proper procedure shall be provided in the above plans to state the software version change control and records shall be provided to the satisfactory of the Engineer that this control measures are being adequately performed during test and commissioning phases.

22.1.14 Where an item of equipment fails to meet the requirements of any particular test or inspection stage then it shall be the responsibility of the Contractor to take corrective action to make good any defect thus found across all items of that type on all production trains and spare parts (refer to PS 24) at his cost.

22.1.15 Between the testing and commissioning phases and handover of the trains, a maintenance regime shall be provided to ensure that all systems, sub-system and equipment remain in the design intended condition. The scope and responsibility for this shall be clearly defined in the Testing Plan (refer to PS 22.1.3) and the Commissioning Plan (refer to PS 22.1.8). Any spares, where appropriate, shall be specified and provided.

22.1.16 Any equipment or component used for the purposes of test including mock up or prototype installation shall be maintained, repaired and made good any defect found or replaced at the Contractor's cost prior to deliver to the Employer.

22.1.17 In the event that any test is failed, the Contractor shall, at his own expense, take whatever action is deemed necessary, such as, rectification, readjustment or design changes (including software modifications) on all production trains and spare parts (refer to PS 24) to the satisfaction of the Engineer, in order to meet the testing requirement.

22.1.18 A full report of all failures occurring during testing shall be submitted to the Engineer, who may require that a modification be carried out to rectify any defects thus encountered.

22.1.19 Before any proposed change is implemented, it shall be subject to a preliminary hazard and RAM assessment according to PS 25.5.1 in order to proof that no adverse effect to the safety and RAM performance will be caused by the proposed change.

22.1.20 All changes and modifications shall be subject to the normal design and Approval processes according to the Configuration Control Program (refer to Appendix P). The Engineer may, at his discretion, request the undertaking of further tests to validate the design changes undertaken at the Contractor's cost.

22.1.21 Modifications required to make equipment pass tests shall be applied to all similar equipment on all production trains and spare parts (refer to PS 24). Modification instructions, test instructions and modification programme shall be submitted for Approval according to the Configuration Control Program (refer to Appendix P). Approval will not be granted unless the Engineer is provided with sufficient information to demonstrate that the results of type tests will not be invalidated by the modification.

22.2 Format of Specifications

22.2.1 Separate specifications shall be submitted for each individual Works Tests, Commissioning Tests, Tests on Completion and Integrated Tests. The specifications shall be applied on both inspections and tests and it shall include the following items:

(a) Detailed testing procedures, the test instrumentation and circuitry to be employed, the exact parameters to be measured and the acceptance criteria to be applied to each measurement.

(b) Test records which shall serve the purpose of certification of the successful completion of a test.

(c) Check-lists to assist the recording process of tests and commissioning.

(d) Annotation to specify the following information:

(i) precise method of confirming the successful completion of a test, for example, a tick.

(ii) clear identification of who carried out the test, for example, printed name and position.

(iii) method of adding reminder notes and comments.

(iv) precise methods of confirming completed sections, for example, individual sheets, series of tests, stage-works.

(v) method of identifying errors and invoking corrective action in the event of failed tests.

(vi) maintenance of test logs showing the tests failed and the remedial action taken.

22.2.2 Should the Engineer consider that the tests/inspections proposed to be inadequate to verify fitness for purpose, the Engineer shall have the right to call for additional tests/inspections stages at no cost to the Employer.

22.2.3 Should any measurements made be subject to a tolerance then this tolerance must be stated in the testing or inspection specification.

22.3 Approval Process

22.3.1 Not less than 90 days before the commencement of any test the detailed Test or Inspection Specification shall be submitted for Approval which shall form part of the level 4 design information as defined in the Appendix N Clause 2.

22.3.2 The Contractor shall submit for Approval a Schedule of Tests according to GS Clause 10.11.4 and 24.2.2. This Schedule shall be based on the Inspection and Testing Plan (refer to GS Clause 8.2.3) and shall indicate the approximate date of the test and the venue of the test.

22.3.3 No tests shall be carried out until:

(a) the full design information has been submitted for Approval and reached an Approved in Principle status; and

(b) both the Test Specification and the Schedule of Tests have been Approved

22.3.4 At the Engineer's discretion, note that any tests carried out before Approval shall be repeated at no extra cost to the Employer and following reasonable notice.

22.4 Testing Facilities

22.4.1 The Contractor shall bear the cost of all testing facilities, including all materials, samples, test pieces, items of equipment, labour, fuel, duly certified instrumentation and measuring equipment.

22.4.2 The Contractor shall provide all facilities at his premises for conducting these tests unless a more appropriate venue is chosen. If this is the case then the Contractor shall advise the new venue for Approval and bear the costs associated with testing at the alternative site.

22.5 Notification of Testing/Inspection

22.5.1 At the discretion of the Engineer, all testing/inspection is subject to the requirement for witnessing by the Engineer or his appointed representative, and as such, notice is required of the commencement of all tests and inspection stages identified in the Inspection and Testing Plan, including the Works Tests, Commissioning Tests, Tests on Completion and Integrated Testing.

22.5.2 A minimum of twenty one (21) days notice in writing shall be given prior to the commencement of any tests or inspection stages (including First Article Inspection) according to the Approved Schedule of Tests (refer to PS 22.3.2). This notice shall state the venue, the starting date and time/duration of the tests.

22.6 Nature of Tests/Inspections

22.6.1 Testing shall be divided into two distinct categories, namely Type Testing and Routine Testing. Type Testing is required to verify that the piece of equipment or system operates in accordance with the Approved Design Data. Routine Testing is required to verify that the equipment or system has been built in such a way that it satisfies the requirements of the Approved Design Data (refer to Appendix N) as verified by the Type Test.

22.6.2 Inspection shall also be divided in a similar manner, namely First Article Inspection and Routine Inspection. The First Article Inspection verifies that the Approved Design criteria have been met and the Routine Inspections ensure that the standard, Approved at First Article Inspection, is being maintained.

22.6.3 To demonstrate consistent production quality these Type and Routine Tests/Inspections shall also be completed in full or in part to the satisfaction of the Engineer at production cycle intervals agreed with the Engineer.

22.7 Tests/Inspections Process

22.7.1 The Contractor shall perform the test/inspection according to the Approved Test and Inspection Specification.

22.7.2 The Engineer shall have the right to witness any of these test/inspection at any stage of test/inspection progress. The Engineer shall also have the right to take independent test/inspection recordings including photographs and videos other than Contractor’s recordings during his witness to any of these test/inspection at any stage of test/inspection progress in the Contractor’s premises or sub-contractor’s premises.

22.7.3 Where a test/inspection stage requires that a measurement be made, then the result of this measurement together with the serial number of the measuring instrument shall be recorded on a suitable results sheet, embodied in the test/inspection specification according to PS 22.2.1 above.

22.8 Acceptance Procedure

22.8.1 Unless otherwise specified, the results of all Type and Routine Inspections/Test shall be submitted for Approval in the form of a report which shall form part of the level 4 design information as defined in the Appendix N Clause 2, no later than ten (10) days following the successful completion of each Type or Routine Inspections/Tests. Approval will only be granted where it is demonstrated to the satisfaction of the Engineer that the passing criteria defined in the Approved test specifications are successfully achieved.

22.8.2 Any subsequent testing which takes place before this Approval is given may result in retesting being required, this retesting being to the cost of the Contractor.

22.8.3 Inspection records from the First Article Inspection shall be submitted for Approval. Approval will only be granted where it is demonstrated to the satisfaction of the Engineer that any areas of non-compliance identified during the FAI have been corrected, and any resultant design changes re-submitted.

22.8.4 Any defects recorded at the First Article Inspection shall be rectified and incorporated in the design and/or manufacturing process at the earliest possible opportunity and shall be fitted retrospectively in an approved manner to all items not thus modified.

22.8.5 Records from Routine Inspection shall be held by the Contractor and made available timely for the Engineer's inspection.

22.8.6 Copies of the Approved routine test results shall be submitted together with the associated train log book (refer to PS 22.8.7).

22.8.7 Train Log Book

In addition to the Configuration Control Program (refer to Appendix P), for each Train Unit of train a Log Book shall be provided which shall include the following items at the point of handover of the associated Train Units of train to the Employer after the completion of the Tests on Completion (refer to PS 22.11.3):

(a) Records of the equipment configurations and serial numbers of all equipment fitted to the train.

(b) Maintain an up-to-date list of outstanding tests, modifications and defects.

(c) Records of all successfully completed vehicle level routine tests.

22.8.8 The acceptance of tests shall be the successful completion of tests, Approval of the test results and receival of the associated train Log Book.

22.8.9 Additional copies of records of all tests/inspections results shall also be held at the Contractors (or subcontractors) works to be made available to the Engineer on demand.

22.9 Works Tests

22.9.1 The Works Tests specified in Appendix C shall constitute the Testing before Delivery of the trains.

22.9.2 The Contractor's attention is drawn to the requirements of COC Clause 57.15.

22.9.3 No Works Tests shall be carried out on the micro-processor based systems, sub-systems or equipment until they are successfully completed all required software tests specified in RS/C6014/05.

22.9.4 In addition to the Works Tests specified in Appendix C, the Contractor shall carry out the following installation tests on a routine basis for each train:

(a) Quality Control Tests which shall include the following test items:

(i) Wire count. A wire count shall be a check of every termination point to ensure that the correct number of wires is terminated. The correct number of wires can be zero, so terminations where no wires are expected are also checked. This check shall be applied on all safety related circuits (refer to PS 9) and the ATC interface circuits (refer to Appendix I Annex 3). If a terminal bar contains spare termination points, then the correct number of wires at these spare terminations shall be zero. The wire count shall include used termination points and spare termination points. The Contractor shall submit the Wire Count Specification for Approval prior to conducting the test. The Wire Count Specification shall indicate the details of the wires to be counted on every termination point for those circuits stipulated above. The result of Wire Count Test shall be submitted for Approval.

(ii) Continuity test. This test shall be carried out to ensure the continuity and correspondence of each individual wire with its wiring diagram.

(iii) Insulation and earth tests. These tests shall be carried out to check both every core of a cable and every other core, and between every core and earth for correct insulation values. For those wires that are impracticable to test between every wire, test on all rack wires to earth shall be applied.

(b) The above Quality Control Tests shall be repeated for any wiring change.

22.10 Commissioning (Tests in Hong Kong)

22.10.1 The Commissioning Tests specified in PS 22.10 shall form part of the Tests on Completion (refer to PS 22.11) of the trains.

22.10.2 The Contractor's attention is drawn to the requirements of GS Section 25. In addition to the Commissioning Tests identified in Appendix C of the PS, the Contractor shall meet the test requirements specified below.

22.10.3 Type Commissioning Tests

(a) On the first train or trains (as convenient) delivered, the Contractor shall undertake at his cost in a comprehensive programme of Type Tests to adequately demonstrate that the requirements of the Specification have been satisfied.

(b) The Contractor shall also participate in system wide integration testing to ensure that the train and its systems do not introduce any adverse effects into the railway and its environment.

(c) This testing shall demonstrate compatibility between the train and the interfacing systems specified in the Appendix I.

(d) Compatibility with the Urban Lines train systems shall be satisfactorily tested.

(e) The Contractor shall be responsible for correcting any interfacing defects thus identified in any equipment or systems included in his scope of supply.

22.10.4 Routine Commissioning Tests

(a) Following delivery of the trains to the Site each train shall be commissioned by the Contractor and at an appropriate time the Engineer will witness certain of these tests to satisfy himself that the trains are acceptable for running in passenger service.

(b) These tests will be a subset of those tests performed at Type Test, to demonstrate that the principal features of the train are compliant with the PS.

(c) This shall include but not be limited to a test of all safety systems.

(d) The Contractor shall provide the Engineer with a full record of the modification status and software versions fitted to a train at the time that the routine commissioning test is conducted.

22.11 Tests on Completion

22.11.1 The Tests on Completion shall include the Commissioning (Tests in Hong Kong)(Refer to PS 22.10) and the Integrated Tests (refer to PS 22.12).

22.11.2 The Contractor's attention is drawn to the requirements of COC Clause 62.1. The Tests on Completion are identified in Appendix C.

22.11.3 Tests on Completion

The Contractor shall demonstrate to the satisfaction of the Engineer in the Tests on Completion that the performance requirements of the train are met and suitable for passenger service in the existing Urban Lines systems.

22.12 Integrated Test

22.12.1 The Integrated Tests specified in PS 22.12 shall constitute the Test Run and Integrated Tests (refer to GS Section 25) of the trains.

22.12.2 According to GS Section 25, the Integrated Tests shall form part of the Tests on Completion of the trains.

22.12.3 The Contractor's attention is drawn to the requirements of GS Section 25. The test requirements for each interfacing systems shall be based on the associated interface specifications under Appendix I and the Approved Integrated Test Schedules (refer to PS 31.3.6).

22.12.4 Integrated Tests

The Contractor shall demonstrate to the satisfaction of the Engineer in the Integrated Tests that the compatibility requirements between the train and the existing Urban Lines systems are met.

22.13 Certificate of Completion for Part of the Works

22.13.1 Upon completion of the following requirements for each train and when it is ready for passenger service, the Contractor may request in accordance with the procedure set out in Clause 74.1 of the COC, a Certificate of Completion for Part of the Works as referred to in Clause 74.3 of the COC:

(a) All tests of Tests on Completion (refer to PS 22.11.4) and integrated tests (refer to PS 22.12.4) are successfully completed and the associated test reports are granted with at least the status of Approved in Principle;

(b) The train Log Book is documented to the satisfaction of the Engineer and delivered to the Engineer;

(c) The following requirements shall be met before over the request of the Certificate of Completion for the first train:

(i) All Approved Type Test results have been delivered to the Engineer;

(ii) All required quantities of Approved spares for running maintenance (refer to PS 24.2.1) have been delivered to the Engineer;

(iii) All required training are satisfactorily implemented; and

(iv) The batch 1 and 2 O&M Manuals are granted with at least the status of Approved in Principle.

22.14 Not Used

SECTION 23

TRAINING REQUIREMENTS

August 2015

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23 TRAINING REQUIREMENTS

23.1 General

23.2 Training Plan

23.3 Training Instructor

23.4 Class Size

23.5 Training Material

23.6 Training Course Content

23.7 Training Course Logistics

23.8 Training Courses

23 TRAINING REQUIREMENTS

23.1 General

23.1.1 The Contractor shall be responsible for providing training for maintenance, operating, training and engineering design staff in all aspects of operations and maintenance of the trains and all their associated equipment, thereafter referred to in this section as the Delivered System.

23.1.2 The targeted training attendees shall include:

(a) First line maintenance staff who are responsible for service checks and corrective maintenance which do not require car lifting

(b) Second line maintenance staff who are responsible for car overhauls, scheduled equipment replacements and corrective maintenance which require car lifting

(c) Third line maintenance staff including staff of Electronic Workshop who are responsible for equipment overhauls which cover the workshop repair, overhaul and testing of all train subsystems / equipment down to Printed Circuit Board (PCB) level

(d) Operating staff including test crew, train operators and supervisors who are responsible for the safe operation of train during test and commissioning and normal passenger service and operating staff from station and Operation Control Centre

(e) Training staff including technical and operating training instructors who are responsible for conducting training sessions to Employer's maintenance and operating staff

(f) Engineering design staff who are responsible for providing technical support to maintenance staff on fault investigation and analysis and future modification

23.1.3 Training shall be designed and delivered to achieve the following objectives:

(a) First line maintenance staff shall acquire sufficient skills and knowledge for carrying out service checks and corrective maintenance which do not require car lifting of the Delivered System to the designed standards.

(b) Second line maintenance staff shall acquire sufficient skills and knowledge for the car overhauls, scheduled equipment replacements and

corrective maintenance which require car lifting of the Delivered System to the designed standards.

(c) Third line maintenance staff (including staff of Electronic Workshop) shall acquire sufficient skills and knowledge for carrying out equipment overhauls to the designed standards.

(d) Operating staff shall acquire sufficient skills and knowledge for operating the Delivered System under normal and equipment failure situations.

(e) Training staff shall acquire sufficient skills and knowledge to conduct future training sessions to other Employer's staff including operating, first line, second line and third line maintenance staff.

(f) Engineering design staff shall acquire sufficient skills and knowledge for providing technical support to the maintenance staff on fault analysis, investigation and modification of the Delivered System to the designed standards.

23.1.4 The objectives shall be achieved in a number of ways including classroom training, hands on practical training and on-the-job maintenance training as specified in PS 23.8.

23.1.5 The Contractor shall provide training material as follows:

(a) a training plan
(b) trainer manuals
(c) trainee manuals
(d) training aids

23.1.6 The training courses (refer to PS 23.8) shall be conducted in accordance with the Approved training programme (refer to PS 23.2.2). If delivery of train is delayed as a result of programme slippage caused by the Contractor, or major changes to the design or performance of equipment after training courses have been conducted, the Contractor shall repeat some or all of the courses at his own expense to the satisfaction of the Engineer.

23.2 Training Plan

23.2.1 The Contractor shall develop and submit a Training Plan for Approval as stipulated in Appendix F.

23.2.2 The Training Plan shall provide a structured training programme to train personnel of the Employer to achieve the objectives as stipulated in PS 23.1.3.

23.2.3 The Training Plan shall include, as a minimum, the following items:

(a) schedule of all training courses / activities including classroom and practical training
(b) objective, syllabus, format, class size, duration of each training course and the trainee's prerequisite
(c) training facilities required to be provided by the Employer
(d) list of training materials and documentation to be included with the training course including trainer and trainee manuals
(e) location of each training course / activity
(f) qualifications and experience level necessary for staff to be trained
(g) the names of training personnel and their qualifications
(h) course evaluation methods

23.3 Training Instructor

23.3.1 Training courses shall be conducted by skilled training instructor who possess good communication skills and are experienced engineers in the subject on which training shall be provided. They shall be thoroughly familiar with the design, installation, operation and maintenance of the Delivered System.

23.3.2 The training instructor shall be a member of the Contractor's staff, subcontractor's staff or equipment supplier’s staff. The training instructor shall conduct the training course(s) in English.

23.4 Class Size

Sufficient number of class(es) shall be conducted for each training course to cater for the number of corresponding attendees with each class accommodating a maximum of fifteen attendees.

23.5 Training Material

23.5.1 The Contractor shall submit all training materials for Approval 18 weeks before the start of the corresponding training course.

23.5.2 The Contractor shall provide materials to support each course in the Training Plan, including trainer manuals, training aids and trainee manuals. All training materials shall become the property of the Employer.

23.5.3 The trainer manuals and trainee manuals shall be submitted in a form that allows easy reproduction. Any transparencies and electronic files used in training shall be supplied along with reproducible copy. Master copies of slides and other audio-visual materials shall also be provided to

allow for reproduction, as necessary. All the above training material shall also be submitted in electronic copies where applicable.

23.5.4 The Contractor shall provide a trainer manual for each training course.

23.5.5 The trainer manual shall include the following:

(a) course agenda
(b) course objectives
(c) lists of resources and facilities required
(d) detailed lesson plan indicating the timing of all training activities and key learning points
(e) training methodologies including outlined presentations, discussion guides, hands on practical training, practical demonstration, fault simulation and rectification, site visit and question and answer
(f) training aids and instructions for using any audio-visual support, mock-ups and simulators
(g) evaluation criteria
(h) evaluation method in the classroom and in the workshop/field

23.5.6 The Contractor shall provide one set of trainee manual to each course attendee for each training course.

23.5.7 The trainee manual shall include the following:

(a) course objectives
(b) course schedule including trainee's prerequisite
(c) course handouts including equipment / system schematic / circuit diagrams
(d) course assignments / exercises
(e) references
(f) evaluation forms

23.5.8 The trainer manuals and trainee manuals shall be submitted in the following format:

(a) all manuals shall be produced as A4 International unless otherwise specified whereas schematic / circuit diagrams shall be produced as A3 or A2 international
(b) the text shall be produced using Microsoft Word for Windows 2003 (or later version, if approved)
(c) graphics and diagrams shall be produced using Microsoft Powerpoint for Windows 2003 (or later version, if approved)
(d) circuit diagrams and engineering drawings shall be produced using AutoCad for Windows 2002 (or later version, if approved)
(e) the paper used shall be good quality, white, and of an adequate thickness for frequent handling and the printing shall not fade with age

(f) each manual shall have a separate binding which shall allow changes and additions to be readily made

(g) each manual shall include a full table of contents and indexing for all key words

23.6 Training Course Content

23.6.1 All training courses shall adopt a top down approach and consists of two parts, where applicable:

(a) Classroom training

A general system overview shall be given indicating the major functions which the system performs and the major items of equipment, then progressing to equipment specific and group or function specific issues and finally a function by function description as necessary for the audience and training objective of the individual training course. Background information, theory, design calculation and analysis, special design features, maintenance philosophy, interfaces between subsystems and written test / exercise if applicable shall be included to facilitate trainees' understanding.

(b) Practical training

Practical training shall be provided which shall include demonstrations of the most commonly performed procedures applicable to the target audience. Simulation exercises including fault simulation and rectification / in-situ recovery, site demonstrations, fault diagnosis and operation of special tools and test equipment (refer to PS 24.3) and hands-on practice / exercise shall be included where applicable and these shall be separately scheduled from classroom training. For Technical Training courses, real equipment / system shall be used for practical training where applicable. Video taken during manufacturing stage shall be used to supplement all the training courses.

23.6.2 Where standard "off-the-shelf" product are used and modified for the application of the system, the general descriptions of these products shall be augmented with full details of the specific modifications in the training course.

23.6.3 The Engineer shall assess the effectiveness of the training course and identify any area to be improved by the Contractor. The Contractor shall take measures to ensure that all specified training requirements shall be achieved to the satisfaction of the Engineer.

23.7 Training Course Logistics

23.7.1 Except for the hands on practical training in the Contractor's Plant and overseas training course(s) in the approved Training Plan, the training courses shall be conducted in the Employer's premises.

23.7.2 Training facilities such as overhead projectors and screens, video recorders and televisions, flip charts and pens, slide projectors and similar items will be made available to the Contractor for the purpose of conducting the training courses. The Contractor shall submit their request to the Engineer at least 30 days in advance for the use of such facilities. Where appropriate, the training courses shall be designed to make effective use of the Delivered System. Any special tools and test equipment (refer to PS 24.3) and train required for training shall be provided by the Contractor.

23.7.3 At the conclusion of each training course, course questionnaires aimed at determining the level of satisfaction of the attendees with the course content, duration and presentation shall be distributed to trainees for completion.

23.8 Training Courses

The Contractor shall provide, as a minimum, the following training courses:

23.8.1 Test Crew and Training Instructors

(a) Objectives

To provide the test crew and training instructors with the skills and knowledge necessary to cope with the test running of trains during the test and commissioning period in Hong Kong.

(b) Course Start Date

This training course shall be conducted not later than 18 weeks after the Approval of the Training Plan.

(c) Course Attendees

A total of 20 experienced train operators, train operating instructors and training instructors of Urban Lines.

(d) Course Content

This training course shall provide attendees with skills and knowledge necessary to cope with the operation of trains for testing and commissioning in Hong Kong. The man-machine interface functions and responses shall be described, explained and demonstrated. Hands-on practical training shall also be provided.

23.8.2 Train Operator Training

(a) Objectives

To provide the train operators with the skills and knowledge necessary to cope with the running of trains for normal passenger service.

(b) Course Start Date

This training course shall be conducted not later than 18 weeks after the Approval of the Training Plan.

(c) Course Attendees

A total of 20 experienced train operators of Urban Lines and train operating instructors.

(d) Course Content

This training course shall provide attendees with skills and knowledge necessary to cope with the operation of trains for passenger service. The train operation and control, man-machine interfaces, special design features, fault handling / backup facilities available shall be described, explained and demonstrated. Hands-on practical training for all topics covered shall also be provided.

23.8.3 Technical Training

(a) Objectives

This training course shall allow the Employer's technical staff including maintenance and engineering design staff to acquire the knowledge and skills necessary to maintain the Delivered System to the designed standards.

(b) Course Start Date

This training course shall be conducted not later than 28 weeks after the Approval of the Training Plan.

(c) Course Attendees

First, second and third line maintenance and engineering design staff

(d) Course Content

This training course shall be structured and conducted in three levels as follows:

(i) Level 1 shall cover background technical information of train including location and general layout of equipment, control logic (input and output), interfaces between subsystems , general performance specifications, special design features and performance (for example self diagnosis capability), description and operating principles of all equipment / systems, basic description of circuits and man-machine interfaces.

A total of 25 first line maintenance staff, 40 second line maintenance staff, 20 third line maintenance staff (including staff of Electronics Workshop) and 5 training instructors will attend the Level 1 technical training.

(ii) Level 2 shall cover all the maintenance activities for each of the equipment / system as stipulated in clause (iii) below which shall include:

(1) preventive maintenance activities
(2) corrective maintenance activities
(3) procedures for replacement of major equipment / components
(4) testing and re-commissioning procedures after maintenance work
(5) overhaul and workshop repair including the use of test and special equipment, sub-assembly bench repair and calibration of all equipment comprising the system (for items of equipment not commercially available)

All installation procedures, testing procedures and the use of special tools and test equipment (refer to PS 24.3) shall be covered to permit the attendees to perform preventive and corrective maintenance activities and to acquire the skills and knowledge to achieve the Maintainability targets (refer to PS 26).

A total of 20 first line maintenance staff, 30 second line maintenance staff, 20 third line maintenance staff (including staff of Electronics Workshop) and 5 training instructors will attend the Level 2 technical training.

(iii) Level 3 shall provide detailed technical information and description of each individual equipment / system down to basic component / PCB level with explanation of the circuitry / logic. One training course for each equipment / system shall be provided and shall be organized based on the Equipment Hierarchy (refer to RS/C6014/12) as follows:

(1) Vehicle Structure
(2) Traction and Braking System
(3) Bogies and Suspension
(4) Auxiliary Electrical System
(5) Pneumatic and Air Distribution System
(6) Air Conditioning System
(7) Door System
(8) Gangway and Couplers
(9) Communications System
(10) Train Management System and Event Recorder
(11) Automatic Train Control
(12) Structure and Vehicle Interior Fittings

A total of 25 first line maintenance staff, 40 second line maintenance staff, 20 third line maintenance staff (including staff of Electronics Workshop) and 5 training instructors will attend the Level 3 technical training.

(iv) Level 4 shall cover all technical support activities to maintenance including :

(1) Fault analysis and investigation
(2) Software training which shall provide attendees with the knowledge and skills necessary for performing parameterisation of the Delivered System and system management. Hands on practical experience on using the software tools, utilities and programming techniques being supplied with the Delivered System shall be included. The Contractor shall be responsible for providing all hardware and software required for software training.

A total of 15 engineering design and software support staff will attend the Level 4 technical training.

23.8.4 Defect Recovery Training - Operation

(a) Objectives

This training course shall allow the Employer's train operator to acquire the knowledge and skills necessary to take appropriate action quickly in event of emergency situations as well as coping with failures of the Delivered System.

(b) Course Start Date

This training course shall be conducted not later than 40 weeks after the Approval of the Training Plan.

(c) Course Attendees

A total of 20 experienced train operators and training instructors of Urban Lines.

(d) Course Content

The Contractor shall be responsible to identify the potential failures of the Delivered System and the correct recovery / handling procedures. Detailed description of the potential failures including the performance of train being affected, audio symptoms and visual symptoms encountered shall be presented and the recovery / handling procedures shall be described in a chronological way. The attendees shall be able to acquire the knowledge and skills in performing these recovery / handling procedures.

23.8.5 Defect Recovery Training - Technical

(a) Objectives

This training course shall allow the Employer's first and second line maintenance staff to acquire the knowledge and skills to correctly diagnose the failures and to take appropriate corrective maintenance.

(b) Course Start Date

This training course shall be conducted not later than 40 weeks after the Approval of the Training Plan.

(c) Course Attendees

A total of 20 maintenance staff and 5 training instructors.

(d) Course Content

The Contractor shall be responsible to identify the potential failures of the Delivered System and the associated corrective maintenance procedures. Detailed description of the potential failures including the performance of train being affected, audio symptoms and visual symptoms encountered shall be presented and the associated corrective maintenance procedures shall be described in a chronological way. At the end of the course, the attendees shall be able to correctly diagnose the failed equipment / systems, replace any defective equipment, verify that the failure is rectified and restore the train to service condition.

23.8.6 On the Job Maintenance Training

(a) Objectives

This training course shall allow the Employer's maintenance staff to gain actual field experience on fault diagnosis, first and second line corrective and preventive maintenance activities, equipment repair and overhaul.

(b) Course Start Date

This training course shall be conducted not later than 44 weeks after the Approval of the Training Plan.

(c) Course Attendees

A total of 16 maintenance staff.

(d) Course Content

This training course shall provide on-the-job training opportunities to the Employer's maintenance staff to gain actual field experience prior to the passenger service of the trains in Urban Lines. The Contractor shall on site transfer the knowledge and skills on fault diagnosis, first and second line corrective and preventive maintenance activities, equipment repair and overhaul to the attendees. A dedicated training instructor from the Contractor shall supervise the attendees and ensure the effective delivery of the necessary information / knowledge / skills to the attendees.

SECTION 24

SPARE PARTS, SPECIAL TOOLS

AND TEST EQUIPMENT

August 2015

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24 SPARE PARTS, SPECIAL TOOLS AND TEST EQUIPMENT

24.1 General Requirements

24.2 Spares Recommendation

24.3 Special Tools and Test Equipment

24.4 Submission and Delivery Schedules

24 SPARE PARTS, SPECIAL TOOLS AND TEST EQUIPMENT

24.1 General Requirements

24.1.1 The Contractor shall recommend to the Engineer all spare, special tools and test equipment (refer to PS 24.3) to facilitate the Employer to maintain, repair and overhaul the trains effectively and efficiently while ensuring the trains maintain a high standard of safety and reliability throughout their lives.

24.1.2 All spare parts shall be identical to the equivalent installed items. All items shall be complete and ready for installation except for wire or cable for external connections.

24.1.3 All spare parts, special tools and test equipment, if purchased by the Employer, shall be delivered to a location in Hong Kong as directed by the Engineer suitably packed for protection against weather, rough handling during transportation and subsequent warehouse storage and clearly marked with a unique identification.

24.1.4 The Contractor shall minimise the number of different types of special tools and test equipment required to meet maintenance requirements.

24.1.5 All test equipment shall have the same design life as that of the equipment or system it tests.

24.1.6 Not later than 52 weeks after the date of the Letter of Acceptance, the Contractor shall submit for Approval the lists of spare parts, special tools and test equipment to be supplied. The lists shall be a amplification and confirmation of the lists referred to in Schedule C of the Pricing Document and shall be subsequently modified and amended as necessary with changes in design according to the requirements of Appendix P - Configuration Control Program.

24.1.7 In the event that modifications are introduced in any part of the cars under the terms of the Contract, the Contractor shall ensure that the delivered spare parts, special tools and testing equipment are identical to the installed items.

24.1.8 The Contractor shall confirm and update as necessary the lists of spare parts, special tools and test equipment to align with the latest Approved design. Copy of each of the updated lists shall be submitted to the Engineer according to the requirements specified in Appendix P.

24.1.9 Based on the recommended lists of spare parts, special tools and test equipment, the Engineer will determine those essential parts or items that are required for delivery prior to the commissioning of the first train at a time as specified by the Engineer and those that can be delivered at a later stage.

24.1.10 Each item of spare parts, sub-assemblies and assemblies shall be clearly and precisely labelled/tagged showing appropriate part numbers and parts descriptions and component/assembly identification codes for unique identification purpose.

24.1.11 The information supplied in respect of each spare part shall include, but not be limited to, the following:

(a) Detailed part description
(b) Unique component/assembly identification code (for easy identification of assembly/module/unit/system it belongs to)
(c) Name and address of the manufacturer and the address of its Hong Kong agent (if any)
(d) Manufacturer's part number
(e) Contractor's part number
(f) Manufacturer/Contractor drawing number
(g) Unit price
(h) Number off per train with special remark on interchangeability of the parts
(i) Estimated service life/annual consumption rate
(j) Shelf life (if any)
(k) Recommended quantity
(l) Minimum order quantity for subsequent orders
(m) Lead time for delivery of additional quantities (n) Overall dimensions including packing (if any)
(o) Special storage requirements (if any)

24.1.12 The information supplied in respect of each special tool and test equipment shall include, but not be limited to, the following:

(a) Full description of the tool/test equipment
(b) Application
(c) Name and address of manufacturer and tool/equipment model number
(d) Delivery period
(e) Recommended quantity
(f) Minimum order quantity for subsequent orders
(g) Power rating (if applicable)
(h) Dimensions, with/without packing
(i) Special storage requirements (if any)
(j) Weight

(k) Unit price
(l) Lead time for delivery of additional quantities

24.1.13 If a spare part, special tool or test equipment is to be produced by the Employer, the Contractor shall provide detailed technical specifications and drawings for the manufacture of the tools.

24.1.14 When a spare part, special tool or test equipment, or any part thereof including any software, is no longer available from the original supplier, the Contractor shall provide the Employer with an equivalent substitute which shall fulfil all the functions of the original item to not worse than the original performance standards.

24.2 Spares Recommendation

24.2.1 Spares for Running Maintenance

The final list shall be submitted for Approval 3 months before delivery of the first train.

24.2.2 Other Maintenance Spares

(a) The list shall also include those major items, such as, traction motors and bogies, which must be held as a float for unit exchange purpose.

(b) The final recommendation shall be submitted for Approval within 2 months following delivery of the first train.

24.2.3 Commissioning/Warranty Spares

(a) The final recommendations shall be submitted for the Engineer's Approval at least 6 months prior to the delivery of the first train and shall be delivered together with the first train.

(b) The Contractor shall provide and maintain this spares holding throughout the Defects Liability Period.

24.2.4 Special Spares

A special spare list for those spare parts/components which require delivery lead time longer than 6 months, such as, wheelset, pantograph or any specifically made parts/component, shall be submitted for Approval at least 6 months prior to the delivery of the first train.

24.2.5 Strategic Spares

A list of strategic spare parts likely to be required for contingency or replacement after major incidents, such as, collision and derailment, shall be submitted for Approval at least 6 months prior to the delivery of the first train.

24.3 Special Tools and Test Equipment

24.3.1 Special tools and test equipment shall be:

(a) those that are not easily acquired from the commercial markets;

(b) those that cannot be found in the reputable tools supplier's catalogues (such as RS Components International and McMaster - Carr Supply Company);

(c) those that are not commonly used in industrial application; or

(d) those that are not included in depot (refer to Appendix I Annex 6).

24.3.2 Special tools and test equipment shall be recommended such as to enable the maintenance personnel of the Engineer to carry out in-house testing and repair of the train and its associated equipment/component. In addition, all special equipment or facilities that are used to test, fault diagnosis and repair the microprocessor based PCBs/equipment shall also be recommended.

24.3.3 The special tools and test equipment recommended shall ensure that all levels of routine maintenance can be carried out to the Approved maintenance schedule with the depot facilities provided.

24.3.4 The recommended special tools and test equipment shall ensure that the maintainability targets specified in PS 25.9 can be achieved.

24.3.5 Where appropriate special tools and test equipment, such as, wheel skates, shall also be recommended for the use of a rescue team during major incidents to achieve fast recovery.

24.3.6 The recommended special tools and test equipment shall be sufficient in number to allow the trains to be maintained and overhauled to the Approved maintenance schedule.

24.3.7 Any recommended additional equipment that are required for the special tools and test equipment to carry out their intended function shall be kept to minimum. Any equipment that uses microprocessor control to analyses the performance of the train system, or its component parts, shall be configured to allow a data download of these test results. This information must provide the date and time of test, the tester's name, type of equipment tested, its modification status and serial number and any test results.

24.3.8 For free standing equipment the Contractor shall advise the storing and fixing arrangements of the special tools and test equipment.

24.3.9 The recommended Special tools and test equipment shall cover, but not be limited to, the following functions:

(a) Special keys and tools for access covers and doors

(b) Operation tools for special equipment and fasteners

(c) Inspection and measuring gauges for preventive and corrective maintenance, including equipment overhauls

(d) Special tools and test equipment required in the installation, removal, repair, adjustment and commissioning of equipment

(e) Test equipment for checking the functions and performance of equipment in-situ on the train

(f) Test equipment for interfacing with the Train Management System and any other microprocessor based equipment on the train to facilitate maintenance for identification of the faulty part down to the LRU level (refer to PS 26.2.5). Such equipment shall provide functions such as downloading fault logs, interrogation and adjustment of parameters.

(g) Test equipment which shall provide simulated inputs to the equipment for accessing its performance in-situ on the train

(h) Test equipment and simulators for checking and verifying the functions and performance of equipment at the workshop in repairs and overhauls

(i) Equipment for programming microprocessor based equipment

(j) Special tools for re-railment and for handling a locked axle

(k) Tools and equipment for supporting any condition-based maintenance schemes

24.3.10 Test equipment and simulators described in (f), (g) and (h) above for electronic equipment shall be so designed that the success rate of fault finding and rectification operations shall not be worse than 95%.

24.3.11 If a portable computer (PC) is recommended for the application of test equipment and simulators described in PS 24.3.9 (f), the Contractor shall ensure that only one single PC running on Windows XP or later operating system shall be recommended for interfacing with all microprocessor controlled equipment on the train, including the TMS, Event Recorder and the control system of other equipment (such as traction converter and doors). All software used for the above test and simulation purpose shall comply with RS/C6014/05.

24.3.12 For Contract purpose, total six (6) nos. of test equipment and simulators and/or PC shall be recommended.

24.3.13 All relevant operation and maintenance information (for example, manuals, drawings, circuit diagrams and etc) for the special tools and test equipment shall be recommended for Approval.

24.3.14 The final list shall be submitted for Approval 6 months before delivery of the first train.

24.3.15 The special tools and test equipment together with the associated operation and maintenance information, if purchased by the Employer shall be delivered not later 3 months after the delivery of the first train.

24.3.15 Training of all special tools and equipment shall be recommended by the Contractor according to the training requirements (refer to PS 23.8).

24.3.16 An additional list of special tools and test equipment which are used in production and are surplus to requirements upon Completion and which the Contractor would be willing to sell to the Employer, may be recommended for the Engineer's review at least 6 months prior to the delivery of the first train.

24.4 Submission and Delivery Schedules

Item	Descriptions	Schedules
1.	Submit the detailed lists of spares, special tools and test equipment	Not later than 52 weeks after the date of the Letter of Acceptance
2.	Update and submit a revised lists of spare parts, special tools and test equipment together with an amplification and confirmation of the lists referred to in Schedule C of the Pricing Document and shall be subsequently modified and amended as necessary with changes in design	SEMP stage 3
3.	Update and submit a revised lists of spare parts, special tools and test equipment	SEMP stage 4
4.	Training of all special tools and equipment if purchased by the Employer	SEMP stage 5
5.	Submit the final list of commissioning/warranty spares	6 months prior to the delivery of the first train
6.	Submit the final list of special and strategic spare	6 months prior to the delivery of the first train
7.	Submit the final list of special tools and test equipment	6 months prior to the delivery of the first train
8.	Submit all relevant operation and maintenance information (for example, manuals, drawings, circuit diagrams and etc) for the special tools and test equipment, if purchased by the Employer	6 months prior to the delivery of the first train
9.	Submit an additional list of special tools and test equipment which are used in production and are surplus to requirements upon Completion and which the Contractor would be willing to sell to the Employer	6 months prior to the delivery of the first train
10.	Submit the final list of spare parts for running maintenance	3 months prior to the delivery of the first train
11.	Submit the final list of other maintenance spares	2 months prior to the delivery of the first train
12.	Delivery of spare parts for running maintenance and commissioning/warranty spares if purchased by the Employer	Together with the first train
13.	Deliver the special tools and test equipment together with the operation and maintenance information if purchased by the Employer	Not later 3 months after the delivery of the first train

SECTION 25

SYSTEM ASSURANCE

August 2015

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25 SYSTEM ASSURANCE

25.1 Introduction

25.2 Key Deliverables

25.3 General System Assurance Requirements

25.4 Contractor's Hazard Registration System

25.5 Specific System Assurance Tasks

25.6 Safety Requirements

25.7 Reliability Requirements

25.8 Availability Requirements

25.9 Maintainability Requirements

25.10 System Assurance Audits

25.11 Not Used

Table 25-1 Summary of System Assurance Tasks and Deliverables by Project Stages

Table 25-2 System Safety Report Structure

Table 25-3 Hazard Log Template

Table 25-4 Deterministic Safety Assessment Template

Table 25-5 Failure Modes Effects and Criticality Analysis Template

Table 25-6 Safety Critical Item Identification Sample Template

Table 25-7 Service Criteria Item identification Sample Template

Table 25-8 Risk Matrix

Table 25-9 Maintenance Requirements Analysis Template

25 SYSTEM ASSURANCE

25.1 Introduction

25.1.1 This Section defines the requirements and techniques for system assurance. The general requirements and specific tasks for the System Assurance Plan (refer to PS 25.2.1) during the design development, production, and initial operation of the train are also provided.

25.1.2 The Contractor shall ensure that all system assurance requirements are met for each System Engineering Management Plan (SEMP) stage. The required tasks and deliverables are summarised against each SEMP stage (refer to PS 21.3.4) in Table 25-1at the end of this Section.

25.1.3 Independent Safety Assessor

(a) The Engineer will retain an Independent Safety Assessor to review all design development processes and system safety analyses, and verify that all safety related requirements have been met. This will include verification that the systems have been developed and validated appropriately for their application to the Employer. The Contractor shall make available to the Assessor any data required in addition to technical submissions specifically identified in this Specification.

(b) The Independent Safety Assessor will conduct audits during the design, construction, testing and commissioning phase of the project at the Contractor’s factories and design offices, the Contractor’s Hong Kong office, the Employer’s design office and work sites in Hong Kong.

(c) The Independent Safety Assessor will develop and submit the audit plan and report for the approval of the Engineer.

25.2 Key Deliverables

25.2.1 System Assurance Plan

(a) As an integral part of the System Engineering Management Plan (refer to PS 21.2.3), the Contractor shall provide a System Assurance Plan which shall detail the Contractor's intended methodology to plan, manage and control the system assurance process.

(b) The objectives of the System Assurance Plan are:

(i) to ensure that the requirements of safety, reliability, availability and maintainability are fulfilled

(ii) to ensure that hazards and RAM problems can be identified early in the project

(iii) to ensure that any improvements found necessary during the system assurance process be included in the design in a timely manner.

(c) The contents of the System Assurance Plan shall consist of, but not be limited to, the following elements:

(i) Organisation, roles and responsibilities of key personnel of the Contractor/ sub-contractors that will carry responsibility for the implementation of the System Assurance Plan and the way of communication

(ii) Resumes covering personal qualification and experience of key personnel of the Contractor/ sub-contractors that will carry responsibility for the implementation of the System Assurance Plan

(iii) Outline of system assurance tasks and the methodologies that will be adopted in safety and RAM analyses

(iv) Procedures for monitoring and control of the system assurance activities of the Contractor/ sub-contractors

(v) Procedures for the integration of system assurance activities within the overall design / construction processes

(vi) Performance targets to be met

(vii) Programme of system assurance tasks (refer to PS 25.3.1)

(viii) Internal audit program

(d) The Contractor shall update and submit the System Assurance Plan as part of the SEMP presentation (refer to PS 21.3.5) for each defined stage.

25.2.2 RAM Demonstration Plan

(a) The Contractor shall provide a RAM Demonstration Plan at SEMP 2 stage and the updated version at the remaining stages to cover testing and demonstrations associated with the reliability, availability and maintainability of the trains and its subsystems. The RAM Demonstration Plan shall address any pre-production and production tests and demonstrations on the achievement of RAM targets after the commencement of the Defects Liability Period.

(b) The contents of the RAM Demonstration Plan shall include, as a minimum, the following:

(i) Organisation and key personnel responsible for RAM demonstration

(ii) Roles and responsibilities of key personnel responsible for RAM demonstration

(iii) RAM targets to be met by demonstration

(iv) Items to which demonstration shall be carried out

(v) Suggested testing methods, format and procedures, consumer and producer's risk and proposed confidence Intervals.

(vi) Techniques and methods to be employed, including allowance for burn-in and reliability growth

(vii) Unequivocal definition of pass and fail criteria including failure counting criteria

(viii) RAM demonstration activity programme, including test period

(ix) Description of the Failure Reporting And Corrective Action System (refer to PS 25.5.18)

25.2.3 System Safety Report

(a) The Contractor shall prepare and submit a draft System Safety Report at SEMP stage 3 and the final version before the delivery of the first train under the Contract.

(b) The System Safety Report shall summarise the system safety activities undertaken, key safety issues and findings. The Contractor shall follow the report structure as shown in Table 25-2.

25.2.4 RAM Demonstration Reports

(a) The Contractor shall submit separate reports on reliability, availability and maintainability demonstrations within 1 month after the completion of the respective demonstrations. The report shall provide evidence that the respective RAM targets have been achieved and shall include any supporting information and calculations.

(b) The Contractor shall submit interim reports to monitor RAM performance, and to determine the effectiveness of corrective actions, if any, on a regular basis. The frequency of submission of the interim reports shall be agreed in the RAM Demonstration Plan.

25.3 General System Assurance Requirements

25.3.1 System Assurance Tasks

(a) The Contractor shall carry out system assurance tasks at different stages of the SEMP and during the Defects Liability Period in order to ensure that all system assurance requirements, in particular, those issues related to software and interface design, can be satisfied.

(b) System assurance tasks shall be integrated into the design, development, manufacturing and installation activities as a systematic approach. Outputs of such tasks shall be fed back to the respective activities and corrective actions shall be developed and implemented where necessary.

(c) The Programme of system assurance tasks shall include, but not be limited to, the following:

(i) Theoretical system assurance analyses, which shall include, but not be limited to:
- Preliminary Hazard Analysis
- Deterministic Safety Assessment
- Interface Hazard Analysis
- System Hazard Analysis
- Operating & Support Hazard Analysis
- Safety Integrity Level Analysis
- Failure Modes, Effects and Criticality Analysis
- Quantified Risk Assessment/Fault Tree Analysis
- Preliminary RAM Analysis
- Derivation and Apportionment of RAM targets
- RAM Modelling and Predictions

The Contractor may propose for Approval alternative techniques to the ones specified provided that they can achieve the same objectives.

(ii) Safety Verification

(iii) RAM Testing/ Commissioning

(iv) RAM Performance Demonstrations

(v) Failure Reporting And Corrective Action System (FRACAS)

(d) The outputs of system assurance tasks shall be submitted as level 4 Design Data (refer to Appendix N Clause 2.5).

25.3.2 Theoretical System Assurance Analyses

(a) The Contractor shall carry out theoretical analyses to assess the safety and RAM performance of the train, its systems and subsystems. The causes, probability and consequences of individual hazard shall be established and evaluated.

(b) Information such as failure modes and probabilities employed in the theoretical analyses shall be based on life experience or properly designed tests. The Contractor shall provide evidence to justify any assumptions adopted in the analyses.

(c) Theoretical system assurance analyses shall be updated to account for any changes in the design of the trains up to SEMP stage 5.

(d) The results of the theoretical system assurance analyses, including updated versions of the Hazard Log (refer to PS 25.3.3) and Register of Train Failures (refer to 25.3.4), shall be submitted according to Table 25-1.

(e) The results of the theoretical safety analyses shall be consolidated into the hazard log (refer to PS 25.3.3).

(f) The following assumptions shall be adopted in all theoretical safety and RAM analyses:

Running distance per car per year: 120,000 km
Distance between station stops: 1 km
Train operating time per day: 19 hours

25.3.3 Hazard Log

(a) The Contractor shall establish a Hazard Log to register hazards identified in the various safety analyses. The Hazard Log shall be submitted at SEMP 2 stage and updated at the remaining stages. Hazard Log is a part of the System Safety Report (refer to PS 25.2.3).

(b) The format of the Hazard Log shall follow the template in Table 25-3.

25.3.4 Register of Train Failures

(a) In addition to the Hazard Log, the Contractor shall also set up and maintain a Register of Train Failures to document all scenarios which will result in a train failure (refer to PS 25.7.4). The causes, consequential effects and impact on train service shall be recorded for each entry in the Register.

(b) The Register of Train Failures shall be submitted in both printed and electronic copies at SEMP 2 stage and updated at the remaining stages. The electronic copy shall be prepared in Microsoft Excel 2003, or a later version as Approved, stored in a CD ROM.

25.3.5 Performance Targets

(a) For the purpose of train service commitment, it is deemed necessary that the train shall achieve performances targets for the following aspects:

(i) Safety (refer to PS 25.6)
(ii) Reliability (refer to PS 25.7)
(iii) Availability (refer to PS 25.8)
(iv) Maintainability (refer to PS 25.9)

(b) The above performance targets shall be achieved under the condition that maintenance is performed by the Employer as follows:

(i) Maintenance work is carried out by skilled and suitably qualified personnel appropriate to the work

(ii) The maintenance team is constituted according to the approved Operation and Maintenance Manual (refer to RS/ C6014/12)

(iii) The work is carried out according to maintenance procedures in the approved Operation and Maintenance Manual (refer to RS/C6014/12)

(iv) Tools and spare parts required by the work are readily available

(v) The work is carried out using the Employer's maintenance facilities as described in Appendix I Annex 6.

(c) Failure to achieve any of the performance targets defined in PS 25.6 to PS 25.9 shall be deemed to be a defect under COC Section 75.

25.4 Contractor's Hazard Registration System

25.4.1 The Contractor shall establish a Contractor's Hazard Registration System to register and control the identified hazards.

25.4.2 In order to ensure that the hazards identified in the Contractor's Hazard Registration System will be given adequate attention early in the design stage and in such a way that changes can be made in a cost effective manner, the Contractor shall carry out a thorough review of the following information:

(a) Employer's Rolling Stock hazards;

(b) Analyses from similar works undertaken before.

25.4.3 The Contractor shall comply with the frequency and consequence and risk acceptance classification system (refer to Table 25-8) when completing the various safety hazard analyses. The Contractor shall be required to submit proposals for mitigation of all risks, other than those classified as "R4 " or outside the Contractor's scope or control, in accordance with the principles given in Table 25-8 Risk Matrix.

25.4.4 Apart from the newly identified hazards, the Contractor shall document hazards from the above information that are deemed applicable to the Works into the relevant hazard analyses. Where practicable, the design shall incorporate the same safeguards for these hazards. The Contractor shall clearly identify the new hazards in the hazard analyses and shall make every effort to avoid duplication of hazards.

25.4.5 The Contractor shall adopt the hazard log template in Table 25-3 to record all the hazards identified in the various hazard analyses. A softcopy of the hazard log shall be submitted to the Engineer.

25.4.6 The hazard log shall be constructed in the format of Microsoft Excel 2003 or a later version as Approved.

25.4.7 The Engineer will from time to time review the Contractor's hazard log and the Contractor shall draw to the attention of the Engineer for any newly identified hazards.

25.4.8 The following areas shall be highlighted in the summary of the respective hazard analysis for the Engineer's attention:

(a) All new hazards identified by the Contractor as a result of the new system design, interfaces, usage or operational environment shall be highlighted with new Contractor's Hazard Identification Numbers

(b) Any potential increase in risk level of existing hazards to an R1 or R2 Level due to change in hazard frequency or consequence;

(c) Proposed design options to mitigate the risk level to as low as reasonably practicable level, together with Cost Benefit Analyses and recommendation;

(d) Any uncontrolled risks that are outside the Contractor's responsibility and require the Engineer or other contractor's actions.

25.5 Specific System Assurance Tasks

25.5.1 Preliminary Hazard Analysis

(a) Preliminary Hazard Analysis shall provide an early, top level assessment of the design for possible hazards and to initiate appropriate actions to mitigate/eliminate hazards.

(b) The Contractor shall submit the Preliminary Hazard Analysis Report at SEMP 1 stage and the final version at SEMP 2 stage. The Preliminary Hazard Analysis Report is a part of the Safety Analysis Report.

(c) The hazards identified in the Preliminary Hazard Analysis shall be reported using the Hazard Log template in Table 25-3.

25.5.2 Deterministic Safety Assessment

(a) At SEMP 2 stage, the Contractor shall assess the design in respect of the application of, and compliance/non-compliance with current design codes and standards. This assessment will include the identification and assessment of any design safety principles associated with each aspect of the design and to confirm compliance/non-compliance with these principles.

(b) The Contractor shall use the Deterministic Safety Assessment template in Table 25-4 to report the Deterministic Safety Assessment and submit at SEMP 2 stage. The updated version of the Deterministic Safety Assessment shall be submitted in the remaining stages.

(c) The Deterministic Safety Assessment Report is a part of the Safety Analysis Report.

25.5.3 Interface Hazard Analysis

(a) The Interface Hazard Analysis shall be conducted upon completion of the Preliminary Hazard Analysis.

(b) The Interface Hazard Analysis identifies and assesses existing or potential hazards between subsystems and/or systems and their effect on overall system safety and operations. The emphasis is on interfaces. The Interface Hazard Analysis shall be conducted on the critical interrelationships of each subsystem and system to determine the cause and effect of possible independent, dependent and simultaneous failures that could present a hazardous condition, including failures of safety devices. When the Interface Hazard Analysis indicates a potential problem, it should be made known to the Engineer immediately.

(c) The Contractor shall submit the Interface Hazard Analysis Report at SEMP 2 stage and the final version at SEMP 3 stage. The Interface Hazard Analysis Report is a part of the Safety Analysis Report

(d) The Interface Hazard Analysis shall be reported using the Hazard Log template in Table 25-3.

(e) All hazards identified in the Interface Hazard Analysis shall be registered in the Hazard Log.

25.5.4 System Hazard Analysis

(a) The System Hazard Analysis shall be conducted upon completion of the Preliminary Hazard Analysis.

(b) The System Hazard Analysis shall identify and assess hazards associated with the design of systems including component failure modes, software errors and hazards resulting from functional relationships between components and equipment comprising each system.

(c) The Contractor shall submit the System Hazard Analysis Report at SEMP 2 stage and the final version at SEMP 3 stage. The System Hazard Analysis Report is a part of the Safety Analysis Report

(d) The System Hazard Analysis shall be reported using the Hazard Log template in Table 25-3

(e) All hazards identified in the System Hazard Analysis shall be registered in the Hazard Log.

25.5.5 Operating & Support Hazard Analysis

(a) The Operating & Support Hazard Analysis shall be conducted upon completion of Preliminary Hazard Analysis.

(b) The Operating & Support Hazard Analysis shall be conducted on all tasks and human actions, including acts of omission and commission, by persons interacting with the system, subsystems and assemblies at any level, and including the public. All human factors and ergonomic aspects of the design and its operation shall be considered. When the Operating & Support Hazard Analysis indicates a potential safety hazard, it shall be made known to the Engineer immediately.

(c) The Contractor shall submit the Operating & Support Hazard Analysis Report at SEMP 2 stage and the final version at SEMP 3 stage. The Operating & Support Hazard Analysis Report is a part of the Safety Analysis Report.

(d) The Operating & Support Hazard Analysis shall be reported using the Hazard Log template in Table 25-3.

(e) All hazards identified in the Operating & Support Hazard Analysis shall be registered in the Hazard Log.

25.5.6 Safety Integrity Level Analysis

(a) A Safety Integrity Level Analysis shall be carried out for all safety related system softwares. The Contractor shall allocate a Safety Integrity Level for each safety related system software based on the various System Requirements Document (refer to Appendix N), PS requirements and hazard analyses. In determining Safety Integrity Level, all causes of failures (including random hardware failures, systematic failures and software errors) which lead to an unsafe state should be included. The Safety Integrity Level assessment shall be produced as part of the Preliminary Hazard Analysis, and shall be used to determine the appropriate design and development techniques. The Safety Integrity Levels (SIL) defined in IEC 61508 shall be used. The software system design and development process shall comply with the relevant requirements stipulated in EN50128 and EN50129.

(b) The Contractor shall demonstrate in the safety analysis that the SIL of the software system shall be able to reduce the risks to As Low As Reasonably Practicable (ALARP). The SIL requirement for software shall apply to all the applicable systems, sub-systems and its interfaces delivering the identified safety functions.

(c) The safety analysis shall be conducted on the interface function in accordance with the EN50129 and IEC61508 and benchmarking with the SIL of similar railway systems shall be carried out. The SIL assessment methodology shall be submitted for the Engineer's review before commencement of the work.

(d) All safety analyses associated with SIL shall be reported in the Safety Integrity Level Analysis Report and submitted at SEMP 2 stage. The final version of this report shall be submitted at SEMP 3 stage.

(e) The Safety Integrity Level Analysis Report is a part of the Safety Analysis Report.

25.5.7 Failure Modes, Effects and Criticality Analysis (FMECA)

(a) At SEMP 2 stage, the Failure Modes, Effects and Criticality Analysis shall be undertaken and highlighted on all components in systems or equipment which are found to have failure modes whose failure consequences are classified as "Serious" or worse in accordance with the Hazard Consequence Categories of Risk Matrix in Table 25-8, or cause train delay greater than two minutes.

(b) FMECA shall adopt a bottom-up approach to identify the effects on the operating railway due to failure of low level equipment. The scope shall also cover software and human factors. The effects of different modes of component failure shall be propagated to the next level of the system or equipment and this process shall be continued until the overall effect on system function can be determined. The effect of any equipment redundancy shall be incorporated into the results.

(c) An estimation of the effects of the failure on passengers and staff shall also be made, including the delay to the service, and an estimation of time taken to restore the system to normal operation will also be required.

(d) The Contractor shall submit the Failure Modes, Effects and Criticality Analysis Report at SEMP 2 stage. The updated version of the Failure Modes, Effects and Criticality Analysis Report shall be submitted in the remaining stages.

(e) The report of the Failure Modes, Effects and Criticality Analysis shall adopt the template in Table 25-5.

25.5.8 Quantified Risk Assessment/Fault Tree Analysis

(a) Quantified Risk Assessment shall be conducted for those hazards which have satisfied the following conditions:

(i) Residual Risk Level is assessed as R1 or R2; and
(ii) Likely to cause fatality of passenger and/or staff

Quantified Risk Assessment can adopt Fault Tree Analysis, Event Tree Analysis or other appropriate methodology.

(b) The Contractor shall conduct Fault Tree Analysis for the following “top events”:

- Train collision on main line
- Train derailment on main line
- Train fire
- Smouldering/Smoke in train
- Train separation on main line
- Undemanded passenger door opening on main line
- Failure to deploy emergency door in ramp or slide mode

Fault Tree Analysis shall involve the preparation of a logic diagram, which traces the events or combinations of contributing events which have led to an undesirable occurrence (referred to as the "top event"). Each of the contributing event(s) shall be also considered in turn, together with the subsidiary events involved in those failures. The process shall be continued with each event being scrutinised for its causes until it is not practical to proceed to a lower level or the process need not be continued because the probability of the occurrence of the event is demonstrably negligible. The effects of software, human factors and environmental factors shall be considered in the analysis.

(c) The Contractor shall submit the Quantified Risk Assessment/Fault Tree Analysis Report at SEMP 2 stage. The updated version of the Quantified Risk Assessment/Fault Tree Analysis Report shall be submitted in the remaining stages. The Quantified Risk Assessment/ Fault Tree Analysis Report is a part of the Safety Analysis Report.

25.5.9 Safety Critical Item

(a) A Safety Critical Item (SCI) is an engineering item whose integrity is critical to the safe operation of the railway. Its failure to perform its functions could lead to an accident involving loss of life or injury to the staff, Contractor, passengers or the public, it requires stringent maintenance controls to ensure that it continues to satisfactorily perform the required safety functions.

(b) A reference list of SCI will be provided by the Engineer containing the relevant SCI records of the existing railway. The Contractor shall review the reference list of SCI and identify those items applicable to the Works. The Contractor shall also identify any further SCIs that are not contained in the reference list. The Contractor shall propose appropriate maintenance control measures during the design stage.

(c) The methodology for the identification of SCIs shall be submitted to the Engineer for Approval before commencing the activity.

The following selection criteria are used to determine the safety consequence of the credible failures of an engineering item being assessed (items that satisfy any of the first three criteria are considered safety critical):

(i) Single failure that leads to Serious (< 5 major injuries) or worse consequence;

(ii) Double independent failures that lead to Critical (< 5 fatalities or 5-50 major injuries) or worse consequence;

(iii) Triple independent failures that lead to Catastrophic (5-50 fatalities or 51-500 major injuries) or worse consequence; and

(iv) Ignore Quadruple (or more) Failures.

(d) The Contractor shall record the SCI identification results in accordance with the SCI sample template as outlined in Table 25-6 and submit (in both hardcopy and softcopy in Microsoft® Excel format) to the Engineer for Approval before the end of detailed design stage.

(e) The Contractor shall review the Hazard Log against the SCI identification results to ensure that all identified SCIs are included within the Hazard Log and the risks of the associated hazards are reduced to ALARP.

25.5.10 Service Critical Item (SeCI)

(a) A Service Critical Item (SeCI) is an engineering item whose integrity is critical to the service performance of the railway. Its failure to perform its intended functions may lead to incident involving disruption to train or station services. (Note: refer to 25.5.9 (e) for the selection criteria).

(b) Each SeCI shall be subject to a vigorous design process with the objectives that:

(i) the availability of the SeCI is maximised; and

(ii) where appropriate, preventive maintenance controls may be considered to assure that it will deliver the required service level.

(c) A reference list of SeCI will be provided by the Engineer containing the relevant SeCI records of the existing railway. The Contractor shall review the reference list of SeCI and identify those items applicable to the Works. The Contractor shall also identify any further SeCIs that are not contained in the reference list. The Contractor shall propose appropriate design and maintenance control measures during the design stage.

(d) The methodology for the identification of SeCIs shall be submitted to the Engineer for Approval before commencing the activity.

(e) The following selection criteria shall be used to determine the service consequence of the credible failures of an engineering item being assessed (items that satisfy any of the following four criteria are considered service critical):

The loss of function that would potentially lead to:

(i) Total suspension of train service > 30 minutes

(ii) Accumulative delay of train service > 60 minutes

(iii) Total suspension of station ≥ 1 day

(iv) Crowd control is triggered inside station of ≥ 1 day

2 types of “loss of function” that shall be considered:

(i) Loss of function caused by single failure

(ii) Loss of function caused by double failures if the first component failure is hidden and the second failure is credible and revealed. In such case, only the first component is considered as a service critical item.

(f) The Contractor shall record the SeCI identification results in accordance with the SeCI sample template as outlined in Table 25-7 and submit (in both hardcopy and softcopy in Microsoft® Excel format) to the Engineer for Approval during the design stage.

25.5.11 Safety Analysis Report

(a) The Safety Analysis Report shall include the following analysis reports:

Section 1: Preliminary Hazard Analysis Report
Section 2: Interface Hazard Analysis Report
Section 3: System Hazard Analysis Report
Section 4: Operating & Support Hazard Analysis Report
Section 5: Safety Integrity Level Analysis Report
Section 6: Deterministic Safety Assessment Report
Section 7: Quantified Risk Assessment/Fault Tree Analysis Report
Section 8: Safety Criteria Item Identification

The Contractor shall submit Section 1 of the Safety Analysis Report at SEMP 1 stage and Sections 2 – 7 at SEMP 2 stage. The Contractor shall also submit the final version or the updated version of the reports in the remaining stages according to the requirements of individual reports. Details refer to Table 25-1.

25.5.12 Derivation and Apportionment of RAM Targets

(a) At SEMP 1 stage, the Contractor shall decide, subjected to the agreement of the Engineer, to what extent the overall targets for RAM of their Works shall be decomposed to sub-system/component level. The Contractor shall then apportion the overall targets among the sub-systems / components. Those aspects of design which are contributing disproportionately high levels of risk to the non-achievement of RAM targets shall be identified.

(b) The Contractor shall submit the RAM Target Apportionment Report at SEMP 1 stage and the final version at SEMP 2 stage.

25.5.13 Preliminary RAM Analysis

(a) At SEMP 1 stage, the Contractor shall conduct a Preliminary RAM Analysis which shall give an initial indication of any RAM problems which may arise.

(b) The Preliminary RAM Analysis shall include a preliminary assessment of the likely levels of RAM to be achieved.

(c) The Contractor shall submit the Preliminary RAM Analysis Report at SEMP 1 stage and the final version at SEMP 2 stage.

25.5.14 RAM Modelling and Predictions

(a) At SEMP 2 stage, the Contractor shall adopt Reliability Block Diagram, Fault Tree Analysis, FMECA or other appropriate methodologies to conduct RAM modelling and predict RAM performance so as to verify that the design of systems/sub-systems on the train can achieve the RAM targets.

(b) The purpose of RAM modelling is to develop a model of the functional interdependencies of the system/sub-system on the train. It shall provide an analytical framework for apportioning the system level RAM targets into lower level estimates to generate design goals.

(c) RAM prediction is a bottom up analytical process which provides quantitative estimates on overall system RAM performance based on estimates of lower level sub-systems.

(d) RAM prediction shall identify weak links in the system, provide quantitative assessment of a design with respect to achievement of the RAM targets and highlight areas having the largest potential for improvement.

(e) Documents shall be provided to show how the configuration of the system contributes to its overall safety and RAM performance, and the trade-off between relevant parameters.

(f) The Contractor shall submit the RAM Modelling and Predictions Report at SEMP 2 stage and the final version at SEMP 3 stage.

25.5.15 RAM Testing/Commissioning

(a) During specific SEMP stages as defined in Table 25-1, individual components and sub-assemblies shall be tested to establish whether they shall be able to achieve the RAM targets established in the design process (refer to PS 25.5.14(a) & (b)).

(b) As a minimum requirement, simulated endurance tests shall be carried out, during SEMP stages 3 and 4, on each of the top 5 items of equipment which are expected to contribute to the greatest number of incidents in accordance with the theoretical analyses (refer to PS 25.7.1).

(c) Such tests shall be carried out on representative samples of the equipment to verify the reliability predicted in the analyses to 90% confidence level single sided lower limit and to the requirements in PS 22.1.

(d) Each item to be tested shall be operated under simulated operation conditions for at least 1.2 times of the number of duty cycles or operating time that it shall experience in actual service between overhauls or replacements. Details of the test and the results shall be submitted as part of the RAM Demonstration Report.

(e) Details of the tests shall be submitted for the Engineer's approval in the RAM Demonstration Plan as defined in PS 25.2.2.

25.5.16 Safety Verification

The objective of Safety Verification is to demonstrate that safety functions / features which are an integral part of the design shall work as intended. The process shall be covered by type test and commissioning tests on items of equipment critical to safety.

25.5.17 RAM Performance Demonstrations

(a) RAM performance demonstrations shall be carried out as defined in the respective RAM requirements (refer to PS 25.7 to 25.9). This shall be a statistical process that requires a predefined and significant period of operation. The information collected shall enable comparison to be made with the theoretical work undertaken during the design through to testing & commissioning stages, with an aim to ensure that the required level of RAM is achieved in service.

(b) The Contractor shall propose for Approval accept / reject criteria in the formulation of the RAM Demonstration Plan (refer to PS 25.2.2), which shall take into account the following factors:

(i) RAM targets specified in the PS;
(ii) Quantity of equipment in operation under scope of supply of the Contract;
(iii) Accumulative operational time or distance travelled;
(iv) The requirement for 90% confidence level single sided lower limit

(c) If the required confidence level of the RAM targets cannot be demonstrated during the Defects Liability Period, then the Contractor shall present an alternative demonstration proposal in the RAM Demonstration Plan.

25.5.18 Failure Reporting and Corrective Action System

(a) The Contractor shall establish a Failure Reporting and Corrective Action System throughout the defined SEMP stages to provide a documented

history of any problems and failures and their associated corrective actions as well as detailing how and why each problem arose, or failure occurred.

(b) The Failure Reporting and Corrective Action System shall monitor the safety and RAM performance of the equipment, from the design (where changes may result from conclusions of the predictive analysis), through testing and commissioning and into operation. The system shall be used to monitor the performance of components and to identify patterns of failures so that corrective action can be taken to improve both current and future systems.

25.6 Safety Requirements

25.6.1 Safety is defined as freedom from those conditions that can cause death, injury, occupational illness, or damage to or loss of equipment or property, or damage to the environment.

25.6.2 Safety performance shall be assessed by the Risk Index of individual hazards identified during the System Assurance process.

25.6.3 The Risk Index of a hazard shall be identified from the Risk Matrix in Table 25-8 in accordance with the following parameters associated with the hazard:

(a) The hazard frequency ranking (A to J), as defined in Table 25-8. This shall be calculated for the entire fleet under the assumptions defined in PS 25.3.2(f); and

(b) The hazard Consequence category (1 to 7), as defined in Table 25-8, based on an average passenger load per train.

25.6.4 The Contractor shall ensure that the Risk Index of all hazards on the train shall not be worse than either "R3" or "R4" as defined in the Risk Matrix in Table 25-8.

25.7 Reliability Requirements

25.7.1 Definition of an Incident

The reliability of the trains shall be measured based on the number of train service disruption incidents, hereafter referred to as incidents, which are caused by train failures during operation. An incident is defined as any one of the following events which are caused by a train failure (refer to PS 25.7.4):

(a) Removal from Service

A train is removed from passenger service.

(b) Delay to Train Service

A train is delayed by 2 minutes or more. Both initial and accumulative delays, whichever is the greater, shall be counted. Initial delay refers to the increase in journey time experienced by passengers on the failed train at the incident location. Accumulative delay refers to the longest increase in journey time experienced by passengers on the failed train and clocked at the terminus.

(c) Failure to be Despatched

A train which is scheduled to enter passenger service cannot be despatched at the scheduled time of departure

Events which have evidence to indicate that a train failure has occurred but which end up with causes unknown shall be included retrospectively as incidents once they are confirmed to have arisen from genuine train failures.

25.7.2 Measurement of Reliability

The reliability of the trains shall be assessed using the following measures:

(a) Number of Incidents per Million Car Kilometres

The average number of incidents per million car kilometres achieved in a given period by all cars supplied under the Contract. It shall be calculated using the following formula:

$$\frac{\text{Total number of incidents in a given period} \times 1{,}000{,}000}{\text{Total running distance in km covered by all cars in the period}}$$

(b) Number of 2-minute Delays per Million Car Kilometres

The average number of delays of or over 2 minutes per million car kilometres achieved by all cars in a given period. It shall be calculated using the following formula:

$$\frac{\text{Total number of delays of or over 2 mins. in a given period} \times 1{,}000{,}000}{\text{Total running distance in km covered by all cars in the period}}$$

(c) Number of 5-minute Delays per Million Car Kilometres

The average number of delays of or over 5 minutes per million car kilometres achieved by all cars in a given period. It shall be calculated using the following formula:

$$\frac{\text{Total number of delays of or over 5 mins. in a given period} \times 1{,}000{,}000}{\text{Total running distance in km covered by all cars in the period}}$$

25.7.3 Reliability Targets

The trains shall achieve the following reliability targets by the end of the reliability demonstration period

(a) not more than 6.0 incidents per million car kilometres

(b) not more than 1.82 cases of delay of or over 2 minutes per million car kilometres

(c) not more than 0.25 cases of delay of or over 5 minutes per million car kilometres

25.7.4 Conditions for Train Failures

A train failure is defined as a failure or deterioration of a system, a function, or a component on a train which renders it unfit for passenger service. Failures due to free issued items on the train shall be excluded.

Trains under the following conditions are deemed to be unfit for passenger service:

(a) A failure, or symptoms that suggest the presence of such failure, which endangers the safe and / or normal operation of the railway.

Examples are:

- a failure in the brake system
- a failure in a safety interlock or protection circuit, such as the door loop
- abnormal noise in the underframe
- smouldering
- serious wheel flat
- arcing on the pantograph
- failure of any emergency equipment
- failure of part of the traction equipment so that the train will not be able to perform emergency push-out duty

(b) A failure, or symptoms that suggest the presence of such failure, which will render the train not able to meet the minimum headway requirement

Examples are:

- a failure in the traction equipment so that the train is not able to meet the service speed profile
- 2 or more doors on a train cannot operate properly
- a failure that requires more than 2 instances of reset or recovery action by the train operator within 30 minutes

(c) A failure, or symptoms that suggest the presence of such failure, which will degrade the quality of passenger or train operator comfort

Examples are:

- more than one air conditioning unit on a train fail
- noisy air conditioning unit
- 1/3 or more of the lighting in a car fail
- cab air conditioning failure
- jerky movement

(d) A failure, or symptoms that suggest the presence of such failure, which will aggravate the damage on the train or other railway equipment if the train remains in service

Examples are:

- wheel flats
- arcing on the pantograph
- brake hanging on

Further failure examples to be agreed with the Engineer.

25.7.5 Recovery from Train Failures

To minimise service disruption incidents caused by train failures, the trains shall be designed to meet the following requirements:

(a) When a failure occurs on a train which may render it unfit for passenger service (refer to PS 25.7.4), the train operator, with the aid of the Train Management System (refer to PS 10), should be able to recover the train from the failure within two minutes so that the train can continue its scheduled service.

(b) In the event that the failure cannot be recovered and the train is required to be withdrawn from service, the train operator shall, within five minutes, be able to carry out failure isolation and start the return journey at fully laden load (refer to PS 4.4.11) under the train's own power, to the nearest depot or refuge siding.

(c) In the event that no tractive power is available from the defective train and an assistance train is required, the train operator shall, within five minutes, be able to prepare the train for emergency push out or pull out operation (refer to PS 4.4.3).

25.7.6 Demonstration of Reliability Performance

(a) The reliability demonstration period shall begin immediately after the commencement of passenger service of the last train in respect of the Sections of the Works and the whole of the Works which are related to the Completion Obligation for Completion of Tests on Completion and ready for Passenger Service referred to in Appendix F.

The trains shall be assessed collectively on per batch basis. Each batch shall comprise the number of trains to be completed for each of the above mentioned Sections of the Works and the whole of the Works. (e.g., 2 trains in Section 4 of the Works, 26 trains in Section 6 of the Works, and so on.) The period of assessment for each batch of trains shall be for at least 12 months and shall end when the reliability targets are achieved.

Systematic failures are failures not caused by failure mechanisms such as component wear out, but by a design defect. All incidents attributed to the systematic failure will be initially chargeable. However, subject to the Engineer’s Approval, they may be re-classified as non-chargeable when the failure mechanism, which is associated with a design defect, is identified and corrective action is satisfactorily retrofitted.

(b) During the Reliability Demonstration Period, the Engineer will maintain records for all incidents and details of train failures. Such records shall be made available to the Contractor.

(c) During the Reliability Demonstration Period, the Engineer will review train failure records and decide whether additional scenarios are to be incorporated into the Register of Train Failures. The Contractor shall then update the Register for the Engineer's Approval within 30 days of the Engineer's notice for updating.

(d) The failure records of same batch of the trains shall be assessed at the end of the 12th month of the reliability demonstration period. The value of each of the three reliability measures defined in PS 25.7.2 shall be

calculated from the records for the preceding 12 consecutive months and compared to the reliability targets.

(e) In the event that any reliability targets are not achieved, the DLP of the trains under the same batch shall be extended at the Contractor's cost and the determination of reliability achievement shall be continued at monthly intervals until all reliability targets are achieved over a 12 consecutive months period.

(f) In the event that any reliability target is not achieved, the Contractor shall, at his own expense, take whatever action is deemed necessary to meet the reliability requirement.

25.7.7 Reliability Growth Management

(a) The Contractor shall during the mock-up development stage incorporate reliability growth management requirements in order to identify any design deficiencies or defects for improvement to ensure that the delivered system will meet relevant reliability requirements.

(b) Reliability growth management shall include but not limit to specifying required system / sub-system tests, test schedules (from prototype development to manufacture), test methods, duration and acceptance criteria.

(c) The Contractor may refer to MIL-STD-189 and MIL-STD-781 for relevant techniques and methods.

(d) The Reliability Growth Management processes shall be completed before the commencement of passenger service.

25.8 Availability Requirements

25.8.1 Measurement of Availability

(a) Availability shall be assessed by the following measure:

$$\text{Availability} = 1 - \frac{DT(RE)/3 + DT(OPM) + DT(CM)}{\text{Total Time}}$$

where:

(i) Total Time is the time in hours in the assessment period multiplied by the number of trains supplied under the Contract.

(ii) DT(RE), or Down Time due to service checks, is the total down time in hours due to service checks (refer to PS 26.3.2), summed over all Train Units supplied under the Contract during the assessment period.

(iii) DT(OPM), or Down Time due to Other Preventive Maintenance, is the total down time in hours due to Preventive Maintenance (refer to PS 26.3) other than service checks (refer to PS 26.3.2), summed over all sessions carried out on the trains supplied under the Contract during the assessment period.

(iv) DT(CM), or Down Time due to Corrective Maintenance, is the total down time in hours due to corrective maintenance (refer to PS 26.4), summed over all sessions carried out on the trains supplied under the Contract during the assessment period. Time spent on train integrity inspections after train reformations arising from corrective maintenance work shall be included.

(b) The above down times shall be counted starting from the moment when work is physically started on a Train Unit or train and shall end when the Train Unit or train is restored to service condition (PS 2.1.6). The time shall cover the full content of the maintenance work concerned, including safety precautions, inspections, servicing, replacement of equipment, defect detection and rectification, testing and restoration to service condition.

25.8.2 Availability Target

The trains supplied shall achieve a minimum availability of 96.5%.

25.8.3 Demonstration of Availability Performance

(a) The Availability Demonstration Period shall begin immediately after the commencement of passenger service of the last train in respect of the Sections of the Works and the whole of the Works which are related to the Completion Obligation for Completion of Tests on Completion and ready for Passenger Service referred to in Appendix F.

The trains shall be assessed collectively on per batch basis. Each batch shall comprise the number of trains to be completed for each of the above mentioned Sections of the Works and the whole of the Works. (e.g., 2 trains in Section 4 of the Works, 26 trains in Section 6 of the Works, and so on.) The period of assessment for each batch of trains shall be for at least 12 months and shall end when the availability target is achieved.

The total maintenance down times for per batch basis will be collected by the Engineer and the average availability during the preceding 12 months, shall be worked out from the above formula.

(b) In the event that any availability targets are not achieved, the DLP of the trains under the same batch shall be extended at the Contractor's cost and the determination of availability achievement shall be continued at monthly intervals until the availability target is achieved over a 12 consecutive months period.

(c) In the event that the availability target is not achieved, the Contractor shall, at his own expense, take whatever action is deemed necessary to meet the availability requirement.

25.9 Maintainability Requirements

25.9.1 Maintainability Target

The maintainability of a given maintenance operation shall be measured by the arithmetic mean of the times required to complete a sample of the same operation. After the maintenance operation the train involved shall be restored to service condition.

The trains shall meet the following maintainability targets:

(a) A Service Check - not more than 6 hours per 4 cars with a team size of not more than 2 persons

(b) B Service Check - not more than 6 hours per 4 cars with a team size of not more than 8 persons

(c) Service Check on a complete train - not more than 6 hours per train with a team size of not more than 10 persons.

(d) General Overhauls - not more than 56 hours (7 working days) per train

(e) Scheduled Equipment Replacements - not more than 6 hours per session

(f) Corrective Maintenance operations (including defect identification, replacement of defective LRUs and restoration to service condition) that do not require car lifting - not more than 4 hours.

(g) Replacement of LRUs that do not require car lifting - not more than 30 minutes.

(h) Corrective Maintenance operations (including defect identification, replacement of defective LRUs and restoration to service condition) that require car lifting, excluding time required for shunting - not more than 6 hours. In this case it is assumed that car lifting is carried out using the underfloor car lifting equipment specified in Clause 3.3 of Appendix I Annex 6.

(i) Internal Light Cleaning - not more than 2.5 hours per train with a team size of 2 persons

(j) Internal Heavy Cleaning - not more than 6 hours per car with a team size of 1 person

(k) Window Cleaning - not more than 2 hours per car with a team size of 1 person

(l) K Service Check - not more than 6 hours per train with a team size of not more than 6 persons.

In addition to the above maintainability targets, the trains shall also satisfy maintenance requirements specified in PS 26. Any replacement of good LRUs due to inaccurate diagnosis shall be included in the maintenance time.

25.9.2 Demonstration of Maintainability Performance

(a) As part of RAM testing / commissioning (refer to PS 25.5.15) and RAM performance demonstration (refer to PS 25.5.17), the Contractor shall carry out tests to show that all maintainability targets are met.

(b) The tests shall cover all preventive maintenance sessions (refer to PS 26.3), cleaning (refer to PS 26.5) sessions and a representative sample of actual or simulated corrective maintenance (refer to PS 26.4) operations for the calculation of the maintainability target specified in the Letter of Clarification. Reference shall be made to MIL-STD-471 in the formulation of the maintainability tests.

(c) All maintainability tests shall be completed within 6 months after the first train is put into passenger service. For General Overhaul Service Check items, the maintainability demonstration shall be completed within 24 months after the first train is put into passenger service. Moreover, all maintainability demonstration shall be performed in Hong Kong.

(d) In the event that any maintainability targets are not achieved, the Contractor shall, at his own expense, take whatever action is deemed necessary to meet the maintainability requirement.

(e) In the event that the maintenance cost of LCC as stipulated in Appendix M is not achieved, the DLP of the trains shall be extended at the Contractor's cost and the determination of maintenance cost achievement shall be continued until the maintenance cost target is achieved.

25.9.3 Maintenance Requirements Analysis

(a) The Contractor shall conduct a structured Maintenance Requirements Analysis to formulate the maintenance requirements and determine the optimum maintenance policy. One possible technique that the Contractor can apply is Reliability Centred Maintenance (RCM), which is a logical process for identifying preventive and corrective maintenance tasks to realise the inherent reliability of equipment at optimum expenditure of resources.

(b) The Maintenance Requirements Analysis shall identify for each system function the potential functional failures, failure consequences, and the appropriate maintenance methods such as visual inspection, condition maintenance, preventive maintenance, hard time replacement, overhaul etc.

(c) The Contractor shall use the template in Table 25-9 for conducting Maintenance Requirements Analysis.

(d) The Maintenance Requirements Analysis results shall include a summary of:

(i) The consolidated maintenance programme;
(ii) A list of tasks to be undertaken at different time intervals and the manning levels required;
(iii) The critical equipment or assembly requiring frequent inspection and maintenance and the justifications;
(iv) The list of equipments that are subject to condition based maintenance.

(e) The Contractor shall, for each maintenance activity, identify maintenance logistics requirements such as

(i) Personnel – skills, training, call-out process, location, crew size;
(ii) Spares – quantity, turnaround times, inventory, etc.;
(iii) Tools & Test Equipment – including computer & software;
(iv) Maintenance facilities – power, compressed air, water, environment controls, lighting, etc;
(v) Transportation & Handling – mode of transportation for personnel, equipment & spares, manual handling requirements.

(f) The Contractor shall submit the Maintenance Requirements Analysis results at SEMP 3 stage and the final version at SEMP 4 stage for the Engineer's Approval, subsequent to which the maintenance requirements derived from the analysis shall be incorporated into the Operating and Maintenance Manuals.

25.10 System Assurance Audits

25.10.1 The Engineer shall conduct audits during design, development, manufacture and testing and commissioning phases to ensure that the Contractor has met all relevant system assurance requirements. The Engineer shall give 7 days notice to the Contractor about the audit arrangement. The Contractor shall provide all necessary assistance to enable the Engineer or his representative complete the audit (e.g. arrange proper staff to attend interviews, provide relevant documents etc.).

25.10.2 After the audit is completed, the Engineer shall recommend various system assurance related improvement actions. The Contractor shall provide evidence (e.g. documents) to ensure that all improvement actions have been completed before agreed completion dates.

25.11 Not Used

Table 25-1 Summary of System Assurance Tasks and Deliverables by Project Stages

Item	System Assurance Tasks / Document	PS Ref	SEMP Stage					
			SEMP 1	SEMP 2	SEMP 3	SEMP 4	SEMP 5	DLP
			Concept Exploration	Design Development and Review	Design Verification and Validation	Engineering and Manufacturing Development Phase	Inspection. Testing, Commissioning, Demonstration and Training	Defects Liability Period
	Safety Management Related Tasks							
1	System Assurance Plan (including RAMS)	25.2.1	D	D	D	D	D	–
2	Safety Analysis Report Section 1: Preliminary Hazard Analysis Report	25.5.11 25.5.1	D	D	-	-	-	-
3	Safety Analysis Report Section 2: Interface Hazard Analysis Report Section 3: System Hazard Analysis Report Section 4: Operating & Support Hazard Analysis Report Section 5: Safety Integrity Level Analysis Report	25.5.11 25.5.3 25.5.4 25.5.5 25.5.6	-	D	D	-	-	-
4	Safety Analysis Report Section 6: Deterministic Safety Assessment Report Section 7: Quantified Risk Assessment/Fault Tree Analysis Report Section 8: Safety Criteria Item Identification	25.5.11 25.5.2 25.5.8 25.5.9	-	D	D	D	D	-
5	Hazard Log	25.3.3	-	D	D	D	D	-
6	Safety Verification	25.5.16	-	–	–	-	A	–
7	System Safety Report	25.2.3	-	–	D	–	D	-
	RAM Management Related Tasks							
1	Preliminary RAM Analysis Report	25.5.13	D	D	-	-	-	-
2	Derivation and Apportionment of RAM Target	25.5.12	D	D	-	-	-	-
3	RAM Modelling and Predictions	25.5.14	-	D	D	-	-	-
4	Failure Modes, Effects and Critically Analysis With Service Criteria Items identification	25.5.7 25.5.10	-	D	D	D	D	-
5	Register of Train Failure	25.3.4	-	D	D	D	D	-
6	RAM Demonstration Plan (including Failure Reporting And Corrective Action System)	25.2.2, 25.5.18	-	D	D	D	D	D
7	RAM Testing / Commissioning	25.5.15	-	-	A	A	A	-
8	RAM Performance Demonstration	25.5.17	-	-	-	-	A	A
9	RAM Demonstration Reports	25.2.4	-	-	-	-	-	D
10	Maintenance Requirements Analysis	25.9.3	-	-	D	D	-	-

Legend: A - Activity
D - Deliverable

Table 25-2 System Safety Report Structure

1. Introduction
    - 1.1 Background
    - 1.2 Definition
    - 1.3 Abbreviations

2. System Description
    - 2.1 Overview
    - 2.2 System and Sub-systems
    - 2.3 Interfaces
    - 2.4 Safety Features
    - 2.5 Backup or Emergency Operations

3. Safety Management
    - 3.1 Safety Policy
    - 3.2 Safety Management Organisation and Responsibilities
    - 3.3 Safety Management Process
    - 3.4 Safety Management Activities in Different Project Phases
    - 3.5 Safety Justification Documentation

4. Hazard Identification & Control
    - 4.1 Introduction
    - 4.2 Hazard Identification and Control
    - 4.3 Summary of Hazard Close-out
    - 4.4 Description of Safety Critical Hazards
    - 4.5 Safety Critical Item Identification List
    - 4.6 Service Criteria Item Identification List

5. Deterministic Safety Assessment
    - 5.1 Introduction
    - 5.2 Methodology
    - 5.3 Summary of Results

6. Quantified Risk Assessment / Fault Tree Analysis (if applicable)
    - 6.1 Introduction
    - 6.2 Methodology
    - 6.3 Summary of Results

7. Operation Safety Assessment
    - 7.1 Summary of Operational Mitigation Measures
    - 7.2 Summary of Maintenance Mitigation Measures
    - 7.3 Training

8. Conclusion
    - 8.1 Safety Management
    - 8.2 Hazard Identification and Control
    - 8.3 Progress of Non-compliance and On-going Items (if applicable)

8.4 Operation Hazards to be Transferred to Operations Division with Residual Risk at R1 or R2 (if applicable)
8.5 Overall Conclusion

9. Appendices (if applicable)

Table 25-3 Hazard Log Template

Hazard I D	System / Activity Category	Sub-system / Specific Activity	Hazard Description	Location	Potential Cause(s)	Affects						Effect(s)/ Consequence(s)	Original Risk			Hazard Controller (Projects)	Proposed Safeguard shall be detail specified by following stage (1) Design - Design submission / specification ref. (2) Construction - Construction Plan (3) Testing & Commissioning - T&C activity / test record / check / procedure ref. (4) O&M - Operation / Maintenance procedure ref.	Residual Risk			Remarks	Target Completion Date	Status update			Closed (Y/N)	Rev. Date
						Public	Passenger	Staff	Contractor	Environment	Service Disruption		Frequency	Severity	Risk Index			Frequency	Severity	Risk Index			Evidence of hazard close-out (e.g.) 1. Design Submission 2. Test Report 3. O&M Procedure 4. Training etc	Individual O - Outstanding C - Completed	Overall O - Outstanding P - Partially Completed C - All Completed		

Table 25-4 Deterministic Safety Assessment Template

Item No.	System	Subsystem	Design Feature	Reference Clause	Associated Potential Safety Hazards	Relevant Design / Operations Safety Principles / Codes of Practice / Legislation Specification Requirements	Current Compliance Status	Verification Method	Compliance Category*

*Key for Compliance Category:
C: Fully compliant – no further action or monitoring required N/C: Non-compliant – subject to rework, re-test, etc.
W: Non-compliant – waiver approved
O/G: On-going action during operations
I/C: Inconclusive – review incomplete, awaiting testing, procedures under review or preparation

Table 25-5 Failure Modes Effects and Criticality Analysis Template

ID	Item	Function	Failure Mode	Cause(s) of Failure	Failure Detection Method			Failure Behaviour (Burn-in, Random, Wear out, Weibull)	Failure Effects / Consequences					Criticality Analysis								Remarks/ Assumptions/ Comments
																Affected categories					Action Necessary to Restore System		
					Detectable means to Operator	Detectable means to Maintainer	Built-in-test Function		Subsystem (Local)	System (Overall)	Safety	Service/ Operation: A. Changeover B. Withdrawal C. Degraded service D. Line disruption E. Station disruption F. Operator actions G. Others (please specify)	Time affected (minutes)	Failure Rate	Severity Class	S-Safety ?	E-Environmental ?	O-Operational (reliability)?	Design Safeguard or Procedures for Hazard Mitigation	Immediate Action during TH	Follow-up Action at NTH	

Table 25-6 Sample Template for Safety Critical Item Identification

(1) SCI Number (To be assigned by ASR tool)	(2) SCI Owner (Select from the pull-down menu)	(3) System (Select from the pull-down menu)	(4) Sub-system (Select from the pull-down menu)	(5) Equipment	(6) Description of SCI	(7) Function of SCI	(8) Parallel System <The system that operates in parallel with the assembly / component which can partially or fully provide the same function as the evaluated system>	(9) Protection System & its Safety Function <The system that provides protection to the assembly / component to prevent the occurrence or adverse consequence>	(10) Description of Failure Scenario	(11) No. of Independent Failure(s) required to cause adverse consequence	(12) Additional Independent Failure(s) <The additional independent failure(s) required to cause adverse consequence> Note: On top of the SCI in column 6, the equipment / parts mentioned here may also be registered as SCI as it has contributed to the failure consequence.	(13) Failure Consequence <The adverse effect if the assembly / component lose its function under the stated failure scenario>	(14) Severity Level of Failure Consequence (Select from the pull down manual)	(15) SCI (Y/N)	(16) Critical Maintenance Task <If item is judged to be an SCI, describe the maintenance task (with ref. no. of the concerned maintenance procedure) that specifically address the relevant failure scenario>	(17) Applicable to Lines (Select from the pull-down menu)

(18) Applicable to Vehicle Types (Select from the pull-down menu)	(19) Type of tests to be done [with cross-reference to Test Specification (Name, Reference, Clause No.)]	(20) Test standard to be met [with cross-reference to Test Specification (Name, Reference, Clause No.)]	(21) Test Record [Report Name, Reference, Clause No.]	(22) Remark	(23) Discipline	(24) Contract Requirements				(25) Contractor design related submission (CSF no.)				(26) Factory related activities (CSF no.)				(27) HK Site related activities (CSF no.)	
						(a) PS	(b) M&W	(c) Specific requirements	(d) Statute related	(a) Equipment / Material submission	(b) Approved Integrated Test Plan	(c) Drawing no	(d) 3rd Party Test Certificate / Report	(a) FAI test record	(b) FAT test record	(c) Factory in-house routine inspection record	(d) Pre-delivery inspection	(a) SAT	(b) system Handover demonstration to Operations

Table 25-7 Sample Template for Service Criteria Item Identification

Service Critical Items review results

Credible scenario: _____
Relevant system: _____
Worst case scenario : _____

		Functional descriptions of item					Failure Effects		To be filled in for items identified as Service Critical Items								
									Existing design / maintenance measures	Analysis of new control measures that can be provided							
										Design mitigations			Maintenance enhancement			Other control measures	Reasons if no new control measures identified
ID	Area of application	Subsystem	Equipment Component (replaceable unit)	Function of component	Failure mode of component	Causes of failure mode	Local effect (system failure)	Final effect (operation impact)		Design-out (eliminate failure mode totally)	Redundancy (provide additional equipment item as redundancy)	Design margin (increase design margin for same equipment item)	CBM (continuous monitoring with alarm triggered if failure detected)	Regular condition tests (scheduled PM check)	Hard time replacement (scheduled replacement based on asset condition)		
							Functional failure of the system due to component failure	>60 min for line disruption or 1 day station disruption? (i.e. Service Critical Item)									

Table 25-8 Risk Matrix

				CONSEQUENCE						
				7	6	5	4	3	2	1
				Trivial	Negligible	Marginal	Serious	Critical	Catastrophic	Disastrous
		Staff/Contractor Safety	Fatality					<5	5 or more	
			Major Injury				<5	5 or more		
			Minor Injury with ≥3 days sick leave			<5	5 or more			
			Minor Injury with < 3 days sick leave		<5	5 or more				
		Passenger/Public Safety	Fatality					<5	5-50	51-500
			Major Injury				<5	5-50	51-500	501 - 5000
			Minor Injury			<5	5-50	51-500	501 - 5000	>5000
		Service	System Disruption			<20 min	1 hour	1 day	1 week	1 month
			Line Disruption		20-60min	few hours	1 day	1 week	1 month	few months
			Station Disruption	<20min	few hours	1 day	1 week	1 month	few months	1 year
FREQUENCY	A	Few times per week or more	≥100 /year	R3	**R1**	**R1**	**R1**	**R1**	**R1**	**R1**
	B	Few times per month	≥10 - <100 /year	R4	**R2**	**R1**	**R1**	**R1**	**R1**	**R1**
	C	Few times per year	≥1 - <10 /year	R4	**R2**	**R2**	**R1**	**R1**	**R1**	**R1**
	D	Few times in 10 years	≥ 0.1 - <1 /year	R4	R3	**R2**	**R1**	**R1**	**R1**	**R1**
	E	Once since operation	≥ 1E-2 - <1E-1 /year	R4	R3	R3	**R2**	**R1**	**R1**	**R1**
	F	Unlikely to occur	≥ 1E-3 - <1E-2 /year	R4	R4	R3	R3	**R2**	**R1**	**R1**
	G	Very unlikely to occur	≥ 1E-4 - <1E-3 /year	R4	R4	R4	R3	R3	**R2**	**R1**
	H	Remote	≥ 1E-5 - <1E-4 /year	R4	R4	R4	R4	R3	R3	**R2**
	I	Improbable	≥ 1E-6 - <1E-5 /year	R4	R4	R4	R4	R4	R3	R3
	J	Incredible	< 1E-6 /year	R4	R4	R4	R4	R4	R4	R3

DEFINITIONS OF RISK INDICES

R1 Risk must be reduced save in exceptional circumstances.
R2 Risk must be reduced if it is reasonably practicable to do so.
R3 Risk is tolerable but should be further reduced if it is cost effective to do so.
R4 Risk is acceptable.

DEFINITIONS OF INJURY:

Major Injury:
- Fracture of any bone (but not a bone in the hand or foot)
- Amputation of hand or foot, or complete severance of a finger or toe
- Penetrating injury or burn to an eye or loss of sight
- Electric shock requiring immediate medical treatment
- Loss of consciousness resulting from lack of oxygen
- Inhalation or ingestion through the skin of any substance leading to acute illness or requirement for medical treatment
- Medical treatment resulting from exposure to a pathogen
- Any other injury requiring admittance to hospital for observation or treatment immediately after an incident

Minor Injury: - Any personal injury which is not a major injury

INSTRUCTIONS FOR USE

1. The worst case and most likely case frequency/consequence pairs shall be classified on the risk matrix. This may result in two different risk classifications being obtained (e.g. worst case is R4(H,4) but most likely case is R3(E,5)). In this case, the most severe classification of the two (R3(E,5)) shall be taken as being the representative risk arising from the hazard.
2. The hazard should be assessed based on its effect on the whole system. For example, a generic station hazard will affect all stations, while a station-specific hazard will only affect 1 station. The hazard rating shall reflect the total frequency of the event and the aggregate effect on all passengers, staff and contractor's employees.

Table 25-9 Maintenance Requirements Analysis Template

Maintenance Requirements Analysis Worksheet

System:

ID	Sub-System	Equipment / Component	Function	Functional Failure	Failure Mode / Cause of Failure	Failure Effects (Applicable Criteria)				Severity Class				Preventive Tasks				Failure Behaviour (Burn-in, Random, Wear out, Weibull)	Quantities of Equipment/Component Per Train	Failure nos. per year						Criticality Rating (C1, C2, C3, C4)	Failure Detection Method			Action Necessary to Restore System				Proposed Tasks / Design Safeguards (Compensating Provisions)	Proposed PM Interval (Maintenance)	Existing Maintenance Programme (Maintenance Contract PM interval)
						Subsystem (Local)	System (Protective device if any)	Service (Withdrawal / Changeover (Immed.) / Changeover (ASAP) / Remain in Service)	Safety	H-Detectable ?	S-Safety ?	E-Environmental ?	O-Operational (reliability) ?	Any measurable condition before failure (e.g. temp, vibration) ?	Regular restoration & inspection reduces failure rate (age limit related failure) ?	Regular replacement reduces failure rate (life limit related failure) ?	Protective device, failure detectable (if applicable) ?			No. of failures without delay (0-2")	No. of failures causing delay 2" - <5 min (C3)	No. of failures causing delay 2.5 hrs - 20 hrs (C2)	No. of failures causing delay > 20 hrs - <48 hrs (C1)	No. of failures causing delay of > 2 days (C1)	Total no. of failures (with and without delay)		Detectable means in Operation	Detectable means in Maintenance	Built-in-test Function	Immediate Action during TH (Recovery)	Primary Recovery Time during TH	Follow-up Action at NTH (Repair)	Repair Time during NTH			

SECTION 26

MAINTENANCE REQUIREMENTS

August 2015

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26 MAINTENANCE REQUIREMENTS

26.1 General

26.2 Design for Maintenance

26.3 Preventive Maintenance

26.4 Corrective Maintenance

26.5 Cleaning

26.6 Equipment Identification Labels

26.7 O&M Manual

26.8 As-built Drawings

26 MAINTENANCE REQUIREMENTS

26.1 General

26.1.1 Maintenance Programme

(a) The maintenance of the trains will be carried out by the Employer. The Contractor shall establish and provide documentation for a comprehensive maintenance programme for upholding the service condition (refer to PS 2.1.6) of the trains. The objective of the maintenance programme shall be to ensure that the trains will satisfy the following requirements throughout their design life:

(i) Operational safety requirements as defined in PS 25.6
(ii) Reliability requirements as defined in PS 25.7
(iii) Availability requirements as defined in PS 25.8
(iv) Maintainability requirements as defined in PS 25.9
(v) Quality of comfort, including cleanliness and appearance, experienced by passengers
(vi) Minimum life cycle cost

(b) The maintenance programme shall cover preventive maintenance, corrective maintenance, cleaning, condition-based maintenance and any other activities necessary to maintain the trains in a condition that can fulfil the above requirements. Within the context of this Specification and unless otherwise specified, the term 'maintenance' shall include all activities covered by the maintenance programme.

26.1.2 Maintenance Policy

(a) The maintenance programme shall be based on a planned preventive maintenance approach. Each train will undergo a series of regular maintenance sessions, the contents of which will be increased progressively in accordance with the amount of service and in line with the maintenance requirements of individual equipment. Where appropriate, condition-based maintenance techniques shall also be adopted to minimise the amount of maintenance work, downtimes and the associated costs.

(b) Service checks and cleaning work shall be so organised that they can be completed within the time limits specified under maintainability requirements.

(c) All corrective maintenance work shall be completed within the time limits specified under maintainability requirement.

26.1.3 Submission

Information pertaining to maintenance requirements shall constitute part of the design documents to be submitted for Approval.

26.2 Design for Maintenance

The Contractor shall ensure that maintenance considerations are duly incorporated into the design of the train. Features that can minimise or facilitate maintenance shall be built into the design as integral elements. As a minimum, the following requirements shall be satisfied:

26.2.1 Health and Safety

(a) The design of the trains shall be such that all maintenance activities can be carried out safely.

(b) The Contractor shall identify all potential hazards to personnel or equipment that may arise during all maintenance activities in Operating and Support Hazard Analyses (refer to PS 25.5.5) or similar studies.

(c) The Contractor shall establish and specify, for each potential hazard, corresponding preventive, mitigative or protective measures to reduce the risk to an acceptable level as defined in the Risk Assessment Matrix in Table 25-4 of PS 25.

(d) The Contractor shall ensure that all maintenance activities shall comply with relevant legislation in Hong Kong regarding health and safety.

(e) Testing procedures shall be built into all maintenance work to ensure that the trains shall be restored to a safe operation condition upon completion of the maintenance work.

26.2.2 Human Factors

(a) Ergonomic principles shall be adopted in the design of the train so that maintenance and cleaning activities are tailored to suit the capability and limitations of the maintenance staff. In general, guidelines in BS EN ISO 6385: 2004 and MOD Defence Standard 00-25: Part 11 shall be adhered to. Anthropometric dimensions for the Hong Kong Chinese population (refer to RS/C6014/14) shall be adopted.

(b) The design of maintenance work shall be such that skills and training requirements are minimised. This shall be achieved with the aid of the Train Management System (refer to PS 10) and other special tools and equipment supplied under the Contract.

26.2.3 Accessibility

(a) Access to equipment shall require minimum effort and shall not impose undue strain to maintenance and cleaning personnel.

(b) Equipment shall be configured in such a way that ease of access corresponds with the frequency of access for both preventive and corrective maintenance, with the most frequently accessed part having the easiest access.

(c) The layout and mounting of equipment shall facilitate inspections, testing and replacement during fault finding. Adequate access shall be provided so that when replacing one particular LRU it will not be necessary to remove other components which may block the access.

(d) Access covers and doors of equipment cases and cabinets shall be provided with quick release fasteners to reduce the time and effort for removal and restoration. Access covers and doors accessible by passengers shall be designed against tampering.

(e) The design of access to underframe mounted equipment shall take account of the fact that personnel working on the underframe will wear bump caps.

26.2.4 Interface with Employer's Maintenance Facilities

The trains will be maintained and stabled at the Employer's maintenance facilities as described in Appendix I Annex 6. The Contractor shall ensure that

(a) The trains and the maintenance programme are designed to interface safely, effectively and efficiently with the maintenance facilities in all aspects

(b) All maintenance activities are so organised that they can be completed to the required standards under the technical and operational constraints imposed by the maintenance facilities

26.2.5 Line Replaceable Units (LRUs)

(a) Equipment shall be constructed in such a way that when a failure occurs, the train can be restored to service condition by replacing the defective equipment items that give rise to the failure. Such defective equipment items are referred to as Line Replaceable Units, or LRUs.

(b) LRUs shall be designed for quick and easy replacement so that maintainability targets for corrective maintenance defined in PS 25.9.1 can be achieved.

(c) Equipment items with a failure rate of more than 1 in 10 million car km (Approx. 10 train running years) shall be designed as LRUs.

(d) In order to avoid replacing unnecessary complete higher level assemblies which will increase the costs in replacement, handling, reconditioning and spares holding, LRUs shall generally be the lowest level items in the equipment system which satisfy one of the following conditions:

(i) Replacement or repair of lower level components in the item will require extensive stripping down and it is not practicable to design the item otherwise

(ii) Replacement or repair of any defective part within the item can only be achieved with proper equipment in a workshop environment and it is not practicable to design the item otherwise

(e) To give some examples, the following items shall be designed for replacement as LRUs:

(i) Contacts of a contactor
(ii) Electronic printed circuit boards
(iii) Electrical relays
(iv) Brake actuators
(v) Air compressors
(vi) Autocouplers
(vii) Bogies
(viii) Window glazing

(f) As far as practicable, quick release connections such as plugs and adapters shall be provided between a LRU and the train to facilitate replacement. Relay connections shall be of the plug-in type such that no wire disconnection and reconnection are required during replacement. All quick release connections shall have a robust design which shall be able to accommodate LRU replacements throughout their design life.

(g) LRUs mounted on the underframe, except for bogies, items on the traction drives and the suspension, shall be designed so that they can be replaced at the Running Maintenance Area of the Employer's depots (refer to Clause 2 of Appendix I Annex 6).

26.2.6 Workshop Replaceable Units (WRUs)

(a) Equipment which are functionally closely related shall be grouped into manageable physical modules, hereafter referred to as Workshop Replaceable Units (WRUs), to minimise the time and effort required by their replacement during car overhauls (refer to PS 26.3.3) and scheduled equipment replacement (refer to PS 26.3.4) sessions.

(b) Examples of WRUs are:

(i) A pneumatic block to hold components in the compressed air system
(ii) A brake equipment module containing valves in the air brake system
(iii) Complete equipment cases containing contactors and relays in the traction inverter or auxiliary converter

(c) WRUs shall be designed in such a way that the time for recommissioning tests on the train is shortened by relocating most of the testing upstream at the overhaul workshop.

(d) Connections, other than mechanical mountings, between a WRU and the train shall be achieved through quick release fittings such as multiway jumper plugs. Such quick release fittings shall have a robust design which shall be able to accommodate WRU replacements throughout their design life.

(e) As far as practicable, WRUs mounted on the underframe shall be designed to allow replacement to be carried out with the train standing at a track at the Running Maintenance Area. Only when this is not feasible, for example bogies, shall replacement be performed at a Lifting / Heavy Maintenance Area described in Clause 3 of Appendix I Annex 6.

(f) Notwithstanding the above requirements, the design of WRUs shall allow any LRU which forms part of the WRU to be replaced, in-situ without replacing the entire WRU, within the time limit specified under relevant maintainability targets (refer to PS 25.9.1).

26.2.7 Lifting and Towing

(a) Proper handles shall be provided on heavy equipment designed for manual lifting.

(b) Equipment or components weighing over 20 kg shall be designed for handling with overhead cranes and forklift trucks. Where necessary, they shall be provided with integral lifting lugs or eyes, or attachment points for similar fittings.

(c) Towing points shall be provided on each car to allow towing as specified in Appendix I Annex 6.

26.2.8 Running Hour Counter

(a) In order to facilitate maintenance scheduling, a running hour counter function shall be provided for each major equipment such as traction motor, air compressor, refrigerant compressor and doors for recording the running hours (or cycles in the case of doors and similar equipment) accumulated on the equipment.

(b) The running hours shall be recorded in the Train Management System (refer to PS 10). Such information will then be downloaded for further processing.

(c) The running hour counter shall be reset when the equipment on the train is replaced by a new item.

26.2.9 Submission

(a) Interface with Employer's Maintenance Facilities

(i) At SEMP stage 3, the Contractor shall submit for Approval any modification necessary to the Employer's maintenance facilities specified in Appendix I Annex 6 in order that the trains can interface with such facilities. All the modifications shall be carried out by the Contractor and shall not adversely affect its use by the Urban Line Trains.

(ii) At SEMP stage 4, the Contractor shall submit for Approval a schedule of tests to demonstrate that the trains shall be compatible with each of the Employer's maintenance facilities in accordance with PS 26.2.4.

(iii) The Contractor shall carry out tests to demonstrate that the trains can interface with each of the Employer's maintenance facilities as specified under PS 26.2.4.

(b) WRUs and LRUs

(i) At each of SEMP stages 3 and 4, the Contractor shall submit an updated list of LRUs and WRUs for Approval.

The list shall identify all LRUs and WRUs on the train as defined in PS 26.2.5 and 26.2.6 respectively. For simplicity, LRUs may be enumerated in generic terms in conjunction with a statement of any exceptions.

Any equipment items that are not able to meet the full requirements specified in PS 26.2.5 and 26.2.6 shall be reported to the Engineer.

(ii) At each of SEMP stages 4 and 5, the Contractor shall, upon the request of the Engineer, demonstrate by physical exercises that the design of specific WRUs or LRUs is able to meet relevant maintainability requirements.

(c) Running Hour Counter

At SEMP stage 2, the Contractor shall submit a list of equipment to be covered by the running hour counter for Approval.

(d) Additional Submissions Related to Design for Maintenance

At the request of the Engineer, the Contractor shall submit additional details regarding Design for Maintenance as defined in PS 26.2 above for Approval, and to demonstrate physically that relevant requirements are satisfied.

26.3 Preventive Maintenance

26.3.1 Organization of Preventive Maintenance Work

The Contractor shall establish and provide documentation for a preventive maintenance programme for the trains in accordance with the following requirements:

(a) Maintenance Action

Maintenance action is defined as the smallest sub-division of maintenance work to be carried out in-situ on the trains, such as bearing lubrication, filter change and relay operation check.

(b) Maintenance Tasks

(i) Preventive maintenance actions to be carried out in-situ on the trains shall be grouped into logical blocks referred to as maintenance tasks.

(ii) The maintenance actions in a maintenance task shall be carried out together as a complete module. They shall either be done on the same equipment / equipment system, such as the pantograph; or at the same location, such as saloon or driving cab.

(iii) Maintenance tasks shall form the basic building blocks of all maintenance sessions other than equipment overhauls. Low level tasks such as basic safety inspections shall be repeated in all preventive maintenance sessions while high level tasks such as bogie replacement shall only be carried out at specific car overhauls.

(iv) Separate tasks shall be provided to cover maintenance actions to be carried out at different stages of a maintenance session.

(c) Maintenance Sessions

(i) Preventive maintenance work to be carried out in-situ on the trains shall be grouped into Maintenance Sessions during which a train will not be available for service. Maintenance sessions shall be designed to maximise availability and reliability while minimizing costs at the same time.

(ii) Each maintenance session shall be divided into a number of logical work stages such as preparation, servicing and inspections, and recommissioning, as defined in RS/C6014/12. Each stage shall consist of individual maintenance tasks.

(iii) The maintenance sessions shall cover the following types of maintenance requirements of trains at different service ages:

- Service Checks
- Car Overhauls

- Scheduled Equipment Replacements

(iv) The minimum requirements for each type of maintenance session are specified in PS 26.3.2 to 26.3.4 below. The Contractor may propose alternatives to such arrangements for Approval.

(d) Equipment Overhauls

Equipment overhauls refers to the following:

(i) scheduled overhauls of individual equipment
(ii) repair of defective equipment removed from the trains during corrective maintenance

Such work shall be carried out outside the trains at a workshop furnished with the required tools and equipment for the work.

26.3.2 Service Checks

(a) General Requirements

(i) Service checks include all regular safety checks, inspections and servicing necessary for maintaining the trains in service condition.

(ii) The interval of B Service Checks shall be integral multiples of that for A Service Checks.

(iii) Service checks shall be designed to be carried out on complete trains so that each train will only be required to visit the depot once within the lowest service check interval. However the design of the trains and the service check contents shall also allow the service checks be carried out separately on individual Train Units at different times.

(iv) The downtime for a service check session on a train shall not be more than the hours stated in PS 26.3.2 (b), (c) and (d).

(v) The team size for a service check session on a train shall not be more than the number of persons stated in PS 26.3.2 (b), (c) and (d). To achieve this, the constituent Train Units of a train may be scheduled for a combination of different A and B Service Checks (for example, A Service Checks for 4 cars and B Service Check for the remaining 4 cars)

(vi) The 'balanced-check' approach shall be implemented in structuring service checks so that the downtimes and manpower for individual service check sessions will not differ by more than 5% from each other.

(vii) 'B type tasks' which need not be carried out in every B Service Check (for example those with maintenance interval of 60,000 km, if any) shall be evenly distributed over the respective maintenance cycles so that the downtimes and manpower requirements for each B Service Check do not differ by more than 5%. To facilitate efficient management, the number of different B Service Checks for each type of Train Unit shall not exceed 4.

(b) A Service Check

Interval:	7,500 km (approx. 24 days) minimum
Downtime:	Not more than 6 hours (including work arising) per 4 cars
Location:	Running Maintenance Area (refer to Appendix I Annex 6)
Work Content:	'A type tasks' - Checks on safety and reliability critical equipment, general visual inspections, and replenishment of items such as lubricants and water.
Team Size:	Not more than 2 persons per 4 cars

(c) B Service Check

Interval:	15,000 km (Approx. 45 days) minimum
Downtime:	Not more than 6 hours (including work arising) per 4 cars
Location:	Running Maintenance Area
Work Content:	'A type tasks' plus items at multiples of 15,000 km intervals ('B type tasks')
Team Size:	Not more than 8 persons per 4 cars

(d) K Service Check

Interval:	120,000 km (Approx. one year) minimum
Downtime:	Not more than 6 hours (including work arising) per train
Location:	Running Maintenance Area
Work Content:	Maintenance items between B Service Check and Overhaul
Team Size:	Not more than 6 persons per train

26.3.3 Car Overhauls

(a) General Requirements

(i) Car overhauls are high level service checks which require the train or cars to be down for more than one day.

(ii) The contents of car overhauls shall be designed to meet the maintenance requirements of individual equipment while making the best use of their service lives between overhauls or replacements.

(iii) To minimise downtime, major equipment shall be replaced on an item-for-item exchange basis. Repair or overhaul of the used equipment shall be carried out independent of the car overhauls.

(iv) The car body shall require minimal attention at overhauls. Pipework and electrical cables shall last for the life of the car.

(v) Car overhauls shall normally be carried out on complete trains. However the design of the trains and the service check contents shall also allow the overhauls be carried out separately on individual Train Units at different times.

(b) General Overhauls

Interval:	480,000 km (approx. 48 months) minimum
Downtime:	Not more than 10 working days (including work arising) per train
Location:	Lifting / Heavy Maintenance Area (refer to Appendix I Annex 6)
Work Content:	'A & B type tasks' plus inspections, equipment replacements and repairs that require extensive stripping down.

(c) Mid-life Refurbishment

Minimum Interval:	2.4 million km (approx. 20 years)
Location:	Lifting / Heavy Maintenance Area
Work Content:	As that of general overhauls plus complete refurbishment and replacements or repairs that require further stripping down

After mid-life refurbishment, the cars shall be returned to a condition which will enable them to run until the expiry of their design lives without major attention.

26.3.4 Scheduled Equipment Replacements

(a) Normally equipment shall be replaced during car overhauls to minimise downtime and overhead. Equipment that are not able to accommodate the 480,000 km car overhaul interval will be replaced according to a separate programme independent of the overhauls. Where possible, such replacements shall be carried out during service checks.

(b) The number of scheduled equipment replacements outside service checks shall not exceed 1 per Train Unit per year, or 3 per train per year.

26.3.5 Submission

(a) General

(i) The Contractor shall submit a Master Maintenance Schedule (refer to RS/C6014/12) in progressive amount of details for Approval at various stages of design development.

(ii) The Master Maintenance Schedule shall contain information for every type of service checks, car overhauls and scheduled equipment replacements, as specified in RS/C6014/12.

(iii) Such information shall be documented systematically in the form of Microsoft Excel 2003 spreadsheet (or a later version as Approved). To facilitate the Engineer's work on maintenance planning, the electronic files for the Master Maintenance Schedule shall also be submitted at each stage.

(b) SEMP Stage 2 - Basic Outline

An outline of each of the preventive maintenance sessions (refer to PS 26.3.1(c)) shall be submitted for Approval at SEMP stage 2. Each outline shall contain the following information:

(i) Name of maintenance session
(ii) Brief description of work content
(iii) Maintenance interval
(iv) Estimated downtime
(v) Estimated manpower and skills requirement

(c) SEMP Stage 3 - Detailed Outline

Preliminary versions of the following documents, as defined in RS/C6014/12, shall be submitted for Approval:

(i) Master Maintenance Schedule
(ii) Maintenance Tasks Matrix
(iii) Maintenance Checklists

(d) SEMP Stage 4 - Full Details

Complete versions of the following documents, as defined in RS/C6014/12, shall be submitted for Approval:

(i) Master Maintenance Schedule
(ii) Maintenance Tasks Matrix
(iii) Maintenance Checklists

26.4 Corrective Maintenance

26.4.1 Corrective maintenance refers to the following works:

(a) Identification and rectification of defects or alleged failures on the trains in order to restore them to service condition

(b) Rectification of defects found during preventive maintenance sessions

(c) Repair of defective equipment at the workshop

26.4.2 The design of equipment on the trains shall facilitate fault finding so that defects can be identified and repaired within the time limits specified under maintainability requirements.

26.4.3 As a basic requirement, fault indicators shall be provided to indicate any failures to both the train operator during service and the maintenance personnel during service checks.

26.4.4 The Train Management System on the train shall provide aids for identifying the source of the failure down to the LRU in which the defect is located.

26.4.5 Major equipment systems on the train shall be equipped with self diagnostics and fault logging systems which can capture relevant information at the time of equipment failure. Such information shall be

made readily available to maintenance personnel for fault finding purposes.

26.4.6 The Contractor shall provide special test equipment which can furnish in-situ assessments of the function and performance of equipment on the train.

26.4.7 The above provisions, together with diagnostics aids in the Train Management System, shall form an integrated system for supporting all corrective maintenance activities on the trains.

26.5 Cleaning

The external and interior of the trains will be cleaned regularly to maintain the trains at a high standard of cleanliness. The Contractor shall develop and specify a comprehensive cleaning programme for the up-keeping of the cleanliness standard. The cleaning programme shall consist of detailed cleaning methods, cleaning procedures, materials, cleaning intervals, train downtimes and the manpower required to carry out the work.

No cleaning work will be carried out when the trains are in passenger service.

26.5.1 External Cleaning

(a) Water / Detergent Washing

(i) The external body of the trains will be cleaned regularly by an automatic water / detergent wash plant described in Appendix I Annex 6.

(ii) The trains shall be designed such that no damage shall be done to any part of the train by the washing process. No water shall be allowed to enter the saloon, the driving cab or any other unintended enclosures on the train.

(iii) The Contractor shall specify the frequency of water / detergent washing, which shall not be more than once per 2 service days.

(iv) The Contractor shall specify the chemicals and the concentration required for the wash process.

(b) Acid Washing

(i) The Contractor shall specify whether acid washing is necessary to maintain the car body at the required standard of cleanliness.

(ii) Acid wash, where required, will be carried out at an automated acid wash plant described in Appendix I Annex 6. The Contractor shall specify details of the acid wash process, which shall include, but not be limited to, the following:

- frequency of washing, which shall not be more than once per 30 days

- chemicals, concentration, soaking period and number of passes

(iii) Where acid washing is required, the train shall be designed such that it is not adversely affected by the acid washing process.

(c) Window Cleaning

(i) The window glass of the trains will be kept free from water stains at all times. Where this cannot be achieved by the automatic external washing defined in PS 26.5.1(a) and (b) above, the Contractor shall develop and specify a cleaning process to remove the stains.

(ii) Where regular cleaning is required, the Contractor shall ensure that parts of the train that will be affected by the process, for example car body finishes, window seals and fittings, will not be adversely affected by the process.

(iii) The cleaning process shall only be carried out during internal heavy cleaning sessions and shall meet the following requirements:

Interval: not less than 60 days
Manpower: not more than 2 manhours per car

26.5.2 Internal Cleaning

The Contractor shall ensure that material finishes in the saloon and driving cab are designed to minimise the downtime and manpower for internal cleaning.

Internal fittings which require cleaning, such as air conditioning air grills and light diffusers, shall be readily accessible to the cleaning personnel and shall be easily cleaned by simple tools.

The material finishes in the saloon and driving cab shall be designed to withstand the action of common cleaning agents and water used during all internal cleaning activities.

(a) Internal Light Cleaning

(i) Internal light cleaning will take place daily in the stabling sidings at night during non-traffic hours. No services will be provided in the siding, hence power assisted cleaning will be limited to that which can be provided from the on board power sockets.

(ii) Such cleaning will be limited to mopping of the floor, cleaning the seats and wiping down internal surfaces. The Contractor shall specify detailed requirements for such cleaning.

(iii) Internal light cleaning shall be completed with not more than 5 manhours per train.

(b) Internal Heavy Cleaning

(i) Internal heavy cleaning will take place in dedicated heavy cleaning tracks (refer to Appendix I Annex 6), which will be equipped with full length, car floor level platforms, with provision for electrical power and water.

(ii) Such cleaning shall be carried out at intervals of not less than 30 days.

(iii) The Contractor shall specify detailed requirements for such cleaning.

(iv) Internal heavy cleaning shall be completed with not more than 6 manhours per car.

26.5.3 Submission

(a) SEMP Stage 2 - Outline

The following information shall be submitted for Approval for each type of cleaning described in PS 26.5.1 and 26.5.2:

(i) Brief description of work contents
(ii) Cleaning intervals
(iii) Estimated downtime

(iv) Estimated manpower requirement

(b) SEMP stage 4 - Details

Information shall be submitted for Approval for each type of cleaning described in PS 26.5.1 and 26.5.2. Such information shall include, but not be limited to, the following:

(i) For external cleaning:

- Specification of chemicals to be used at automated washing plants and for window cleaning (where necessary)
- Cleaning intervals
- Compatibility with existing chemicals for cleaning and the cleaning processes

(ii) For internal cleaning:

- Cleaning methods and procedures
- Specifications for cleaning tools and materials
- Cleaning intervals
- Manpower and skills requirements
- Downtime

26.6 Equipment Identification Labels

26.6.1 General Requirements

(a) The Contractor shall provide equipment identification labels on all items of equipment that are subject to workshop overhauls and repairs, ranging from complete equipment assemblies or WRUs such as bogies and inverter assemblies, down to the lowest component that is to be overhauled or repaired as a single entity, such as brake actuators and electronic printed circuit boards.

(b) Equipment identification labels shall be positioned so that when the equipment is mounted on the train, the markings can be readily read by maintenance personnel during maintenance inspections, without the need for extensive stripping down.

(c) Equipment identification labels shall be designed to last for the life of the equipment on which they are attached. The markings shall withstand the operation and maintenance environment experienced by the equipment

and shall be capable of being updated subsequent to equipment modifications.

(d) Each equipment identification label shall be marked with the part number, serial number, and the version number of any modifications in alphanumeric characters. The part numbers shall be consistent with those given in the Illustrated Parts Catalogue described in RS/C6014/12. Each item of equipment shall have a serial number that is unique to any other items of the same model.

(e) The Contractor shall provide detailed specifications on equipment for producing the equipment identification labels and identify sources where the equipment can be obtained by the Employer.

26.6.2 Submission

The Contractor shall submit the following for Approval:

(a) at SEMP stage 3, a list of equipment on the train to be provided with identification labels.

(b) at SEMP stage 4:

(i) Design of equipment identification labels
(ii) Specification and sources for the equipment for producing the equipment identification labels

26.7 O&M Manual

26.7.1 Deliverables

(a) The Contractor shall provide a comprehensive set of printed Operation and Maintenance Manual for the trains in accordance with the requirements in RS/C6014/12.

(b) The final deliverables shall include the following:

(i) Twenty complete sets of the Approved printed O&M Manual in hard copy

(ii) Two copies of the Approved text and databases for the printed O&M Manual in electronic format on CD-ROM/ DVD-ROM

(iii) Two copies of all Approved illustrations in electronic format in AutoCAD™ 2002 (or later version, if approved), on CD-ROM/ DVD-ROM.

(c) The printed O&M Manual shall be processed in 3 separate batches:

(i) Batch 1 shall consist of the following volumes:

- Volume I, Technical Descriptions Manual
- Volume II, Train Operator's Manual

(ii) Batch 2 shall consist of the following volumes, excluding parts on car overhauls and equipment overhauls:

- Volume III, Equipment Maintenance Manual
- Volume IV, Fault Diagnostics Manual
- Volume V, Illustrated Parts Catalogue
- Volume VII, Special Tools and Test Equipment

(iii) Batch 3 shall consist of the following:

- Volume VI, Software Manual
- Volume VIII, Vendor Documentation
- Remaining parts of Volumes III, IV, V and VII excluded in Batch 2.

26.7.2 Submission

(a) SEMP Stage 3

The Contractor shall submit the following for Approval at SEMP stage 3:

(i) Outline of the structure and contents of individual volumes of the printed O&M Manual. This shall include:

- the titles of all chapters, sections and subsections for each volume
- breakdown of each item in the equipment hierarchy into 2 lower levels of details

(ii) Sample formats and layouts for all parts of the manuals, including items such as text, illustrations, maintenance schedules, work instructions, checklists and illustrated parts catalogues.

(b) SEMP Stage 4

The Contractor shall submit the draft versions of all volumes of the printed O&M Manual at SEMP stage 4. Such submissions shall be provided in the batches defined in PS 26.7.1(c) above. Three copies of the draft documents shall be provided in each submission.

(i) The first draft for Batch 1 of the printed O&M Manual shall be submitted immediately upon commencement of the O&M Manual Programme specified in the Schedule of Key Dates for Design Submissions in Appendix F.

(ii) The first draft for Batch 2 of the printed O&M Manual shall be submitted not later than 2 months after the commencement of the O&M Manual Programme specified in the Schedule of Key Dates for Design Submissions in Appendix F.

(iii) The first draft for Batch 3 of the printed O&M Manual shall be submitted not later than 6 months after the commencement of the O&M Manual Programme specified in the Schedule of Key Dates for Design Submissions in Appendix F.

(c) SEMP Stage 5

(i) The Contractor shall submit the final drafts of the printed O&M Manual in batches as defined in PS 26.7.1(c) at SEMP stage 5. Such submissions shall be provided within 2 months after issue of the Engineer's comments on the respective first drafts of the printed O&M Manual.

(ii) The final version of the printed O&M Manual shall be submitted for Approval within 2 months after the issue of the Engineer's comments on the respective final drafts of the printed O&M Manual.

26.7.3 Amendments

(a) The Contractor shall make any necessary amendments to the printed O&M Manual during testing and commissioning of the trains and the Defect Liability Period. Amendments shall be submitted in the form of replacements leaflets and electronic files. A list summarizing the changes and the reasons shall be submitted with each set of amendments.

(b) Changes to the printed O&M Manual found necessary during testing, commissioning and the Defect Liability Period shall be completed within 2 months after the need for amendment is identified.

(c) Subsequent amendments shall be completed 1 month prior to the issue of the Defects Correction Certificate.

26.8 As-built Drawings

26.8.1 Scope of the As-built Drawings

The Contractor shall provide all drawings necessary for the operation, maintenance and repair of the equipment, by the Employer. Such drawings shall cover, but not be limited to, the following:

(a) Equipment layout drawings for the complete cars and individual equipment

(b) Mechanical drawings of cars, equipment and components, with relevant information such as key dimensions, tolerances, material specifications, quantities, manufacturing and assembly specifications.

(c) System block diagrams for equipment systems and subsystems

(d) Control circuit schematics for all electrical, pneumatic and hydraulic systems.

(e) System architecture, control circuit schematics and signal flow diagrams for electronic equipment. Details provided in electronic circuit diagrams shall be down to circuit board level.

(f) Wiring diagrams detailing the identity and locations of cables, terminal and electrical equipment

(g) Piping diagrams detailing the identity and locations of pneumatic and hydraulic equipment systems

26.8.2 General Requirements

(a) All as-built drawings shall be prepared in AutoCAD™ 2002 or a later version as Approved.

(b) The Contractor shall adopt the Operations Engineering Drawing Numbering Standard (S/NT-prm/CS/01(00)) and the standard title blocks and templates for producing drawings.

26.8.3 Deliverables

The deliverables for as-built drawings shall include the following:-

(a) Three complete sets of full size printed copies of all As-built Drawings

(b) Two complete sets of all As-built Drawings in electronic format onCD-ROM/ DVD-ROM.

(c) Three copies of the schedule of As-built Drawings tabulating the drawing number, title, paper size, revision number and date of all asbuilt drawings.

(d) Two electronic copies of the schedule of As-built Drawings in Microsoft Excel 2003 (or a later version as Approved), stored in CD-ROM/ DVD-ROM.

26.8.4 Submission

(a) At SEMP stage 4, the Contractor shall submit for Approval a list of all As-built Drawings to be delivered.

(b) At SEMP stage 5, the Contractor shall submit the As-built Drawings for Approval not later than the handover of the first train. All submissions shall be completed within 4 months.

26.8.5 Amendments

(a) The Contractor shall make any necessary amendments to the as-built drawings, during testing and commissioning of the equipment and the Defect Liability Period.

(b) Amendments to as-built drawings shall be provided in both printed copies and electronic files as defined in PS 26.8.3. They shall be delivered within 2 months after the change concerned is Approved.

26.8.6 All amendments shall be completed 1 month prior to the issue of the Defects Correction Certificate

SECTION 27

QUALITY MANAGEMENT

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27 QUALITY MANAGEMENT

27.1 Quality Plan

27.2 Design Control

27.3 Purchasing

27.4 Process Control

27.5 Corrective Action

27.6 System Engineering Management System

27 QUALITY MANAGEMENT

27.1 Quality Plan

27.1.1 The quality plan shall include, in addition to the requirements as set out in the General Specification, the following:

(a) a statement detailing the records that the Contractor proposes to keep, the time during which they will be prepared and the subsequent period and manner in which they will be stored;

(b) a system to enable the Engineer to conduct compliance audits on any aspect of design and to allow the Engineer to trace the cause of material / workmanship defects back to design, through the manufacturing, installation, testing and setting to work stages. This shall be supported by the Configuration Control Program (refer to Appendix P).

(c) Design verification and validation plan, purchasing plan and process control plan as described below in PS 27.2 to PS 27.4.

27.2 Design Control

27.2.1 The quality plan shall include details on how the Contractor shall develop the Contract requirements into concept design and then detailed design in a systematic manner with the SEMS approach (refer to PS 21).

27.2.2 As part of the quality plan the Contractor shall submit a design verification and validation plan for Approval.

27.2.3 The design verification and validation plan shall include descriptions of the following :

(a) system functional and interface requirements
(b) any assumptions made on system / subsystem parameters / characteristics
(c) technique used in design verification and validation for each system / subsystem that may include calculation, theoretical / numerical analysis, computer simulation, comparison with a similar proven design, tests and demonstrations using prototype or similar design equipment (d) schedule of the design verification and validation activities

27.2.4 The results of the design verification and validation shall form part of the SEMP report and be submitted in accordance with the requirements of the SEMS (refer to PS 21).

27.3 Purchasing

27.3.1 As part of the quality plan the Contractor shall submit a purchasing plan for Approval. The purchasing plan shall identify all products / services to be purchased for the Contract and all activities to be conducted in assuring the quality of the purchased products / services.

27.3.2 The purchasing plan shall include descriptions of the following:

(a) Products/services to be purchased

(b) Purchasing documents describing each product / service to be purchased and all the required product / service quality records including specification, standard, code of practice, certificate and statutory documents

(c) Contractor's review and approval procedures of the purchasing documents in ensuring correctness and adequacy of the specified requirements

(d) Incoming goods / materials inspection procedures together with the inspection sample size and the acceptable quality standard

27.3.3 All the purchasing documents and the related product / service quality records shall be properly maintained by the Contractor and shall be made available to the Engineer on request.

27.3.4 The Contractor shall be responsible for the validation of all subcontracted work.

27.4 Process Control

27.4.1 As part of the quality plan the Contractor shall submit a process control plan for Approval 3 months before the start of any one of the processes.

27.4.2 The process control plan shall include descriptions of the following:

(a) Procedures defining the manner of production, installation and servicing

(b) Equipment used in these processes and the required working environment

(c) Methodology in ensuring compliance with the required standards / codes of practice

(d) Monitoring, control and approval procedures including in-process inspection and final product inspection for the process parameters, product characteristics, equipment and working environment (e) Qualification of equipment and personnel required

27.4.3 Photographic Progress Records

(a) The Contractor shall submit photographic records to illustrate progress of manufacturing whenever appropriate, from SEMP Stage 4 upon completion of the Work.

(b) The photographic records shall be submitted with the monthly progress report.

27.5 Corrective Action

Corrective actions requiring changes to designs / procedures shall be properly documented and submitted for Approval in accordance with the Configuration Control Program (refer to Appendix P).

27.6 System Engineering Management System

As an integral part of the Quality Management System, the Contractor shall operate a System Engineering Management System (SEMS) as described in PS 21.

SECTION 28

ENVIRONMENTAL REQUIREMENTS

August 2015

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28 ENVIRONMENTAL REQUIREMENTS

28.1 Purpose

28.2 Policies

28.3 Environmental Management System (EMS)

28.4 Environmental Management Plan (EMP)

28 ENVIRONMENTAL REQUIREMENTS

28.1 Purpose

28.1.1 The policies and procedures presented in this Section establish a common frame of reference for developing the Environmental Management System (EMS) according to the Environmental Policy of the Employer. Copy of the Employer's Environmental Policy is available for the Contractor's reference.

28.1.2 These policies and procedures establish the basis for a systematic approach to meeting environmental obligations.

28.1.3 This Section supplements the General Specification on the environmental management requirements and shall apply to all subcontractors and suppliers.

28.1.4 The Contractor shall establish and maintain the EMS in accordance with the policies and procedures.

28.2 Policies

28.2.1 In order to ensure that the quality of the Contractor's Works meet the quality requirements and to provide evidence of such quality to the Engineer, a Quality Management System to the ISO 9000 series (refer to PS 27) shall be adopted as an integrated part of the EMS.

28.2.2 The ISO 14000 series, in particular, the ISO 14001: 2004 - Environmental Management System Specification, or the equivalent standards, such as, the National Sanitation Foundation (NSF) 110, the Eco-Management and Audit Scheme (EMAS), the International Chamber of Commerce (ICC) Sustainable Development Principles, and the Global Environmental Management Initiative (GEMI) shall be applied to implement an effective environmental management system.

28.2.3 According to the GS Clause 17.1.2, a policy statement shall be provided to demonstrate the commitment of the top management of the Contractor.

28.2.4 The confirmed commitments shall be able to:

(a) comply with the relevant environmental legislation;

(b) minimise the environmental impact;

(c) comply with the global initiatives, such as, the Montreal Protocol for the elimination of CFCs;

(d) set measurable performance goals for continuous improvement;

(e) audit progress against these goals;

(f) be specific to apply it to the Contract;

(g) be broad enough to meet the site requirements on different locations of production;

(h) protect the health and safety of the users of the trains, including the passengers, train operators and maintainers; and

(i) be updated to reflect all necessary changes.

28.3 Environmental Management System (EMS)

28.3.1 The EMS shall be a systematic approach applied to the management of the Contractor's environment performance i.e. adherence to a suitable environmental policy, the meeting of environmental objectives and the ability to demonstrate to the Engineer that the policy requirements and objectives are met.

28.3.2 The EMS framework shall identify resources for developing, implementing, measuring, and periodically reviewing the Contractor's progress toward achieving the environmental policy.

28.3.3 The EMS framework shall include but not limited to the following items:

(a) the Contractor's organisational structure;

(b) planning activities;

(c) defined responsibilities; and

(d) standard practices, procedures and processes.

28.3.4 The EMS framework shall be recorded in an Environmental Management Plan (refer to PS 28.4) and submitted for Approval (refer to GS Clause 17.1.1).

28.3.5 An environmental performance evaluation mechanism shall be provided in the EMS to measure, analyze, assess and describe the Contractor's environmental performance particularly those associated with pollution preventions.

28.3.6 A life cycle assessment process shall be provided in the EMS to evaluate the environmental attributes, burdens and impacts associated with the product, process or service.

28.3.7 The life cycle assessment shall be able to measure the environmental impact of a product from raw material extraction to final disposal. It shall also include the impact of manufacturing, distribution and transportation, product use and recycling.

28.4 Environmental Management Plan (EMP)

28.4.1 The EMP shall include the following items, in addition to the requirements as set out in the GS Section 17:

(a) defining the overall aims;

(b) understanding the constraints;

(c) identifying the task elements;

(d) setting the overall timetable;

(e) determining the resources needed;

(f) deciding on the project management approach; and

(g) establishing progress monitoring system.

28.4.2 Guidelines or standards on how to manage specific issues, such as, CFC elimination or energy conservation, shall be addressed at the management level. These guidelines or standards shall be formalised into specific procedures at the implementation level.

28.4.3 The general guidelines specified in the ISO 14004: 2004 shall be followed as far as applicable.

28.4.4 In addition to the site arrangements specified in PS 30, the Contractor shall ensure that the legislation and regulations of Hong Kong particularly those listed in the GS Clause 17.1.9 shall be complied with.

SECTION 29

PROGRAMME

August 2015

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29 PROGRAMME

29.1 General

29.2 Delivery, Testing and Commissioning in Hong Kong

29.3 Training and Operation and Maintenance Manuals

29 PROGRAMME

29.1 General

29.1.1 The Contractor's attention is drawn to the requirements of Clauses 15, 64, and 67 of the Conditions of Contract (COC) and Sections 4, 8, 10, 13, 14, 16, 21, 23, 24 and 25 of the General Specification (GS).

29.1.2 The following programming data is included with the Particular Specification :-
Appendix E - Schedule of Delivery
Appendix F - Engineer’s Preliminary Programme, Project Calendar, Schedule of Critical Dates and Schedule of Key Dates

29.1.3 The Contractor shall complete the Works by the completion dates as specified in the Schedule of Critical Dates contained in Appendix F or such other dates as may be determined under the Contract.

29.1.4 Not used.

29.1.5 The Completion Obligations to which liquidated damages or general damages shall apply are identified in the Schedule of Critical Dates. The aggregate of liquidated and general damages (Conditions of Contract - Clause 70.11) and daily rate of liquidated damages (Conditions of Contract - Clause 70.4) are stated in the Appendix to the Form of Tender.

29.1.6 The Contractor's attention is drawn to the provisions of Clause 70.5 of the Conditions of Contract regarding the application of general damages.

29.1.7 The Contractor’s attention is drawn to the provision of Clause 15.3 of the Conditions of Contract on the Schedule of Designs. The Contractor shall allow adequate duration for comment, resubmission and Approval of his Design Data. The Engineer’s Preliminary Programme includes a sub-programme in Appendix F Section 4, Schedule of Key Dates for Design Submissions, which is provided as reference for the Contractor to develop a detailed submission programme.

29.1.8 The Contractor shall plan in detail the full scope of Works taking into account the complex nature and different phases and aspects of the Contract and shall provide programmes which reflect the detail planning undertaken, are realistic, achievable and are accompanied by detailed supporting information. All programmes must clearly identify the critical path.

29.1.9 The Contractor's attention is drawn to the following programme submission as required by the Engineer:

29.1.9.1 Contractor's Design and Manufacturing Programme.

29.1.9.2 Contractor's Preliminary Installation Programme.

29.1.9.3 Contractor's Installation Programme.

29.1.9.4 Software Development Programme.

29.1.9.5 Commissioning Programme in the form of a subprogramme to the Contractor's Preliminary Installation Programme and Contractor's Installation Programme.

29.1.9.6 New Trains Delivery to Siu Ho Wan Depot Programme.

29.1.9.7 Three Month Rolling Programme.

29.1.9.8 Any other programmes required by the Engineer.

29.1.10 The following Interfacing Contractors will complete the following design works no later than the dates shown in the following table:

Interfacing Contract	**Completion of Design Works (Month/Year)**
Train borne ATC equipment	Oct 2016
Electronic Information Display System equipment	Jun 2016
Door Chime System equipment	Dec 2015

29.1.11 The following Interfacing Contractors will deliver the following equipment for type testing no later than the dates shown in the following table. The Contractor shall be responsible to collect these equipment from Hong Kong except for the Electronic Information Display System equipment for the first train which shall be installed in the Contractor's factory:

Interfacing Contract	Interfacing Contractor's Point of Delivery	Interfacing Contractor's Completion of Delivery of Equipment (Month/Year)
Train borne ATC equipment (for 2 trains)	Hong Kong	Apr 2017
Train borne ATC equipment (for remaining trains)	Hong Kong	To be determined based on the detailed Project Programme
Electronic Information Display System equipment (for 1 train)	Contractor's factory	Dec 2016
Electronic Information Display System equipment (for remaining trains)	Hong Kong	To be determined based on the detailed Project Programme
Door Chime System equipment (for 1 train)	Hong Kong	Dec 2016
Door Chime System equipment (for remaining trains)	Hong Kong	To be determined based on the detailed Project Programme

29.1.12 The following Interfacing Contractors will deliver the specific cable and cable harness as specified in Attachment App-I-Annex-4 and Appendix I Annex 4 Clause 5.1 by batches for installation by the Contractor. The first batch for the 2nd to 18th trains will be delivered no later than the dates shown in the following table. The delivery schedule of later batches for remaining trains shall be determined upon the detailed project programme. The Contractor shall be responsible to collect those equipment from Hong Kong to the Contractor's factory for installation.

Interfacing Contract	**Interfacing Contractor's Point of Delivery**	**Interfacing Contractor's Completion of Delivery of Equipment (Month/Year)**
Electronic Information Display System equipment - Cable & cable harness (for 2nd to 18th trains)	Hong Kong	Jul 2017
Door Chime System equipment - Cable & cable harness (for 2nd to 18th trains)	Hong Kong	Jul 2017

29.2 Delivery, Testing and Commissioning in Hong Kong

29.2.1 The Schedule of Delivery in Appendix E and the Engineer's Preliminary Programme and the Completion Obligations shall be planned in accordance with the constrains and requirements specified in PS 30, Appendices G and H, in particular on the availability of works areas, works train and track access. The Contractor shall note the provisions provided for the testing and commissioning of the trains in Siu Ho Wan Depot, Urban Line Depots and Urban Lines and coordinate his activities to optimise the utilisation.

29.2.2 The Contractor shall deliver the trains to Siu Ho Wan Depot according to the Delivery Dates as stipulated in Appendix E. Due to constraints in depot track availability, 4 tracks are reserved for testing and commissioning and stabling at any time. The delivery of new trains shall be at a maximum rate of 2 trains per month. The Contractor shall allow in the programme a duration of four weeks per train for testing and commissioning at Siu Ho Wan Depot. The Contractor shall unload a new train at Siu Ho Wan Depot only when at least 1 of the preceding trains at Siu Ho Wan Depot have completed the required testing and commissioning.

29.2.3 When the trains are delivered, the Contractor shall carry out testing and commissioning of the trains at Siu Ho Wan Depot as much as possible. After the required testing and commissioning is completed at Siu Ho Wan Depot, the Employer will arrange to shunt the trains to Urban Lines at the request of the Contractor. The Contractor shall allow 3 NTH possessions for stock transfer from SHD to URL depots. When shunted to URL, the Contractor shall allow the remaining time before the 'Ready for Passenger Service Dates' referred to the Engineer's Programme in Appendix F for the Employer to arrange for Test Run. Test Run as specified in shall be carried out to make the trains ready for Passenger Service.

29.2.4 The Test Run in URL in item 5.3 of Appendix C shall be conducted on each new train subject to the available non-peak hours daily and subject to traffic conditions of Operation Railways. The Contractor shall make due allowance in the programme when planning for the commissioning works.

29.2.5 The Delivery Dates for the trains in Appendix E may be advanced by up to four weeks subject to the depot track availability and the Approval by the Engineer.

29.3 Training and Operation and Maintenance Manuals

29.3.1 The programme for Training, and Operation and Maintenance Manuals in Appendix F Section 4 shall be coordinated with the handing over of the first train to facilitate the passenger service of the handed over trains.

SECTION 30

SITE ARRANGEMENTS

August 2015

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30 SITE ARRANGEMENTS

30.1 General

30.2 Work Site at Siu Ho Wan Depot

30.3 Work Site at Urban Lines Depots

30.4 Contractor's Staff Training

30 SITE ARRANGEMENTS

30.1 General

30.1.1 The Site

(a) The following two work sites will be provided to the Contractor for the execution of the Contract:

(i) Siu Ho Wan Depot (SHD)

During the period of train delivery and train preparation works before train transfer from SHD to Urban Lines Depots, the Employer will allocate work areas at SHD to the Contractor. The layout and location of the work site within the SHD is specified in Appendix G.

(ii) Urban Lines Depots (CWD, KBD, TKD and TWD)

During the period of testing and commissioning and Integrated Testing of the trains with the Urban Line systems, Test Running and the Defects Liability Periods, the Employer will allocate work areas at URL Depots to the Contractor. The layout and location of the work site within the URL Depots is specified in Appendix G.

(b) At the time of gaining access to the work site the Contractor shall, in the presence of the Engineer, inspect the work site to satisfy himself, inter alia, that:

(i) The area is clean.

(ii) Where access is given the specified services are in place.

(iii) The adjacent works to be protected are all identified.

(iv) The access for staff and materials is agreed.

(c) The Contractor shall refer to GS Section 12, 13, 14 and 16 and Appendix H which set out the rules and procedures which the Contractor shall need to observe while working within or adjacent to the railways and railways under construction.

(d) The Contractor shall submit a Safety Management Plan to the requirements as set out in the GS Section 15. The safety classification of the Contract shall be considered as Classification 2. The Contractor shall

conform to the ”Contractor Fitness for Duty Management” requirements as stipulated in Appendix H Annex 2 under this PS.

(e) The Contractor shall comply with the environmental requirements in PS 30 for any activities on the work site.

(f) The Contractor shall submit a Site Management Plan, during SEMP Stage 3, to analyze the complete range of activities that shall be undertaken to achieve the testing and commissioning programme as specified in PS 29 and subject to the site requirements as specified in PS 30. The Site Management Plan shall include the following details:

(i) Work flow activity programme incorporating timescales and resources level showing all the key activities associated with the delivery, testing and commissioning of all the train sets. The programme shall identify the location, the track occupancy duration and frequency, and the manpower level associated with each activity.

(ii) Method statement on each key activity, including the delivery of the train from the Contractor's site to the work sites.

(iii) All the working assumptions shall be stated.

30.1.2 Contractor's Facilities

(a) The Contractor shall provide any additional facilities required for the Works, such as cranage and lifting jacks, taking into account the facilities to be provided by the Employer as specified in this Section.

(b) Where the Contractor intends to provide additional facilities he shall submit details of the equipment such as loading of the floor or of the depot civil structure, where it is intended to use such equipment, and shall obtain Approval for its use.

(c) Proof-load test certificates of such equipment/ structures shall also be submitted to the Engineer. All such equipment shall meet the statutory requirements of the appropriate Hong Kong Government Department.

(d) The Contractor is responsible, at his own cost, for arranging with the telecom and internet service providers for the installation of telephone and internet lines within the work site.

(e) The Contractor shall not use any accommodation bogie in view of the limited space of the work site.

30.1.3 Site Office

(a) The locations allocated for the site offices have yet to be finalized but will be within the areas shown on the Drawings as specified in Appendix G Clause 1.4. The Contractor shall be responsible for the construction of the office and maintenance of all facilities required by him together with the subsequent removal.

(b) Prior to the construction of the office, detailed layout drawings of the proposed office, utility and storage requirements shall be submitted for Approval. All costs arising from the construction of the site office shall be to the Contractor's account.

30.1.4 Storage Area

(a) The Employer will allocate storage space as specified in Appendix G Clause 1.4.

(b) The Contractor shall be responsible for security of equipment stored.

(c) The Contractor shall obtain Approval on the employment of security staff.

(d) Hazardous Goods Store will be arranged subject to agreement with the Engineer.

(e) No storage of materials and tools shall be allowed outside the designated storage areas.

30.1.5 Controlled Environment

(a) The Contractor shall take every precaution necessary to protect the adjacent equipment, facilities, properties and structures from damage and shall bear all costs incurred in remedying any damage due to the lack of proper care on his part during the execution of the Works.

(b) The Works shall be executed with the minimum of disturbance to surrounding structures, roads, facilities, cables, equipment, services etc. and shall be carried out in such a manner as may be directed by the Engineer.

(c) The installation of any special plant equipment or services at the work site by the Contractor shall be subject to Approval. Approval will be limited to safe operation, and to any modification to finishes, structure or facilities of the work site.

(d) Large scale painting is not allowed at the site.

(e) The Contractor shall be responsible, at his own cost, for the cleaning and house keeping of the work site during his occupancy.

(f) The Contractor shall comply with any related statutory requirements on handling, packaging, storage and conveyance of chemical waste within the work site.

30.1.6 Monitoring and Liaison

(a) The Contractor shall provide upon the work site a competent English or Cantonese speaking representative who shall accept all instructions issued by the Engineer in relation to the execution of the Works.

(b) The Employer reserves the right to inspect and monitor the work site and where necessary, require appropriate actions to be taken by the Contractor relating to safe working practice, site house keeping, noise, working practices, statutory requirements, fire precautions, and effects on Employer's work adjacent to the site (such as dust, fumes and smell).

(c) Regular local liaison meeting will be called by the Engineer as he deems necessary to address such matters. A responsible representative from the Contractor shall attend such meetings. Local liaison meeting will be conducted in Hong Kong at the Engineer’s premises.

(d) The Employer reserves the right to stop the site activity if the Contractor violates the relevant rules and regulations. Any subsequent impact to the Contract shall be the responsibility of the Contractor.

30.1.7 Contractor's Staff Movement

(a) All Contractor's workpeople shall carry and display identity passes provided by the Employer. They shall be produced for inspection upon demand at any time within the work site.

(b) The identity passes issued to the Contractor's workpeople shall be surrendered to the Engineer on the completion of the Works or the ceasing of employment of the Contractor's workpeople whichever occurs earlier. The Contractor shall be responsible for the loss and/or damage of such passes. In such event, the Employer may either refuse to re-issue such passes and/or require the Contractor to pay an amount to be determined by the Employer representing the cost of re-issuing the passes.

(c) The Contractor shall not allow unauthorised visitors on the work site.

(d) The Contractor shall ensure his workpeople do not trespass beyond the limits of the work site or his particular area of operation. The Contractor shall be held responsible for any acts of trespass by his workpeople.

(e) The Employer reserves the right to expel the Contractor's workpeople from the site for their act of mis-conduct.

30.1.8 Road Vehicle Movement

(a) The Contractor shall use only those roads and/or routes within the relevant depot which are designated by the Engineer. The Contractor shall observe all traffic regulations within the relevant depot, particularly where posted speed limits and designated stop signs apply.

(b) Vehicle traffic shall be minimized within the depot. The Contractor shall inform the Employer's Security Section at the relevant depot of the schedule of any pick up and delivery. Vehicles shall be parked in prearranged parking bays only.

30.1.9 Material/Equipment Delivery

(a) Train cars shall only be delivered to the SHD during day time. Other material/equipment will be allowed to deliver during day time hours. All delivery shall require the consent of the Engineer or his representative.

(b) The Contractor shall provide all necessary tools, equipment, lifting gear and labour for the delivery of the material/equipment to the work site and handling of such within the site.

(c) The Contractor shall remove any redundant material and equipment from the working site.

(d) Movement of any goods out of the depot will require a permit from the Employer.

30.1.10 Rail Vehicle Movement

(a) No vehicles shall be allowed to shunt, either by its own power or by other shunting vehicles, unless it has been certified to be safe for movement by the Engineer.

(b) The use of any vehicle shunting device, such as road tractors, shall be subjected to Approval.

(c) The Contractor shall not operate any railed vehicle regardless of whether they belong to the Contractor or not.

(d) All railed vehicle shall be operated by the Employer's train operator only. Advance notice shall be made to the Engineer for any vehicle movement.

30.1.11 Work Site Occupancy

(a) The work site will be made available for use by the Contractor 30 days before the commencement of the relevant activities as described in PS 30.1.1.

(b) The Contractor shall be responsible to reinstate the work site before it is vacated. This includes the removal of special plant, equipment or services and the making good of finishes, structures or facilities which have been modified by the Contractor.

(c) In the event that the Contractor fails to vacate from the work site within the date specified in PS 30.2.4 and PS 30.3.2, the Employer reserves the right to carry out such work necessary to clear and reinstate at the Contractor’s risk and expense.

30.1.12 Restrictions on the Use of the Site

(a) Except with written permission, no radio transmission device shall be used within the work site or the Employer’s premises. Details of such devices shall be submitted for Approval.

(b) The work site is equipped with smoke and fire detection system. Welding and any other activities requiring the use of naked flame shall be reported to the Fire Control Centre of the work site in advance.

(c) None of the Contractor's workpeople shall be permitted to live in the work site at any time throughout the Contract.

(d) Roof access requiring OHL isolation will be permitted subject to 1 day advance notice.

30.1.13 Work Site Capacity

(a) The Engineer reserves the right to stop the delivery of the train to the work sites should all the Employer's facilities in the relevant work site as specified in PS 30 has been fully occupied. If the Engineer would exercise this right, the details and the exact work site will be confirmed to the Contractor 6 months before the delivery of the first train to Hong Kong.

(b) Under situation specified in PS 30.1.13(a), the Engineer may allocate work areas at the URL Depots to enable the Contractor to continue the testing and commissioning works. The Contractor shall undertake the

testing and commissioning works at the URL Depots, if allocated to the Contractor, at no extra cost to the Contract. Details of the work site facilities, such as the office space and the track access, shall be agreed with the Engineer.

30.2 Work Site at Siu Ho Wan Depot

30.2.1 Employer's Facilities

The following facilities will be provided by the Employer at SHD:

(a) Vertical Seawall Facility (refer to Appendix G Clause 3.3)

The vertical seawall will be made available for use by the Contractor subject to 14 days advance notice. The Contractor shall unload the train cars directly onto the rail track adjacent to the seawall.

(b) Site Office and Storage Space

Adequate space for site office and storage will be provided to the Contractor. The details, including the size and the exact location, will be confirmed to the Contractor 6 months before the delivery of the first train to Hong Kong.

(c) Light Maintenance Track

Light maintenance track(s) of 8-car length and with pit and roof access will be made available for use by the Contractor for the assembly of train cars subject to 7 days advance notice.

(d) Stabling Track

Stabling track(s) will be made available for use by the Contractor subject to one day advance notice. The Contractor may be asked to relocate to another track(s) to allow access for depot operations.

(e) Shunting Movements

Provision for shunting movement of cars will be made upon notification to the Engineer, one day in advance.

(f) Depot Test Track

(i) A depot test track will be made available for use by the Contractor during the testing and commissioning period, subject to 7 days advance notice.

(ii) The length of the depot test track is 1500 m and the maximum speed limit is 80 km/h.

(iii) Occupancy of the depot test track shall be limited to 2 days per week.

(g) Power Supplies

A 60 A 3 phase 415 V 50 Hz 4-wire power supply isolator will be located in the assigned work area by the Employer. The Contractor shall be responsible for the outgoing installations from this isolator. All electrical installations shall comply with the relevant statutory requirements and power supply company's regulation.

(h) Compressed Air Supplies

The Contractor may obtain compressed air supplies, of 7.5 bars or less, from the depot existing outlets. The Contractor shall be responsible for any extra requirements for compressed air supplies. Such extra requirement shall be subject to Approval.

(i) Water Supplies

The Contractor may obtain water from the depot existing outlets. The Contractor shall be responsible for any extra requirement for water intending as train loads for commissioning tests, and such requirement shall be subject to Approval.

(j) Access to Canteen, Toilets and Ablutions

The Contractor's staff will be entitled to use the depot existing canteen, toilets and ablution facilities. No shower facilities will be provided.

(k) Waste Disposal

The Contractor may reasonably utilize waste disposal facilities within the premises for office waste.

30.2.2 Train Preparation Works

(a) The Contractor shall perform suitable train preparation works at SHD and shall be responsible to ensure that the train is fit for delivery from SHD to URL Depots in a safe and reliable manner.

(b) The train preparation works shall include, as a minimum, the following:

(i) the security of the equipment installation

(ii) the proper operation of the traction system, braking system, emergency brake system and the associated 110V DC control circuits

(iii) the air tightness of the air brake system

(c) The Contractor shall identify the train preparation requirements in the testing plans as specified in PS 22.1.

(d) The Contractor shall conduct comprehensive hazard analysis to identify and analyze all hazards that may jeopardise the safe and on-time delivery of train from SHD to URL Depots. The Contractor shall implement suitable mitigation measures to ensure that the risks are reduced to an acceptable level (refer to PS 25.6).

30.2.3 Access to Main Running Line for Train Delivery

(a) The train will be driven by the Employer from SHD to URL Depots under traction system fall back operation (refer to PS 9.12.4) during non-traffic hours as specified in Appendix H Clause 4. The Contractor shall make application for access to mainline in accordance with Appendix H Clause 3.

(b) The number of mainline delivery shall be one night per 8-car train.

(c) The Contractor shall provide a competent engineering person on each train consist to attend the train delivery and to provide technical advice to the train operator where necessary.

30.2.4 Work Site Occupancy

The Contractor is required to vacate the site at SHD no later than 30 days after the delivery of the last train to URL Depots.

30.3 Work Site at Urban Lines Depots

30.3.1 Employer's Facilities

The following facilities will be provided by the Employer at Urban Line Depots (CWD, KBD, TKD and TWD):

(a) Site Office

A space for accommodation will be provided to the Contractor subject to agreement by the Engineer.

(b) Storage Space

A storage space will be provided to the Contractor subject to agreement with the Engineer.

(c) Heavy Maintenance Track

Heavy maintenance track(s) with lifting facilities will be made available for use by the Contractor, at the discretion of the Engineer, subject to one day advance notice. The Contractor may be asked to relocate to another track to allow access for depot operations.

(d) Light Maintenance Track

Light maintenance track(s) of 8-car length and with pit and roof access, will be made available for use by the Contractor during the testing and commissioning period. The Contractor may be asked to relocate to another track(s) to allow access for depot operations.

(e) Stabling Track

Stabling track(s) of 8-car length will be made available for use by the Contractor during the testing and commissioning period. The Contractor may be asked to relocate to another track(s) to allow access for depot operations.

(f) Shunting Movements

Provision for shunting movement of cars will be made upon notification to the Engineer, one day in advance.

(g) Not used

(h) Access to Main Running Line for Dynamic Test

(i) Test paths on mainline will only be available during non-traffic hours as specified in Appendix H Clause 4.

(ii) The Contractor shall make application for access to mainline test path in accordance with Appendix H Clause 3.

(iii) Subject to the availability, the main line test path shall be no more than 3 nights per week.

(i) Power Supplies

A 60 A 3 phase 415 V 50 Hz 4-wire power supply isolator will be located in the assigned work area by the Employer. The Contractor shall be responsible for the outgoing installations from this isolator. All electrical installations shall comply with the relevant statutory requirements and power supply company's regulation.

(j) Compressed Air Supplies

The Contractor may obtain compressed air supplies, of 7.5 bars or less, from the depot existing outlets. The Contractor shall be responsible for any extra requirements for compressed air supplies. Such extra requirement shall be subject to Approval.

(k) Water Supplies

The Contractor may obtain water from the depot existing outlets. The Contractor shall be responsible for any extra requirement for water intending as train loads for commissioning tests, and such requirement shall be subject to Approval.

(l) Access to Canteen, Toilets and Ablutions

The Contractor's staff will be entitled to use the depot existing canteen, toilets and ablution facilities. No shower facilities will be provided.

(m) Waste Disposal

The Contractor may reasonably utilize waste disposal facilities within the premises for office waste.

30.3.2 Work Site Occupancy

The Contractor is required to vacate the site no later than 30 days after the issue of the Final Certificate.

30.4 Contractor's Staff Training

30.4.1 Railway Safety Training

(a) Contractor's staff who require to work in the depot operations areas must receive the Safety Induction Training Course in basic railway safety as specified in Appendix H.

(b) The training will be conducted in the Employer's Training Centre and the Contractor's staff shall have to pass relevant tests in order to be given the authority to enter and carry out activity in the depot operations areas. They will be required to undertake a refresher course after twelve months interval.

(c) Some of the Contractor's staff have to attend Competent Person Training Course (refer to Appendix H Clause 2.5) and to be qualified as Competent Person for the supervision of working parties.

30.4.2 Lifting Equipment Operation Training

(a) The lifting facilities shall only be operated by qualified persons who have received and passed the training provided by the Employer's Training Centre in accordance with the relevant rules and regulations as specified in Appendix H.

(b) Contractor's staff who require to operate the Employer's lifting facilities must receive and pass the training in order to be given the authority to operate the equipment.

SECTION 31

INTERFACE ARRANGEMENTS

August 2015

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31 INTERFACE ARRANGEMENTS

31.1 Introduction

31.2 General Requirements

31.3 Detailed Interface Management Requirements

Table 31-1 Interfacing Systems / Designated Contracts

31 INTERFACE ARRANGEMENTS

31.1 Introduction

31.1.1 The interfacing Systems or Designated Contract which have an interface with the Works are listed in Table 31-1. The Contractor shall note that all Designated Contracts have already been completed with the exception of the Cab Simulator System.

31.1.2 The Contractor shall be responsible to undertake all the necessary interfacing duties with the Designated Contractor, Named Suppliers, the Engineer and all third parties in order to ensure complete compatibility with the interfacing systems and setting to work of the Works. Where necessary, the access of design data, personnel, items of plant, equipment and building materials shall be granted.

31.1.3 The detailed interface requirements with the Designated Contractors, Named Suppliers, the Engineer and all third parties are described in details in Appendix I Annex 1 to Annex 10. The annexes cover the following areas:

(a) Annex 1 P-way Interface (Track Data) contains details of the Urban Lines track on which the trains will run.

(b) Annex 2 Overhead Line / Traction Power Supply System Interfaces defines the interface requirements for the overhead line / traction power supply system and the train system. Compatibility of the train with the existing Urban Lines overhead line / traction power supply systems is also specified.

(c) Annex 3 ATC Interfaces defines the interface requirements for the Automatic Train Control (ATC) and the train system. Compatibility of the train with the ATC system is also specified.

(d) Annex 4 Communication Interfaces defines the interface requirements for all Communications Equipment and the train system including Trainborne Radio, In-Cab CCTV, EIDS, Trainborne Video Display, In-Saloon CCTV and Door Chime System.

(e) Annex 5 PSD Interfaces defines the interface requirements for the PSD and the train system.

(f) Annex 6 Depot Interfaces defines the interface requirements for the depots and the train system.

(g) Annex 7 Electric Vehicle Interfaces defines the interface requirements for the existing electric vehicles and the train system.

(h) Annex 8 Not used.

(i) Annex 9 Dynamic Route Map Interfaces defines the interface requirements for the DRM and the train system/equipment including TMS, DVAS & PA, GSM Modem Assemblies and Doors.

(j) Annex 10 Cab Simulator Coordination defines the coordination requirements between the Contractor and the Cab Simulator System Contractor to be developed.

31.1.4 The Drawings issued with the above Annexes are intended to assist the Contractor for liaison and coordination with others. As such, these Drawings shall not reduce the Contractor's responsibility to ensure the compatibility of their Work with that of others.

31.2 General Requirements

31.2.1 As an integral part of the System Engineering Management System (refer to PS 21.2.2), the Contractor shall perform interface management.

31.2.2 The Contractor shall be responsible to purchase the systems/equipment from the Named Suppliers as described in Appendix I.

31.2.3 The Contractor shall be responsible for the system design and integration, purchase, installation, testing, commissioning, training, documentation and warranty of the purchased systems/equipment.

31.2.4 The Contractor shall assume full responsibility in ensuring the proper functioning of the purchased systems/equipment from the Named Suppliers.

31.2.5 The Contractor shall liaise with the Named Suppliers in ensuring that the purchased systems/equipment shall meet the intended functional and performance requirements of the systems/equipment as defined in the PS.

31.2.6 The Contractor shall investigate all interface matters and satisfy himself regarding the availability of the required information for interface designs from the Designated and Interfacing Contractors, Named Suppliers, the Engineer and all third parties. Any interface issues that may affect the performance of the Works shall be brought to the attention of the Engineer.

31.2.7 All changes in interface design shall refer to the Configuration Management detailed in PS 21.3.10.

31.2.8 Any interface issue that is related to system assurance shall refer to PS 25.

31.2.9 Any interface issue that is related to the Electromagnetic Compatibility shall refer to RS/C6014/04.

31.2.10 Any interface issue that is related to the software design shall refer to RS/C6014/05.

31.3 Detailed Interface Management Requirements

31.3.1 The Contractor shall submit an organisation chart together with the associated Curriculum Vitae of the key design personnel of the coordination team which shall be under the responsibility of the System Engineering Management representative (refer to PS 21.2.1).

31.3.2 By the end of the SEMP stage 1, the Contractor shall submit all required interface documentations for Approval.For the above interface documents, there shall be a corresponding reference in an item-by-item manner to the respective interface requirements specified in the PS. In addition, a master interface index to summarise all interface requirements corresponding to the individual systems, shall be provided for easy reference.

31.3.3 By the end of the SEMP stage 2, the Contractor shall submit all required System Specification Documents which will form part of the detailed interface specification for each interfacing system/equipment according to Appendix N Clause 2.3.

31.3.4 By the end of the SEMP stage 3, the Contractor shall submit all required System Design Documents to demonstrate how the proposed design will comply with all interfacing functions according to Appendix N Clause 2.4.

31.3.5 By the end of the SEMP stage 4, the Contractor shall submit all required interface design proposals according to which shall form part of the Level 4 Design Data (refer to Appendix N Clause 2.5).

31.3.6 By the end of the SEMP stage 5, the Contractor shall submit a schedule of Integrated Test (refer to PS 22.12) for each interfacing system/equipment for Approval. The Contractor shall obtain agreement with the associated Designated and Interfacing Contractors, Named Suppliers, the Engineer and all third parties beforehand regarding the scopes of work, methodologies, responsibilities, test site arrangements, expected test date, test procedures, durations and reports beforehand and record in the above Integrated Test Schedule.

Table 31-1 Interfacing Systems / Designated Contracts

Contract Number (if applicable)	Designated Contract or Interfacing Systems	Designated Contract / Interfacing Systems
N/A	Urban Lines Trackwork	Interfacing Systems
N/A	Overhead Line System and Power Supply System	Interfacing Systems
3036	CBTC Signalling System	Designated Contract
N/A	Communication Systems	Interfacing Systems
N/A	Platform Screen Door	Interfacing Systems
N/A	Depots including KBD, TWD, CWD, TKD & SHD	Interfacing Systems
N/A	Electric Vehicle and Existing Train Systems	Interfacing Systems
N/A	Dynamic Route Map System	Interfacing Systems
N/A	Cab Simulator System	Interfacing Systems

SECTION 32

ATTENDANCE

August 2015

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32 ATTENDANCE

32.1 Attendance During Testing, Commissioning and Defects Liability Period

32 ATTENDANCE

32.1 Attendance During Testing, Commissioning and Defects Liability Period

32.1.1 Site Office

(a) During the Testing, Commissioning and the Defects Liability Periods, the Contractor shall maintain a site office (refer to PS 30) with office hours from 08:30 to 17:30 hours Hong Kong time on every day except Sundays or Public Holidays.

(b) The Contractor shall provide a telephone hot line, a fax enquiry service or an internet service in order to maintain a 24-hour contact between the Engineer and the Contractor's representative on all issues regarding train failures and site matters.

32.1.2 Contractor's Representative

(a) The site office shall be manned by a technically competent Contractor's representative.

(b) The Contractor's representative shall represent the Contractor on all matters concerning train reliability, defects liability and site issues. The Contractor's representative shall be required to carry out whatever actions that are necessary to ensure the RAM performance of the train meeting the requirements in PS 25.

32.1.3 Response Time

(a) The Contractor's representative shall respond within ten minutes to a train failure reported by the Engineer.

(b) If required by the Engineer, a technically competent person shall be provided by the Contractor within thirty minutes for an on site repairing work in order to minimise the downtime of the defective train.

(c) Any failure by the Contractor to respond to a train failure reported by the Engineer within the required response time as specified in PS 32.1.3(a) and (b) and cause the train not available for the scheduled service (refer to PS 25.7) will constitute a defect under COC Clause 75.

MTR CORPORATION LIMITED

CONTRACT C6014-14E

PROCUREMENT OF NEW TRAINS

Particular Specification

Volume 2 of 4

August 2015

MTR CORPORATION LIMITED

CONTRACT C6014-14E

PROCUREMENT OF NEW TRAINS

PARTICULAR SPECIFICATION

WORKING DOCUMENT

VOLUME 2 OF 4

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CONTRACT C6014-14E
PROCUREMENT OF NEW TRAINS
PARTICULAR SPECIFICATION
WORKING DOCUMENT

CONTENTS

[VOLUME 1 OF 4]

Section 1: Introduction

Section 2: Definitions and Abbreviations

Section 3: Scope of the Works

Section 4: System Description and Performance Requirements

Section 5: Infrastructure Constraints

Section 6: Car Body Structure and Exterior

Section 7: Interior of Car Body

Section 8: Cab Facilities and Layout

Section 9: Operation and Control

Section 10: Train Management System

Section 11: Traction and Braking Equipment

Section 12: Bogies and Suspensions

Section 13: Pneumatics and Air Distribution Systems

Section 14: Gangways and Couplers

Section 15: Air Conditioning and Ventilation

Section 16: Doors

Section 17: Auxiliary Electrical Supply

[VOLUME 1 OF 4 (CONT'D)]

Section 18: Communications

Section 19: Not Used

Section 20: Materials and Workmanship Requirements

Section 21: Design Requirements

Section 22: Testing Requirements

Section 23: Training Requirements

Section 24: Spare Parts, Special Tools and Test Equipment

Section 25: System Assurance

Section 26: Maintenance Requirements

Section 27: Quality Management

Section 28: Environmental Requirements

Section 29: Programme

Section 30: Site Arrangements

Section 31: Interface Arrangements

Section 32: Attendance

[VOLUME 2 OF 4]

APPENDICES

Appendix A: Schedules of Drawings

Appendix B: Codes and Standards

Appendix C: Schedule of Tests

Appendix D: Not Used

Appendix E: Schedule of Delivery

Appendix F: Engineer's Preliminary Programme, Project Calendar, Schedule of Critical Dates and Schedule of Key Dates

Appendix G: Site Layout and Works Areas

Appendix H: Rules and Procedures for Working Within or Adjacent to the Railway

- Annex 1 P-Licensing System - Caring and Coaching System for New Contractor Workers
- Annex 2 Contractor Fitness for Duty Management

Appendix I: Designated Contracts and Interfacing Systems

- Annex 1 P-way Interface (Track Data)
- Annex 2 Overhead Line/ Traction Power Supply System Interfaces
- Annex 3 ATC Interfaces
- Annex 4 Communications Interfaces
- Annex 5 Platform Screen Door Interfaces
- Annex 6 Depot Interfaces
- Annex 7 Electric Vehicle Interfaces
- Annex 8 Not Used
- Annex 9 Dynamic Route Map Interfaces
- Annex 10 Cab Simulator System Coordination

Appendix J: Not Used

Appendix K: Not Used

Appendix L: Interior Styling Schedule

[VOLUME 2 OF 4 (CONT'D)]

Appendix M: Life Cycle Cost

Appendix N: Design Data

Appendix O: Delivery of Equipment

Appendix P: Configuration Control Programme

Appendix Q: List of Named Suppliers

[VOLUME 3 OF 4]

ROLLING STOCK STANDARDS

RS/C6014/01:	Data Transmission and Management
RS/C6014/02:	Constructional and Workmanship Requirements
RS/C6014/03:	Electrical and Design Requirements
RS/C6014/04:	Electromagnetic Compatibility
RS/C6014/05:	Software
RS/C6014/06:	Cables
RS/C6014/07:	Pneumatic Equipment
RS/C6014/08:	Fire Performance
RS/C6014/09:	Wheelsets
RS/C6014/10:	Pantograph
RS/C6014/11:	Battery
RS/C6014/12:	Operation and Maintenance Manual
RS/C6014/13:	Noise Performance and Measurement
RS/C6014/14:	Operability Design Guidelines
RS/C6014/15:	Keys and Locks
RS/C6014/16:	LED Lighting Standard

[VOLUME 4 OF 4]

Drawings

APPENDIX A

SCHEDULES OF DRAWINGS

August 2015

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APPENDIX A SCHEDULE OF DRAWINGS

GENERAL

COUPLING ARRANGEMENT

TRAIN EXTERIOR DESIGN

CAB INTERIOR DESIGN

SALOON INTERIOR DESIGN

INTERFACE

DEPOT

TRACK DATA

APPENDIX A SCHEDULE OF DRAWINGS

GENERAL		
Drawing No.	**Title**	**Revision**
C6014-14E/TSEG/010/001	Kinematic Envelope and Structure Gauge	A
C6014-14E/TSEG/010/002	Kinematic Envelope in Depot Maintenance Tracks	A
C6014-14E/TSEG/010/003	Rolling Stock Wheel Tread Profile (P8 Modified)	A
C6014-14E/TSEG/010/004	Track Irregularities	A
C6014-14E/TSEG/010/005	Definition of Vehicle on Track Twist	A
C6014-14E/TSEG/010/006	Vehicle Ride - Acceleration Weighting Characteristic	A
C6014-14E/TSEG/010/007	Explanation of Train Speed Profile w.r.t. Change of Speed Code	A
C6014-14E/TSEG/010/008	Cable Ratings	A
C6014-14E/TSEG/010/009	Train Consist and Car Numbering	A
C6014-14E/TSEG/010/010	Bogie, Axle and Wheel Numbering	A
C6014-14E/TSEG/010/011	Doors and Passenger Alarm Layout and Numbering	A
C6014-14E/TSEG/010/012	General Arrangement of Existing M Train	A
C6014-14E/TSEG/010/013	General Arrangement of Cab and Non-cab End Vehicles	A
C6014-14E/TSEG/010/014	Carbody Contour	A
C6014-14E/TSEG/010/015	In-Saloon CCTV Camera Layout and Numbering	A
C6014-14E/TSEG/010/016	Not used	-
C6014-14E/TSEG/010/017	Train Configuration Arrangement	A

COUPLING ARRANGEMENT		
Drawing No.	**Title**	**Revision**
OD4/311/00001/012	Service Loco. Coupler (ALVI Draftgear)	E
OD4/311/00001/014	General Arrangement of Diesel Locomotive	B
OD4/312/00001/008	BE Loco (MK II) Drawgear Arrangement for Dual Mode Locomotive	B
OD4/312/00001/051	BE Loco (MK I) Drawgear Arrangement Showing AL VI Draftgear	B
OD2/301/00015/001	MTR Standard Automatic Coupler for Passenger Cars	C
OD4/361/00715/0003	Automatic Coupler for Cab End	B
C6014-14E/TSEG/115/001	Automatic Coupler for Cab End of C Train	A

TRAIN EXTERIOR DESIGN		
Drawing No.	**Title**	**Revision**
C6014-14E/TSEG/060/001	Train Exterior – Cab Perspective View	A
C6014-14E/TSEG/060/002	Not Used	-
C6014-14E/TSEG/060/003	Train Exterior – Colour Scheme	A
C6014-14E/TSEG/060/004	Cab Exterior – General Arrangement	A
C6014-14E/TSEG/060/005	Train Exterior – General Arrangement	A
C6014-14E/TSEG/060/006	Cab – Vertical Cross Section	A
C6014-14E/TSEG/060/007	Cab – Horizontal Cross Section	A
C6014-14E/TSEG/060/008	Destination and Special Messages For Electronic Destination Display	A
OD1/307/00009/001	General Arrangement of Mock-Up Emergency Cab Door in Deployed Ramp Position	A
OD1/307/00009/002	General Arrangement of Mock-Up Emergency Cab Door in Plug Door Position	A
OD1/307/00009/003	Mock-Up Emergency Cab Door in Ramp Deployment Sequence	A

CAB INTERIOR DESIGN		
Drawing No.	**Title**	**Revision**
C6014-14E/TSEG/110/001	Cab Interior General Arrangement	A
C6014-14E/TSEG/110/002	Train Operator's Console and Window - Zone A	A
C6014-14E/TSEG/110/003	Auxiliary Console and Window - Zone B	A
C6014-14E/TSEG/110/004	A Side Cab Back Wall - Zone C	A
C6014-14E/TSEG/110/005	B Side Cab Back Wall - Zone D	A
C6014-14E/TSEG/110/006	Cab Ceiling - Zone E	A
C6014-14E/TSEG/110/007	Bardic Signal Lamp	A
C6014-14E/TSEG/110/008	Not Used	-
C6014-14E/TSEG/110/009	Train Operator's Seat	A

SALOON INTERIOR DESIGN		
Drawing No.	**Title**	**Revision**
C6014-14E/TSEG/100/001	General Saloon Interior Arrangement – A car	A
C6014-14E/TSEG/100/002	General Saloon Interior Arrangement – B car in 'ACB' Unit	A
C6014-14E/TSEG/100/003	General Saloon Interior Arrangement – B car in 'BC' Unit	A
C6014-14E/TSEG/100/004	General Saloon Interior Arrangement – C car in 'ACB' Unit	A
C6014-14E/TSEG/100/005	General Saloon Interior Arrangement – C car in 'BC' Unit	A
C6014-14E/TSEG/100/006	Saloon Interior – Overall Perspective View	A
C6014-14E/TSEG/100/007	Saloon Interior – Perspective View at Seat Bench Sh 1 of 2	A
C6014-14E/TSEG/100/007	Saloon Interior – Perspective View at Seat Bench Sh 2 of 2	A
C6014-14E/TSEG/100/008	Saloon Interior – Perspective View at Multi-purpose Area	A
C6014-14E/TSEG/100/009	Saloon Interior – Perspective View at Enlarged Multi-purpose Area	A
C6014-14E/TSEG/100/010	Saloon Interior – Perspective View at Cab End Bulkhead	A
C6014-14E/TSEG/100/011	Saloon Interior – Perspective View at Intercar Gangway	A
C6014-14E/TSEG/100/012	Saloon Interior – Colour Scheme	A
C6014-14E/TSEG/100/013	Multi-Purpose Area General Arrangement	A
C6014-14E/TSEG/100/014	Enlarged Multi-Purpose Area General Arrangement	A
C6014-14E/TSEG/100/015	Bodyside Interior Trim General Arrangement Sh 1 of 2	A
C6014-14E/TSEG/100/015	Bodyside Interior Trim General Arrangement Sh 2 of 2	A
C6014-14E/TSEG/100/016	Bodyside Door General Arrangement	A
C6014-14E/TSEG/100/017	Cab End Bulkhead General Arrangement	A
C6014-14E/TSEG/100/018	Intercar Gangway General Arrangement	A
C6014-14E/TSEG/100/019	Vestibule Interior Cross-Section General Arrangement	A
C6014-14E/TSEG/100/020	Ceiling General Arrangement	A
C6014-14E/TSEG/100/021	Seating	A
C6014-14E/TSEG/100/022	Not Used	-
C6014-14E/TSEG/100/023	Floor Covering Arrangement	A
C6014-14E/TSEG/100/024	Priority Seat Graphics General Arrangement	A
C6014-14E/TSEG/100/025	Straphanger	A
C6014-14E/TSEG/100/026	Door Gap Gauge	A
C6014-14E/TSEG/100/027	Door Obstacle Gauge	A
OD4/362/00510/0261	Fire Extinguisher	A

INTERFACE		
Drawing No.	**Title**	**Revision**
C6014-14E/TSEG/077/001	Platform Interface with Vehicle K.E.	A
C6014-14E/TSEG/077/002	Train / PSD Door Opening Scenario	A
C6014-14E/TSEG/077/003	Train / PSD Door Closing Scenario	A
C6014-14E/TSEG/077/004	Platform Screen Door Section for Interface Arrangement	A
C6014-14E/TSEG/157/001	Urban Lines Trains Cab End Coupler Electrical Box Pin Arrangement	A
C6014-14E/TSEG/417/001	Train Conceptual Safety Proving Circuit	A
C6014-14E/TSEG/497/001	Conceptual Architecture of TMS	A
C6014-14E/TSEG/497/002	ATC / Communications System / DRM Interface with TMS	A
C6014-14E/TSEG/497/003	ATC/DVAS/EIDS/DRM Conceptual Data Flow	A
C6014-14E/TSEG/667/008	CCTV Trainborne Equipment Connection Schematics	A
C6014-14E/TSEG/687/001	HPF Applicator	A
OD4/302/00003/0011	Schematic Diagram Of Power Circuit	C
OD4/302/00303/0002	'I' Stock Melco Chopper (248-256) Auxiliary Circuit Diagram "A", "C" & "D" Cars	L
OD4/303/00042/027	Power Circuit Diagram For EMU Cars Chopper/Aux. Inverter	B
OD4/303/00042/108	Circuit Diagram Of Static Auxiliary Inverter Chopper/Aux. Inverter	B
OD4/303/00063/0011	'G' Stock Auxiliary Circuit Diagram., EMU Cars A-CT-D, Chopper/Aux. Inverter (Sheet 1 of 1)	E
OD4/305/00141/001	'M' Stock Chopper Conversion Power Circuit Diagram For EMU Cars	C
OD4/305/00141/0009	'M' Stock 'A'-Car Auxiliary & Control Wiring Diagram (Sheet No.1) Chopper Conversion	E
OD4/305/00162/0001	'M' Stock Chopper Conversion Auxiliary Circuit Diagram A-CT-D Cars	G
OD4/305/00241/004	'T' Stock Chopper Conversion Power Circuit Diagram For EMU Cars	C
OD4/305/00262/0001	'T' Stock Chopper Conversion Auxiliary Circuit Diagram A-CT-D Cars	G
OD4/306/00041/001	Power Circuit Diagram For EMU Cars Additional Rolling Stock	N
OD4/306/00063/003	Circuit Diagram Of Static Auxiliary Converter	B
OD4/306/00063/0004	'H' Stock Auxiliary Circuit Diagram EMU Cars A-CT-D Additional Rolling Stock (1/1)	E
C6014-14E/TSEG/637/001	Schematic Diagram of SIV Power Circuit (Sheet 1 of 2)	A
C6014-14E/TSEG/637/002	Schematic Diagram of SIV Power Circuit (Sheet 2 of 2)	A
C6014-14E/TSEG/637/003	Power Circuit Diagram For EMU Cars	A
C6014-14E/TSEG/637/004	Circuit Diagram Of Auxiliary Static Inverter	A
OD4/312/00005/0001	BE Loco (MK I & II) Power Circuit Diagram Battery Electric Locomotive	D
OD4/312/00005/0002	Dual Mode Locomotive (MK I & II) Auxiliary Circuit Diagram	G
OD4/313/00005/0026	BE Loco (MK III) Power Circuit Diagram	B
OD4/313/00005/0027	BE Loco (MK III) Power Circuit Diagram	B
OD4/313/00005/0028	BE Loco (MK III) Power Circuit Diagram	B
OD4/313/00005/049	BE Loco (MK III) Auxiliary Circuit Diagram	A
OD4/306/00041/0002	H Stock Control Circuit Diagram "A-C_T-D" Cars (SHT. 1 OF 3)	N
OD4/306/00063/0005	H Stock Auxiliary Circuit Diagram EMU Cars "B-C" Additional Rolling Stock	C
OD4/361/00742/0034	Schematic Diagram of Power Circuit	A
OD4/361/00741/9731	SIV Control (C, B, B1, C1 Car)	A

DEPOT		
Drawing No.	**Title**	**Revision**
C6014-14E/TSEG/990/001	Typical Cross Section of Running Maintenance Area in Existing Depots	A
C6014-14E/TSEG/990/002	Typical Cross Section of Heavy Maintenance Area	A
C6014-14E/TSEG/990/003	Position of Jacking Points for Existing URL Train	A
C6014-14E/TSEG/990/004	Typical Dimensions of Lifting Claws of Lifting Jacks	A
C6014-14E/TSEG/990/005	Conceptual Sketch of Underfloor Jacks	A
C6014-14E/TSEG/990/006	Existing Accommodation Bogie at KBD	A
C6014-14E/TSEG/990/007	Typical Arrangement and Details of Towing Points of Existing M Trains	A
C6014-14E/TSEG/990/008	Details of Hold Down Device for Underfloor Wheel Lathe	A
C6014-14E/TSEG/990/009	Not Used	-
C6014-14E/TSEG/990/010	Typical Details of Target	A
C6014-14E/TSEG/990/011	Details of Target Holder	A
C6014-14E/TSEG/990/012	Pneumatic Connector Plug Schrader Plug 1/8"	A
C6014-14E/TSEG/990/013	Typical Recovery Procedure for EMU De-railment	A
C6014-14E/TSEG/990/014	Existing Wheel Skate of Operating Railway	A
C6014-14E/TSEG/990/015	Stripe Pattern For Identification of Jacking Point on Rolling Stock Vehicle	A
C6014-14E/TSEG/990/016	KBD Ground Floor Level Plan	A
520/Z/00/PWY/C30/362	Siu Ho Wan Depot General Arrangement	A
EMS/C3202.A/AFA/02-07	Chai Wan Depot Layout at G/F	-
USP/M/TKD3/XXX/A00/XXX	Tseung Kwan O Depot (TKD) Ground Level (+5.400) Arch- Depot Layout Plan	B
USP/TWD1/A12/001	Tsuen Wan Depot (TWD) Ground Floor Level Architectural Layout-Updated Station Plan	A1

TRACK DATA		
Drawing No.	**Title**	**Revision**
OD8/501/00001/0057	Rail Profile of 60E1, UIC60 and BS 90A(M) Section	D
KTL/M/SQ/W02/301	Yau Ma Tei Station Track Diagrams Volume 1	A
KTL/M/SQ/W02/302	Mong Kok Station – Prince Edward Station Track Diagrams Volume 1	A
OD4/900/00105/0003	Shek Kip Mei Station Track Diagrams Volume 1	E
OD4/900/00105/0004	Kowloon Tong Station – Lok Fu Station Track Diagrams Volume 1	E
OD4/900/00105/0005	Wong Tai Sin Station – Diamond Hill Station Track Diagrams Volume 1	C
KTL/M/SQ/W02/306	Choi Hung Station Track Diagrams Volume 1	A
KTL/SQ/TD1/R38/307	Kowloon Bay Station – Ngau Tau Kok Station Track Diagrams Volume 1	A
OD4/900/00105/0008	Kwun Tong Station Track Diagrams Volume 1	E
KTL/M/SQ/W02/309	Lam Tin Station Track Diagrams Volume 1	A
OD4/900/00105/1031	Yau Tong Station (Kwun Tong Line) Track Diagrams Volume 1	A
KTL/M/SQ/W02/311	Tiu Keng Leng Station and Crossover Track Diagrams Volume 1	A
OD4/501/00104/0003	YMT Sidings – YMT Line Diagram - KTL	B
OD4/501/00104/0004	YMT – MOK Line Diagram - KTL	B
OD4/501/00104/005	MOK Line Diagram - KTL	A
OD4/501/00104/0006	MOK – PRE Line Diagram - KTL	B
OD4/501/00104/0007	PRE – SKM Line Diagram - KTL	B
OD4/501/00104/0008	SKM– KOT Line Diagram - KTL	B
OD4/501/00104/0009	KOT– LOF Line Diagram - KTL	B
OD4/501/00104/0010	LOF – WTS Line Diagram - KTL	B
OD4/501/00104/0011	WTS – DIH Line Diagram - KTL	B
OD4/501/00104/0012	DIH – CHH Line Diagram - KTL	C
OD4/501/00104/013	CHH – KOB Line Diagram - KTL	A
OD4/501/00104/014	CHH – RT1 & 2 Line Diagram - KTL	A
OD4/501/00104/0015	KOB – NTK Line Diagram - KTL	B
OD4/501/00104/0016	Line Diagram - KTL Dep & Reception TK - NTK	A
OD4/501/00104/0017	NTK – KWT Line Diagram - KTL	D
OD4/501/00104/0018	KWT – LAT Line Diagram - KTL	D
OD4/501/00104/0019	LAT – YAT Line Diagram - KTL	C
OD4/501/00104/0020	YAT – TIK Line Diagram - KTL	C
OD4/501/00104/0021	TIK – Overrun Line Diagram - KTL	C
OD4/501/00104/0022	LAT – CVB Line Diagram - KTL LAT Service Connection	A
TWL/M/SQ/W02/201	Central Station – Admiralty Station Track Diagrams Volume 1	A
OD4/900/00205/0002	Immersed Tube Track Diagrams Volume 1	D
OD4/900/00205/0003	Tsim Sha Tsui Station – Jordon Station Track Diagrams Volume 1	D
TWL/M/SQ/W02/204	Yau Ma Tei Station – Mong Kok Station Track Diagrams Volume 1	A
OD4/900/00205/0005	Prince Edward Station – Sham Shui Po Station Track Diagrams Volume 1	D
OD4/900/00205/0006	Cheung Sha Wan Station – Lai Chi Kok Station Track Diagrams Volume 1	C
OD4/900/00205/0007	Mei Foo Station Track Diagrams Volume 1	C
OD4/900/00205/0008	Lai King Station Track Diagrams Volume 1	F
TWL/SQ/TD1/R38/209	Kwai Fong Station Track Diagrams Volume 1	A
OD4/900/00205/0010	Kwai Hing Station – Tai Wo Hau Station Track Diagrams Volume 1	C
TWL/SQ/TD1/R38/211	Tsuen Wan Station Track Diagrams Volume 1	A
OD4/501/00204/0002	CEN – ADM Line Diagram – TWL	D
OD4/501/00204/0003	ADM – SVB Line Diagram – TWL	B
OD4/501/00204/0004	SVB – TST Line Diagram – TWL	B
OD4/501/00204/0005	TST – JOR Line Diagram – TWL	B
OD4/501/00204/006	JOR – YMT Line Diagram – TWL	A
OD4/501/00204/007	YMT – MOK Line Diagram – TWL	A
OD4/501/00204/008	MOK – PRE Line Diagram – TWL	A

TRACK DATA		
Drawing No.	**Title**	**Revision**
OD4/501/00204/009	PRE – SSP Line Diagram – TWL	A
OD4/501/00204/0010	SSP – CSW Line Diagram – TWL	B
OD4/501/00204/011	CSW – LCK Line Diagram – TWL	A
OD4/501/00204/012	LCK – MEF Line Diagram – TWL	A
OD4/501/00204/0013	MEF – LAK Line Diagram – TWL	D
OD4/501/00204/0014	LAK – KWF Line Diagram – TWL	C
OD4/501/00204/0015	KWF – KWH Line Diagram – TWL	B
OD4/501/00204/0016	KWH – TWH Line Diagram – TWL	B
OD4/501/00204/017	TWH – TSW Line Diagram – TWL	A
OD4/501/00204/0018	TSW – H/S Line Diagram – TWL	B
OD4/900/00305/0001	Sheung Wan Station – Central Station Track Diagrams Volume 1	F
ISL/M/SQ/W02/102	Admiralty Station– Wan Chai Station Track Diagrams Volume 1	A
ISL/M/SQ/W02/103	Causeway Bay Station Track Diagrams Volume 1	A
OD4/900/00305/0004	Tin Hau Station – Fortress Hill Station Track Diagrams Volume 1	C
OD4/900/00305/0005	North Point Station – Quarry Bay Station Track Diagrams Volume 1	D
OD4/900/00305/0006	Tai Koo Station Track Diagrams Volume 1	F
OD4/900/00305/0007	Sai Wan Ho Station – Shau Kei Wan Station Track Diagrams Volume 1	C
OD4/900/00305/0008	Heng Fa Chuen Station Track Diagrams Volume 1	G
OD4/900/00305/0009	Chai Wan Station Track Diagrams Volume 1	F
OD4/501/00304/002	Overrun – SHW Line Diagram – ISL	A
OD4/501/00304/003	SHW – CEN Line Diagram – ISL	A
OD4/501/00304/004	CEN – ADM Line Diagram – ISL	A
OD4/501/00304/005	ADM – WAC Line Diagram – ISL	A
OD4/501/00304/006	WAC – CAB Line Diagram – ISL	A
OD4/501/00304/007	CAB – TIH Line Diagram – ISL	A
OD4/501/00304/008	TIH – FOH Line Diagram – ISL	A
OD4/501/00304/009	FOH – NOP Line Diagram – ISL	A
OD4/501/00304/0010	NOP – QUB Line Diagram – ISL	B
OD4/501/00304/0011	QUB – TAK Line Diagram – ISL	B
OD4/501/00304/012	TAK – SWH Line Diagram – ISL	A
OD4/501/00304/0013	SWH – SKW Line Diagram – ISL	B
OD4/501/00304/014	SKW – HFC Line Diagram – ISL	A
OD4/501/00304/015	HFC – CHW Line Diagram – ISL	A
TKL/M/SQ/W02/401	North Point Station Track Diagrams Volume 1	A
TKL/M/SQ/W02/402	Quarry Bay Station Track Diagrams Volume 1	A
TKL/M/SQ/W02/403	Eastern Immersed Tube Track Diagrams Volume 1	A
TKL/M/SQ/W02/404	Yau Tong Station (Tseung Kwan O Line) Track Diagrams Volume 1	A
TKL/M/SQ/W02/405	Tiu Keng Leng Station Track Diagrams Volume 1	A
TKL/M/SQ/W02/406	Tseung Kwan O Station Track Diagrams Volume 1	A
TKL/M/SQ/W02/407	Hang Hau Station Track Diagrams Volume 1	A
TKL/M/SQ/W02/408	Po Lam Station Track Diagrams Volume 1	A
TKL/SQ/TD1/R38/451	LOHAS Park Station Track Diagrams Volume 1	B1
OD4/501/00704/0030	NOP Sidings – NOP Line Diagram – TKL	-
OD4/501/00704/0031	NOP – QVB Line Diagram – TKL	-
OD4/501/00704/0032	QVB – CVB Line Diagram – TKL	-
OD4/501/00704/0033	CVB – YAT Line Diagram – TKL	-
OD4/501/00704/0034	YAT – TIK Line Diagram – TKL	-
OD4/501/00704/0035	TIK – TKO Line Diagram – TKL	-

TRACK DATA		
Drawing No.	**Title**	**Revision**
OD4/501/00704/0036	TKO – HAH Line Diagram – TKL	-
OD4/501/00704/0037	HAH – POA Line Diagram – TKL	-
OD4/501/00704/0038	TKO – PSK Line Diagram - TKL	-
OD4/501/00704/0039	PSK – LHP Line Diagram – TKL	A
715/W/WIL/MTR/C01/001	General Notes	A
715/W/WIL/MTR/C01/002	Legend	A
715/W/WIL/MTR/C01/003	Site Location Plan	A
715/W/WIL/MTR/C01/004	Overall Track Schematic Diagram	A
715/W/WIL/MTR/C01/005	Permanent Speed Restriction Diagram	B
715/W/WIL/MTR/C31/001	Track Schematics – Sheung Wan To Sai Ying Pun	B
715/W/WIL/MTR/C31/002	Track Schematics - Hong Kong University To Kennedy Town	A
715/W/WIL/MTR/C31/003	Track Schematics – Turnback Siding	A
715/W/WIL/MTR/C31/004	Interface Schedule and Buffer Stop Schedule	B
715/W/WIL/MTR/C31/005	Stage Opening of Refuge Siding at SHW	A
715/W/WIL/MTR/C30/001	Alignment - Sheung Wan Station To Sai Ying Pun Station Sheet 1 of 2	A
715/W/WIL/MTR/C30/002	Alignment - Sheung Wan Station To Sai Ying Pun Station Sheet 2 of 2	A
715/W/WIL/MTR/C30/003	Alignment – Sai Ying Pun Station to Hong Kong University Station	A
715/W/WIL/MTR/C30/004	Alignment – Hong Kong University Station to Kennedy Town Sheet 1 of 2	A
715/W/WIL/MTR/C30/005	Alignment – Hong Kong University Station to Kennedy Town Sheet 2 of 2	A
715/W/WIL/MTR/C30/006	Alignment – Kennedy Town Station to Track End Sheet 1 of 2	A
715/W/WIL/MTR/C30/007	Alignment – Kennedy Town Station to Track End Sheet 2 of 2	A
715/W/WIL/MTR/C30/008	Alignment – Sheung Wan Station Crossover Track	A
715/W/WIL/MTR/C30/009	Alignment Data Sheet	A
715/W/WIL/MTR/C33/001	Junction Layouts Track End to KET T 181	A
715/W/WIL/MTR/C32/001	Circular Tunnel Non-Ballasted BCT Trackform (MAB)	A
715/W/WIL/MTR/C32/002	Circular Tunnel Non-Ballasted BCT Trackform (HAB)	A
715/W/WIL/MTR/C32/003	Horseshoe Tunnel Non-Ballasted BCT Trackform (HAB)	A
715/W/WIL/MTR/C32/004	Horseshoe Tunnel Non-Ballasted BCT Trackform (MAB)	A
715/W/WIL/MTR/C33/001	Track End to Kennedy Town Station T 181	A
1020/W/KTE/MTR/C01/005	Permanent Speed Restriction Diagram	B
1020/W/KTE/MTR/C30/001	Yau Ma Tei Station to Ho Man Tin Station Sheet 1 of 4	A
1020/W/KTE/MTR/C30/002	Yau Ma Tei Station to Ho Man Tin Station Sheet 2 of 4	A
1020/W/KTE/MTR/C30/003	Yau Ma Tei Station to Ho Man Tin Station Sheet 3 of 4	A
1020/W/KTE/MTR/C30/004	Yau Ma Tei Station to Ho Man Tin Station Sheet 4 of 4	C
1020/W/KTE/MTR/C30/005	Ho Man Tin Station to Whampoa Station Sheet 1 of 2	A
1020/W/KTE/MTR/C30/006	Ho Man Tin Station to Whampoa Station Sheet 2 of 2	A
1020/W/KTE/MTR/C30/007	Crossover East of HOM	A
1020/W/KTE/MTR/C30/008	Alignment Data Sheet Horizontal Alignment	A
1020/W/KTE/MTR/C30/009	Alignment Data Sheet Vertical Alignment	A
752/DRW/0083	Final Scheme Plan	B
OD1/411/00129/0002	KTL Pre Scheme Plan Sacem Sectors Stopping Points	H
OD1/411/00229/002	TWL Pre Scheme Plan Sacem Sectors Stopping Points	J1
OD1/411/00329/002	ISL Pre Scheme Plan Sacem Sectors Stopping Points	-
752/DRW/1019	Contract No. 752 Final Scheme Plan	B
NOP->QUB->EHJ TKL Line	Contract 652 Track Layout NOP->QUB->EHJ TKL Line	-
EHJ->YAT->TIK->TKO->HAH->POA TKL Line	Contract 652 Track Layout EHJ->YAT->TIK->TKO->HAH->POA	-
TKO->TKS TKL Line	Contract 652 Track Layout TKO->TKS TKL Line	-
LAT->YAT->TIK KTL Line	Contract 652 Track Layout LAT->YAT->TIK KTL Line	-
LAT->EHJ->QUB KTL/TKL Line	Contract 652 Track Layout LAT->EHJ->QUB KTL/TKL Line	-
Depot TKL Line	Contract 652 Track Layout Depot TKL Line	-
C6014-14E/TSEG/080/001	ISL Dwell Time Requirement	A
C6014-14E/TSEG/080/002	KTL Dwell Time Requirement	A
C6014-14E/TSEG/080/003	TKL Dwell Time Requirement	A
C6014-14E/TSEG/080/004	TWL Dwell Time Requirement	A

APPENDIX B

CODES AND STANDARDS

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APPENDIX B CODES AND STANDARDS

1 Rolling Stock Standards

2 International Standards

3 Information on Standards

APPENDIX B CODES AND STANDARDS

1 Rolling Stock Standards

The following Rolling Stock Standards form part of the Particular Specification.

Standard Reference	Title	Current Revision
RS/C6014/01	Data Transmission and Management	A1
RS/C6014/02	Constructional and Workmanship Requirements	A1
RS/C6014/03	Electrical and Electronic Design Requirements	A1
RS/C6014/04	Electromagnetic Compatibility	A1
RS/C6014/05	Software	A1
RS/C6014/06	Cables	A1
RS/C6014/07	Pneumatic Equipment	A1
RS/C6014/08	Fire Performance	A1
RS/C6014/09	Wheelsets	A1
RS/C6014/10	Pantograph	A1
RS/C6014/11	Battery	A1
RS/C6014/12	O&M Manual	A1
RS/C6014/13	Noise Performance and Requirement	A1
RS/C6014/14	Operability Design Guidelines	A1
RS/C6014/15	Keys and Locks	A1
RS/C6014/16	LED Lighting Standard	A1

2 International Standards

The Particular Specification has made reference to following international codes and standards.

British Standards and European Standards	
Standard Reference	**Title**
BS 11: 1985	Railway rails
BS 476: Pt 4: 1970	Fire tests on building materials and structures – Part 4: Non-combustibility test for materials
BS 476: Pt 6: 1989	Fire tests on building materials and structures – Part 6: Method of test for fire propagation for products

BS 476: Pt 7: 1997	Fire tests on building materials and structures – Part 7: Method of test to determine the classification of the surface spread of flame of products
BS 476: Pt 20: 1987	Fire tests on building materials and structures - Part 20: Method for determination of the fire resistance of elements of construction (general principles)
BS 476: Pt 22: 1987	Fire tests on building materials and structures – Part 22: Methods for determination of the fire resistance of nonloadbearing elements of construction
BS 848: Pt 1: 1997	Fans for general purposes – Part 1: Performance testing using standardized airways

British Standards and European Standards	
Standard Reference	**Title**
BS 857: 1967	Specification for safety glass for land transport
BS 1363: Pt 2: 1995	13A plugs, socket-outlets, adaptors and connection units – Part 2: Specification for 13A switched and unswitched socket-outlets
BS 2572: 1995	Specification for phenolic laminated sheet and epoxy cotton fabric laminated sheet
BS 2618: 1975	Electric traction equipment
BS 3682: Pt 1: 1994	Railway brake hose – Part 1: Specification for compressed air brake hose
BS 3692: 2014	ISO metric precision hexagon bolts, screws and nuts.
BS 3693: 1992	Recommendations for design of scales and indexes on analogue indicating instruments
BS 3900: Pt E7: 1974	Methods of test for paints – Part E7: Resistance to impact (falling ball test)
BS 4174: 1972	Self-tapping screws and metallic drive screws
BS 4183: 1967	Machine screws and machine screw nuts. Metric series
BS 4568-1: 1970	Steel conduit and fittings with metric thread of ISO form for electrical installations
BS 5308: 1986	Instrumentation cables
BS 5425: 1986	Coaxial cable for wideband distribution systems
BS 5825: 1991	Low voltage switchgear and control gear for industrial use mounting rails G-profile for the fixing of terminal blocks
BS 6360: 1991	Specification for conductors in insulated cables and cords
BS 6469: 1990	Insulation and sheaths of electric cables

BS 6500: 2000	Electric cables - flexible cords rated up to 300/500 v, for use with appliances and equipment intended for domestic, office and similar environments
BS 6853: 1999	Code of practice for fire precautions in the design and construction of passenger carrying trains
BS 7608: 2014	Guide to fatigue design and assessment of steel products
BS 7671: 2001	Requirements for electrical installations – IEE wiring regulations - Sixteenth edition
BS 8118: Pt 1: 1991	Structural use of aluminium: Part 1: Code of practice for design
BS 9000: Pt 1 to Pt 3: 1996	General requirements for a system for electronic components of assessed quality

British Standards and European Standards	
Standard Reference	**Title**
BS 9522 N003: 1990	Detail specification for Multi-contact circular electrical connectors for d.c. and low frequency applications Bayonet coupling non-barrier sealed, environment resistant with rear insertable, rear release, rear removable crimp contacts also barrier sealed with nonremovable solder contact styles Full plus airframe fit assessment
BS AU 148: Pt 15: 1969	Methods of test for motor vehicle paints – Part 15: Resistance to chipping
BS EN 286: Pt 3: 1995	Steel pressure vessels designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock
BS EN 287-1: 2004	Qualification test of welders – Fusion welding – Part 1: Steels
BS EN 473: 2000	Non-destructive testing – Qualification and certification of NDT personnel – General principles
BS EN 571-1: 1997	Non-destructive testing – Penetrant testing: Part 1: General principles
BS EN 779: 2002	Particulate air filters for general ventilation – Determination of the filtration performance
BS EN 970: 1997	Non-destructive examination of fusion Welds - Visual examination
BS EN 1011-1: 2009	Welding – Recommendations for welding of metallic materials - Part 1: General guidance for arc welding
BS EN 1011-2: 2001	Welding – Recommendations for welding of metallic materials - Part 2: Arc welding of ferritic steels

BS EN 1011-3: 2000	Welding – Recommendations for welding of metallic materials - Part 3: Arc welding of stainless steels
BS EN 1011-4: 2000	Welding – Recommendations for welding of metallic materials - Part 4: Arc welding of aluminium and aluminium alloys
BS EN 1289: 1998	Non-destructive testing of welds – Penetrant testing of welds – Acceptance levels
BS EN 1290: 1998	Non-destructive testing of welds – Magnetic particle testing of welds
BS EN 1291: 1998	Non-destructive testing of welds – Magnetic particle testing of welds – Acceptance levels
BS EN 1418: 1998	Welding personnel – Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials
BS EN 1435: 1997	Non-destructive testing of welds – Radiographic testing of welded joints
BS EN 1712: 1997	Non-destructive testing of welds – Ultrasonic testing of welded joints – Acceptance levels

British Standards and European Standards	
Standard Reference	**Title**
BS EN 1714: 1998	Non-destructive testing of welds – Ultrasonic testing of welded joints
BS EN 10216: Pt 5: 2004	Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 5: Stainless steel tubes
BS EN 12062: 1998	Non-destructive examination of welds – General rules for metallic materials
BS EN 12082: 1998	Railway applications – Axleboxes – Performance testing
BS EN 12449: 1999	Copper and copper alloys – Seamless, round tubes for general purposes
BS EN 12517-1: 2006	Non-destructive testing of welds – Part 1: Evaluation of welded joints in steel, nickel, titanium and their alloys by radiography – Acceptance levels
BS EN 13103: 2001	Railway applications – Wheelsets and bogies – Nonpowered axles – Design method
BS EN 13104: 2001	Railway applications – Wheelsets and bogies – Powered axles – Design method
BS EN 13260: 2003	Railway applications – Wheelsets and bogies – Wheelsets – Product requirements
BS EN 13261: 2003	Railway applications – Wheelsets and bogies – Axles – Product requirements

BS EN 13262: 2004	Railway applications – Wheelsets and bogies – Wheels – Product requirements
BS EN 13979: Pt 1: 2003	Railway applications – Wheelsets and bogies – Monobloc wheels – Technical approval procedure – Part 1: Forged and rolled wheels
BS EN 14752: 2005	Railway applications – Bodyside entrance systems
BS EN 15227: 2009	Railway applications - Crashworthiness requirements for railway vehicle bodies
BS EN 45502-2-1 :2003	Active Implantable Medical Devices Part 2-1
BS EN 45545: 2013	Railway applications — Fire protection on railway vehicles
BS EN 50085-1: 2005	Cable trunking and cable ducting systems for electrical installations - Part 1: General requirements
BS EN 50117-1: 2002	Coaxial cables - Part 1: Generic specification
BS EN 50121-1: 2006	Railway applications - Electromagnetic compatibility - Part 1: General
BS EN 50121-3-1 : 2006	Railway applications - Electromagnetic compatibility Part 3-1 : Rolling stock -Train and complete vehicle
BS EN 50121-3-2 : 2006	Railway applications - Electromagnetic compatibility Part 3-2 : Rolling stock - Apparatus
BS EN 50121-4: 2006	Railway applications – Electromagnetic compatibility Part 4: Emission and immunity of the signalling and telecommunications apparatus
BS EN 50128:2011	Railway applications. Communication, signalling and processing systems. Software for railway control and protection systems
BS EN 50129: 2003	Railway applications. Communication, signalling and processing systems. Safety related electronic systems for signalling
BS EN 50153: 2002	Railway applications - Rolling stock - Protective provisions relating to electrical hazards
BS EN 50155: 2007	Railway applications - Electronic equipment used on rolling stock

British Standards and European Standards	
Standard Reference	**Title**
BS EN 50200: 2006	Method of test for resistance to fire of unprotected small cables for use in emergency circuits
BS EN 50266-1: 2001	Common test methods for cables under fire conditions – Test for vertical flame spread of vertically-mounted bunched wires or cables – Part 1: Apparatus

BS EN 50266-2-1: 2001	Common test methods for cables under fire conditions – Test for vertical flame spread of vertically-mounted bunched wires or cables – Part 2-1: Procedures – Category A F/R
BS EN 50266-2-2: 2001	Common test methods for cables under fire conditions – Test for vertical flame spread of vertically-mounted bunched wires or cables – Part 2-2: Procedures – Category A
BS EN 50266-2-3: 2001	Common test methods for cables under fire conditions – Test for vertical flame spread of vertically-mounted bunched wires or cables – Part 2-3: Procedures – Category B
BS EN 50266-2-4: 2001	Common test methods for cables under fire conditions – Test for vertical flame spread of vertically-mounted bunched wires or cables – Part 2-4: Procedures – Category C
BS EN 50266-2-5: 2001	Common test methods for cables under fire conditions – Test for vertical flame spread of vertically-mounted bunched wires or cables – Part 2-5: Procedures – Small cables - Category D
BS EN 55011: 2007	Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment
BS EN 60061-1: 1997	Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 1: Lamp caps
BS EN 60073: 2002	Basic and Safety Principles for Man-Machine Interface, Marking and Identification - Coding Principles for Indication Devices and Actuators
BS EN 60081: 1998	Double-capped fluorescent lamps – Performance specifications
BS EN 60310: 2004	Traction transformers and inductors on board rolling stock
BS EN 60447: 2004	Basic and Safety Principles for Man-Machine Interface, Marking and Identification – Actuating Principles
BS EN 60529: 1992	Degrees of protection provided by enclosures (IP code)
BS EN 61000-6-2: 2005	Electromagnetic compatibility Part 6-2: Generic standards - Immunity for industrial environments
BS EN 61000-6-4: 2007	Electromagnetic compatibility Part 6-4: Generic standards - Emission standard for industrial environments
BS EN 61386-1: 2008	Conduit systems for cable management - Part 1: General requirements

British Standards and European Standards	
Standard Reference	**Title**
BS EN 61249-2-7: 2002	Materials for printed boards and other interconnecting structures Part 2-7: Reinforced base materials clad and unclad - Epoxide woven e-glass laminated sheet of defined flammability (vertical burning test),copper-clad
BS EN 61373: 2013	Shock and Vibration requirements for rolling stock equipment
BS EN ISO 105-A01: 1996	Textiles – Tests for colour fastness – Part A01: General principles of testing
BS EN ISO 1234: 1998	Split pins
BS EN ISO 1518: 2001	Methods of test for paints – Part E2: Scratch test
BS EN ISO 1520: 2007	Paints and varnishes – Cupping test
BS ISO 1940: Pt 1: 2003	Mechanical vibration – Balance quality requirements for rotors in a constant (rigid) state – Part 1: Specification and verification of balance tolerances
BS EN ISO 2320: 2008	Prevailing torque type steel hexagonal nuts – Mechanical and performance requirements
BS EN ISO 2409: 2013	Paints and varnishes – Cross cut test
BS EN ISO 2439: 2001	Flexible cellular polymeric materials – Determination of hardness (indentation technique)
BS EN ISO 2813: 2000	Paints and varnishes – Determination of specular gloss of non-metallic paint films at 20°, 60° & 85°
EN ISO 3095: 2005	Railway applications - Acoustics - Measurement of noise emitted by railbound vehicles
BS EN ISO 3381: 2005	Railway applications - Acoustics - Measurement of noise inside railbound vehicles
BS EN ISO 4287: 2000	Geometric Product Specification – Surface texture: Profile method – Terms, definitions and surface texture parameters
BS EN ISO 4288: 1998	Geometric Product Specification – Surface texture – Profile method: Rules and procedures for the assessment of surface texture
BS EN ISO 4589-2: 1999	Plastics – Determination of burning behaviour by oxygen index – Part 2: Ambient-temperature test
BS EN ISO 4589-3: 1996	Plastics – Determination of burning behaviour by oxygen index – Part 3: Elevated-temperature test
BS EN ISO 5817: 2003	Welding – Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) – Quality levels for imperfections
BS EN ISO 6385: 2004	Ergonomic Principles in the Design of Work Systems

BS EN ISO 6860: 2007	Paints and varnishes – Bend test (conical mandrel)
BS EN ISO 7010: 2012	Graphical symbols - Safety colours and safety signs - Registered safety signs
BS EN ISO 7042: 2013	Prevailing torque type all-metal hexagonal nuts, style 2 – Property classes 5, 8, 10 and 12
BS EN ISO 7719: 2013	Prevailing torque type all-metal hexagonal nuts, style 1 – Property classes 5, 8 and 10

British Standards and European Standards	
Standard Reference	**Title**
BS EN ISO 9239-1: 2002	Reaction to fire tests for floorings – Part 1: Determination of the burning behaviour using a radiant heat source
BS EN ISO 9606-2: 2004	Qualification test of welders – Fusion welding – Part 2: Aluminium and aluminium alloys
BS EN ISO 10042: 2006	Welding – Arc-welded joints in aluminium and its alloys – Quality levels for imperfections
BS EN ISO 10075-2: 2000	Ergonomic Principles Related to Mental Workload - Part 2: Design Principles
BS EN ISO 12947-1: 1999	Textiles – Determination of the abrasion resistance of fabrics by the Martindale method – Part 1: Martindale abrasion testing apparatus
BS EN ISO 12947-2: 1999	Textiles – Determination of the abrasion resistance of fabrics by the Martindale method – Part 2: Determination of specimen breakdown
BS EN ISO 12947-3: 1999	Textiles – Determination of the abrasion resistance of fabrics by the Martindale method – Part 3: Determination of mass loss
BS EN ISO 12947-4: 1999	Textiles – Determination of the abrasion resistance of fabrics by the Martindale method – Part 4: Assessment of appearance change
BS EN ISO 13934-1: 1999	Textiles – Tensile properties of fabrics – Part 1: Determination of maximum force and elongation at maximum force using the strip method
BS EN ISO 13938-1: 1999	Textiles – Bursting properties of fabrics – Part 1: Hydraulic method for determination of bursting strength and bursting distension
BS EN ISO 13938-2: 1999	Textiles – Bursting properties of fabrics – Part 2: Pneumatic method for determination of bursting strength and bursting distension
BS EN ISO 15607: 2003	Specification and qualification of welding procedures for metallic materials – General rules

BS EN ISO 15609-1: 2004	Specification and qualification of welding procedures for metallic materials – Welding procedure specification – Part 1: Arc welding
BS EN ISO 15609-2: 2001	Specification and qualification of welding procedures for metallic materials – Welding procedure specification – Part 2: Gas welding
BS EN ISO 15609-5: 2011	Specification and qualification of welding procedures for metallic materials – Welding procedure specification – Part 5: Resistance welding
BS EN ISO 15614-1: 2004	Specification and qualification of welding procedures for metallic materials – Welding procedure test – Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys
British Standards and European Standards	
Standard Reference	**Title**
BS EN ISO 15614-2: 2005	Specification and qualification of welding procedures for metallic materials – Welding procedure test – Part 2: Arc welding of aluminium and its alloys
BS EN ISO 15614-12: 2014	Specification and qualification of welding procedures for metallic materials – Welding procedure test – Part 12: Spot, seam and projection welding

IEC Standards	
Standard Reference	
IEC 60051 Part 1 to 9	Direct acting indicating analogue electrical measuring instruments and their accessories
IEC 60077-1: 1999	Railway applications - Electric equipment for rolling stock - Part 1: General service conditions and general rules
IEC 60077-2: 1999	Railway applications - Electric equipment for rolling stock - Part 2: Electrotechnical components - General rules
IEC 60077-3: 2001	Railway applications - Electric equipment for rolling stock - Part 3: Electrotechnical components - Rules for d.c. circuit-breakers
IEC 60077-4: 2003	Railway applications - Electric equipment for rolling stock - Part 4: Electrotechnical components - Rules for AC circuit-breakers
IEC 60077-5: 2003	Railway applications - Electric equipment for rolling stock - Part 5: Electrotechnical components - Rules for HV fuses

IEC 60099-4: 2006	Surge arresters – Part 4: Metal-oxide surge arresters without gaps for A.C. systems
IEC 60269-1: 2006	Low Voltage Fuses – Part 1: General requirements
IEC 60269-2: 2006	Low Voltage Fuses – Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) - Examples of standardized systems of fuses A to I
IEC 60309-1: 2005	Plugs, socket-outlets and couplers for industrial purposes – Part 1 : General requirements
IEC 60322: 2001	Railway applications - Electric equipment for rolling stock - Rules for power resistors of open construction
IEC 60349-1: 2010	Electric traction - Rotating electrical machines for rail and road vehicles - Part 1: Machines other than electronic convertor-fed alternating current motors
IEC 60349-2: 2010	Electric traction - Rotating electrical machines for rail and road vehicles - Part 2: Electronic convertor-fed alternating current motors

IEC Standards	
Standard Reference	
IEC 60494-2: 2002	Railway applications - Rolling stock - Pantographs - characteristics and tests - Part 2: Pantographs for metros and light rail vehicles
IEC 60529: 2001	Specification for classification of degrees of protection provided by enclosures
IEC 60571: 2006	Electronic equipment used on rail vehicles
IEC 60623: 2001	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Vented nickel-cadmium prismatic rechargeable single cells
IEC 60811-1-1: 2001	Common test methods for insulating and sheathing materials of electric cables and optical cables Part 1-1: Methods for general application - Section 1: Measurement of thickness and overall dimensions - Tests for determining the mechanical properties
IEC 60811-1-2: 1985	Common test methods for insulating and sheathing materials of electric cables and optical cables Part 1-2: Methods for general application - Section 2: Thermal ageing methods
IEC 60811-1-3: 2001	Common test methods for insulating and sheathing materials of electric cables and optical cables Part 1-3: Methods for general application - Section 3: Methods for determining the density - Water absorption tests - Shrinkage test

IEC 60811-1-4: 1985	Common test methods for insulating and sheathing materials of electric cables and optical cables Part 1-4: Methods for general application – Section 4: Test at low temperature
IEC 60947-1: 2007	Low-voltage switchgear and controlgear - Part 1 : Circuit-breakers
IEC 60947-2: 2001	Low-voltage switchgear and controlgear - Part 2: Circuit-breakers
IEC 60990: 1999	Methods of measurement of touch-current and protective conductor current
IEC 60993: 1989	Electrolyte for vented nickel-cadmium cells
IEC 61000-4-1: 2006	Testing and measurement techniques section 1 : Overview of IEC 61000-4 series
IEC 61000-4-2: 2001	Testing and measurement techniques section 2 : Electrostatic discharge immunity test
IEC 61000-4-3: 2006	Testing and measurement techniques section 3 : Radiated, radio-frequency, electromagnetic field immunity test
IEC 61000-4-4: 2004	Testing and measurement techniques section 4 : Electrical fast transient / burst immunity test
IEC 61000-4-5: 2005	Testing and measurement techniques section 5 : Surge immunity test
IEC Standards	
Standard Reference	
IEC 61000-4-6: 2006	Testing and measurement techniques section 6 : Immunity to conducted disturbances, induced by radio frequency fields
IEC 61000-4-8: 2001	Testing and measurement techniques section 8 : Power frequency magnetic field immunity test
IEC 61082-1: 2006	Preparation of documents used in electrotechnology – Part 1: Rules
IEC 61133: 2006	Railway applications - rolling stock - testing of rolling stock on completion of construction and before entry into service
IEC 61287-1: 2005	Power converters installed on board rolling stock. Part 1 : Characteristic and test methods
IEC 61287-2: 2001	Power converters installed on board railway rolling stock Part 2: Additional technical information
IEC 61377-1: 2006	Electric traction - Rolling stock - Combined testing of inverter - Fed alternating current motors and their control system

IEC/TR 61508-0: 2005	Functional safety of electrical/ electronic/ programmable electronic safety related systems – Part 0: Functional safety and IEC 61508
IEC 61508-1: 1998	Functional safety of electrical/ electronic/ programmable electronic safety related systems – Part 1: General requirements
IEC 61508-2: 2000	Functional safety of electrical/ electronic/ programmable electronic safety related systems – Part 2: Requirements for electrical/ electronic/ programmable electronic safety-related systems
IEC 61508-3: 1998	Functional safety of electrical/ electronic/ programmable electronic safety related systems – Part 3: Software requirements
IEC 61508-4: 1998	Functional safety of electrical/ electronic/ programmable electronic safety related systems – Part 4: Definitions and abbreviations
IEC 61508-5: 1998	Functional safety of electrical/ electronic/ programmable electronic safety related systems – Part 5: Examples of methods for the determination of safety integrity levels
IEC 61508-6: 2000	Functional safety of electrical/ electronic/ programmable electronic safety related systems – Part 6: Guidelines on the application of IEC 61508-2 and IEC 61508-3
IEC 61508-7: 2000	Functional safety of electrical/ electronic/ programmable electronic safety related systems – Part 7: Overview of techniques and measures

ISO Standards

Standard Reference	
ISO 5660: Pt 1: 2002	Reaction to fire tests - Heat release, smoke production and mass loss rate Part 1: Heat release rate (cone calorimeter method)
ISO 7183: 1986	Compressed air dryers - Specifications and testing
ISO 7183: Pt 2: 1996	Compressed air dryers – Part 2: Performance ratings
ISO 7498: Pt 1: 1996	Information technology - Open systems interconnection, basic reference model : The basic model
ISO 9000: All parts	Quality management and quality assurance standards
ISO 9001: 2000	Quality management systems - Requirements
ISO 9646: Pt 1: 1996	Information technology-open systems interconnectionconformance testing methodology and framework part 1. general concepts
ISO 14001: 2004	Environmental management systems - specification with guidance for use

ISO 14004: 2004	Environmental management systems - general guidelines on principles, systems and supporting techniques
ISO 90003: 2004	Software engineering - guidelines for the application of iso 9001:2000 to computer software

ANSI Standards	
Standard Reference	
ANSI S12.10: 1985	Methods for the measurement and designation of noise emitted by computer and business equipment

RIA Standards	
Standard Reference	
RIA 22: 1990	Technical guide on EMC for electronic equipment used on traction and rolling stock

DIN Standards	
Standard Reference	
DIN 18516-4: 1990	Back-ventilated, non-loadbearing, external enclosures of buildings, made from tempered safety glass panels – Requirements and testing

French Standards	
Standard Reference	
NF X 70-100: 1986	Fire Tests - Analysis of pyrolysis and combustion gases - Tube furnace method
French Standards	
Standard Reference	
NF F 72010: 1991	Point to point bi-directional serial asynchronous transmission procedures
NF C 32-021: 1985	Test methods for cables used under special conditions
NF C 93-522: 1982	Electrical wires for wrapped connections

UIC Codes	
Standard Reference	
UIC ORE B106: 1971 RP2 1980	Loadings of coach bodies and their components
UIC 515: 1984	Coaches running gear (1)
UIC 541-05: 2005	Brakes - Regulations concerning the construction of the various brake components: wheel slip prevention
UIC leaflet no. 861-3: 1969	Standard profiles for point rails adapted to the UIC 54kg/m and 60kg/m rail profiles

Miscellaneous	
Standard Reference	
ASTM D4060 - 2007	Standard test method for abrasion resistance of organic coating by the Taber Abraser
BR 566: 1989 BRB	Specification for high impact resistant windows
GM/RT 2483: 2004	Visibility requirements for trains
NSF 110: 1995	Environmental management systems - guiding principles and generic requirements
EMAS	Eco-management & Audit Scheme
ICC	International chamber of commerce sustainable development principles
GEMI	Global Environmental Management
E1A RS-232C: 1969	Electronic Industries Association Standard
E1A RS-485: 1983	Electronic Industries Association Standard
MIL-STD-471	Maintainability verification / demonstration / evaluation
MIL-STD-1472	Department of Defense Design Criteria Standard: Human Engineering
MIL-HDBK-189	Military Handbook Reliability Growth Management
MIL-HDBK-759	Handbook for Human Engineering Design Guidelines
MIL-HDBK-781	Handbook for Raliability Test Methods, Plans, and Environments for Engineering, Development Qualification and Production
MOD 00-25: Part 11	Design for maintainability
CCITT-Recommendation K.18	Calculation of voltage induced into telecommunication lines from radio station broadcasts and methods of reducing interference
CCITT-Recommendation K.24	Method for measuring radio-frequency induced noise on telecommunication pairs

CCITT-Recommendation K.25	Protection of optical fibre cables - series K
CCITT-Recommendation K.32	Immunity requirements and test methods for electrostatic discharge to telecommunication equipment - Generic EMC recommendation
Miscellaneous	
Standard Reference	
CCITT-Recommendation K.33	Limits for people safety related to coupling into telecommunications system form A.C. electric power and A.C. electrified railway installations in fault conditions
CCITT-Recommendation K.37	High frequency EMC mitigation techniques for telecommunication installations (basic EMC recommendation)
CCITT-Recommendation K.38	Radiated emission test procedure for physically large systems

3 Information on Standards

The information sources for the above standards are listed as below for reference:

3.1 European Standards, British Standards, IEC Standards, ISO Standards, DIN Standards

Customer Services
389 Chiswick High Road
London
W4 4AL

Tel : 0181 996 7000 Fax : 0181 996 7001

3.2 ANSI Standards

The Institute of Electrical and Electronics Engineers, Inc
345 East 47th Street,
New York,
NY 10017

3.3 RIA Standards, BRB Standards

Railway Industry Association
6 Buckingham Gate
London
SW1E 6JP

Tel : 071 834 1426 Fax : 071 821 1640

3.4 French Standards

Bureau de Normalisation des Cheminsde Fer (BNF) et par L'association de Normalisation (afnor) tour Europe
Paris CEDEX 7 La Defense
France

Tel : (1) 42 91 55 55

3.5 UIC Codes

International Union of Railways
16, rue Jean Rey
F-75015 Paris

Tel : (33.1) 44 49 20 20 Fax : (33.1) 44 49 20 29

3.6 MIL Standards, MOD Standards

Ministry of Defence
Room 5138
Kentigern House
65 Brown Street
Glasgow G2 8EX
England

Tel : 041 248 7890 / 041 224 7890

APPENDIX C

SCHEDULE OF TESTS

August 2015

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APPENDIX C SCHEDULE OF TESTS

1 Introduction

2 Works Tests

3 Commissioning (Tests in Hong Kong)

4 Tests on Completion

5 Integrated Testing

Table App-C-1 Table for Summary of Work Tests

Table App-C-2 Table for Summary of Commissioning Tests

Table App-C-3 Table for Summary of Tests on Completion

Table App-C-4 Table for Summary of Integrated Testing

APPENDIX C SCHEDULE OF TESTS

1 Introduction

1.1 According to PS 22, all tests specified in this Appendix shall constitute the Works Tests, Commissioning (Tests in Hong Kong), Tests on Completion and Integrated Testing of the trains as the minimum testing requirements which are acceptable to the Engineer.

1.2 The Contractor may offer alternative testing proposals which are equivalent to or better than those herein, and which the Contractor shall justify to the satisfaction of the Engineer.

1.3 The tests related to the train level shall follow the IEC 61133: 2006 where applicable.

1.4 The tests related to the major system/component level tests shall follow the specified testing requirements of this Appendix and the approved test specifications prepared by the Contractor.

1.5 The tests related to the other system/component level tests which are not mentioned in this Appendix, shall refer to the approved supplier's recommendation provided by the Contractor, individual PS or Rolling Stock Standards where applicable.

2 Works Tests

2.1 Car Body Structure and Exterior

2.1.1 Car Body Structure

(a) The Contractor shall undertake a series of Type Tests to demonstrate that the requirements of PS 6.4 for a service life as defined in PS 4.5.5 have been achieved. The tests shall include, but not be limited to, all the load cases specified in PS 4.5.4.

(b) A preliminary Type Test report which shall detail general stress levels, and shall highlight any areas of excessive stress and explain what corrective action is proposed, shall be submitted for Approval.

(c) Following this corrective action retest shall be required and a final report shall be submitted for Approval.

(d) This report shall contain a full commentary on the test results, together with a comparison of the measured stresses against the stresses

predicted by the Finite Element Analysis (FEA). In all areas where the measured stress differs from the stress predicted by FEA by more than 10% of the predicted value, a detailed explanation for the difference shall be given.

2.1.2 Train Sway Test

The Contractor shall submit for Approval and carry out a static vehicle sway test to verify his method for calculation of the Kinematic Envelope and to confirm that the requirements of the Kinematic Envelope given in PS 5.1 have been achieved.

2.1.3 Water Resistance Test

The Contractor shall submit for Approval and carry out tests to ensure that all trains will remain water tight under all operating conditions. The testing shall confirm that there is no penetration of water into passenger, train operator or equipment areas, or into any area where the presence of water or cleaning fluid may cause malfunction or in any way adversely affect any part of the train.

2.1.4 Window Test

The Contractor shall submit for Approval a procedure and carry out tests to ensure that all windows and glazing meet the requirements of PS 6.11.

2.1.5 Weighing Test

The Contractor shall carry out weighing tests to demonstrate compliance on axle load requirement (refer to PS 5.5) and train weight requirement (refer to PS 5.6).

2.2 Car Body Interior

2.2.1 Ergonomic Trials

The Contractor shall submit for Approval a procedure and carry out ergonomic trials to optimise the design of the saloon interior facilities including the seat profile, passenger retentions, passenger alarm device, passenger information display system and interior maintenance access panels.

2.2.2 Strength Test of Interior Panels, Seats, Passenger Retentions, Straphangers, Draught-screens and PA emergency Handles

The Contractor shall conduct tests to verify the strength requirements as specified in PS 7.5, 7.6.3, 7.7.1, 7.7.7, 7.7.8 and 7.11.4 have been achieved.

2.2.3 Flooring Tests

(a) The floor covering in combination with sub floor shall be tested to RS/C6014/08.

(b) The Contractor shall submit for Approval a full abrasion test programme and carry out tests to confirm that the floor covering show no signs of wear and shall remain colour fast to BS EN ISO 105: Part A01: 1996 test conditions for the specified service life.

2.2.4 Lighting Tests

(a) All light fittings shall be tested to IP 54, BS EN 60529: 1992.

(b) The lighting levels of the normal and emergency lightings shall be tested to confirm that the requirements in PS 7.9.3 have been achieved.

2.2.5 Saloon Smoke Detection Test

The Contractor shall submit for Approval a procedure and carry out tests to demonstrate saloon smoke detection requirements in PS 7.18 have been achieved.

2.3 Cab Facilities and Layout

2.3.1 Ergonomic Trials

The Contractor shall submit for Approval a procedure and carry out ergonomic trials on the foamcore mock-up and the full-scale engineering mock-up with an aim:

(a) to optimise the design of the cab facilities including the driver/auxiliary seats, cab controls, detrainment device and interior maintenance access panels.

(b) to ensure the cab pictograms are fit for purpose and require minimum amount of training.

2.3.2 Panels and Controls

(a) All panels and controls shall be tested to IP 65, BS EN 60529: 1992.

(b) The Contractor shall carry out tests to confirm that the pictograms and legends on the panels, indicators and pushbuttons shall remain colour fast and legible for the whole service life.

2.3.3 Seat Strength and Vibration Type Tests

(a) The Contractor shall perform hardness tests to BS EN ISO 2439: 2001 to establish acceptable values for the hardness of the seat headrest, cushion, squab and lumbar support of the production seat.

(b) The strength of the driver and auxiliary seats shall be tested to UIC ORE B106, Passenger Coaches: 1971 RP2 1980 and BS EN 61373: 2013.

(c) The Contractor shall submit for Approval a procedure and carry out tests to verify the seat life. This shall include a Martindale rub test to BS EN ISO 12947: 1999.

(d) The burst strength of the upholstery shall be tested to BS EN ISO 13938: 1999 and a breaking load to BS EN ISO 13934: Part 1: 1999.

(e) Upholstery shall be tested to confirm that it remains colour fast to BS EN ISO 105: Part A01: 1996 test conditions for the specified service life.

2.3.4 Lighting Tests

The lighting levels of the main, reading and detrainment lights shall be tested to confirm that the requirements in PS 8.14 have been achieved.

2.3.5 Switchgear electrical and mechanical endurance tests to IEC 60077.

2.4 Operation and Control

2.4.1 Test for correct operation to IEC 61133 clause 5.7.

2.4.2 Checks for the prevention of accidents to IEC 61133 clause 5.13.

2.4.3 Test for speed regulation and over speed protection systems to IEC 61133 clause 6.6.

2.5 Train Management System

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/01.

2.6 Traction and Braking Equipment

2.6.1 Traction Equipment

(a) A complete system test is required to be performed on the traction package in order to demonstrate compatibility of all train systems.

(b) The tests shall be conducted using simulated running conditions and as a minimum shall be conducted on one complete traction equipment including all line input protection devices and filters, traction electronics both power and control, traction motors and auxiliary equipment.

(c) The test shall also include all on board and wayside equipment and systems and shall demonstrate that the requirements of the design, to satisfy the requirements of the PS, have been complied with.

(d) At the appropriate stage some of the results obtained shall be used in the energy consumption calculations as detailed in Appendix M Clause 4.

(e) The Contractor shall carry out combined tests on the traction equipment according to IEC 61377-1: 2006.

(f) A site verification test on energy consumption shall be carried out in TWL between KWF to KWH stations. The train shall be driven under the following conditions:

(i) Tare load
(ii) All out running with train motors operating at full power to the maximum designed speed, and running at the maximum designed speed at all times as far as it can be achieved

An energy storage device with 500kVA capacity will be installed in TWD which will be connected to the traction substation responsible for absorbing the regenerative braking energy from the train.

2.6.2 Traction Motors

(a) General

(i) All tests shall be in accordance with IEC 60349-2: 2002. The first two machines of each type of each separate contract, and every fortieth of the remainder, shall be type tested. Routine tests shall be carried out on every machine.

(ii) A characteristic test at 1.5 times the rated voltage as defined in IEC 60349-2: 2002 shall be carried out.

(b) Test Through Gearing

A test shall be carried out with the gear drive assembled to a motor and dummy axle for the purpose of demonstrating that noise and lubrication arrangements are to the satisfaction of the Engineer.

(c) Impedance and Inductance Measurement

The total motor resistance and inductance shall be determined at the propulsion chopper operating frequencies.

2.6.3 Braking Resistors

All braking resistors shall be tested to IEC 60322: 2001.

2.6.4 Transformers and Reactors

All transformers and reactors shall be tested to BS EN 60310: 2004.

2.6.5 Power Converters

The power converters shall be tested to IEC 61287-1:2005 and IEC 61287-2: 2001.

2.6.6 Miscellaneous Electric Traction Equipment

All miscellaneous electric traction equipment shall be tested to IEC 60077.

2.6.7 Brake Equipment

(a) The Contractor shall submit for Approval a dynamometer test to indicate the adequacy of the bogie mounted friction brake equipment.

(b) The tests shall demonstrate that the requirements of PS 11.9 have been satisfied.

2.6.8 Friction Brake Units

Type tests shall comprise:-

(a) Functional checks such as working stroke, slack adjuster operation and action of parking brake.

(b) Recording of brake force against cylinder pressure over the working range.

(c) Plotting of curves of brake force against pressure in all conditions of operation of main cylinder and parking brake.

(d) Carrying out of a vibration test as defined in IEC 60077.

2.6.9 Brake Control Equipment

Individual items of electro-pneumatic equipment shall be type tested as follows:

(a) Mechanical Operation and Endurance

As defined in IEC 60077.

(b) Vibration and Shock

As defined in IEC 60077.

(c) Air Tightness

Generally as IEC 60077 except as varied by particular requirements specified in the Contractor's design specification.

(d) Electrical Tests

These shall be generally in accordance with IEC 60077 and shall include checking operation at lowest permitted voltage at 0°C ambient.

(e) Characteristic Tests

Each item of equipment having a pilot or transducing function, shall be tested to confirm compliance with the Contractor's design data, and oscillogram shall be produced in support.

2.6.10 Wheel Slide Protection System

The wheel slide protection system shall be tested to UIC 541-05: 2005.

2.7 Bogie and Suspension

2.7.1 Bogie Static Test

(a) The Contractor shall carry out a static proof test on a strain gauged bogie to confirm that all the requirements of PS 12.9.3 have been achieved.

(b) Strain gauges shall be placed in any area where the stress level predicted by FEA is greater than 80% of the yield stress or 0.2% proof stress of the material, and where the predicted damage over the life of the bogie computed in accordance with PS 12.9.3(b) is greater than 0.7. The positioning of strain gauges shall be submitted for Approval.

(c) The reporting on the proof test shall include, but not be limited to, a comparison between the stresses measured during the proof test with those predicted by the FEA. In all areas where the measured stress differs from the stress predicted by FEA by more than 10% of the predicted value, a detailed explanation for the difference shall be given.

2.7.2 Bogie Dynamic Test

(a) The Contractor shall carry out a dynamic test on the bogie to demonstrate that the requirements of PS 12.9.3 have been achieved.

(b) Strain gauges shall be placed in all areas where the cumulative fatigue damage, evaluated in accordance with PS 12.9.3(b) is greater than 0.7.

(c) The tests shall be carried out over a representative length of track in both directions at the design speed profile and shall cover all loading conditions from tare to fully laden.

(d) The strain gauge signals collected during the testing shall be counted using the rainflow method, or other counting technique and shall be submitted for Approval.

(e) The results shall then be used in conjunction with the fully laden passenger mass given in PS 4.5.4 to assess the fatigue damage over the life of the bogie.

(f) The bogie shall be assumed to travel 15 million km throughout its life.

2.7.3 Wheel Off-loading Test

The Contractor shall carry out tests to confirm compliance with the wheel off-loading performance specified in PS 12.5.

2.7.4 Bogie Rotational Resistance Test

The Contractor shall carry out a test to measure the rotational resistance of the bogies to confirm that the requirements of PS 12.6 have been achieved.

2.7.5 Train Ride Test

(a) The Contractor shall carry out tests to demonstrate that the stability and ride quality requirements of PS 12.2 have been achieved.

(b) Additionally the train shall be ride tested with the air suspension deflated to demonstrate compliance with PS 12.11.2.

(c) The tests shall be carried out on the Urban Lines in both directions.

2.7.6 Axlebox Bearing Test

The Contractor shall carry out bearing rig performance test and sealing test in accordance with BS EN 12082: 1998 to demonstrate compliance with PS 12.10.6.

2.7.7 Bogie Frame Fatigue Test

The bogie frame shall be subjected to a fatigue test in accordance with UIC 515.

2.7.8 Bogie Suspension Systems Test

(a) The Contractor shall carry out design verification type tests to determine suspension characteristics on various bogie suspension systems including primary suspension, secondary suspension, traction centre system and anti roll bar system to verify his method for calculation of the Kinematic Envelope, bogie stability, ride quality, overturning, wheel off-loading and bogie rotational resistance.

(b) The Contractor shall carry out endurance life tests on various bogie suspension rubber components to demonstrate compliance with PS 12.1.1.

2.8 Pneumatics and Air Distribution Systems

The Contractor shall carry out compressor capacity, duty cycle, charge up time, air dryer test, leakage test, air reservoirs test, Main Reservoir Pipe isolation cock venting time, shock and vibration test to satisfy the requirements of PS 13.

2.9 Gangways and Couplers

2.9.1 Gangways

The Contractor shall carry out Type Tests, including but not be limited to the following, to demonstrate that the gangways are capable of withstanding the movements, loadings, deflections and aerodynamic effects in accordance with the approved Design Data submitted to satisfy the requirements of PS 14.

(a) Strength Test

(b) Water Tightness Test

(c) Impact Test

(d) Endurance Life Test

2.9.2 Couplers

The Contractor shall carry out Type Tests to demonstrate that the couplers are capable of withstanding the movements, loadings and deflections, in accordance with the approved Design Data submitted to satisfy the requirements of PS 14.

2.10 Air Conditioning and Ventilation

2.10.1 Mechanical Endurance, Vibration and Shock Type Tests

With the air conditioning unit mounted in a manner fully representative of the on-car arrangement including any flexible or resilient mounting, the unit shall be subjected to the following tests:

(a) The test shall comprise a minimum of 20 000 start-run-stop cycles with a suitable cycle duration and time interval between each cycle. The timing shall be submitted for Approval.

(b) Routine maintenance shall be carried out at intervals equivalent to the maintenance intervals as defined in PS 26, in line with the specified maintenance instructions. A record of all maintenance activities shall be kept for inspection.

(c) A full report of all failures occurring during testing shall be submitted to the Engineer, who may require that a modification be carried out to rectify any defects thus encountered.

(d) Following such a modification it may be necessary to repeat the endurance test at the discretion of the Engineer and shall be at the cost of the Contractor.

(e) One prototype set of equipment type, fully representative of the production equipment, shall be subjected to vibration and shock tests to BS EN 61373: 2013.

(f) Any module or equipment frame used in the test shall not subsequently be used for a train supplied under this or any subsequent contract.

2.10.2 Pressure Test

Pressure tests shall be carried out before and after the vibration and shock tests of the air conditioning unit for any leakage by an approved method.

2.10.3 Equipment Base Performance Test

(a) The Contractor shall provide facilities to enable an air-conditioning unit to be artificially provided with sensible and latent thermal load so that it may operate at full capacity.

(b) The test shall also include the measurement of air flow to demonstrate the air conditioning unit delivers the specified air flow rates.

(c) Suitable instrumentation shall be provided to permit results to be checked against approved Design Data.

(d) The motor temperature rise shall not exceed 90% of that permitted according to IEC 60349-2: 2002, when tested continuously under the full load conditions.

(e) The Type Test shall also include measurements of equipment noise to meet the equipment noise specifications in accordance with RS/C6014/13.

(f) The Type Test shall also include measurements of equipment vibration levels to meet the requirements of BS EN 61373: 2013.

(g) The Contractor shall carry out the Routine Tests to certify every air conditioning unit achieves the specified cooling capacity.

2.10.4 Vehicle Base System Performance Test

A Type Test on vehicle base shall be carried out with the carbody equipped with all interior finish and underframe mounted equipment

representative to the production vehicle to demonstrate the effectiveness of the equipment in meeting the requirements of the PS. The tests shall include, but not be limited to, the following:

(a) Air Flow Tests

Tests shall be carried out to measure the air flows at the outside air intake, return air inlet and exhaust air outlet under all modes of air conditioning operation to achieve the specified air flow requirements in PS 15.

(b) Air Distribution

Tests shall be carried out to verify the requirements of PS 15.6 for evenly distribution of supply air. The static pressure head inside the car shall be measured and recorded under all modes of air conditioning operation.

(c) Air Conditioning

Tests shall be carried to demonstrate the capability of the air conditioning system to maintain the required saloon conditions as specified in PS 15. This test shall include the artificial generation of sensible and latent heat load inside the saloon and the required ambient conditions outside the car.

2.11 Doors

2.11.1 Endurance Tests on Saloon and Cab Doors

(a) An endurance test shall be performed on two sets of saloon door leaves and their operating mechanisms (refer to PS 16.7) to

(i) identify, analyse and rectify design problems and

(ii) to demonstrate compliance with the reliability target as apportioned from the overall train reliability target (refer to PS 25.5.9 and PS 25.5.10).

The test shall be carried out for a minimum of 500,000 complete open/close cycles for each door set.

(b) Similarly, an endurance test shall be performed on two sets of cab door leaves and their operating mechanisms (refer to PS 16.7) for a minimum of 100,000 complete open/close cycles for each door set.

(c) The endurance test for the saloon door mechanisms shall be designed to simulate a door obstruction every 1,000 cycles.

(d) Routine maintenance shall be carried out at intervals equivalent to the maintenance intervals defined in PS 26, in line with the specified maintenance instructions. A record of all maintenance activities shall be kept.

(e) A record of the door leaf velocity profile shall be taken, at the beginning and end of the test and any maintenance activities, to compare with the profile pre-programmed in the door control unit. Any deviations discovered shall be reported.

(f) The Contractor shall produce a full report of all failures occurring during testing and shall calculate the reliability together with the associated confidence level of the door mechanisms at the completion of the test.

(g) The Contractor shall propose design modifications for Approval should the agreed reliability target has not been met. The Engineer may require that a modification be carried out to rectify any defects encountered during the test. The Engineer may, at his discretion, request the undertaking of a further endurance test sequence to validate the design changes undertaken at the Contractor's cost.

(h) Upon completion of the endurance test, all parts of the doors and their actuators shall be dismantled for inspection by the Engineer. The door components shall be rigorously examined for incipient failure and wear and a report submitted on the condition of all parts. Any parts exhibiting such signs shall be subject to redesign at the discretion of the Engineer following which the endurance test may be required to be repeated at the Contractor's cost.

(i) Any module or equipment used in these tests shall not subsequently be used for a train supplied under this or any subsequent contract.

2.11.2 Mechanical Strength Test

The Contractor shall undertake tests to demonstrate the structural strength and stability of the door leaves and suspensions and their deflection when loaded (refer to PS 16.2.5).

2.11.3 Vibration Tests

Vibration tests to BS EN 61373: 2013 shall be carried out on door leaves, suspensions and operating mechanisms of the saloon door, cab door and the emergency detrainment door systems.

2.11.4 Emergency Detrainment Device Type Test

(a) The Contractor shall perform a Type Test to demonstrate, to the satisfaction of the Engineer, that the detrainment device is fit for purpose and that it satisfies the requirements specified in PS 8.16 for the two basic modes of operation, namely, train-to-train detrainment and train-to-track detrainment.

(b) Load Test

A static load test (refer to PS 8.16.6) shall be performed at fully deployed condition without permanent deformation. The test shall simulate the correct heights relative to the car floor level and the door resting on one rail when the car being stopped on a curve of 300m radius. The device shall continue to function within its prescribed operating parameters on completion of the test.

(c) Endurance Test

The emergency door shall be tested for endurance with a total of 100 cycles for ramp mode and re-stowed back to normal operative state, and 100 cycles for sliding to full open and re-close to normal operative state. The device shall be operated within the specified deployment and stowage time (refer to PS 8.16) throughout the test. The Contractor shall calculate the reliability and the associated confidence level of the detrainment door mechanism.

(d) Any failure of the tests, the Contractor shall make necessary rectification through readjustment or design changes to the satisfaction of the Engineer. The Engineer may, at his discretion, request the undertaking of further test sequence to validate the design changes undertaken at the Contractor's cost.

2.12 Auxiliary Electrical Supply

2.12.1 A complete system test is required to be performed on the auxiliary supply system in order to demonstrate compatibility of all train systems.

2.12.2 The tests shall be conducted using simulated running conditions and as a minimum shall be conducted on one complete auxiliary equipment including all line input protection devices and filters, control electronics both power and control, compressor motors and auxiliary equipment.

2.12.3 The test shall also include all emergency equipment and systems and shall demonstrate that the emergency requirements have been complied with.

2.12.4 The Contractor shall carry out tests on the power converters according to IEC 61287-1: 2005.

2.12.5 Auxiliary Machines (other than compressor sets)

(a) General Remarks

(i) All machinery shall be tested to IEC 60349 insofar as applicable, or if test specifications exist and are already agreed between the Engineer and the Contractor then these tests shall be to these specifications unless otherwise agreed.

(ii) For those auxiliary drives where the actual loading conditions cannot be accurately calculated in advance or conveniently simulated at the manufacturers' work, for example, fans and pumps, the electrical driving motors chosen for the application shall be tested to a declared continuous rating which shall subsequently be verified to be adequate by prototype tests on the train. Similarly, the fan or pump chosen shall be type-tested at the manufacturers' works to prove the design characteristics and their suitability for the application subsequently proved by tests on the train. In the case of components which belong to the manufacturers' standard range, test certificates referring to published performance data may be acceptable at the Engineer's discretion.

(iii) It follows from the preceding paragraph that the appliance and its driving motor need not be tested together as one unit although this method is preferred. If tested separately, due regard must be given to possible interaction between components after assembly, particularly as regards vibration. However, when integral construction is adopted for the appliance and its electric driving motor it shall be tested as a complete unit.

(b) Low Voltage Starting Tests (AC machines only)

It shall be demonstrated that the motor at a starting temperature of $0^{o}C$ and with a load having similar torque/speed characteristic to that with which the motor will operate in service, will start and run up to normal speed when supplied at a voltage corresponding to the lowest specified voltage and frequency.

(c) No Load Run (AC machines only)

This run shall be made at rated voltage and the stator current, watts and the speed shall be recorded.

(d) Locked Rotor Test (AC machines only)

This test shall be made at rated stator current and the terminal voltage and watts shall be recorded.

(e) Compressor and Motor Set

(i) These shall be in accordance with IEC 60349 or if test specifications exist and are already agreed between the Engineer and Contractor then these tests shall be to these specifications.

(ii) Oil consumption tests on two sets selected by the Engineer shall also be required.

2.12.6 Battery Charger

The equipment shall be supplied at nominal supply voltage and a load shall be applied consisting of:

(i) Maximum normal auxiliary load, for example, lighting and control.

(ii) A discharged battery of the type to be used with the charger, when supplied by an auxiliary inverter, also of the type to be used with the charger.

(iii) The test shall be continued until maximum temperature conditions are reached.

(iv) Tests shall be carried out to determine the characteristics of the charger at minimum, nominal and maximum input voltages over the full range of load.

(v) Measurements shall be made of input voltage, input current, input power, output voltage and output current.

(vi) The measurements shall include the conditions with the output terminals open-circuited.

(vii) Cathode ray oscillogram of the output quantities shall be made for selected conditions of supply and load. These shall include

examples of the transient response to switching the supply and the load on and off.

Rating and characteristic type tests shall be made on a completely assembled charger with all covers in position.

2.12.7 Miscellaneous Auxiliary Equipment

All miscellaneous auxiliary equipment shall be tested to IEC 60077.

2.13 Communications Equipment

2.13.1 General

The cars, Train Units and trains shall be tested generally in accordance with the requirements of IEC 61133: 2006 to an approved specification. Unless agreed otherwise the tests required by the approved specification shall be carried out at the Contractor's works, and may be performed either on individual cars, units or trains as appropriate.

2.13.2 Trainborne Radio

(a) The Contractor shall agree with the Engineer, a range of tests as recommended by the Named Supplier to be conducted, prior to the dispatch of any equipment from the Named Supplier's works. Visual, electrical and functional tests shall be conducted for each individual element (refer to Appendix I Annex 4 Clause 2.2) and the assembled system / equipment.

(b) When the equipment is delivered to the Contractor's works, the Contractor shall agree with the Engineer, a range of tests as recommended by the Named Supplier to be conducted, prior to the installation of the equipment on train.

(c) The Contractor shall conduct commissioning tests to demonstrate that all the equipment have been correctly installed and adjusted and that the system fulfils all the requirements as stipulated in this Specification.

(d) The trainborne radio shall be re-programmed to satisfy the frequency plan for the Urban Lines. The Contractor shall undertake tests to demonstrate full functional compliance of the trainborne radio for the Urban Lines, Tseung Kwan O Line Extension and West Island Line.

2.13.3 In-Cab CCTV

(a) The Contractor shall agree with the Engineer, a range of tests as recommended by the Named Supplier to be conducted, prior to the dispatch of any equipment from the Named Supplier's works. Visual, electrical and functional tests shall be conducted for each individual element (refer to Appendix I Annex 4 clause 3.2) and the assembled system / equipment.

(b) When the equipment is delivered to the Contractor's works, the Contractor shall agree with the Engineer, a range of tests as recommended by the Named Supplier to be conducted, prior to the installation of the equipment on train.

(c) The Contractor shall conduct commissioning tests to demonstrate that all the equipment have been correctly installed and adjusted and that the system fulfils all the requirements as stipulated in this Specification

(d) The Contractor shall conduct commissioning tests to demonstrate that the TMS interfaces and trainborne video display interfaces fulfil all the requirements as stipulated in PS 18.3 and Appendix I Annex 4 Clause 6.

2.13.4 DVAS & PA

(a) The Contractor shall undertake tests for DVAS & PA to demonstrate full compliance of PS 18.4 and the tests shall cover Manual Broadcasting, Radio Broadcasting, Broadcasting of pre-recorded announcements initiated by the train operator, Broadcasting of pre-recorded announcements based on real time information received via the interface with TMS, Cab-to-Cab Intercom and Passenger Alarm System.

(b) The Contractor shall agree with the Engineer, a range of tests to be conducted, prior to the installation of the equipment on train. Visual, electrical and functional tests shall be conducted for each individual element (refer to PS 18.4.2) and the assembled system / equipment.

(c) The Contractor shall conduct commissioning tests to demonstrate that all the equipment have been correctly installed and adjusted and that the system fulfils all the requirements as stipulated in this Specification.

2.13.5 EIDS Communication Equipment

(a) Wireless LAN Transmission Link

(i) The Contractor shall agree with the Engineer, a range of tests as recommended by the Employer to be conducted, prior to the

dispatch of any equipment from the Employer. Visual, electrical and functional tests shall be conducted for each individual element (refer to Appendix I Annex 4 Clause 4.5) and the assembled system / equipment.

(ii) When the equipment is delivered to the Contractor's works, the Contractor shall agree with the Engineer, a range of tests as recommended by the Employer to be conducted, prior to the installation of the equipment on train.

(iii) The Contractor shall conduct commissioning tests to demonstrate that all the equipment have been correctly installed and adjusted and that the system fulfils all the requirements as stipulated in this Specification.

(b) GSM Link

(i) The Contractor shall agree with the Engineer, a range of tests as recommended by the Employer to be conducted, prior to the dispatch of any equipment from the Employer. Functional tests shall be conducted for each individual element (refer to Appendix I Annex 4 clause 4.5) and the assembled system / equipment.

(ii) Not used.

(iii) Not used.

(c) Train Network

(i) The Contractor shall agree with the Engineer, a range of tests as recommended by the Employer to be conducted, prior to the dispatch of any equipment from the Employer. Visual, electrical and functional tests shall be conducted for each individual element (refer to Appendix I Annex 4 Clause 4.5) and the assembled system / equipment.

(ii) When the equipment is delivered to the Contractor's works, the Contractor shall agree with the Engineer, a range of tests as recommended by the Employer to be conducted, prior to the installation of the equipment on train.

(iii) The Contractor shall conduct commissioning tests to demonstrate that all the equipment have been correctly installed and adjusted and that the system fulfils all the requirements as stipulated in this Specification.

(d) EID Panels

The Contractor shall conduct commissioning tests to demonstrate that the requirements of PS 18.5 have been satisfied.

2.13.6 In-Saloon CCTV

The Contractor shall agree with the Engineer, a range of tests to be conducted to demonstrate that the requirements of PS 18.7 and Appendix I Annex 4 Clauses 6 and 7 have been satisfied.

2.13.7 Provision for Public WiFi Access

The Contractor shall agree with the Engineer, a range of tests to be conducted to demonstrate that the provisional requirements of PS 18.8 have been satisfied.

2.13.8 Dynamic Route Map

(a) The Contractor shall undertake tests for DRM to demonstrate full compliance of PS 10.4 and the tests shall cover route information, scheduled playback, content update, system status reporting, display control, data transmission, message broadcasting and OCC live messages broadcasting via the interface with TMS, DVAS & PA, GSM Modem Assemblies and Doors.

(b) The Contractor shall agree with the Engineer, a range of tests to be conducted, prior to the installation of the equipment on train. Visual, electrical and functional tests shall be conducted for each individual element and the assembled system / equipment.

(c) The Contractor shall conduct commissioning tests to demonstrate that all the equipment have been correctly installed and adjusted and that the system fulfils all the requirements as stipulated in this Specification.

(d) GSM Link

(i) The Contractor shall agree with the Engineer, a range of tests to be conducted, prior to the installation of the equipment on train. Visual, electrical and functional tests shall be conducted for each individual element (refer to Appendix I Annex 9 clause 2.2.2) and the assembled system / equipment.

(ii) Not used.

(iii) The Contractor shall conduct commissioning tests to demonstrate that all the equipment have been correctly installed and adjusted and that the system fulfils all the requirements as stipulated in this Specification.

2.13.9 Door Chime System

(a) The Contractor shall agree with the Engineer, a range of tests as recommended by the Employer to be conducted, prior to the dispatch of any equipment from the Employer. Visual, electrical and functional tests shall be conducted for each individual element (refer to Appendix I Annex 4 Clause 5) and the assembled system / equipment.

(b) When the equipment is delivered to the Contractor's works, the Contractor shall agree with the Engineer, a range of tests as recommended by the Employer to be conducted, prior to the installation of the equipment on train.

(c) The Contractor shall conduct commissioning tests to demonstrate that all the equipment have been correctly installed and adjusted and that the system fulfils all the requirements as stipulated in this Specification.

2.13.10 RFID for Trainborne Radio

(d) The Contractor shall agree with the Engineer, a range of tests as recommended by the Named Supplier to be conducted, prior to the dispatch of any equipment from the Named Supplier’s works. Visual, electrical and functional tests shall be conducted for each individual element (refer to Appendix I Annex 4 Clause 8) and the assembled system / equipment.

(e) When the equipment is delivered to the Contractor's works, the Contractor shall agree with the Engineer, a range of tests as recommended by the Named Supplier to be conducted, prior to the installation of the equipment on train.

(f) The Contractor shall conduct commissioning tests to demonstrate that all the equipment have been correctly installed and adjusted and that the system fulfils all the requirements as stipulated in this Specification.

2.13.11 RFID Axle Box Temperature Detection System

(a) The Contractor shall agree with the Engineer, a range of tests as recommended by the Named Supplier to be conducted, prior to the dispatch of any equipment from the Named Supplier's works. Visual, electrical and functional tests shall be conducted for each individual element (refer to Appendix I Annex 4 Clause 9) and the assembled system / equipment.

(b) When the equipment is delivered to the Contractor's works, the Contractor shall agree with the Engineer, a range of tests as recommended by the Named Supplier to be conducted, prior to the installation of the equipment on train.

(c) The Contractor shall conduct commissioning tests to demonstrate that all the equipment have been correctly installed and adjusted and that the system fulfils all the requirements as stipulated in this Specification.

2.14 Not Used

2.15 EMC and Software Integration Tests

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/04 and RS/C6014/05.

2.16 Cables

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/06.

2.17 Pneumatic Equipment

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/07.

2.18 Fire Performance

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/08.

2.19 Wheelset

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/09.

2.20 Pantograph

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/10.

2.21 Battery

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/11.

2.22 Noise Performance

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/13.

2.23 Operability Performance

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/14.

2.24 Keys and Locks

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/15.

2.25 Other Type Tests

2.25.1 Type Tests on Electronic Equipment

Unless otherwise specified, all electronic equipment used in the train system shall be tested to BS EN 50155: 2007 (refer to RS/C6014/03).

2.25.2 Brake System Tests

(a) A complete set of brake equipment comprising all items of equipment from the Brake Controller or ATO signal generator to a transducer, measuring the force at the brake unit push rod, shall be set up. This shall include identical lengths and diameters of pipe to those on an A Car.

(b) The appropriate reservoir volumes shall be included where these are critical in any way to the correct functioning of the system. The rig may be fed from a suitable air supply other than the car compressor if required.

(c) A complete series of tests shall be carried out on this rig to demonstrate the function of the brake system as a whole both in manual and ATO modes.

(d) The Contractor may combine the test of individual items with the system test.

2.25.3 Shock and Vibration Tests

All equipment modules which include the equipment contained in the module, the mounting frame or box, and the mountings, including mounting bushes and fasteners, which will be mounted on the underframe or inside the vehicles, shall be subjected to a shock and vibration test in accordance with BS EN 61373: 2013.

2.26 Completed Car, Train Unit and Train Tests

2.26.1 Train System Performance Test

(a) The train system performance test shall be the testing of a complete function of train from the power collection to its end function, the train operator and train system interface. All individual sub-systems of this function shall be successfully tested before, hence all the sections of system shall be connected together by their intended interfaces.

(b) The tests required by IEC 61133 that are applicable to the train shall be carried out prior to the delivery under the conditions of:

(i) the train under type test shall be equipped with all interior finish and with all underframe mounted equipment; and

(ii) the tests shall be carried out at the nominal system voltage.

(c) Notwithstanding the above requirements, it shall be a requirement that some of the important type and routine tests, such as, the traction and braking tests, shall be repeated in Hong Kong as part of the commissioning tests.

2.27 Tests on Contractor's Track

2.27.1 In order to eliminate the initial design defects and hence reduce the duration of commissioning the trains, the trains manufactured shall undergo the following tests in the Contractor's test track prior to its delivery to Hong Kong.

(a) Adjustment Tests, ATC System Combined Test, Reliability Proving Test and investigation tests for first manufactured train.

(b) ATC System Combined Test and Test Run in Factory for the second manufactured train.

(c) Test Run in Factory for trains other than the first two manufactured trains.

2.27.2 Adjustment Tests

(a) The adjustment tests shall be carried out to prove the complete function of train according to the IEC 61133: 2006 clause 4.2.

(b) The adjustment tests shall include both static and dynamic tests under the conditions of:

(1) with and without loads; and

(2) fully receptive, partial receptive and non-receptive traction power supply.

(c) All individual sub-systems particularly the traction system combined test specified in Clause 2.6.1 above shall be successfully tested beforehand.

(d) The results of the adjustment test, such as the response times and level setting of the individual systems, sub-systems and equipment, shall be recorded and formed the baseline to develop the associated commissioning test specifications, such that all trains shall be properly adjusted according to the above adjustment test results before submitting to the commissioning tests.

2.27.3 ATC System Combined Test

The ATC system combined test shall be carried out to validate the interface design and performance according to the requirements specified in the Appendix I Annex 3.

2.27.4 Reliability Proving Test

(a) Following the completion of the adjustment tests and the ATC system combined test, the reliability proving test shall be carried out according to the following operation profiles in order to simulate the actual service pattern:

(i) with the train under test is in tare load, start the train with maximum motoring demand to its maximum speed and then stop with

maximum service braking demand (note that re-motoring is allowed if necessary and re-generative braking shall be used for this test purpose);

(ii) perform the platform duties during stop i.e. operate the door and DVAS & PA (note that the train shall not be stopped for more than 20 secs);

(iii) repeat (i) and (ii) again until the accumulative mileage of the train runs reached 10,000km which is approximately equal to 1 month of operation cycle.

(b) For training purpose, a team of experienced train operators may be provided to the test site as the testing crews at the discretion of the Engineer (refer to PS 23.8.1).

(c) For the above 10,000km reliability proving runs, there shall be at least 5,000km runs cumulatively is free from any major equipment failure, such as a power device of the traction equipment failed.

(d) In the event that the requirement of 5,000km fault free runs cannot be met due to a major equipment failure, the Contractor shall, at his own expense, investigate the failure, rectify the fault and take whatever action is deemed necessary to meet the requirement.

(e) In the event that the 5,000km fault free runs is not achieved, the 5,000km fault free runs shall be repeated until the 5,000km fault free requirements set out in Clause 2.27.4(a) is achieved.

2.27.5 Investigation Tests

The investigation tests shall be carried out to obtain those essential information of train characteristics according to the IEC 61133: 2006 clause 4.4.

2.27.6 Test Run in Factory

(a) For all trains except for the first train manufactured, Test Run shall be carried out in the Contractor's test track according to the following operation profiles in order to simulate the actual service pattern:

(i) with the train under test is in tare load, start the train with maximum motoring demand to its maximum speed and then stop with maximum service braking demand (note that re-motoring is allowed if necessary and re-generative braking shall be used for this test purpose);

(ii) perform the platform duties during stop i.e. operate the door and DVAS & PA (note that the train shall not be stopped for more than 20 secs);

(iii) repeat (i) and (ii) again until the accumulative mileage of the train runs reached 300km.

(b) For the above 300km reliability proving runs, the test train shall be free from any of the following failures:

(i) failures defined in the Register of Train Failures (PS 25.3.4);

(ii) failures that the Engineer considers would render the train unfit for passenger service, as defined in PS 25.7.4, conditions for train failures; or

(iii) failures that the Engineer considers would endanger the safe operation of the Railway.

(c) In the event that the requirement of 300km fault free runs cannot be met due to any failure specified in Clause 2.27.6(b), the Contractor shall, at his own expense, investigate the failure, rectify the fault and take whatever action is deemed necessary to meet the requirement.

(d) In the event that the 300km fault free runs is not achieved, the 300km fault free runs shall be repeated until the 300km fault free requirements is achieved.

3 Commissioning (Tests in Hong Kong)

3.1 Check Tests

3.1.1 Check tests shall be performed on each car on arrival, first stationary and then running at low speed in the sidings at Siu Ho Wan Depot, to establish that all equipment is operating correctly. The Contractor shall itemise these tests for Approval. Facilities for trial runs (refer to Clause 6) at high speed will be available, subject to Clause 3.2.

3.1.2 During initial trial runs, the Contractor may make adjustments after which the tests below shall be carried out. The ATC Systems shall be checked and adjusted concurrently with these tests and brought into operation in preparation for the acceptance tests on the trains.

3.1.3 An interference test shall be carried out together with the ATC contractor as an acceptance test to ensure the traction equipment will not interfere with the signalling equipment.

3.1.4 Inspections shall be performed on each car after completion of the commissioning tests to verify that the workmanship required by RS/C6014/02 are met and that no deterioration in performance has taken place during the shipping, erection and commissioning processes. The Contractor shall make good any defect thus found at his own cost.

3.2 Site Arrangements for Tests

3.2.1 The availability of track space in Hong Kong will be limited by the fact that passenger train service will be in operation during the testing period.

3.2.2 Such testing may be carried out, of necessity, at night during the period when the service is shut down (from 01:30 to 05:00 hours approx.).

3.2.3 For this reason it is essential that the maximum amount of testing is carried out at or near the Contractor's Works as set out in PS 30.

3.3 Scope of Tests

The tests specified in Clause 4 below shall be carried out by the Contractor to verify the train performance in the Employer's railway systems.

4 Tests on Completion

4.1 Tests on Completion

4.1.1 In addition to the commissioning (tests in Hong Kong) and the integrated testing, the Tests On Completion shall demonstrate that the performance requirements of the train are met and suitable for passenger service in the Urban Lines systems.

4.1.2 The Tests On Completion that shall be carried out in Hong Kong, shall be all relevant tests specified in IEC 61133 which have been passed prior to delivery (refer to Clause 2.26.1(a)), shall be repeated in Hong Kong. The Contractor shall demonstrate by these test results that the train system is applicable to the conditions in Hong Kong and that no deterioration in performance has taken place during the shipping, erection and commissioning processes.

4.1.3 Not used.

5 Integrated Testing

5.1 The Integrated Testing shall consist of Integrated Tests (refer to Clause 5.2) and Test Run (refer to Clause 5.3).

5.2 Integrated Tests

5.2.1 Objective

(a) The Integrated Tests shall verify that the compatibility requirements between the train and the existing Urban Lines systems are met.

(b) The Contractor shall demonstrate by the result of the Integrated Tests that all interface requirements specified in the associated interface specifications are met.

5.2.2 The Contractor shall carry out all required tests according to the relevant approved interfacing specifications of Appendix I in the existing Urban Lines systems. The system interfaces shall include:

(a) P-way Interface (refer to Appendix I Annex 1),

(b) OHL/Traction Power Supply System Interfaces (refer to Appendix I Annex 2),

(c) ATC Interfaces (refer to Appendix I Annex 3),

(d) Communication Interfaces (refer to Appendix I Annex 4),

(e) PSD Interfaces (refer to Appendix I Annex 5),

(f) Depot Interfaces (refer to Appendix I Annex 6),

(g) Electric Vehicle Interfaces (refer to Appendix I Annex 7),

(h) Not used

(i) Dynamic Route Map Interfaces Test (refer to Appendix I Annex 9)

5.2.3 Specific (Type) Interface Tests

In addition to the requirements specified in the interface specifications, the following specific tests shall be carried out on a type test basis to verify the compatibility between the trains and the specific interfacing system/equipment.

5.2.4 OHL/Traction Power Supply System Interface

To measure interference current generated by the traction and braking and auxiliary supply systems when they appear in the traction supply under both normal and worse case conditions.

5.2.5 ATC interface

(a) Rolling Stock / Signalling

(i) Conductive Interference

To measure the spectrum of the traction and braking and auxiliary supply systems generated harmonics for both continuous and transient conditions.

(ii) Inductive (Magnetic) Interference

To measure direct induction effects in track circuits i.e. "close up" conditions.

(iii) Inductive Interference

To measure direct induction effects in ATP and ATO loops.

(iv) To measure the spectrum of disturbance voltage induced in the trainborne ATO and ATP aerial systems for the traction and braking and auxiliary supply systems generated interference.

(b) Rolling Stock / Signalling / OHL

(i) To measure the spectrum of disturbance voltage induced in the trainborne ATO and ATP aerial systems for traction supply generated interference due to the train system.

(ii) Measure the range of ripple voltages over the range of load current to be conducted on site and the simulated failure mode shall be defined.

5.2.6 Depot Interfaces

(a) Compatibility with abovefloor and underfloor lifting equipment (refer to Clause 3.3, Appendix I Annex 6)

(b) Compatibility with existing accommodation bogies (refer to Clause 3.4, Appendix I Annex 6)

(c) Handling of underframe mounted equipment (refer to Clause 3.5, Appendix I Annex 6)

(d) Towing by tractor (refer to Clause 3.6, Appendix I Annex 6)

(e) Automatic external cleaning facilities (refer to Clauses 4.1 and 4.2, Appendix I Annex 6)

(f) Compatibility with underfloor wheel lathe, including towing winch (refer to Clause 5, Appendix I Annex 6)

(g) Compatibility of miscellaneous interfaces (refer to Clause 6, Appendix I Annex 6):

(i) Target holder
(ii) Pneumatic connector
(iii) Shore auxiliary supply
(iv) Recovery equipment for derailment and locked axle

5.3 Test Run in Urban Line

5.3.1 "Test Run" means that period when the Designated Contractors shall be testing their plant and equipment and run the same in conjunction with the Employer.

5.3.2 Test Run

(a) After the completion of the Integrated Tests (refer to Clause 5.2), each train shall undergo a Test Run one by one in the Urban Lines to verify the reliability requirements between the train and the existing Urban Lines systems are met. The Contractor shall provide a competent engineering personnel to attend the Test Run to provide technical advice to the train operator when it is required, such as, during fault recovery of the train.

(b) In order to simulate the actual service pattern, the Test Run shall be carried out according to the following operation profiles:

(i) With the train under test is in tare load, operate the train according to the service schedules provided by the Automatic Train Regulation system of the Urban Lines.

(ii) A special test path will be assigned to the test train during passenger service periods and no passenger shall be allowed to

go abroad of the test train. The Contractor shall provide appropriate means, such as, to erect barriers at all doors, on the test train to prevent passengers from boarding the test train, as shall take any other precautions to meet the Employer's operating requirements, as instructed by the Engineer.

(iii) At the discretion of the Engineer, another special test path may be assigned to the test train during the non-traffic hours at night, the Contractor shall ensure that the required attendant (refer to Clause 5.3.2(a)) is provided;

(iv) perform the platform duties during stop i.e. operate the door and DVAS;

(v) repeat (i) to (iv) above again until the accumulative mileage of the test train runs reached 600km.

(c) For the above 600km reliability proving runs, the test train shall be free from any of the following failures:

(i) failures defined in the Register of Train Failures (PS 25.3.4);

(ii) failures that the Engineer considers would render the train unfit for passenger service, as defined in PS 25.7.4, conditions for train failures; or

(iii) failures that the Engineer considers would endanger the safe operation of the Railway.

(iv) failures to stop within ±500mm of the designated station stopping point under Auto mode operation.

(d) In the event that the requirement of 600km fault free runs cannot be met due to any failure specified in Clause 5.3.2(c), the Contractor shall, at his own expense, investigate the failure, rectify the fault and take whatever action is deemed necessary to meet the requirement.

(e) In the event that the 600km fault free runs is not achieved, the 600km fault free runs shall be repeated until the 600km fault free requirements is achieved.

(f) The distance travelled of the train recorded by the Train Management System (refer to PS 10.6.1(b)) shall be used for the 600km fault free measurement.

5.3.3 In addition during the above periods system-wide tests shall be undertaken that shall require the attendance of the Contractor and the relevant Designated Contractors and or the Employer.

Works Tests

Table App-C-1 Table for Summary of Work Tests

Equipment	Test Contents	Clause Reference / Standards
Car Body Structure and Exterior	1. Car Body Structure	AppC-2.1.1, PS 6.4, PS 4.5.4
	2. Train Sway	AppC-2.1.2, PS 5.1
	3. Water Resistance	AppC-2.1.3
	4. Window	AppC-2.1.4, PS 6.11
	5. Weighing	AppC-2.1.5, PS 5.5, PS 5.6
Car Body Interior	1. Ergonomic Trial	AppC-2.2.1
	2. Strength	AppC-2.2.2, PS 7.5, PS 7.6.3, PS 7.7.1, PS 7.7.7, PS 7.7.8, PS 7.11.4
	3. Flooring	AppC-2.2.3, RS/C6014/08, BS EN ISO 105-A01
	4. Lighting	AppC-2.2.4, PS 7.9.3, IP 54, BS EN 60529
	5. Saloon Smoke Detection	AppC-2.2.5, PS 7.18
Cab Facilities and Layout	1. Ergonomic Trial	AppC-2.3.1
	2. Panels and Controls	AppC-2.3.2, IP 65, BS EN 60529
	3. Seat Strength and Vibration Test	AppC-2.3.3, BS EN ISO 2439, UIC ORE B106, BS EN 61373, BS EN ISO 12947, BS EN ISO 13938, BS EN ISO 13934-1, BS EN ISO 105-A01
	4. Lighting	
	5. Switchgear Electrical and Mechanical Endurance Test	AppC-2.3.4, PS 8.14 AppC-2.3.5, IEC 60077
Operation and Control	1. Correct Operation	AppC-2.4.1, IEC 61133-5.7
	2. Accidents Prevention	AppC-2.4.2, IEC 61133-5.13
	3. Speed Regulation and Over Speed Protection System	AppC-2.4.3, IEC 61133-6.6
Train Management System	TCN network performance, TCN equipment function & performance requirements, all data transmission services and mode of Data	RS/C6014/01-19.2, ISO 9646-1
	Management shall be tested with the following testing strategy :	
	1. Prototype Test	RS/C6014/01-19.3.1, PS 10
	2. TMS System Integration Test	RS/C6014/01-19.3.2, PS 10

Equipment	Test Contents	Clause Reference / Standards
	3. TMS Vehicle Level Test	RS/C6014/01-19.3.3, PS 10
Traction and Braking Equipment	1. Traction Equipment System Combined Test	AppC-2.6.1, AppM-2.2.6, IEC 61377-1
	2. Traction Motors Routine test, Characteristic test, Gearing test and Impedance & Inductance Measurement	AppC-2.6.2, IEC 60349-2
	3. Braking Resistors	AppC-2.6.3, IEC 60322
	4. Transformers and Reactors	AppC-2.6.4, BS EN 60310
	5. Power Converter	AppC-2.6.5, IEC 61287-1
	6. Miscellaneous Electric Traction Equipment	AppC-2.6.6, IEC 60077
	7. Brake Equipment Dynamometer Test	AppC-2.6.7, PS 11.9
	8. Friction Brake Units	AppC-2.6.8, IEC 60077
	9. Brake Control Equipment Mechanical Operation and Endurance Test, Vibration & Shock Test, Air Tightness, Electrical Test and Characteristic Test	AppC-2.6.9, IEC 60077
	10. Wheel Slide Protection System Test	AppC-2.6.10, UIC 541-05
Bogie and Suspension	1. Bogie Static Test	AppC-2.7.1, PS 12.9.3
	2. Bogie Dynamic Test	AppC-2.7.2, PS 12.9.3, PS 4.5.4
	3. Wheel Off-loading Test	AppC-2.7.3, PS 12.5
	4. Bogie Rotational Resistance Test	AppC-2.7.4, PS 12.6
	5. Train Ride Test	AppC-2.7.5, PS 12.2, PS 12.11.2
	6. Axlebox Bearing Test	AppC-2.7.6, PS 12.10.6, BS EN 12082
	7. Bogie Frame Fatigue Test	AppC-2.7.7, UIC 515
	8. Bogie Suspension Systems Test	AppC-2.7.8, PS 12.1.1
Pneumatic and Air Distribution Systems	1. Compressor, Air Dryer, Air reservoirs, Main Reservoir Pipe isolation cock	AppC-2.8, PS 13
Gangways and Couplers	1. Gangway Strength Test, Water Tightness Test, Impact Test and Endurance Life Test	AppC-2.9.1, PS 14
	2. Couplers	AppC-2.9.2, PS 14

Equipment	Test Contents	Clause Reference / Standards
Air Conditioning and Ventilation	1. Mechanical Endurance, Vibration and Shock Type Test	AppC-2.10.1, PS 26, BS EN 61373
	2. Pressure Test	AppC-2.10.2
	3. Equipment Base Performance Test	AppC-2.10.3, RS/C6014/13, IEC 60349-2, BS EN 61373
	4. Vehicle Base System Performance Test, Air Flow Test, Air Distribution Test and Air Conditioning Test	AppC-2.10.4, PS 15
Doors	1. Saloon and Cab Doors Endurance Test	AppC-2.11.1, PS 16.7, PS 25.5, PS 26
	2. Mechanical Strength Test	AppC-2.11.2, PS 16.2.5
	3. Vibration Test	AppC-2.11.3, BS EN 61373
	4. Emergency Detrainment Device Type Test, Load Test, Endurance Test	AppC-2.11.4, PS 8.16
Auxiliary Electrical Supply	1. Auxiliary Supply System Combined Test	AppC-2.12.1
	2. System Test with Simulated Running Conditions and One Full Set Complete Auxiliary Equipment	AppC-2.12.2
	3. System Test with all Emergency Equipment and System	AppC-2.12.3
	4. Power Converters	AppC-2.12.4, IEC 61287-1
	5. Auxiliary Machines, Low Voltage Starting Test, No Load Run, Locked Rotor Test and Compressor and Motor Set	AppC-2.12.5, IEC 60349
	6. Battery Charger	AppC-2.12.6,
	7. Miscellaneous Auxiliary Equipment	AppC-2.12.7, IEC 60077
Communications Equipment	1. Cars, Train Units and Trains General Test	
	- Trainborne Radio	AppC-2.13.2, AppI-Annex4-2.2, IEC 61133
	- In-Cab CCTV	AppC-2.13.3, PS 18.3.7, AppI-Annex4-3.2, IEC 61133
	- DVAS & PA	AppC-2.13.4, PS 18.4.2, IEC 61133
	- EIDS Communication Equipment * Wireless LAN Transmission Link * GSM Link * Train Network * EID Panels	AppC-2.13.5, PS 18.5, AppI-Annex 4-4.5, IEC 61133
	- In-Saloon CCTV	AppC-2.13.6, PS 18.7, AppI-Annex 4-6 and 7, IEC 61133
	- Provision of Public WiFi Access	AppC-2.13.7, PS 18.8, IEC 61133
	- Dynamic Route Map	RS/C6014/01, PS 10.4, AppI-Annex 9, AppC-2.13.8

Equipment	Test Contents	Clause Reference / Standards
	* GSM Link	
	- Door Chime System	AppC-2.13.9, PS 18.6, AppI-Annex 4-5
	- RFID for Trainborne Radio	AppC-2.13.10, PS 18.9, AppI-Annex 4-8
	- RFID Axle Box Temperature Detection System	AppC-2.13.11, PS 18.10, AppI-Annex 4-9
EMC and Software Integration Test	Specific Test	AppC-2.15, RS/C6014/04, RS/C6014/05
Cables	Specific Test	AppC-2.16, RS/C6014/06
Pneumatic Equipment	Specific Test	AppC-2.17, RS/C6014/07
Fire Performance	Specific Test	AppC-2.18, RS/C6014/08
Wheelset	Specific Test	AppC-2.19, RS/C6014/09
Pantograph	Specific Test	AppC-2.20, RS/C6014/10
Batteries	Specific Test	AppC-2.21, RS/C6014/11
Noise Performance	Specific Test	AppC-2.22, RS/C6014/13
Operability Performance	Specific Test	AppC-2.23, RS/C6014/14
Keys and Locks	Specific Test	AppC-2.24, RS/C6014/15
Other Equipment Type Test	1. Electronic Equipment Type Test	AppC-2.25.1, RS/C6014/03, BS EN 50155
	2. Brake System Test	AppC-2.25.2
	3. All Mounted Equipment Shock and Vibration Test	AppC-2.25.3, BS EN 61373
Completed Car, Train Unit and Train Test	1. Train System Performance Test prior to the delivery	AppC-2.26.1, IEC 61133
Test on Contractor's Track	1. Adjustment Test - Static and dynamic test - All individual sub-systems combined test	AppC-2.27.2, IEC 61133-4.2
	2. ATC System Combined Test	AppC-2.27.3, AppI-Annex3
	3. Reliability Proving Test	AppC-2.27.4, PS 23.8.1
	4. Investigation Test	AppC-2.27.5, IEC 61133
	5. Test Run in Factory	AppC-2.27.6

Commissioning Tests

Table App-C-2 Table for Summary of Commissioning Tests

Test	Description	Clause Reference / Standard
Check Test	1. Check tests on each car on arrival, first stationary and running at low speed in KBD sidings. Facilitate trial runs at high speed.	AppC-3.1.1
	2. ATC Systems check in initial trial runs.	AppC-3.1.2
	3. Interference test for ATC Systems and traction system.	AppC-3.1.3
	4. Verify the workmanships on each car after completion of commissioning tests.	AppC-3.1.4, RS/C6014/02

Tests on Completion

Table App-C-3 Table for Summary of Tests on Completion

Test	Description	Clause Reference / Standard
Tests on Completion	1. Demonstrate the performance requirements of the trains are met and suitable for passenger service in Urban Lines systems.	AppC-4.1.1
	2. Repeat the relevant Train System Performance Test in Hong Kong to demonstrate the proper functionality.	AppC-4.1.2, IEC 61133
	3. Carry out reliability tests and maintainability demonstration tests.	AppC-4.1.3, PS 26

Integrated Testing

Table App-C-4 Table for Summary of Integrated Testing

Test	Description	Clause Reference / Standard
Integrated Testing	1. Interface Tests	
	- P-way Interface Test	AppI-Annex1
	- OHL/Traction Power Supply System Interfaces Test	AppI-Annex2
	- ATC Interfaces Test	AppI-Annex3
	- Communication Interfaces Test	AppI-Annex4
	- PSD Interfaces Test	AppI-Annex5
	- Depot Interfaces Test	AppI-Annex6
	- Electric Car Interfaces Test	AppI-Annex7
	- Dynamic Route Map Interfaces Test	AppI-Annex9
	2. Specific (Type) Interface Tests	
	- OHL/traction power supply system interfaces	AppC-5.2.4
	- ATC interfaces	AppC-5.2.5
	- Depot interfaces	AppC-5.2.6, AppI-Annex6
Test Run in Urban Line	1. Undergo Test Run one by one in Urban Lines to verify the reliability requirements between the train and Urban Lines system are met.	AppC-5.4.3, PS 25.3.4, PS25.7.4, PS 10.6.1.(b)

APPENDIX D

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APPENDIX E

SCHEDULE OF DELIVERY

August 2015

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APPENDIX E SCHEDULE OF DELIVERY

1.1 Delivery Dates for the 78 trains under the Base Contract

Train Number	Completion of delivery to Siu Ho Wan Depot (Week/Year)	Train Number	Completion of delivery to Siu Ho Wan Depot (Week/Year)
1	02/18	23	31/19
2	15/18	24	31/19
3	26/18	25	34/19
4	26/18	26	34/19
5	32/18	27	37/19
6	32/18	28	37/19
7	38/18	29	43/19
8	38/18	30	43/19
9	44/18	31	47/19
10	44/18	32	47/19
11	51/18	33	51/19
12	51/18	34	51/19
13	08/19	35	06/20
14	08/19	36	09/20
15	12/19	37	12/20
16	12/19	38	15/20
17	17/19	39	18/20
18	17/19	40	21/20
19	22/19	41	24/20
20	22/19	42	27/20
21	27/19	43	30/20
22	27/19	44	33/20

Train Number	Completion of delivery to Siu Ho Wan Depot (Week/Year)	Train Number	Completion of delivery to Siu Ho Wan Depot (Week/Year)
45	36/20	70	11/22
46	39/20	71	15/22
47	42/20	72	19/22
48	45/20	73	23/22
49	48/20	74	27/22
50	51/20	75	30/22
51	03/21	76	32/22
52	07/21	77	35/22
53	10/21	78	39/22
54	13/21		
55	16/21		
56	19/21		
57	22/21		
58	25/21		
59	28/21		
60	31/21		
61	34/21		
62	37/21		
63	40/21		
64	43/21		
65	46/21		
66	49/21		
67	52/21		
68	03/22		
69	07/22		

1.2 Delivery Dates for the additional 15 trains under Option 1A

Train Number	Completion of delivery to Siu Ho Wan Depot (Week/Year)	Train Number	Completion of delivery to Siu Ho Wan Depot (Week/Year)
79	46/22	87	20/23
80	49/22	88	23/23
81	01/23	89	26/23
82	05/23	90	29/23
83	08/23	91	32/23
84	11/23	92	36/23
85	14/23	93	39/23
86	17/23		

1.3 Delivery Dates for the additional 15 trains under Option 1B

Train Number	Completion of delivery to Siu Ho Wan Depot (Week/Year)	Train Number	Completion of delivery to Siu Ho Wan Depot (Week/Year)
79	49/28	87	25/34
80	04/29	88	32/34
81	11/29	89	39/34
82	18/29	90	18/35
83	25/29	91	25/35
84	32/29	92	32/35
85	39/29	93	39/35
86	18/34		

Note: The Delivery Dates for the trains may be advanced by up to four weeks subject to depot track availability and the Approval by the Engineer

APPENDIX F

ENGINEER'S PRELIMINARY PROGRAMME,

PROJECT CALENDAR,

SCHEDULE OF CRITICAL DATES AND

SCHEDULE OF KEYDATES

August 2015

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APPENDIX F ENGINEER'S PRELIMINARY PROGRAMME, PROJECT CALENDAR, SCHEDULE OF CRITICAL DATES AND SCHEDULE OF KEY DATES

1 Engineer's Preliminary Programme

2 Project Calendar

3 Schedule of Critical Dates

4 Schedule of Key Dates for Design Submissions

1 ENGINEER'S PRELIMINARY PROGRAMME

1.1 Ready for Passenger Service Dates for the 78 Trains under the Base Contract

Train Number	Ready for Passenger Service (Week/Year)	Train Number	Ready for Passenger Service (Week/Year)
1	39/18	23	45/19
2	39/18	24	46/19
3	43/18	25	47/19
4	46/18	26	48/19
5	49/18	27	50/19
6	52/18	28	52/19
7	03/19	29	06/20
8	06/19	30	09/20
9	09/19	31	12/20
10	12/19	32	15/20
11	16/19	33	18/20
12	19/19	34	21/20
13	25/19	35	24/20
14	27/19	36	27/20
15	29/19	37	30/20
16	32/19	38	33/20
17	34/19	39	36/20
18	36/19	40	39/20
19	39/19	41	42/20
20	42/19	42	45/20
21	43/19	43	48/20
22	44/19	44	51/20

Train Number	Ready for Passenger Service (Week/Year)	Train Number	Ready for Passenger Service (Week/Year)
45	03/21	70	28/22
46	07/21	71	31/22
47	10/21	72	34/22
48	13/21	73	37/22
49	16/21	74	40/22
50	19/21	75	43/22
51	22/21	76	45/22
52	25/21	77	48/22
53	28/21	78	52/22
54	31/21		
55	34/21		
56	37/21		
57	40/21		
58	43/21		
59	46/21		
60	49/21		
61	52/21		
62	03/22		
63	07/22		
64	10/22		
65	13/22		
66	16/22		
67	19/22		
68	22/22		
69	25/22		

1.2 Ready for Passenger Service Dates for the additional 15 trains under Option 1A

Train Number	Ready for Passenger Service (Week/Year)	Train Number	Ready for Passenger Service (Week/Year)
79	07/23	87	33/23
80	10/23	88	36/23
81	15/23	89	39/23
82	18/23	90	43/23
83	21/23	91	46/23
84	24/23	92	49/23
85	27/23	93	52/23
86	30/23		

1.3 Ready for Passenger Service Dates for the additional 15 trains under Option 1B

Train Number	Ready for Passenger Service (Week/Year)	Train Number	Ready for Passenger Service (Week/Year)
79	10/29	87	38/34
80	17/29	88	45/34
81	24/29	89	52/34
82	31/29	90	31/35
83	38/29	91	38/35
84	45/29	92	45/35
85	52/29	93	52/35
86	31/34		

2 PROJECT CALENDAR

2015

	JANUARY					FEBRUARY					MARCH					
Week No.	1	2	3	4	5	5	6	7	8	9	9	10	11	12	13	14
Monday		5	12	19	26		2	9	16	23		2	9	16	23	30
Tuesday		6	13	20	27		3	10	17	24		3	10	17	24	31
Wednesday		7	14	21	28		4	11	18	25		4	11	18	25	
Thursday	1	8	15	22	29		5	12	19	26		5	12	19	26	
Friday	2	9	16	23	30		6	13	20	27		6	13	20	27	
Saturday	3	10	17	24	31		7	14	21	28		7	14	21	28	
Sunday	4	11	18	25		1	8	15	22		1	8	15	22	29	

	APRIL					MAY					JUNE					
Week No.	14	15	16	17	18	18	19	20	21	22	23	24	25	26	27	
Monday		6	13	20	27		4	11	18	25	1	8	15	22	29	
Tuesday		7	14	21	28		5	12	19	26	2	9	16	23	30	
Wednesday	1	8	15	22	29		6	13	20	27	3	10	17	24		
Thursday	2	9	16	23	30		7	14	21	28	4	11	18	25		
Friday	3	10	17	24		1	8	15	22	29	5	12	19	26		
Saturday	4	11	18	25		2	9	16	23	30	6	13	20	27		
Sunday	5	12	19	26		3	10	17	24	31	7	14	21	28		

	JULY					AUGUST						SEPTEMBER				
Week No.	27	28	29	30	31	31	32	33	34	35	36	36	37	38	39	40
Monday		6	13	20	27		3	10	17	24	31		7	14	21	28
Tuesday		7	14	21	28		4	11	18	25		1	8	15	22	29
Wednesday	1	8	15	22	29		5	12	19	26		2	9	16	23	30
Thursday	2	9	16	23	30		6	13	20	27		3	10	17	24	
Friday	3	10	17	24	31		7	14	21	28		4	11	18	25	
Saturday	4	11	18	25		1	8	15	22	29		5	12	19	26	
Sunday	5	12	19	26		2	9	16	23	30		6	13	20	27	

	OCTOBER					NOVEMBER						DECEMBER				
Week No.	40	41	42	43	44	44	45	46	47	48	49	49	50	51	52	53
Monday		5	12	19	26		2	9	16	23	30		7	14	21	28
Tuesday		6	13	20	27		3	10	17	24		1	8	15	22	29
Wednesday		7	14	21	28		4	11	18	25		2	9	16	23	30
Thursday	1	8	15	22	29		5	12	19	26		3	10	17	24	31
Friday	2	9	16	23	30		6	13	20	27		4	11	18	25	
Saturday	3	10	17	24	31		7	14	21	28		5	12	19	26	
Sunday	4	11	18	25		1	8	15	22	29		6	13	20	27	

2016

	JANUARY					FEBRUARY					MARCH				
Week No.	53/15	1	2	3	4	5	6	7	8	9	9	10	11	12	13
Monday		4	11	18	25	1	8	15	22	29		7	14	21	28
Tuesday		5	12	19	26	2	9	16	23		1	8	15	22	29
Wednesday		6	13	20	27	3	10	17	24		2	9	16	23	30
Thursday		7	14	21	28	4	11	18	25		3	10	17	24	31
Friday	1	8	15	22	29	5	12	19	26		4	11	18	25	
Saturday	2	9	16	23	30	6	13	20	27		5	12	19	26	
Sunday	3	10	17	24	31	7	14	21	28		6	13	20	27	

	APRIL					MAY						JUNE				
Week No.	13	14	15	16	17	17	18	19	20	21	22	22	23	24	25	26
Monday		4	11	18	25		2	9	16	23	30		6	13	20	27
Tuesday		5	12	19	26		3	10	17	24	31		7	14	21	28
Wednesday		6	13	20	27		4	11	18	25		1	8	15	22	29
Thursday		7	14	21	28		5	12	19	26		2	9	16	23	30
Friday	1	8	15	22	29		6	13	20	27		3	10	17	24	
Saturday	2	9	16	23	30		7	14	21	28		4	11	18	25	
Sunday	3	10	17	24		1	8	15	22	29		5	12	19	26	

	JULY					AUGUST					SEPTEMBER				
Week No.	26	27	28	29	30	31	32	33	34	35	35	36	37	38	39
Monday		4	11	18	25	1	8	15	22	29		5	12	19	26
Tuesday		5	12	19	26	2	9	16	23	30		6	13	20	27
Wednesday		6	13	20	27	3	10	17	24	31		7	14	21	28
Thursday		7	14	21	28	4	11	18	25		1	8	15	22	29
Friday	1	8	15	22	29	5	12	19	26		2	9	16	23	30
Saturday	2	9	16	23	30	6	13	20	27		3	10	17	24	
Sunday	3	10	17	24	31	7	14	21	28		4	11	18	25	

	OCTOBER						NOVEMBER					DECEMBER				
Week No.	39	40	41	42	43	44	44	45	46	47	48	48	49	50	51	52
Monday		3	10	17	24	31		7	14	21	28		5	12	19	26
Tuesday		4	11	18	25		1	8	15	22	29		6	13	20	27
Wednesday		5	12	19	26		2	9	16	23	30		7	14	21	28
Thursday		6	13	20	27		3	10	17	24		1	8	15	22	29
Friday		7	14	21	28		4	11	18	25		2	9	16	23	30
Saturday	1	8	15	22	29		5	12	19	26		3	10	17	24	31
Sunday	2	9	16	23	30		6	13	20	27		4	11	18	25	

2017

	JANUARY						FEBRUARY					MARCH				
Week No.	52/16	1	2	3	4	5	5	6	7	8	9	9	10	11	12	13
Monday		2	9	16	23	30		6	13	20	27		6	13	20	27
Tuesday		3	10	17	24	31		7	14	21	28		7	14	21	28
Wednesday		4	11	18	25		1	8	15	22		1	8	15	22	29
Thursday		5	12	19	26		2	9	16	23		2	9	16	23	30
Friday		6	13	20	27		3	10	17	24		3	10	17	24	31
Saturday		7	14	21	28		4	11	18	25		4	11	18	25	
Sunday	1	8	15	22	29		5	12	19	26		5	12	19	26	

	APRIL					MAY					JUNE				
Week No.	13	14	15	16	17	18	19	20	21	22	22	23	24	25	26
Monday		3	10	17	24	1	8	15	22	29		5	12	19	26
Tuesday		4	11	18	25	2	9	16	23	30		6	13	20	27
Wednesday		5	12	19	26	3	10	17	24	31		7	14	21	28
Thursday		6	13	20	27	4	11	18	25		1	8	15	22	29
Friday		7	14	21	28	5	12	19	26		2	9	16	23	30
Saturday	1	8	15	22	29	6	13	20	27		3	10	17	24	
Sunday	2	9	16	23	30	7	14	21	28		4	11	18	25	

	JULY						AUGUST					SEPTEMBER				
Week No.	26	27	28	29	30	31	31	32	33	34	35	35	36	37	38	39
Monday		3	10	17	24	31		7	14	21	28		4	11	18	25
Tuesday		4	11	18	25		1	8	15	22	29		5	12	19	26
Wednesday		5	12	19	26		2	9	16	23	30		6	13	20	27
Thursday		6	13	20	27		3	10	17	24	31		7	14	21	28
Friday		7	14	21	28		4	11	18	25		1	8	15	22	29
Saturday	1	8	15	22	29		5	12	19	26		2	9	16	23	30
Sunday	2	9	16	23	30		6	13	20	27		3	10	17	24	

	OCTOBER						NOVEMBER					DECEMBER				
Week No.	39	40	41	42	43	44	44	45	46	47	48	48	49	50	51	52
Monday		2	9	16	23	30		6	13	20	27		4	11	18	25
Tuesday		3	10	17	24	31		7	14	21	28		5	12	19	26
Wednesday		4	11	18	25		1	8	15	22	29		6	13	20	27
Thursday		5	12	19	26		2	9	16	23	30		7	14	21	28
Friday		6	13	20	27		3	10	17	24		1	8	15	22	29
Saturday		7	14	21	28		4	11	18	25		2	9	16	23	30
Sunday	1	8	15	22	29		5	12	19	26		3	10	17	24	31

2018

	JANUARY					FEBRUARY					MARCH				
Week No.		1	2	3	4	5	6	7	8	9		10	11	12	13
Monday		1	8	15	22	29	5	12	19	26		5	12	19	26
Tuesday		2	9	16	23	30	6	13	20	27		6	13	20	27
Wednesday		3	10	17	24	31	7	14	21	28		7	14	21	28
Thursday		4	11	18	25		1 8	15	22		1	8	15	22	29
Friday		5	12	19	26		2 9	16	23		2	9	16	23	30
Saturday		6	13	20	27		3 10	17	24		3	10	17	24	31
Sunday		7	14	21	28		4 11	18	25		4	11	18	25	

	APRIL						MAY					JUNE				
Week No.	13	14	15	16	17	18	18	19	20	21	22		22	23	24	25	26
Monday		2	9	16	23	30		7	14	21	28			4	11	18	25
Tuesday		3	10	17	24		1	8	15	22	29			5	12	19	26
Wednesday		4	11	18	25		2	9	16	23	30			6	13	20	27
Thursday		5	12	19	26		3	10	17	24	31			7	14	21	28
Friday		6	13	20	27		4	11	18	25			1	8	15	22	29
Saturday		7	14	21	28		5	12	19	26			2	9	16	23	30
Sunday	1	8	15	22	29		6	13	20	27			3	10	17	24	

	JULY						AUGUST					SEPTEMBER					
Week No.	26	27	28	29	30	31	31	32	33	34	35		35	36	37	38	39
Monday		2	9	16	23	30		6	13	20	27			3	10	17	24
Tuesday		3	10	17	24	31		7	14	21	28			4	11	18	25
Wednesday		4	11	18	25		1	8	15	22	29			5	12	19	26
Thursday		5	12	19	26		2	9	16	23	30			6	13	20	27
Friday		6	13	20	27		3	10	17	24	31			7	14	21	28
Saturday		7	14	21	28		4	11	18	25			1	8	15	22	29
Sunday	1	8	15	22	29		5	12	19	26			2	9	16	23	30

	OCTOBER						NOVEMBER					DECEMBER					
Week No.		40	41	42	43	44	44	45	46	47	48	48	49	50	51	52	01/19
Monday		1	8	15	22	29		5	12	19	26		3	10	17	24	31
Tuesday		2	9	16	23	30		6	13	20	27		4	11	18	25	
Wednesday		3	10	17	24	31		7	14	21	28		5	12	19	26	
Thursday		4	11	18	25		1	8	15	22	29		6	13	20	27	
Friday		5	12	19	26		2	9	16	23	30		7	14	21	28	
Saturday		6	13	20	27		3	10	17	24		1	8	15	22	29	
Sunday		7	14	21	28		4	11	18	25		2	9	16	23	30	

2019

	JANUARY					FEBRUARY					MARCH					
Week No.	1	2	3	4	5	5	6	7	8	9	9	10	11	12	13	
Monday		7	14	21	28		4	11	18	25		4	11	18	25	
Tuesday	1	8	15	22	29		5	12	19	26		5	12	19	26	
Wednesday	2	9	16	23	30		6	13	20	27		6	13	20	27	
Thursday	3	10	17	24	31		7	14	21	28		7	14	21	28	
Friday	4	11	18	25		1	8	15	22		1	8	15	22	29	
Saturday	5	12	19	26		2	9	16	23		2	9	16	23	30	
Sunday	6	13	20	27		3	10	17	24		3	10	17	24	31	

	APRIL					MAY					JUNE					
Week No.	14	15	16	17	18	18	19	20	21	22	22	23	24	25	26	
Monday	1	8	15	22	29		6	13	20	27		3	10	17	24	
Tuesday	2	9	16	23	30		7	14	21	28		4	11	18	25	
Wednesday	3	10	17	24		1	8	15	22	29		5	12	19	26	
Thursday	4	11	18	25		2	9	16	23	30		6	13	20	27	
Friday	5	12	19	26		3	10	17	24	31		7	14	21	28	
Saturday	6	13	20	27		4	11	18	25		1	8	15	22	29	
Sunday	7	14	21	28		5	12	19	26		2	9	16	23	30	

	JULY					AUGUST					SEPTEMBER					
Week No.	27	28	29	30	31	31	32	33	34	35	35	36	37	38	39	40
Monday	1	8	15	22	29		5	12	19	26		2	9	16	23	30
Tuesday	2	9	16	23	30		6	13	20	27		3	10	17	24	
Wednesday	3	10	17	24	31		7	14	21	28		4	11	18	25	
Thursday	4	11	18	25		1	8	15	22	29		5	12	19	26	
Friday	5	12	19	26		2	9	16	23	30		6	13	20	27	
Saturday	6	13	20	27		3	10	17	24	31		7	14	21	28	
Sunday	7	14	21	28		4	11	18	25		1	8	15	22	29	

	OCTOBER					NOVEMBER					DECEMBER					
Week No.	40	41	42	43	44	44	45	46	47	48	48	49	50	51	52	01/20
Monday		7	14	21	28		4	11	18	25		2	9	16	23	30
Tuesday	1	8	15	22	29		5	12	19	26		3	10	17	24	31
Wednesday	2	9	16	23	30		6	13	20	27		4	11	18	25	
Thursday	3	10	17	24	31		7	14	21	28		5	12	19	26	
Friday	4	11	18	25		1	8	15	22	29		6	13	20	27	
Saturday	5	12	19	26		2	9	16	23	30		7	14	21	28	
Sunday	6	13	20	27		3	10	17	24		1	8	15	22	29	

2020

	JANUARY					FEBRUARY					MARCH					
Week No.	1	2	3	4	5	5	6	7	8	9	9	10	11	12	13	14
Monday		6	13	20	27		3	10	17	24		2	9	16	23	30
Tuesday		7	14	21	28		4	11	18	25		3	10	17	24	31
Wednesday	1	8	15	22	29		5	12	19	26		4	11	18	25	
Thursday	2	9	16	23	30		6	13	20	27		5	12	19	26	
Friday	3	10	17	24	31		7	14	21	28		6	13	20	27	
Saturday	4	11	18	25		1	8	15	22	29		7	14	21	28	
Sunday	5	12	19	26		2	9	16	23		1	8	15	22	29	

	APRIL					MAY					JUNE					
Week No.	14	15	16	17	18	18	19	20	21	22	23	24	25	26	27	
Monday		6	13	20	27		4	11	18	25		1	8	15	22	29
Tuesday		7	14	21	28		5	12	19	26		2	9	16	23	30
Wednesday	1	8	15	22	29		6	13	20	27		3	10	17	24	
Thursday	2	9	16	23	30		7	14	21	28		4	11	18	25	
Friday	3	10	17	24		1	8	15	22	29		5	12	19	26	
Saturday	4	11	18	25		2	9	16	23	30		6	13	20	27	
Sunday	5	12	19	26		3	10	17	24	31		7	14	21	28	

	JULY					AUGUST						SEPTEMBER					
Week No.	27	28	29	30	31	31	32	33	34	35	36	36	37	38	39	40	
Monday		6	13	20	27		3	10	17	24	31			7	14	21	28
Tuesday		7	14	21	28		4	11	18	25			1	8	15	22	29
Wednesday	1	8	15	22	29		5	12	19	26			2	9	16	23	30
Thursday	2	9	16	23	30		6	13	20	27			3	10	17	24	
Friday	3	10	17	24	31		7	14	21	28			4	11	18	25	
Saturday	4	11	18	25		1	8	15	22	29			5	12	19	26	
Sunday	5	12	19	26		2	9	16	23	30			6	13	20	27	

	OCTOBER					NOVEMBER						DECEMBER					
Week No.	40	41	42	43	44	44	45	46	47	48	49	49	50	51	52	53	
Monday		5	12	19	26		2	9	16	23	30			7	14	21	28
Tuesday		6	13	20	27		3	10	17	24			1	8	15	22	29
Wednesday		7	14	21	28		4	11	18	25			2	9	16	23	30
Thursday	1	8	15	22	29		5	12	19	26			3	10	17	24	31
Friday	2	9	16	23	30		6	13	20	27			4	11	18	25	
Saturday	3	10	17	24	31		7	14	21	28			5	12	19	26	
Sunday	4	11	18	25		1	8	15	22	29			6	13	20	27	

2021

	JANUARY					FEBRUARY					MARCH				
Week No.	53/20	1	2	3	4	5	6	7	8		9	10	11	12	13
Monday		4	11	18	25	1	8	15	22		1	8	15	22	29
Tuesday		5	12	19	26	2	9	16	23		2	9	16	23	30
Wednesday		6	13	20	27	3	10	17	24		3	10	17	24	31
Thursday		7	14	21	28	4	11	18	25		4	11	18	25	
Friday	1	8	15	22	29	5	12	19	26		5	12	19	26	
Saturday	2	9	16	23	30	6	13	20	27		6	13	20	27	
Sunday	3	10	17	24	31	7	14	21	28		7	14	21	28	

	APRIL					MAY						JUNE				
Week No.	13	14	15	16	17	17	18	19	20	21	22	22	23	24	25	26
Monday		5	12	19	26		3	10	17	24	31		7	14	21	28
Tuesday		6	13	20	27		4	11	18	25		1	8	15	22	29
Wednesday		7	14	21	28		5	12	19	26		2	9	16	23	30
Thursday	1	8	15	22	29		6	13	20	27		3	10	17	24	
Friday	2	9	16	23	30		7	14	21	28		4	11	18	25	
Saturday	3	10	17	24		1	8	15	22	29		5	12	19	26	
Sunday	4	11	18	25		2	9	16	23	30		6	13	20	27	

	JULY					AUGUST						SEPTEMBER				
Week No.	26	27	28	29	30	30	31	32	33	34	35	35	36	37	38	39
Monday		5	12	19	26		2	9	16	23	30		6	13	20	27
Tuesday		6	13	20	27		3	10	17	24	31		7	14	21	28
Wednesday		7	14	21	28		4	11	18	25		1	8	15	22	29
Thursday	1	8	15	22	29		5	12	19	26		2	9	16	23	30
Friday	2	9	16	23	30		6	13	20	27		3	10	17	24	
Saturday	3	10	17	24	31		7	14	21	28		4	11	18	25	
Sunday	4	11	18	25		1	8	15	22	29		5	12	19	26	

	OCTOBER					NOVEMBER						DECEMBER				
Week No.	39	40	41	42	43	44	45	46	47	48		48	49	50	51	52
Monday		4	11	18	25	1	8	15	22	29			6	13	20	27
Tuesday		5	12	19	26	2	9	16	23	30			7	14	21	28
Wednesday		6	13	20	27	3	10	17	24			1	8	15	22	29
Thursday		7	14	21	28	4	11	18	25			2	9	16	23	30
Friday	1	8	15	22	29	5	12	19	26			3	10	17	24	31
Saturday	2	9	16	23	30	6	13	20	27			4	11	18	25	
Sunday	3	10	17	24	31	7	14	21	28			5	12	19	26	

2022

	JANUARY						FEBRUARY						MARCH					
Week No.	52/21	1	2	3	4	5	5	6	7	8	9		9	10	11	12	13	
Monday		3	10	17	24	31			7	14	21	28		7	14	21	28	
Tuesday		4	11	18	25			1	8	15	22		1	8	15	22	29	
Wednesday		5	12	19	26			2	9	16	23		2	9	16	23	30	
Thursday		6	13	20	27			3	10	17	24		3	10	17	24	31	
Friday		7	14	21	28			4	11	18	25		4	11	18	25		
Saturday	1	8	15	22	29			5	12	19	26		5	12	19	26		
Sunday	2	9	16	23	30			6	13	20	27		6	13	20	27		

	APRIL						MAY						JUNE					
Week No.		13	14	15	16	17	17	18	19	20	21	22	22	23	24	25	26	
Monday			4	11	18	25		2	9	16	23	30		6	13	20	27	
Tuesday			5	12	19	26		3	10	17	24	31		7	14	21	28	
Wednesday			6	13	20	27		4	11	18	25		1	8	15	22	29	
Thursday			7	14	21	28		5	12	19	26		2	9	16	23	30	
Friday		1	8	15	22	29		6	13	20	27		3	10	17	24		
Saturday		2	9	16	23	30		7	14	21	28		4	11	18	25		
Sunday		3	10	17	24		1	8	15	22	29		5	12	19	26		

	JULY						AUGUST						SEPTEMBER					
Week No.		26	27	28	29	30		31	32	33	34	35	35	36	37	38	39	
Monday			4	11	18	25		1	8	15	22	29		5	12	19	26	
Tuesday			5	12	19	26		2	9	16	23	30		6	13	20	27	
Wednesday			6	13	20	27		3	10	17	24	31		7	14	21	28	
Thursday			7	14	21	28		4	11	18	25		1	8	15	22	29	
Friday		1	8	15	22	29		5	12	19	26		2	9	16	23	30	
Saturday		2	9	16	23	30		6	13	20	27		3	10	17	24		
Sunday		3	10	17	24	31		7	14	21	28		4	11	18	25		

	OCTOBER						NOVEMBER						DECEMBER					
Week No.	39	40	41	42	43	44	44	45	46	47	48		48	49	50	51	52	
Monday		3	10	17	24	31			7	14	21	28		5	12	19	26	
Tuesday		4	11	18	25			1	8	15	22	29		6	13	20	27	
Wednesday		5	12	19	26			2	9	16	23	30		7	14	21	28	
Thursday		6	13	20	27			3	10	17	24		1	8	15	22	29	
Friday		7	14	21	28			4	11	18	25		2	9	16	23	30	
Saturday	1	8	15	22	29			5	12	19	26		3	10	17	24	31	
Sunday	2	9	16	23	30			6	13	20	27		4	11	18	25		

2023

	JANUARY						FEBRUARY					MARCH				
Week No.	52/22	1	2	3	4	5	5	6	7	8	9	9	10	11	12	13
Monday		2	9	16	23	30		6	13	20	27		6	13	20	27
Tuesday		3	10	17	24	31		7	14	21	28		7	14	21	28
Wednesday		4	11	18	25		1	8	15	22		1	8	15	22	29
Thursday		5	12	19	26		2	9	16	23		2	9	16	23	30
Friday		6	13	20	27		3	10	17	24		3	10	17	24	31
Saturday		7	14	21	28		4	11	18	25		4	11	18	25	
Sunday	1	8	15	22	29		5	12	19	26		5	12	19	26	

	APRIL						MAY					JUNE				
Week No.		13	14	15	16	17	18	19	20	21	22	22	23	24	25	26
Monday			3	10	17	24	1	8	15	22	29		5	12	19	26
Tuesday			4	11	18	25	2	9	16	23	30		6	13	20	27
Wednesday			5	12	19	26	3	10	17	24	31		7	14	21	28
Thursday			6	13	20	27	4	11	18	25		1	8	15	22	29
Friday			7	14	21	28	5	12	19	26		2	9	16	23	30
Saturday		1	8	15	22	29	6	13	20	27		3	10	17	24	
Sunday		2	9	16	23	30	7	14	21	28		4	11	18	25	

	JULY						AUGUST					SEPTEMBER				
Week No.	26	27	28	29	30	31	31	32	33	34	35	35	36	37	38	39
Monday		3	10	17	24	31		7	14	21	28		4	11	18	25
Tuesday		4	11	18	25		1	8	15	22	29		5	12	19	26
Wednesday		5	12	19	26		2	9	16	23	30		6	13	20	27
Thursday		6	13	20	27		3	10	17	24	31		7	14	21	28
Friday		7	14	21	28		4	11	18	25		1	8	15	22	29
Saturday	1	8	15	22	29		5	12	19	26		2	9	16	23	30
Sunday	2	9	16	23	30		6	13	20	27		3	10	17	24	

	OCTOBER						NOVEMBER					DECEMBER				
Week No.	39	40	41	42	43	44	44	45	46	47	48	48	49	50	51	52
Monday		2	9	16	23	30		6	13	20	27		4	11	18	25
Tuesday		3	10	17	24	31		7	14	21	28		5	12	19	26
Wednesday		4	11	18	25		1	8	15	22	29		6	13	20	27
Thursday		5	12	19	26		2	9	16	23	30		7	14	21	28
Friday		6	13	20	27		3	10	17	24		1	8	15	22	29
Saturday		7	14	21	28		4	11	18	25		2	9	16	23	30
Sunday	1	8	15	22	29		5	12	19	26		3	10	17	24	31

3 SCHEDULE OF CRITICAL DATES

3.1 Date for Commencement

The Date for Commencement of the Works shall be 17 July 2015.

3.2 Completion Obligations for Whole of the Works

The Completion Obligations for the whole of the Works shall be subject to Liquidated Damages as specified in the Appendix to the Form of Tender.

3.2.1 Base Contract: In the event no Option is exercised, the Completion Obligations for the whole of the Works is as follows:

Completion Obligations	Completion Date (Week/Year)
Whole of the Works (Completion of Tests on Completion and ready for Passenger Service for 78 Trains)	52/22

3.2.2 Option 1A: In the event that Option 1A is exercised, the Completion Obligations for the whole of the Works is as follows:

Completion Obligations	Completion Date (Week/Year)
Whole of the Works (Completion of Tests on Completion and ready for Passenger Service for 93 Trains)	52/23

3.2.3 Option 1B: In the event that Option 1B is exercised, the works under the option will be executed under a separate contract. The Completion Obligations for the whole of the Works for the 78 trains and the additional 15 trains (under separate contract) are as follows:

Completion Obligations	Completion Date (Week/Year)
Whole of the Works (Completion of Tests on Completion and ready for Passenger Service for 78 Trains)	52/22
Whole of the Works (Completion of Tests on Completion and ready for Passenger Service for 15 Trains)	52/35

3.3 Completion Obligations for Sections of the Works

The Completion Obligations for the Section 1 of the Works shall be subject to General Damages. The Completion Obligation for remaining Sections of the Works shall be subject to Liquidated Damages as specified in the Appendix to the Form of Tender

3.3.1 Base Contract: In the event no Option is exercised, the Completion Obligations for the Sections of the Works is as follows:

Sections of the Works	Completion Obligations	Completion Date (Week/Year)
1	Completion of Reliability Proving Test at Contractor's Test Facility	52/17
2	Completion of Delivery to Siu Ho Wan Depot for the 1st train	02/18
3	Completion of Delivery to Siu Ho Wan Depot for the 2nd train	15/18
4	Completion of Tests on Completion and ready for Passenger Service for the 1st and 2nd train	39/18
5	Completion of Delivery to Siu Ho Wan Depot for 28 trains (cumulative)	37/19

6	Completion of Tests on Completion and ready for Passenger Service for 28 trains (cumulative)	52/19
7	Completion of Delivery to Siu Ho Wan Depot for 44 trains (cumulative)	33/20
8	Completion of Tests on Completion and ready for Passenger Service for 44 trains (cumulative)	51/20
9	Completion of Delivery to Siu Ho Wan Depot for 61 trains (cumulative)	34/21
10	Completion of Tests on Completion and ready for Passenger Service for 61 trains (cumulative)	52/21
11	Completion of Delivery to Siu Ho Wan Depot for 78 trains (cumulative)	39/22

3.3.2 Option 1A: In the event that Option 1A is exercised, the Completion Obligations for the Sections of the Works is as follows:

Sections of the Works	Completion Obligations	Completion Date (Week/Year)
1	Completion of Reliability Proving Test at Contractor's Test Facility	52/17
2	Completion of Delivery to Siu Ho Wan Depot for the 1st train	02/18
3	Completion of Delivery to Siu Ho Wan Depot for the 2nd train	15/18
4	Completion of Tests on Completion and ready for Passenger Service for the 1st and 2nd train	39/18
5	Completion of Delivery to Siu Ho Wan Depot for 28 trains (cumulative)	37/19
6	Completion of Tests on Completion and ready for Passenger Service for 28 trains (cumulative)	52/19

7	Completion of Delivery to Siu Ho Wan Depot for 44 trains (cumulative)	33/20
8	Completion of Tests on Completion and ready for Passenger Service for 44 trains (cumulative)	51/20
9	Completion of Delivery to Siu Ho Wan Depot for 61 trains (cumulative)	34/21
10	Completion of Tests on Completion and ready for Passenger Service for 61 trains (cumulative)	52/21
11	Completion of Delivery to Siu Ho Wan Depot for 78 trains (cumulative)	39/22
12	Completion of Tests on Completion and ready for Passenger Service for 78 trains (cumulative)	52/22
13	Completion of Delivery to Siu Ho Wan Depot for 93 trains (cumulative)	39/23

3.3.3 Option 1B: In the event that Option 1B is exercised, the Works under the Option will be executed under a separate contract. The Completion Obligations for the Sections of the Works for the 78 trains and the additional 15 trains (under separate contract) are as follows:

Sections of the Works	Completion Obligations (78 Trains)	Completion Date (Week/Year)
1	Completion of Reliability Proving Test at Contractor's Test Facility	52/17
2	Completion of Delivery to Siu Ho Wan Depot for the 1st train	02/18
3	Completion of Delivery to Siu Ho Wan Depot for the 2nd train	15/18
4	Completion of Tests on Completion and ready for Passenger Service for the 1st and 2nd train	39/18
5	Completion of Delivery to Siu Ho Wan Depot for 28 trains (cumulative)	37/19

6	Completion of Tests on Completion and ready for Passenger Service for 28 trains (cumulative)	52/19
7	Completion of Delivery to Siu Ho Wan Depot for 44 trains (cumulative)	33/20
8	Completion of Tests on Completion and ready for Passenger Service for 44 trains (cumulative)	51/20
9	Completion of Delivery to Siu Ho Wan Depot for 61 trains (cumulative)	34/21
10	Completion of Tests on Completion and ready for Passenger Service for 61 trains (cumulative)	52/21
11	Completion of Delivery to Siu Ho Wan Depot for 78 trains (cumulative)	39/22

Sections of the Works	Completion Obligations (Additional 15 Trains)	Completion Date (Week/Year)
1	Completion of Delivery to Siu Ho Wan Depot for 7 trains (cumulative)	39/29
2	Completion of Tests on Completion and ready for Passenger Service for 7 trains (cumulative)	52/29
3	Completion of Delivery to Siu Ho Wan Depot for 11 trains (cumulative)	39/34
4	Completion of Tests on Completion and ready for Passenger Service for 11 trains (cumulative)	52/34
5	Completion of Delivery to Siu Ho Wan Depot for 15 trains (cumulative)	39/35

3.4 Specified Parts of the Works definition in each train

3.4.1 The Completion of Tests on Completion and ready for passenger service for each train is a specified part of the Works.

4 SCHEDULE OF KEY DATES FOR DESIGN SUBMISSIONS

Key Date Number	Activity	Week (Not later than)
KD1	* Approval in Principle (AIP) of major sub-contractors and equipment suppliers	35/15
KD2	* Approval of SEMP Stage 1 * Orders placed for major equipment * Approval of ***specified plans***	52/15
KD3	* Approval in Principle (AIP) of the full-scale foamcore cab mock-up * Approval of Design, Manufacturing & Commissioning Programme and Design Submission Plan	06/16
KD4	* Approval of detailed Manufacturing and Delivery Programme * Approval of material control schedule	09/16
KD5	* Approval of SEMP Stage 2 * Engineer's confirmation of effective operation of programme management system * Engineer's confirmation of effective operation of ***specified plans***	22/16
KD6	* Car shell and sub-assembly tooling complete	26/16
KD7	* Approval in Principle (AIP) of full-scale engineering cab / saloon mock-up	30/16
KD8	* Approval of preliminary test plan * Approval in Principle (AIP) of underframe mock-up and layout * Approval of design for sub-assembly of underframe, roof and bodyside	39/16
KD9	* Complete sub-assembly of car bodyshell and available for test * Delivery of traction equipment including all underframe equipment and motors to Contractor’s works for first train	05/17
KD10	* Approval of structural test report on car body	12/17

Key Date Number	Activity	Week (Not later than)
KD11	* Complete assembly of first manufactured train for testing at Contractor's test track including all systems and sub-systems	21/17
KD12	* Approval of SEMP Stage 3 * Approval of training plan * Commencement of O&M Manual Programme	25/17
KD13	* Approval of combined test	43/17
KD14	* Availability of first train for shipment * Completion of training for test crew, training instructors and train operators	48/17
KD15	* Approval of SEMP Stage 4 * Delivery of critical running, maintenance and commissioning / warranty spares	08/18
KD16	* Completion of technical training * Delivery of critical special tools and testing equipment * Approval of batch 2 printed O&M Manuals * Completion of defect recovery training	25/18
KD17	* Approval of SEMP Stage 5 * Approval of As Built Drawings and O&M Manuals	52/18

Note: Specified plans are defined as Safety Plan, Quality Plan and Environmental Management Plan

APPENDIX G

SITE LAYOUT AND WORKS AREAS

August 2015

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APPENDIX G SITE LAYOUT AND WORKS AREAS

1 Siu Ho Wan Depot (SHD)

1.1 The work site within the SHD as described in PS 30 is as outlined in the Drg. No. 520/Z/00/PWY/C30/362 for your reference. The layout of the SHD may be subjected to some minor changes.

1.2 The following areas outlined in the Drg. No. 520/Z/00/PWY/C30/362 are to be made available for use by the Contractor subject to the conditions stated in PS 30 and to the agreement with the Engineer:

(a) Vertical seawall

(b) Light maintenance track

(c) Stabling track

(d) Depot test track

1.3 Vertical Seawall Facility

(a) The vertical seawall facility is located to the north west of the SHD. This facility is 80 m long and provides direct access to the Seawall Maintenance Access Road and the Main Depot Entry Road.

(b) There is no lifting facility on the seawall and that all lifting from sea transport will be with mobile crane to be provided by the Contractor.

(c) The area adjacent to this facility has no overhead wire. The car will be unloaded directly onto the rail track adjacent to the seawall.

1.4 Site Office and Storage Space

(a) A space for accommodating three 20-fleet containers as site office; and

(b) A space of approximately 210 m^2 as storage area.

2 Urban Lines (URL) Depots

2.1 The work sites within the Urban Lines Depots (CWD, KBD, TKD and TWD) as described in PS 30 are as outlined in the Drg. Nos. OD2/206/40422/0003, C6014-14E/TSEG/990/016, USP/M/TKD3/XXX/A00/XXX and USP/TWD1/A12/001 respectively.

2.2 The area in each depot for the Contractor subject to agreement with the Engineer.

2.3 The tracks in each depot to be made available for the Contractor subject to the conditions stated in PS 30 and agreement with the Engineer:

(a) Heavy maintenance track

(b) Light maintenance track

(c) Stabling track

(d) Depot test track (SHD and KBD)

APPENDIX H

RULES AND PROCEDURES FOR WORKING WITHIN OR ADJACENT TO THE RAILWAY

August 2015

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APPENDIX H RULES AND PROCEDURES FOR WORKING WITHIN OR ADJACENT TO THE RAILWAY

1 Introduction

2 Competent Person

3 Application for Access to Mainline Test Run

4 Working Hours for Mainline Test Run

5 Working Requirements and Restrictions

Annex 1 : P-Licensing System - Caring and Coaching System for new Contractor workers

Annex 2 : Contractor Fitness for Duty Management

1 Introduction

1.1 The principal point for controlling all construction work within or adjacent to the railway is the Mass Transit Railway Corporation Ordinance CAP 270.

"23E (1) A person commits an offence if he wilfully does or omits to do anything in relation to the railway and the safety of any person travelling or being upon the railway is thereby endangered, or likely to be endangered.

(2) A person who commits an offence under subsection (1) is liable to a fine of $5000 and to imprisonment for 6 months."

1.2 The operation of the Railway is subject to independent review by:

(a) The Railway Development Office of the Highways Department

(b) The Safety and Security Co-ordinating Committee (SSCC)

(c) Railway Branch of Electrical and Mechanical Services Department (EMSD-RB)

Each has its own statutory authority.

1.3 To give effect to the Ordinance, the Engineer requires the Contractor to comply with the following:

(a) Advance notice of all intended works shall be given for Approval and modification as required.

(b) All works shall be carried out under supervisors trained in the appropriate discipline(s). A so-called P-Licencing System for caring and coaching of new workers on understanding the safety requirements is established, details refer to Annex 1 of this Appendix.

(c) Strict control shall be maintained on access to all areas where trains are in operation, including platforms.

(d) The shift-in-charge's authority for approving execution of works which affects normal depot operation, on a day to day basis, shall be complied with.

1.4 Legislation and Codes of Practice

The Contractor shall comply with all the current legislation, Codes of Practice and guidance document approved by the Hong Kong Government as specified in GS Section 17.

1.5 Specific procedures "for the safe operation of the Railway" which shall be observed by "contractors, sub-contractors and agents" are laid down in the following Employer's manuals:

(a) Railway Safety Rules for Contractor

(b) Accident, Incident and Emergency Procedures Manual

(c) Project Health and Safety Manual (refer to GS Section 15)

1.6 The Contractor shall comply with the safety and quality standards set out in the Contract, and in addition shall meet the specific safety standards of the Railway.

1.7 Instructions given to the Contractor which are intended to remove a safety hazard shall be complied with if the Contractor is not to commit an offence of the kind covered by section 23E of the Ordinance. Modifications to Approved operations may be necessary where emergencies develop on the Railway or an unforeseen hazard develops.

1.8 Approved Method Statements and contract requirements shall not be deviated from unless for the reasons cited above. Work will be stopped, if such is the case, by a verbal instruction given by the Engineer to the Contractor's person-in-charge, and subsequently confirmed in writing.

2 Competent Persons

2.1 The shift-in-charge at the Depot (refer to PS 30 for the work site arrangement) may issue a verbal instruction to the Contractor to stop work, to be confirmed subsequently in writing. The Contractor shall stop work on receipt of the order and contact the Engineer as soon as practicable, for further instruction from him

2.2 The Contractor shall provide sufficient staff to attend the Competent Person Training Courses organised by the Employer to enable him to have sufficient number of Competent Persons to cover all shifts, holidays and absenteeism.

2.3 Only Competent Person qualified by the Employer can supervise the work on or adjacent to the Railway.

2.4 All the Contractor's staff working within or adjacent to the Railway shall need to attend the Safety Induction Training Course organised by the Employer.

2.5 The regular two-day courses for Competent Persons take up to two months to organise. At the start of the Contract, courses specifically for the Contractors staff may be run at the Contractors request to provide the required number of Competent Persons.

2.6 The Contractor shall bear at his own cost to attend all the courses (e.g. CP(T), CP(NT), RSI, Fire Marshall etc.) provided by the Employer. Notwithstanding the requirement of GS Clause 15.2.4.3(d), the charges for all courses are shown in the below table.

Type of Training Course		Duration of the Course	Duration of Job Attachment	Validity of Qualification	Training Course Fee (HK$ per person per course)
Competent Person (Track)	CP(T)	2 days	4 nights	1 year	1,000
Competent Person (Non-Track)	CP(NT)	1.5 days	2 nights	1 year	800
Railway Safety Induction	RSI	1 day	N/A	1 year	500
Fire Marshall	FM	0.5 day	N/A	2 years	300

Refresher courses at the same rate shall be taken upon expiry of the qualification.

Notwithstanding the provision of GS Clause 15.2.4.3(e), the Contractor shall pay the training fee before submitting their nomination. No refund will be given by the Employer for not passing any of the examinations or for being absent from training courses or the examination.

2.7 Not used.

2.8 The Contractor shall inform the shift-in-charge at the Depot before commencement of work who shall be the Competent Person in charge.

3 Application for Access to Mainline Test Run

3.1 The Contractor shall nominate persons for making applications for access to work on or adjacent to the Railway.

3.2 Applications shall be made through the Engineer to the Chairman of the Engineering Works Meeting 28 days in advance and should state the following details:-

(a) Date and time
(b) Location: (e.g. track chainages, plant room name)
(c) Nature of work
(d) Facilities required from Railway e.g. Works Train, Railway Competent Person (RCP)
(e) Contractor's named supervisor on Site
(f) Contractor's Competent Person (CP)

3.3 Each application shall be accompanied with a five week rolling programme.

3.4 Responses to applications will be sent to the Contractor through the Engineer. In order that Railway resources are deployed efficiently, the "Nature of Work" should be clearly described since work may be permitted without a RCP. This will be made clear to the Contractor in the response.

3.5 Only applications from the Contractor's nominated co-ordinator will be accepted.

3.6 The Employer will not accept the responsibility for delay or additional cost caused by non-availability of the test path resulting from the requirements of the Employer.

4 Working Hours for Mainline Test Run

4.1 Test run on the Urban Lines shall be carried out during non-traffic hours. Non-traffic hours is a duration of up to 3 hours during the period of 0200 to 0500. The actual time of commencement is to be agreed with the Engineer when agreeing possession for the relevant works. The working period of 3 hours shall commence at the nominated location for track access and complete at the nominated location for track egress.

4.2 The Contractor is advised that the actual time available for testing will be reduced by operational handover and possession requirements. The remaining test time on the Urban Lines shall be about 2.5 hours per night.

4.3 On vacating the mainline test path and handing it over to the Engineer at the end of each working period, the Contractor is required to take all necessary measures to protect the works which have been completed. The mainline test path shall be cleared and left tidy to the satisfaction of the Engineer.

5 Working Requirements and Restrictions

1.1 Temporary Works shall comply with structure gauge requirements. (All materials and tools must be totally removed from the track area at the end of each shift).

1.2 Authority of the shift-in-charge at the Depot and Competent Person shall be made known to workforce.

1.3 Workforce shall be instructed not to trespass outside designated works area and not to smoke in premises. Passes, issued by the Employer, shall be worn by all members of the Contractor's workforce when on the Railway.

1.4 Names and trades of all work force shall be forwarded to the Engineer, together with name of the person-in-charge. The person-in-charge shall remain at the site throughout the working period and be responsible for ensuring that the Site is in a safe condition at the end of the working period.

1.5 Protection measures to existing finishes, equipment and installations shall be detailed. Warning signs shall be placed for workforce and passengers.

1.6 The Contractor shall not allow work to commence on any Employer equipment unless prior Approval has been obtained. All existing electric cables shall be considered as "Live" and work shall only commence after the method of working has been Approved.

1.7 Suitable personal protection equipment such as high visibility clothing shall be worn by all workmen when working on or near the tracks. High visibility vests will be provided by the Employer at the Contractor's Cost.

1.8 All persons, tools and materials shall be cleared from the track on completion of each workshift.

1.9 For works to be carried out in close proximity of the tracks and when instructed by the Engineer the provision of Look-out men and Competent Persons will be arranged by the Engineer with the Employer.

1.10 The Contractor shall not carry out any work which may require any part of a person or any tool or material to be used on or adjacent to the overhead line equipment, unless the overhead line equipment has been isolated and earthed in accordance with the Employer's Railway Safety Rules for Contractor. Approval to commence work must be obtained from the RCP prior to the start of each workshift.

Annex 1 P-Licensing System - Caring and Coaching System for New Contractor Workers

1 Aim

The P-Licensing System shall provide first line orientation and guidance to the new workers (or green workers with few experience) to clearly understand the safety requirements of the Employer, and to increase their safety awareness with a view to enhancing site safety, particularly the railway related safety.

2 Categories of New Workers

2.1 Probationer (P) refers to any worker who has less than 6 months' construction site experience and no experience of working at the Site of the Contract with the Employer.

2.2 Newcomer (N) refers to any worker who has attained at least 6 months' construction site experience but no experience of any working in MTR operational premises. Worker who has obtained at least one month past working experience of operational related Site of the Employer could be regarded as waiver to requirements of Newcomer. However, it would be up to Contractor to decide and judge whether a particular worker would require to undergo the familiarization programme same as a "New Comer" notwithstanding that the particular worker concerned has acquired more than 1 month site experience with the operational railway of the Employer.

3 System Implementation

3.1 Probationer

3.1.1 The Probationer will be identified with a "P" sticker label affixed to his/ her safety helmet. If wearing of safety helmet is not mandatory for any contracts (e.g. cleaner contract), the Probationer will be identified with a "P" sticker affixed on the working ID card or badge on his/her chest.

3.1.2 The Contractor shall conduct a min. 1.5-hour briefing to the Probationer on the general principles and practices of site safety and the safety matters which are relevant to the Site of the Contract with the Employer (please refer to para. 5 of this Annex for details).

3.1.3 The Contractor shall appoint a skilled or semi-skilled worker, who has past working experience of the operation related contracts with the Employer, to act as a mentor/ coach.

3.1.4 The Contractor shall arrange a mentor to take care of remind the Probationer of the site safety requirements from time to time for a

minimum period of 3 months.

3.1.5 The mentor will only be permitted to take care of a maximum of 4 Probationers/Newcomers at the same time.

3.1.6 The mentor shall, on full time basis, accompany the Probationer to work including the daily pre-work safety briefing and allocation of work.

3.1.7 A performance review shall be arranged to appraise the general safety performance of the Probationer after 3 months' coaching (please refer to Para. 6 of this Annex for details).

3.1.8 If the general safety performance is satisfactory as determined in the safety performance review, the Probationer will be allowed to work on his / her own without the "P" sticker label on the helmet. Otherwise, the Probationer shall continue with the mentoring/ coaching process until satisfactory performance is achieved.

3.2 Newcomer

3.2.1 The Newcomer will be identified with a "N" sticker on his / her safety helmet. If wearing of safety helmet is not mandatory, the Newcomer will be identified with a "N" sticker label affixed on the working ID card or badge on his/her chest.

3.2.2 The Contractor shall conduct a min. 1 hour briefing to the Newcomer on the safety matters which are relevant to working in the Site of the Contract with the Employer (please refer to para. 5 of this Annex for details).

3.2.3 The Contractor shall appoint a skilled or semi-skilled worker, who has past working experience of the operation related contracts with the Employer, to act as a mentor/ coach.

3.2.4 The Contractor shall arrange a mentor to take care of/ remind the Newcomer of the site safety requirements from time to time for a minimum period of 1 month.

3.2.5 The mentor will only be permitted to take care of a maximum of 4 Probationers/Newcomers at the same time.

3.2.6 A performance review shall be arranged to appraise the general safety performance of the Newcomer after 1 months' coaching period (Please refer to para. 6 of this Annex for details).

3.2.7 With satisfactory safety performance, the Newcomer will be allowed to work on his / her own without the label of "N" affixed on the helmet. Otherwise, the Newcomer shall continue with the mentoring process until satisfactory performance is achieved.

4 Identification Sticker Label

4.1 The sticker labels will be provided by the Employer at a reasonable quantity.

4.2 The sticker labels will be affixed to the safety helmets throughout the mentoring period.

"P" Sticker Label

"N" Sticker Label

5 Training Materials

5.1 A Contractor Information Centre is currently available in the Employer's website http://cic.mtr.com.hk in which many safety related information are uploaded. Details of the P-Licensing System are also uploaded to this website. The Contractor shall prepare the training materials for providing safety briefing to workers based on related P-licensing training materials in the website.

5.2 The safety briefing shall be conducted by the Safety Officer or Safety Supervisor in such a way that the Contractor will address both the general industrial related site safety principles and practices, and the railway related safety matters for working at the Site. The safety briefing should include safety requirements for works under all working locations within the Site, the relevant lesson learnt case(s) extracted from the Construction Industry Council and the sample case(s) provided by the Employer. Both the industrial and railway related safety topics shall carry proper weighting in the safety briefing.

6 Safety Performance Review

6.1 The Safety Performance Review shall be undertaken by two assessors. One Safety Officer and one safety competent supervisory staff of the Contractor shall be nominated as the joint assessors for the Engineer's approval. The assessment result of the Safety Performance Review will be documented in the P-Licensing System as proper records by the Contractor.

6.2 In the event that there are frequent in/out movements of the Probationers or Newcomers under the P-Licensing System during the Contract Period, the related working experience of such workers shall be reviewed by the Contractor's assessors, with the final results of the review endorsed by the Engineer. In any case, no workers shall be considered fulfilling the mentoring requirements unless at least 80% of the mentoring period has been achieved under the P-Licensing System.

6.3 The assessors shall take into account of the different general safety degree/ level of risks and hazards in different locations of the Site in the performance review. For instance, the risks for the works at the running tracks may be higher than those at the station concourse.

Annex 2 Contractor Fitness for Duty Management

1 Definition of Fitness-for duty

Fitness-for-duty means that an employee is in a physical, mental, and emotional state which enables him/her to perform the essential tasks of his or her work assignment in a manner which does NOT threaten the safety or health of oneself, co-workers, property, or the public at large.

2 Contractor Fitness for Duty Management Requirements

2.1 The Contractor shall establish systems for ensuring all direct & in-direct workers performed physical duties not suffering from physical and/or mental conditions, or being taking medical treatment likely to cause:

- sudden loss of consciousness;
- impairment of awareness or concentration;
- sudden incapability;
- impairment of balance or co-ordination
- significant limitation of mobility.

2.2 The Contractor shall set up test system at work site against use of drugs & alcohols.

2.3 The Contractor shall disseminate Information provided by the Employer on any “Contractor Fitness for Duty Management” to workers and other persons that are likely to be affected.

2.4 The GS Section 12 shall serve as a base requirement in addition to this PS.

APPENDIX I

DESIGNATED CONTRACTS AND

INTERFACING SYSTEMS

August 2015

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APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 1 P-WAY INTERFACE (TRACK DATA)

1 Introduction

2 Alignment Data

3 Track Gauge

4 Trackform and Rail Profile

5 Track Tolerances

6 Location of Structures

7 Tunnels

8 Code Speed

9 Supplementary Information

Table App-I-Annex-1-1 Maintenance Tolerances of Track

Attachments - Supplementary Information

Design Standards Manual Section 3.2 Alignment Design

Design Standards Manual Section 3.4 Trackform Design

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 1 P-WAY INTERFACE (TRACK DATA)

1 INTRODUCTION

This Annex of Appendix I contains details of the track over which the trains will run on the Urban Lines. This Annex shall read in conjunction with PS 5, PS 12 and Appendix M.

2 ALIGNMENT DATA

Vertical and horizontal alignment data shall refer to track alignment drawings listed in Appendix A under category of Track Data. Supplementary information for alignment design shall refer to Clause 9.1 of this Annex.

3 TRACK GAUGE

The nominal track gauge of the running lines in the Urban Lines will be 1 432 mm.

4 TRACKFORM AND RAIL PROFILE

4.1 Cross sections of the various types of trackform used in Urban Lines can be found from the supplementary information for trackform design which shall refer to Clause 9.2 of this Annex.

4.2 The rail profile will be type UIC 60 in accordance with UIC leaflet number 861-3: 1969 for LAT to TIK on KTL, ISL, TKL and TCL (refer to Drg. No. OD8/501/00001/0057). The rail profile will be BS rail section no. 90A in accordance with BS 11: 1985 and modified to a common profile (refer to Drg. No. OD8/501/00001/0057) for KBD, TWD, CWD, TKD, SHD, TWL and KTL except LAT to TIK.

4.3 Track parameters are as follows:-

4.3.1 Ballasted Track

(a)	Mass:	565 kg/m	(including rails, fastenings and sleepers)
(b)	Stiffness:	62 kN/mm	(per sleeper end, 650 mm centres)
(c)	Damping:	20%	

4.3.2 Non-Ballasted Track

(a)	Mass:	410 kg/m	(including rails, fastenings and blocks)
(b)	Stiffness:	25 kN/mm	(nominal, per rail support, 650 mm centres)
(c)	Damping:	26% minimum	

5 TRACK TOLERANCES

5.1 Tolerances for track at the maintenance limit are given in Table App-I-Annex-1-1.

5.2 Rail corrugations will be limited to a depth of 0.2 mm on installation and 0.5 mm for the maintenance limit.

6 LOCATIONS OF STRUCTURES

Cross sections and locations of structures (such as stations, tunnels) on Urban Lines shall refer to trackform type drawings and track schematic drawings listed in Appendix A under category of Track Data.

7 TUNNELS

Cross sections and locations of tunnels on Urban Lines shall refer to trackform type drawings and track schematic drawings listed in Appendix A under category of Track Data.

8 CODE SPEED

The details of the maximum allowable speed permitted for trains operating under the control of the signalling system on Urban Lines shall refer to track schematic drawings listed in Appendix A under category of Track Data.

9 SUPPLEMENTARY INFORMATION

9.1 Extract of Section 3.2 Alignment Design from the Employer's Design Standards Manual is reproduced hereafter as supplementary information to give details of the criteria and their application which will be used in the route alignment design.

9.2 Extract of Section 3.4 Trackform Design from the Employer's Design Standards Manual is reproduced hereafter as supplementary information to give details of the criteria and their application which will be used in the trackform design.

URBAN LINES - TRACK MAINTENANCE TOLERANCES				
PARAMETER	MAINTENANCE TOLERANCE			
	Ballasted	Non-ballasted except Straight Platforms	Non-ballasted Straight Platforms	Depot Tracks
Track Gauge[2]	+8/-2	+8/-2	+5/-2	+12/-3
Sidewear (Sidecut)[1]	8	8	0	10
Gauge + Sidewear[1]	+13/-2	+13/-2	+5/-2	+15/-3
Rate of Change of Gauge[2]	1 in 1000	1 in 1000	1 in 1000	1 in 500
Horizontal Position[2]	±15	±5	±5	N/A
Rate of Change of Horiz. Position[2]	1 in 500	1 in 1000	1 in 1000	1 in 250
Vertical Position[3]	+25/-50	±5	±5	N/A
Rail Topwear	15	15	15	20
Cross Level Error - St. & Cir. Curves - Transitions	 ±10 ±10	 ±15 ±15	 ±8 ±8	 ±15 ±15
Twist[4] - 2.5m base - 15m base	 1 in 150 1 in 250	 1 in 150 1 in 250	 1 in 400 1 in 1500	 1 in 150 1 in 150
Rate of Change of Vertical Position[4]	1 in 150	1 in 150	1 in 400	N/A

Table App-I-Annex-1-1 Maintenance Tolerances of Track

[1] Assumes sidewear can only occur on one rail and no sidewear occurs on straight track
[2] Assumed to new rail position (no sidewear)
[3] Assumed to new rail position (no headwear)
[4] Maintenance tolerance includes effect of cant transitions

Attachments – Supplementary Information
Design Standards Manual Section 3.2 Alignment Design
Design Standards Manual Section 3.4 Trackform Design

3.2 ALIGNMENT DESIGN

3.2.1 Introduction

The following criteria apply to the track alignment design for new lines.

3.2.2 Definitions

Civil Engineering and Building terms used within this Section of the Manual are in accordance with BS6100 - Glossary of Building and Civil Engineering Terms unless noted otherwise. Where terms are apparently contradictory or their use is unclear, clarification from the Corporation shall be sought before proceeding with design.

See also definitions in other subsections.

Track Gauge

The distance between the inside (gauge) faces of the rails in the plane tangential to the top of the rails. Track Gauge shall be 1 432 mm in plain line (both straight and curved track), switches and crossings.

Track Centre

The location mid-way between the inside (gauge) faces of the rails in the plane tangential to the top of the rails.

Rail Level

The level of the crown of the lower (grade) rail of the curved/canted track. and either rail in uncanted track.

Grade Rail

The reference rail used for defining the vertical track alignment. The lower rail in canted track.

Track Alignment

The Horizontal Alignment is the longitudinal locus of the track centre.

The Vertical Alignment is the vertical locus of the levels, gradients and vertical curves of the lower rail of the track.

Chainage

The measurement of horizontal distance along a planar centreline track alignment, measured from a reference point such as the centreline of platform. The actual travelled distance will differ when allowance for track gradients is made.

Throw - Horizontal and Vertical

The horizontal throw of a vehicle is the lateral displacement that occurs on a horizontal curve between the centre-line of the vehicle and the co-ordinated track centreline, measured perpendicularly to the track centreline. The vehicle is assumed to be symmetrical on the track with the centres of the bogies coincident with the track centre.

Vertical vehicular throw occurs on vertical curves in a similar manner to horizontal vehicular throw on horizontal curves.

Centre Throw

The centre throw is the distance from the track centreline to the measured perpendicular to the vehicle centreline midway between the bogies and is the maximum displacement that can occur towards the inside of a curve.

End Throw

The end throw is the distance measured at the extreme end of a vehicle and is the maximum displacement that can occur towards the outside of a curve.

Circular Curve

A curve of constant radius.

Transition Curve

A curve of uniformly varying radius linking either a straight and a circular curve or two circular curves.

Compound Curve

A curve formed by two circular curves of different radii but curving in the same direction. They may or may not be joined by a transition curve.

Reverse Curve

A curve formed by two circular curves which curve in opposite directions and may or may not be linked by transition curves.

Horizontal Intersection Point (HIP)

The intersection point of two horizontal curve tangents.

Vertical Curve

A curve of constant radius joining two separate gradients.

Vertical Intersection Point (VIP)

The intersection point of two gradients.

Design Speed

The actual running speed at which trains travel on a section of track under normal operating conditions. It is used for the calculation of applied cant on any curved section of track.

Maximum Speed

The theoretical maximum speed at which any train may travel on a section of track based on the track design criteria.

Code Speed

The maximum speed permitted for trains operating under the control of the signalling system on a section of track.

Maximum Attainable Code Speed

The speed in excess of the Code Speed which a train may attain prior to the application of the brakes. The applied cant on curves shall allow for this condition.

Cant

The amount by which one rail on a curve is raised above the other rail. It is positive when the outer rail of curved track is raised above the inner rail and negative when the inner rail is raised above the outer rail.

Equilibrium Cant

The cant required to enable a train to negotiate a curve at a particular speed without being subjected to an unbalanced centrifugal force such that both rails are loaded equally. The speed at which this condition applies is known as the *Equilibrium Speed.*

Applied Cant

The amount of cant specified for application to a circular curve.

Deficiency of Cant

The amount by which the applied cant is less than that needed to keep a train negotiating a curve at a particular speed in equilibrium.

Excess Cant

The amount by which the applied cant is more than that needed to keep a train negotiating a curve at a particular speed in equilibrium.

Cant Gradient

The rate at which the applied cant is uniformly increased or decreased expressed as a gradient.

Rate of Change of Cant or *Deficiency of Cant*

The rate at which cant or deficiency of cant is increased or decreased relative to the speed of a train.

Civil Speed Restriction

The maximum allowable train speed as determined by constraints on the alignment due to physical features on the infrastructure.

Double Track

Two, essentially parallel single tracks, whose separation is controlled solely by Railway Engineering requirements.

Twin Track

Two, essentially parallel single tracks, whose separation is controlled by an intervening structure.

3.2.3 Abbreviations

CWR - Continuous Welded Rail.

LWR - Long Welded Rail.

HIP - Horizontal Intersection Point.

VIP - Vertical Intersection Point.

WCB - Whole Circle Bearing.

BVC - Beginning of Vertical Curve.

EVC - End of Vertical Curve.

CLM - Centre Line Measure.

3.2.4 Code Speed and Maximum Attainable Code Speed

The Code Speed and Maximum Attainable Code Speed for each project are defined in the Functional Requirements Manual for the particular project.

3.2.5 Overruns and Sidings

Terminal Stations - overrun allowance

3.2.5.1 An overrun allowance of plain track shall be made beyond the terminal station on Running Lines. The allowance shall be:-

a)	stopping distance from station headwall	80m
b)	buffer stop sliding length (from buffer face)	30m
	Total	110m

Turnback Sidings and Refuge Sidings - minimum length

3.2.5.2 The minimum length required for turnback and refuge sidings shall be determined by the following requirements:-

LENGTH REQUIREMENTS	TURNBACK SIDING	REFUGE SIDING
a) Distance from end of turnout (stock rail 'fronts' joint) to start of track circuit	5m	5m
b) Distance from start of track circuit to signal	5m	5m
c) Sighting distance	10m	10m
d) Train length (8-Car consist)	184m	184m
e) Train overhang and allowance for stopping (including distance from headwall or platform end)	10m	10m
f) Overrun allowance	80m	34m
g) Buffer stop track occupation length (from buffer face)	30m	10m
Total	324m	258m

Stabling Sidings

3.2.5.3 Requirements for a stabling siding in the Depot shall be determined as for refuge Sidings 3.2.5.2 above.

3.2.6 Design Criteria - Horizontal Alignment

Applied Cant

3.2.6.1	Desirable maximum	130mm
	Absolute maximum	150mm
	Throughout Station Platforms	0 mm

Deficiency of Cant

3.2.6.2	Plain line (CWR) and main line through turnouts:	
	Maximum	110mm
	Minimum (nominal)	25mm
	Turnout curves - maximum	90mm
	Switch toe effective radius - maximum	125mm

Negative Cant

3.2.6.3	Switches and crossings - maximum	80mm

Rate of Change of Cant

3.2.6.4	Desirable maximum	37.5mm/sec
	Absolute maximum	55mm/sec

Rate of Change of Deficiency of Cant

3.2.6.5	Plain line and main line through turnouts;	
	Desirable maximum	37.5mm/sec
	Absolute maximum	55mm/sec
	Turnout curves - maximum	80mm/sec

Cant Gradient

3.2.6.6	Absolute Maximum	1-in-440
	Absolute Minimum	1-in-1 000

Horizontal Curves

3.2.6.7	Absolute minimum radius on Running Line for maximum speed of 80 km/h	300m
	Absolute minimum radius at Station Platform. Wherever practicable, a straight alignment shall be adopted at Stations. There should be no change of horizontal alignment throughout the platform length plus at least 18 metres beyond the extent of both ends of the platform.	2000 m
	Absolute minimum radius in Depot Connecting Line	300 m
	Absolute minimum radius in Depot	140 m
	Length of circular arc between transitions: - Desirable minimum	25 m

(The specified minimum distance seeks to prevent the car 'bridging' between two adjacent curves, based on a bogie spacing of 15.6m.)

Separation between tracks

3.2.6.8 Reference should be made to subsection 3.3 of this Manual for required separation distances between Double Track and Twin Track, appropriate to the support structure.

3.2.7 Design Criteria - Vertical Alignment

Gradients

3.2.7.1	Running Lines and Depot Connecting Lines	
	Desirable Maximum	±3%
	Minimum	Level
	Absolute Maximum*	±4%

***Note:** To be used when exceptional circumstances dictate and with written Approval only.

Through station platforms	Level
Tunnels, Bridges and Viaducts	
Maximum as Running Lines above	
Minimum	±0.3%
Sidings	
- Maximum	±0.3%
- Minimum	Level
Maintenance sidings	Level
Depot fans:	
- Maximum	±1%
- Minimum	Level

Vertical Curves for Running Lines

3.2.7.2	Desirable minimum radius (max speed 140km/h)	4 800 m
	Desirable minimum radius (max speed 80km/h)	3 000 m
	Absolute minimum radius	1 500 m
	Length of constant gradient between vertical curves:	
	Desirable minimum	50 m
	Absolute minimum	20 m

(The specified minimum distance seeks to prevent the car 'bridging' between two adjacent curves, based on a bogie spacing of 15.6m.)

3.2.8 Design Principles - Horizontal Alignment

Straights

3.2.8.1 Maximum use shall be made of straight track for Running Lines.

Alignments shall be such that Running Lines are straight and parallel through stations, crossover roads and other switch and crossing work unless accepted in writing by the Corporation. Switches and crossings are not to be located on transition curves.

Circular Curves

3.2.8.2 Curve design is based on the relationship between radius R (m), speed V (km/h), applied cant E (mm), and deficiency of cant D (mm). It is quantified by the use of the equation:

$$(E+D) = \frac{11.8\,V^2}{R} \quad \text{.....Eqn 1}$$

Curves shall be designed for near-equilibrium conditions with a nominal deficiency of cant of 25mm to provide a positive wheel guidance force. Cant shall be applied when the nominal deficiency of cant is exceeded and shall then be increased in increments of 5mm to suit the design speed of the curve, maintaining the nominal cant deficiency. When the maximum cant has been applied, increased cant deficiency may be utilised up to the maximum cant deficiency allowable.

At stations, where train speeds are either accelerating or decelerating, the design speed shall be taken as the mean speed of the front and rear of the train. On horizontal curves where the speed varies appreciably between front and near of the train, the cant and cant deficiency may be varied according to the mean train speed at any point on the curve.

Where cant changes within a curve of constant radius, the length over which the change takes place shall conform to the specified rates of change of cant, cant deficiency and limiting cant gradients.

Transition Curves

3.2.8.3 Transition curves take the form of a clothoid spiral where the shift 'S' and the distance of the point of shift from the toe of the transition measured along the extended straight 'C' can be evaluated as follows:

$$S = \frac{L^2}{24R} - \frac{L^4}{2\,688R^3} \quad \text{.....Eqn 2}$$

$$C = \frac{L}{2} - \frac{L^3}{240R^2} \quad \text{.....Eqn 3}$$

For geometrical details of transitions refer to Figures 3.2.1 and 3.2.2.

The desirable length of transition shall be, in practical units, the greater of the lengths obtained from the following equations:

$$L = \frac{(E \text{ or } D_1)\, V_1}{135} \quad \ldots\ldots\ldots\ldots \quad \text{Eqn 4}$$

$$L = \frac{(D_2 \text{ or } E)\, V_2}{198} \quad \ldots\ldots\ldots\ldots \quad \text{Eqn 5}$$

where,

L	=	length of spiral	(m)
V_1	=	design speed	(km/h)
V_2	=	max. attainable speed	(km/h)
E	=	applied cant	(mm)
D_1	=	deficiency of cant at V_1	(mm)
D_2	=	deficiency of cant at V_2	(mm)

When a transition curve is located within an acceleration or a deceleration zone, for example, adjacent to a station, its length shall be determined from Eqn 4 above where:

V_1 = maximum speed of any part of the train obtained at the heel of the transition (i.e. the SC or CS point)

E = the cant applied to the circular curve adjacent to the heel of the transition

D_1 = deficiency of cant obtained with V_1 and E above.

Under no circumstances shall the length of a transition curve be less than:

$$L = 0.44\, E \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad \text{Eqn 6}$$

Where adjacent parallel tracks enter concentric curves, one transition curve shall be adjusted in its length to maintain a constant spacing between tracks throughout the curve. The same shall apply at concentric curves exiting onto parallel tracks.

Transition between Compound Curves

3.2.8.4 For a compound curve where the design speed is constant, the desirable length of transition connecting the two circular curves shall be obtained by substituting differences in cant and deficiency of cant for the two circular curves for E, D_1, and D_2 in Eqn 4 and Eqn 5. For geometrical details refer to Figure 3.2.2.

Transitions between Reverse Curves

3.2.8.5 A length of straight track shall be provided between the toes of transitions of reverse curves as follows:

Desirable minimum	50 m
Absolute minimum	20 m

Where it is not possible to provide this length of straight track, then the transition curves themselves shall be continuous with a common tangent point. The lengths of these transition curves, as calculated from Eqn 4 and Eqn 5, may require adjustment to ensure a uniform cant gradient throughout the transition curves.

Virtual Transition

3.2.8.6 Where it is impossible to provide a transition curve onto or from a circular curve, the concept of virtual transition is employed in the determination of the maximum permissible speed on the affected circular curve.

The length of virtual transition 'L' is deemed to be the length between centres of bogies, which shall be taken as 15.6 m.

Deficiency of cant is considered as being gained over the length of the virtual transition, commencing on the straight 7.8 m before the tangent point and terminating on the curve 7.8 m beyond the tangent point.

Cant, where applied, will normally be gained in the same length and similar manner but the cant gradient must not exceed the permitted maximum. For the absolute maximum cant gradient specified, therefore, the cant on the curve must not exceed 35 mm. Where the cant is in excess of this amount, then either the length of cant run-up shall be extended or the cant on the curve shall be reduced.

The maximum permissible speed over the length of a virtual transition may be evaluated as follows:

a) *Circular Curve - Canted*

The maximum permissible speed V (km/h) over the virtual transition length L (m) shall be obtained when the applied cant E (mm) and deficiency of cant D (mm) are equal. Therefore, if the rates of change of cant and deficiency of cant q (mm/sec) are also equal, then:

$$V = \frac{3.6\ q\ L}{\frac{1}{2}(E+D)} \quad \ldots\ldots\ldots\ldots \quad \text{Eqn 7}$$

b) *Circular Curve - Uncanted*

With circular curve radius R (m)

$$V = \left(\frac{3.6\ q\ L\ R}{11.8}\right)^{1/3} \quad \ldots\ldots \quad \text{Eqn 8}$$

c) *Compound Curve - Uncanted*

As in Eqn 8 above but use equivalent radius R_e in place of R where:

$$R_e = \frac{R_1 \times R_2}{R_1 - R_2} \qquad \text{and } R_1 > R_2$$

d) *Reverse Curve - Uncanted*

As in (Equation 8) above but use equivalent radius R_e in place R where:-

$$R_e = \frac{R_1 \times R_2}{R_1 + R_2}$$

3.2.9 Design Principles - Vertical Alignment

Gradients

3.2.9.1 Accelerating and braking gradients shall be provided adjacent to stations where possible, generally at the maximum permitted gradient. (Refer to Figure 3.2.3.)

A minimum gradient of 0.3% shall be provided at all locations on Running Lines, except station platform areas where the gradient shall be horizontal. (Refer Clause 3.2.7)

Where track support structures have less than 1% gradient, imposed localised falls shall be designed as stated in Clause 4.9.8.2.

Combinations of maximum up gradients and small radius horizontal curves shall be avoided, to prevent potential problems with push-out of disabled trains.

Vertical Curves

3.2.9.2 Vertical curves shall be curves of constant radius. Wherever possible, the radius of a vertical curve shall be greater than the minimum. Switches and crossings shall not be located on vertical curves.

At stations, vertical curves shall not be located within the length of the platform.

A vertical curve within the length of a horizontal transition curve is undesirable.

The length of a vertical curve shall be calculated from the equation:

$$L = \frac{(p-s)R}{100} \quad \ldots\ldots\ldots\ldots \quad \text{Eqn 9}$$

where,

L =length of vertical curve (m)
R =radius of vertical curve (m)
(p-s) =the algebraic difference between the two percentage grades

3.2.10 Turnouts

General

3.2.10.1 Turnouts on Running Lines shall maintain the rail inclination (1:20) and track gauge of plain line throughout. Nomenclature for turnout related items are shown in Figure 3.2.4.

Turnouts for installation on Running Lines shall be selected based on the required speed through the turnout track.

Turnouts shall consist of Circular Curve Turnouts, as shown in Table 3.2.1 or Transitioned Turnouts as shown in Table 3.2.2, as appropriate.

Wherever practicable, the horizontal alignment shall be designed such that a standard Circular Curve Turnout from Table 3.2.1 can be located within straight alignments of track. Transitioned Turnouts shall only be located in straight alignments of track.

Where constraints dictate the use of similar flexure, contra-flexure or equal-split turnouts, they shall be based on Circular Curve Turnouts of Table 3.2.1 and the equivalent radius evaluated in accordance with Clause 3.2.10.5.

Turnouts to be located within Depot Lines shall be standard 1 in 7 Circular Curve Turnouts.

Circular Curve Turnouts

3.2.10.2 The geometry of Circular Curve Turnouts shall be as shown in Figure 3.2.5. and 3.2.6. The range of Circular Curve Turnouts is as follows:-

Table 3.2.1 - Circular Curve Turnouts

Maximum Speed Crossing Type		Turnout Rad. (Centreline)	Turnout Crossing Angle	Turnout Designation
Curved	Straight			
30 Km/h	30 Km/h	140.336m	7	1 in 7
45 Km/h	45 Km/h	315.756m	10.5	1 in 10.5
55 Km/h	50 Km/h	412.416m	12	1 in 12
65 Km/h	60 Km/h	561.344m	14	1 in 14
80 Km/h	70 Km/h	927.936m	18	1 in 18

Transitioned Turnouts

3.2.10.3 The geometry of Transitioned Turnouts shall be as shown in Figure 3.2.7. The range of Transitioned Turnouts is as follows:-

Table 3.2.2 - Transitioned Turnouts

Maximum Speed Crossing Type	Switch Rad. (Centreline)	Crossing Angle	Turnout Designation
Straight			
60 Km/h	561.344m	18	1 in 14/18
80 Km/h	927.936m	24	1 in 18/24
100 Km/h	1386.176m	28	1 in 22/28
135 Km/h	2577.600m	38	1 in 30/38

Diamond Crossings

3.2.10.4 Diamond crossings shall not be located in Running Lines except at terminal stations and depots.

The obtuse crossing of a diamond crossing shall not be flatter than 1 in 7.5.

Speed Through Turnouts

3.2.10.5 The maximum permissible speeds through turnout curves in straight track are given in Tables 3.2.1 and 3.2.2. Values have been obtained by consideration of the maximum permissible deficiency of cant, the maximum rate of change of deficiency, turnout curve radius and the geometric conditions beyond the turnout.

The maximum permissible speed on a turnout where both lines are curved is governed by the amount of applied cant on the through line, the maximum permissible deficiencies on both lines and both curve radii. The equivalent radius (R_e) of a turnout, for calculation of speed through turnouts located on curved through lines, shall be obtained as follows:

a) *Similar Flexure*

$$R_e = \frac{R\,(R_m - G/2)}{R_m + R} \quad \text{where } R_e < R_m$$

$$R_e = \frac{R\,(R_m + G/2)}{R - R_m} \quad \text{where } R_e > R_m$$

b) *Contra-flexure*

$$R_e = \frac{R\,(R_m + G/2)}{R_m - R} \quad \text{where } R_e < R_m$$

$$R_e = \frac{R\,(R_m - G/2)}{R_m - R} \quad \text{where } R_e > R_m$$

c) *Equal Split*

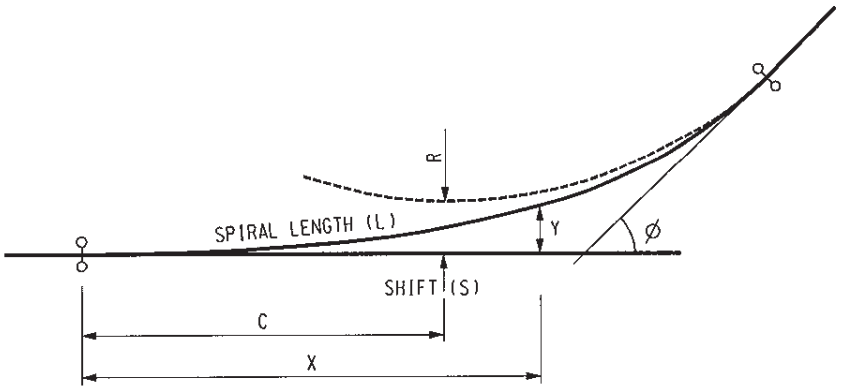
$$R_e = R + [R^2 + R.\,G/2]^{1/2}$$

all where,

R_e = equivalent radius of turnout curve centre line
R_m = centre line radius of main or through line
R = $2\,GN^2$ = centre line radius of turnout curve out of straight
G = track gauge (in metres)
N = turnout crossing angle (CLM)

For a contra-flexure turnout in a canted through-line, negative cant will be present on the turnout curve and, therefore, the maximum permissible speed calculated in accordance with Eqn 1 of Clause 3.2.8.2, shall be governed by a deficiency of cant value of (90-E) where E = negative cant.

Where untransitioned turnouts form a crossover with a length of straight between crossings, the maximum permissible speed through the crossover shall be ascertained by employing the principle of virtual transition : refer clause 3.2.8.6.



CLOTHOID SPIRAL

"l" IS DISTANCE MEASURED ALONG SPIRAL

$$\varnothing = \frac{l^2}{2RL} \text{ RADIANS} \qquad = \frac{90\ L}{\pi\ R} \text{ DEGREES}$$

$$S = \frac{L^2}{24R} - \frac{L^4}{2688\ R^3} \qquad C = \frac{L}{2} - \frac{L^3}{240\ R^2}$$

$$X = l - \frac{l^5}{40\ (RL)^2} \qquad Y = \frac{l^3}{6RL} - \frac{l^7}{336\ (RL)^3}$$

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HONG KONG
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TITLE

TRANSITION FROM STRAIGHT TO CIRCULAR CURVE

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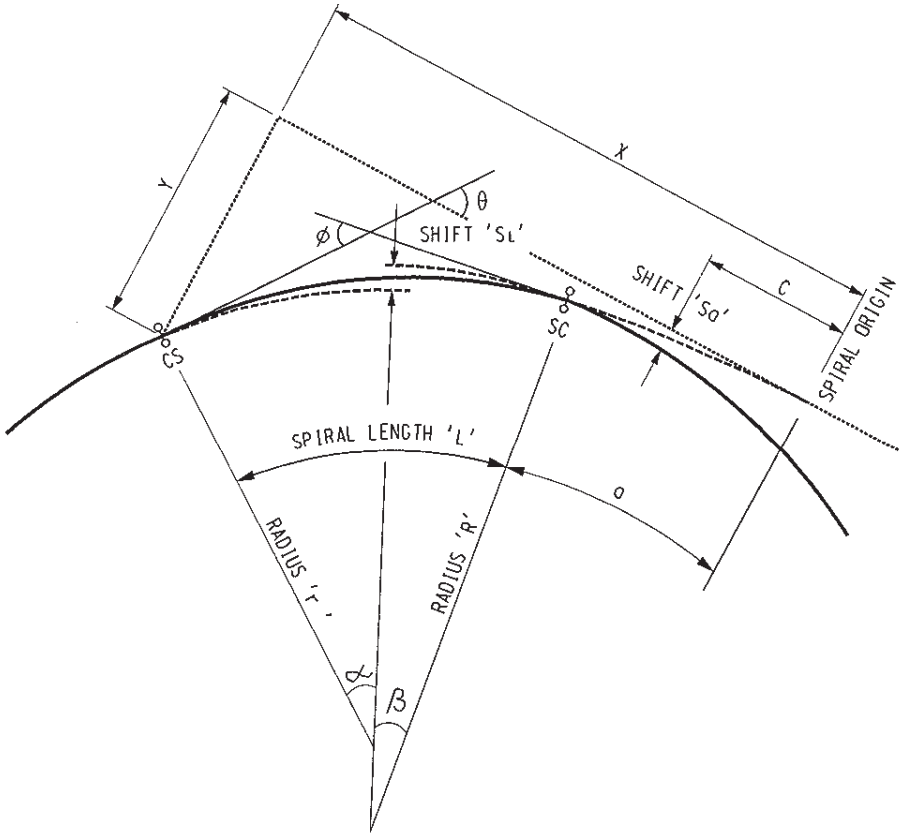

CLOTHOID SPIRAL

$$a = \frac{r\,L}{R - r} \qquad l = a + L$$

$$X = l - \frac{l^3}{40\,r^2} \qquad Y = \frac{l^2}{6\,r} - \frac{l^4}{336\,r^3}$$

$$Sa = \frac{a^2}{24R} - \frac{a^4}{2688\,R^3} \qquad C = \frac{a}{2} - \frac{a^3}{240\,R^2}$$

$$\theta = \frac{90\,l}{\pi\,r} \qquad \phi = \theta - \frac{90\,a}{\pi\,r}$$

$$\alpha = \frac{\phi\,R}{R + r} \qquad \beta = \frac{\phi\,r}{R + r}$$

$$S_L = (R - r) - \sqrt{\{(R+Sa)-(Y+r\cos\theta)\}^2 + \{X - C - r\sin\theta\}^2}$$

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TRANSITION JOINING TWO CIRCULAR CURVES

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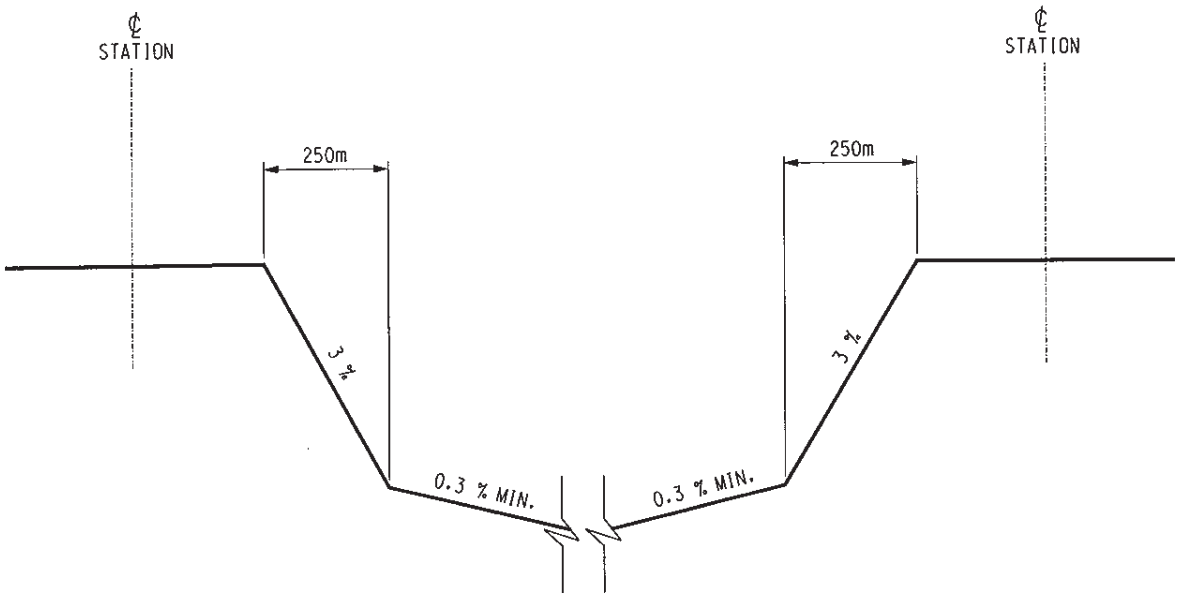
NOTES :

1. THE LENGTHS OF 0.3 % GRADE WILL VARY WITH THE RELATIVE LEVELS OF ADJOINING STATIONS AND THE DISTANCE BETWEEN THEM.

2. REFER TO CLAUSE 3.2.7.1 REGARDING MAXIMUM GRADIENTS FOR RUNNING AND DEPOT CONNECTING LINE.



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PROFILE OF BORED TUNNELS FOR OPTIMUM ENERGY CONSUMPTION

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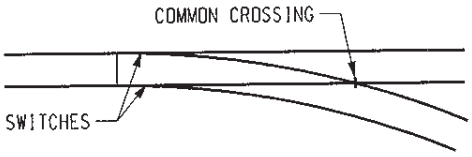
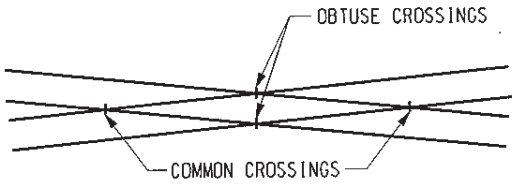
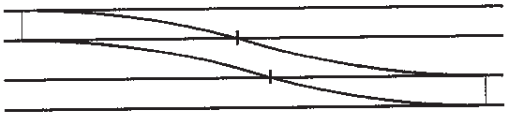
TURNOUT



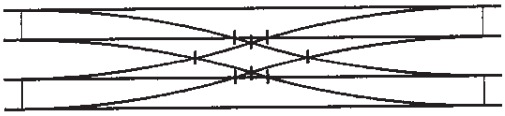
DIAMOND



SINGLE CROSSOVER



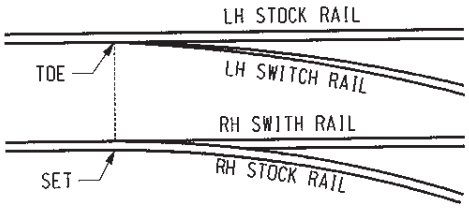
SCISSORS CROSSOVER



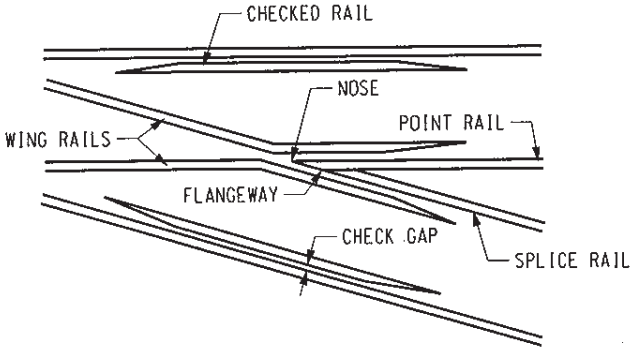
SINGLE SLIP DIAMOND

DOUBLE SLIP DIAMOND

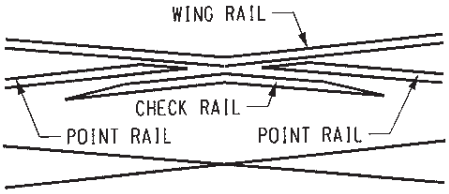
R.H. SWITCHES



R.H. SPLICE COMMON CROSSING



OBTUSE CROSSING



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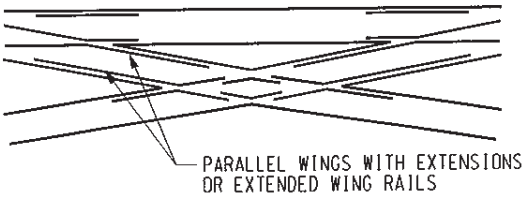

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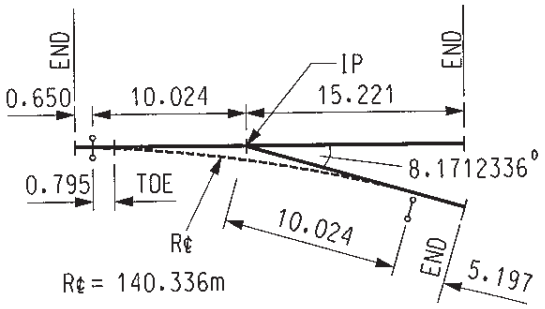
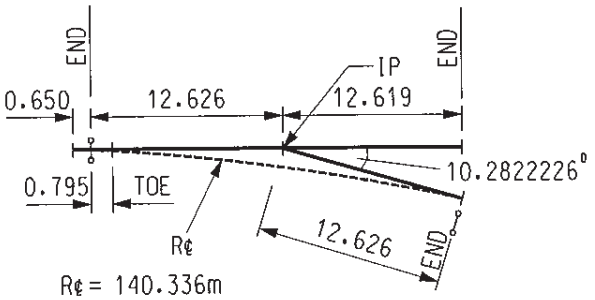
UIC 60 - CIRCULAR CURVE TURNOUTS



R¢ = 140.336m

1 IN 7 (STRAIGHT CROSSING)

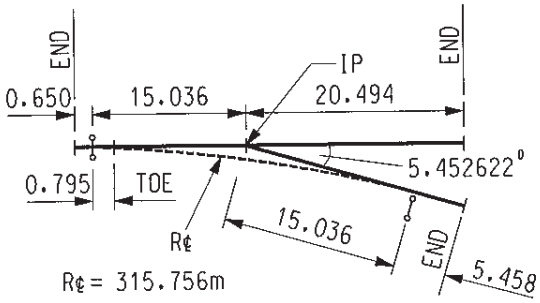
Maximum Speed : 30 km/h



R¢ = 140.336m

1 IN 7 (CURVED CROSSING)

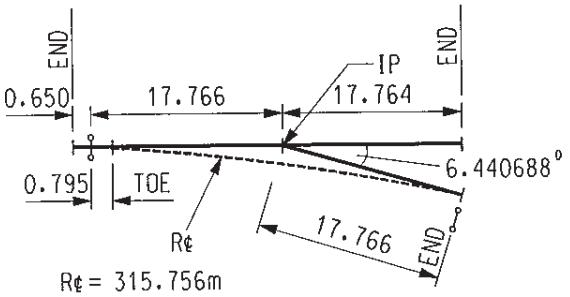
Maximum Speed : 30 km/h



R¢ = 315.756m

1 IN 10.5 (STRAIGHT CROSSING)

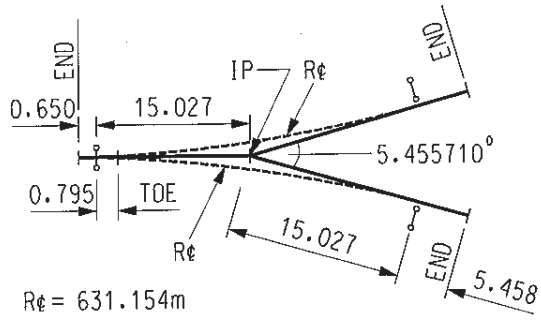
Maximum Speed : 45 km/h



R¢ = 315.756m

1 IN 10.5 (CURVED CROSSING)

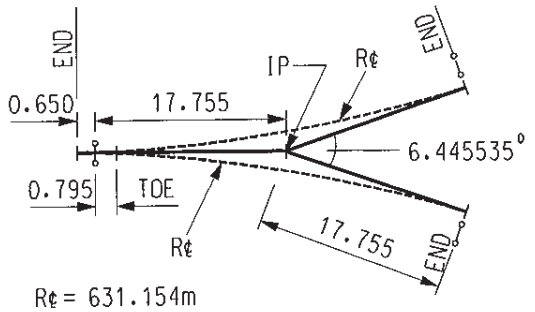
Maximum Speed : 45 km/h



R¢ = 631.154m

1 IN 10.5 EQUAL SPLIT (STRAIGHT CROSSING)

Maximum Speed : 60 km/h



R¢ = 631.154m

1 IN 10.5 EQUAL SPLIT (CURVED CROSSING)

Maximum Speed : 65 km/h

NOTE: ALL DIMENSIONS IN METRES UNLESS SHOWN OTHERWISE.

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CAD REF	FIG325.DGN		

NEW WORKS DESIGN STANDARDS MANUAL ~ FIGURES

TITLE

TURNOUT GEOMETRY
CIRCULAR TURNOUTS
(SHEET 1 OF 2)

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FIGURE 3.2.5	A

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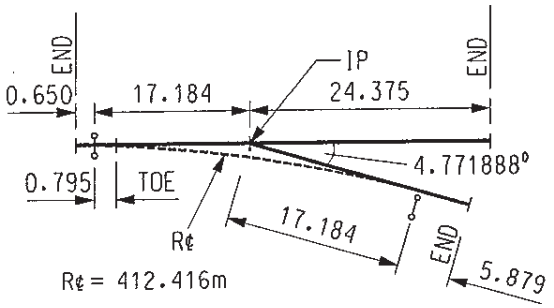
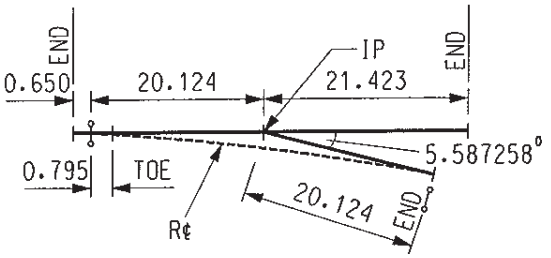
UIC 60 - CIRCULAR CURVE TURNOUTS



R¢ = 412.416m

1 IN 12 (STRAIGHT CROSSING)

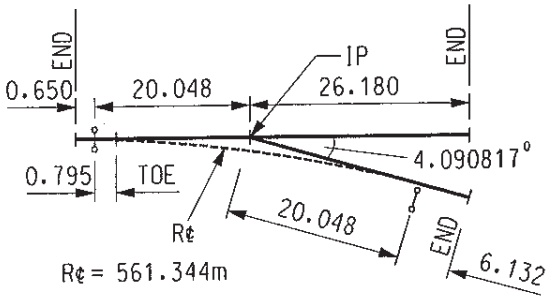
Maximum Speed : 50 km/h



R¢ = 412.416m

1 IN 12 (CURVED CROSSING)

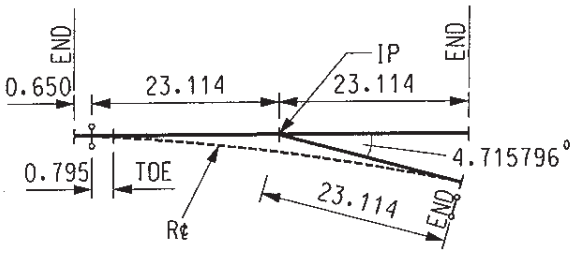
Maximum Speed : 55 km/h



R¢ = 561.344m

1 IN 14 (STRAIGHT CROSSING)

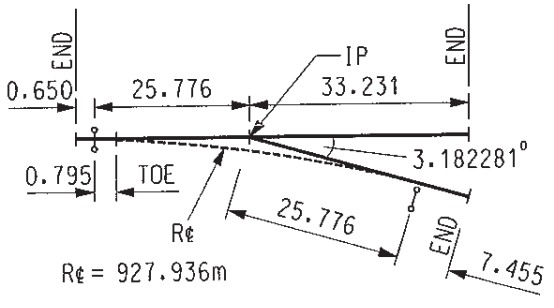
Maximum Speed : 60 km/h



R¢ = 561.344m

1 IN 14 (CURVED CROSSING)

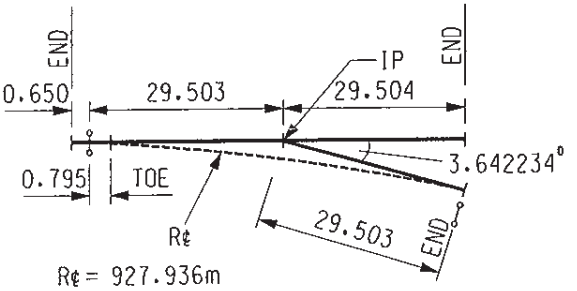
Maximum Speed : 65 km/h



R¢ = 927.936m

1 IN 18 (STRAIGHT CROSSING)

Maximum Speed : 70 km/h



R¢ = 927.936m

1 IN 18 (CURVED CROSSING)

Maximum Speed : 80 km/h

NOTE: ALL DIMENSIONS IN METRES UNLESS SHOWN OTHERWISE.

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CAD REF	FIG326.DGN	MTR Corporation Limited PROJECT DIVISION	

NEW WORKS DESIGN STANDARDS MANUAL ~ FIGURES

TITLE

TURNOUT GEOMETRY
CIRCULAR TURNOUTS
(SHEET 2 OF 2)

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DRAWING NO FIGURE 3.2.6

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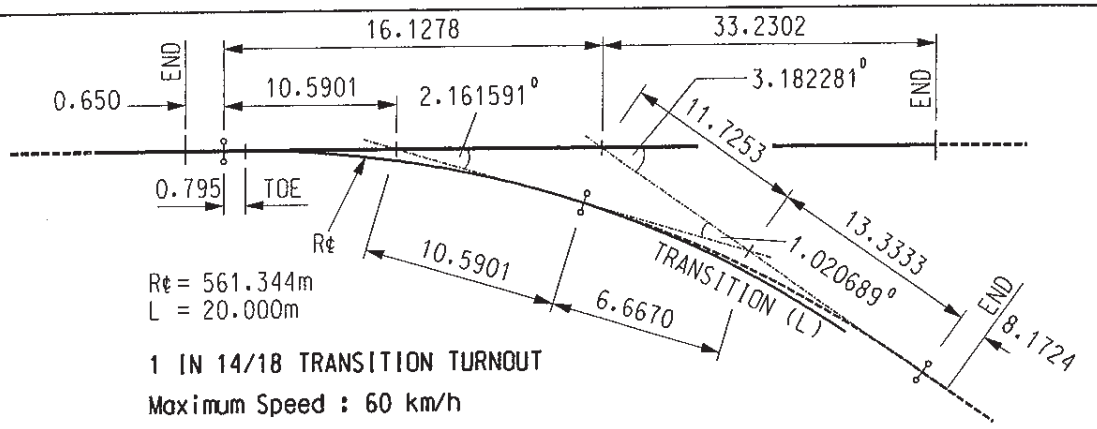
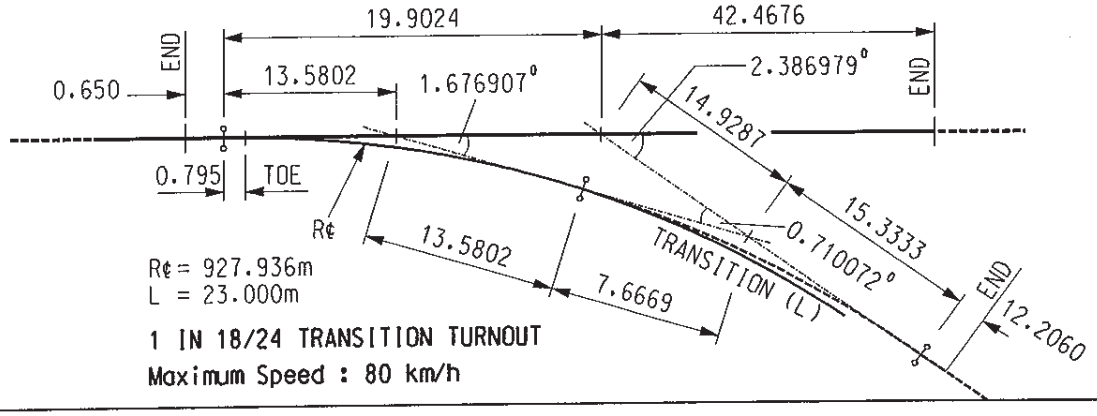


R¢ = 561.344m
L = 20.000m

1 IN 14/18 TRANSITION TURNOUT

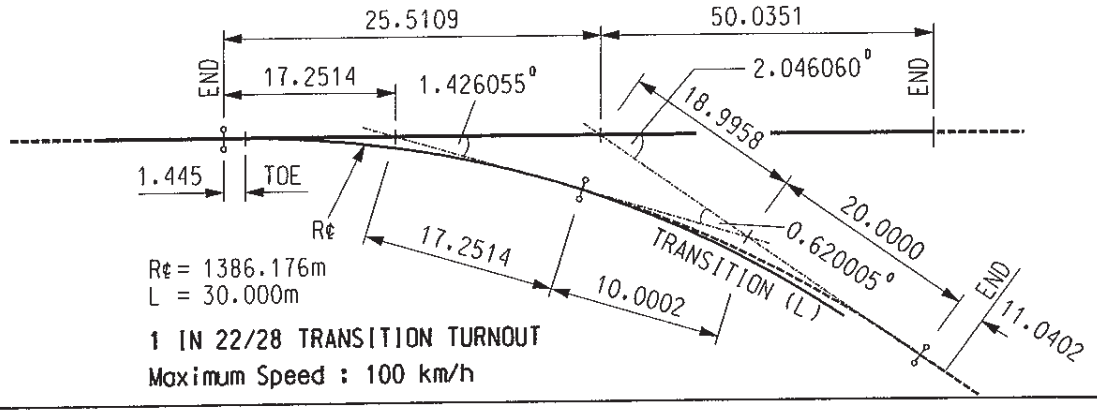
Maximum Speed : 60 km/h



R¢ = 927.936m
L = 23.000m

1 IN 18/24 TRANSITION TURNOUT

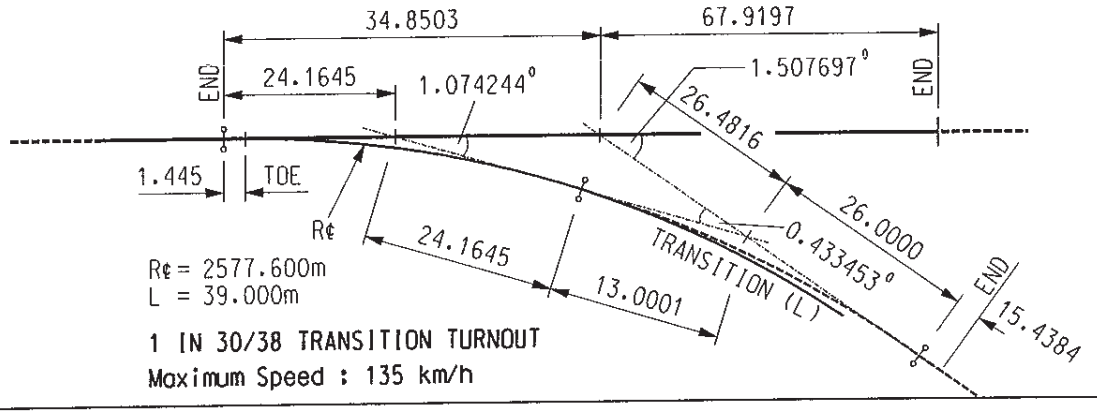
Maximum Speed : 80 km/h



R¢ = 1386.176m
L = 30.000m

1 IN 22/28 TRANSITION TURNOUT

Maximum Speed : 100 km/h



R¢ = 2577.600m
L = 39.000m

1 IN 30/38 TRANSITION TURNOUT

Maximum Speed : 135 km/h

NOTE: ALL DIMENSIONS IN METRES UNLESS SHOWN OTHERWISE.

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DATE	13 JUN 2001	ORIGINATOR	MTR Corporation Limited PROJECT DIVISION
CAD REF	FIG327.DGN		

NEW WORKS DESIGN STANDARDS MANUAL ~ FIGURES

TITLE

TURNOUT GEOMETRY TRANSITION TURNOUTS

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DRAWING NO FIGURE 3.2.7

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3.4 TRACKFORM DESIGN

3.4.1 Introduction

3.4.1.1 This section defines the general design criteria and principal design standards for the design of all trackform and associated components comprising the ballasted and non-ballasted trackforms, rail components, fastenings, switches and crossings and track-related items.

3.4.1.2 The Corporation has developed various standard trackform types that shall be used on all new railway extensions in locations approved by the Corporation's Representative. The details of standard trackforms and functional requirements are given in the Standard Details and Functional Requirements Manual respectively.

3.4.1.3 The trackform designer shall use these trackform types accordingly and he shall satisfy himself that all requirements of the Manual shall be achieved in the particular circumstances of the relevant new extension. The supporting structure designer shall similarly satisfy himself for his area of responsibility. In any case of conflict the matter shall be raised with the Corporation's Representative for clarification or approval for alternative schemes.

3.4.2 Definitions and Abbreviations

3.4.2.1 General

This list includes the most commonly used definitions and abbreviations. A full list is given in BS6100 (Subsection 2.4.2).

3.4.2.2 **Rail** - Definitions and Abbreviations

Grade Rail

The reference rail used for defining the vertical track alignment. The lower rail in canted track.

High Rail

Outer running rail of a curved section of track.

3.4.2.3 **Components** - Definitions and Abbreviations

Baseplate

Rolled steel or cast iron rail support mounted on sleepers or concrete base by means of holding-down bolts or sleeper screws.

Vibration Isolating Baseplate

A composite cast iron and rubber rail support in which the upper plate supports the rail foot and is separated by rubber to the lower plate which is mounted on the sleeper or concrete base.

Fishplate

Clamps (pair) with four or six holes, used to connect two ends of rail together by means of nuts and bolts located through the rail webs.

Insulated Rail Joint (IRJ)

An insulated connection between two rail ends comprising of a pair of insulated fishplates connected by bolts located through the rail webs.

Insulator

A non-conductive insert located between the rail fastener and rail foot to prevent stray currents passing through the rail fastener into the supporting structure and to provide adequate rail-rail resistance for signalling purposes.

Rail Pad

A resilient insulating material located between rail foot and baseplate (concrete sleeper or block)

Shoulder

A cast iron component cast in concrete sleeper or block and used to locate rail fastener.

Spring Clip

A metal fastener made of spring steel which clamps the rail foot to the block, sleeper, or baseplate.

3.4.2.4 ***Turnout*** - Definitions and Abbreviations

A set of switches, crossings, stretcher bars, check rails, lead and closure rails which enable trains to diverge from one track to another, or to converge from one track into another.

Turnouts are designated as Left-hand or Right-hand according to the direction of divergence of the curved track away from the straight track when facing the front of the turnout at the stock rail joint.

Equal split indicates a turnout which curves equally in both directions from the front.

Crossing

An assembly to permit the passage of wheel flanges across other rails where tracks intersect.

Junction

A location where running lines converge, diverge or cross. A junction may comprise one or more turnouts, with or without an associated diamond.

Switches

An assembly of moving rail sections and other components for diverting vehicles from one track to another.

Trap Points

A set of switches located on sidings and depot access lines before the junction with the running lines to prevent unauthorised entry of rolling stock onto the primary track.

3.4.2.5 **Trackform** - Definitions and Abbreviations

Ballasted Trackform

Ballasted trackform comprises running rails, rail fastenings, insulators, rail pads, concrete or timber sleepers, ballast and sub-ballast.

Non-ballasted Trackform

Non-ballasted trackform incorporates the track elements comprising running rails, rail fastenings, insulators, rail pads, baseplates or concrete blocks, resilient pads, rubber boots, and concrete trackbase.

Floating Slab Track (FST)

A high-performance trackform, with a precast or insitu cast concrete slab located on elastomeric or rubber support bearings, designed to significantly reduce the transmission of noise and vibration into the surrounding structure. The trackform comprises running rails; resilient baseplates; concrete slab; discrete support bearings, side bearings; end bearings; bearing brackets and concrete upstands.

Isolated Slab Track (IST)

A medium-performance trackform, designed to moderately reduce transmission of noise and vibration into the surrounding structure comprising a resilient layer inserted between an insitu concrete trackbase and the supporting structure.

Trackbase

The track support medium within the trackform that consists of ballast and sub-ballast or concrete.

Track Support Structure

The part of the support structure which supports the trackform which normally comprises:

- prestressed or reinforced concrete members forming bridge decks, station structures, or viaducts for overhead structures;
- the base of cut and cover tunnels, station boxes, or mass concrete inverts to other tunnels;
- reinforced concrete slabs on at grade sections;
- the sub-grade on ballasted track sections.

3.4.2.6 **Derailment Protection** - Definitions and Abbreviations

Derailment Upstand

A structure located outside the running rails at specific locations to provide lateral guidance to derailed vehicles.

Check Rails

Rails provided inside running rails to guide wheels through crossings in junctions.

Guard Rails

Inverted steel channels located on the outside of Running Line track on ballasted and non-ballasted tracks.

'Cut Water' Shaped Protection Structures

Tapered concrete structures (facing the normal direction of running) placed at the base of columns supporting overhead structures.

3.4.2.7 **Movement Joints** - Definitions and Abbreviations

Rail Movement Joint (RMJ)

A joint provided in the running rails to accommodate thermal movements and the relative movements and rotations of a bridge deck or other supporting structure.

Movement Joint (MJ)

A joint between adjacent structural members enabling the movement of one structure relative to another.

3.4.3 Trackform Design - General

3.4.3.1 All trackforms including special trackwork (turnouts, rail movement joints, etc) shall be designed to meet the requirements, criteria and trackform performance and functional provisions detailed in Section 3.1.6 of this Manual.

The trackform to be used on each section of line shall generally be determined by the type of infrastructure on which the trackform is located. Specific requirements (e.g. noise and vibration attenuation) shall determine the use of special resilient trackforms.

3.4.3.2 The trackform shall be designed such that the maximum vertical deflection shall not exceed 7mm with a rail gradient not greater than 1:1000 under the worst live loading conditions. The analyses shall consider normal operations, including the effects of worn rail or broken rail conditions.

3.4.3.3 Reclamation shall be designed and constructed to ensure that a maximum long term vertical settlement shall be limited to 50mm below the trackform, and differential settlement shall not cause a change in longitudinal profile of greater than 1:1000.

3.4.3.4 The trackform design shall ensure that the design life is achieved for each component with due consideration taken of their interaction, the trackform performance requirements, dynamic characteristics of the rolling stock, and any influences due to the type of track support structure.

Ballasted Trackform

3.4.3.5 Ballasted track shall generally be used on at grade sections, to allow for possible ground settlements, on embankments and on structures that do not exceed 300 m in length with adjacent sections of ballasted track.

3.4.3.6 The profile of the ballasted track shall comply with the relevant Standard Detail Drawings which define the relationship between the track, ballast, sub-ballast, drainage, cable troughs, OHL and E&M equipment and fencing.

Should any modifications be required to incorporate any specific site requirements, applications for approval shall be made to the Corporation's Representative.

Non-ballasted Trackform

3.4.3.7 Non-ballasted trackform only shall be used where tracks are located on structures and slabs, except where the provisions of clause 3.4.3.5 apply. Non-ballasted trackform shall only be used at grade where short sections (less than 300m) exist between longer sections of non-ballasted trackform which are on a structure or on a firm sub-base e.g. rock.

3.4.3.8 The standard trackform is either the Precast Concrete Block Trackform (PCBT) or the Vibration Isolating Baseplate Track (VIBT). Vibration isolating baseplates may be used on structures subject to lateral movement or settlement. Resilient baseplates are to be used for special trackwork items.

Refer to Trackwork Standard Details for further information.

Track Installation

3.4.3.9 The design of the trackform shall take into consideration that installation of the non-ballasted trackform will be by the `top-down' method. Therefore, due allowance shall be made in specifying the level of the track support structure to ensure that adequate clearances exist below the rail supports for the bending of rebars and placing and compaction of concrete trackbase.

3.4.3.10 Generic types of trackform are differentiated below. In designing for specific situations, the overall design intent shall be respected which may require detailed amendments with the approval of the Corporation.

3.4.4 Ballasted Trackform

3.4.4.1 *Ballast*

a) *Location*

The ballast layer shall be designed for at grade sections on previously prepared sub-ballast.

b) *Placement*

The ballast layer shall be constructed in layers to enable maximum *in situ* compaction to be achieved.

c) *Purpose*

The ballast layer shall be required to:

- distribute track loads (from supporting sleepers) both laterally and vertically over the sub-ballast layer
- support the trackform to line and level
- provide adequate drainage
- distribute any localised settlement of the formation
- be graded to suit sub-ballast
- be capable of withstanding loads (static and dynamic) for the required design life in the actual location.

d) *Material*

The ballast shall be designed to support the track structure and imposed dynamic loads. The ballast shall consist of crushed, freshly quarried igneous rock to the requirements given in the Materials and Workmanship Specification for Trackwork.

3.4.4.2 *Sub-ballast*

a) *Location*

Sub-ballast shall be designed for placing on prepared sub-grade formation.

b) *Placement*

The sub-ballast shall be designed to enable the compaction stated in the Materials and Workmanship Specification for Trackwork, for the full depth of the sub-ballast layer. The top of the sub-ballast layer shall incorporate a 1-in-40 transverse grade crossfall to provide adequate surface water run-off.

c) *Purpose*

The sub-ballast layer shall be designed to distribute loading from the track and ballast to the prepared sub-grade and to provide adequate drainage.

d) *Material*

Materials acceptable for use as sub-ballast are clean, unweathered, uniformly graded sand/gravel mixtures containing not more than 5% of material finer than silt size. Alternatively, uniformly graded rock may be used but in conjunction with a designed filter layer located between the sub-ballast and the sub-grade and subject to the Engineer's approval. Approved materials and the required particle size distribution are given in the Materials and Workmanship Specification for Trackwork.

e) *Drainage*

Where ballasted track is used on structure or slab, run-off from rainfall may be considered as Foul Water; appropriate instructions for its disposal are to be sought from the Corporation.

The following is applicable to drainage of ballasted trackform on sub-grade, where track run-off from rainfall is to be considered as Surface Water.

Trackform Surface Water and, if necessary, Ground Water drainage systems shall be constructed in the sub-ballast layer, extended and modified as necessary.

They shall be designed in accordance with this Section and Section 4 of this Manual to provide protection against flooding and the degradation effects of water.

Alternatively, where the sub-grade within the railway boundary is already drained by drainage systems (or where such systems may be designed and installed) which satisfy this requirement, the trackform drainage systems may be omitted.

3.4.4.3 *Sub-grade*

The sub-grade (or formation) is the base layer on which the trackform is placed, at the locations shown on the track diagram. The sub-grade requires to consist of either:

a) in situ material with a CBR of 10% or better as tested in accordance with BS1377 - Test No 16.

b) reclaimed material comprising generally sand or silty sand compacted to 95% or better relative compaction as defined in accordance with BS1377 - Test Nos. 12 and 15, above approximately +2.5 mPD, and vibrocompacted to achieve a minimum CPT net tip resistance of 10 MPa below that level; or.

c) selected fill material, compacted to 95% relative compaction or better in accordance with BS1377 - Test Nos. 12 and 15; or

d) the formation level of excavation in rock of grades I to IV.

The Trackform Ground Water drainage system, if required, shall be designed to maintain these properties.

3.4.4.4 The sub-grade shall be graded to fall, transversely to the track centreline, at a minimum slope of 1:25 under the sub-ballast to direct percolating Surface Water to the drainage system.

3.4.5 Non-ballasted Trackform

3.4.5.1 *General*

a) *Location*

Non-ballasted trackform shall be designed for installation on viaducts, in tunnels, and on specified sections at grade as required.

b) *Installation*

Track shall be located and temporarily supported to the correct line and level, including blocks/baseplates and fastenings, and the concrete for the support structure then cast around the suspended trackwork. ('top-down' method of construction)

c) *Purpose*

The trackbase shall be required to:

- distribute track loads from the rail fasteners both laterally and vertically
- maintain uniform line and level of the trackform
- provide adequate drainage.

d) *Quality*

The trackbase shall be designed to support the track structure for a period of 120 years.

3.4.5.2 *Floating Slab Track*

a) Floating Slab Track sections may be required in or near to station areas in order to comply with vibration criteria as defined in Section 2 of this Manual.

b) The arrangement shall be designed as a mass-spring system which will allow for vertical movement of the floating slab on its bearings independent from the supporting structure.

c) Floating Slab Track shall be designed to have a natural frequency at or below 16Hz and to provide a minimum vibration attenuation of 20dB(A) in the frequency range 63-250Hz.

d) Provision shall be made to access the bearings either from the side of the trackform or through centrally located manholes for inspection purposes.

3.4.5.3 *Isolated Slab Track*

a) Isolated Slab Track may be required in or near to station or residential areas to comply with vibration criteria defined in Section 2 of this Manual.

b) The arrangement shall be designed as a mass-spring system which will allow for the vertical movement of the isolated slab on the ballast mat independent from the supporting structure.

c) Isolated Slab Track shall be designed to have a natural frequency at or below 25Hz and to provide a minimum vibration attenuation of 15dB(A) in the frequency range 63-250Hz.

3.4.6 Corrosion Control Design

Stray Current Control

3.4.6.1 Rail to earth resistance shall be increased between track and structure to provide protection to the infrastructure from stray currents. Track components shall be arranged such that all metal components are separated by insulating materials in order to increase the stray current leakage path from the rail to earth. The design shall ensure that moisture and dirt cannot accumulate at the interfaces between the various components. (See Section 7 of this Manual for details.)

3.4.6.2 The design of insulating materials shall ensure a minimum rail-to-earth resistance of 100 ohms km of single track for ballasted tracks and 250 ohms km of single track for non-ballasted tracks.

3.4.6.3 Suitable rail protection against atmospheric corrosion or moisture shall be provided by means of non-carcinogenic paint protection, particularly in areas with an aggressive environment.

3.4.7 Rail Selection

The specified rail section has been selected on the basis of a cost-benefit analysis of the various sections available, due allowance for design axle load, train speed, predicted traffic levels, fatigue loading, sleeper spacing, and relative costs for switches, crossings and rail movement joints. Head hardened rails shall be used on curves to reduce head wear and increase the design life.

Standard rail sections shall be used as follows:

- UIC60 Grade 900A and Grade 900A Heat Treated/Head Hardened - Running Lines
- UIC60 Grade 900A and BS90A(M) Wear Resisting A Grade - Depot Lines

3.4.8 Rail Inclination

Rails shall be inclined at 1:20 on all plain line and in Running Line switches and crossings.

3.4.9 Rail Analyses and Design

3.4.9.1 Rail shall be designed taking due cognizance of the lateral and longitudinal loads induced in the track, both on straight and curved track.

3.4.9.2 Similarly the loads induced in the rail as a consequence of the trackform and supporting structure shall be similarly considered in the rail design.

3.4.10 Continuous Welded Rail

3.4.10.1 Rails shall be flash butt welded into continuous lengths, and welded *in situ* after installation to line and level to form continuous welded rails.

3.4.10.2 The rails shall not include any joints except for Insulated Rail Joints and Rail Movement Joints.

3.4.11 Welding and Destressing

After the rails have been placed to the correct line and level, they shall be destressed, except where located in tunnels, and the closing weld completed, using approved methods within the stress-free temperature range and in accordance with British Railways Engineering Handbook No. 11 or other national railway authority standard approved by the Corporation.

3.4.12 Flash Butt Welding

Except as detailed in Clause 3.4.13 below, all rails shall be flash butt welded by an approved welding process, to ensure consistent quality.

3.4.13 Alumino Thermic Welding

Alumino Thermic Welding shall only be used:

- in isolated locations on site which are inaccessible by mobile flash butt welder
- to install a closure rail e.g. after destressing
- to install an Insulated Rail Joint
- between switches and crossings and on crossovers
- in the Depot
- for remedial works.

3.4.14 Insulated Rail Joints

3.4.14.1 Insulated Rail Joints (IRJs) are required to separate track circuits for signalling purposes, or direct traction return currents between the running rails, and shall be capable of transmitting loads from stressed rails.

a) *Location*

IRJs shall be installed in plain line or within turnouts and in the Depot as defined by signalling and traction return current requirements. Installation in the Depot shall be in accordance with Section 5 of this Manual.

b) *Design*

They shall be to an approved design which has been in satisfactory service in an operating railway.

c) *Specification*

IRJ's shall conform to the requirements given in the Materials and Workmanship Specification for Trackwork and to the details shown in Standard Details.

3.4.15 Turnouts and Trap Points

Turnout Design

3.4.15.1 Turnouts shall be designed to facilitate the operational requirements, taking due cognizance of the alignment and train speed requirements.

3.4.15.2 Turnouts shall be designed for the following criteria:

- design maximum axle load of 20 tonnes
- rail section to be compatible with the running rails
- maximum line speed
- turnout angle to be compatible with junction speed requirement
- 600 switch movements per day
- loads as defined in Subsection 4.3

3.4.15.3 Turnouts shall incorporate the following :

a) Switches and crossings shall be to an inclined design.

b) The design shall include for all component parts and rail fastening assemblies required to enable the turnouts to be manufactured and installed in the track complete.

c) The track gauge through switches and crossings shall be 1 432 mm measured between the gauge corners of the rails in the plane tangential to the crown of the rails.

d) All switches and crossings in running lines shall be designed for installation in continuously welded track with all rail joints through the switches and crossings welded except at IRJ locations.

e) Switches and crossings shall be discretely supported on baseplates.

f) Switches and crossings in at grade sections on formation shall be supported on baseplates on timber or concrete bearers in ballast.

g) Where required, the turnouts shall be based on existing designs, which have been proven under similar service conditions and traffic density loadings and installed in continuously welded track. The slide chairs

shall incorporate low friction inserts or roller bearings.

h) All turnouts and associated components, located on Running Lines shall be designed for the Maximum Speed. Turnout components for use in the depot shall be designed for an operating speed of 45 km/h.

i) Where switches and fixed crossings are to be installed in continuously welded track, the rails in both switches and crossings shall be tied together to control differential movement between rails due to thermal stresses resulting from a variation in rail temperature of 40°C.

j) The geometrical design of the standard turnouts shall be as set out in Figures 3.2.5 and 3.2.6.

k) The transitioned turnouts which incorporate a tangential switch curve with varying turnout radius, shall be as set out in Figure 3.2.7.

l) Crossing angles are defined by Centre Line Measure (CLM).

m) A geometrical detail of each Junction shall be drawn and placed in a volume of Junction Layout drawings.

n) Baseplate assemblies throughout the turnouts shall incorporate the `Pandrol' rail fastening system. They shall be suitable for installation on either concrete or ballasted track. Baseplates shall be located on the concrete by means of cast-in bolts and to timbers by sleeper screws.

Switches

3.4.15.4 a) Each pair of switches consists of one left hand and one right hand stock rail, and one left hand and one right hand switch rail. They shall be designed to suit the UIC 60 section rail profile and be suitable for installation on either a non-ballasted or ballasted trackform.

b) Switch rail shall be designed to suit the special asymmetrical section rail UIC Section 60B (depot lines) or 60D (running lines). The stock rail shall be secured on the inner face by an elastic internal bracing clip located within the switch slide-plate .

c) The design shall provide for suitable flangeway clearance between the stock rail and the switch rail with the switch rail in the open position. The minimum flangeway clearance shall be not less than 56 mm.

d) Switches are required to be designed for installation in the following types of turnouts:

- standard curve out of straight
- similar flexure
- contra-flexure
- equal split

e) Soleplates shall be designed for use with switches on timber bearers. The soleplates shall be insulated. However, when they are for use with manually operated switches the soleplates shall be non-insulated.

f) Soleplates may be required for switches on non-ballasted trackform, depending on the designated Signalling Contractors point machine requirement. Where required, the soleplates shall be insulated.

g) The switch design shall include drilling details for point machines to suit the designated Signalling Contractor's requirement.

h) Stretcher bars shall be designed to be adjustable and insulated.

i) For manually operated switches, a switch hand-lever shall be provided and shall be capable of setting the switches for either the through track or turnout track. The handle shall be of a hinge type construction which will allow it to remain horizontal and below rail level until the switches are required to be operated.

Common Crossings

3.4.15.5 a) Common crossings shall be designed to suit the UIC 60 section rail profile and be suitable for installation on either a non-ballasted or ballasted trackform.

b) Crossings for use in main lines shall be one of the following:

- cast mono-block
- swing nose crossing
- flexibly moveable point rail and splice rail
- flexibly moveable wing rails.

c) The type of crossing to be utilised shall be suitable for the crossing angle of the turnout in which it is to be installed.

d) The crossings for use in depot sidings shall be fabricated spliced nose crossings.

e) Fabricated crossings shall be designed to suit the use of high tension multi-groove friction grip pins.

f) Check rails shall be of UIC 33 section rail and be rigidly fastened to the adjacent running rail to provide adequate flangeway clearance.

g) The length of check rail and the flare at the check rail ends shall be designed to suit the angle of the crossing and the allowable maximum speed.

Obtuse Crossings (in Diamond Crossings)

3.4.15.6 a) Obtuse crossings shall be designed to the rail profile and be suitable for installation on either a non-ballasted or ballasted trackform.

b) Obtuse crossings for use in running lines shall be of mono-block design.

c) Obtuse crossings for use in depot sidings shall be of standard fabricated design and shall be suitable for installation on ballasted track with crossing timbers.

d) Fabricated crossings shall be designed to suit the use of high tension multi-groove friction grip pins.

e) Obtuse crossings are required in diamond crossings with:

- both tracks straight
- both tracks curved

Adequate flangeway clearances shall be provided for both check rails and wing rails.

Trap Points

3.4.15.7 Trap points shall be designed to derail any train proceeding from a secondary line onto a main line without authorization in such a manner that the derailed train is guided parallel or away from the main line, and brought to rest within less than a car length. The infrastructure shall be designed to accommodate the derailed portion of the train accordingly.

3.4.16 Rail Movement Joints

General

3.4.16.1 Rail Movement Joints (RMJs) shall be installed at junctions between continuously welded and jointed track (ballasted trackform), and adjacent to all structural movement joints where shrinkage, creep and/or temperature movements occur.

3.4.16.2 Rail Movement Joints are required to accommodate all longitudinal and rotational movements within the track. They shall be designed to incorporate the full section rail profile.

3.4.16.3 Maximum rail span between baseplate supports on adjacent structures shall be not more than 950 mm (c/c).

Rail Movement Joint Design

3.4.16.4 The design of RMJs shall incorporate all movement ranges of the support structure, train design speed and the requirements of this Manual.

Movement Range

3.4.16.5 RMJs shall be designed for the following range of movements horizontally along the track:

RMJ Type 1 : total movement ≤ 150mm, ie +/- 75mm
RMJ Type 2 : total movement up to 600mm, ie +/- 300mm

3.4.16.6 The range and type of predicted movement of the Movement Joints (MJs) located in the support structure are used to determine the Type of RMJ required.

3.4.16.7 Total structural movements to be accommodated are included in the Schedule of RMJs. The required format for the presentation of the RMJ movement information is given in the Drawing and CADD Manual.

3.4.16.8 For RMJ Type 1 the design shall be suitable for use in both ballasted and non-ballasted trackforms.

3.4.16.9 For RMJ Type 2 the design shall be suitable for use in non-ballasted trackforms only.

3.4.16.10 If the total range of movement for the RMJ exceeds 600mm, the designer shall notify the Corporation's Representative and additionally design a support beam for each rail across the movement joint.

3.4.16.11 RMJ's shall be located on straight track (horizontal and vertical planes) in order to minimise the influence of secondary movements on the design operation and maintenance of the RMJs. Exceptions shall only be permitted with the approval of the Corporation's Representative.

3.4.16.12 Where RMJs are located in curved and canted track the design shall provide for the effects of trains running with the maximum allowable deficiency of cant of 110 mm.

3.4.17 Buffer Stops

a) *Types*

Three types are required. They are as follows:

- Type B1
  Multi-shoe friction type - used on Running Lines, other than terminal station locations and at the Depot except as shown below.
- Type B2
  Fixed buffer stops - on Depot tracks used by Engineers Trains.
- Type B3
  Multi-shoe friction type with hydraulic buffer - used on Running Line terminal stations.

b) *Design*

Buffer stops shall be designed to achieve the following requirements:

- minimise initial impact forces
- apply an acceptable deceleration rate to the rolling stock

c) *Design Criteria*

Buffer stops shall be designed using the following design criteria:

- Mass of train = 511 t (loaded 8-car train: Running Line)
- Mass of train = 331 t (unloaded 8-car train: Sidings and Depot.)
- Maximum impact speed = 25 km/h (Restricted Manual)
- Available sliding length = 30 m

The phased build up of train consists shall be considered in the design of the buffer stops and, if required, friction shoes, shall be added to allow for the increasing train consist length in order to achieve the following buffer stop acceptance criteria :

Table 3.4.17T1 Acceptable Deceleration and Jerk Values

	Deceleration (m/s^2)	**Jerk (m/s^3)**	**Train Loaded State (tonnes)**
1. Free standing passenger	1.2	1.5	511
2. Standing passenger with hand hold	2	3	511
3. Seated passengers	3.5	4	331

The buffer stop deceleration and jerk acceptance values may be combined with the train loaded state as noted above in order to rationalize the design of the buffer stops.

The buffer stop design shall make due allowance for the potential variability of the retardation elements and shall clearly establish the range of retardation factors to be considered in the design. In this respect the likely retardation factor when combined with the above design criteria shall meet the acceptable deceleration and jerk noted above.

The highest retardation factors when similarly applied shall not exceed the above acceptable value by more than 10%.

Consideration of the lowest retardation factor, when similarly applied, shall not cause the buffer stop sliding length to be overrun and in any event shall not give rise to deceleration and jerk values in excess of the acceptance value.

d) *End of Track Clearance*

Wherever buffer stops are located, there shall be a minimum one metre clearance between the end of the track and any solid obstruction, eg. tunnel and wall.

3.4.18 Depot Trackwork

The design of the Depot trackforms shall be fully compatible with the type of supporting structure, and with the requirements of the various activity areas within the Depot. These are defined as follows:

Areas	Trackform Type
Stabling Sidings and Fan Areas	Ballasted track
Main Depot Building	
· Maintenance tracks (at Inspection Pits)	Rails on steel beams supported by columns
· Roadway crossings	Paved/Embedded rails
· Bogie changing tracks	Paved/Embedded rails
· Heavy cleaning track	Non-ballasted baseplated track
Train Wash Facilities	
· Train Wash	Concrete columns
· Underframe Wash	Non-ballasted baseplated track
Permanent Way Depot	
· Arrival Sidings and Fan Area	Ballasted
· Locomotive Maintenance and Inspection Vehicle Maintenance Building	Inspection pit and Paved/Embedded rails.
· Rail Stacking Platform	Paved/Embedded rails
· Ballast Stockpile Siding	Paved/Embedded rails
· Track Machine Sidings	Ballasted track
Level Crossings	Pre-cast concrete panels, pre-formed rubber panels or Embedded Rail

Table 3.4.18T1 - Depot Trackform Types

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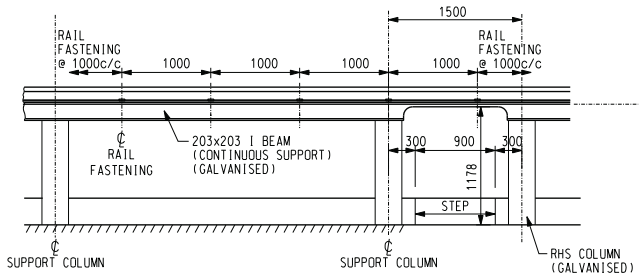
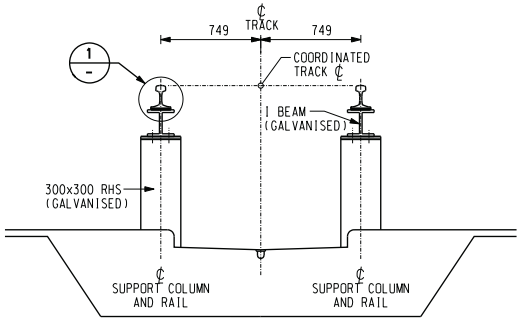
NOTE :

1. BOLT HOLES TO BE DRILLED THOROUGHLY DEGREASED AND CLEANED BEFORE CORROSION PROTECTION BY "GALVAFROID" PAINT OR SIMILAR APPROVED.
2. UIC 60 RAIL SECTION SHOWN ON ALL DETAILS.



MAINTENANCE PIT - ELEVATION
SCALE 1 : 60



TYPICAL SECTION BETWEEN SUPPORTS
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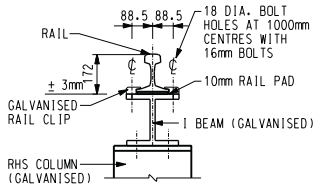
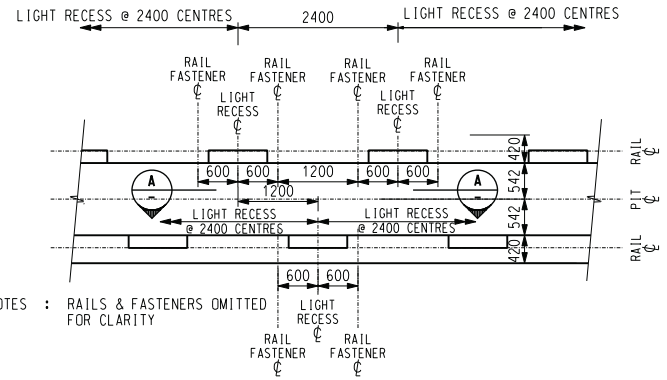


RAIL FIXING LOCATION
DETAIL 1
SCALE 1 : 20

DEPOT MAINTENANCE PIT TRACKFORM



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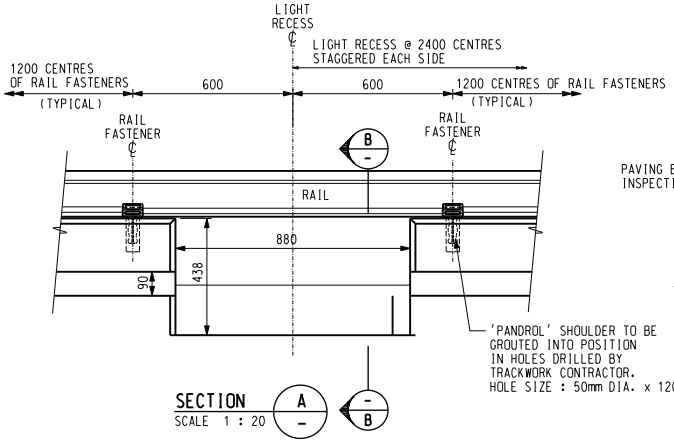
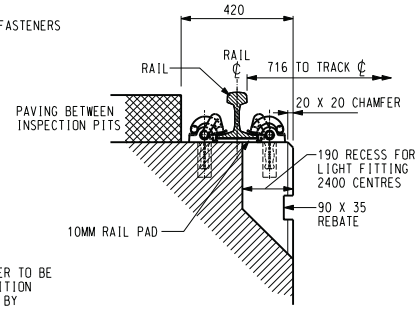
SCALE 1 : 80



SECTION A-B
SCALE 1 : 20



SECTION B
SCALE 1 : 20

DEPOT INSPECTION PIT TRACKFORM

This drawing is approved on 10 October 2005

Signed:

A.M.Gibson (CDM)

REVISION	DESCRIPTION	BY	DATE	APPROVED
A	FIRST ISSUE	TC	10/05	AMG

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MTR TOWER
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NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE
PERMANENT WAY
DEPOT TRACKFORM -
MAINTENANCE PIT TRACKFORM &
INSPECTION PIT TRACKFORM

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DATE	OCTOBER 2005	AS BUILT DWG NO	-	-	
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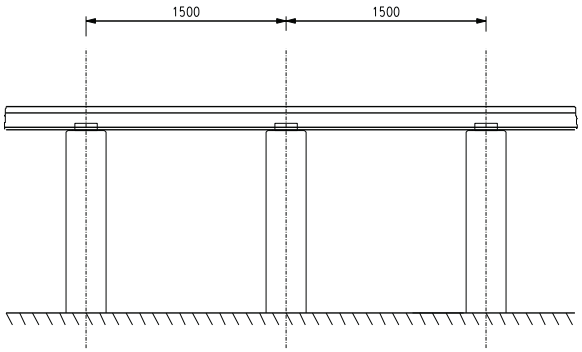

UNDERFRAME WASH - CONCRETE COLUMNS
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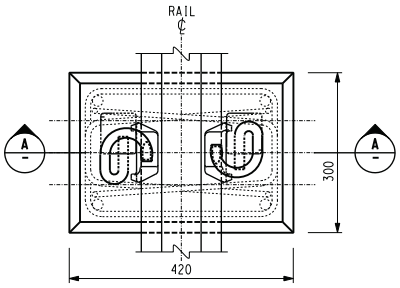
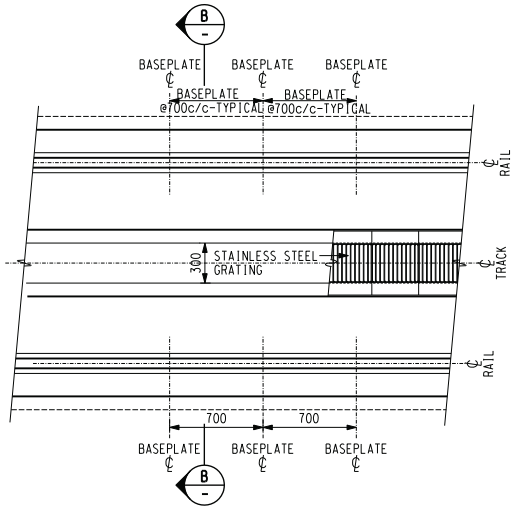
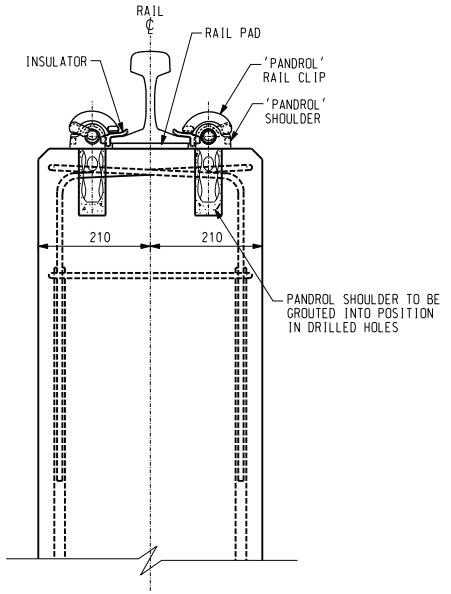


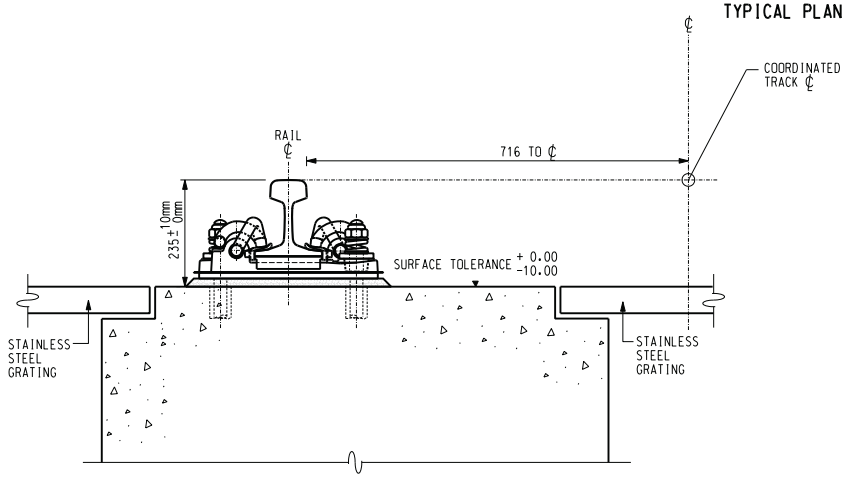
PLAN
SCALE 1 : 10



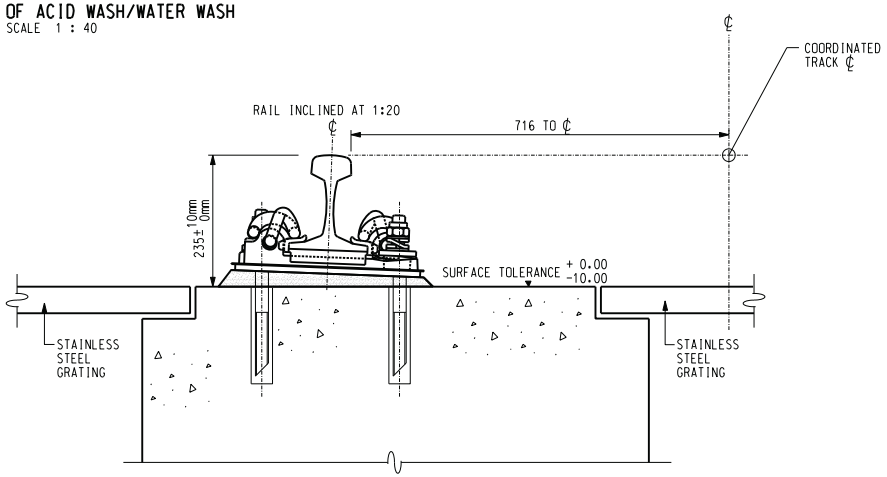
TYPICAL PLAN OF ACID WASH/WATER WASH
SCALE 1 : 40



SECTION A
SCALE 1 : 10



DEPOT ACID WASH



DEPOT WATER WASH

SECTION B
SCALE 1 : 10

NOTES :

1. UIC 60 RAIL SECTION SHOWN ON ALL DETAILS

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on 10 October 2005

Signed:

A.M.Gibson (CDM)

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A	FIRST ISSUE	TC	10/05	AMG

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NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE
PERMANENT WAY
DEPOT TRACKFORM -
UNDERFRAME WASH &
DEPOT ACID WASH / WATER WASH

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DATE	OCTOBER 2005	AS BUILT DWG NO	-	-	
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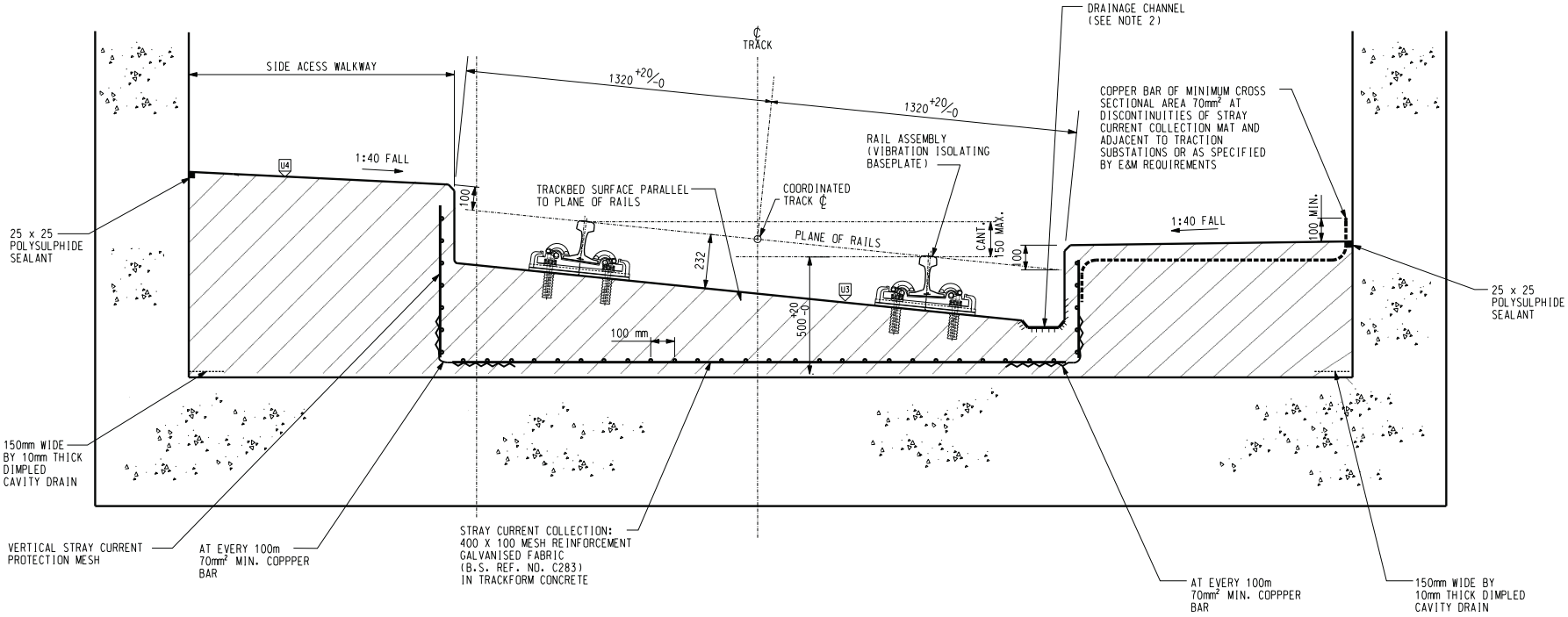

TYPICAL CROSS SECTION THROUGH RECTANGULAR TUNNEL WITH CANTED TRACK

SCALE 1:20

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NOTES:

1. NOMINAL CONCRETE COVER TO STRAY CURRENT COLLECTION MAT SHALL BE 50mm.
2. SURFACE DRAINAGE TO FLOW BY GRAVITY TO TUNNEL LOW POINT AND TO BE CONNECTED INTO MAIN DRAINAGE.
3. TRACKFORM CONCRETE TO BE CLASS 30/20 CATEGORY 'B' NON-METALLIC FIBRE REINFORCED CONCRETE IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS.
4. THE LOCATION OF THE SIDE ACCESS WALKWAY IS INDICATIVE ONLY. EXACT LOCATION OF SIDE ACCESS SHALL BE DETERMINED BY THE DESIGNATED CONTRACTOR FOR TRACKSIDE AUXILIARIES.
5. TRANSVERSE JOINTS AND MOVEMENT JOINTS TO BE PROVIDED TO THE TRACKFORM CONCRETE AS PER M & W SPECIFICATION FOR TRACKWORK.
6. AT EVERY 100 METRES, THE TRACKWORK CONTRACTOR IS REQUIRED TO CONNECT VERTICAL STRAY CURRENT MESH AND HORIZONTAL MESH WITH COPPER BAR BY BRAZING OR SIMILAR MEANS APPROVED.
7. LAP LENGTH OF COPPER BAR TO BE 300 MIN.

LEGEND :

SUPPORT STRUCTURE CONCRETE

TRACKFORM CONCRETE

This drawing is approved on 10 October 2005

Signed:

A.M.Gibson (CDM)

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A	FIRST ISSUE	TC	10/05	AMG

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CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
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TITLE
PERMANENT WAY
VIBT TRACKFORM – RECTANGULAR TUNNEL

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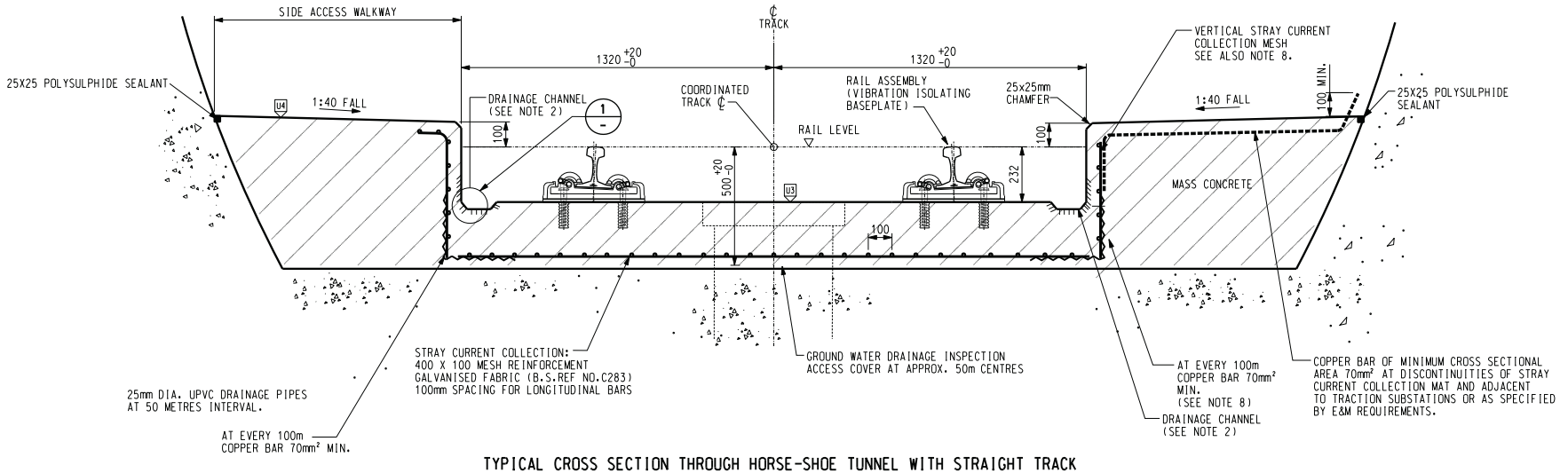
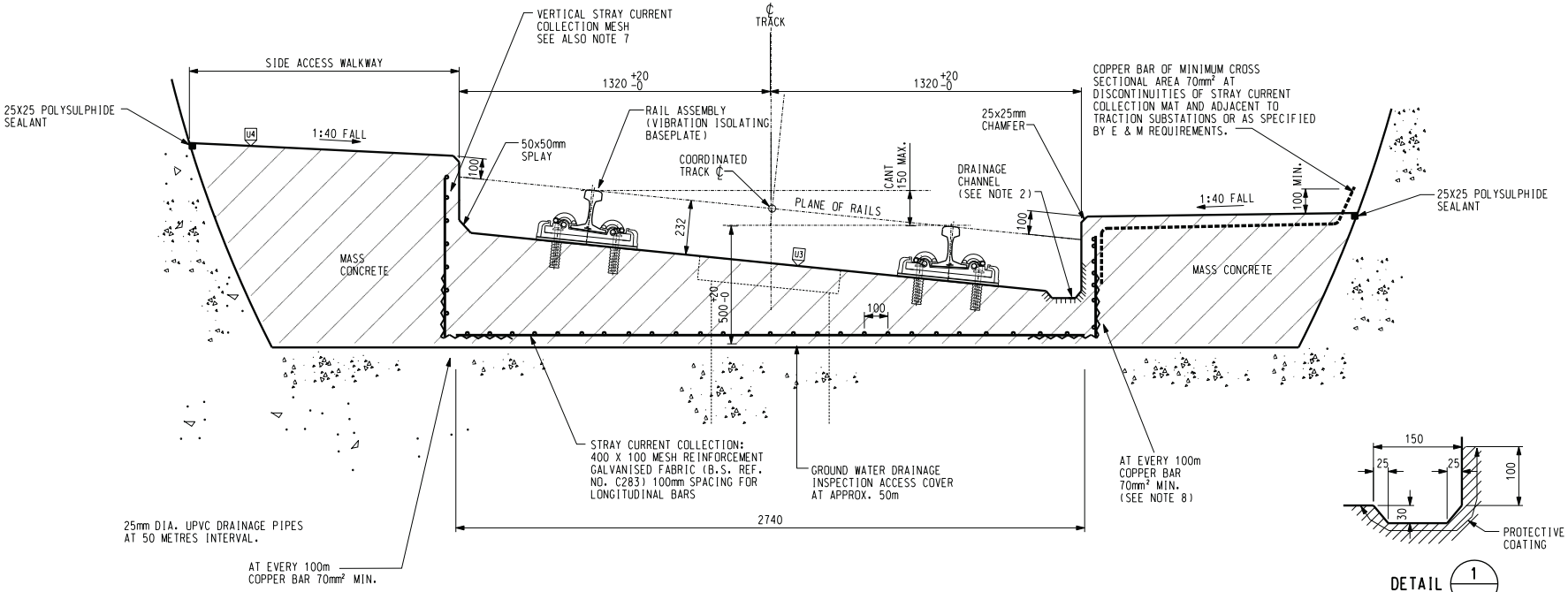


TYPICAL CROSS SECTION THROUGH HORSE-SHOE TUNNEL WITH STRAIGHT TRACK

SCALE 1:20



TYPICAL CROSS SECTION THROUGH HORSE-SHOE TUNNEL WITH CANTED TRACK

SCALE 1:20

DETAIL 1

SCALE 1:2.5

NOTES:

1. NOMINAL CONCRETE COVER TO STRAY CURRENT REINFORCEMENT SHALL BE 50mm.
2. TUNNEL SURFACE DRAINAGE TO FLOW BY GRAVITY TO LOW POINT AND TO BE CONNECTED INTO MAIN DRAINAGE.
3. TRACKFORM CONCRETE TO BE CLASS 30/20 CATEGORY 'B' NON-METALLIC FIBRE REINFORCED CONCRETE IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS.
4. TUNNEL SECTIONS SHOWN ARE FOR HORSE-SHOE TUNNEL. SIMILAR DETAILS SHALL APPLY TO CIRCULAR TUNNEL.
5. THE LOCATION OF THE SIDE ACCESS WALKWAY IS INDICATIVE ONLY. EXACT LOCATION OF SIDE ACCESS WALKWAY SHALL BE DETERMINED BY THE DESIGNATED CONTRACTOR FOR TRACKSIDE AUXILIARIES.
6. TRANSVERSE JOINTS AND MOVEMENT JOINTS TO BE PROVIDED TO THE TRACKFORM CONCRETE AS PER THE M & W SPECIFICATION FOR TRACKWORK.
7. AT EVERY 100 METRES, THE TRACKWORK CONTRACTOR IS REQUIRED TO CONNECT VERTICAL STRAY CURRENT MESH AND HORIZONTAL MESH WITH COPPER BAR BY BRAZING OR SIMILAR MEANS APPROVED.
8. LAP LENGTH OF COPPER BAR TO BE 300 MIN.

LEGEND :

SUPPORT STRUCTURE CONCRETE

TRACKFORM CONCRETE

This drawing is approved on 10 October 2005

Signed:

A.M.Gibson (CDM)

REVISION	DESCRIPTION	BY	DATE	APPROVED
A	FIRST ISSUE	TC	10/05	AMG

地鐵公司 MTR Corporation
MTR TOWER
TELFORD PLAZA – KOWLOON BAY
HONG KONG
TEL : 2993 2111 FAX : 2798 8822

NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE

PERMANENT WAY

VIBT TRACKFORM –
HORSE SHOE & CIRCULAR TUNNEL

SCALE	AS SHOWN	CAD REF	C04005.DGN	AS BUILT APPROVED	
DATE	OCTOBER 2005	AS BUILT DWG NO	–	–	
DRAWN	LFB	DESIGNED	TC	DRAWING NO	REV
CHECKED	TC	APPROVED	DE	NWS/S/GEN/PPW/C04/005	A

17/10/2005 .. 09:36:12 f:\nws\sgen\PPW\c04005.dgn

0 100mm ON ORIGINAL

CADD REF *grspec

PLOTTING TIME 1to1=1me

DO NOT SCALE DRAWINGS. VERIFY ALL DIMENSIONS ON SITE

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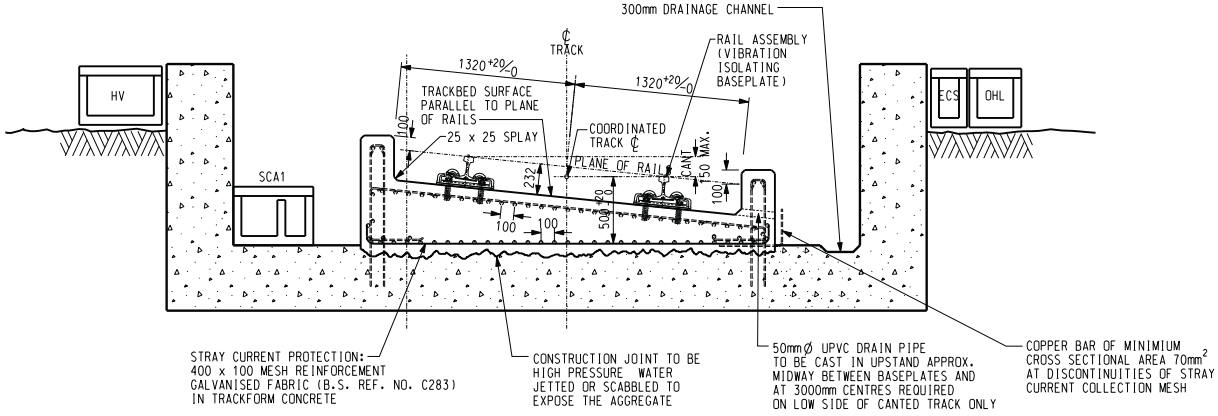
NOTES:

1. NOMINAL CONCRETE COVER TO STRAY CURRENT REINFORCEMENT SHALL BE 50mm.
2. TRACKFORM CONCRETE TO BE CLASS 40/20 CATEGORY 'A' IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS.
3. TRACK BASE TO BE IN DISCRETE LENGTHS IN ACCORDANCE WITH M&W SPECIFICATION FOR TRACKWORK.
4. FOR REINFORCEMENT DETAILS REFER TO DRAWING No. NWS/S/GEN/PPW/C04/007.



TYPICAL CROSS SECTION THROUGH CANTED VIBT TRACK AT OPEN TRACK SECTION

SCALE 1:40

This drawing is approved on 10 October 2005

Signed:

A.M.Gibson (CDM)

REVISION	DESCRIPTION	BY	DATE	APPROVED
A	FIRST ISSUE	TC	10/05	AMG

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HONG KONG
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NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE
PERMANENT WAY
VIBT TRACKFORM – OPEN SECTION

SCALE	AS SHOWN		CAD REF	C04006.DGN	AS BUILT APPROVED
DATE	OCTOBER 2005		AS BUILT DWG NO	–	–
DRAWN	LFB	DESIGNED TC	DRAWING NO	NWS/S/GEN/PPW/C04/006	REV A
CHECKED	TC	APPROVED DE			

DRAWING NO NWS/S/GEN/PPW/C04/006

17/10/2005 •• 09:37:32 f:\nws\sgen\PPW\C04006.dgn

CADD REF *gnspec

PLOTTING TIME Skyline

0 100mm ON ORIGINAL

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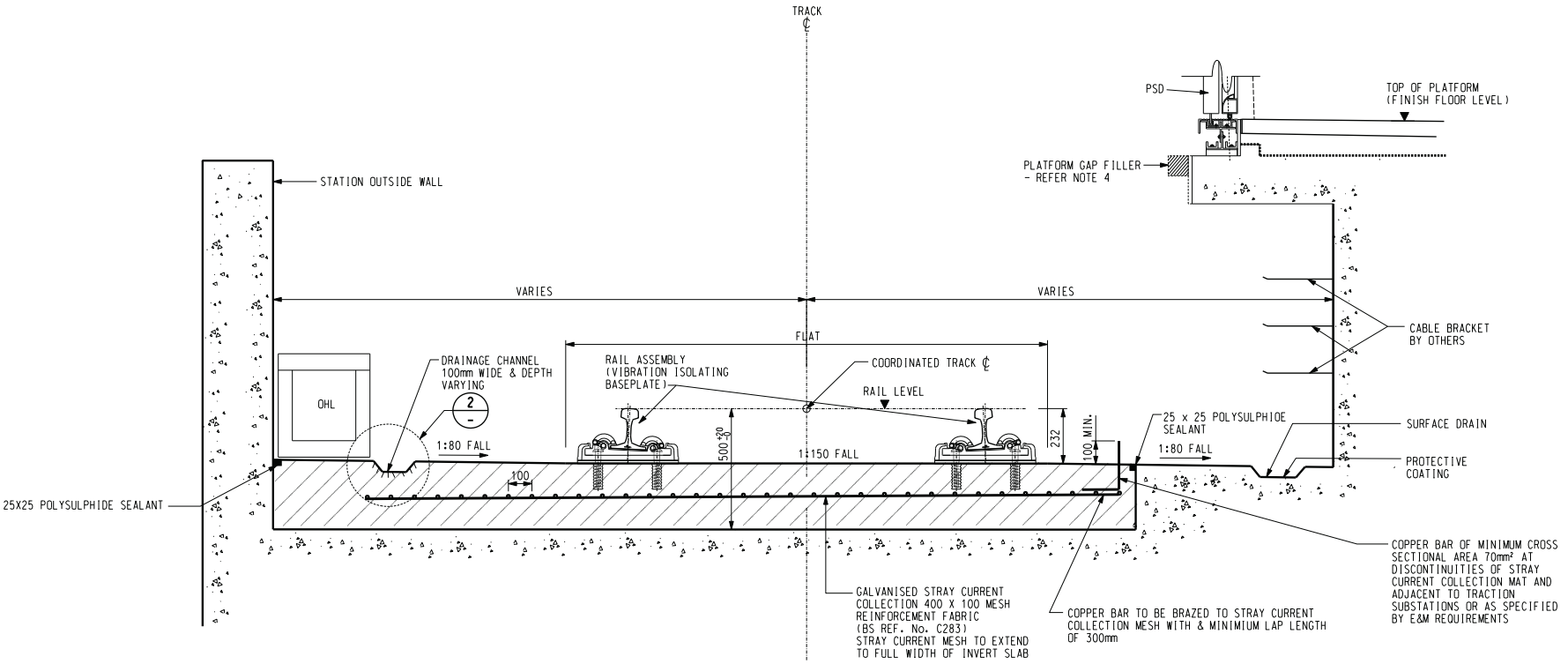
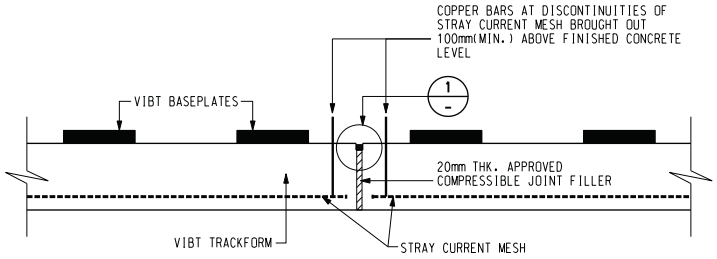
DRAWING NO
NWS/S/GEN/PPW/C04/008



TYPICAL SECTION THROUGH STATION VIBT TRACKFORM

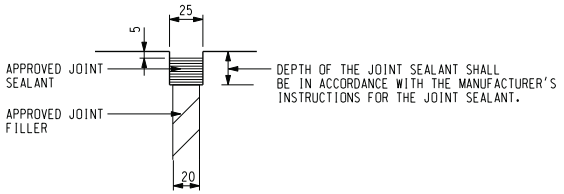
SCALE 1 : 20



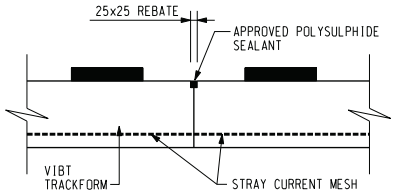
MOVEMENT JOINT

(TO BE PROVIDED AT MOVEMENT JOINTS OF SUPPORTING STRUCTURE AND AT LOCATIONS AS SPECIFIED IN THE M&W FOR TRACKWORK)

N.T.S.



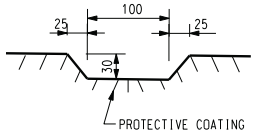
DETAIL 1 — SCALE 1 : 4



TRANSVERSE CONSTRUCTION JOINT

(TO BE PROVIDED AT A TYPICAL SPACING OF APPROX. 11.9m TO THE TRACKFORM CONCRETE. DETAILS AS PER M&W SPECIFICATION FOR TRACKWORK SECTION 4)

N.T.S.



DETAIL 2

NOTES :

1. NOMINAL CONCRETE COVER TO STRAY CURRENT REINFORCEMENT SHALL BE 50mm.
2. TRACKFORM CONCRETE TO BE CLASS 30/20 CATEGORY 'B' NON-METALLIC FIBRE REINFORCED CONCRETE IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS.
3. DRAINAGE TO BE CONNECTED TO THE UNDER PLATFORM DRAIN FORMED.
4. PLATFORM GAP FILLER TO BE INSTALLED TO EDGE OF PLATFORM COPING IF GAP BETWEEN TRAIN AND PLATFORM EXCEEDS 115mm. FOR FURTHER DETAIL REFER TO DRAWING No. NWS/S/GEN/PPW/C04/018.

LEGEND :

SUPPORT STRUCTURE CONCRETE

TRACKFORM CONCRETE

This drawing is approved on 10 October 2005

Signed:

A.M.Gibson (CDM)

REVISION	DESCRIPTION	BY	DATE	APPROVED
A	FIRST ISSUE	TC	10/05	AMG

地鐵公司 MTR Corporation
MTR TOWER
TELFORD PLAZA – KOWLOON BAY
HONG KONG
TEL : 2993 2111 FAX : 2798 8822

NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE

PERMANENT WAY

VIBT TRACKFORM – STATION

SCALE	AS SHOWN	CAD REF	C04008.DGN	AS BUILT APPROVED	
DATE	OCTOBER 2005	AS BUILT DWG NO	–		–
DRAWN	LFB	DESIGNED	TC	DRAWING NO	REV
CHECKED	TC	APPROVED	DE	NWS/S/GEN/PPW/C04/008	A

17/10/2005 .. 09:40:59 f:\nws\sgen\PPW\C04008.dgn

PLOTTING TIME 1to1=1me

CADD REF *grispec

0 100mm ON ORIGINAL

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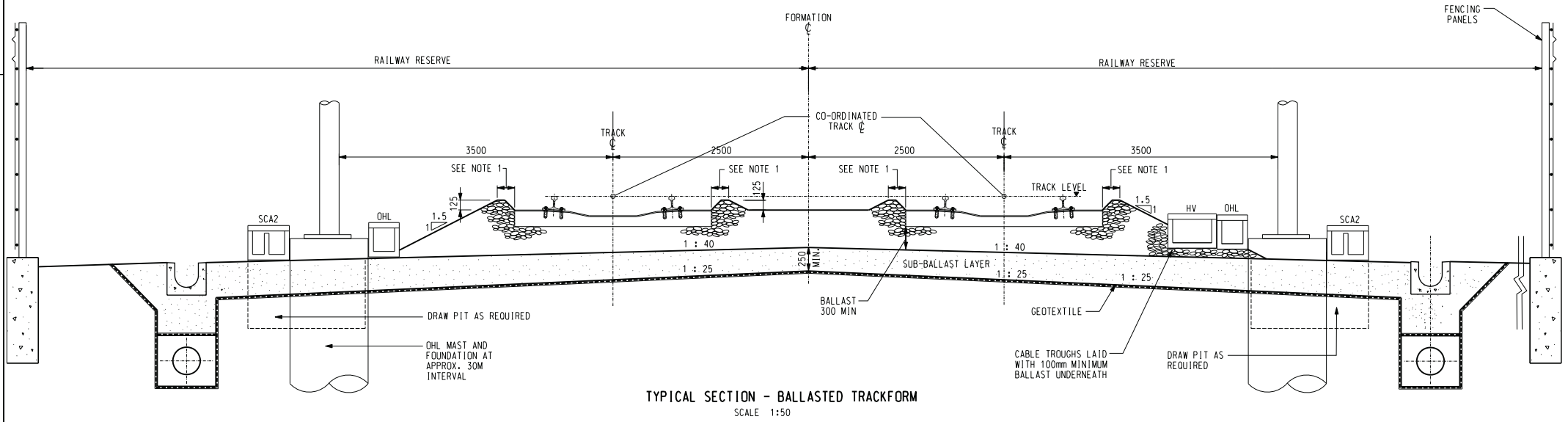
DRAWING NO
NWS/S/GEN/PPW/C04/009

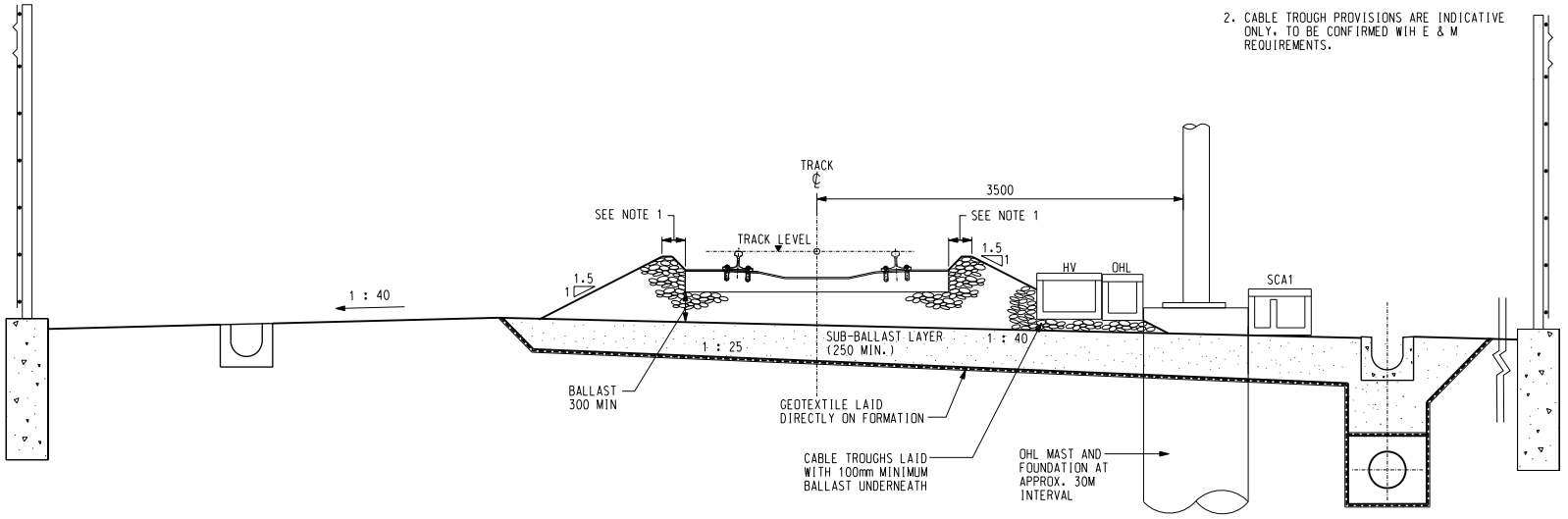


TYPICAL SECTION - BALLASTED TRACKFORM
SCALE 1:50

NOTES:

1. BALLAST SHOULDERS SHALL BE :-
   - STRAIGHT TRACK = 380mm
   - CURVES LARGER THAN 800 m RADIUS = 460mm
   - CURVES EQUAL AND LESS THAN 800 m RADIUS = 530 mm
   - ALL SHOULDERS TO BE HEAPED 125 mm ABOVE THE SLEEPER TOP LEVEL.

2. CABLE TROUGH PROVISIONS ARE INDICATIVE ONLY, TO BE CONFIRMED WIH E & M REQUIREMENTS.



TYPICAL SECTION - SINGLE BALLASTED TRACK
SCALE 1:50

This drawing is approved on 10 October 2005

Signed:
A.M.Gibson (CDM)

REVISION	DESCRIPTION	BY	DATE	APPROVED
A	FIRST ISSUE	TC	10/05	AMG

地鐵公司 MTR Corporation
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NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE
PERMANENT WAY
BALLASTED TRACKFORM

SCALE	AS SHOWN	CAD REF	C04009.DGN	AS BUILT APPROVED	
DATE	OCTOBER 2005	AS BUILT DWG NO	-	-	
DRAWN	LFB	DESIGNED	TC	DRAWING NO	REV
CHECKED	TC	APPROVED	DE	NWS/S/GEN/PPW/C04/009	A

CADD REF *gnspec

17/10/2005 ** 09:43:31 f:\nws\sgen\PPW\C04009.dgn

PLOTTING TIME Tay:rme

0 100mm ON ORIGINAL

DRAWING NO
NWS/S/GEN/PPW/C04/010

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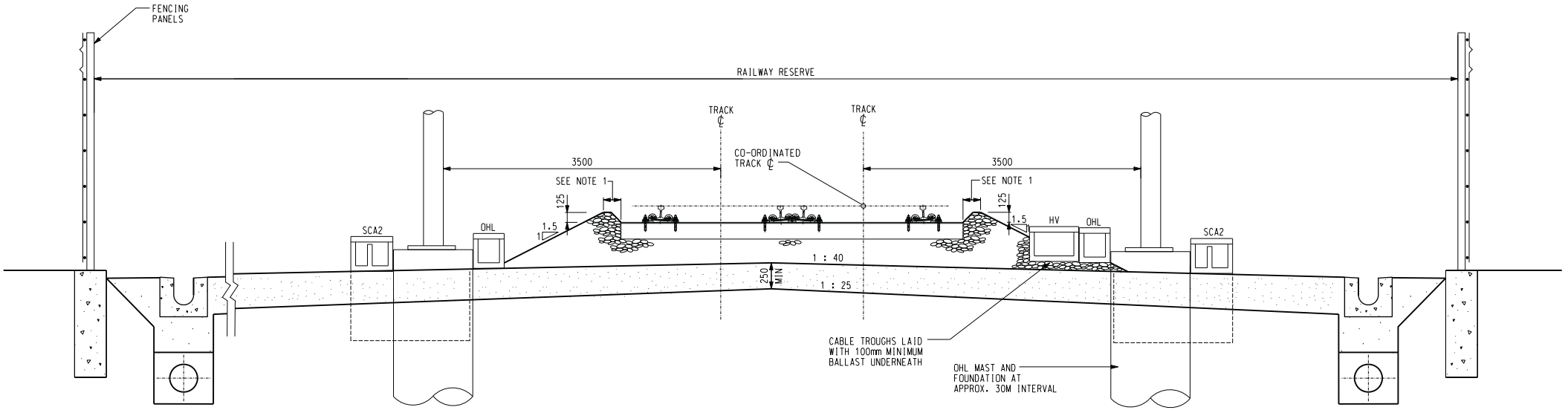
NOTES:

1. BALLAST SHOULDERS WERE :-
   - STRAIGHT TRACK = 380mm
   - CURVES LARGER THAN 800m RADIUS = 460mm
   - CURVES EQUAL AND LESS THAN 800m RADIUS = 530mm
   - ALL SHOULDERS WERE HEAPED 125mm ABOVE THE SLEEPER TOP LEVEL.

2. CABLE TROUGHS PROVISIONS ARE INDICATIVE ONLY, TO BE CONFIRMED BY E & M REQUIREMENTS.



TYPICAL SECTION - BALLASTED TURNOUT TRACKFORM

SCALE 1:50

This drawing is approved on 10 October 2005

Signed:

A.M.Gibson (CDM)

REVISION	DESCRIPTION	BY	DATE	APPROVED
A	FIRST ISSUE	TC	10/05	AMG

地鐵公司 MTR Corporation
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NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE
PERMANENT WAY
BALLASTED TRACKFORM - TURNOUT

SCALE	AS SHOWN	CAD REF	C04010.DGN	AS BUILT APPROVED	
DATE	OCTOBER 2005	AS BUILT DWG NO	-		-
DRAWN	LFB	DESIGNED	TC	DRAWING NO	REV
CHECKED	TC	APPROVED	DE	NWS/S/GEN/PPW/C04/010	A

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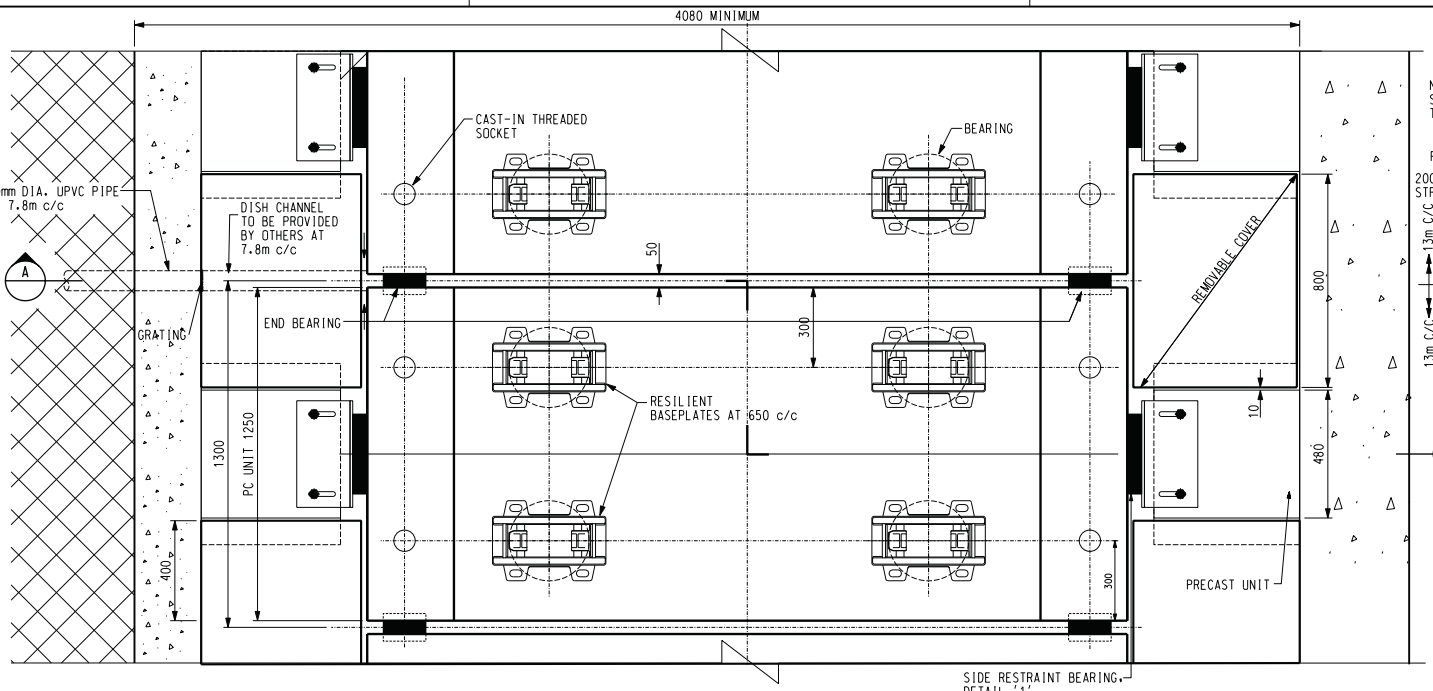
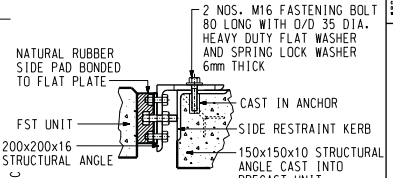
CADD REF *grspec

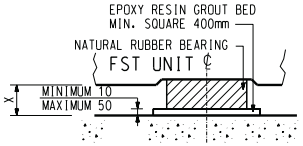
PLOTTING TIME 1to1=1me



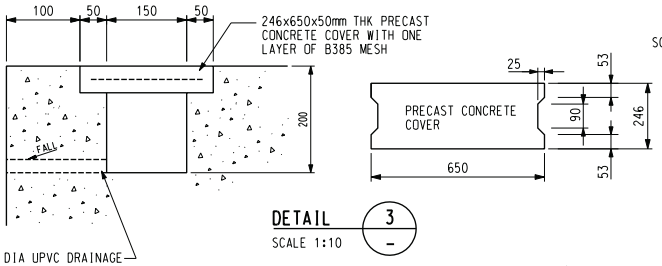
PLAN
SCALE 1:20



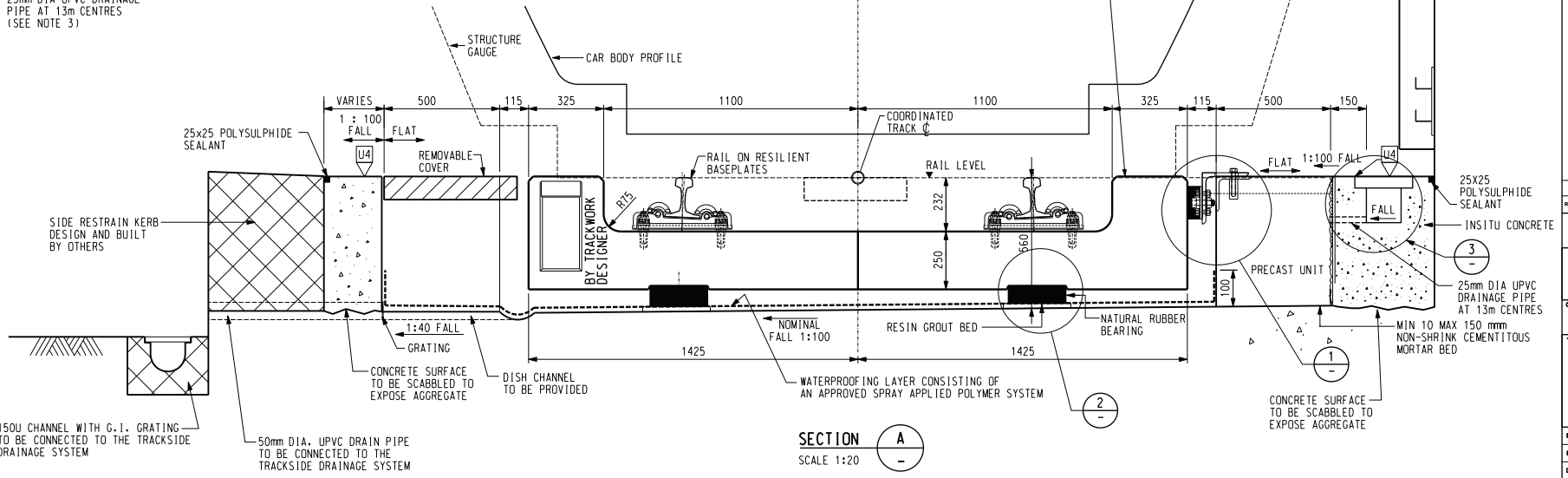
DETAIL 1
SCALE 1:20



DETAIL 2
SCALE 1:20
(WHERE 70 < X < 110)



DETAIL 3
SCALE 1:10



SECTION A
SCALE 1:20

NOTES:

1. A WATERPROOFING LAYER IS REQUIRED WITHIN THE STATION STRUCTURES.
2. BASEPLATES SHOWN ARE INDICATIVE ONLY.
3. DRAINAGE PIPES ARE TO BE LOCATED BETWEEN PRECAST SIDE RESTRAINT UNITS.
4. INSITU CONCRETE TO BE CLASS 30/20 CATEGORY "B" IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS.
5. PLATFORM GAP FILLER TO BE INSTALLED TO EDGE OF PLATFORM COPING IF GAP BETWEEN TRAIN AND PLATFORM EXCEEDS 115mm. FOR FURTHER DETAILS REFER TO DRAWING No. NWS/S/GEN/PPS/C04/018.

This drawing is approved on 10 October 2005

Signed:

A.M.Gibson (CDM)

REVISION	DESCRIPTION	BY	DATE	APPROVED
A	FIRST ISSUE	TC	10/05	AMG

MTR Corporation
MTR TOWER
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NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE
PERMANENT WAY
FLOATING SLAB TRACKFORM – STATION

SCALE	AS SHOWN	CAD REF	C04011.DGN	AS BUILT APPROVED	
DATE	OCTOBER 2005	AS BUILT DWG NO	-	-	
DRAWN	LFB	DESIGNED	TC	DRAWING NO	REV
CHECKED	TC	APPROVED	DE	NWS/S/GEN/PPW/C04/011	A

DRAWING NO NWS/S/GEN/PPW/C04/011

17/10/2005 ** 09:47:03 f:\nws\sgen\PPW\C04011.dgn

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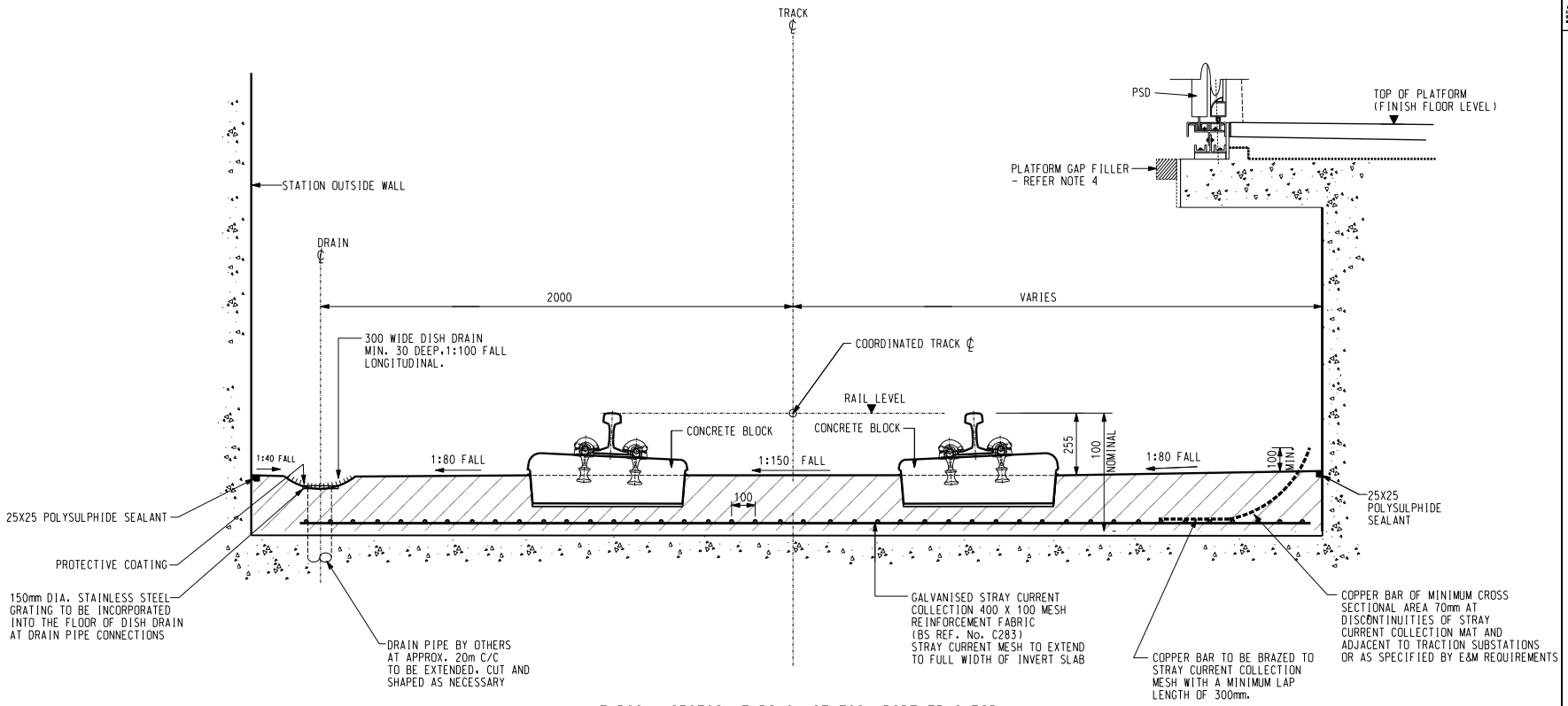
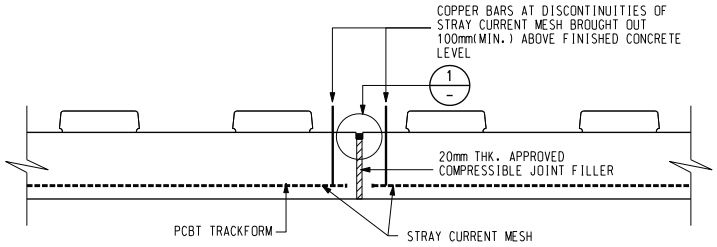
PLOTTING TIME 16:17:11

CADD REF *grspec

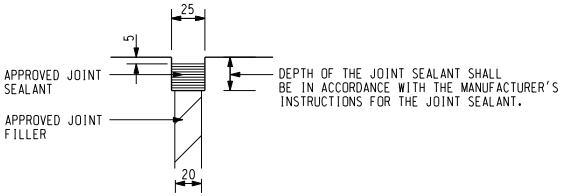
DRAWING NO
NWS/S/GEN/PPW/C04/012



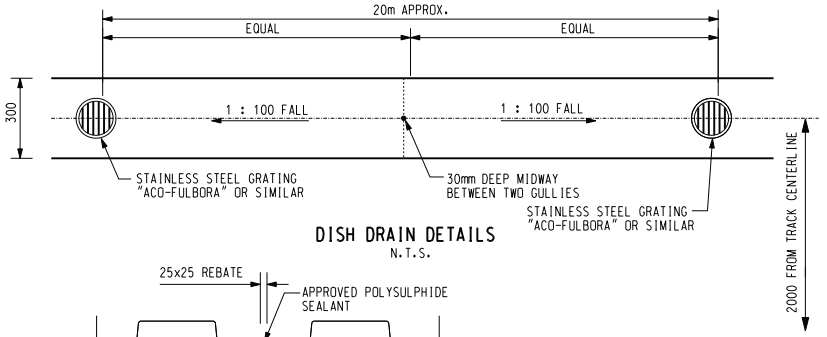
TYPICAL SECTION THROUGH STATION PCBT TRACKFORM
SCALE 1 : 20



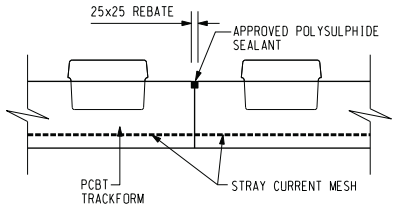
MOVEMENT JOINT
(TO BE PROVIDED AT MOVEMENT JOINTS OF SUPPORTING STRUCTURE AT LOCATIONS AS SPECIFIED IN THE M&W FOR TRACKWORK)
N.T.S.



DETAIL 1
SCALE 1 : 4



DISH DRAIN DETAILS
N.T.S.



TRANSVERSE CONSTRUCTION JOINT
(TO BE PROVIDED AT A TYPICAL SPACING OF APPROX. 11.9m TO THE TRACKFORM CONCRETE AS PER M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS VOLUME 1 SECTION 8)
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NOTES :

1. NOMINAL CONCRETE COVER TO STRAY CURRENT REINFORCEMENT SHALL BE 50mm.
2. TRACKFORM CONCRETE TO BE CLASS 30/20 CATEGORY 'B' NON-METALLIC FIBRE REINFORCED CONCRETE IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS
3. LAP LENGTH OF COPPER BAR TO BE 300mm MIN.
4. PLATFORM GAP FILLER TO BE INSTALLED TO EDGE OF PLATFORM COPING IF GAP BETWEEN TRAIN AND PLATFORM EXCEEDS 115mm. FOR FURTHER DETAILS REFER TO DRAWING No. NWS/S/GEN/PPW/C04/018.

LEGEND :

SUPPORT STRUCTURE CONCRETE

TRACKFORM CONCRETE

This drawing is approved on 10 October 2005

Signed:

A.M.Gibson (CDM)

REVISION	DESCRIPTION	BY	DATE	APPROVED
A	FIRST ISSUE	TC	10/05	AMG

地鐵公司 MTR Corporation
MTR TOWER
TELFORD PLAZA - KOWLOON BAY
HONG KONG
TEL : 2993 2111 FAX : 2798 8822

NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE
PERMANENT WAY
PCBT TRACKFORM - STATION

SCALE	AS SHOWN	CAD REF	C04012.DGN	AS BUILT APPROVED	
DATE	OCTOBER 2005	AS BUILT DWG NO	-	-	
DRAWN	LFB	DESIGNED	TC	DRAWING NO	REV
CHECKED	TC	APPROVED	DE	NWS/S/GEN/PPW/C04/012	A

17/10/2005 .. 09:48:07 f:\nws\sgen\PPW\C04012.dgn
PLOTTING TIME Skyline
CADD REF *grspec
0 100mm ON ORIGINAL

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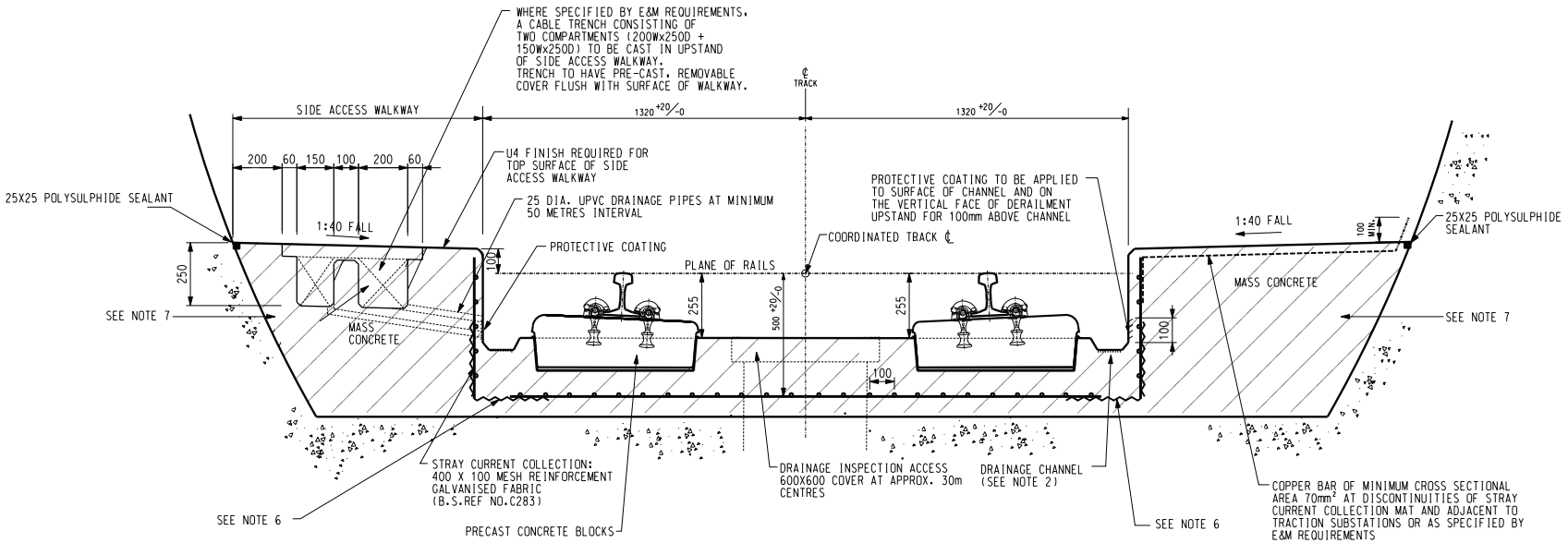
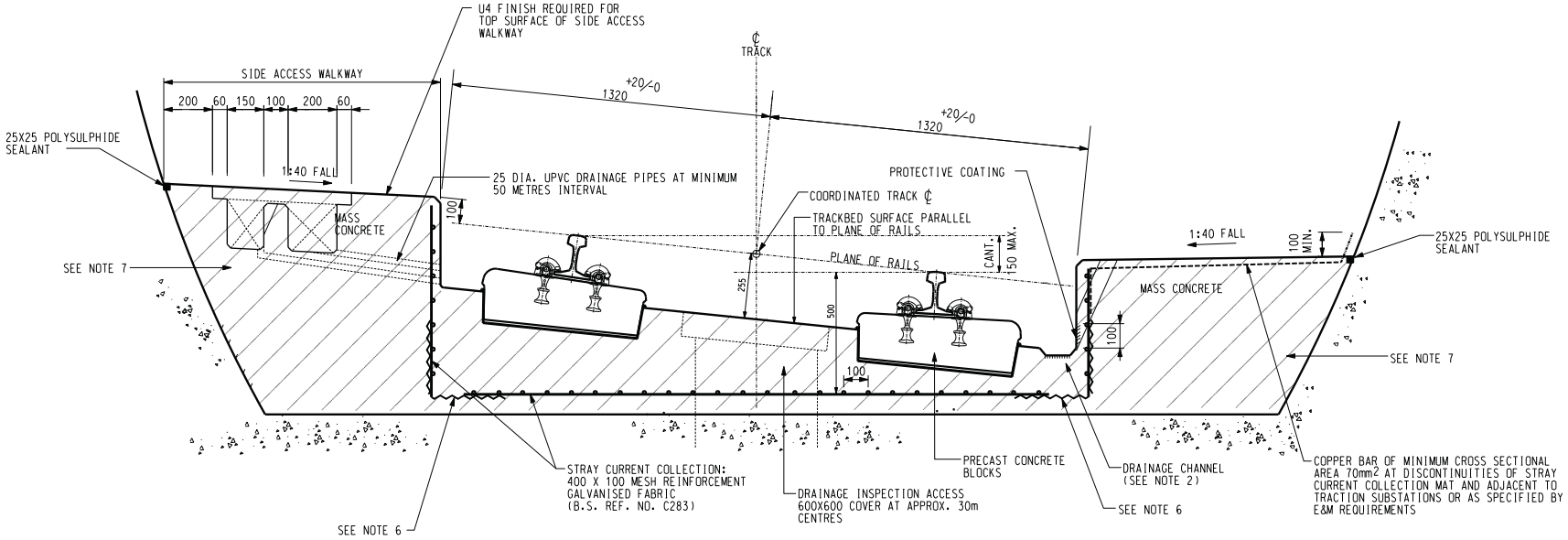


TYPICAL CROSS SECTION THROUGH HORSE-SHOE TUNNEL WITH STRAIGHT TRACK

SCALE 1:20



TYPICAL CROSS SECTION THROUGH HORSE-SHOE TUNNEL WITH CANTED TRACK

SCALE 1:20

NOTES:

1. NOMINAL CONCRETE COVER TO STRAY CURRENT REINFORCEMENT SHALL BE 50mm.
2. TUNNEL SURFACE DRAINAGE TO FLOW BY GRAVITY TO LOW POINT AND TO BE CONNECTED INTO MAIN DRAINAGE.
3. TRACKFORM CONCRETE TO BE CLASS 30/20 CATEGORY 'B' NON-METALLIC FIBRE REINFORCED CONCRETE IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS.
4. TUNNEL SECTIONS SHOWN ARE FOR HORSE-SHOE TUNNEL. SIMILAR DETAILS SHALL APPLY TO CIRCULAR TUNNEL.
5. THE LOCATION OF THE SIDE ACCESS WALKWAY IS DEFINED ON SEPARATE DRAWING.
6. AT EVERY 100 METRES, THE CONTRACTOR IS REQUIRED TO CONNECT VERTICAL STRAY CURRENT MESH TO HORIZONTAL STRAY CURRENT MESH USING A COPPER BAR OF MIN. CROSS SECTIONAL AREA 70mm² ATTACHED BY BRAZING OR A MEANS APPROVED BY THE ENGINEER.
7. THE SIDE ACCESS WALKWAY AND THE DERAILMENT UPSTAND SHALL BE CONSTRUCTED, INCLUDING ALL CAST IN ITEMS SHOWN, BY THE CONTRACTOR AT ALL TEMPORARY ACCESS SHAFT OPENINGS
8. LAP LENGTH OF COPPER BAR TO BE 300mm MIN.

LEGEND :

SUPPORT STRUCTURE CONCRETE

TRACKFORM CONCRETE

This drawing is approved on 10 October 2005

Signed:

A.M.Gibson (CDM)

REVISION	DESCRIPTION	BY	DATE	APPROVED
A	FIRST ISSUE	TC	10/05	AMG

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TELFORD PLAZA – KOWLOON BAY
HONG KONG
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NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE
PERMANENT WAY
PCBT TRACKFORM –
HORSE-SHOE AND CIRCULAR TUNNEL

SCALE	AS SHOWN	CAD REF	C04013.DGN	AS BUILT APPROVED	
DATE	OCTOBER 2005	AS BUILT DWG NO	-		-
DRAWN	LFB	DESIGNED	TC	DRAWING NO	REV
CHECKED	TC	APPROVED	DE	NWS/S/GEN/PPW/C04/013	A

DRAWING NO NWS/S/GEN/PPW/C04/013

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PLOTTING TIME 1to1=1me

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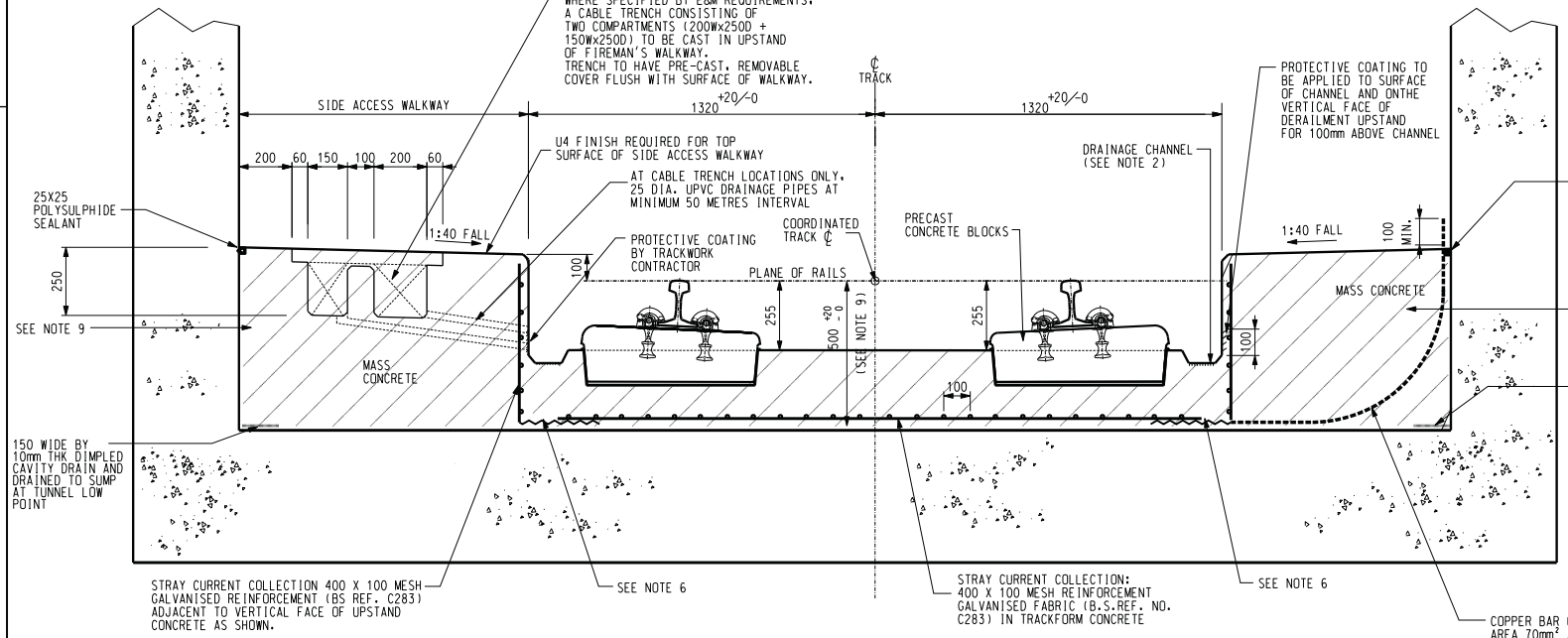
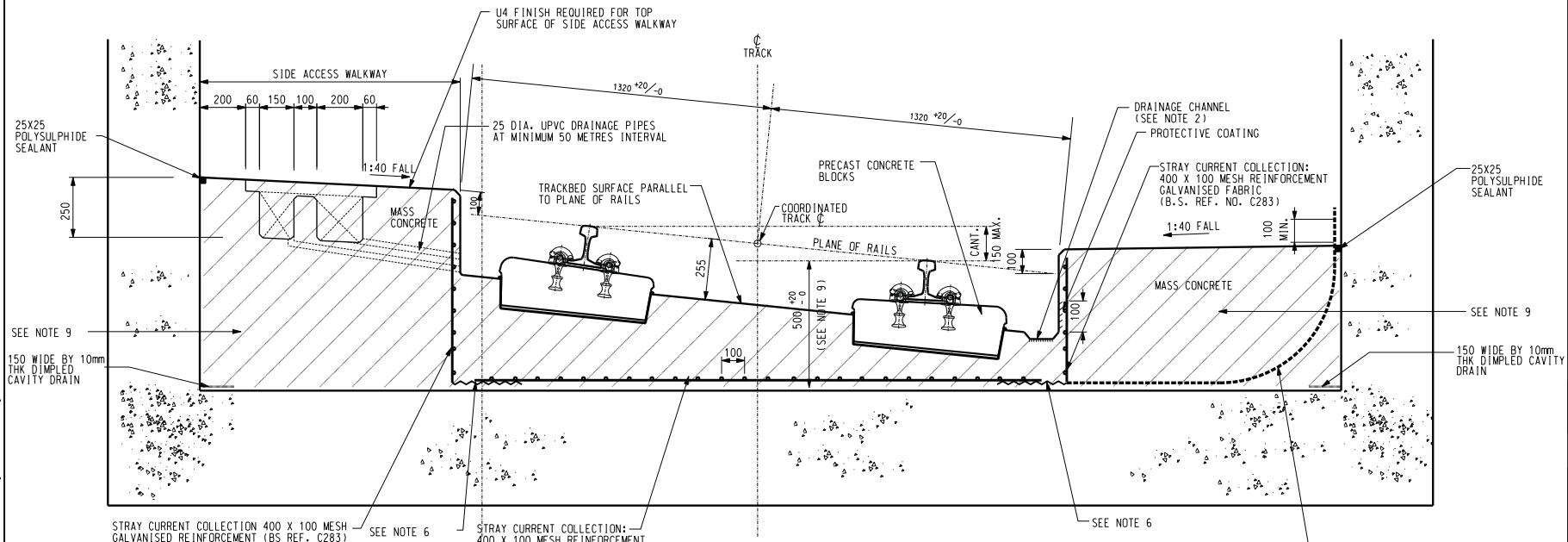


TYPICAL CROSS SECTION THROUGH CUT AND COVER TUNNEL WITH STRAIGHT TRACK

SCALE 1:20



TYPICAL CROSS SECTION THROUGH CUT AND COVER TUNNEL WITH CANTED TRACK

SCALE 1:20

NOTES:

1. NOMINAL CONCRETE COVER TO STRAY CURRENT REINFORCEMENT SHALL BE 50mm.
2. TUNNEL SURFACE DRAINAGE TO FLOW BY GRAVITY TO TUNNEL LOW POINT AND TO BE CONNECTED INTO MAIN CIVIL CONTRACT DRAINAGE.
3. TRACKFORM CONCRETE TO BE CLASS 30/20 CATEGORY 'B' NON-METALLIC FIBRE REINFORCED CONCRETE IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS.
4. DETAILS SHOWN ARE APPLICABLE TO CUT AND COVER TUNNELS ONLY.
5. THE LOCATION OF THE SIDE ACESS WALKWAY IS DEFINED ON INDIVIDUAL CIVIL CONTRACT DRAWINGS.
6. AT EVERY 100 METRES, THE TRACKWORK CONTRACTOR IS REQUIRED TO CONNECT VERTICAL STRAY CURRENT MESH AND HORIZONTAL MESH WIDTH COPPER BAR BY BRAZING OR SIMILAR MEANS APPROVED.
7. TRANSVERSE JOINTS AND MOVEMENT JOINTS TO BE PROVIDED TO THE TRACKFORM CONCRETE AS PER THE M & W SPECIFICATION FOR TRACKWORK. 2
8. THE MIN. DEPTH REQUIRED IS 500mm.
9. THE SIDE ACCESS WALKWAY AND THE DERAILMENT UPSTAND SHALL BE CONSTRUCTED, INCLUDING ALL CAST IN ITEMS SHOWN, BY THE CONTRACTOR AT ALL TEMPORARY ACCESS SHAFT OPENINGS.
10. LAP LENGTH OF COPPER BAR TO BE 300mM MIN.

LEGEND :

SUPPORT STRUCTURE CONCRETE

TRACKFORM CONCRETE

This drawing is approved on 10 October 2005

Signed:

A.M.Gibson (CDM)

REVISION	DESCRIPTION	BY	DATE	APPROVED
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NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE
PERMANENT WAY
PCBT TRACKFORM - CUT AND COVER TUNNEL

SCALE	AS SHOWN		CAD REF	C04014.DGN	AS BUILT APPROVED
DATE	OCTOBER 2005		AS BUILT DWG NO	-	-
DRAWN	LFB	DESIGNED TC	DRAWING NO	NWS/S/GEN/PPW/C04/014	REV A
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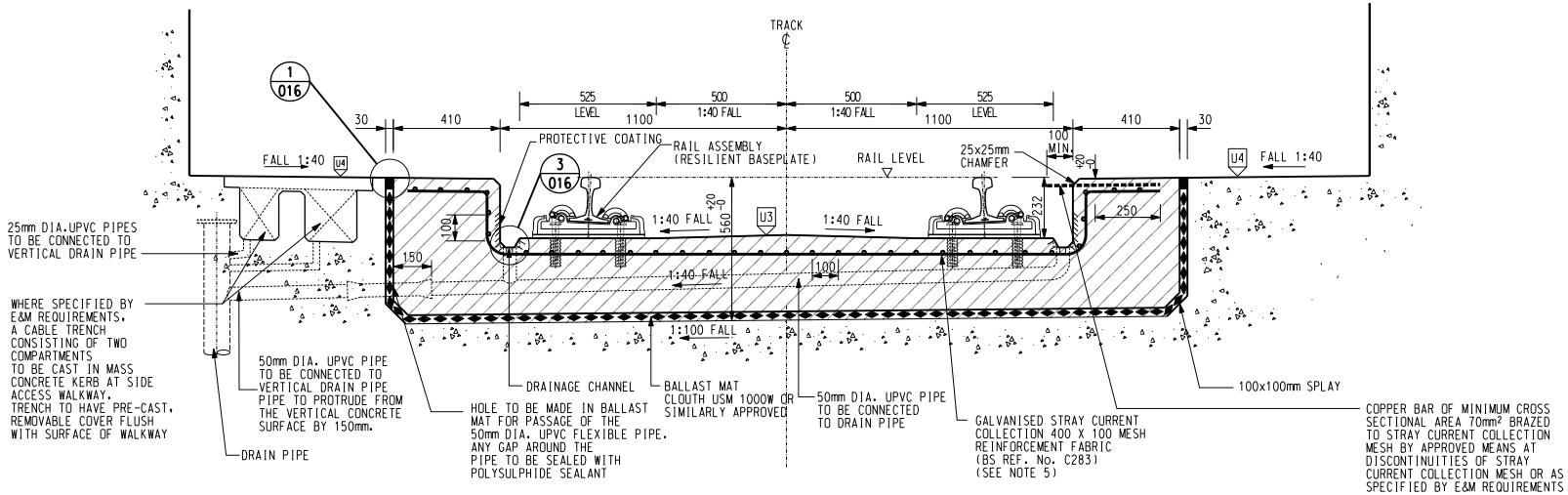
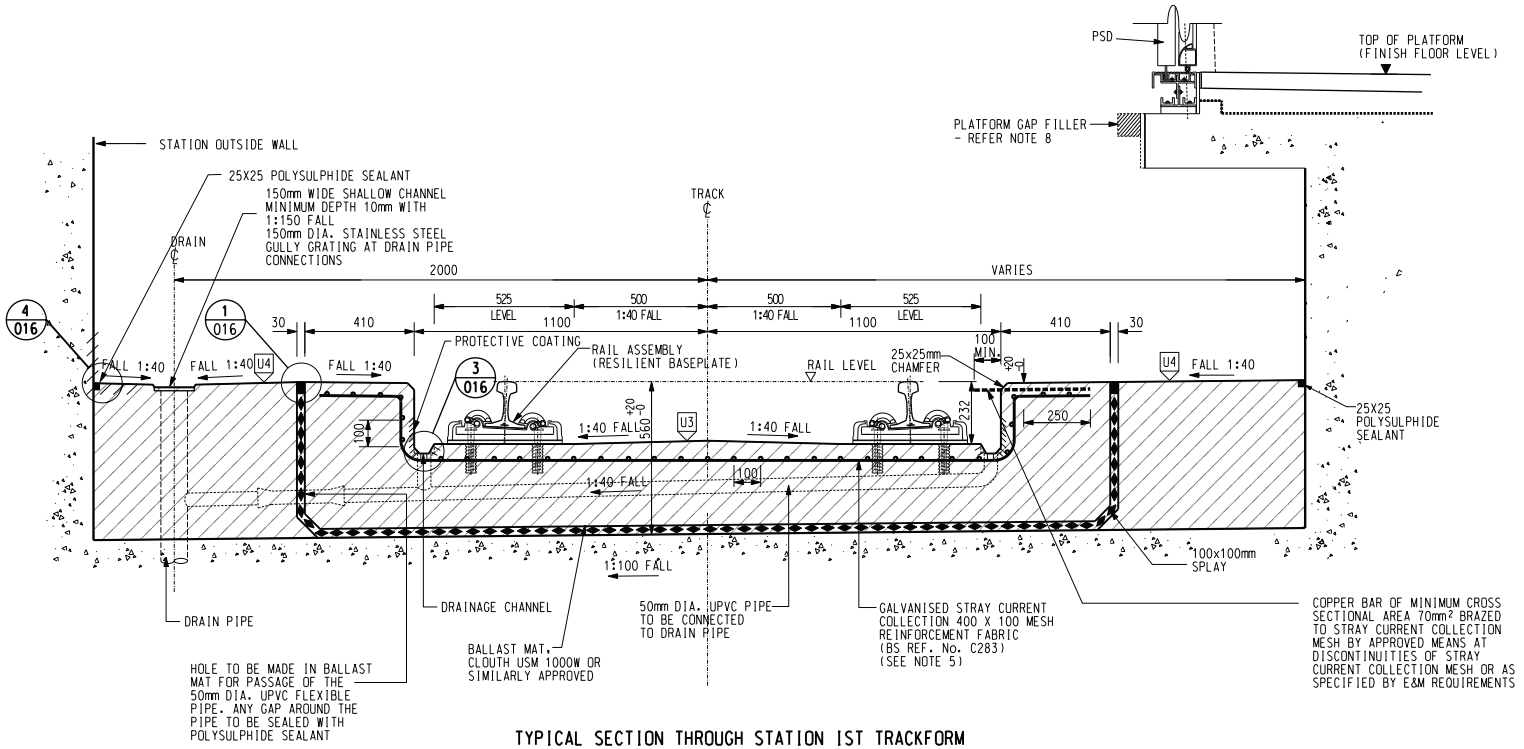
PLOTTING TIME Tasy=me

DRAWING NO. NWS/S/GEN/PPW/C04/015



SECTION THROUGH IST TRACKFORM AT STATION PLANT ROOM AREA

SCALE 1 : 20



TYPICAL SECTION THROUGH STATION IST TRACKFORM

SCALE 1 : 20

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NOTES:

1. NOMINAL CONCRETE COVER TO STRAY CURRENT REINFORCEMENT SHALL BE 50mm.
2. TRACKFORM CONCRETE TO BE CLASS 30/20 CATEGORY 'B' NON-METALLIC FIBRE REINFORCED CONCRETE IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS.
3. A SHEET OF PLASTIC FILM IS TO BE LAID OVER THE WHOLE BALLAST MAT AREA AND CLAMPED UNDER THE 'Z' PROFILE BEFORE TRACKFORM CONCRETING. (REFER TO M & W SPECIFICATIONS FOR TRACKWORK)
4. CONCRETE FINISHES FOR SURFACES RECEIVING THE BALLAST MAT SHALL BE F3 FOR FORMED SURFACES AND U3 FOR UNFORMED SURFACES.
5. MESH TO BE MADE CONTINUOUS BY BRAZING OF COPPER BARS AT ALL LOCATIONS THAT HAVE TO BE CUT FOR HOLDING DOWN ASSEMBLIES OR DRAINAGE PIPES.
6. CONSTRUCTION JOINT TO BE FORMED IN ACCORDANCE WITH THE M&W SPECIFICATION FOR TRACKWORK.
7. LAP LENGTH OF COPPER BAR TO BE 300mm MIN. UNLESS NOTED OTHERWISE.
8. PLATFORM GAP FILLER TO BE INSTALLED TO EDGE OF PLATFORM COPING IF GAP BETWEEN TRAIN AND PLATFORM EXCEEDS 115mm. FOR FURTHER DETAILS REFER TO DRAWING No. NWS/S/GEN/PPS/C04/018.

LEGEND :

SUPPORT STRUCTURE CONCRETE

TRACKFORM CONCRETE

U4 CONCRETE SURFACE FINISH

This drawing is approved on 10 October 2005

Signed:

A.M.Gibson (CDM)

REVISION	DESCRIPTION	BY	DATE	APPROVED
A	FIRST ISSUE	TC	10/05	AMG

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NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR: PROJECT DIVISION

TITLE: PERMANENT WAY
IST TRACKFORM – STATION (SHEET 1 OF 2)

SCALE	AS SHOWN	CAD REF	C04015.DGN	AS BUILT APPROVED	
DATE	OCTOBER 2005	AS BUILT DWG NO	–	–	
DRAWN	LFB	DESIGNED	TC	DRAWING NO	REV
CHECKED	TC	APPROVED	DE	NWS/S/GEN/PPW/C04/015	A

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PLOTTING TIME 1to1=1me

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CADD REF *grspec

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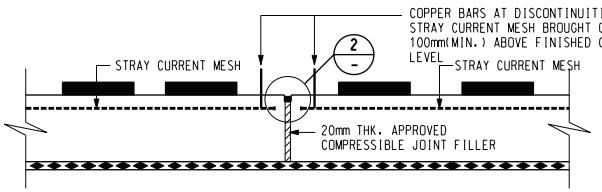
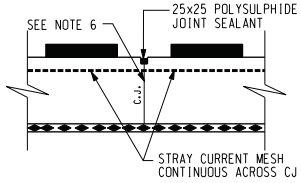
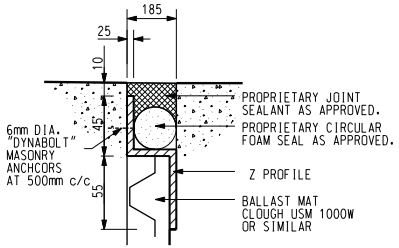


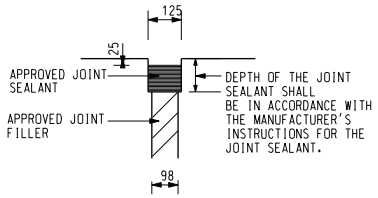
MOVEMENT JOINT
(TO BE PROVIDED IN ACCORDANCE WITH M & W SPECIFICATIONS FOR TRACKWORK)
N.T.S.



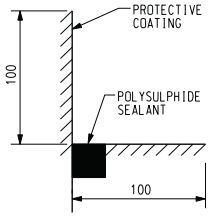
TRANSVERSE CONSTRUCTION JOINT
(TO BE PROVIDED AT A SPACING OF 21m MAXIMUM)
N.T.S.



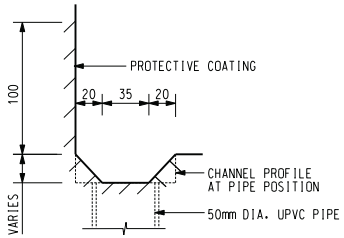
DETAIL 1 / 015
SCALE 1:4



DETAIL 2 / –
SCALE 1:4



DETAIL 4 / 015
SCALE 1:4



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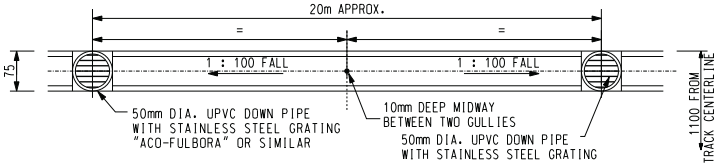

DRAINAGE CHANNEL DETAILS N.T.S.

NOTES:

1. NOMINAL CONCRETE COVER TO STRAY CURRENT REINFORCEMENT SHALL BE 50mm.
2. TRACKFORM CONCRETE TO BE CLASS 30/20 CATEGORY 'B' NON-METALLIC FIBRE REINFORCED CONCRETE IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS.
3. A SHEET OF PLASTIC FILM IS TO BE LAID OVER THE WHOLE BALLAST MAT AREA AND CLAMPED UNDER THE 'Z' PROFILE BEFORE TRACKFORM CONCRETING. (REFER TO M & W SPECIFICATIONS FOR TRACKWORK)
4. CONCRETE FINISHES FOR SURFACES RECEIVING THE BALLAST MAT SHALL BE F3 FOR FORMED SURFACES AND U3 FOR UNFORMED SURFACES.
5. MESH TO BE MADE CONTINUOUS BY BRAZING OF COPPER BARS AT ALL LOCATIONS THAT HAVE TO BE CUT FOR HOLDING DOWN ASSEMBLIES OR DRAINAGE PIPES.
6. CONSTRUCTION JOINT TO BE FORMED IN ACCORDANCE WITH THE M&W SPECIFICATION FOR TRACKWORK.
7. LAP LENGTH OF COPPER BAR TO BE 300mm MIN. UNLESS NOTED OTHERWISE.

LEGEND :

SUPPORT STRUCTURE CONCRETE

TRACKFORM CONCRETE

U4 — CONCRETE SURFACE FINISH

C.J. — CONSTRUCTION JOINT

This drawing is approved on 10 October 2005

Signed:
A.M.Gibson (CDM)

REVISION	DESCRIPTION	BY	DATE	APPROVED
A	FIRST ISSUE	TC	10/05	AMG

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NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE
PERMANENT WAY
IST TRACKFORM –
STATION (SHEET 2 OF 2)

SCALE	AS SHOWN		CAD REF	C04016.DGN	AS BUILT APPROVED
DATE	OCTOBER 2005		AS BUILT DWG NO	–	–
DRAWN	LFB	DESIGNED TC	DRAWING NO	NWS/S/GEN/PPW/C04/016	REV A
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PLOTTING TIME Tasy time

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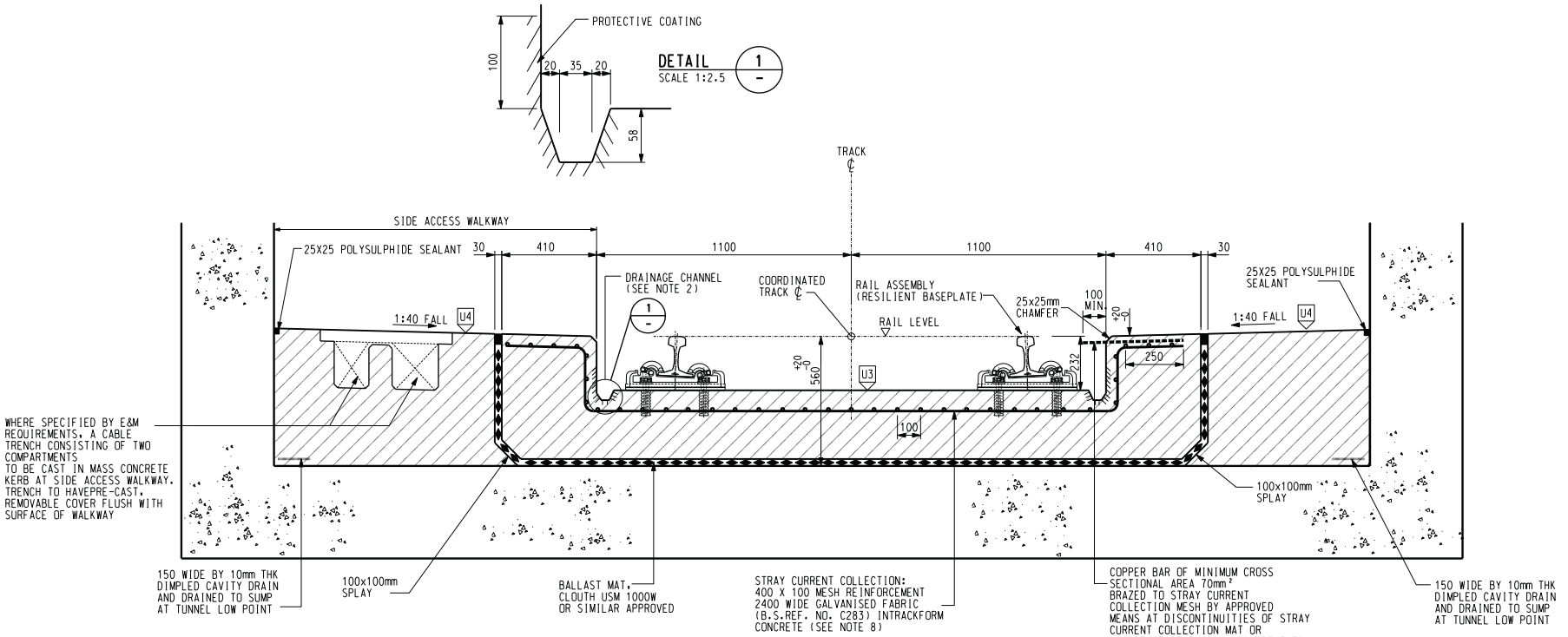
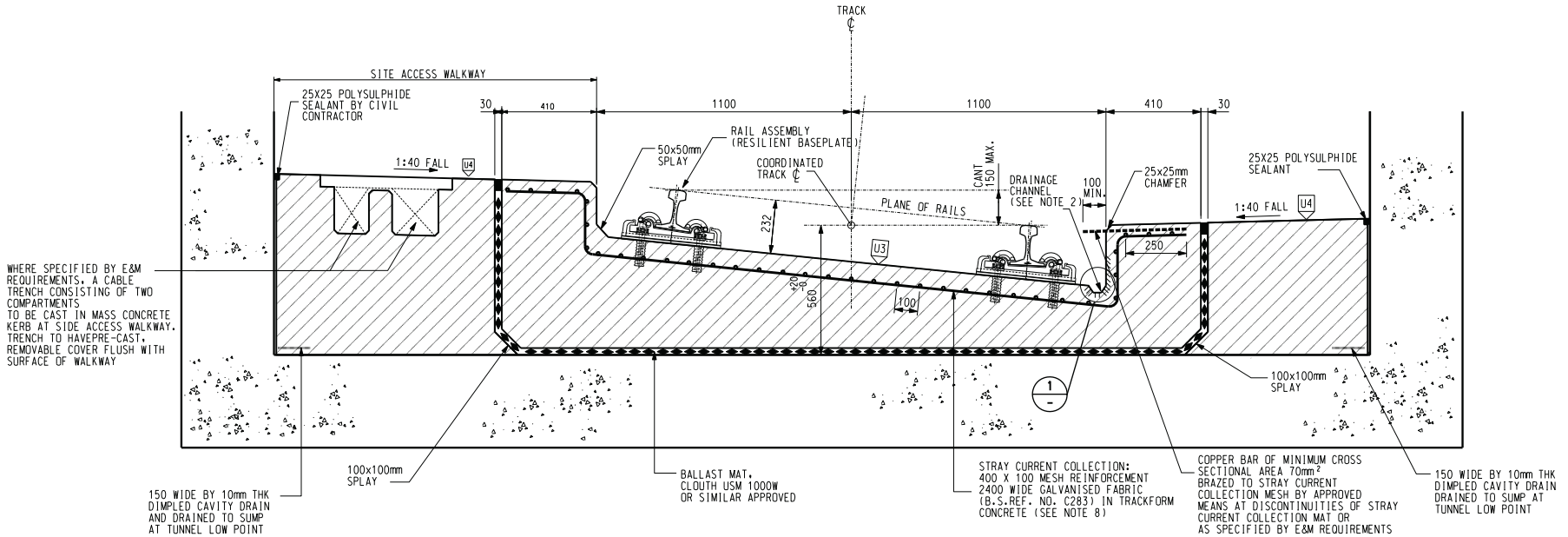
NWS/S/GEN/PPW/C04/017



TYPICAL CROSS SECTION THROUGH STRAIGHT CUT & COVER TUNNEL

SCALE 1 : 20



TYPICAL CROSS SECTION THROUGH CANTED CUT & COVER TUNNEL

SCALE 1 : 20

NOTES:

1. NOMINAL CONCRETE COVER TO STRAY CURRENT REINFORCEMENT SHALL BE 50mm.
2. TUNNEL SURFACE DRAINAGE TO FLOW BY GRAVITY INTO MAIN CIVIL CONTRACT DRAINAGE AT TUNNEL LOW POINTS.
3. TRACKFORM CONCRETE TO BE CLASS 30/20 CATEGORY 'B' NON-METALLIC FIBRE REINFORCED CONCRETE IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS.
4. AT EVERY 100 METRES, THE TRACKWORK CONTRACTOR IS REQUIRED TO CONNECT VERTICAL STRAY CURRENT MESH AND HORIZONTAL MESH WIDTH COPPER BAR BY BRAZING OR SIMILAR MEANS APPROVED.
5. TRANSVERSE JOINTS AND MOVEMENT JOINTS TO BE PROVIDED TO THE TRACKFORM CONCRETE AS PER THE M & W SPECIFICATION FOR TRACKWORK.
6. A SHEET OF PLASTIC FILM IS TO BE LAID OVER THE WHOLE BALLAST MAT AREA AND CLAMPED UNDER THE 'Z' PROFILE BEFORE TRACKFORM CONCRETING. (REFER TO M & W SPECIFICATIONS FOR TRACKWORK).
7. CONCRETE FINISHES FOR SURFACES RECEIVING THE BALLAST MAT SHALL BE F3 FOR FORMED SURFACES AND U3 FOR UNFORMED SURFACES.
8. MESH TO BE MADE CONTINUOUS BY BRAZING OF COPPER BARS AT ALL LOCATIONS THAT HAVE TO BE CUT FOR HOLDING DOWN ASSEMBLIES OR DRAINAGE PIPES.
9. LAP LENGTH OF COPPER BAR TO BE 300mm MIN. UNLESS NOTED OTHERWISE.

LEGEND :

SUPPORT STRUCTURE CONCRETE

TRACKFORM CONCRETE

U4 CONCRETE SURFACE FINISH

This drawing is approved on 10 October 2005

Signed:

A.M.Gibson (CDM)

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NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE
PERMANENT WAY
IST TRACKFORM –
CUT AND COVER TUNNEL

SCALE	AS SHOWN	CAD REF	C04017.DGN	AS BUILT APPROVED	
DATE	OCTOBER 2005	AS BUILT DWG NO	-		-
DRAWN	LFB	DESIGNED	TC	DRAWING NO	REV
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CADD REF *grspec

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APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 2 OVERHEAD LINE / TRACTION POWER SUPPLY SYSTEM INTERFACES

1 Introduction

2 General Description of the OHL System

3 Performance Requirements of the OHL and Train System Interfaces

4 Design Constraints

5 Confirmation of Design Information

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 2 OVERHEAD LINE / TRACTION POWER SUPPLY SYSTEM INTERFACES

1 Introduction

1.1 This Annex defines the interface requirements for the overhead line / traction power supply system (hereafter referred as the OHL system) and the train system.

1.2 The physical interface point for the Contract shall be defined as the point of contact between the head of the pantograph and the OHL contact wire.

1.3 Detailed requirements of the pantograph shall be referred to RS/C6014/10.

1.4 The 1500VDC bus is fed from the overhead traction power supply through a pantograph via the OHL contact wire. Three pantographs shall be provided on an 8 car train consist.

1.5 The train consist is depicted in Drg. No. C6014-14E/TSEG/010/009. A single pantograph shall be provided on each C car.

2 General Description of the OHL System

2.1 The supply of traction power to the train will be at a nominal voltage of 1,500VDC derived from the 33kVAC supply via the Rectifier Transformer and Rectifiers (T-R) units at traction substations. Normally two T-R units are operated in parallel, each rectifier transformer will have + or - 7.5 degree phase shift arrangement on the primary side of the transformer to enable an overall 24 pulses rectification output voltage. However, when only one T-R unit will be in service, it results in 12 pulses rectification output voltage

2.2 Currents will be supplied to the train by the OHL and will return to the traction substations via the running rails. The OHL system will be connected such that the OHL contact wire will be the positive pole and the running rails the negative pole.

2.3 The OHL system will consist of a number of traction substations such that it forms a continuous system which will supply power to the trains without interruption under normal conditions. The OHL system will, however, be divided into a number of electrical sections between the traction substations to meet the operational requirements.

2.4 The majority of the electrical sections are fed by two DC track feeder circuit breakers connected to substation 1500VDC busbars, while the remainder are fed

by single DC track feeder circuit breakers connected to 1500VDC busbars. In the later case, the distant ends of parallelled electrical sections may be connected by a tie breaker.

3 Performance Requirements of the OHL and Train System Interfaces

3.1 Supply Voltage

The nominal OHL catenary voltage is 1500V DC. All train performance requirements, except as otherwise stated, shall be met or surpassed at all voltages from 1000V to 1800VDC.

3.2 Supply Transient

Whilst the terms "nominal OHL voltage" or "1500VDC" are used in this Specification, these shall be construed as intending to describe circuits with design voltage range of 900V to 1900VDC inclusive. All train equipment shall be protected from damage resulting from transient over and under-voltage conditions which may occur in the actual operating environment or as a result of the train design. The Contractor shall provide suitable transient suppression.

3.3 Supply Surge

All sections of the OHL system will be subjected to surges of both polarities up to 5kV. Outdoor sections will be subjected to lightning surges, and all outdoor insulation shall be designed to withstand 75kVp, 1/50 μs waveform impulse tests of both polarities. The Contractor shall provide suitable surge protection to the train equipment.

3.4 Overcurrent Protection

The maximum fault level appearing at any one DC busbar is expected to be 54kA steady state and 76kA peak asymmetric. Each DC track feeder circuit breakers will be fitted with instantaneous overcurrent trips having a maximum setting of 10kA, and a time delayed overcurrent relay having a maximum setting of 3.6kA for a maximum time of 25s; it is expected they will clear the maximum short circuits within 20ms. In view of the fact that severe service interruption will be caused by the operation of the DC track feeder circuit breaker due to an overcurrent fault, the design of the train system shall be capable to clear the overcurrent fault of the train equipment, such as, the traction system (refer to PS 11), without causing superfluous operation the OHL DC track feeder circuit breaker.

3.5 Current Limit

In order to avoid nuisance tripping of the OHL DC track feeder breaker, the design of the traction system (refer to PS 11) of the train shall ensure that the maximum peak current of 3.6 kA per train is not exceeded. The duration of line current remains at maximum peak during motoring shall not exceed 10 seconds at all out running.

3.6 Radio Frequency Interference

The Contractor shall ensure that the pantograph system shall not radiate radio frequency interference (RFI) or cause RFI to be generated by the OHL system. A RFI filter shall be fitted to suppress the above interference.

3.7 Compatibility Test

3.7.1 An interface test to confirm the compatibility of the pantograph with the OHL system under the worst operating conditions shall be carried out by the Contractor.

3.7.2 This test shall include a measurement of each individual and the total cumulative arcing times.

3.7.3 It is a requirement that for each arcing time, it shall be less than 0.1s.

3.7.4 For the total cumulative arcing time, it shall be less than 1.0% of the total run time.

4 Design Constraints

4.1 Temperature Rise Limit

4.1.1 The maximum allowable temperature rise above the ambient for the OHL contact wire is 65°C and the maximum spot temperature on any OHL equipment other than the OHL contact wire above the train roof is 55°C at standstill. The Contractor shall demonstrate to the satisfaction of the Engineer that under all worse conditions, the train shall not cause excessive OHL equipment temperature rise specified above.

4.1.2 The carbon strip material shall meet the above requirements at a temperature not exceeding its maximum allowable temperature at any point of contact.

4.1.3 No lubrication of the contact material shall be necessary.

4.2 Corrosion and Moisture inside Tunnel

4.2.1 Equipment mounted in the roofs of the train will be subjected to saline dripping which may include other salts that can be deposited on the pantograph, for example, lime. In addition, air in tunnels carries a heavy dust content, both induced by the ventilation system and caused by the railway operation. The combination of the above will have an adverse effect on the insulation creepage surfaces and the life of the metal components.

4.2.2 The general atmosphere contains a high level of industrial pollutants and salt spray.

4.2.3 The pantograph shall be surface treated against the above environmental impacts.

4.3 Contact Wire Position

4.3.1 Contact wire locations shall be referred to GS Clauses 6.3.1 and 6.3.2.

4.3.2 Contact Wire Sweep

(a) Sweep is defined as the lateral movement of the contact wire across the pantograph during its travel between any two registration points and is the sum of such movement, either from one side of the track centre to the other, or from one side toward the track centre and back towards the same side.

(b) Sweep will be sufficient to ensure that the contact wire continually slides across the pantograph and will be at the rate of at least 150mm per 100m movement along track and not more than 750mm per 100m movement along track on all lines.

4.3.3 The current collectors shall maintain adequate contact pressure as specified in RS/C6014/10 with the contact wire under conditions specified above and the most adverse combination of all manufacturing and service tolerances, dynamic movements and maximum wear on all related components on both the train and the overhead wire.

4.4 Pantograph Kinematic Envelope

The pantograph shall not infringe the Kinematic Envelope as shown in Drg. No. C6014-14E/TSEG/010/001 with the pantograph in both operating and stowed positions.

5 Confirmation of Design Information

5.1 For the purpose of OHL design study, the Contractor shall ensure that the performance parameters as specified in RS/C6014/10 are achieved.

5.2 Any change to the above pantograph performance parameters shall be submitted for Approval according to the configuration control program (refer to Appendix P).

5.3 The Contractor shall finalise the pantograph characteristics after taking into account the OHL system characteristics during the design interface by SEMP stage 3 (refer to PS 21.3.4).

5.4 The following additional information shall be submitted before the end of SEMP stage 3:

5.4.1 Actual distance between pantographs in a train consist.

5.4.2 Actual head mass.

5.4.3 Actual maximum lateral displacements of the pantograph from the track centre line under all defined track conditions and confirmation that they shall not infringe the Kinematic Envelope as shown in Drg. No. C6014-14E/TSEG/010/001

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 3 ATC INTERFACES

1 General

2 Performance Requirements of the ATC and Train System Interfaces

3 Inter-system Electromagnetic Compatibility (EMC)

4 Design Constraints

5 Confirmation of Design Information

Attachment App-I-Annex-3 Interface Requirements Specification

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 3 ATC INTERFACES

1 General

1.1 Introduction

1.1.1 This Annex defines the interface requirements for the Automatic Train Control (ATC) and the train systems.

1.1.2 The train is required to work with the Urban Lines track side and trainborne ATC equipment, in order to ensure the compatibility between the ATC and the train systems, the following system requirements and design constraints for the ATC interface are specified according to the Urban Lines ATC trackside equipment and the ATC trainborne equipment.

1.1.3 Not used.

1.1.4 Unless it is requested by the Contractor by the end of SEMP 2, all ATC interface design information will be made available to the Contractor prior to the commencement of SEMP 4. The Contractor shall carry out final design and vehicle build according to the information given beforehand.

1.2 General System Requirements

1.2.1 Each A-car with driving cab shall be equipped with one set of ATC equipment i.e. Trainborne CBTC Controller to be installed in the B side of the driving cab, one Primary Train Operator Display and one Secondary Train Operator Display to be installed on the driver's desk, two radio antennas, one 4G/LTE antenna (if applicable) to be installed at the roof of A-car, CBTC antennas / radars / tags to be installed at A-car underframe, two speed sensors to be installed on two motor and service brake free axle ends per A-car. Each B-car shall be equipped with two sets of Ethernet Repeater in gangway cubicles.

1.2.2 The Contractor shall provide accommodation including mounting points, equipment cabinets and cable access for the installation of the ATC equipment in line with the requirements specified by the Engineer.

1.2.3 The Contractor shall be responsible for providing an interface circuit between the ATC and the train systems as specified in the PS.

1.2.4 Due consideration shall be given to ensure that no wiring fault of this interface circuit shall cause a wrong side failure.

1.2.5 The Contractor shall be responsible for providing the appropriate DC power supply, including the power supply interface and the protection device, to the ATC equipment, in accordance with RS/C6014/03.

1.2.6 The Contractor shall ensure that the equipment can be easily operated, removed and replaced.

1.3 Extent of Work

The Contractor shall liaise with the Engineer to incorporate appropriate interfaces, power supply, delivery schedule, installation, testing and setting to work.

1.4 Contract Demarcations

1.4.1 Based on the interface requirements stipulated in this Annex, a detailed interface specification shall be provided with the liaison of the Engineer (refer to PS 31.3).

1.4.2 The Contractor shall specify in the above detailed interface specification all additional design information required on system interfaces which are not provided in this Annex. A programme for the submission of interface design information shall also be submitted for Approval.

1.4.3 For those interface designs that may affect the manufacturing programme shall be finalised prior to the commencement of SEMP 4. In the event that the required interface design information are not available from the Engineer by the period specified in the above programme, the Contractor shall carry out interface design based on his own judgement and submit for Approval.

1.4.4 Subject to the detailed interface specification, the contract demarcations specified in this Clause shall be complied with.

1.4.5 The Contractor shall provide the following items, as a minimum requirement:

(a) Accommodation of the ATC equipment according to Clause 4.1.

(b) All cables with cable identifications for the functional links between the ATC cubicle and others ATC equipment according to Attachment App-I-Annex-3. Unless otherwise specified, all cables shall be adequately rated according to the voltage free contact specified in Clause 1.4.5(d) and comply with RS/C6014/06. Special attention shall be paid on the identification of safety wires and the shielding requirements for EMI protection.

(c) Except those special electrical plugs and sockets that are directly connected to the ATC equipment, all interconnections and the associated cable terminals and electrical connections for the above ATC equipment shall be provided. All these electrical connections mounted in the external area, including underframe, shall be sealed to IEC 60529:2001 IP65 (refer to RS/C6014/02 Clause 10.1).

(d) Interfacing signals for the ATC cubicle according to Clause 2. Unless otherwise specified, a voltage free contact rated at least 2 A DC inductive loads with a time constant of 15ms at 110 VDC shall be provided for the above signal interfaces. Interface cable terminal bars and all associated cables and terminals of the above interfacing signals shall be provided nearby the ATC cubicle. Cables from the ATC cubicle to the interface terminal bars shall not exceed 2.5m in length.

(e) All remaining cables together with the cable identifications between the interconnection points (refer to Clause 1.4.5(c)) or interface terminal bars (refer to Clause 1.4.5(d)) and the ATC equipment shall be provided, properly secured, protected and cable end capsulated.

(f) The following in accordance with Attachment App-I-Annex-3:

- Installation, testing and commissioning of full set trainborne ATC equipment on first two trains in Contractor's factory
- Installation of equipment, cables and accessories as identified in the ATC Connectors & Tail Cables Specifications table in Attachment A of Attachment App-I-Annex 3, Appendix 3, Annex C13
- Installation of roof mounted equipment , i.e. radio antennas and LTE antennas on all trains in Contractor's factory
- All necessary inspections, checks and testing for ensuring the quality of workmanship of these installation works

(g) Proper delivery of trainborne ATC equipment from Hong Kong to Contractor's factory for installation at Contractor's own cost.

(h) Supervision on the installation, testing and commissioning of trainborne ATC equipment on all trains in Employer's premises.

(i) A competent testing engineer throughout the period of the tests and commissioning to participate all ATC system related interface tests.

1.4.6 The Employer will provide the following items:

(a) All ATC equipment in Hong Kong according to Attachment App-I-Annex-3.

(b) All electrical plugs and sockets that are directly connected to the ATC equipment.

(c) Interfacing signals for the ATC cubicle according to Clause 2.

(d) Not used.

(e) Not used.

(f) Supervision on the installation, testing and commissioning of trainborne ATC equipment on the first two trains in Contractor's factory.

(g) A competent testing engineer throughout the period of the tests and commissioning to participate and facilitate all ATC system related interface tests.

(h) Not used.

(i) Not used.

(j) Not used.

(k) Not used.

(l) All required instructions, drawings and special tools (if necessary) to facilitate the Contractor to perform the works as specified in Clause 1.4.5(f).

(m) Site supervision and training to facilitate the Contractor to perform the works as specified in Clause 1.4.5(f) in order to ensure the Contractor's workmanship meets the quality of work as required by the Engineer.

1.5 Interface Design Management

The Contractor shall comply with the following specific arrangements in order to maintain an effective interface design management with the Engineer:

(a) At SEMP stage 1, upon receiving the finalized Electro-Magnetic Disturbance Level (EMDL) from the Engineer, the Contractor shall incorporate this EMDL into the EMC plan according to Clause 9.1 of RS/C6014/04.

(b) At SEMP stages 2 to 4, the Contractor shall carry out all required EMC study and submit the associated results according to Clauses 9.2 to 9.4 of RS/C6014/04. The Contractor shall ensure that a mutual agreement on the detailed interface specification is reached with the Engineer.

(c) Before SEMP stage 5, the Contractor shall obtain agreement with the Engineer on the test case for test and commissioning purpose according to PS 31.3.6.

(d) At SEMP stage 5, the Contractor shall conduct on-site tests and measurements to validate the ATC interface including the EMC performance. The above activities shall be performed at:

(i) Contractor's test track;

(ii) SHD test track and Urban Lines depot test tracks; and

(iii) Main running line in Urban Lines.

2 Performance Requirements of the ATC and Train System Interfaces

The Contractor shall refer to Attachment App-I-Annex-3 "Interface Requirement Specification" and Attachment A of Attachment App-I-Annex-3 "Detailed Interface Design Specification for Automatic Train Control". The Contractor shall ensure the trains are fully adapted to the ATC equipment.

2.1 Use of Attachment App-I-Annex-3 and Attachment A of Attachment App-I-Annex-3

Attachment App-I-Annex-3 and Attachment A of Attachment App-I-Annex-3 shall be read in conjunction with other Clauses in the PS Appendix I Annex 3. To the extent that any provision of Attachment App-I-Annex-3 and Attachment A of Attachment App-I-Annex-3 is inconsistent with any provision of other Clauses in PS Appendix I Annex 3, the provisions of the Attachment App-I-Annex-3 and Attachment A of Attachment App-I-Annex-3 shall prevail.

2.2 The requirements in Attachment App-I-Annex-3 and Attachment A of Attachment App-I Annex-3 are applicable to the Contractor with the following interpretation:

(a) The New Train Contractor, the New Train and RS shall be interpreted as the Contractor or the train.

(b) Not used

(c) Not used

(d) Door Open Enable, Door Open authorization and ATC door enable are referring to the same signal provided by ATP to the door control circuit when ATP considers it is safe to open the passenger doors.

2.3 Not used

2.4 The car numbering arrangement shall follow Drg. No. C6014-14E/TSEG/010/009.

2.5 Not used.

2.6 The actual distance travelled by the train under worst wheel slide scenario shall not be longer than 15% of the distance measured by the ATP system via the tachogenerators.

2.7 Status of the following ATP vital outputs shall be monitored by TMS and recorded in Event Recorder:

(a) EBR1;
(b) EBR2;
(c) ZVR1;
(d) ZVR2.

2.8 In conjunction with PS 9.9.11(b), when the train is operating from a driving cab with mode selector moved at “reverse” position, the head lights of this active cab car shall be automatically turned off and its tail lights shall be automatically turned on. Meanwhile, the head lights of the rear cab car shall be automatically turned on and its tail lights shall be automatically turned off.

2.9 The circuit integrity of brake signal distributed to traction and brake system shall be properly maintained in order to prevent no single point failure resulting in signal interruption, i.e. bad contact or etc.

3 Inter-system Electromagnetic Compatibility (EMC)

3.1 The Contractor shall ensure that all train equipment are designed and constructed in accordance with RS/C6014/04 or equivalent, to ensure proper functioning.

3.2 Consideration shall be given to the EMC of the complete ATC and train systems.

3.3 The Contractor shall interface with the Engineer to ensure that EMC is achieved between all ATC and train systems.

3.4 The Contractor shall, through this interface, develop an EMC interface specification including a Signalling Compatibility Specification. This shall define the levels of susceptibility and emissivity for all the trainborne equipment which will guarantee compatibility.

3.5 Equipment shall be EMC tested to the requirements of the PS. An appropriate technical construction file shall be developed in accordance with the EC EMC Directives and be certified by an appropriate Competent Body for the compliance of the EMC Directives.

3.6 The following electro-magnetic disturbance sources shall be taken into account in the interface design:

3.6.1 harmonics generated by rectifiers in the traction substation;

3.6.2 main frequency harmonics in the traction supply;

3.6.3 transients generated by switching action of the inverter controlled traction and auxiliary equipment;

3.6.4 magnetic sources of the train, for example, chokes;

3.6.5 magnetic field generates by the current in the catenary;

3.6.6 radiated electric field from the trainborne equipment; and

3.6.7 radiated field from the catenary.

3.7 The Contractor shall submit a computer simulation result to predict the expected magnitudes of the above electro-magnetic disturbances, normal and fault conditions shall be considered, at SEMP stage 2, verify these simulation results by test during SEMP stage 3 and conduct an on-site measurement to validate the actual train performance by SEMP stage 5.

3.8 The total electromagnetic interference induced by the trainborne equipment to the ATC equipment shall be regarded as permissible conducted current on rail and permissible radiated emissions from train. The particular requirements are specified below:

3.8.1 The total permissible conducted current on rail due to the trainborne equipment (including the traction inverters, auxiliary converters and auxiliary inverters) of a train shall not be greater than the threshold limits of the signalling systems as specified in Clause 4.2. This current shall be measured under worst case scenario on any section of rail, like in front of, underneath and behind the train.

3.8.2 Permissible radiated emissions measured at a distance of 0.5m in any direction from any component of the rolling stock equipment shall be:

50 Hz to 1K Hz <62dBμA/m

1K Hz to 500K Hz <27dBμA /m

Band width of measurement shall ±100Hz

4 Design Constraints

4.1 Accommodation of the ATC Equipment

4.1.1 Typical dimensions of the ATC equipment are shown in Attachment App-I-Annex-3.

4.1.2 As a minimum requirement, the following mounting arrangements shall be provided:

(a) For the ATC cubicle:

(i) a removable steel support framework with adequately sized shall be provided for mounting the ATC cubicle in a vertical plane;

(ii) shall be adequately shielded to withstand a minimum level of 20V/m RF radiated interference over frequency range 27MHz to 2 GHz;

(iii) the front panel and side covers shall be removable for easy maintenance access; and

(iv) mechanical ventilation by the air inside the driving cab shall be provided (refer to PS 15.8.2).

(b) For the antenna and beacon sensor, pick up coils and tachogenerators, the mounting arrangements shall comply with the typical dimensions of the bogie/axle mounted equipment as shown in the Attachment App-I-Annex-3. The Contractor shall ensure that the strength requirements for all bogie and axle mounted equipment as specified in PS 12.9.3 are met.

4.2 EMC Constraints

The total emission from all components of the train equipment shall not be greater than the maximum allowable electro-magnetic interference (EMI) shown in the following table:

Permissible EMI Emissions from the Train Equipment

Item	SACEM ATC Equipment or Operation	Mode or Source of Disturbance	Maximum Allowable EMI
1.	Track circuits	Traction return current	
1.a	50Hz track circuit	Traction return current	Total rail current at 50Hz shall not exceed 10A with a bandwidth of 10Hz
1.b	CVCM circuit track	Traction return current	a) Total rail current shall not exceed 50mA at 8.2kHz, 8.6kHz, 9.2kHz, 10.0kHz, 10.6kHz, 11.0kHz and 12.3kHz with a bandwidth of 200Hz. b) The magnitude of rail to rail voltage shall not exceed 70mVrms at 8.2kHz, 8.6kHz, 9.2kHz, 10.0kHz, 10.6kHz, 11.0kHz and 12.3kHz with a bandwidth of 200Hz.
1.c	FTGS track circuit	Traction return current	Total rail return current shall not exceed: a) 600mA at 4.75kHz with a bandwidth of 240Hz b) 350mA at 5.25kHz with a bandwidth of 240Hz c) 250mA at 5.75kHz with a bandwidth of 240Hz d) 150mA at 6.25kHz with a bandwidth of 240Hz e) 40mA at 9.5kHz with a bandwidth of 500Hz f) 35mA at 10.5kHz with a bandwidth of 500Hz g) 30mA at 11.5kHz, 12.5kHz, 13.5kHz, 14.5kHz, 15.5kHz and 16.5kHz with a bandwidth of 500Hz
2.	SACEM track to train continuous transmissions	Traction return current	The magnitude of resultant in-band interference signals produced by the disturbance sources in Clause 3.6 of this Annex shall not exceed at all times for a level equivalent to the loop-feeding of 15mA in the frequency ranges of 45 to 65kHz.
3.	Track to train and train to track transmissions	Traction return current	Return current of whole train shall be less than 250mA in the frequency range of 50kHz to 80 kHz. Asymmetry current in the rail shall be less than 5%.

Permissible EMI Emissions from the Train Equipment			
Item	SACEM ATC Equipment or Operation	Mode or Source of Disturbance	Maximum Allowable EMI
4.	Not used	Not used	Not used
5.	Beacon sensors	Close-up effect	Susceptibility threshold for vertical polartisation of H field is 125mA/m at operating frequencies of 90, 110 and 124kHz, and 4A/m in the frequency range of 3 to 7kHz. The susceptibility limits shall not be exceeded and all sensitive magnetic sources shall be magnetically shielded.
6.	Trainborne ATC cubicle	Radiated field from other trainborne equipment	The trainborne ATC cubicle meets the susceptibility limits as specified in BS EN 50121-4. Radiated field from other trainborne equipment shall be at least 3dB below the susceptibility limits.

4.3 Wheelset Impedance

The maximum impedance per wheelset assembly shall be not greater than 0.2 ohms from DC to a frequency ranges of 13 to 140 kHz and capable of operating the track circuits and axle counters.

4.4 Accuracy of Station Stopping

Trains shall respond to ATC commands and shall consistently stop within ± 500mm of the designated station stopping point for 99.99% of stops utilising service brake only.

4.5 Train Formation

Trains consists shall be formed by an 8 car basis according to the Drg. No. C6014-14E/TSEG/010/009.

4.6 Communication Interfaces Between the ATC and TMS

It is a requirement that the trainborne ATC shall interface with the train management system (TMS). In order to ensure the compatibility between the train and the trainborne ATC sub-system, the communication interface shall comply with the requirements as specified in Attachment App-I-Annex-3.

4.7 Power Supply Interfaces Between the ATC and Auxiliary Supply System

4.7.1 A DC power supply shall be continuously provided to supply the ATC equipment, the DC power supply shall meet the requirements as specified in Attachment App-I-Annex-3.

4.7.2 The DC power supply shall be supplied from the D1 wire (refer to PS 17.4.1(e)) and D2 wire (refer to PS 17.4.1(d)) where appropriate via a dedicated miniature circuit breaker (MCB). This MCB shall be calibrated according to the ATC power supplies characteristics as shown in Attachment App-I-Annex-3.

4.8 Performance Interfaces Between the ATC and Traction and Braking System

4.8.1 The Contractor shall ensure that no roll-back more than 1 m shall be allowed in any case, especially when the train starts. The design of this feature shall assume that the predefined state of the brake is maximum service brake and the traction is set in the way to limit the jerk at the maximum value (0.8 m/s^3) in the worst gradient of -3%.

4.8.2 Characteristic for both friction and electric brakes shall be identical for the same order of both positive and negative accelerations.

4.8.3 Brake blending between friction and electric brakes shall be as smooth as possible for the ATO.

4.8.4 The jerk limitation of 0.8 m/s^3 shall be identical in both motoring and braking operations.

4.8.5 In the AUTO mode only, the ATO shall directly control the brake deceleration and no feed back loop from the braking equipment shall be required.

4.8.6 The acceleration and deceleration signal from the ATC to the traction and braking system will be measured in m/s^2 compensated with gradient.

4.8.7 Not used.

4.9 Maintenance Performances

4.9.1 The maintenance access to the ATC equipment shall be restricted by means of a lockable cubicle.

4.9.2 Access to the compartments of ATC equipment shall only be gained from the front and by the means of an approved key as defined in RS/C6014/15.

4.9.3 All electronic racks of the ATC equipment inside the driving cab shall be removed by the front.

4.9.4 The ATC equipment inside the driving cab shall be accessible by the front and the right side (related to the front view of ATC cubicle) to remove relays and to disconnect connectors.

4.9.5 Access, disconnection and connection of ATC wires on the interface terminal bars shall be gained from the right side (related to the front view of ATC cubicle). Easy access for depot maintenance operation shall be provided.

4.10 Safety Related Performances

4.10.1 In addition to the required rate of deceleration of train under a normal operating condition as specified in PS 11.14, for the purpose of interface design with the ATC system and in order to ensure sufficient safety margins are provided in the integrated system design, the following emergency braking performance of train under all predictable worse case scenario, for example, single point failure of brake equipment and excessive loss of adhesion, shall be met:

If an emergency brake is requested by ATP, the worse case deceleration rate and the response time shall be at least:-

(a) 1.3 m/s^2 with a degradation of 25% (0.975 m/s^2) in tunnel and 40% in open section (0.78 m/s^2) excluding the response time; and

(b) maximum time delay of 1.6s from emergency brake to be triggered to emergency brake to be applied.

4.10.2 Passenger doors shall not be opened unless the signals of both ATC door enable and zero velocity (refer to PS 16.2.6) are delivered from the ATC.

4.10.3 At station stops, no traction effort shall be provided to the traction equipment while the passenger doors are not fully closed (refer to PS 9.9.7(f)).

4.10.4 No failure shall result in energising of any ATC vital input via the voltage free contacts which will be used as the ATC input.

4.10.5 Holding brake shall be performed according to Attachment App-I-Annex-3.

4.11 Not used.

4.12 Control Interface with the Safety Cut-Out Switch

For illustration purpose, the conceptual circuit arrangements are depicted in Drg. No.C6014-14E/TSEG/417/001.

4.12.1 The Safety Cut-Out Switch (SCOS) shall be a sealed rotary switch which consists of four rotary positions as below:

Angular Position	Description	Detailed in
0°, vertical up	Normal (N) (rotary movement R↔N↔TFB	4.12.2
$+90^{o}$, clockwise	Traction Fall-back (TFB) (sealed by breakable seal wire; rotary movement N↔TFB)	4.12.4
-90°, anticlockwise	Reset (R) (rotary movement R↔N)	4.12.5

4.12.2 Normal position

When the SCOS is stayed in the normal position which shall be the defaulted position, the safety proving circuit shall be operated according to PS 9.9.5.

4.12.3 Not used.

4.12.4 Traction fall-back position

(a) Traction fall-back mode will be used when the ATC system has completely failed.

(b) When the SCOS is operated to the traction fall-back position, a speed detection circuit shall be provided by the traction and braking system which shall respond according to the following requirements:

(i) The safety proving circuit shall be operated according to PS 9.9.5 via the contacts of RS1 or RS2 which shall provide the zero velocity proving function from the traction and braking system of the individual motor cars of B or C to the safety proving circuit.

(ii) The train movement shall be obtained according to PS 9.6.

(iii) The traction and braking system shall check that the speed of the train is less than or equal to 22 km/h and emergency brake shall be applied if the speed limit is exceeded by opening the contacts of RS3 or RS4 which shall provide the overspeed protection from the traction and braking system of the individual motor cars of B or C.

(c) The system integrity of the above speed detection circuits particularly the correct contact states of RS1 to RS4 provided by the traction and braking system shall be continuously monitored by the TMS disregard the SCOS position. Any abnormality occurred in these speed detection circuit shall be reported to the train operator and logged into the Event Recorder. The Contractor shall demonstrate that no single point failure of the speed detection circuits shall lead to an unsafe condition. The failure mode of this speed detection circuit shall be a right side failure and self-manifesto.

(d) Detailed operation of traction fall-back mode shall refer to PS 9.12.4.

4.12.5 Reset position

When the SCOS is operated to the reset position, the power supply (refer to Clause 4.7) shall be interrupted for resetting the ATC system. The power supply shall be resumed normal when the SCOS position is switched back to the normal position.

4.12.6 Operating the SCOS directly from the reset position to the traction fallback position and vice versa, shall not be allowed.

4.12.7 Operation of the Safety Cut-Out Switch shall be reported to the Event Recorder.

4.13 Not used.

4.13.1 Not used.

4.13.2 Not used.

4.13.3 Not used.

4.13.4 Not used.

4.13.5 Not used.

5 Confirmation of Design Information

5.1 In addition to the train performance requirements specified in PS 4, for the purpose of ATC compatibility, the Contractor shall ensure that the train performance parameters are as the same as the list of the parameters and their values shown in Attachment App-I-Annex-3.

5.2 Not used

5.3 The following additional information shall be submitted before the end of SEMP stage 3:

5.3.1 Not used.

5.3.2 Not used.

5.3.3 Not used.

5.3.4 Motor characteristic curves showing:

(a) Tractive effort (kN) at wheel tread against train speed (km/h); and

(b) Motor current (A) against train speed (km/h).

5.3.5 Coefficient of rotating mass:

(a) for motor car (%)

(b) for trailer car (%)

5.3.6 Maximum train length (m)

5.3.7 Minimum train length (m)

5.3.8 Technical specification of the safety interlock relays.

5.3.9 Train mass data

5.3.10 Train resistance formulae

5.4 ATC System Combined Test

5.4.1 In order to validate the interface design, an ATC system combined test shall be carried out on the first two trains manufactured at the Contractor's test track which shall form part of the Tests on Contractor's Track (refer to Appendix C Clause 2.27) during the SEMP stage 5.

ATTACHMENT APP-I-ANNEX-3 INTERFACE REQUIREMENTS SPECIFICATION

Interface Requirements Specification between Replacement of Signalling Systems for ISL, KTL, TWL, TKL, AEL, TCL & DRL (Contract 3036) and the New Train (Contract C6014)

CONTENTS

1.GENERAL

2.DEFINITION

3.EQUIPMENT SPACE

4.TRAINLINES

5.CABLE CONDUITS PROVISION

6.FUNCTIONAL INTERFACE

7.INSTALLATION ARRANGEMETN AND PROVISION

8.INTERFACE DOCUMENTATION

ATTACHMENT A – DETAILED INTERFACE DESIGN SPECIFICATION FOR AUTOMATIC TRAIN CONTROL

ATTACHMENT B – NOT USED

ATTACHMENT C – NOT USED

ATTACHMENT D – NOT USED

ATTACHMENT E – NOT USED

ATTACHMENT F – NOT USED

ATTACHMENT G – NOT USED

ATTACHMENT H – SECONDARY TOD

ATTACHMENT I – PRIMARY TOD

1. GENERAL

1.1 This Interface Requirements Specification (IRS) outlines the interface requirements between Replacement of Signalling Systems for ISL, KTL, TWL, TKL, AEL, TCL & DRL (Contract 3036) and the New Train (Contract C6014) including the scope of work of the SIG Contractor and the New Train Contractor specified in Attachment A.

1.2 In this IRS the Contractor for Contract 3036 shall be the “SIG Contractor” and the Contractor for the New Train (Contract C6014) shall be the "New Train Contractor".

1.3 The New Train Contractor shall follow the same interfacing design as specified in Attachment A. “RS” in Attachment A shall be interpreted as the New Train Contractor / The New Train. The New Train Contractor’s scope in the New Train/SIG interface shall follow the scope of Contract 6554-07E for existing C-Train as specified in Attachment A. The Train performance parameters shall not be modified in the course of this Works.

1.4 The SIG Contractor will adopt the same interfacing design in the course of the Works to fulfil all functional, mechanical, electrical and electromagnetic compatibility requirements as specified in Particular Specification (PS) of Contract 3036. All equipment, components, systems, subsystems, cables, wires, parts supplied under Contract 3036 will be fully compatible with the New Train and its environment.

1.5 The interfaces and requirements detailed in this IRS are not exhaustive, and the nature and full extent of the Works to be performed in connection with each interface are to be ascertained by referring to the Drawings, the Contract 6014 PS, the General Specification for E&M Works (GS) and the Conditions of Contracts.

1.6 The SIG Contractor will be responsible for all design, installation, modification, Testing and Commissioning of the interfacing systems/equipment.

1.7 The SIG Contractor will develop the interface documents to cover all aspects of the implementation of the interface works stipulated in this IRS.

2. DEFINITION

2.1 The term “momentary” is referred to a signal which is activated (logic 1) for a short period of time and then de-activated (logic 0) even all required conditions for activation of this signal have been met.

2.2 The term “continuous” is referred to a signal which is activated (logic 1) as far as all required conditions for activation of this signal are met.

2.3 The term “vital output” is referred to an output that is required to be implemented in a safety-critical system in a fail-safe manner.

2.4 The term “vital input” is referred to an input that is required to be implemented in a safety-critical system in a fail-safe manner.

2.5 The term “non-vital output” is referred to an output that is required to be implemented in either non-safety-critical system or safety-critical system.

2.6 The term “non-vital input” is referred to an input that is required to be implemented in either non-safety-critical system or safety-critical system.

2.7 The term “fully redundant output” is referred to an output that is driven by two different and individual Train-borne CBTC Controllers configured in hot-standby redundancy manner. When either one of the Train-borne CBTC Controllers fails the output is still under controlled by the remaining healthy Train-borne CBTC Controller.

2.8 The term “fully redundant input” is referred to a signal feeding to two different and individual Train-borne CBTC Controllers (configured in hot-standby redundancy manner) at the same time without any time delay. When either one of the Train-borne CBTC Controllers fails the signal is still detected by the remaining healthy Train-borne CBTC Controller for maintaining CBTC functions.

3. EQUIPMENT SPACE

3.1 Equipment space in New Train shall be provided by the New Train Contractor for the installation of CBTC Train-borne Subsystem supplied by the SIG Contractor. The demarcation of the Works shall follow tab.Infs.SIG.New Train.01 and Fig.infs.SIG.New Train.02.

3.2 All underframe mounted equipment supplied by the SIG Contractor will comply with IP66 and IEC61373 requirements.

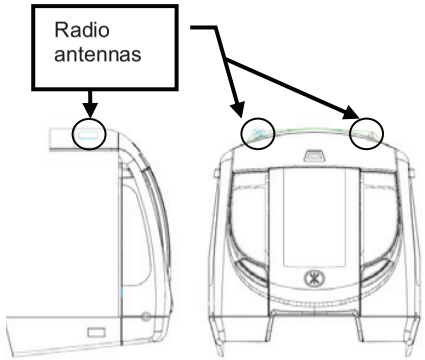
3.3 All underframe mounted equipment supplied by the SIG Contractor will be designed to withstand, or be protected from, repeated impacts from ballast up to 75 mm in diameter at speeds of up to 80 km/h.

3.4 Anti-loosen mounting fixture shall be used for all underframe mounted equipment supplied by the SIG Contractor.

3.5 All external CBTC train-borne equipment shall fulfil the Kinematic Envelope requirements specified in PS Clauses 5.1, 5.2 and 5.3.

Space Identity	Description	Works by the New Train Contractor	Works by SIG Contractor
SIG.New Train.P.1	Secondary Train Operator Display (STOD) Space	a) To provide mounting including mounting brackets, hinge, etc. for the installation of Secondary Train Operator Display (STOD) provided by SIG Contractor in each Train Operator's Cab with maximum dimensions of 350mm (L) x 250mm (H) x 100mm (W) and maximum weight of 5kg. b) To liaise with the SIG Contractor through the Engineer for finalising the mounting detail and clearance requirement of the STOD. 	To design, supply, install, Testing and Commissioning the Secondary Train Operator Displays in two Train Operator's cabs of New Train with dimensions not exceeding the 350mm (L) x 250mm (H) x 100mm (W) and maximum weight of 5kg as illustrated in Attachment H of this IRS.

Space Identity	Description	Works by the New Train Contractor	Works by SIG Contractor
SIG.New Train.P.1.1	Primary Train Operator Display (PTOD) Space	a) To modify the mounting hole for signalling speedometer as illustrated below for the installation of Primary Train Operator Display (PTOD) provided by the SIG Contractor. b) To liaise with the SIG Contractor through the Engineer for finalising the mounting detail and clearance requirement of the PTOD. c) The mounting hole dimensions shall be at least 90mm (L) x 80mm (H). d) The dimensions of the space reserved for the display panel of the PTOD shall be at least 120mm (L) x 120mm (H). 	To design, supply, install, Testing and Commissioning the Primary Train Operator Display in two Train Operator's cabs of New Train with the dimensions as illustrated in Attachment I of this IRS.
SIG.New Train.P.2	Radio Antenna Space	a) To provide space and mounting for two individual overhead radio antennas (include cable pass-through) located at the roof of A-car. Each radio antenna space shall be 260mm (L) x 100mm (W) x 90mm (H) with metal-free area of 60 degree	a) To design, supply, install, Testing and Commissioning the IEEE 802.11 radio antennas, coaxial cables, connectors and cable glands. The dimensions of each antenna shall not exceed 260mm (L) x 100mm (W) x 90mm (H) and weight of 2kg each.

Space Identity	Description	Works by the New Train Contractor	Works by SIG Contractor
		measured from the sensitivity axis of the radio antenna. b) To provide space and mounting for the third overhead radio antenna (include cable pass-through) located at the roof of A-car in the event that the 4G/LTE radio antennas are externally mounted. c) To liaise with the SIG Contractor through the Engineer for finalising the mounting detail, cable routing and clearance requirement of the radio antennas. 	b) The lateral spacing between the two adjacent radio antennas shall be at least 1648mm apart if the radio antenna height is 90mm. c) To design, supply, install, Testing and Commissioning the 4G/LTE radio antennas, coaxial cables, connectors and cable glands. d) In the event that the 4G/LTE radio antennas are externally mounted, the SIG Contractor shall liaise with the Engineer on the mounting detail. The dimension and weight of the 4G/LTE radio antenna shall not exceed those requirements for the IEEE 802.11 radio antenna.
SIG.New Train.P.3	Ethernet Repeaters Space	a) To provide two individual Ethernet Repeaters Space inside each B-car and mounting including mounting brackets, hinge etc. for the installation of two Ethernet Repeaters provided	a) To design, supply, install, Testing and Commissioning the Ethernet Repeaters, all applicable coaxial cables, connectors and cable glands. The dimensions of each repeater shall not exceed 300mm (L) x 300mm (W) x 200mm

Space Identity	Description	Works by the New Train Contractor	Works by SIG Contractor
		by SIG Contractor. (Four Ethernet Repeaters are to be installed inside two B-car of each 8 car train consist. The dimensions of each repeater shall not exceed 300mm (L) x 300mm (W) x 200mm (H) and weight of 5kg each.) b) To liaise with the SIG Contractor through the Engineer for finalising the mounting detail, cable routing and clearance requirement of the Ethernet Repeaters.	(H) and weight of 5kg each.

tab.Infs.SIG.New Train.01 – Equipment Space Schedule

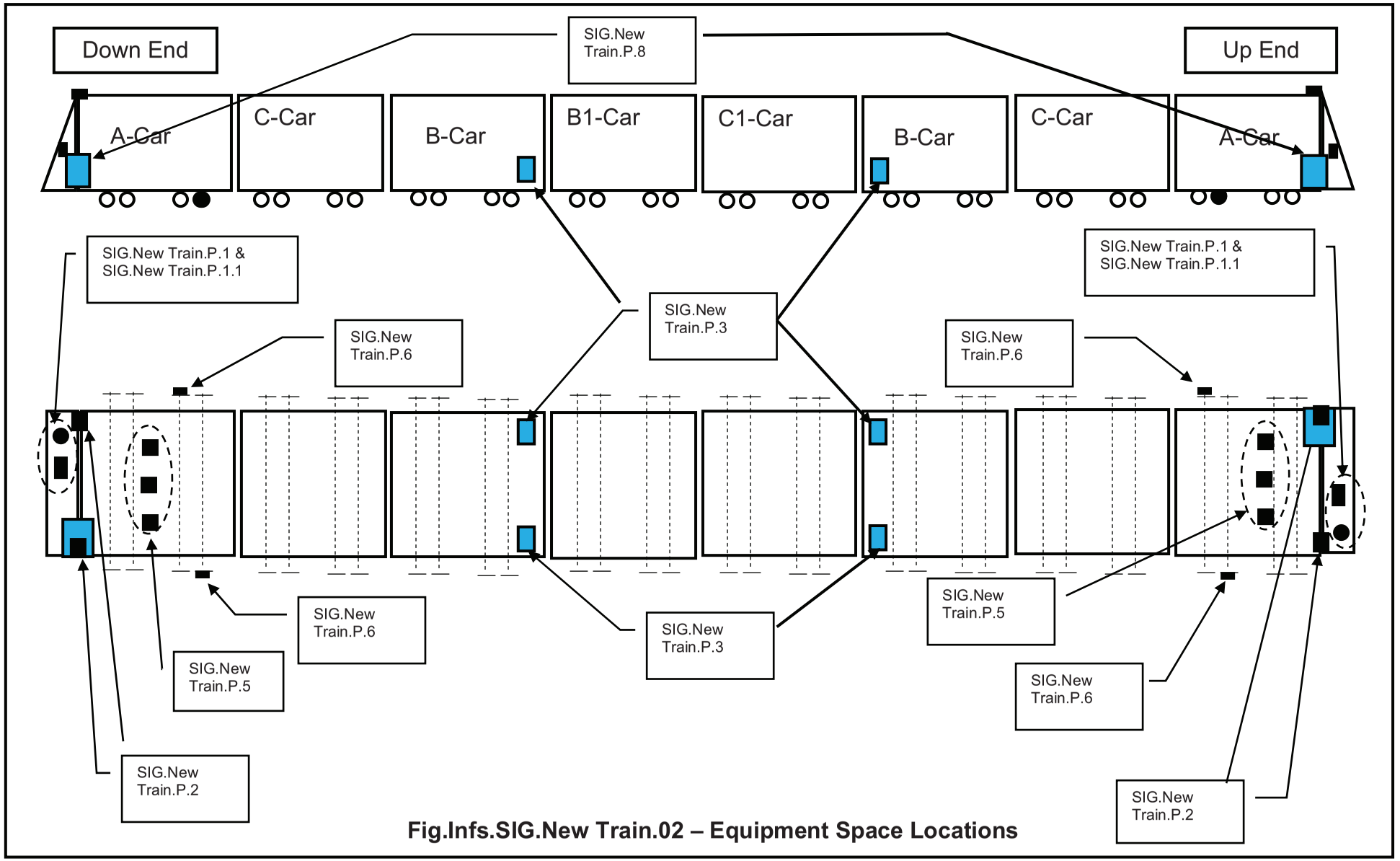


Fig.Infs.SIG.New Train.02 – Equipment Space Locations

4. TRAINLINES

4.1 The New Train Contractor shall provide all the additional trainlines required for the functioning of CBTC Train-borne Subsystem and to achieve the hot-standby redundancy configuration of CBTC Train-borne Subsystem.

4.2 In order to provide redundancy and to avoid single point failure affecting the reliability performance of the CBTC Train-borne Subsystem, the New Train Contractor shall provide four separate trainline paths to avoid common mode failure due to bad contact, short circuit and open circuit of the trainlines.

4.3 The trainline cables shall be routed to interface the underframe mounted and inside car mounted CBTC equipment located at A-cars and B-cars as specified in Fig.Infs.SIG.New Train.02. The exact cabling paths shall be proposed by the New Train Contractor and subject to approval by the Engineer.

Trainlines Identity	Description	Works by New Train Contractor	Works by SIG Contractor
CA1, CA5 & CA9	Trainline Cable Bundle No.1	a) To design, supply, install, Testing and Commissioning 25 x single core 1.5mm^2 AWG15 trainlines (21 cores for CBTC functions and 4 cores for spare) including all pins, connectors, connection boxes, cable conduits, PMA sheath and cable glands. b) The trainline cable CA1 shall be routed from the Down End A-car Driver Cab CBTC equipment compartment to the Down End B-car Underframe. c) The trainline cable CA5 shall be routed from the Down End B-car Underframe to the Up End B-car Underframe. d) The trainline cable CA9 shall be	a) The SIG Contractor shall use the single core trainlines for vital inputs and outputs as specified in this IRS. b) The SIG Contractor shall be responsible for design, supply, install, Testing and Commissioning of the required terminals, terminal lugs, connectors, sockets, connector pins for termination of trainlines and complete for the intended functions of the CBTC equipment.

Trainlines Identity	Description	Works by New Train Contractor	Works by SIG Contractor
		routed from the Up End B-car Underframe to the Up End A-car Driver Cab CBTC equipment compartment.	
CA2, CA6 & CA10	Trainline Cable Bundle No. 2	a) To design, supply, install, Testing and Commissioning 3 Cat 5 trainline cables with conductor size of AWG20 (each CAT5 cable shall comprise 4 cores shielded twisted pairs) including all pins, connectors, connection boxes, cable conduits, PMA sheath and cable glands. b) The trainline cable CA2 shall be routed from the Down End A-car Driver Cab CBTC equipment compartment through A-C-B car underframe to the Ethernet Repeater installed in Down End B-car equipment compartment. c) The trainline cable CA6 shall be routed from the Ethernet Repeater installed in Down End B-car equipment compartment through B1-C1 car underframe to the Ethernet Repeater installed in Up End B-car equipment compartment. d) The trainline cable CA10 shall be routed from the Ethernet Repeater installed in Up End B-car	a) The SIG Contractor shall be responsible for all wire termination b) The SIG Contractor shall be responsible for design, supply, install, Testing and Commissioning of the required terminals, terminal lugs, connectors, sockets, connector pins for termination of trainlines and complete for the intended functions of the CBTC equipment.

Trainlines Identity	Description	Works by New Train Contractor	Works by SIG Contractor
		equipment compartment through A-C-B car underframe to the Up End A-car Driver Cab CBTC equipment compartment. e) All shields of the trainline cables shall be earthed at both ends in the same car.	
CA3, CA7 & CA11	Trainline Cable Bundle No. 3	a) To design, supply, install, Testing and Commissioning 3 Cat 5 trainline cables with conductor size of AWG20 (each CAT5 cable shall comprise 4 cores shielded twisted pairs) including all pins, connectors, connection boxes, cable conduits, PMA sheath and cable glands. b) The trainline cable CA3 shall be routed from the Down End A-car Driver Cab CBTC equipment compartment through A-C-B car underframe to the Ethernet Repeater installed in Down End B-car equipment compartment. c) The trainline cable CA7 shall be routed from the Ethernet Repeater installed in Down End B-car equipment compartment through B1-C1 car underframe to the Ethernet Repeater installed in Up End B-car equipment compartment. d) The trainline cable CA11 shall be	a) The SIG Contractor shall be responsible for all wire termination b) The SIG Contractor shall be responsible for design, supply, install, Testing and Commissioning of the required terminals, terminal lugs, connectors, sockets, connector pins for termination of trainlines and complete for the intended functions of the CBTC equipment.

Trainlines Identity	Description	Works by New Train Contractor	Works by SIG Contractor
		routed from the Ethernet Repeater installed in Up End B-car equipment compartment through A-C-B car underframe to the Up End A-car Driver Cab CBTC equipment compartment. e) All shields of the trainline cables shall be earthed at both ends in the same car.	
CA4, CA8 & CA12	Trainline Cable Bundle No. 4	a) To design, supply, install, Testing and Commissioning 25 x single core 1.5mm2 AWG15 trainlines (21 cores for CBTC functions and 4 cores for spare) including all pins, connectors, connection boxes, cable conduits, PMA sheath and cable glands. b) The trainline cable CA4 shall be routed from the Down End A-car Driver Cab CBTC equipment compartment to the Down End B-car Underframe c) The trainline cable CA8 shall be routed from the Down End B-car Underframe to the Up End B-car Underframe. d) The trainline cable CA12 shall be routed from the Up End B-car Underframe to the Up End A-car	a) The SIG Contractor shall use the single core trainline for vital inputs and outputs as specified in this IRS. b) The SIG Contractor shall be responsible for design, supply, install, Testing and Commissioning of the required terminals, terminal lugs, connectors, sockets, connector pins for termination of the trainlines and complete for the intended functions of the CBTC equipment.

Trainlines Identity	Description	Works by New Train Contractor	Works by SIG Contractor
		Driver Cab CBTC equipment compartment.	
J1 & J2	Inter-car Jumpers	a) To design, supply, install, Testing and Commissioning 7 pairs of inter-car jumpers cables including all pins, connectors, connection boxes, cable conduits, PMA sheath and cable glands. b) Each jumper cable shall carry 25 single cores with conductor size of 1.5mm^2 AWG15 and 3 CAT 5 AWG20 cables. The two types of cables shall be individual screened and single-end earthed. c) The connector design shall be child and parent type. The connector shall ensure that individual and dedicated connectors provided for respective Cat 5 cables and the single core cable.	Not applicable

tab.Infs.SIG.New Train.02 – Trainlines Schedule

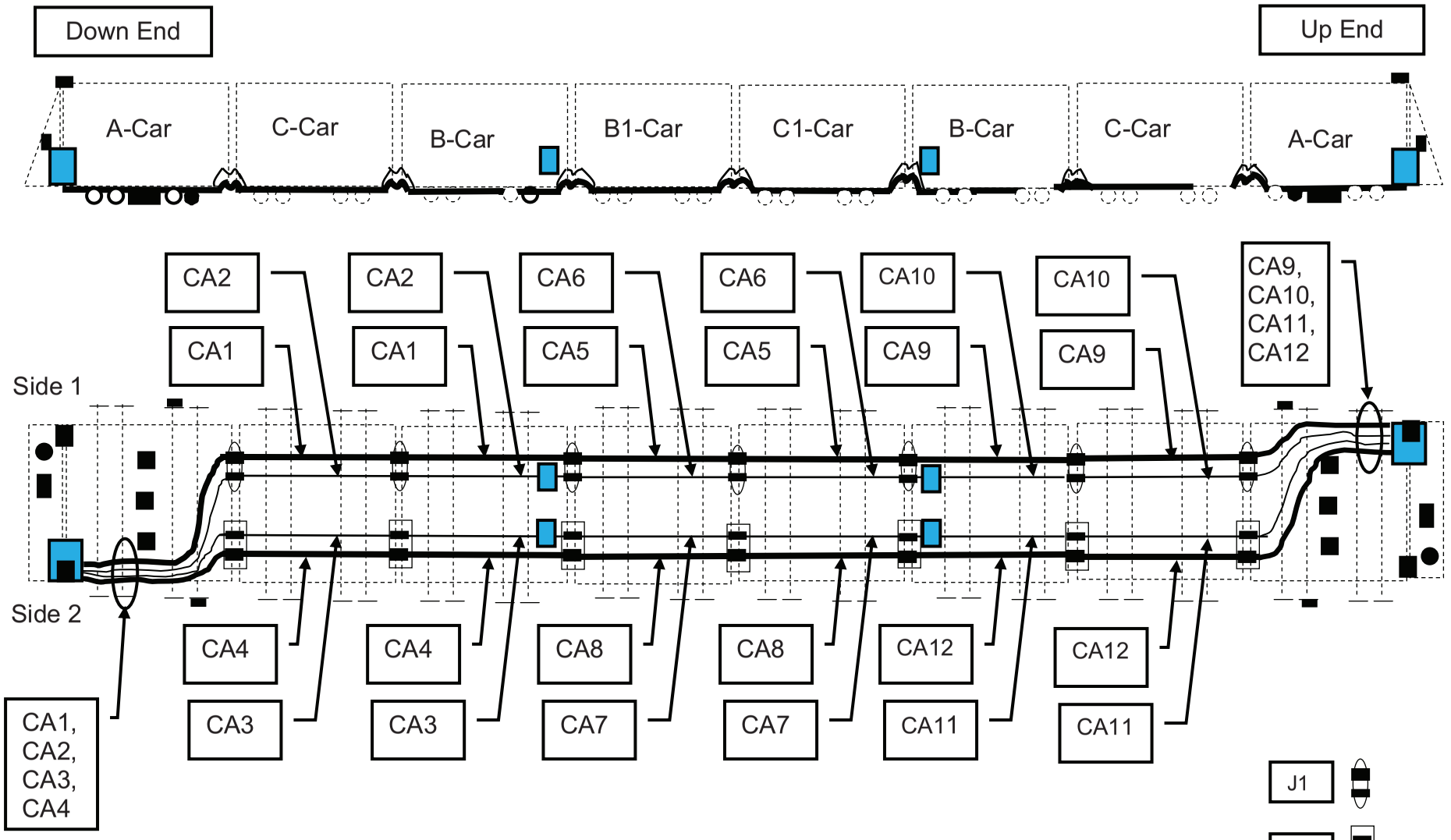


Fig.Infs.SIG.New Train.03 – Trainlines Provision

5. CABLE CONDUITS PROVISION

5.1 The scope of provision of cable conduits for the Train-borne CBTC Controller shall be in accordance with tab.Infs.SIG.New Train.03 and Fig.infs.SIG.New Train.04. The New Train Contractor shall liaise with the SIG Contractor through the Engineer for finalising the material, dimension, bending radius and clearance requirements of the cable conduits.

Cable Conduit Identify	Description	Works by New Train Contractor	Works by SIG Contractor
CC1	Flexible cable conduit CC1	a) To design, supply, and install one flexible cable conduit including draw wires and cable glands (i.e. two per New Train) b) The flexible cable conduit CC1 shall be routed from the CBTC equipment compartment to the locations of the Primary and Secondary Train Operator Displays.	a) To design, supply, install, Testing and Commissioning all required cables for the Primary and Secondary Train Operator Displays.
CC2	Not used		
CC3	Not used		
CC4	Underframe cable conduit CC4	a) To design, supply, install, Testing and Commissioning all underframe cable conduits including all mounting, junction boxes, PMA sheath and cable glands.	a) To design, supply, install, Testing and Commissioning all required cables, wires, terminal lugs, terminals, terminal blocks, flexible cable conduits and connectors for the Underframe antennas/tag readers/radars, proximity sensor, speed sensors in A-car.
CC5	Flexible cable conduit CC5	a) To design, supply, and install six flexible cable conduits including draw wires and cable glands (i.e. six per New Train)	a) To design, supply, install, Testing and Commissioning all required cables, wires, terminal lugs, terminals and connectors for connecting the radio

Cable Conduit Identify	Description	Works by New Train Contractor	Works by SIG Contractor
		for the use of CBTC Train-borne Subsystem. b) Two flexible cable conduits CC5 shall be routed from each CBTC equipment compartment to the overhead radio antennas locations. c) One flexible cable conduits CC5 shall be routed from each CBTC equipment compartment to 4G LTE radio antenna location in the Train Operator's Cab or overhead radio antennas location in the event that the 4G/LTE radio antennas are externally mounted.	antennas.

tab.Infs.SIG.New Train.03 – Cable Conduit Schedule

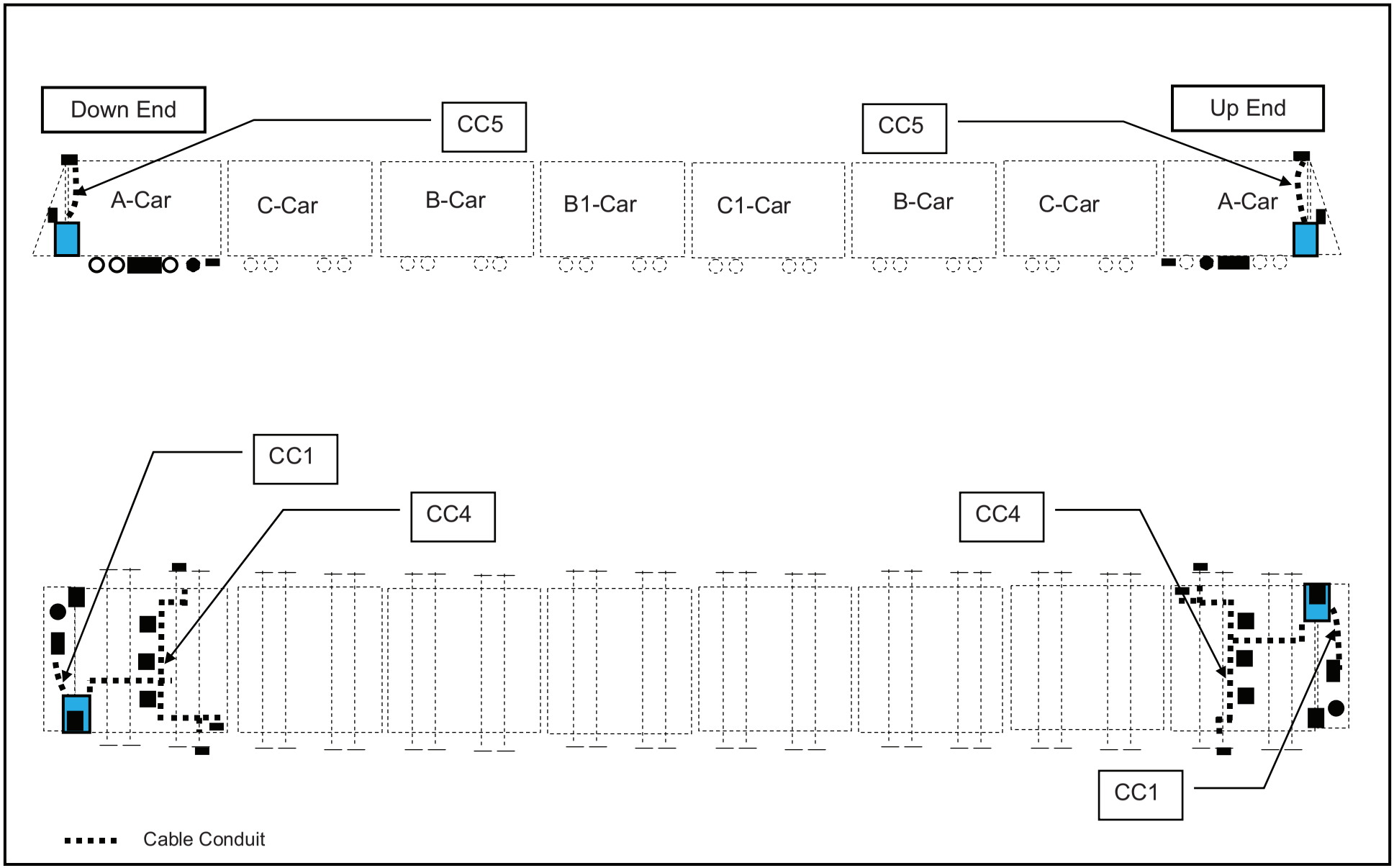

Down End
CC5
CC5
Up End
A-Car
C-Car
B-Car
B1-Car
C1-Car
B-Car
C-Car
A-Car
CC1
CC4
CC4
CC1
Cable Conduit

Fig.Infs.SIG.New Train.04 – Cable Conduits Provision

6. FUNCTIONAL INTERFACE

6.1 The New Train's additional functional requirements are specified in tabl.infs.SIG.New Train.04.

Functional Input Identity	Signal name	Functional Requirements	Works by New Train Contractor	Works by SIG Contractor
SIG.New Train.F.IN.6	Power Supply for A-car	To provide power supply to the train-borne CBTC equipment located at A-car	To provide power supply to the train-borne CBTC equipment located at A-car. There are two sets of train-borne CBTC equipment to be installed at respective A-car of New Train. Each power supply shall comply with the following: i. Nominal Voltage: 110Vdc (77Vdc to 137.5Vdc) ii. Maximum Power: 520W iii. Sleep Mode Power: 100W for at least 12 hours iv. 6 MCBs for over current protection	To design, supply, install, Testing and Commissioning the train-borne CBTC equipment not exceeding the power supply provided including sleep mode power supply.

Functional Input Identity	Signal name	Functional Requirements	Works by New Train Contractor	Works by SIG Contractor
SIG.New Train.F.IN.7	Power Supply for B-car	To provide power supply to two Ethernet Repeaters located inside each B-car.	To provide 110Vdc power supply with separate and independent MCB to each of two Ethernet Repeaters located inside B-car. Four Ethernet Repeaters are to be installed inside two B-cars of 8 car train consist. The power rating of each Ethernet Repeater is to be determined by SIG contractor. Each power supply shall comply with the following: i. Nominal Voltage: 110Vdc (77Vdc to 137.5Vdc) ii. Maximum Power: to be determined by SIG Contractor iii. One independent MCB for each repeater for over current protection iv. The power supply shall be available at all times regardless of the Mode Selector position and the up/down status of pantographs.	a) To design, supply, install, Testing and Commissioning the Ethernet Repeaters, all applicable coaxial cables, connectors and cable glands. The dimensions of each repeater shall not exceed 300mm (L) x 300mm (W) x 200mm (H) and weight of 5kg each. The power rating of each repeater shall not exceed 100W.

tab.Infs.SIG.New Train.04

7. INSTALLATION ARRANGEMENT AND PROVISION

7.1 Except as identified in the ATC Connectors & Tail Cables Specifications table in Attachment A of Attachment App-I-Annex 3, Appendix 3, Annex C13, the SIG Contractor will provide all CBTC train-borne equipment.

7.2 New Train Contractor shall collect and arrange delivery of all train-borne CBTC equipment for first two trainsets from Hong Kong to car-builder factory for installation. The installation of all train-borne CBTC equipment for first two trainsets (T1 and T2) of New Trains shall be completed in car-builder factory by the New Train Contractor. The SIG Contractor will provide installation specification, method statement and site supervision in car-builder factory according to implementation programme approved by the Engineer.

7.3 New Train Contractor shall provide Stabling Track and Test Track with OHL supply for carrying out static test, interface test and low speed dynamic test in car-builder factory for the first two trainsets (T1 and T2). The Test Track shall be at least 500m in length and allow train running at speed of 40Kph for both directions. The details of Test Track design, power supply provision and installation of signalling facilities shall be finalised separately according to the implementation programme approved by the Engineer.

7.4 For the third train onwards, all the CBTC train-borne equipment shall be installed, tested and commissioned by the SIG Contractor in Hong Kong except the roof top mounted radio antennas in A-car in section 3 and as identified in Attachment A of Attachment App-I-Annex 3, Appendix 3, Annex C13 “ATC Connectors & Tail Cables Specifications table” which shall be installed by the New Train Contractor. Trainlines in section 4, cable conduits in section 5 and power supply & sleep mode power in section 6 as specified in this Interface requirement Specification shall be supplied & installed by the New Train Contractor. New Train Contractor shall collect and arrange delivery of all roof top mounted radio antennas (and accessories if applicable) in one batch provided by the SIG Contractor 3 months in advance the installation programme for remaining 76 trainsets from Hong Kong to car-builder factory for installation by the New Train Contractor.

7.5 New Train Contractor shall be the lead contractor to make the train ready for CBTC Systems Tests and set up applicable protections or test conditions in Test Track and in car side to enable the SIG contractor to carry out all approved Test and commissioning activities for all New Trains.

8. INTERFACE DOCUMENTATION

8.1 The SIG Contractor will be responsible for preparing the interface documents related to the interface in accordance with table tab.Infs.SIG-New Train.11 below. The interface documents of the New Train Contractor shall be submitted to the Engineer for approval.

Ref. No.	Documents
12.1.1	Detailed Interface Specification
12.1.2	Detailed Interface Test Plan
12.1.3	Interface Test Specifications

tab.Infs.SIG.New Train.11

---------- End of the Contract 6014 - SIG and New Train Interface Requirements Specification ----------

Attachment A – Detailed Interface Design Specification for Automatic Train Control

Attachment A
_20141124

Detailed Interface Design Specification for Automatic Train Control

Contents

1 Introduction.....3
1.1 Abbreviations and Acronyms.....3
Appendices.....4

1 Introduction

This document describes the detailed interfaces between Rolling Stock (RS) and the Automatic Train Control (ATC). The document will reflect the design in how the interface requirements are met.

1.1 Abbreviations and Acronyms

ATC	Automatic Train Control
ATO	Automatic Train Operation
ATP	Automatic Train Protection
RS Contractor	Rolling Stock Contractor
DDS	Detailed Design Specification
DID	Detailed Interface Document (including the Interface Design Specification)
EMC	Electromagnetic Compatibility
GS	General Specification
IMP	Interface Management Plan
MTR	Mass Transit Railway
PIP	Project Interface Plan
PS	Particular Specification
PSD	Platform Station Doors
RS	Rolling Stock
SACEM	Système d'Aide à la Conduite à l'Entretien et à la Maintenance
TBC	Traction Brake Controller
TKE	Tseung Kwan O Extension
TMS	Train Management System
TSE	Trainborne Signalling Equipment

Appendices

Appendix 1	Not Used
Appendix 2	Comparison Table between PS Requirements and DIS-ATC
Appendix 3	Detailed Interface Specification Ver.2.5

Appendix 2
Signal/RS Electrical Interface Comparison Table Between PS Requirements and ATC

OBCU Name (PS)	Type	ATC Name	Remarks
NORMAL	INPUT	ATC Mode	
REMD	INPUT	--	Not REMD in ATC
NSD	INPUT	NOT_SD	
RMF	INPUT	Forward	
RMR	INPUT	Reverse	
DCCSA	INPUT	--	
DCCSB	INPUT	--	
DOCSA	INPUT	DOSA	
DOCSB	INPUT	DOSB	
ADC	INPUT	Door Status	To check door operation sequence
SIR1_Status	INPUT	SIR1 Status	
SIR2_Status	INPUT	SIR2 Status	
EB_applied	INPUT	EMPB	
TRS_Status	INPUT	--	
DTO_Command	INPUT	DKPB	Driverless Control Push Button
AM	INPUT	AUTO	
CM	INPUT	CM	
SB	INPUT	SB	
Start_Command	INPUT	AUTO Start PB	AUTO Start Pushbutton
Holding_Brake	INPUT	--	
RX_TMS	INPUT	RX_TMS	
--	INPUT	DT_SD	ATC monitors the SD position
--	INPUT	EBR1 status	1=EB, 0=NO EB by ATC monitor
--	INPUT	EBR2 status	1=EB, 0=NO EB by ATC monitor
--	INPUT	ZVR1 Status	1=moving, 0=zero speed
--	INPUT	ZVR2 Status	1=moving, 0=zero speed
--	INPUT	EMPB	1=EB not applied, 0= EB applied
DOEA	OUTPUT	DERA	
DOEB	OUTPUT	DERB	
PSDC	OUTPUT	--	Monitor by software
EBR1	OUTPUT	EBR1	1=NO EB, 0=EB applied by ATC
EBR2	OUTPUT	EBR2	1=NO EB, 0=EB applied by ATC
ZVAR	OUTPUT	--	No such requirement
ZVR1	OUTPUT	ZVR1	1=Zero Speed, 0=Train Move
ZVR2	OUTPUT	ZVR2	1=Zero Speed, 0=Train Move
DTO_SR	OUTPUT	DCR/2	When MS at SD position, 1=DT & 0= Not DT
DTO_MSS	OUTPUT	SSIR/1	To reset SIR circuit in DT mode
DTO_Mode_Indicator	OUTPUT	Driverless Ind.	
AM_Fault_Indicator	OUTPUT	AUTO Fault Ind.	
CM_Fault_Indicator	OUTPUT	CM Fault Ind.	
RM-Fault_Indicator	OUTPUT	RM Fault Ind.	
EB_Application_Indicator	OUTPUT	EB Triggered Ind.	
Locked_Axle_Indicator	OUTPUT	Locked Axle Ind.	
Train_Hold_Indicator	OUTPUT	Train Hold Ind.	
REMD_Mode_Indicator	OUTPUT	--	

PSD_Open_Indicator	OUTPUT	--	
Overspeed_Alarm	OUTPUT	Overspeed Alram	
DTO_DOCA-1	OUTPUT	DORA/1	
DTO_DOCA-2	OUTPUT	DORA/2	
DTO_DOCB-1	OUTPUT	DORB/1	
DTO_DOCB-2	OUTPUT	DORB/2	
Brake_demand	OUTPUT	Brake Demand	
Motor_demand	OUTPUT	Motor Demand	
ATO_PWM Level	OUTPUT	ATO_PWM	
TX_TRS	OUTPUT	--	Not TRS requirement in PS
TX_TMS	OUTPUT	TX_TMS	
--	OUTPUT	DCR/1	When MS at SD position, 1=DT & 0= Not DT
--	OUTPUT	DCR/3	When MS at SD position, 1=DT & 0= Not DT
--	OUTPUT	DCR/4	When MS at SD position, 1=DT & 0= Not DT
--	OUTPUT	DCR/5	When MS at SD position, 1=DT & 0= Not DT
--	OUTPUT	ATC Fault	ATC fault indicator
--	OUTPUT	Start Hold Fault	1=ATO Start authorized, 0=ATC Start not authorized
--	OUTPUT	Door Test Ind.	1=Door Test faulure, 0=Door Test Passed
--	OUTPUT	SIR1 Ind	SIR1 Indicator
--	OUTPUT	SIR2 Ind.	SIR2 Indicator
--	INPUT	FB110	

DETAILED INTERFACE SPECIFICATION

TABLE OF CONTENTS

1. INTRODUCTION 6

2. ABBREVIATIONS AND DEFINITIONS 7

3. REFERENCE 9

4. SYSTEM CONFIGURATION 10

4.1 TRAIN CONSIST 10

4.2 TRACTION AND BRAKE PERFORMANCE 10

4.3 ROLLING STOCK CHARACTERISTICS 10

4.4 SYSTEM DEFINITION 10

4.5 CAR / SACEM/ A-CAR PLUG NUMBERING 13

5. GENERAL INTERFACE PRINCIPLES 14

5.1 MODE SELECTION EQUIPMENTS 14

5.2 NORMAL DRIVING MODES 14

5.2.1 AUTOMATIC Mode 14

5.2.2 CODED MANUAL Mode 14

5.3 SPECIFIC DRIVING MODES 14

5.3.1 Restricted Manual Forward / Reverse Mode 14

5.3.2 Driverless Turnaround Mode 15

5.3.3 Traction Fall-back Mode 15

5.4 NON-DRIVING MODE 15

5.4.1 Standby Mode 15

5.4.2 Shutdown Mode 15

5.4.3 Reset Mode 15

6. CONTROL SYSTEM BLOCK DIAGRAM 16

7. GENERAL SAFETY DEFINITIONS AND CONSTRAINTS 17

7.1 DEFINITION 17

7.2 CONSTRAINTS 17

7.3 EMC REQUIREMENTS 17

7.3.1 EMC requirements concerning the wiring between the signaling equipment 17

7.3.2 Class of signal 19

7.3.3 Protection of cables from noisy trainborne equipment 20

7.4 EARTHING POLICY 20

7.4.1 Serial links 20

7.4.2 Pick-up coils and odometer 21

8. MECHANICAL INTERFACE 22

8.1 EQUIPMENT WEIGHT 22

DETAILED INTERFACE SPECIFICATION

8.2 RC ANTENNA & CT SENSORS 22
8.2.1 Metal Free Zone 22
8.2.2 RC Antenna Installation Constraints 22
8.2.3 CT Sensor Installation Constraints 22
8.2.4 Mounting Arrangement 22
8.3 ATC CUBICLE 22
8.3.1 Mounting Arrangement 22
8.4 SPEEDOMETER 22
8.4.1 Mounting Arrangement 22
8.5 ODOMETER 22
8.5.1 Odometer Main Specifications 22
8.5.2 Odometer Environmental Specifications 22
8.5.3 Odometer Mounting Precautions 23
9. ELECTRICAL INTERFACE 24
9.1 ATC INPUTS AND OUTPUTS ELECTRICAL CHARACTERISTICS 24
9.2 CABLE SPECIFICATIONS 24
9.3 SCOS REQUIREMENTS 24
9.4 ATC POWER SUPPLY REQUIREMENTS 24
9.5 ATC I/O CIRCUITS 24
10. FUNCTIONAL INTERFACE 25
10.1 TRACTION AND SERVICE BRAKE CONTROLS 25
10.1.1 ATC Outputs 25
10.1.2 Functional Description 25
10.1.3 Remarks 27
10.1.4 Holding Brake Management 27
10.2 EMERGENCY BRAKE CONTROL 30
10.2.1 ATC Outputs 30
10.2.2 Functional Description 30
10.2.3 Remarks 30
10.3 ZERO VELOCITY RELAY CONTROL 30
10.3.1 ATC Outputs 30
10.3.2 Functional Description 30
10.3.3 Remarks 31
10.4 DOOR AUTHORIZATION 31
10.4.1 ATC Outputs 31
10.4.2 Functional Descritption 31
11. ANNEX 32

DETAILED INTERFACE SPECIFICATION

1. INTRODUCTION

This interface specification defines the detailed interface arrangement between Signalling Contractor – Trainborne Signalling Equipment and RS Contractor – Rolling Stocks.

The Trainborne Signalling Equipment (TSE) supplied by Signalling Contractor is the on-board ATC system namely SACEM currently used in M-train on URL.

The TSE consists of (i) one ATC cubicle which contains all electronic processor modules to monitor, compute and command all ATP and ATO functions, (ii) two CT sensors which are used to prick up the track-to-train signaling message from the CT loops mounted on both rails, (iii) one SACEM odometer located at axle end 4B for speed and distance measurement, (iv) one tacho-generator located at axle end 3A for zero speed detection, (v) one RC antenna to determine the train position as well as sending train-to-track message to the trackside return channel for PSD controls and this RC antenna is also used to report ATC faults via the trackside return channel and (vi) one speedometer to indicate the current and target speed to the train drivers.

Each train consists of two TSEs and each TSE is working independent from the other.

This document covers the detailed mechanical, electrical and functional interfaces.

DETAILED INTERFACE SPECIFICATION

2. ABBREVIATIONS AND DEFINITIONS

ADC	All Doors Closed
ATC	Automatic Train Control
ATO	Automatic Train Operation
ATP	Automatic Train Protection
AM	Automatic mode
CM	Coded Manual
CT	Continuous Transmission
DC	Direct Current
DCCA/ DCCB	Door Close Control– Side A / Side B
DCCSA/ DCCSB	Door Close Control State – Side A / Side B
DOCA/ DOCB	Door Open Control– Side A / Side B
DOCSA/ DOCSB	Door Open Control State – Side A / Side B
DOEA / DOEB	Door Open Enable – Side A / Side B
DTO	Driverless Turnround Operation
EB	Emergency Brake
ESS	Emergency Stop Switch
EBR	Emergency Brake Relay
EMC	Electromagnetic Compatibility
FSK	Frequency Shift Keying
MCB	Micro Circuit Breaker
MS	Mode Selector
MTBF	Mean Time Between Failure
MTRC	Mass Transit Railway Corporation
PSD	Platform Station Doors
PSDC	Platform Station Doors Closed
PTO	Passenger Train Operator
RC	Return Channel
REMD	Rear End Mode Driving
RM	Restricted Manual mode
RMF	Restricted Manual mode – Forward direction
RMR	Restricted Manual mode – Reverse direction
RS	Rolling Stock
SACEM	Système d'Aide à la Conduite à l'Entretien et à la

DETAILED INTERFACE SPECIFICATION

	Maintenance
SIR	Safety Interlock Relay
SCOS	Safety Cut Out Switch
TBC	Traction Brake Controller
TBD	To Be Defined
TKE	Tseung Kwan O Extension
TMS	Train Management System
TSE	Trainborne Signalling Equipment
TRS	Train Radio System
URL	Urban Line
ZVR	Zero Velocity Relay

DETAILED INTERFACE SPECIFICATION

3. REFERENCE

1. General Specification
2. Particular Specification

DETAILED INTERFACE SPECIFICATION

4. SYSTEM CONFIGURATION

4.1 TRAIN CONSIST

The train-consist for the new EMU supplied under contract comprises 8 cars. 6 motor cars and 2 driving trailer cars. The configurations are shown on the General Arrangement Concept drawing and Train Formation drawings in Annex A1. General Arrangement of the cars is shown in Annex A2.

4.2 TRACTION AND BRAKE PERFORMANCE

The traction and brake performance of the new EMU are specified in Annex A3 – Traction Motor Characteristic Curve and Annex A4 – Braking Performance Curve.

4.3 ROLLING STOCK CHARACTERISTICS

The characteristics of the new EMU related the ATC are specified in Annex A5 – Rolling Stock Parameters.

4.4 SYSTEM DEFINITION

The labelings rules concerning the motion direction and the door control side definition depend upon the selected cab of the train (see figures 4.4.1 and 4.4.2)

- The **Selected cab** is the cab where the Mode Selector switch is NOT at SHUTDOWN position, or at SHUTDOWN position if "Driverless Turnround Operation" is in operation; the ATC is then **active**.
- The Front **car** is the A-car of the train whose cab is selected.
- The Front **cab** is the cab of the Front car.
- The **Rear car** is the A-car opposite the Front car.
- The **Rear cab** is the cab of the Rear car.
- The **Forward direction** is the direction given by the front cab.
- The **Reverse direction** is the back direction given by the front cab.

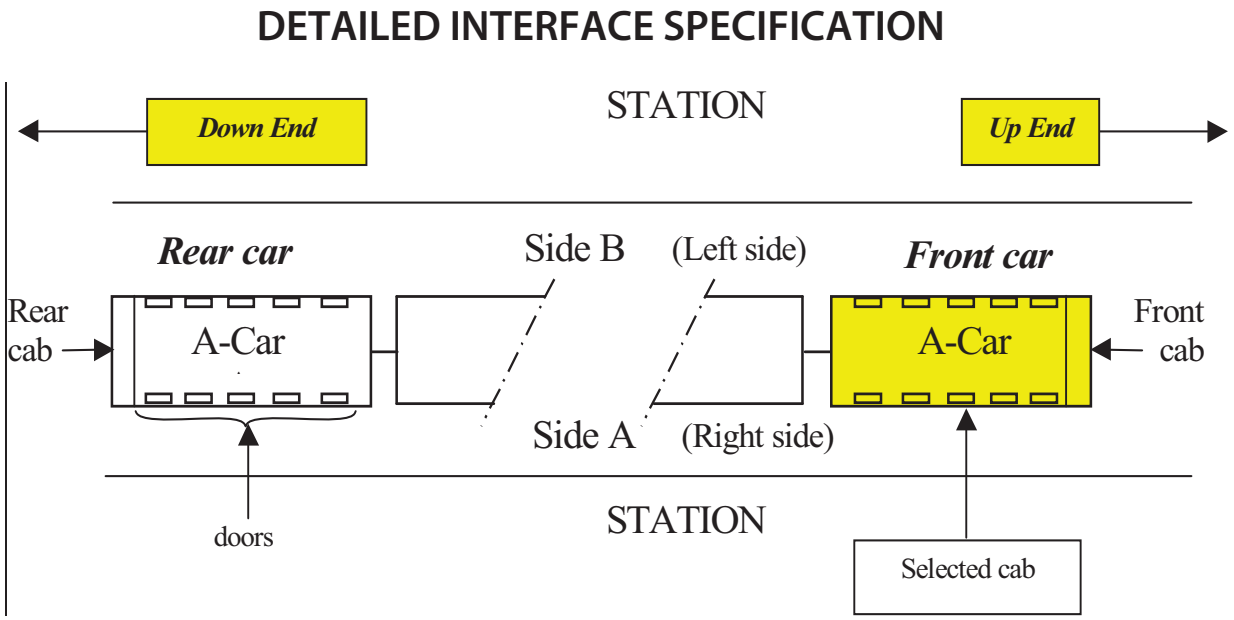


Figure 4.2.1: labelling for A-car facing Up End of the line (top view)

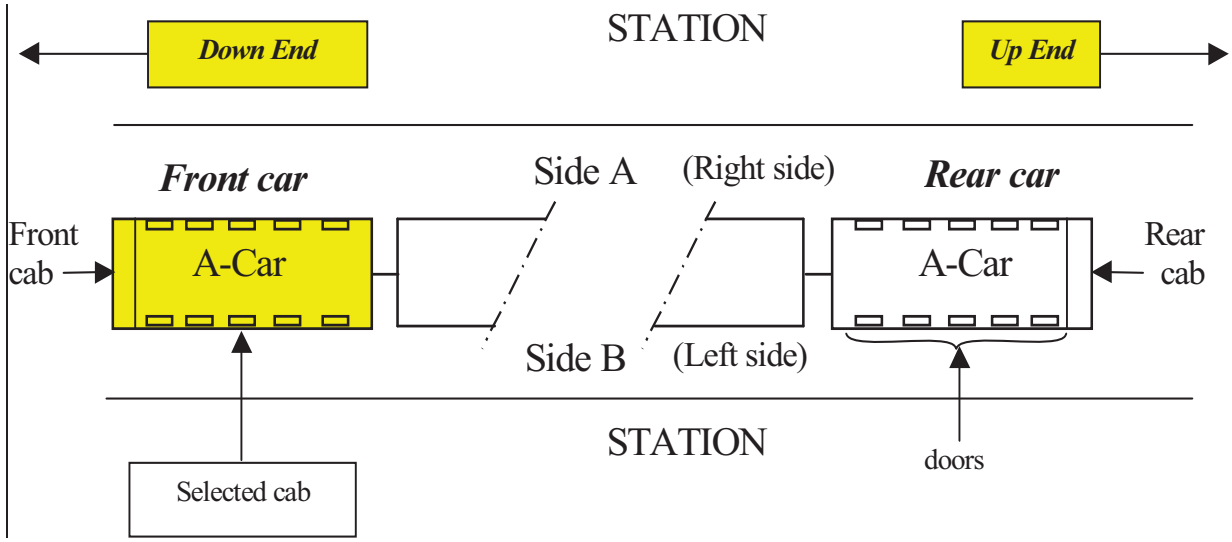


Figure 4.2.2 : labelling for A-car facing Down End of the line (top view)

In this document, as far as signalling equipment is named, we will speak about:

- The **ATC**, as the generic term for the whole signalling equipment.
- The **ATC Cubicle**, as the unit that manages the Automatic Train Control and Monitoring functions
- The **ATP**, as **the** unit that manages the ATC Cubicle vital functions (and some non vital

DETAILED INTERFACE SPECIFICATION

functions)

- The **ATO**, as the unit that manages the ATC Cubicle regulation functions

DETAILED INTERFACE SPECIFICATION

4.5 Not Used

DETAILED INTERFACE SPECIFICATION

5. GENERAL INTERFACE PRINCIPLES

5.1 MODE SELECTION EQUIPMENTS

There are three Rolling Stock equipments used to select the operating modes of the ATC. They are Mode Selector (MS) handle, Traction and Brake Controller (TBC) and Safety Cut-out Switch (SCOS).

The MS handle has six selectable positions namely SD – Shutdown, REV – RMR, SB – Standby, FOR – RMF, CM – Coded Manual and AUTO – Automatic.

The TBC has six fixed positions namely EM – Emergency Brake, Maximum Service Brake, Minimum Service Brake, COASTING, Minimum Motoring and Maximum Motoring. Furthermore, the TBC can be moved freely between (i) Maximum Service Brake and Minimum Service Brake to command different braking efforts, and (ii) Minimum Motoring and Maximum Motoring to command different traction efforts.

Annex A6 – Traction Brake Controller Out Line illustrates the operation of the MS handle and the Traction and Brake Controller.

The SCOS has three selectable positions namely Normal, Reset and Fallback.

5.2 NORMAL DRIVING MODES

Two operating modes, Automatic Mode and Coded Manual Mode, are used for normal train operation. A driving cab is said to be active if its MS handle is switched to any positions rather than Shutdown.

5.2.1 AUTOMATIC Mode

This mode is selected when the MS handle is switched to AUTO position (the TBC must at Maximum service brake position before the MS handle can be switched to AUTO position) and the Safety Cut-out Switch (SCOS) is at Normal position. In this mode, the ATO takes control of the train's traction and service brake system in order to perform train starting, precise station and signal stops, regulate the train speed and apply coasting order under the protection of the ATP.

5.2.2 CODED MANUAL Mode

This mode is selected when the MS handle is switched to CM position and the SCOS is at Normal position. In this mode, the PTO takes control of the train's traction and service brake system for train starting, precise station and signal stops, regulate the train speed and apply coasting under the protection of the ATP.

5.3 SPECIFIC DRIVING MODES

There are other specific operating modes can be selected by the MS handle and the SCOS for degraded mode operation or for driverless turning around.

5.3.1 Restricted Manual Forward / Reverse Mode

DETAILED INTERFACE SPECIFICATION

This mode is selected when (i) SCOS at Normal position and (ii) the MS handle is switched to FOR position for Restricted Manual Forward mode or the MS handle is switched to REV position for Restricted Manual Reverse Mode. In these modes, the PTO can drive the train without any signalling authorization but the on-board ATP will restrict the train speed to 22kph. All the train movement are controlled and responsible by the PTO.

5.3.2 Driverless Turnaround Mode

This mode is selected when (i) SCOS at Normal position, (ii) the MS handle is switched to Shutdown position and (iii) PTO action on the DTO button. This particular operating mode allows turning around of train at the end of the line without train driver. This mode will be terminated automatically when the train arrive the departure platform and the train doors are opened.

5.3.3 Traction Fall-back Mode

This mode is selected when fatal ATC equipment failure occurs. It can be selected by putting the SCOS to Fallback position. In this mode, the ATC is powered off and its outputs are put at the most restrictive states. The ATC speedometer will not show any train speed nor target speed. The PTO can drive the train with RMF or RMR modes only. The Rolling Stock's TMS will display the train speed information to the PTO and the Rolling Stock equipment will limit the train speed to 22kph and will apply emergency brake if the train speed over 22kph.

5.4 NON-DRIVING MODE

5.4.1 Standby Mode

This mode is selected by putting the MS handle to SB position in order to allow preparation of the train.

5.4.2 Shutdown Mode

This mode is selected by putting the MS handle to SD position when driver leave the driving cab and the train is withdrawn from service.

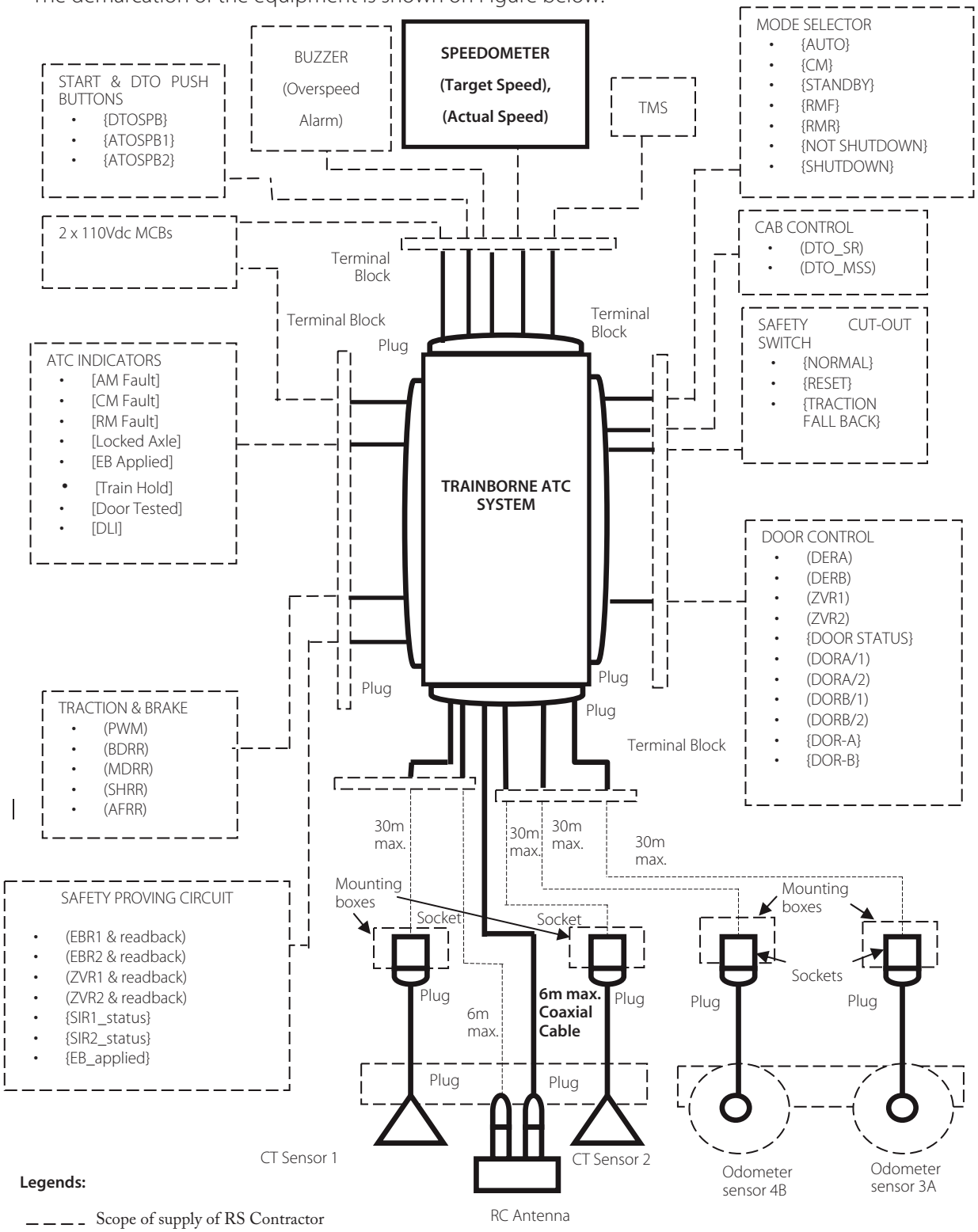
5.4.3 Reset Mode

This mode is selected by putting the SCOS switch to Reset position, this mode allows to reset the ATC in case of ATP blockage control because of failure detection (ex: CKD fall,…).

DETAILED INTERFACE SPECIFICATION

6. CONTROL SYSTEM BLOCK DIAGRAM

The demarcation of the equipment is shown on Figure below.



Legends:

Scope of supply of RS Contractor

Scope of supply of Signalling Contractor

( ) supplied by Signalling Contractor; [ ] outputs supplied by Signalling Contractor & indicators supplied by RS Contractor ; { } inputs supplied by Signalling Contractor & voltage free contacts supplied by RS Contractor ;

DETAILED INTERFACE SPECIFICATION

7. GENERAL SAFETY DEFINITIONS AND CONSTRAINTS

7.1 DEFINITION

"Vital" or "fail-safe" : such that in the event of a failure, it enters or remains in a safe state.
"0" is the safe state
"1" means : close contact or high voltage (e.g. 24V or 110V)
"0" means : open contact or low voltage (0V)

7.2 CONSTRAINTS

Some of ATC/RS interfaces are safety links which requires special cares.

- For those RS requirements defined in the present spec, that refer to vital interfaces, RS must maintain a high standard of manufacturing quality,
- Vital inputs shall be generated and provided in an appropriate safe manner by RS. In case of failure in the RS circuits, a false "1" delivered to the ATC is not acceptable. RS design must guarantee this.
- Vital output shall be processed in an appropriate safe manner by RS. In case of failure in the RS circuit, a "0" output command delivered by the ATC must not be realized as it was a "1". RS design must guarantee this.
- During normal operation, RS must ensure that doors will not be opened unless doors opening enable (vital information) is delivered from ATP (i.e.: previous state is "doors closed"),
- Vital inputs for Mode selection and for Door Closed functions have to be provided in an appropriate safe manner by RS.

7.3 EMC REQUIREMENTS

7.3.1 EMC requirements concerning the wiring between the signaling equipment

EMC rules must be applied to the cabling, wiring and installation of signaling equipment. This section is intended to stand by itself.

The electrical links between the signaling equipment must comply with the following requirements:

- In twisted pair lead, twisting of the signal high lead with its low (return) lead results in less loop area for inductive pick-up and lower inductance per foot. Lower inductance allows higher frequencies to be transmitted over a longer distances before signal loss and distortion become significant. In addition, inductive loading effects on the signal source are reduced. The minimal spacing of the high and low (return) signal leads affects cancellation of magnetic fields of the conductor currents. Cancellation of the conductor fields reduces inductive coupling with other signal leads. For these reasons twisted leads must be used wherever and whenever possible instead of non-twisted signal leads.

- Multiple conductor cable used for the transmission of several individual signals shall consist of twisted pair signal leads. Each twisted pair shall have an electrostatic shield.

DETAILED INTERFACE SPECIFICATION

- Multiple conductor cables must have an overall electrostatic shield.
- Unused conductors and shields shall be terminated. Where multiple conductors cables are involved, half of unused conductors and shields shall be terminated at one end of the cable and the remainder at the other end of the cable.
- High power leads (for example 96V DC equipment power) must be kept closely spaced to maximize the cancellation of conductor magnetic fields (magnetic loops).
- All shields must be terminated at both ends.
- Where twisted shielded leads must be broken (for example, input-output terminal boards), minimize the untwisted, unshielded lead length.
- Whenever possible, low-level signal lines shall be run unbroken from signal source to signal receiver.
- Cable routing must be utilized. Cables shall be routed around than through high-noise areas. If two cables carrying signals of different classifications must cross, they must cross at 90 ° rather than gradually over a long distance. Some sensitivity classes of the electrical circuits are defined :
    - Class 1: AC power conductors
    - Class 2: DC power conductors
    - Class 3: Conductors for sensitive digital and analogue signals
    - Class 4: Conductors for communication
    - Class 5: High Voltage and High power signals
- Low voltage cables of unlike classification must be kept physically separated – see chapter 7.3.2 for Class of signal
- Low voltage cables (lower than 100V) must be kept apart from high voltage cables. High voltage and low voltage cables must be installed in two separate trays (approx. 0,2 m).
- Each circuit must include in the same cable strand the two polarities of the signal: power supply and its common (0V), signals group and their electrical reference, pairs of wires for each output signals (relay free contact). Nevertheless vital output signals are wired with shielded mono-wire to avoid unwanted supply.
- Cables must laid on metallic support (tray, conduit) to reduce capacitive and inductive coupling.
- Cables trays are interconnected and bonded to the ground.
- Impedance of the ground and zero network is minimized.
- The grounding of following equipment : ATC cubicle and antenna, must be achieved with single or multiple braided wires. The braid must be as short as possible between the grounding screw of the equipment and the driving car frame.

DETAILED INTERFACE SPECIFICATION

7.3.2 Class of signal

1. Class 1 - High Susceptibility :

Analogue signals with AC<50V

- A : Audio and video analogue circuits
- B : HF transmitting / receiving circuits HF

2. Class 2 - Medium Susceptibility :

Digital signals, and analogue signal with AC > 50 V

- A : Digital circuits (Ethernet network,…)
- B : Transducer circuits (power supply and measurement signals)

3. Class 3 - Low Susceptibility :

Semi-conductor firing control circuits

4. Class 4 - Medium Emittivity :

Battery referenced circuits

- A : Power Input of apparatus (Electronics power suppl)
- B : Relay logic input/output
- C : Battery charger output (Control signals for relays, switchgears, magnet valves)

5. Class 5 - Power lines :

DC or AC power supply lines, with voltage higher than 75V or current higher than 20A.

- A : Catenary's voltage
- B : Propulsion current
- C : Auxiliary power supplies, 500V, 380V, etc.
- D : Battery charging lines, etc.

6. Class 6 :

Special circuits

The equipment cable class is defined below:

- **antenna :**

- analogical link and power signal (in two cables) : class 2B and 1B

- **Pick up coil (CT sensor) :**

- analogical link and power signal (in same cables) :class 2B

- **Odometer :**

- 0-24VDC signal link: class 2B

DETAILED INTERFACE SPECIFICATION

In case of long cables (above 1 meter) , the cables of different classes shall be separated. The separation distance shall depend on the type of classes:

Classes	1	2	3	4	5	6
1	0					
2	3-6cm	0				
3	3-6cm	3-6cm	0			
4	9cm	9cm	9cm	0		
5	15-20cm	15-20cm	15-20cm	15-20cm	0	
6	3-6cm	3-6cm	3-6cm	9cm	15-20cm	0

Figure 1 : Segregation classes

The cable laying design shall be submitted to ALSTOM by RS.

7.3.3 Protection of cables from noisy trainborne equipment

- Braid shield cables shall be used for the sensitive cable such as communication and signal lines
- Separate connectors shall be used for different functions such as high-level signals, low-level signals and protection of cables from noisy trainborne equipment ower supplies. If low and high-level signals have to be taken through the same connector, it shall be segregated with grounded connections between the groups.
- Corrugated tube with braid and cable duct shall be used to reduce interference from noisy equipment and cables

7.4 EARTHING POLICY

7.4.1 Serial links

The earthing policy concerning the serial lines is to connect the shield of the cable to the frame of the equipment on each side of the serial link as described in the following sketch:

DETAILED INTERFACE SPECIFICATION

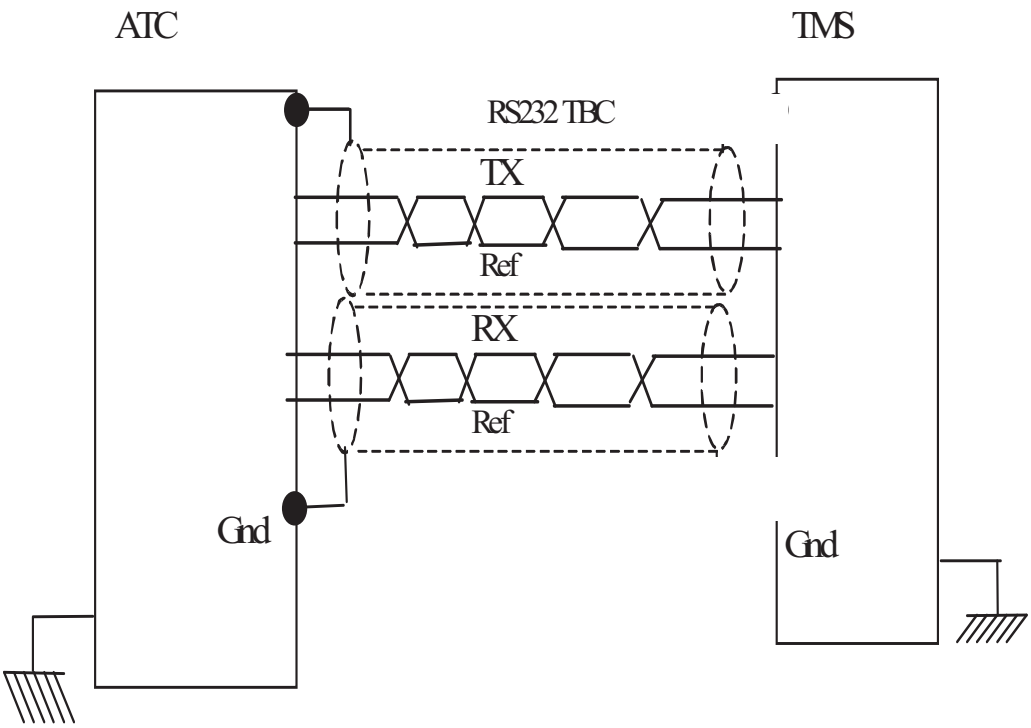


Figure 2 : Earthing policy concerning serial link

Note: Assumption : ATC and TMS are in same car.

7.4.2 Pick-up coils and odometer.

This Shields must be isolated from any potential at train level.
(Shields for this links are managed inside the ATC cubicle)

DETAILED INTERFACE SPECIFICATION

8. MECHANICAL INTERFACE

8.1 EQUIPMENT WEIGHT

The general location of the ATC equipment and their weight are specified in Annex B1, figure UF1.

8.2 RC ANTENNA & CT SENSORS

8.2.1 Metal Free Zone

The description of metal free zone for the RC antenna and CT sensors are specified in Annex B1, figure B1.U.1.1.

8.2.2 RC Antenna Installation Constraints

The RC antenna installation constraints are specified in Annex B1, section B1.U.1.2

8.2.3 CT Sensor Installation Constraints

The CT Sensor installation constrains are specified in Annex B1, section B1.U.1.3.

8.2.4 Mounting Arrangement

The detail mounting requirements of the RC antenna and CT sensors are specified in figures UF2, UF3, UF4, RC1, RC2, CT1 and CT2 of Annex B1.

8.3 ATC CUBICLE

8.3.1 Mounting Arrangement

The detailed installation and mounting requirements of the ATC cubicle are specified in figures ATC1, ATC2 and ATC3 of Annex B1.

8.4 SPEEDOMETER

8.4.1 Mounting Arrangement

The detailed installation and mounting requirements of the speedometer are specified in figure SP1 of Annex B1.

8.5 ODOMETER

8.5.1 Odometer Main Specifications

The specifications of the odometer are specified in section B1.O.1.1 of Annex B1.

8.5.2 Odometer Environmental Specifications

The environmental specifications of the odometer are specified in section B1.O.1.2 of Annex B1.

DETAILED INTERFACE SPECIFICATION

8.5.3 Odometer Mounting Precautions

The detail mounting requirement and mounting precautions of the odometers are specified in section B1.O.1.3, figures OD1, OD2, OD3, OD4, OD5 1 and OD5 2 of Annex B1.

DETAILED INTERFACE SPECIFICATION

9. ELECTRICAL INTERFACE

9.1 ATC INPUTS AND OUTPUTS ELECTRICAL CHARACTERISTICS

The details of ATC Inputs and Outputs Electrical Characteristics are specified in section C1.1 of Annex C1.

9.2 CABLE SPECIFICATIONS

The details of cables are specified in section C1.2 of Annex C1.

9.3 SCOS REQUIREMENTS

The requirements of SCOS are specified in section C1.3 of Annex C1.

9.4 ATC POWER SUPPLY REQUIREMENTS

The ATC Power Supply requirements are specified in section C1.4 of Annex C1.

9.5 ATC I/O CIRCUITS

The details of ATC I/O circuits are specified in Annex C2.

DETAILED INTERFACE SPECIFICATION

10. FUNCTIONAL INTERFACE

10.1 TRACTION AND SERVICE BRAKE CONTROLS

10.1.1 ATC Outputs

MDR, BDR and ATO_PWM

10.1.2 Functional Description

When the ATO drives the train in automatic mode (AUTO mode), the traction and brake commands are sent to RS by using MDR, BDR and ATO PWM signals.

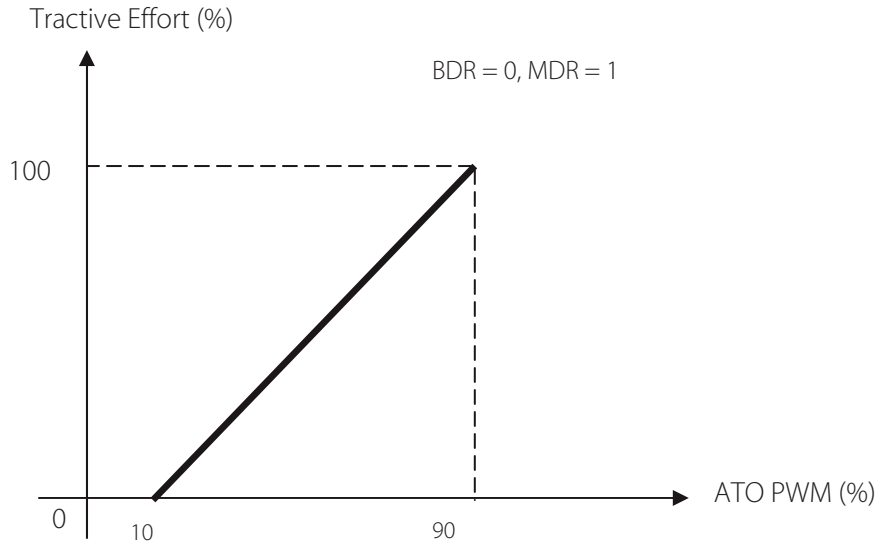
- MDR is for motoring action
- BDR is for braking action.
- ATO PWM is the variable effort level for braking and motoring action.

	MDR	BDR	ATO PWM	Driving order for RS	Traction & Brake System Responses
Normal	0	0	**10%.**	Coasting order	Coasting
	1	0	from **10% to 90%.**	Motoring order	Motoring and the traction effort is linear proportional to the PWM rate.
	0	1	from **10% to 90%.**	Braking order	Braking and the braking effort is linear proportional to the PWM rate.
Abnormal Operation	1	1	from **10% to 90%.**	Normally not commanded by ATO except under failure scenario.	Brake mode and the braking effort are in accordance with the PWM rate.
	1	1	Out of range (i.e. 0%-3%, 97%-100%)	Normally not commanded by ATO except under failure scenario.	Full Service Brake
	0	1	Out of range (i.e. 0%-3%, 97%-100%)	Normally not commanded by ATO except under failure scenario.	Full Service Brake
	1	0	Out of range (i.e. 0%-3%, 97%-100%)	Normally not commanded by ATO except under failure scenario.	Full Service Brake
	0	0	Out of range (i.e. 0%-3%, 97%-100%)	Normally not commanded by ATO except under failure scenario.	Full Service Brake

ATC Traction and Brake Orders Definition

DETAILED INTERFACE SPECIFICATION

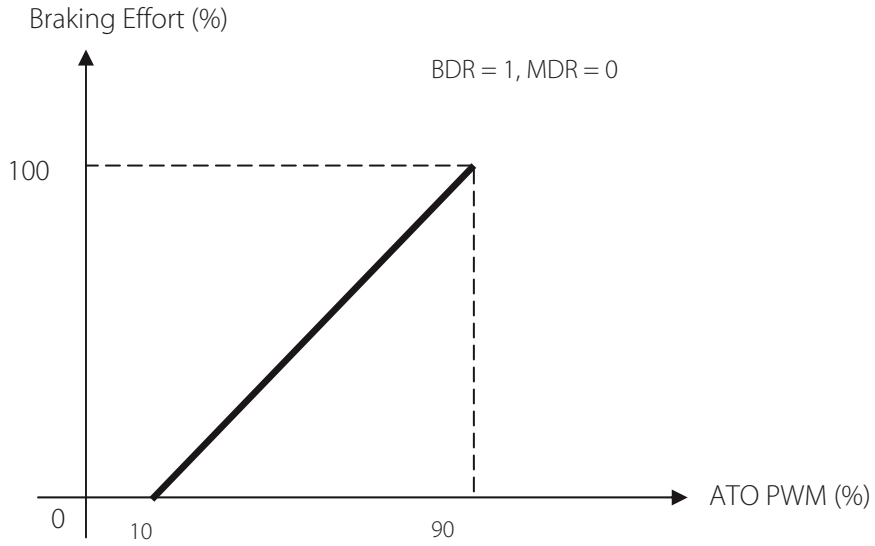
When motoring is requested (MDR=1 and BDR=0), ATO PWM indicates the level of motoring effort requested to RS as follows:



Tractive Effort vs ATO PWM

Tractive effort and ATO PWM output

ATO PWM= 10% corresponds to the zero tractive effort
ATO PWM = 90% correspond to the maximal tractive effort
When braking is requested (MDR=0 and BDR=1), ATO PWM indicates the level of braking effort requested to RS as follows:



Braking Effort vs ATO PWM

ATO PWM = 10% corresponds to the zero braking effort
ATO PWM = 90% corresponds to the maximal braking effort

DETAILED INTERFACE SPECIFICATION

10.1.3 Remarks

- MDR, BDR are discrete non-vital outputs and ATO PWM is an analogical output.
- There are two ATOs located at the UP and DN ends respectively.
- Only the active ATO will command the motoring and braking commands in AUTO and Driverless Turnaround mode.
- In AUTO mode, the ATO is activated by the AUTO position of the Mode Selector Switch.
- In Driverless Turnaround mode, the ATO is activated by the trackside signaling system.
- In RM, CM modes, the motoring command, braking command and PWM signal are driven by the Traction and Brake Controller of the RS.

10.1.4 Holding Brake Management

When a train is at standstill, there shall be sufficient retention of brakes such that the train does not roll back at a gradient. The brake application shall be retained while traction power is applied and the train takes forward movement.

R0052	A load weighing holding brake application must be applied with brake demand of **A_HB_LEVEL** when **HoldingBrakeState** is active. If any other higher brake demand than **A_HB_LEVEL** is requested, this higher brake demand request must be applied.	KB

R0053	During **HoldingBrakeState,** the **EDBrakeEffort** shall be ignored.	KB

The signal **'HoldingBrake'** will be taken not only to judge when the holding brake should be released, but also to apply the holding brake.

For applying the holding brake, we take not only the information of **'HoldingBrake'** signal from VVVF into consideration, but also use the information from EBCU's own reference speed.

It means, in the normal **ServiceBrakeState** or **Driving_CoastingState**, holding brake will be applied only when EBCU detects the **StandStill** state as well as **'HoldingBrake'** signal from VVVF is set in case of a correct '**HoldingBrake**' signal.

In the diagram A, the red line marked the point when the holding brake will be applied.

Regarding with the concept for the holding brake release. The information of the **'HoldingBrake'** signal is needed since it tells the moment when the enough traction torque is build up to avoid the rollback.

For releasing the holding brake, there is only one possible transition for this project, from the **HoldingBrakeState** to **Driving_CoastingState.**

In case of no braking or emergency brake signal, the holding brake will be released as soon as **'HoldingBrake'** signal from VVVF is reset.

In the diagram A, the green line marked the point when the holding brake will be released.

In case of a failure of 'HoldingBrake' signal from VVVF ('HoldingBrake' always low), EBCU will only apply the holding brake in the ServiceBrakeState, **not** in **Driving_CoastingState.** During

DETAILED INTERFACE SPECIFICATION

ServiceBrakeState, the EBCU will apply the holding brake when the '**StandStill**' status is detected for a period of time '**T_HB_APPLY**'. And the holding brake will be released as soon as the **Driving_CoastingState** is entered.

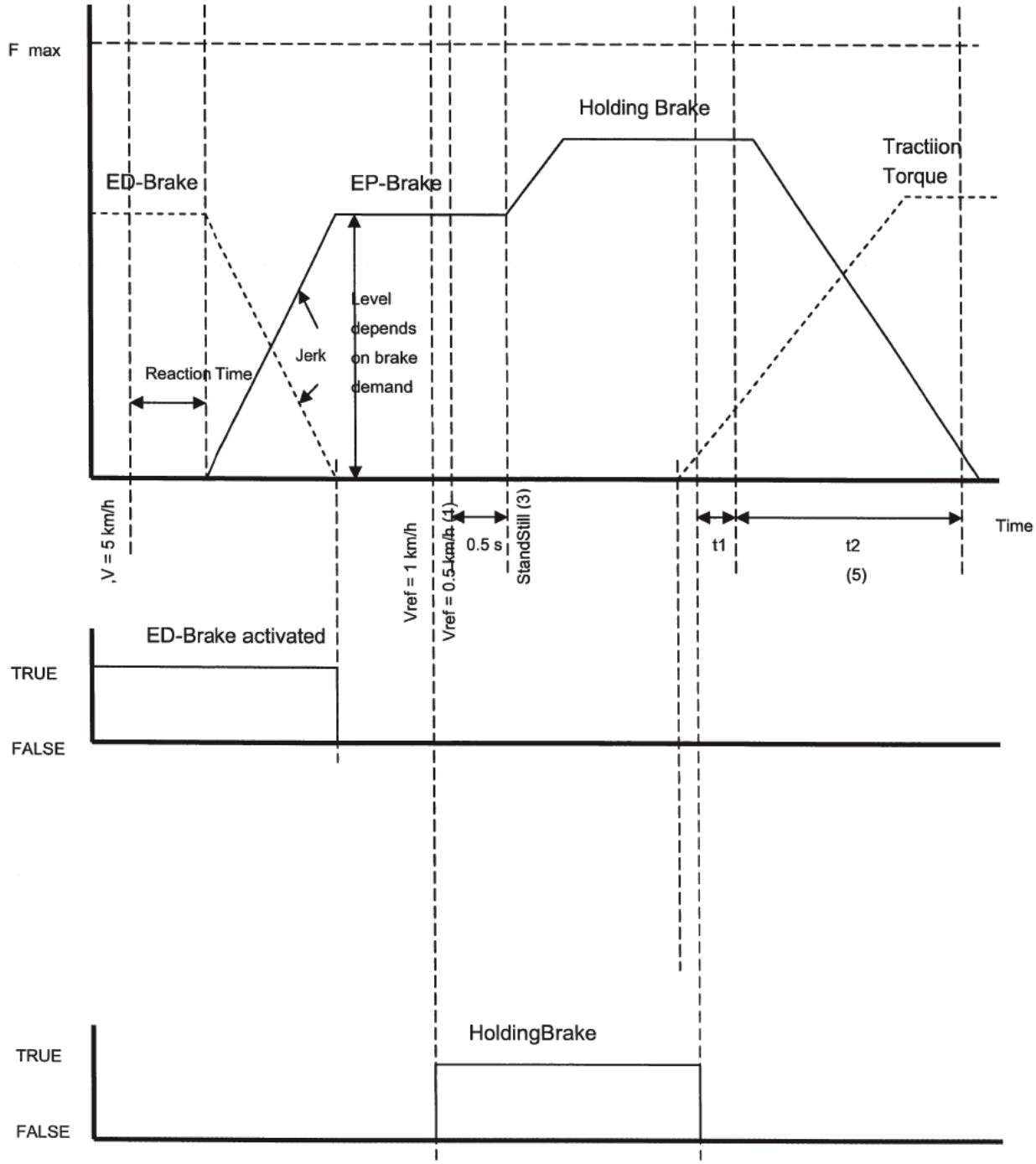
Please refer to Schematic Diagram B.

In case of a failure of **'HoldingBrake'** signal from VVVF ('**HoldingBrake**' always high), the holding brake will be released if the train reach a certain speed, e.g. 5km/h (**V_HB_RELEASED**).

Please refer to Schematic Diagram C.

1) This parameter is **V_STANDSTILL**
2) This parameter is **T_STANDSTILL_ON**
3) **StandStill** is set inside the software of EBCU
4) t1 : reaction time, including the signal processing time as well as the DCL regulating time for the BCP. (about 0.8s)
5) t2: releasing time for the EP brake (about 4.0s)
6) This parameter is **T_HB_APPLY**
7) This parameter is **V_HB_RELEASED**

DETAILED INTERFACE SPECIFICATION



DETAILED INTERFACE SPECIFICATION

10.2 EMERGENCY BRAKE CONTROL

10.2.1 ATC Outputs

EBR1 and EBR2

10.2.2 Functional Description

The ATC system will de-active the EBR1 and EBR2 when the conditions to trigger emergency brake are met.

The EBR1 and EBR2 should not directly control the emergency brake loop but to condition the Safety Interlock Circuit (refer to Annex D3 for detail).

Once the emergency brake is triggered by ATC, it can only be reset when the train is completely stopped and the condition to trigger the emergency brake is removed.

10.2.3 Remarks

- Once the emergency brake is triggered by ATC, after train has come to completely stop, driver needs to put the MS to FOR or REV positions and put the TBC to emergency brake position in order to reset the emergency brake.
- Zero Velocity Relay ZVR1 and ZVR2 are used to condition the zero speed condition in the Safety Interlock Circuit.

10.3 ZERO VELOCITY RELAY CONTROL

10.3.1 ATC Outputs

ZVR1 and ZVR2

10.3.2 Functional Description

Relays ZVR1 and ZVR2 are controlled by the on-board ATP safety-related output namely ZVR. These relays are used to reset the Emergency Braking.

The controls of ZVR1 and ZVR2 are independent of the driving mode.

If ATC does not apply emergency brake, the ZVR1 and ZVR2 are activated when train speed is under 0.9 kph.

If ATC applies emergency brake, the ZVR1 and ZVR2 are activated only when train is confirmed to be complete stop (i.e. no any cog is detected in one ATP cycle).

DETAILED INTERFACE SPECIFICATION

10.3.3 Remarks

- ZVR1 and ZVR2 are also used to condition (i) the opening of cab door, (ii) opening of saloon door and (iii) Automatic Door Opening system. Thus, sufficient numbers of spare contacts should be provisioned in these two relays.

10.4 DOOR AUTHORIZATION

10.4.1 ATC Outputs

DERA and DERB

10.4.2 Functional Description

The following conditions must be met in order to activate the DERA and DERB:

1) Train is confirmed to be complete stop (i.e. no any cog is detected in one ATP cycle),
2) The train type is EMU,
3) The train is localized or pre-localized in station,
4) ATC modes is RM or CM or AUTO,
5) The train is stopped within the docking window of the station,
6) If A side is authorized then DERA is activated. If B side is authorized then DERB is activated.

DETAILED INTERFACE SPECIFICATION

ANNEX A1
GENERAL ARRANGEMENT CONCEPT DRAWING AND TRAIN FORMATION DRAWINGS

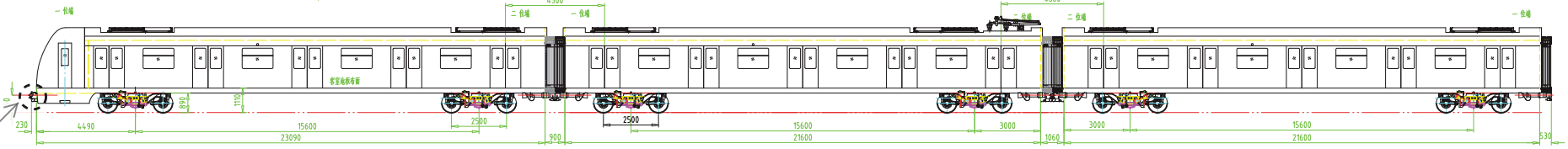
DKZZ28-00-00-000

Down End

A Car:UNLADEN WEIGHT = 37.846 tons
DK108 A 车

C Car:UNLADEN WEIGHT = 42.341 tons
DK105 C 车

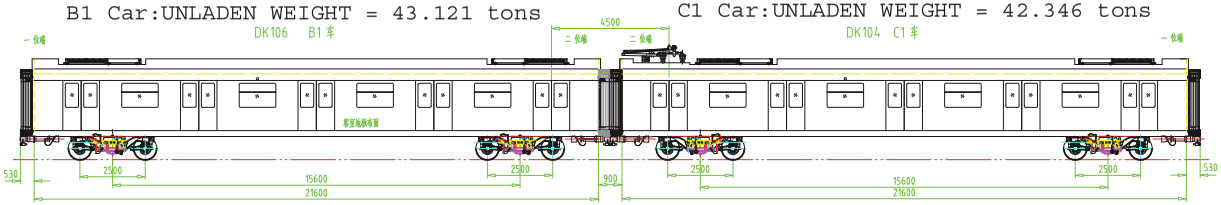
B Car:UNLADEN WEIGHT = 41.079 tons
DK107 B 车



Coupler face to coupler extremity = 115mm

B1 Car:UNLADEN WEIGHT = 43.121 tons
DK106 B1 车

C1 Car:UNLADEN WEIGHT = 42.346 tons
DK104 C1 车

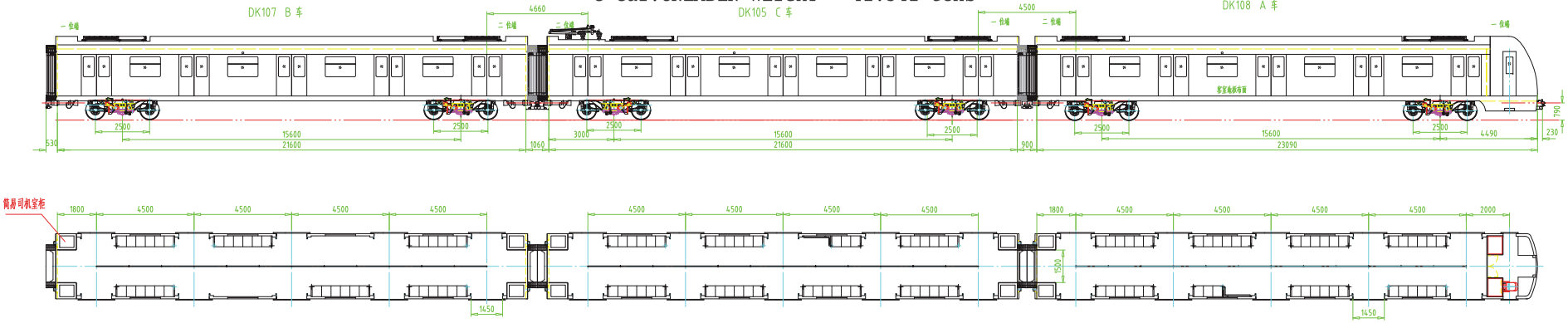


B Car:UNLADEN WEIGHT = 41.079 tons
DK107 B 车

C Car:UNLADEN WEIGHT = 42.341 tons
DK105 C 车

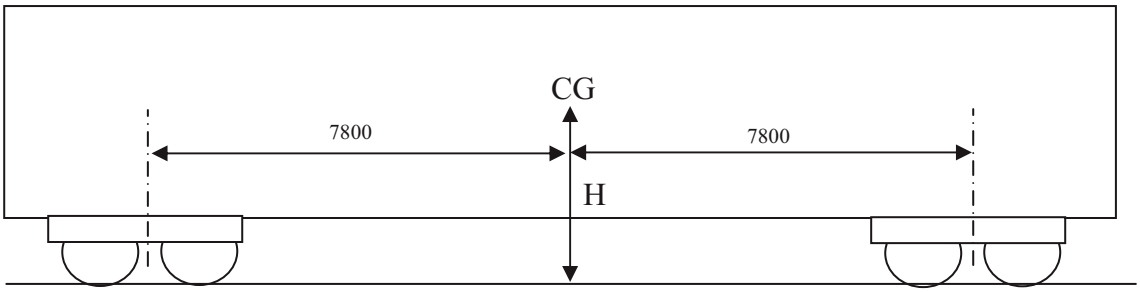
A Car:UNLADEN WEIGHT = 37.846 tons
DK108 A 车

Up End



Remark: 1) Passenger weight = 60 kg x 450 = 27 tons/car
2) Train Composition : A - C - B - B1 - C1 - B - C - A

设计	关凯	2009-1-16		对称件	
审核		标准		列车编组图	
主管		校工		版本 A	重量	比例 1:100	图幅 A1
工艺		绘图软件 AutoCAD2006 SP1		共 1 张 第 1 张	DKZ28-00-00-000



CAR	Load	Height (H) (mm)
A	M1	1350 +/-100
A	M5	1516 +/-100
B	M1	1350 +/-100
B	M5	1516 +/-100
B1	M1	1350 +/-100
B1	M5	1516 +/-100
C	M1	1350 +/-100
C	M5	1516 +/-100
C1	M1	1350 +/-100
C1	M5	1516 +/-100

Remark:

M1 Train in tare condition

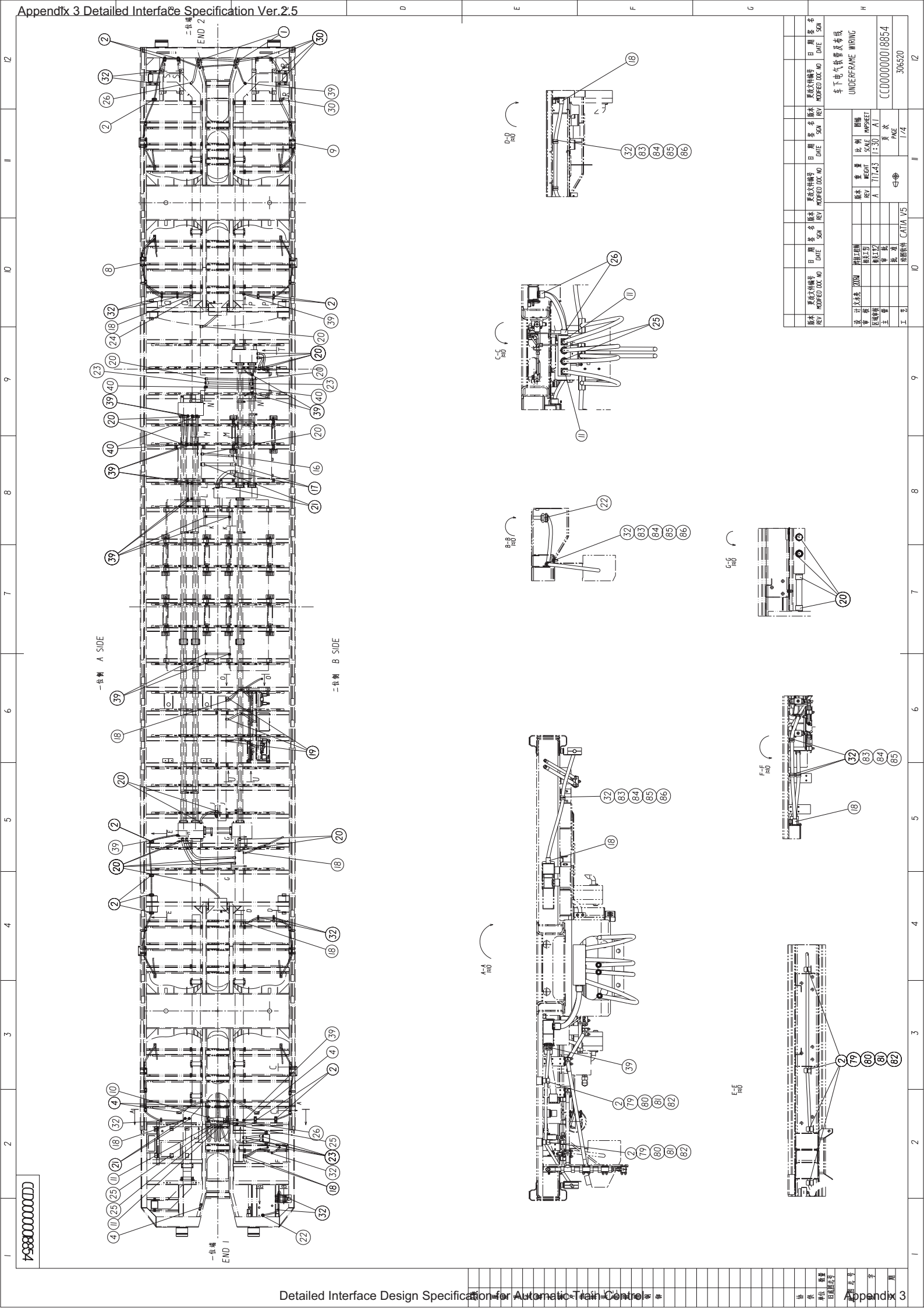
M2 Train in average load condition with 60kg x 200 passengers per car

M4 Train in fully laden condition with 60kg x 312 passengers per car

M5 Train in fully laden condition with 60kg x 450 passengers per car

DETAILED INTERFACE SPECIFICATION

ANNEX A2
GENERAL ARRANGEMENT OF THE CARS

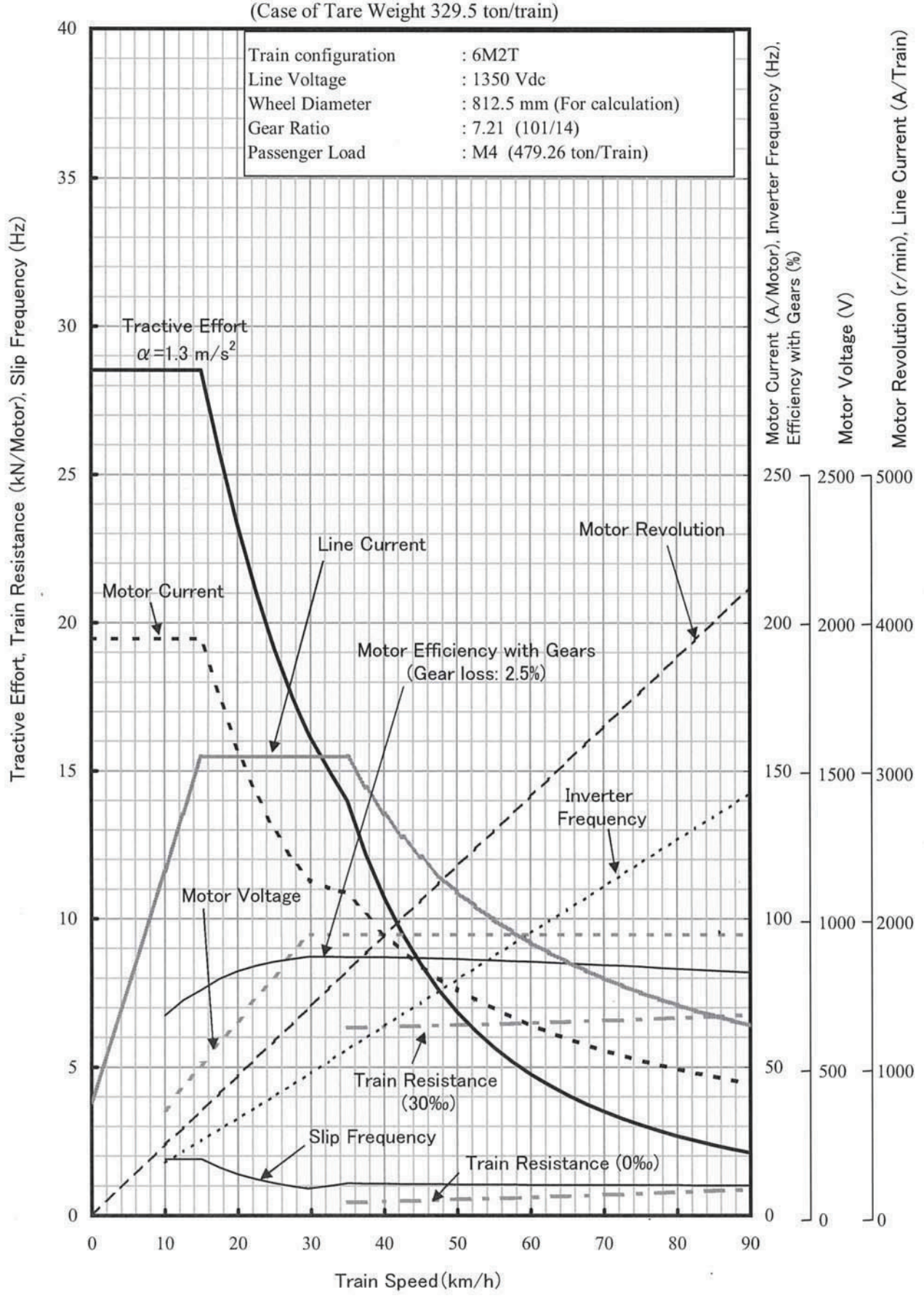

一位端 END 2
一位侧 A SIDE
一位侧 B SIDE
一位端 END 1
D-D
C-C
B-B
G-G
F-F
A-A
E-E
车下电气管线布线
UNDERFRAME WIRING
CCD0000008854
306520

DETAILED INTERFACE SPECIFICATION

ANNEX A3
TRACTION MOTOR CHARACTERISTIC CURVE

Powering Performance Curve (M4 Load)

(Case of Tare Weight 329.5 ton/train)



RC-B308

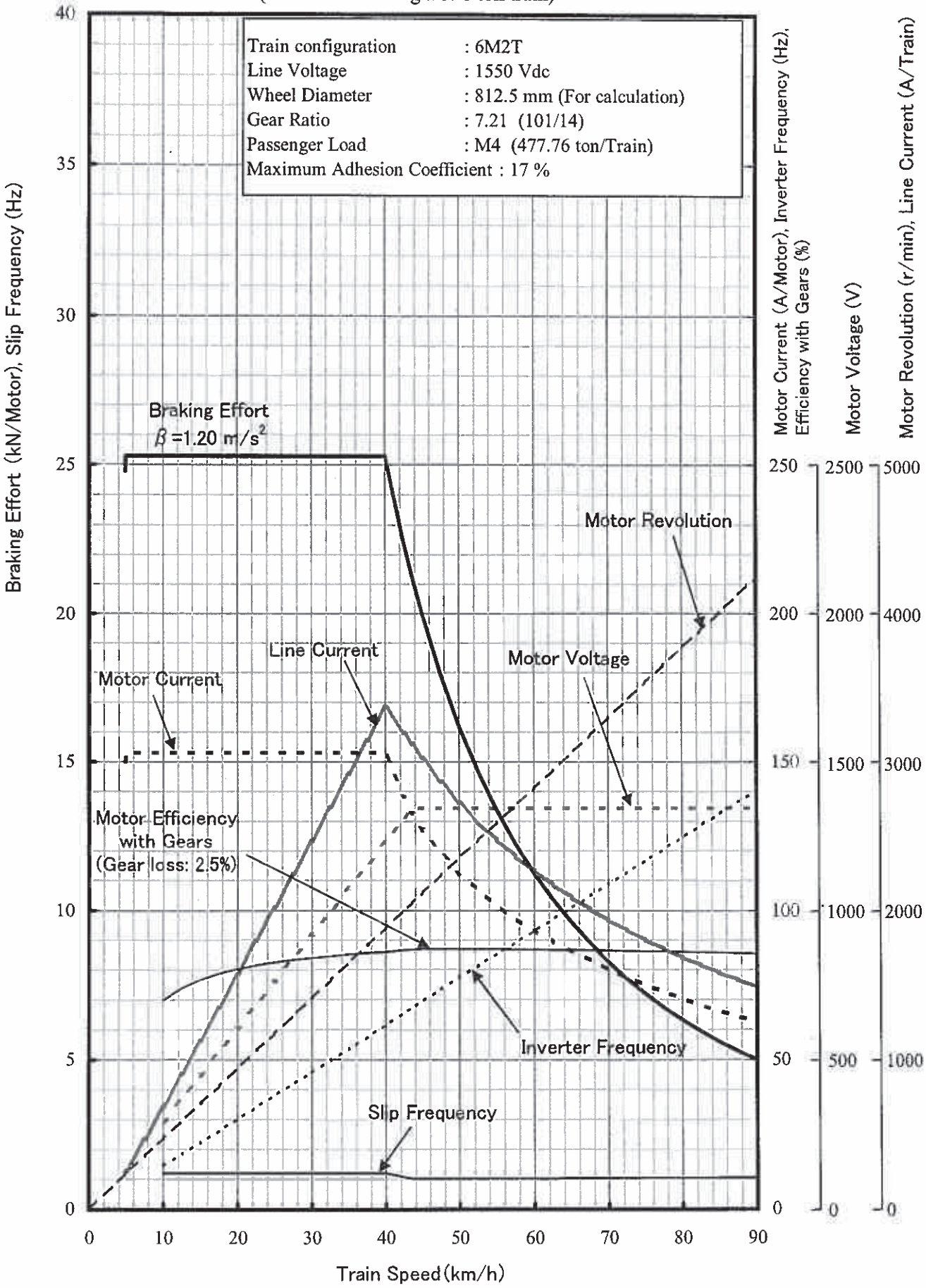
2012/2/3 K.Otsu

DETAILED INTERFACE SPECIFICATION

ANNEX A4
BRAKING PERFORMANCE CURVE

Braking Performance Curve (M4)

(Case of Tare Weight 328 ton/train)



RC-A354

2009/9/14 S.Nakai

DETAILED INTERFACE SPECIFICATION

ANNEX A5
ROLLING STOCK PARAMETERS

Rolling Stock Parameters

Description	SACEM ATC Abbreviation	M-Train[i] Value	C-Train Value	Unit	Remark
Maximum Train Length	MaxTrainLength	182	183.41 (+0.096, -0.000)	m	This is the maximum length of the train measured from the front end coupler extremity to another end's coupler extremity.
Maximum Train Speed	Maximum train speed	80	80	km/h	This is the maximum operating speed of the train.
Position of the CT sensors		2360	2987 (-15, 30)	mm	This is the CT sensors position measured from the centre line of the CT sensor to the extremity of the front end coupler.
Position of the RC antenna	$DistHeadAntenna_{EMU}$	2360	2987 (-15, 30)	mm	This is the RC antenna position measured from the centre line of the RC antenna to the extremity of the front end coupler. (The SACEM on-board parameter "$DistHeadAntenna_{EMU}$" is set to 2.512m in order to ensure the new train door centre align with PSD centre on existing URL stations)
Guaranteed Emergency Brake Rate	γEB	Tunnel Section: 1	Tunnel Section: 0.975	m/s^2	The maximum emergency brake rate is 1.4 m/s^2. This is the Guaranteed Emergency Brake Rate (GEBR) in (i) Tunnel section and (ii) Open section.
		Open Section: 0.83	Open Section: 0.78		
Maximum Traction Acceleration	γtr	1.35	1.3	m/s^2	This is the maximum acceleration of the train.

Description	SACEM ATC Abbreviation	M-Train[i] Value	C-Train Value	Unit	Remark
Maximum Tractive Effort Cut Response Time	t1	0.7	In emergency brake case: 200ms In other case: 2.2s	sec.	This is the maximum time delay to cut off the tractive effort.
Maximum emergency brake response time	t2	1.6	1.6	sec.	This is the maximum time delay for emergency brake application.
Coefficient of rotating mass (α)	α	1.075	1.0593 (M5) 1.0675 (M4) 1.0983 (M1)		This is the maximum value of the coefficient of the train mass and is used by the SACEM ATC to compensate the processing delay in ATC speed computation.
Full Service Brake Rate	service_braking_max	1	1.35	m/s^2	This is the maximum service brake rate achievable by the train.
Service Brake Control Response Time	Tbrake_stop	0.7	N/A	Sec.	This is the maximum time delay of the braking system when switching from coasting to braking or braking to heavier braking.
Service Brake Response Time when the train is motoring	Tbrake_traction	2.1	2.0	Sec.	This is the maximum time delay of the braking system when switching from motoring to braking.
Minimum Wheel diameter	ϕ_{min}	775	775	mm	This is the minimum wheel diameter.
Maximum Wheel diameter	ϕ_{max}	860	850	mm	This is the maximum wheel diameter.
Position of the axle 1 from		3145	3470 (-10,+20)	mm	This is the location of the 1st axle measured from the

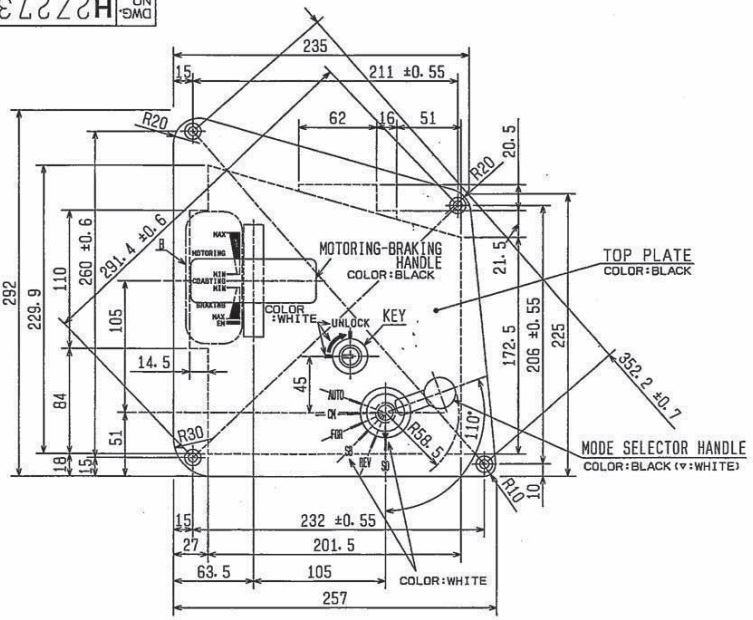
Description	SACEM ATC Abbreviation	M-Train[i] Value	C-Train Value	Unit	Remark
coupler face					front end coupler face.
Position of the axle 2 from coupler face		5645	5970 (-10,+20)	mm	This is the location of the 2nd axle measured from the front end coupler face.
Position of the 1st Saloon Door Centre from the coupler face		3195	3520 (-10,+20)	mm	This is the location of the 1st Saloon Door Centre line measured from the front end coupler face.

[i] Information captured from Appendix C. List of parameters used, On-board ATP Software Specification Document, ref. 782M00/DL/DSL/0520/1.8.3 dated 12.09.2002

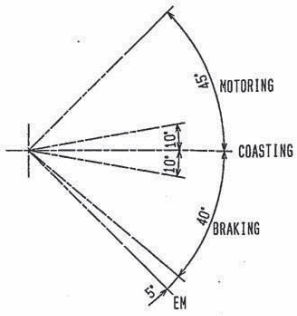
DETAILED INTERFACE SPECIFICATION

ANNEX A6
TRACTION BRAKE CONTROLLER OUT LINE

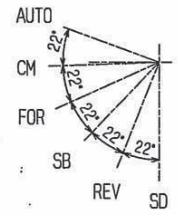
DWG. NO. H2Z2733

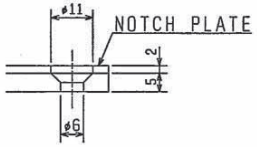


HANDLE OPERATING ANGLE OF MOTORING-BRAKING HANDLE

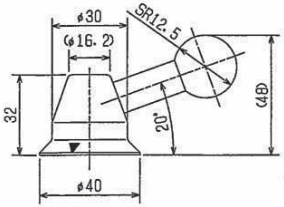


HANDLE OPERATING ANGLE OF MODE SELECTOR HANDLE

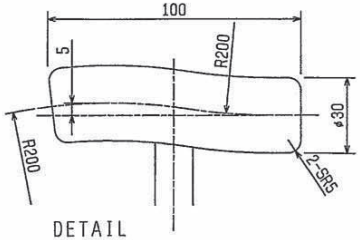




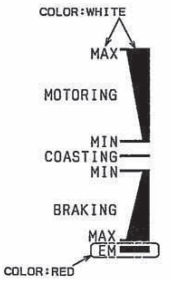
DETAIL A
(1/1)



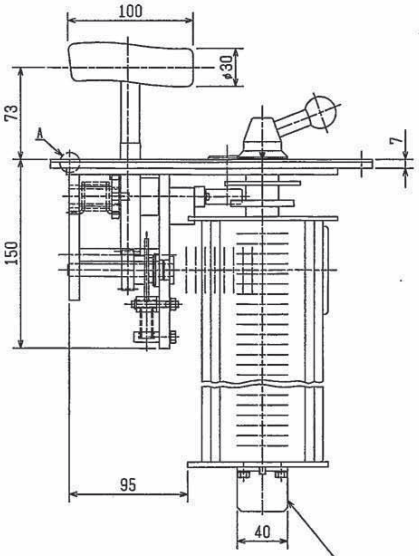
DETAIL
MODE SELECTOR HANDLE

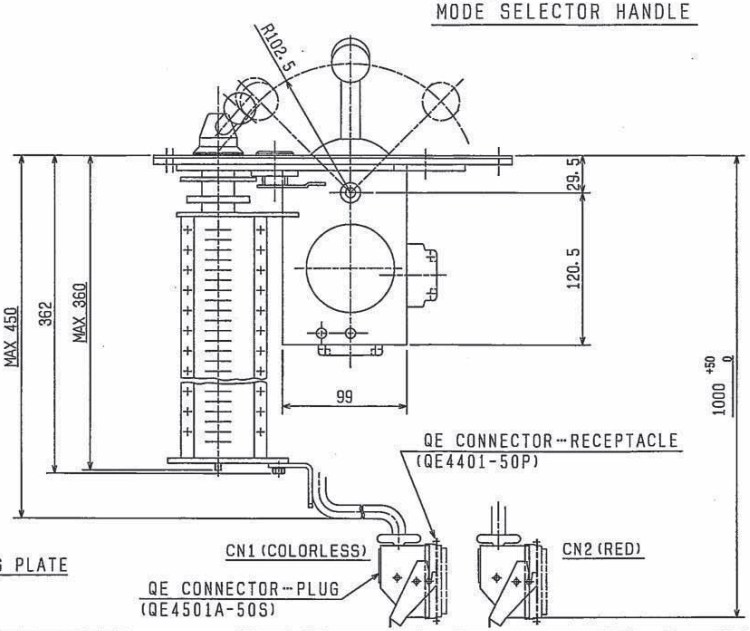


DETAIL
MOTORING-BRAKING HANDLE



DETAIL B





NOTE
1. KEY CAN BE TURNED TO "LOCK" POSITION AND REMOVED ONLY WHEN MODE SELECTOR HANDLE IS AT "SD" POSITION AND TBC IS AT "BRAKE MAX" POSITION.
2. CONTROLLER IS UNLOCKED WHEN KEY IS TURNED CLOCKWISE THROUGH 90 DEGREES FOR "UNLOCK" POSITION.
3. MODE SELECTOR HANDLE CAN BE OPERATED ONLY WHEN
   (1) KEY IS AT "UNLOCK" POSITION.
   (2) MOTORING-BRAKING HANDLE IS AT "BRAKE MAX" POSITION.
4. MOTORING-BRAKING HANDLE CAN BE OPERATED ONLY WHEN MODE SELECTOR HANDLE IS AT "REV" "SB" "FOR" "CM" POSITION.
5. UPON RELEASING THE CONTROL AT POSITION POWERING AREA, OFF AND BRAKING AREA . IT WILL RETURN TO BRAKE MAX POSITION.
6. CAMLOCK NUMBER IS "KV33.231.102" AND KEY NUMBER IS "FA136448BH".
7. A RED MARK OF CAM SWITCH COVERS SHOWS THE DISPLAY OF THE POLARITY.

APPROX MASS 11kg
DECISION MASS 11kg

改	年	CHANGE
A	APR-23-'08	FX4:DIM.382 WAS ADDED. FX7:DIM.122 WAS REVISED TO 120.5 GX5:SKETCH OF QE CONNECTOR WAS CHANGED. GX3.5:CABLE MTG PLATE WAS ADDED. GX3:DIM.40 WAS ADDED. NOTE.6 WAS CHANGED. DECISION MASS WAS ADDED. FEB-26-'10 M.TAKABE

Ref:H2S3977

FR. NO. OF	R. DATE	DWG. SEC.	2 SYM.	SPECIAL CODE	K.	S.	PRINT	DUP. DIST.
SKIP DUP —		839Y	76	KL6024B N	0	2		

MITSUBISHI ELECTRIC CORPORATION

尺度 SCALE	1 : 3 NTS	設計 DESIGNED	T. OKAI, R. SEO
作成 DRAWN	T. TOKUAMI	製図 CHECKED	I. OKUI, N. TERAGUCHI
作成日 DATE	APR-23-'08	承認 APPROVED	I. OKUI, H. OKAYAMA

DIM. IN mm

TITLE
TRACTION BRAKE CONTROLLER OUT LINE

DWG. NO. H 2Z2733

DETAILED INTERFACE SPECIFICATION

ANNEX A7
SPECIFICATION OF PWM GENERATOR

To		Rev	Date	Written	Checked	Approved
		A	'09/8/3	R.Seo	A.Murahashi	H.Okayama
Project		B	'09/8/19	R.Seo	A.Murahashi	H.Okayama
Title	**Specification of PWM Generator**					

Ref. No. : HCN-L6195-3

Revision : B

In this document specification of PWM Generator.

Table of contents

1. General
2. Functions
 2-1. Block diagram
 2-2. Specification
3. Construction

Copies to		Traction Systems Department Itami Works Mitsubishi Electric Corporation	Date	22 Apr. 2008
			Written	R.Seo
		Issued by : Power Electronics Systems Designing Section-A	Checked	A.Murahashi
			Approved	H.Okayama

Our Ref. No. HCN-L6195-3	Revision No. B	Total pages : 4

Specification of PWM Generator

HCN-L6195-3 Revision : B

Document Revisions

Revision	Date (yyyy.mm.dd)	Description of changes
0	2008-4-22	Original Issue
A	2009-8-3	2-2 (3) Input voltage and PWM ratio were revised at +10° of powering. 2-2 (3) Note was revised. 2-2 (4) PWM ratio of Hostler mode was revised.
B	2009-8-19	2-2 (3) and (4) were revised.

Specification of PWM Generator

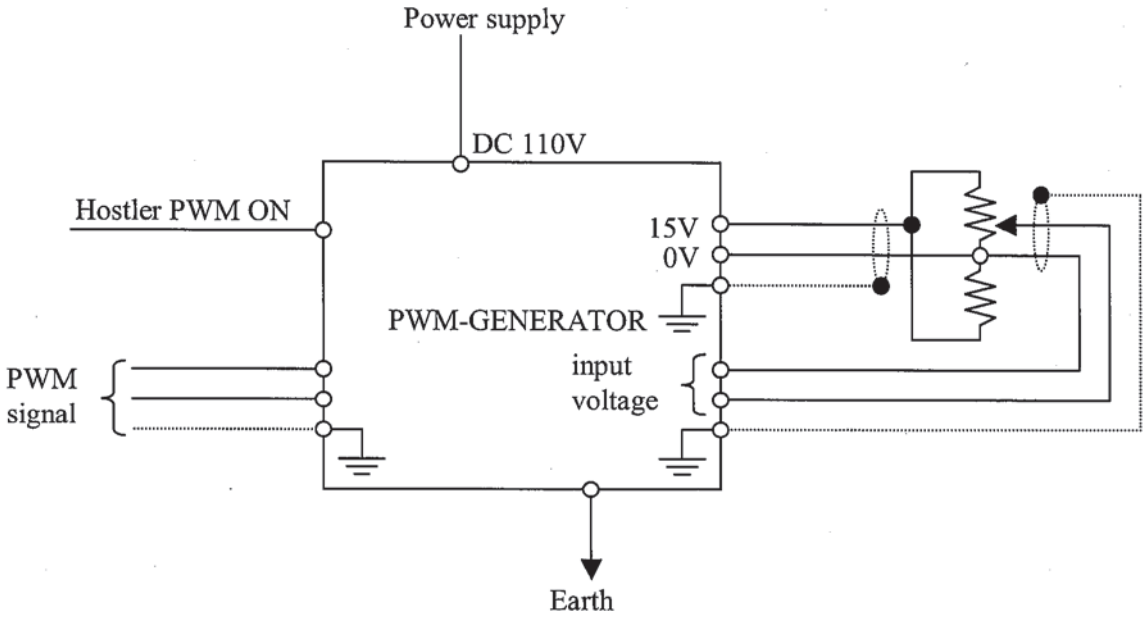
HCN-L6195-3
Revision : B

1. General

PWM Generator provides the regulated voltage (15 VDC) to the potentiometer and receives the voltage signal that is corresponded to the TBC position.
PWM Generator converts this voltage signal to the pulse-modulated signal.

2. Functions

2-1. Block diagram



2-2. Specification

(1) Voltage of power supply : 110 VDC (77 VDC to 137.5 VDC)

(2) Output voltage for TBC : 15 VDC (14.85 VDC to 15.15 VDC)

(3) Characteristic of PWM signal :

	Angle of traction brake handle	Input voltage (V)	PWM signal (%)
Powering	+ 45°	15.0	93 ± 3
	+ 10°	5.0 A B	41 ± 3 A B
Coasting	0°	0.0	15 ± 3
Braking	- 10°	0.0	15 ± 3
	- 40°	15.0	93 ± 3
	- 45° (Emergency)	15.0	93 ± 3

Note) Input voltage of PWM Generator is decided by output signal of the potentiometer described in HCN-L6195-4 section 4-9. A

(4) Hostler PWM ON signal :

When this signal is received, the PWM signal of 41 ± 3% is generated. A B

(5) PWM frequency : 97.7 Hz ~ 98.3 Hz

(6) Output current

for TMS : 3.3 mA × 4 car = 13.2 mA

for VVVF : 3.3 mA × 12 car = 39.6 mA

for Pneumtic Brake : 3.3 mA × 16 car = 52.8 mA

Total = 105.6 mA

Over current protection (200mA) of the output is provided.

3. Construction

Degree of protection provided by enclosure (IEC529).

IP20

This unit is designed to mount in the electric cubicle which protect a ingress of dust and water.

DETAILED INTERFACE SPECIFICATION

ANNEX A8
SPECIFICATION OF TRACTION BRAKE CONTROLLER

To		Rev	Date	Written	Checked	Approved
		C	'09/9/15	R.Seo	A.Murahashi	H.Okayama
Project		D	'09/10/26	R.Seo	A.Murahashi	H.Okayama
		E	'10/2/4	Y.Kono R.Seo	A.Murahashi	H.Okayama
Title	**Specification of Traction Brake controller**	F	'10/3/1	Y.Kono R.Seo	K.Kusano	H.Okayama
		G	'10/7/12	Y.Kono R.Seo	A.Murahashi	K.Kusano
		H	'10/09/22	R.Seo		

Ref. No. : HCN-L6195-4

Revision : H

In this document, specification of Traction Brake controller is described.

Table of contents

1. General
2. Mode selector
3. Key switch
4. Controller handle

Attachment

Specification of Cam diagram for mode selector switch and traction brake controller for TKE

Copies to				
		Traction Systems Department Itami Works Mitsubishi Electric Corporation	**Date**	22 Apr. 2008
			Written	R.Seo
		Issued by : Power Electronics Systems Designing Section-A	**Checked**	A.Murahashi
			Approved	H.Okayama
Our Ref. No. HCN-L6195-4		Revision No. H	**Total pages :**	17

Specification of Traction Brake controller

HCN-L6195-4 Revision : H

Document Revisions

Revision	Date (yyyy.mm.dd)	Description of changes
0	2008.04.22	Original Issue
A	2009.08.3	2-3 Maximum current of S826a was revised. 2-5 Destinations from cam switches and line numbers were deleted except Traction control and TMS. 4-1 Contact No.5-a Line number was revised. 4-8 (2) Potentiometer was revised. 4-9 Output signal of the potentiometer was revised. 4-11 Destinations from cam switches and line numbers were deleted except Traction control and TMS. 4-12 Maximum current was revised. Attachment (Specification of Cam diagram for mode selector switch and traction brake controller for TKE) was added.
B	2009.08.19	4-8 was revised. 4-9 was revised.
C	2009.09.15	2-7 was added. 4-14 was added.
D	2009.10.26	4-8 (1) was revised.
E	2010.2.4	2-5 Cam diagram of Mode Selector Switch was revised. Clause number of 2-7 was revised to 2-6. 4-11 Cam diagram of Traction Braking Controller was revised. 4-12 Line number was added. 4-15 was added.
F	2010.3.1	2-5 Cam diagram of Mode Selector Switch was revised. (Spare wiring numbers of SP1~SP8 were added.) 4-11 Cam diagram of Traction Braking Controller was revised (Spare wiring numbers of SP9~SP12 were added.) and the number of used S800a contact was corrected.
G	2010.7.12	3-4 Key Number was revised. 4-11 Line number M6121 at Cam No.6-a was changed to M6921. 4-12 Line number M6120 was changed to M6104.
H	2010.9.22	3-4 Key Number was changed.

Specification of Traction Brake controller

HCN-L6195-4 Revision : H

1. General

This specification describes on the Traction Brake Controller which consists of Mode selector, Controller handle and Key switch.

2. Mode selector

2-1 The mode selector has the following six valid sequential positions.

(a) Shutdown

All controls except the auxiliary function is inoperative. Emergency brake is applied in this mode of operation.

(b) Reverse

Manual driving in a reverse direction without any guidance provided by the automatic train control system and the maximum speed is limited to 22 km/h.

A maximum distance to travel will be limited to 44m by the ATC system when the train is operated in the driving cab under the Reverse mode.

(c) Standby

Minimum control function of some train systems, such as, train management, door and communication, is provided for train standing by purpose.

In this mode of operation:

(1) the traction controls are inoperative; and

(2) emergency brake is applied, if the safety proving circuit is not energized or the brake loop circuit is not completed; or

(3) full service brake is applied, if the safety proving circuit is energized and the brake loop circuit is completed.

(d) Forward

Manual driving in a forward direction without any supervision provided by the automatic train control system other than a maximum speed limit of 22 km/h.

(e) Coded Manual

Manual driving in a forward direction with speed control provided by the Automatic Train Control system. ATP protection is provided.

(f) Auto

Automatic driving in a forward direction by the Automatic Train control system.

2-2 It is not possible to directly select Auto mode from the Shutdown position, or vice versa, without previously having selected each of the other modes:

2-3 Specification of Cam switch
Diagram : shown in Figure 1
Specification of Cam switch

for normal load

Type	: S826a
Manufacturer	: Schaltbau
Voltage	: DC 110 V
Maximum Current	: 0.3 A
Minimum Current	: 1 mA (at DC 6 V)
Contact Resistance	: 10 mΩ
Mechanical life time	: 10,000,000 times
Electrical life time	: 1,000,000 times

A

for heavy load

Type	: S800a
Manufacturer	: Schaltbau
Voltage	: DC 110 V
Maximum Current	: 3.5 A (L/R Load with surge absorber)
Minimum Current	: 10 mA (at DC 20 V)
Contact Resistance	: 10 mΩ
Mechanical life time	: 10,000,000 times
Electrical life time	: 1,000,000 times

Cam switch is not overlapped.

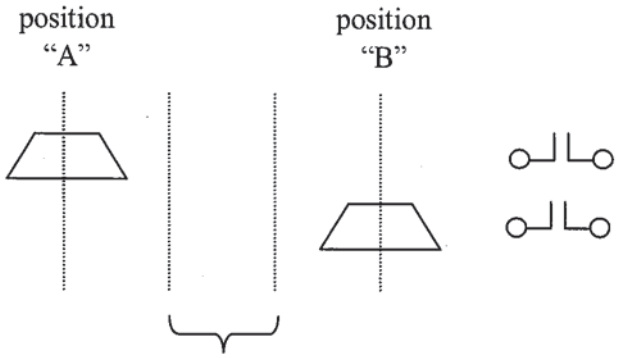


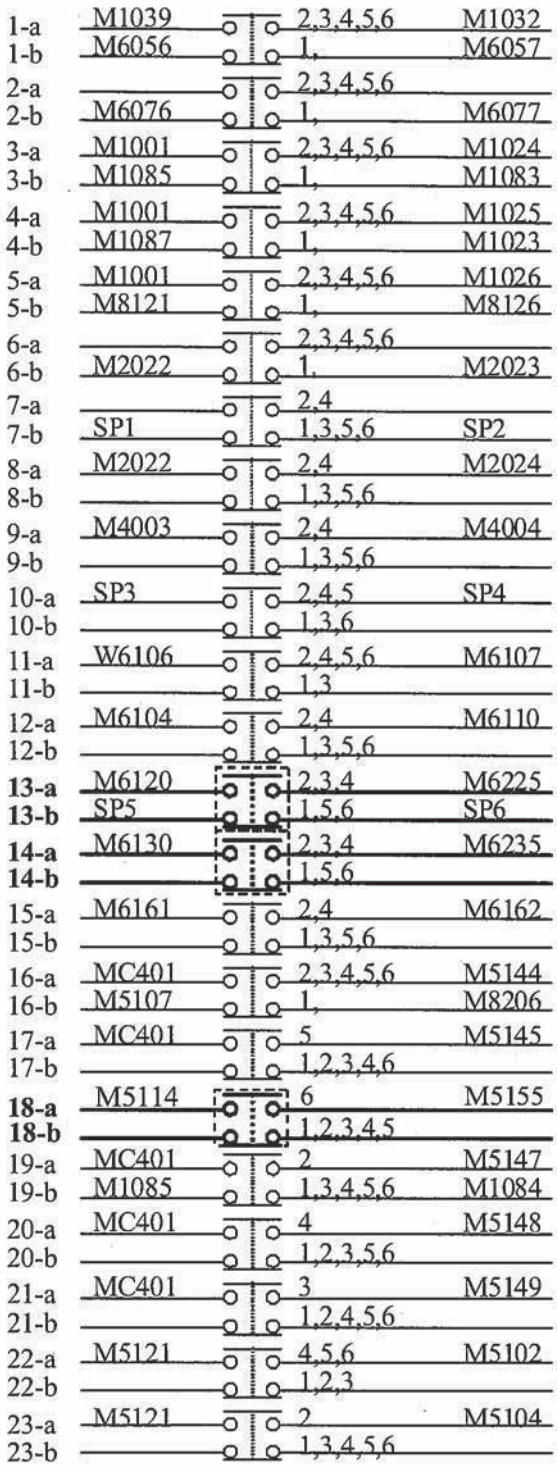
Fig.1 Cam switch

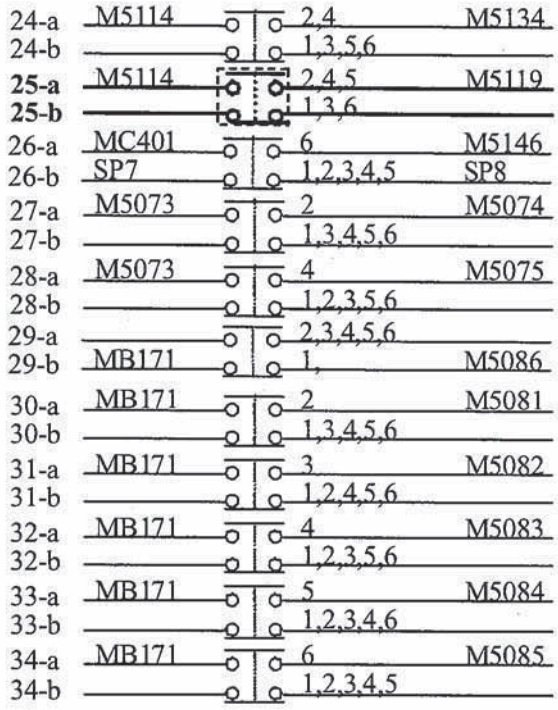
(Note) If the contact is closed at both position "A" and "B", then the contact will be continuously closed when moving from "A" to "B".

2-4. Mode selector handle can be operated only when
(1) The key is inserted and rotated to the unlocked position.
(2) The position of traction brake controller is brake max.

2-5 The supply voltage of control lines connecting to the mode selector switch is 110VDC.

MODE SELECTOR SWITCH





TRACTION CONTROL

TRACTION CONTROL

TO TMS

TO TMS

TO TMS

TO TMS

TO TMS

TO TMS

A

E

F

---- 1 = SHUTDOWN
---- 2 = REVERSE
---- 3 = STANDBY
---- 4 = FORWARD
---- 5 = CODED MANUAL
---- 6 = AUTO

a : a-contact
b : b-contact

for normal load
Type : S826a
Manufacturer : Schaltbau
Voltage : DC 110 V
Current : 0.3A

for heavy load
Type : S800a
Manufacturer : Schaltbau
Voltage : DC 110 V
Current : 3.5 A
(L/R Load with surge absorber)

	S826a		S800a	
	Cam	Contact	Cam	Contact
Used	30	37	4	5
Spare	0	23	0	3
Total	30	60	4	8

Fig.2 Diagram of the mode selector switch.

2-6 Moving force of the mode selector switch C

Moving force of the mode selector switch is shown as follows.

SD → REV	: 28N	REV→SD	: 21N
REV → SB	: 21N	SB→REV	: 24N
SB → FOR	: 24N	FOR→SB	: 23N
FOR → CM	: 20N	CM→FOR	: 25N
CM → AUTO	: 20N	AUTO→CM	: 11N

3. Key switch

3-1 The mode selector includes a key switch mechanism, incorporating two positions (Locked and Unlocked) that is controlled only by the approved train operator key.

3-2 The key switch mechanically inhibits the rotation of the mode selector, unless the train operator key is inserted and rotated to the unlocked position.

3-3 The train operator key is physically retained in the unlocked position, thus removal of the key is only possible in the locked position.
The selection of the locked position is only possible with the mode selector in the shutdown position and Traction Brake Controller in the brake max position.

3-4 Specification of Key Switch
KABA Key (Masterkeying) will be applied.
KV 33.231.102 Camlock
Key Number: 6087-0001 | H
Diameter 23 mm (single flat)
Two key entry, 90° movement
Finish :
• Cylinder – Bright nickel plated.
• Cam (C227) – Nickel plated.
Fixing :
• Flange (3.0 mm)

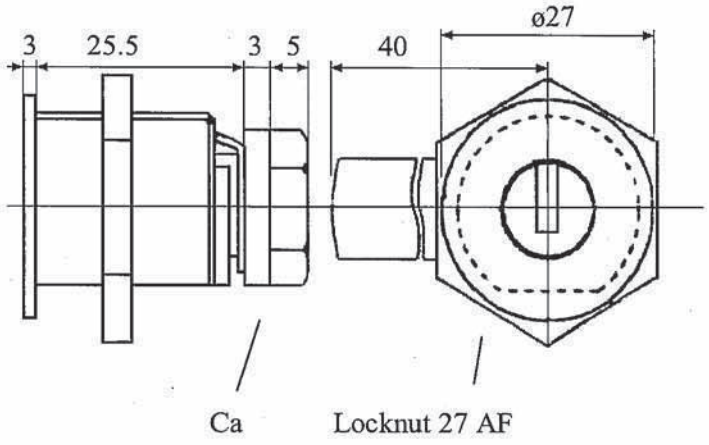


Fig. 3 Key switch.

4. Controller handle .

4-1 The controller handle incorporates four distinct positions or operating ranges:

(1) Coasting
This position inhibits the power contactors control and also provide a zero traction/braking effort demand.
(2) Motoring
This range initiate the power contactor control and provide the tractive effort demand.
(3) Braking
This range initiate the power contactor control and provide the brake effort deadman.
(4) Emergency
This position initiates the emergency brake application.

4-2 The characteristics of the tractive effort/braking effort output versus the traction brake controller position is according to Table 9-1 of the particular specification.

4-3 All positions are visually identified by an engraved position identifications.
And notch feeling is required at +45° , +10° , 0° , -10° , -40° , and -45° .

The traction brake controller is unlocked when
(1) the key is turned to the unlocked position.
(2) the mode selector handle is turned to REV, SB, FOR and CM position.

4-4 The controller handle is spring biased towards the full service braking position when unattended.

4-5 The level of spring force and the operating resistance of the controller handle and the deadman device doesn't causes any stress or fatigue hazard to the train operator for an average 8 hours of continuous train operation by using the traction brake controller. As a minimum requirement, for the controller handle, a maximum operating resistance by whole hand grip of 120N and angular displacement of 45° for both direction of motion is adopted. Limb support by using the arm rest of the train operator's seat is adopted if necessary. For the deadman safety device, thumb operated type or press down type is applied.

4-6 The length of the lever of the controller handle is determined by the mechanical advantage of the system according to the train operator position and the limitations of the 5th percentile female train operator. Handle sharp is cylindrical, spherical or shaped to fit the hand grip but with no sharp edges. Anti-slip texturing is applied.

4-7 Schematic diagram of the connection of the potentiometer.

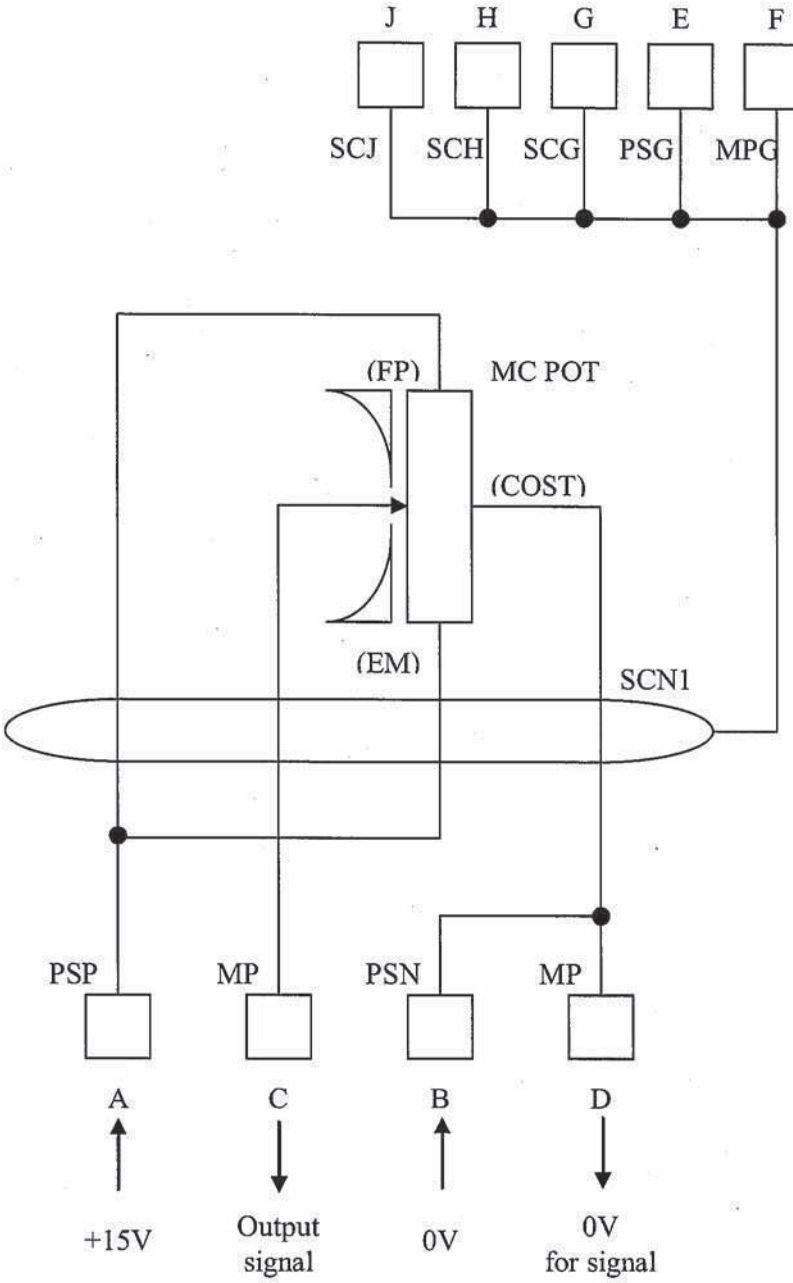


Fig. 4 Schematic diagram of the connection of the potentiometer

4-8 Specification of the potentiometer

(1) Type: PW70 series, Oil type (Corresponding to high humidity)
(2) Construction

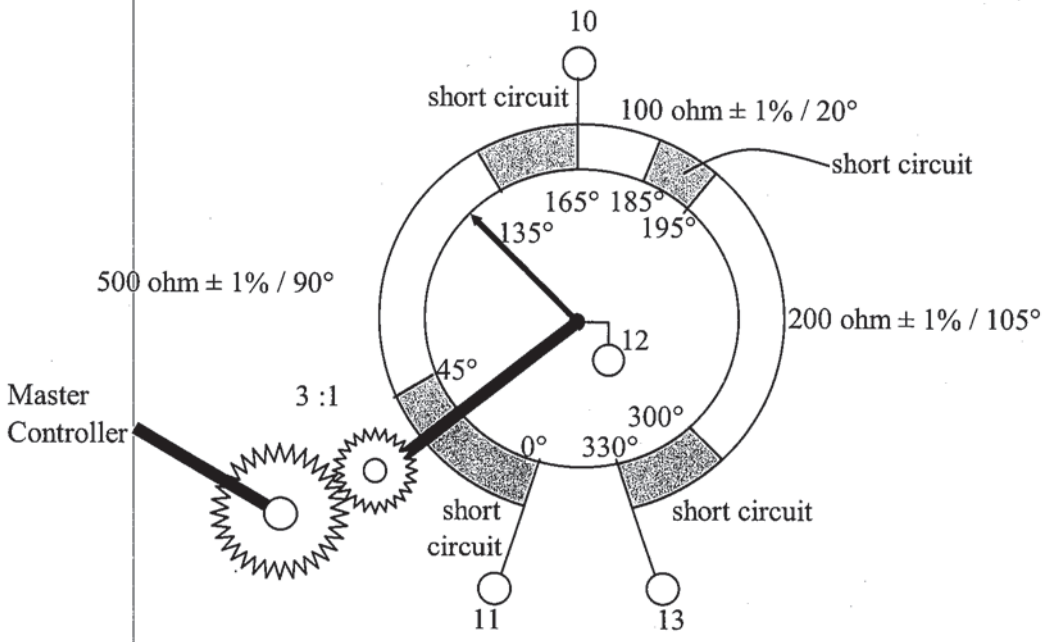


Fig. 5 Potentiometer

(3) Winding angle : 330°
(4) Resistance

Angle (degree)	Resistance
0 ~ 45	short circuit
45 ~ 135	500 ohm ± 1% / 90°
135 ~ 165	short circuit
165 ~ 185	100 ohm ± 1% / 20°
185 ~ 195	short circuit
195 ~ 300	200 ohm ± 1% / 105°
300 ~ 330	short circuit

(5) Resistance element : Constantan
(6) Surface of contact chip : Gold
(7) Life time : 100 million operations
(8) Operating temperature :- 50 ~ +80 °C
(9) Maximum load : 6 W (at 20 °C)
(10) Maximum operating voltage : 60 VDC

A
B
D

4-9 Output signal of the potentiometer

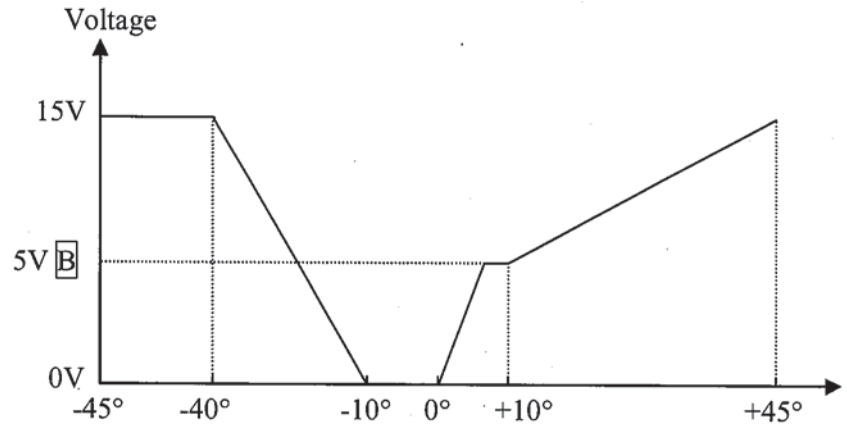


Fig. 6 Output signal of the potentiometer

A
B

Note) According to PS 9.6.3 (f) (ii) at +10° of inclination of the traction brake controller handle, the unit/train should forward at a 3 % up gradient.
Output signal value of the potentiometer at +10° of inclination is decided as follows.

Minimum necessity tractive effort at 3% gradient for 3 car unit and tare load is 6.42kN per 1 motor. (Starting acceleration is 0.083m/s^2)
On the other hand maximum tractive effort at tare load is 19.5kN.

Therefore Equivalent PWM ratio is as follows in the above condition.
(x[%]-10[%])/(90[%]-10[%])=6.42[kN]/19.5[kN]
x=37[%]

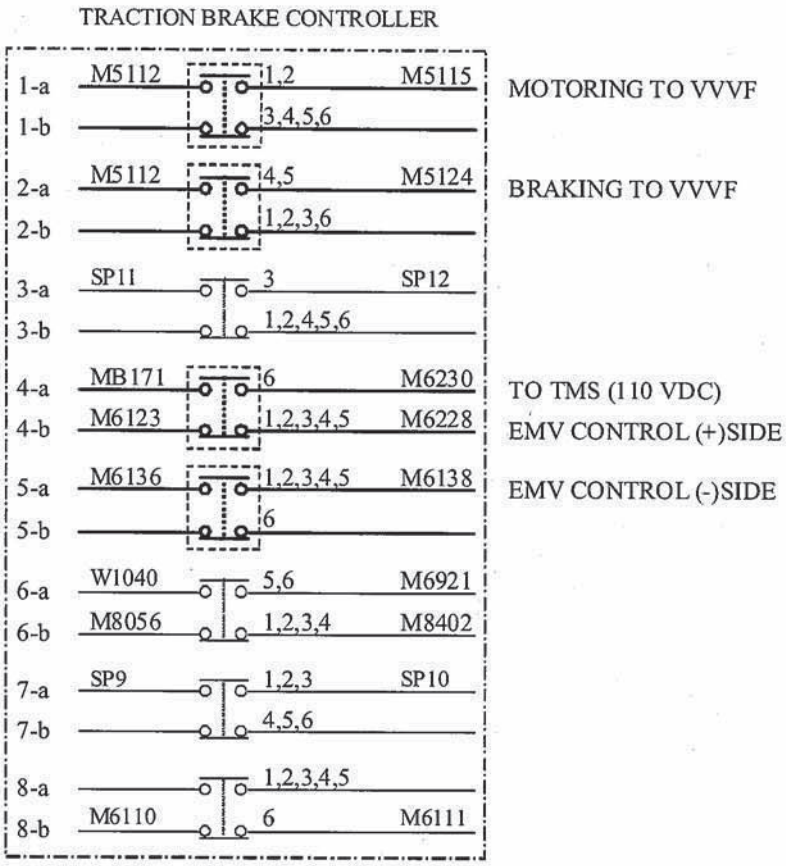
If PWM ratio of 37% is secured in any condition, PWM signal should be set to 41% in consideration for error of PWM signal and output signal of potentiometer.

For output PWM ratio of 41% is output from PWM Generator, output signal value is calculated as follows.
(15[V]-0[V])×(41[%]-15[%])/(93[%]-15[%])=5.0[V]

4-10 Specification of Cam Switch for the controller handle.
Type : S826a

4-11 Traction Braking Controller

The supply voltage of all control lines connecting to the traction braking controller is 110 VDC but the control line interfacing with TMS is supplied with 24 VDC.



----- 1 = FULL MOTORING
----- 2 = LIMITED MOTORING
----- 3 = COASTING
----- 4 = MINIMUM BRAKING
----- 5 = FULL SERVICE BRAKING
----- 6 = EMERGENCY BRAKING

for normal load
Type : S826a
Manufacturer : Schaltbau
Voltage : DC 110 V
Current : 0.3A

for heavy load
Type : S800a
Manufacturer : Schaltbau
Voltage : DC 110 V
Current : 3.5 A
(L/R Load with surge absorber)

	S826a		S800a	
	Cam	Contact	Cam	Contact
Used	4	5	4	5
Spare	0	3	0	3
Total	4	8	4	8

Fig. 7 Diagram of the traction braking controller

A
E
F
G

4-12 Deadman safety device

The traction brake controller provides deadman safety device to the safety proving system.

Type	: S826a
Manufacturer	: Schaltbau
Voltage	: DC 110V
Maximum Current	: 0.3A [A]
Minimum Current	: 1mA (at DC 6V)
Contact Resistance	: 10mΩ
Mechanical life time	: 10,000,000 times
Electrical life time	: 1,000,000 times

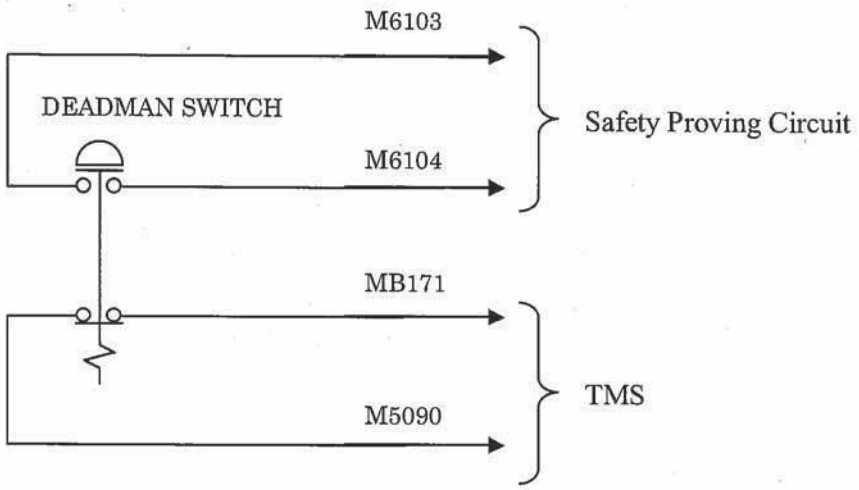


Fig. 8 Schematic diagram of the Deadman switch.

[E]
[G]

4-13 Connector

Type : QE4401-50P × 2 pieces

4-14 Moving force of the traction brake controller [C]

Moving force of the traction brake controller is shown as follows.

Emergency → Bmax	: 95N	Bmax → Emergency	: 113N
Bmax → Bmin	: 10N	Bmin → Bmax	: 4N (for holding the handle)
Bmin → COAST	: 14N	COAST → Bmin	: 4N (for holding the handle)
COAST→Pmin	: 15N	Pmin → COAST	: 4N (for holding the handle)
Pmin → Pmax	: 18N	Pmax → Pmin	: 4N (for holding the handle)

4-15 Pin assignment [E]

Refer to the drawing of H9F0751 "PIN ARRANGEMENT OF CONNECTOR PLUG".

Specification of Traction Brake controller

HCN-L6195-4 Revision : H

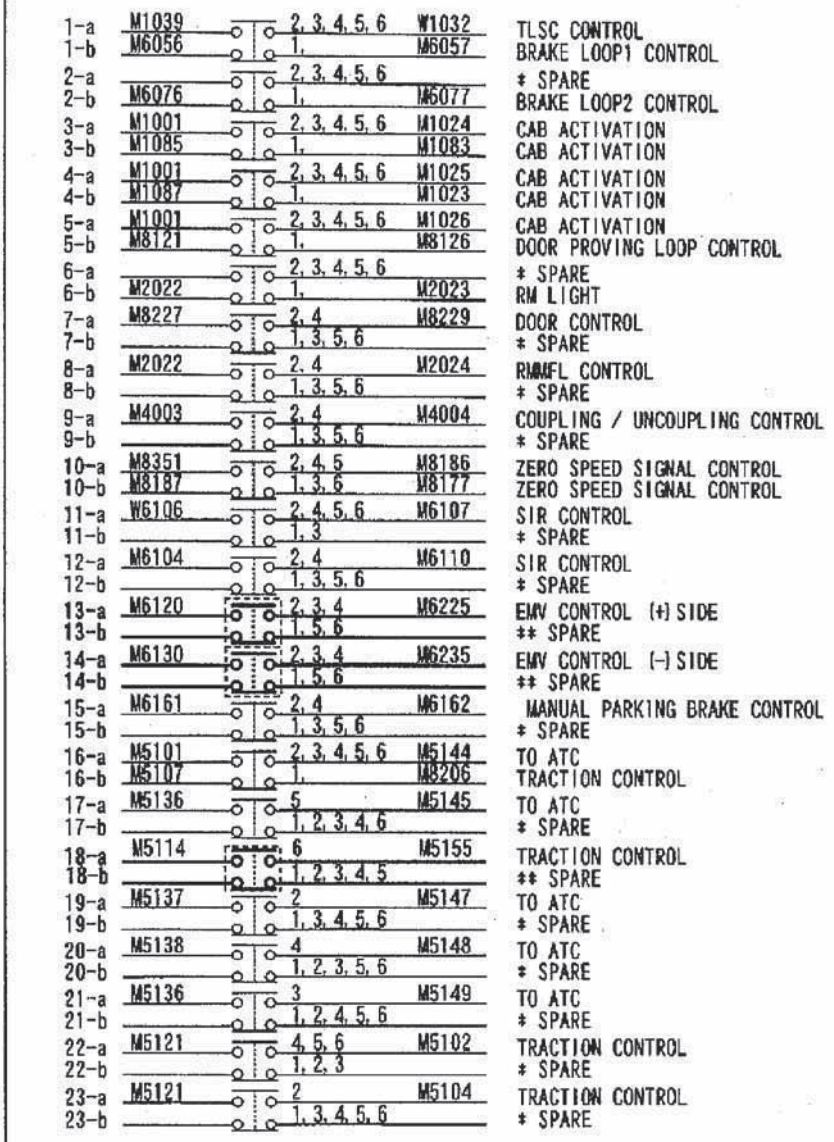
Attachment

Specification of Cam diagram for mode selector switch and traction brake controller for TKE is shown in the following.

3-4 The supply voltage of control lines connecting to the mode selector switch is 110 VDC.

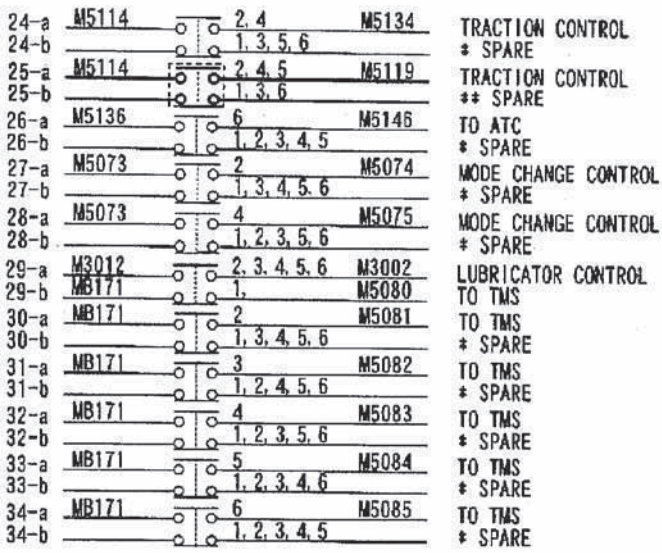
L K J G F C B

MODE SELECTOR SWITCH



Ref. No.	HCN-L5551-46N	Page	8

A



A

---- 1 = SHUTDOWN
---- 2 = REVERSE
---- 3 = STANDBY
---- 4 = FORWARD
---- 5 = CODED MANUAL
---- 6 = AUTO

a:a-contact
b:b-contact

for normal load
Type : S826a
Manufacturer : Schaltbau
Voltage : DC 110 V
Current : 0.4 A

for heavy load
Type : S800a
Manufacturer : Schaltbau
Voltage : DC 110 V
Current : 3.5 A
(L/R Load with surge absorber)

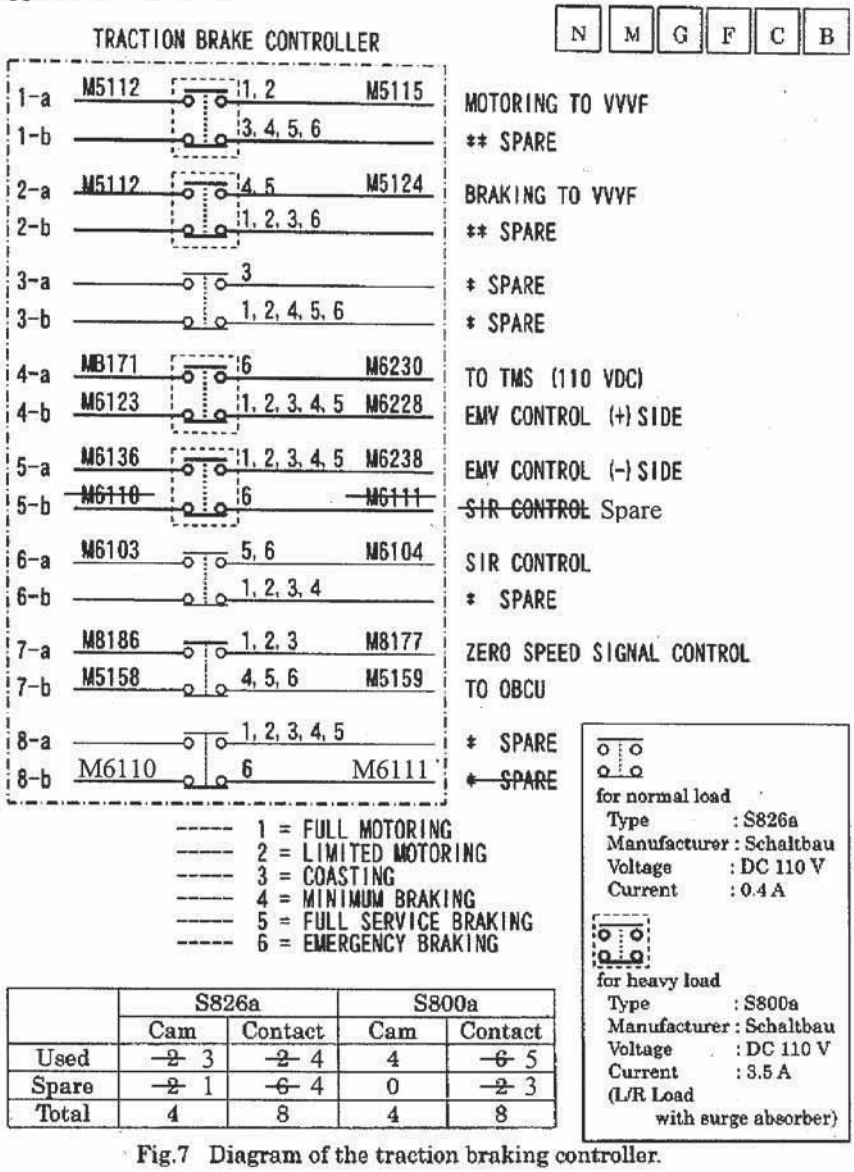
	S826a		S800a	
	Cam	Contact	Cam	Contact
Used	~~29~~ 30	~~32~~ 37	4	4
Spare	~~1~~ 0	~~28~~ 23	0	4
Total	30	60	4	8

Fig.2 Diagram of the mode selector switch.

Ref. No.	HCN-L5551-46N	Page	9

5-11 Traction Braking Controller

The supply voltage of all control lines connecting to the traction braking controller is 110 VDC but the control line interfacing with TMS is supplied with 24 VDC.



	S826a		S800a	
	Cam	Contact	Cam	Contact
Used	~~2~~ 3	~~2~~ 4	4	~~6~~ 5
Spare	~~2~~ 1	~~6~~ 4	0	~~2~~ 3
Total	4	8	4	8

Fig.7 Diagram of the traction braking controller.

Ref. No.	HCN-L5551-46N	Page	15

A

DETAILED INTERFACE SPECIFICATION

ANNEX A9
DESIGN NOTE – 772DN001
ATC INDICATORS AND ATC ALARMS FOR NEW TRAIN

DESIGN NOTES

1. Background

In the Signalling Preliminary Hazard Identification Workshop held on 18th September 2009, Train Crew Representatives expressed their concerns on the proposed ATC indicators and AFI Codes arrangements due to the adoption of ALSTOM SACEM on-board signalling equipment instead of Siemens OBCU. Further discussions were made via e-mail exchanges and another meeting was held on 2nd October 2009 to conclude the design.

The purpose of this design note is to form the traceability of the design requirements and to formalize the agreement between project teams and the end users.

Subsequent to the discussion in the Interface Hazard Analysis held on 20th October 2009, some new suggestions were raised in regard to the ATC indicators and the AFI codes. This design note is thus updated and supersedes the previous version dated 9 October 2009.

2. Design Requirements

2.1 ATC Indicators

2.1.1 The Door Tested indicator currently used in M-stock will be maintained in order to detect contact jam of the Door Proving Relay (DPR) in accordance with the train preparation procedure. This indicator will be driven by the ATC 110Vdc output.

2.1.2 The FB FAULT indicator currently used in M-stock is no longer required as the on-board ATC system for the train will not provide the fall back protection. Instead, the train's traction and brake systems and the TMS display will provide the required fall back functions.

2.1.3 The REMD FAULT indicator currently used in K-stock is not required as the ALSTOM on-board ATC cannot provide this function.

2.1.4 The CKD Indicator currently used in K-stock is not required as the ALSTOM on-board ATC will provide the same function by AFI code AF0

DESIGN NOTES

via the ATC-TMS serial link.

2.1.5 The ATC General Fault Indicator will be replaced by the TMS level 1 alarm namely SACEM HARDWARE FAULT in order to prompt the train driver immediately. See paragraph 2.2.1, 2.2.2 and 2.2.3 for detail description.

2.1.6 The on-board ATC will provide 110Vdc/10mA outputs to drive the AUTO FAULT, CM FAULT, RM FAULT, LOCKED AXLE, TRAIN HOLD and EMERGENCY BRAKE indicators. Furthermore, the on-board ATC will provide 24Vdc to drive a reed relay namely DLIRR which, in turn, drives the 110Vdc DLI indicator.

2.1.7 The SIR1 and SIR2 indicators will be driven by voltage free contacts in SIR1 relay and SIR2 relay, respectively.

2.1.8 All indicators are provided by RS Contractor.

2.1.9 The finalised layout of the required ATC indicators and their general arrangement on driver desk is shown in Figure 1 below.

Figure 1 – ATC Indicators Layout

DESIGN NOTES

2.1.10 The decals, colours and the location sequences of the ATC Indicators and the Cab Occupied indicator are detailed in Table 1 below:

Location Sequences (From Left to Right)	Decal	Type	Colour
1	AUTO FAULT	ATC Indicator	Red
2	CM FAULT	ATC Indicator	Red
3	RM FAULT	ATC Indicator	Red
4	LOCKED AXLE	ATC Indicator	Red
5	TRAIN HOLD	ATC Indicator	Red
6	SIR1	ATC Indicator	Yellow
7	SIR2	ATC Indicator	Yellow
8	EMERGENCY BRAKE	ATC Indicator	Yellow
9	DOOR TESTED	ATC indicator	Yellow
10	CAB OCCUPIED	Train Indicator	Amber

Table 1

2.1.11 One yellow colour Driverless Operation Pushbutton is provided to inform the ATC system that the train is ready for the driverless turnaround operation. The pushbutton is integrated with the DLI indicator. The pictogram of the pushbutton is shown in Figure 2 below.

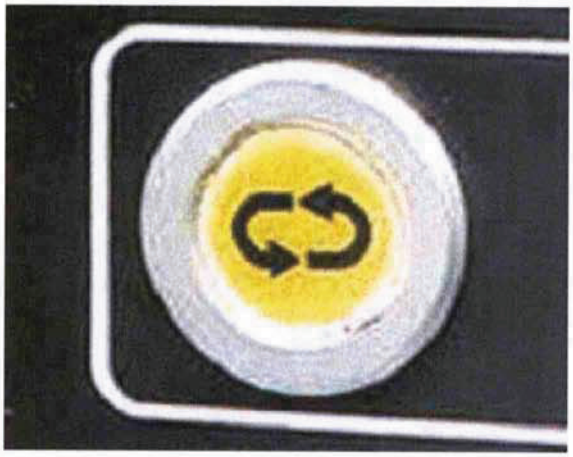


Figure 2 – Driverless Operation Pushbutton Pictogram

DESIGN NOTES

2.1.12 The Driverless Operation Pushbutton is installed on the A side front wall as highlighted in red in Figure 3 below.

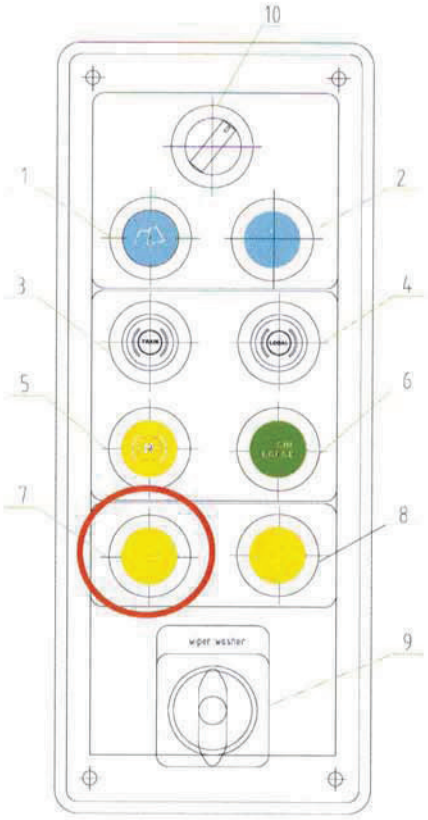


Figure 3 – Driverless Operation Pushbutton Layout

2.2 ATC Alarms

2.2.1 A new level 1 TMS Alarm namely "SACEM Hardware Fault" will be added in TMS system. This alarm will be triggered by one of 110Vdc input port number DIH21 which was previously reserved for the PSD Opened status in K-stock.

2.2.2 The 110Vdc voltage free contact in AFRR reed relay provided by ALSTOM currently used to drive the ATC General Fault indicator will be used to drive the TMS input port number DIH21.

2.2.3 The logical conditions and the definition of the SACEM Hardware Fault alarm are specified in Table 2 below.

DESIGN NOTES

ATC Condition	AFRR	TMS input	Level	TMS Display
The same conditions used to drive the ATC General Fault Indicator in M-stock will be used to drive the AFRR (i.e. ATP/ATO HW Failure detected OR no messages received from ATO OR CKD detected low)	Close	Logical = 1 (i.e.110Vdc)	1	Fault Name: **SACEM HARDWARE FAULT** TO Hint: Obtain authorization for Startup
ATC is normal	Open	Logical = 0 (i.e. 0Vdc)		

Table 2

2.2.4 A new AFI code AF0 will be sent by ATC to TMS via the ATC-TMS serial link in order to trigger a level 1 TMS alarm namely SACEM Computer Lock-up. This AF0 is conditioned by the ATO variable namely CKD_LOW.

2.2.5 A new AFI code AF1 will be sent by ATC to TMS via the ATC-TMS serial link in order to trigger a level 1 TMS alarm namely SACEM Delocalized. This AF1 is conditioned by the ATP variable namely Delocalized. When this variable is set the AF1 is triggered.

2.2.6 A new AFI code AF2 will be sent by ATC to TMS via the. ATC-TMS serial link in order to trigger a level 1 TMS alarm namely PSD Open Failure. This AF2 is conditioned by one of the existing ATC alarm (Set ID = 28 & Event ID = 129). In addition, the ATP parameter namely WaitAlarmPSD will be changed from 15 sec. to 10 sec. in order to compromise the required failure detection and the sensitivity of this failure.

DESIGN NOTES

2.2.7 A new AFI code AF3 will be sent by ATC to TMS via the. ATC-TMS serial link in order to trigger a level 3 TMS alarm namely PSD Closed.

DESIGN NOTES

2.2.8 The detail description of the new AFI codes is specified in Table 3 below.

AFI Codes	Messages	Triggering Conditions	Failure Meaning	TMS Criticality Level	TMS Display
AF0	ATC Halt	This AFI code is set when the ATP or the ATO detects the CKD state is low which means CKD is low. This AFI code is unset when ATC is normal	ATC is halt 1 = ATC is halt 0 = ATC is normal	1	Fault Name: **SACEM COMPUTER LOCKED UP** TO Hint: Obtain authorization for Startup
AF1	ATC Delocalized	This AFI code will be set if ATP is delocalized. This AFI code is unset when ATP are localized. The ATP is localized means the ATP is at the following localization states: 2: " Waiting for departure" after the ATP founds a Stationary Initialization Beacon in the invariants 3: " Waiting for MTIB beacon": the ATP has read a STIB and waits a Moving Train Initialization Beacon 5: " Total localization": The ATP has found the Moving Train Initialization	ATC is delocalized 1 = ATC is delocalized 0 = ATC is localized	1	Fault Name: **SACEM DELOCALIZED** TO Hint: Obtain TC authorization for RM

		Beacon in the invariants 6: " Pre-localized state" : during change ends": the ATP waits for invariants 7: "Waiting for active cab" : Active cab has become inactive and complete stop is lost (change ends finalized) [Remark: the ATP is considered delocalized in the states 0, 1 & 4 (see details in ATP SwRS §6.3.4.1)]			
AF2	PSD Failed to Open	SetID = 28 & EvenID=129 PSD is not detected opened 10 seconds after driver pressing the door open button in PSD/APG fitted platform	PSD Failed to Open 1 = PSD is not opened after an expected delay 0 = PSD open normally	1	Fault Name: **PSD FAILED TO OPEN** TO Hint: Press PDOB. If Fail, use PSL
AF3	PSD Closed	This AFI code is set to 1 when the PSD variant is received and equal to 1.	PSD Closed 1 = PSD closed 0 = PSD opened or unknown	3	Fault Name: PSD Closed

DESIGN NOTES

		This AFI code is set to 0 when either the PSD variant is not received or it is received and equal to 0.			
AF4			Reserved AFI code	-	Nothing
AF5			Reserved AFI code	-	Nothing
AF6			Reserved AFI code	-	Nothing
AF7			Reserved AFI code	-	Nothing
AF8			Reserved AFI code	-	Nothing
AF9			Reserved AFI code	-	Nothing
AF10			Reserved AFI code	-	Nothing
AF11			Reserved AFI code	-	Nothing
AF12			Reserved AFI code	-	Nothing
AF13			Reserved AFI code	-	Nothing
AF14	COMPLETE_STOP	This AFI code is set when ATO detected train is completely stopped (i.e. < 0.5kph). This AFI code is unset when ATO is not detected completely stopped	Complete Stop 1 = Complete Stop 0 = moving	-	Nothing
AF15			Reserved AFI code	-	Nothing

Table 3

DETAILED INTERFACE SPECIFICATION

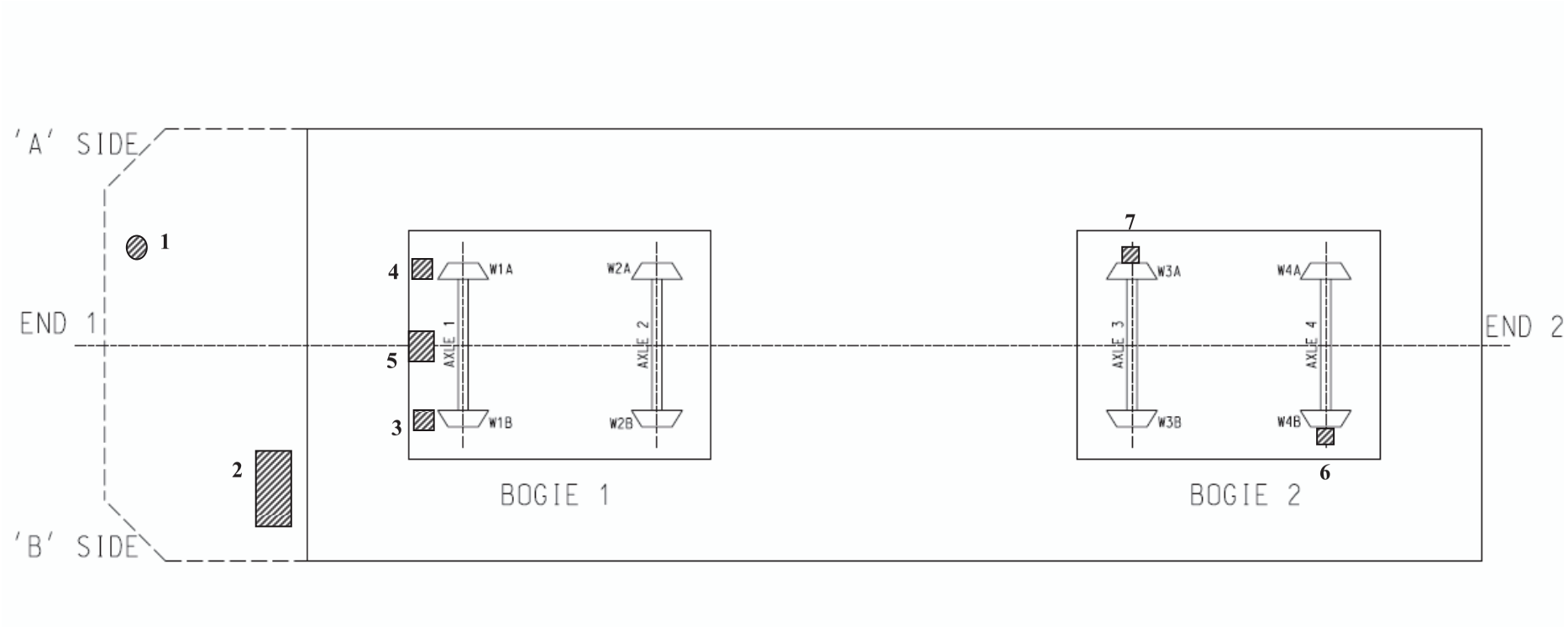
ANNEX B1
ATC MECHANICAL INTERFACE REQUIREMENTS

ANNEX B1 - ATC Mechanical Interface Requirement

AMENDMENT RECORDS

Author	Version	Date	§	Modifications
Joseph Sin	1.0	11 May 09	All	First issue
Joseph Sin	1.1	13 May 09	All	Second issue
Joseph Sin	1.2	19 May 09	All	Third issue
Joseph Sin	1.3	27 May 09	All	Fourth issue
Joseph Sin	1.4	29 May 09	All	Fifth issue
Joseph Sin	1.5	8 Jun 09	All	Sixth issue
Joseph Sin	1.6	17 Jun 09	All	Seventh issue
Joseph Sin	1.7	2 Jul 09	All	Eighth issue
Joseph Sin	1.8	3 Jul 09	All	Ninth issue
Joseph Sin	1.9	16 Jul 09	Fig. UF1 - revised, Fig. RC2 - revised, Fig. CT2 - revised, Fig. ATC1 - revised, Fig. ATC2 - revised, Fig. ATC4 - removed, Odometer Photo 1 - revised, Fig. OD7 – removed.	Tenth issue
Joseph Sin	2.0	21 Aug 09	Page 2, 15, Figures OD5 & OD6	Eleventh issue
Joseph Sin	2.1	10 Sep 09	1. Rename Figure OD5 to OD5_1 and updated with new version due to change on number of teeth and diameter of the pole wheel. 2. Add Figure OD5_2 to show the detail of adaptation shim. 3. Odometer 3B => Odometer 4B, Odometer 4A=>Odometer 3A 4. Figure OD6 removed.	Twelfth issue
Joseph Sin	2.3	10 May 10	1. Figure RC2, CT2, ATC3, OD4, OD5_1 and OD1 are updated. 2. Figure OD5 is removed.	Fourteenth issue
Joseph Sin	2.4	14 Jan 11	1. Figure OD5_1 is revised.	Fifteenth issue

ANNEX B1 - ATC Mechanical Interface Requirement



Location of on-board ATC equipment					
Items	Description	Weight	Items	Description	Weight
1	Speedometer	1 kg	6	Odometer 4B (with cable & plug)	3.2 kg +/- 0.1 kg
2	ATC Cubicle (without cable & plug)	78 kg +/- 1 kg	7	FAIVELEY Odometer 3A (with cable & plug)	0.8 kg +/- 0.1 kg
3	CT Sensor 1B (without cable & connector)	4.5 kg +/- 0.1 kg			
4	CT Sensor 1A (without cable & connector)	4.5 kg +/- 0.1 kg			
5	RC Antenna (without cable & connector)	8.8 kg +/- 0.1 kg			

FIGURE UF 1 – ATC Equipment Locations

ANNEX B1 - ATC Mechanical Interface Requirement

B1.U.1 RC ANTENNA & CT SENSORS

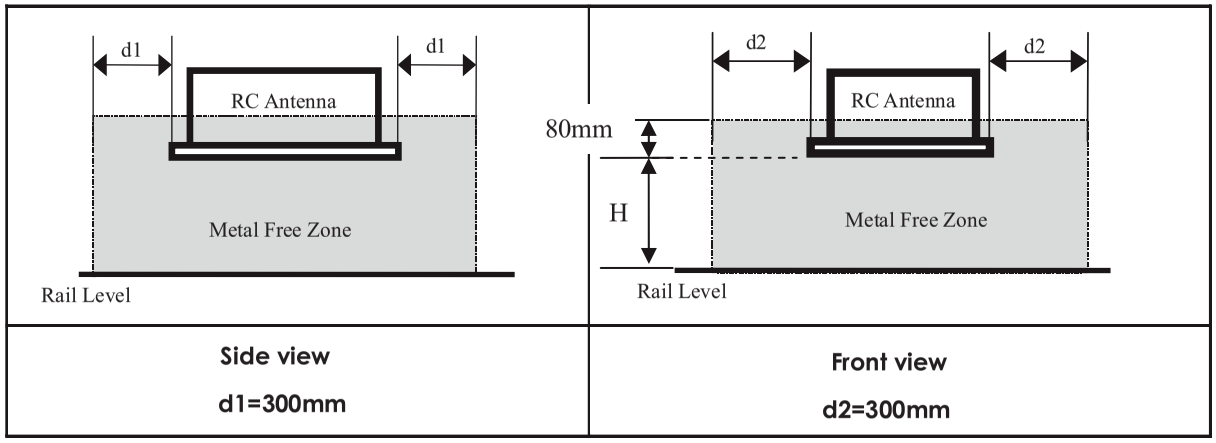
The RC Antenna is used for data transmission between the trackside beacons and the ATC. The length of cable between antenna and ATC cubicle shall not exceed 6m.

The RC antenna is made up of a sturdy body enclosing PCBs with transmission and logical electronic components. The other parts of the antenna are the non-metallic emitting face, the two connectors sockets and the mechanical interface including the shock absorbers. See Figures B1.U.1.1, UF2, UF3, UF4, RC1 and RC2 for details.

Its electrical interface with the ATC cubicle is made with two specific cables equipped with plugs.

B1.U.1.1 Metal Free Zone

To ensure clearance of the antenna in dynamic operations, no metallic parts shall be fixed around the antenna and its mechanical interface. The antenna must be positioned in an area without metallic parts as illustrated in figures below.



Note: refer to Figure B1.U.1.2 for value of H

ANNEX B1 - ATC Mechanical Interface Requirement

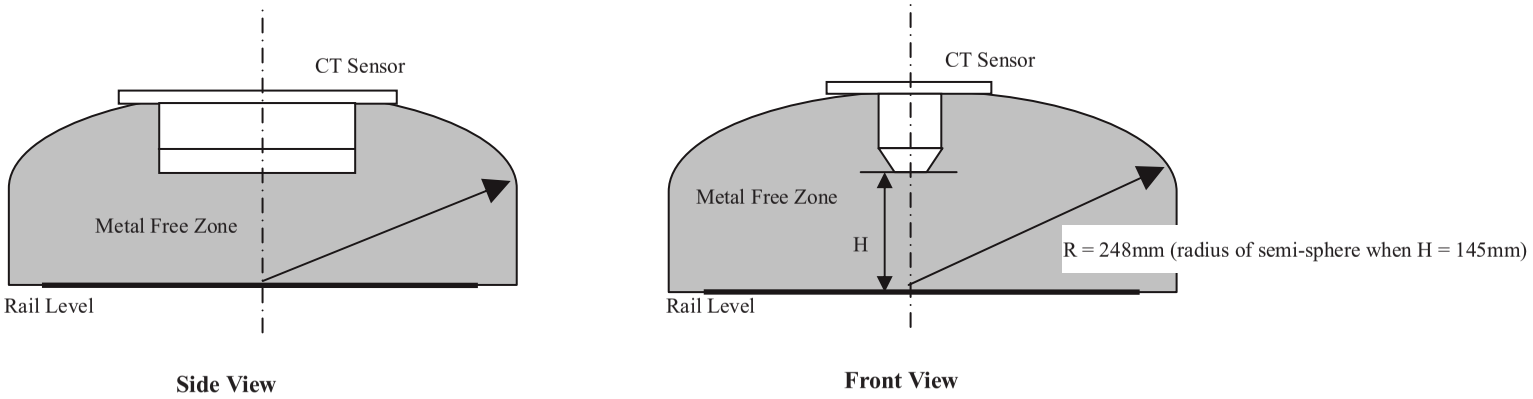
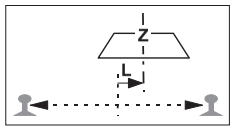
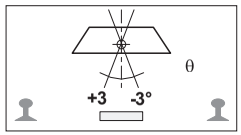
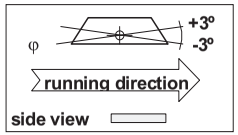
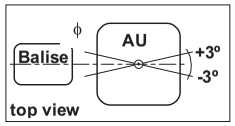


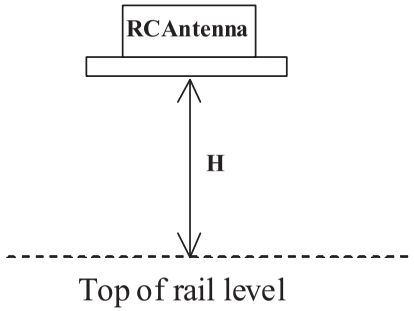
Figure B1.U.1.1 – RC antenna and CT Sensor Metal Free Zones

B1.U.1.2 RC Antenna Installation Constraints

The longitudinal axis of the RC antenna is centered with the track axis. The following figures illustrates the installation constrains of the RC antenna. The minimum and maximum dimensions are the extreme dimensions insuring the good functioning of the devices, and should be respected whatever the dynamics conditions.

ANNEX B1 - ATC Mechanical Interface Requirement

Description	minimum	typical	maximum	
Lateral gap with the longitudinal track axle = L	0 mm	(±10 mm)	±60 mm	
Tilting = θ	0°	(±1°)	±3°	
Pitching = φ	0°	(±1°)	±3°	
Yawing = ϕ	0°	(±1°)	±3°	



Value of H:

Maximum: 145mm

Nominal: 135mm – 140mm

Minimum: 75mm

FIGURE B1.U.1.2 – RC Antenna Installation Constraints

ANNEX B1 - ATC Mechanical Interface Requirement

B1.U.1.3 CT Sensor Installation Constraints

The CT sensor acquires the continuous track to train transmission for the on-board ATP/ATO cubicle. It is made up of a pair of sensors installed over each rail in front of the first axle of the first bogie of the train. Each sensor is equipped with one coil for loop transmission reception. It is mechanically coupled with the bogie with a specific mounting, and it is equipped with one connector socket for electrical interface with the train body. The dimensions and mounting details are given in Figures B1.U.1.3, UF2, UF3, UF4, CT1 and CT2.

Value of H:
Maximum: 150mm
Nominal: 140mm-145mm
Minimum: 75mm

Value of L:
Towards Rail: +20mm
Nominal: 0mm
Towards Track Centre: -60mm

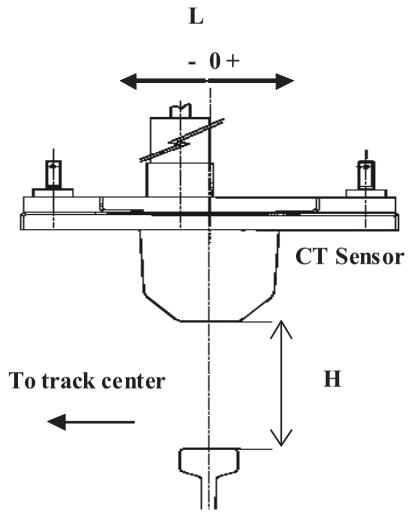
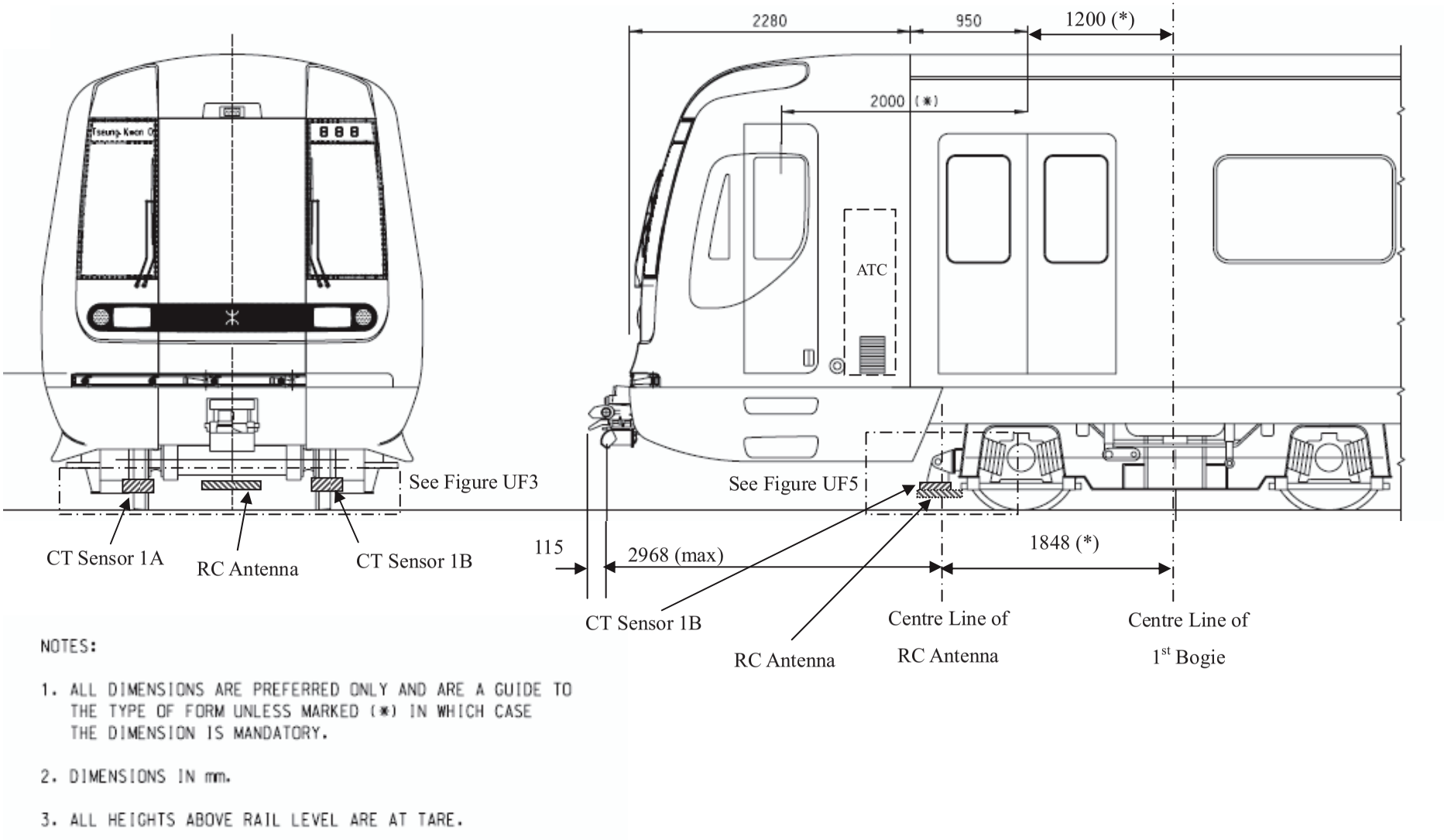


Figure B1.U.1.3 – CT Sensor Installation Constraints

ANNEX B1 - ATC Mechanical Interface Requirement



NOTES:

1. ALL DIMENSIONS ARE PREFERRED ONLY AND ARE A GUIDE TO THE TYPE OF FORM UNLESS MARKED (*) IN WHICH CASE THE DIMENSION IS MANDATORY.

2. DIMENSIONS IN mm.

3. ALL HEIGHTS ABOVE RAIL LEVEL ARE AT TARE.

FIGURE UF 2 –Proposed Locations of RC Antenna & CT Sensors

ANNEX B1 - ATC Mechanical Interface Requirement

Notes:

1. **ALL ARRANGEMENTS ARE FOR ILLUSTRATION & REFERENCE ONLY.**
2. **DIMENSIONS MARED WITH (*) ARE MANDATORY.**
3. **DIMENSIONS IN mm.**
4. **ALL HEIGHTS ABOVE RAIL LEVEL ARE TARE**

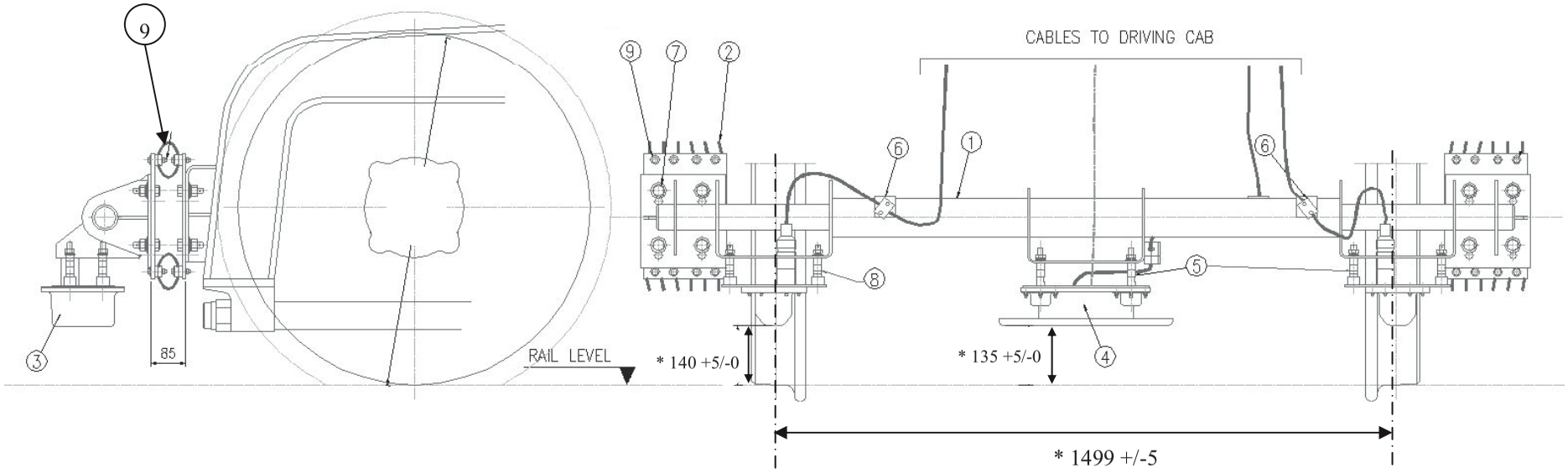


FIGURE UF 3 - Beam for R.C. Antenna & C.T. Sensor (For Reference Only)

ANNEX B1 - ATC Mechanical Interface Requirement

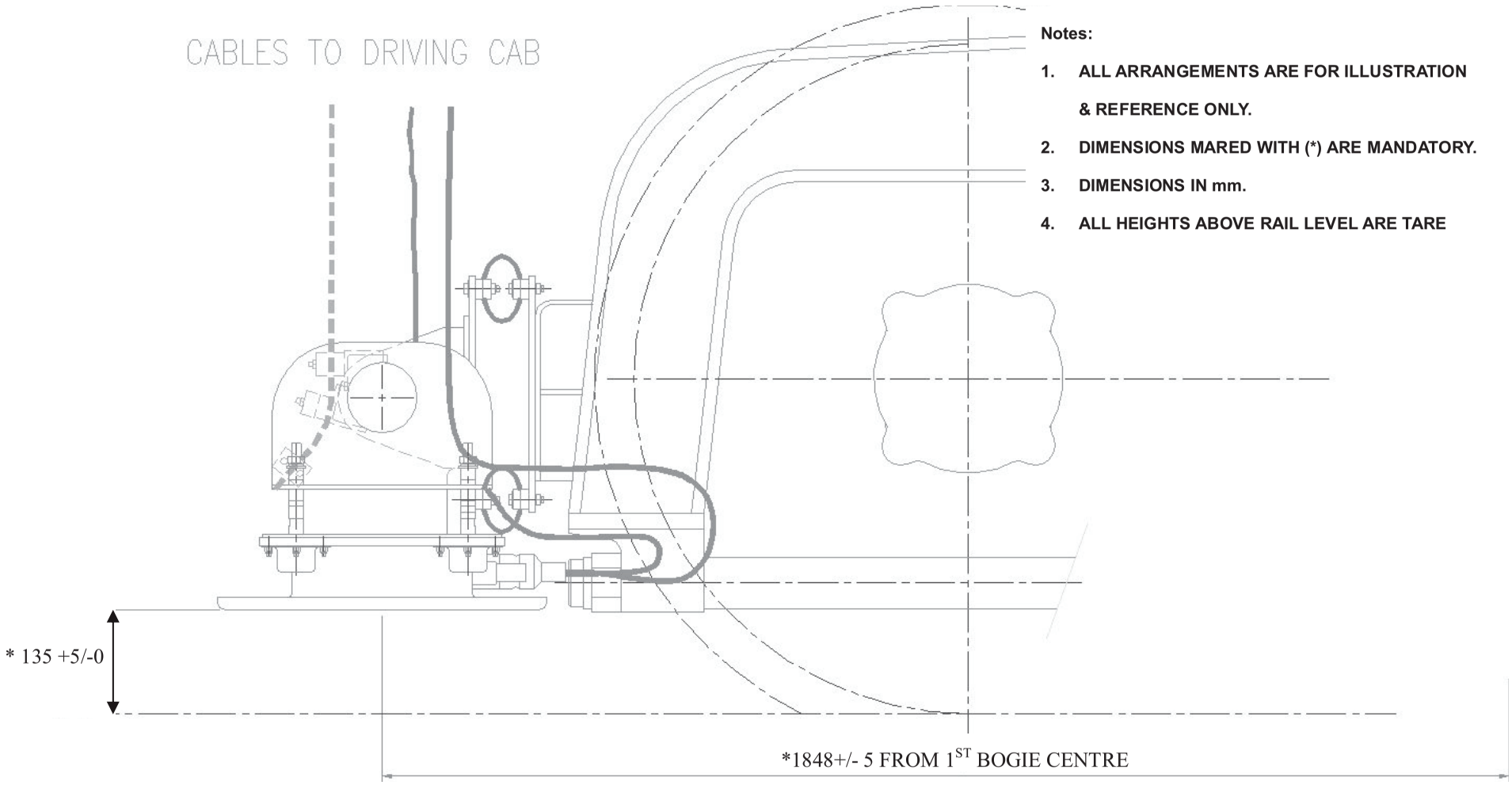


FIGURE UF 4 - RC Antenna Underframe Arrangement

ANNEX B1 - ATC Mechanical Interface Requirement

B1.U.2 RC ANTENNA & CT SENSOR SPACERS REQUIREMENTS

- Max (new) wheel diameter = 850mm, Min wheel diameter = 775mm
- Max bogie suspension compression/ vertical displacement = 30mm (tare to crush load) + 20mm (knematic movement)
- Nominal height of RC antenna (from rail top) = 135mm
- Nominal height of CT sensor (from rail top) = 140mm
- Kinematic envelope (from rail top) = 75mm
- If the CT sensor starts at 140mm from rail top with new wheels, the min. height of the CT sensor due to vertical displacement of the suspension is (140-50) = 90mm with 15mm margin before hitting the K.E..
- If the RC antenna starts at 135mm from rail top with new wheels, the min. height of the RC is (135-50) = 85mm with 10mm margin before hitting the K.E..
- The current URL maintenance regime is to adjust the antenna height after wheel wear of 10mm. The range of wheel wear is (850-775)/2 = 37mm. As a result, the numbers and size of the spacers required for the RC antenna and CT Sensors are 3 x 10mm and 1 x 7mm.

ANNEX B1 - ATC Mechanical Interface Requirement

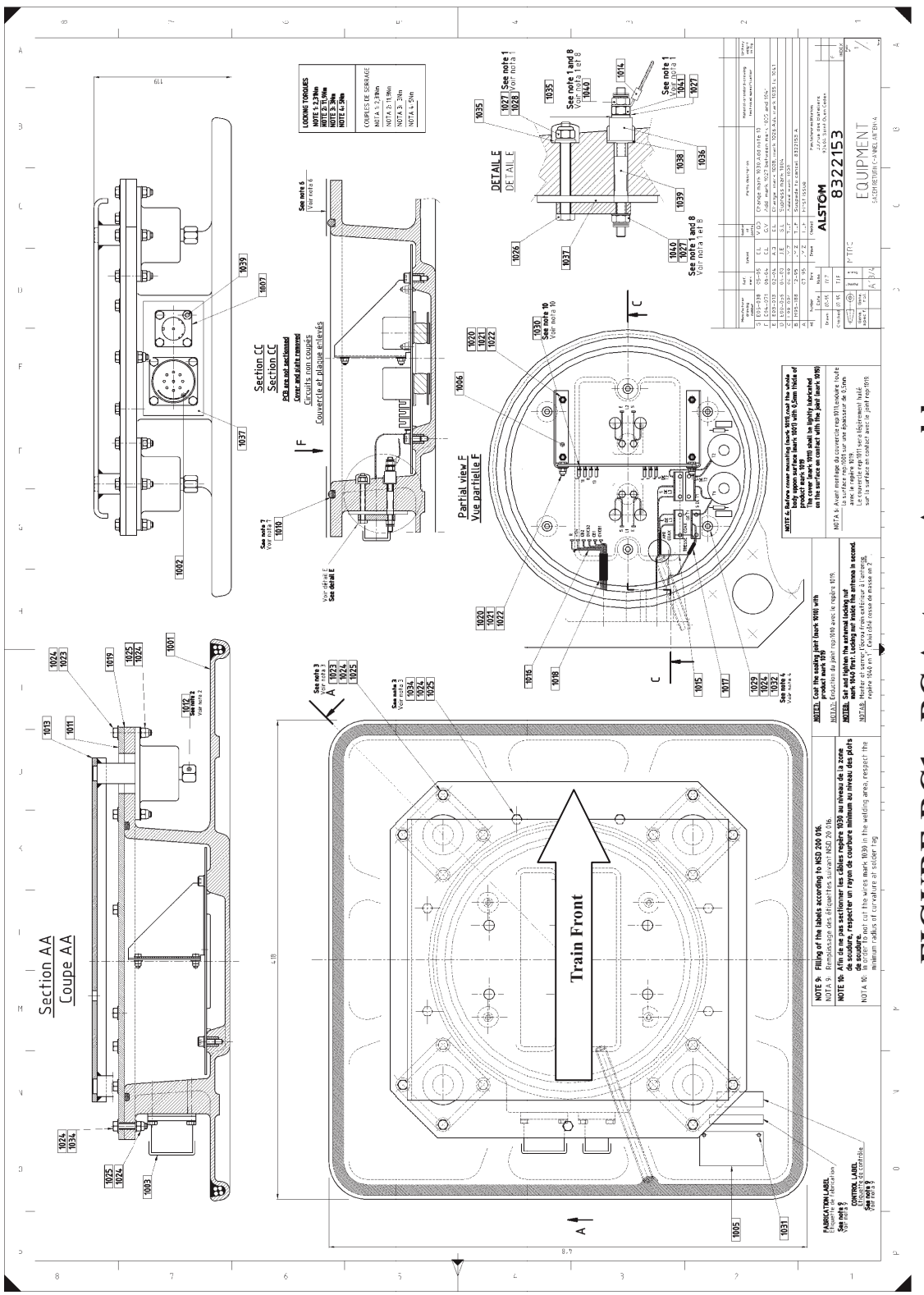
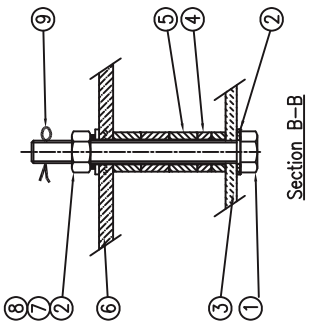


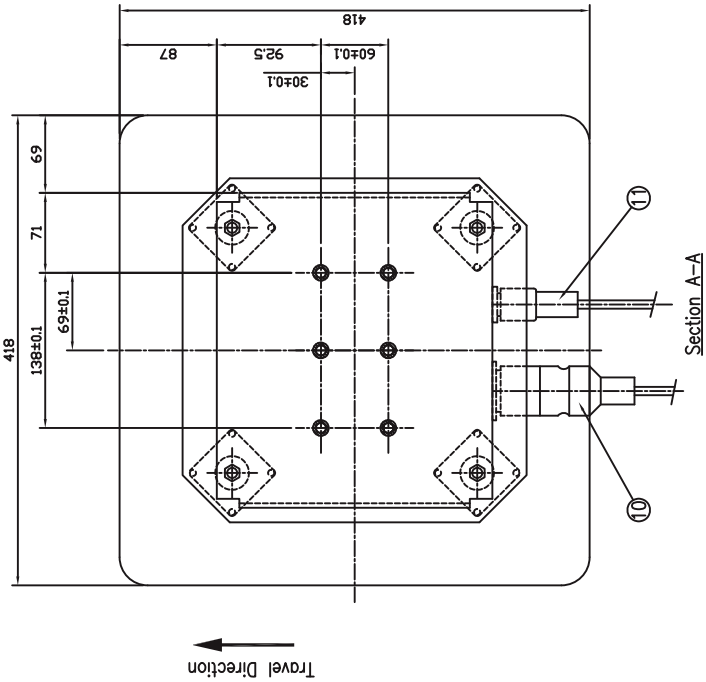
FIGURE RC1 - RC Antenna Assembly

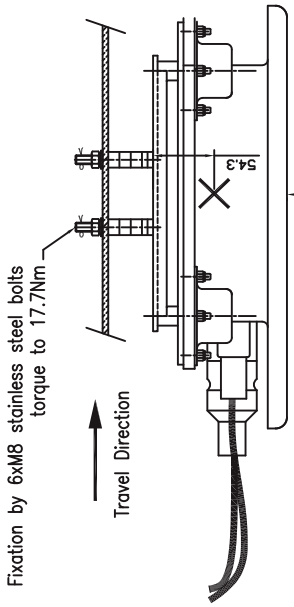
ANNEX B1 - ATC Mechanical Interface Requirement

Item	Description	Qty	Supplied by
1	Hex M8x80mm stainless steel bolt	6	772
2	Plain washer	12	C6554-07E
3	Plaque support	1	772
4	5mm stainless steel spacer	12	C6554-07E
5	10mm stainless steel spacer	18	C6554-07E
6	Mounting bracket	1	C6554-07E
7	Spring washer	6	C6554-07E
8	Nylon lock nut	6	C6554-07E
9	Split pin	6	C6554-07E
10	SOURIAU Plug/ socket	1 set	772
11	JUPITER Coaxial plug/ socket	1 set	772
12	RC antenna assembly	1	772

Note
For dynamic gauge add ±6mm displacement in 3 directions.







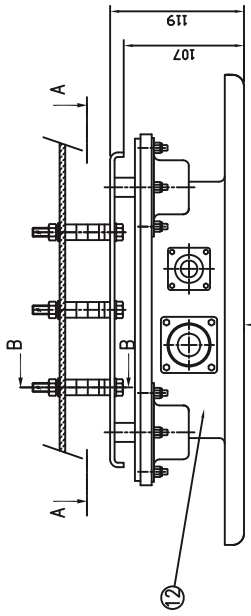


FIGURE RC2 - RC Antenna Mounting

Iss	Date	Designed	Drawn	Checked	Approved	Description
1.2	20/04/10	E.L.	R.AY.	I.T.		ISSUE FOR 772/C6554-07E DIS AS ANNEX B1
1.1	04/08/09	E.L.	R.AY.	I.T.		ISSUE FOR 772/C6554-07E DIS AS ANNEX B1
1.0	17/06/09	E.L.	R.AY.	I.T.		ISSUE FOR 772/C6554-07E DIS AS ANNEX B1

Iss	Date	Designed	Drawn	Checked	Approved	Description

ALSTOM

MTR Corporation

CONTRACT 772-TRAINBORNE SIGNALLING EQUIPMENT

RC Antenna Interface
Mounting Arrangement

CAT No. 772/C6554-07E/INT/MEC/RC001
CAD No. RC001.DWG
Sht. No.

SIZE A3

ANNEX B1 - ATC Mechanical Interface Requirement

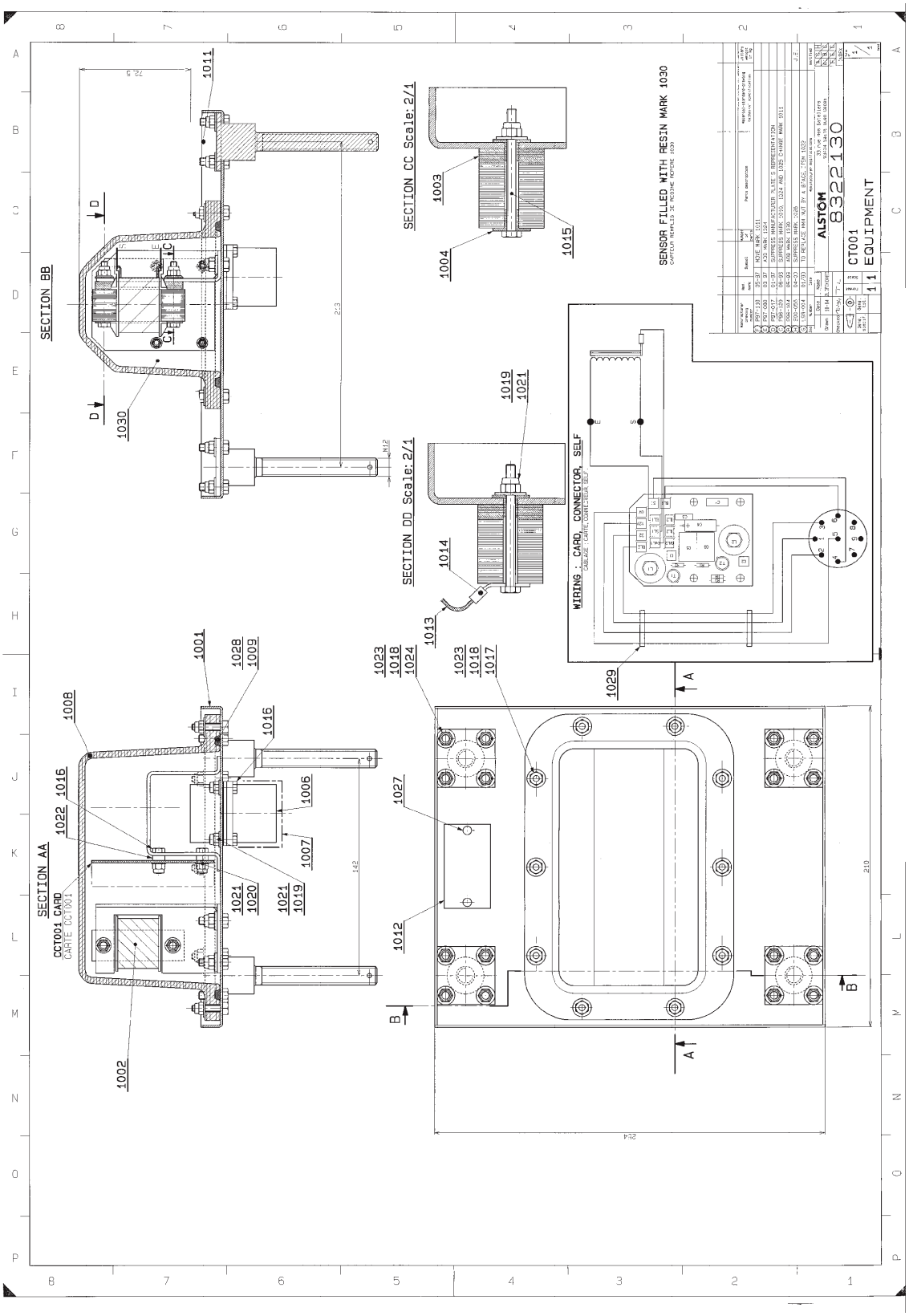


FIGURE CT1 - CT Sensor Assembly

Annex B1 rev. 2.4
Date: 14 Jan 11

ANNEX B1 - ATC Mechanical Interface Requirement

ITEM	DESCRIPTION	Qty	SUPPLIED BY
1	10mm Stainless steel spacer	12	C6554-07E
2	5mm Stainless steel spacer	8	C6554-07E
3	Plain washer	4	C6554-07E
4	Spring washer	4	C6554-07E
5	M12 nylon lock nut	4	C6554-07E
6	Split pin	4	C6554-07E
7	M12 stud	4	772
8	Mounting bracket	1	C6554-07E
9	CT sensor assembly	1	772
10	Cable plug	1	772

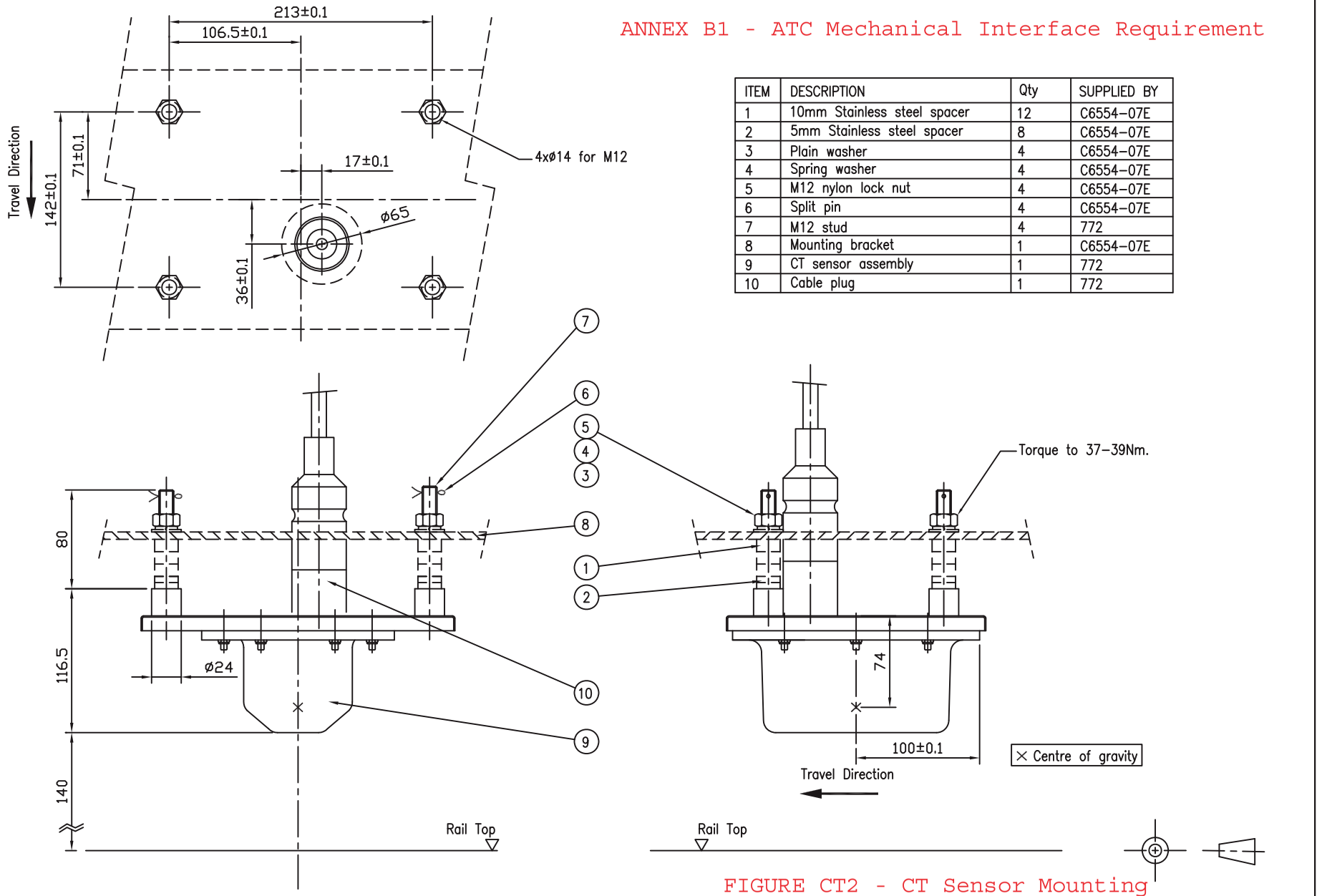


FIGURE CT2 - CT Sensor Mounting

Iss	Date	Designed	Drawn	Checked	Approved	Description
1.2	14/04/10	E.L.	R.AY.	I.T.		ISSUE FOR 772/C6554-07E DIS AS ANNEX B1
1.1	04/08/09	E.L.	R.AY.	I.T.		ISSUE FOR 772/C6554-07E DIS AS ANNEX B1
1.0	17/06/09	E.L.	R.AY.	I.T.		ISSUE FOR 772/C6554-07E DIS AS ANNEX B1

ALSTOM

CONTRACT 772-TRAINBORNE SIGNALLING EQUIPMENT

CT Sensor Interface Mounting Arrangement

MTR Corporation

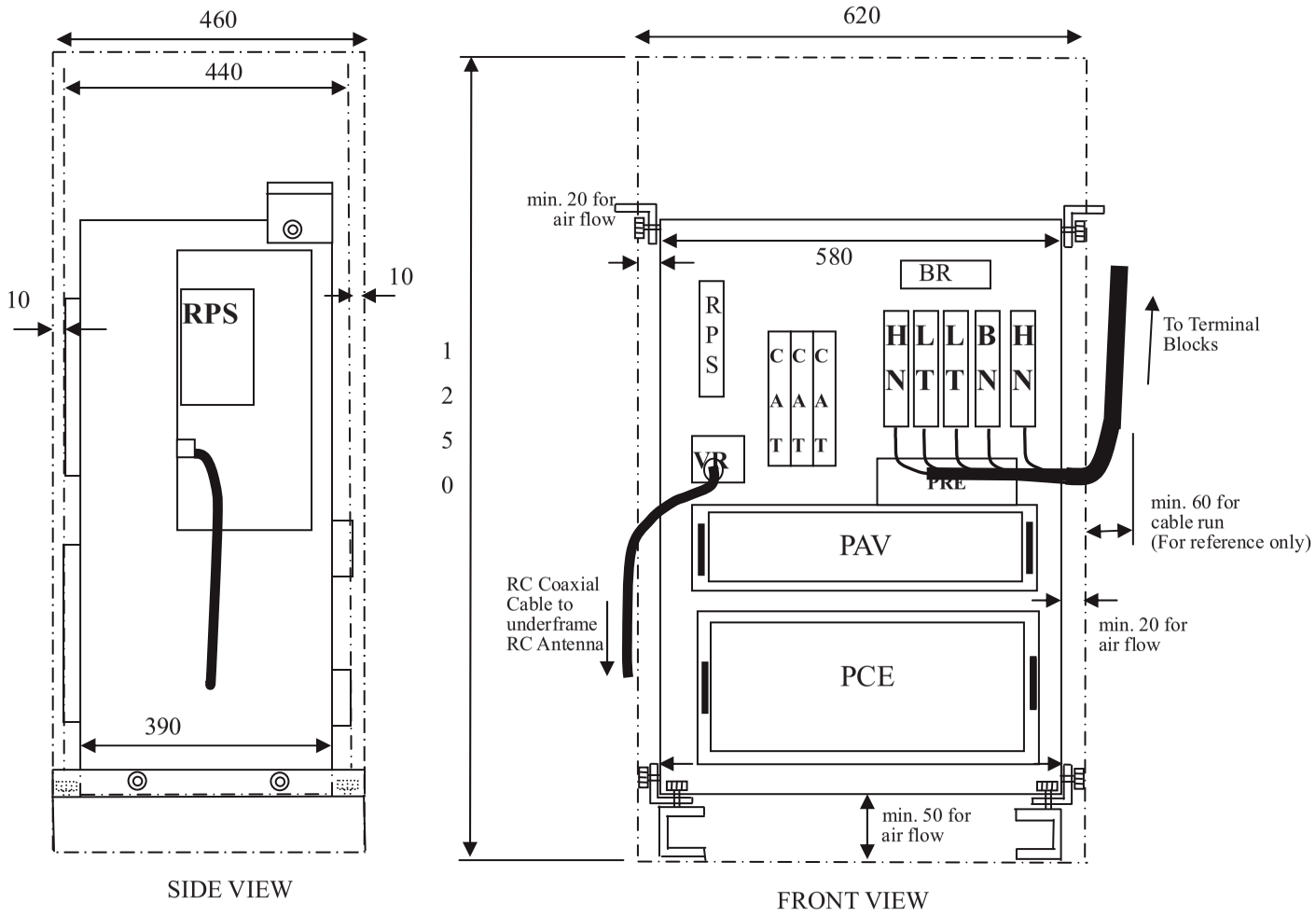
GAT No. 772/6554-07E/INT/MEC/CT001

CAD No. CT001_1.2.DWG

Sht.No.

SIZE A3

ANNEX B1 - ATC Mechanical Interface Requirement

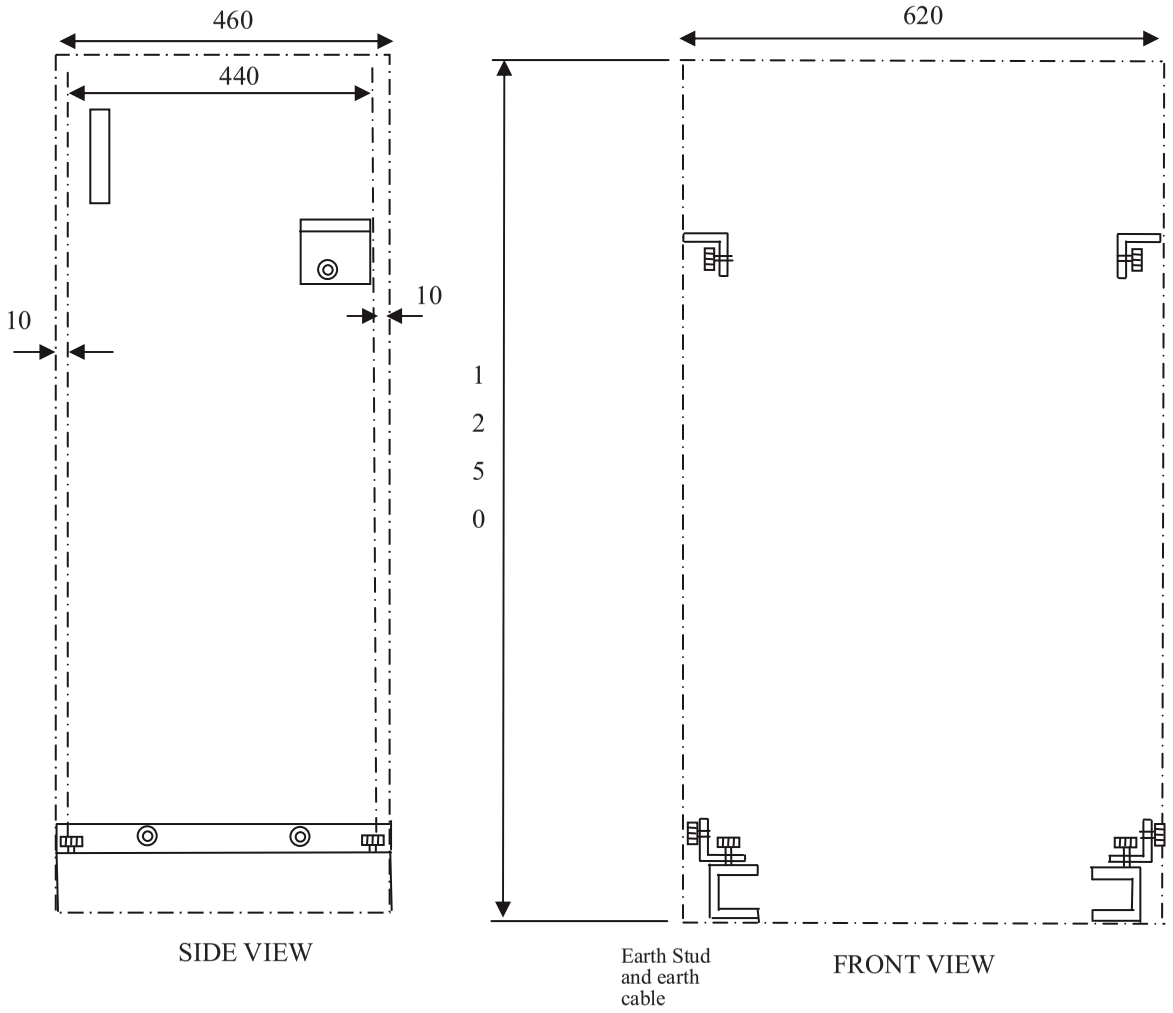


Notes:

DIMENSIONS IN mm.

FIGURE ATC1 - Proposed ATC Cubicle Arrangement

ANNEX B1 - ATC Mechanical Interface Requirement



Notes:

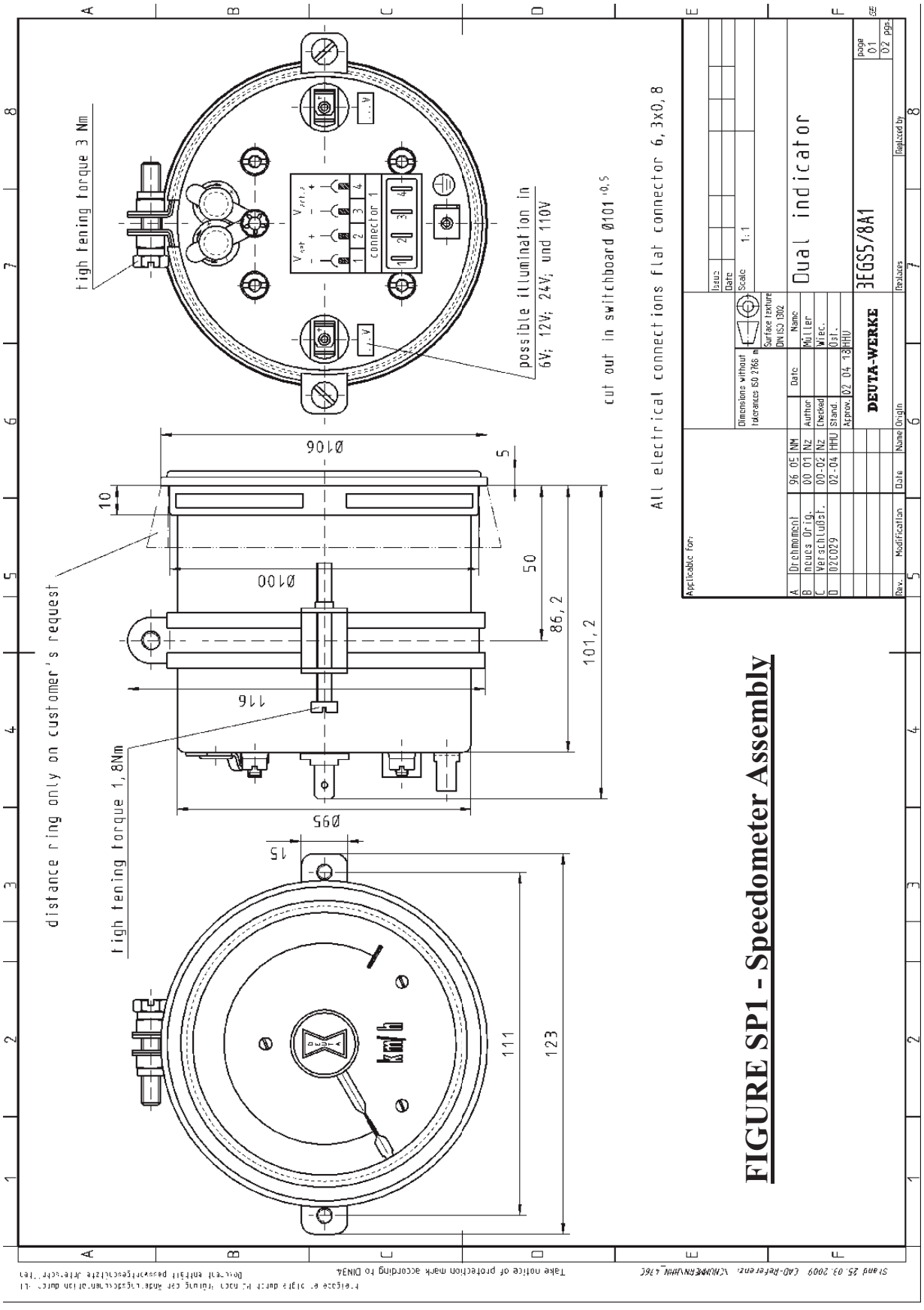
DIMENSIONS IN mm.

FIGURE ATC2 – SCOPE OF SUPPLY

SIZE A3 PLOTTED $$$DATE$$$TIME$$$ USER $$USER$$ FILENAME $$$$DGNSPEC$$$

ATC Cubicle

ANNEX B1 - ATC Mechanical Interface Requirement



Speedometer
110V
110V
V-Real
V-Set
1-
2+
3-
4+
Approvals
Casing
Additional indicator
sheet steel
depending on anode or
depending on cathode

Speedometer
110V
110V

Speedometer

Speedometer
0
20
40
60
80
100
km/h
Back Light On

ANNEX B1 - ATC Mechanical Interface Requirement

B1.O.1 ODOMETER

The odometer 4B acquires speed and displacement information of the train, for electronic processing by the ATC. It is made up of a sturdy equipment case, Hasler type 5.8600.034, containing 4 optical sensors and a punched disc. The length of interface cable between odometer 4B and ATC cubicle inside the driving cab shall not exceed 30m.

The odometer 4B is mechanically coupled with the bogie axle with a specific coupling system, and it is equipped with one connector plug for electrical interface with the train body. All the dimensions are given on the manufacturer drawings, see Figure OD1. The Odometer 4B is mounted on axle end, on the axle box, with a metallic interface part. The speed acquisition with the axle is made with a single fork coupling system.

B1.O.1.1 Odometer 4B Main Specifications

Coded Odometer (Haslerrail ref. 5.8600.034)	
type	with 4 sensors and ATP/ATO coded disk
dimensions	diameter 155mm, thickness 130mm (without cable and coupling)
weight	about 4.5kg (without cable and connector)
Body	aluminum casting
Connector	Aluminum with surface treatment
Coupling speed maxi	2000 rpm
Cable bending radius (mini)	150mm
Cable	Huber+Suhner cable
Connector (plug)	SAIB connector 123-319-04 ind C –

ANNEX B1 - ATC Mechanical Interface Requirement

	AUD-SP-ADPE-004 ind C (Alstom ref. 22905)

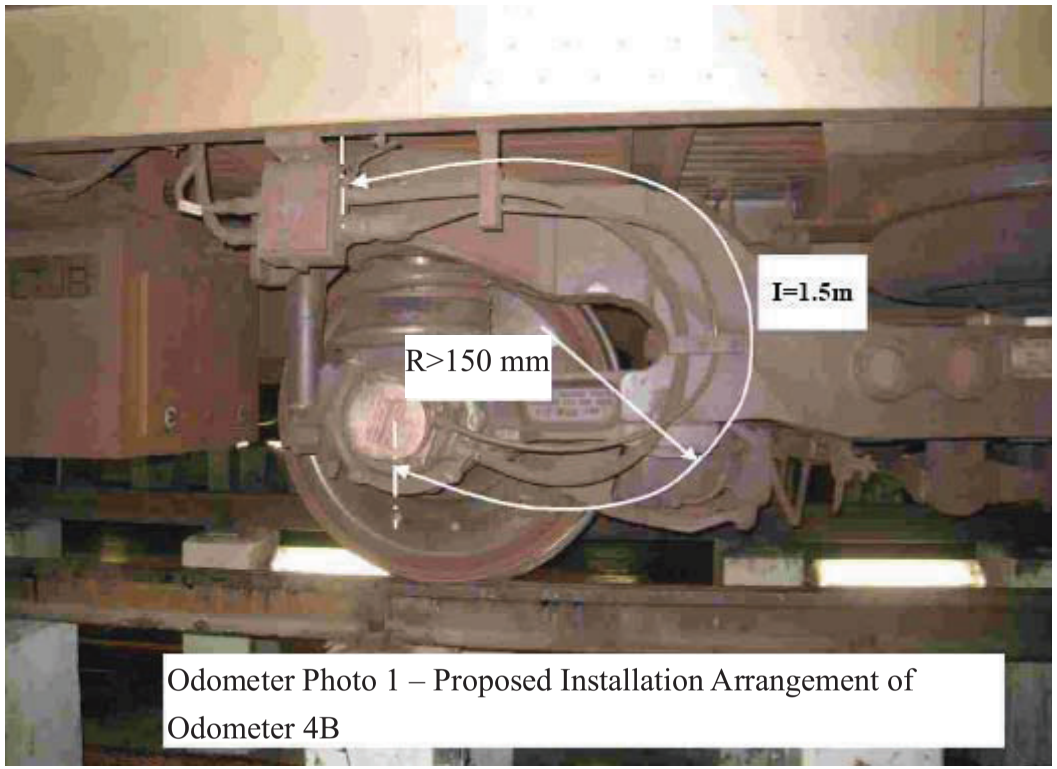
B1.O.1.2 Odometer 4B Environmental Specifications

Temperature (EN 50-155 Class T3)	-40°C / +70°C
Hygrometry	95% RH
Dielectric strength (EN 50-155)	1000V RMS, 50Hz, for 1 minute
EMC	according EN50121-3-2
Vibrations (IEC 61373) (Cat3) 300 m.s	300 m.s-2 RMS, 10Hz<f<500Hz on vertical axis 270 m.s-2 RMS, 10Hz<f<500Hz on transverse axis 135 m.s-2 RMS, 10Hz<f<500Hz on longitudinal axis
Shocks (IEC 61373)	1000 m.s-2 (peak), 6ms on 3 axis (Half sine pulse, 6 directions)
Protection (EN60529)	IP68
Salt spray (IEC68-2-11)	500 hours
Fire and smokes	according NFF16101, NFF16102 (Requirement 0)

B1.O.1.3 Odometer 4B Mounting precautions

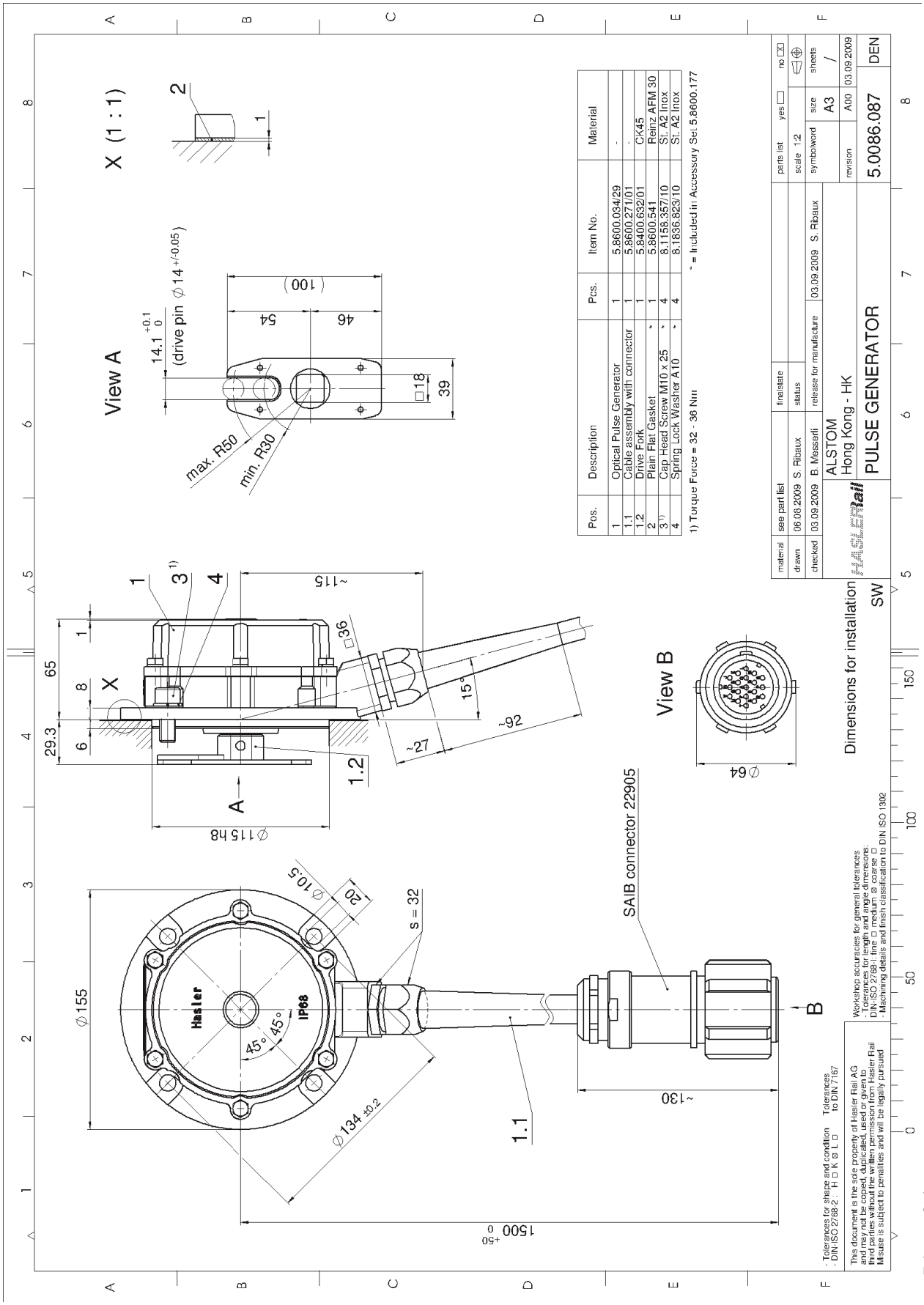
The cable must be attached to the bogie frame, near the Odometer body. Its connection with the under frame of the car must be made as short as possible, according its minimal bending radius and movement of the bogie in relation to the body. The under frame position of the socket is chosen to reduce the clearance between body car and bogie frame. The odometer must be mounted on a free axle (not motorized and not service braked).

ANNEX B1 - ATC Mechanical Interface Requirement



Odometer Photo 1 – Proposed Installation Arrangement of Odometer 4B

ANNEX B1 - ATC Mechanical Interface Requirement



Pos.	Description	Pcs.	Item No.	Material
1	Optical Pulse Generator	1	5.8600.034/29	-
1.1	Cable assembly with connector	1	5.8600.271/01	-
1.2	Drive Fork	1	5.8400.632/01	CK45
2	Plain Flat Gasket	* 1	5.8600.541	Reinz AFM 30
3 1)	Cap Head Screw M10 x 25	* 4	8.1158.357/10	St. A2 Inox
4	Spring Lock Washer A10	* 4	8.1836.823/10	St. A2 Inox

1) Torque Force = 32 - 36 Nm

* = Included in Accessory Set 5.8600.177

FIGURE OD1 – Odometer 4B Assembly

Annex B1 rev. 2.4
Date: 14 Jan 11

ANNEX B1 - ATC Mechanical Interface Requirement

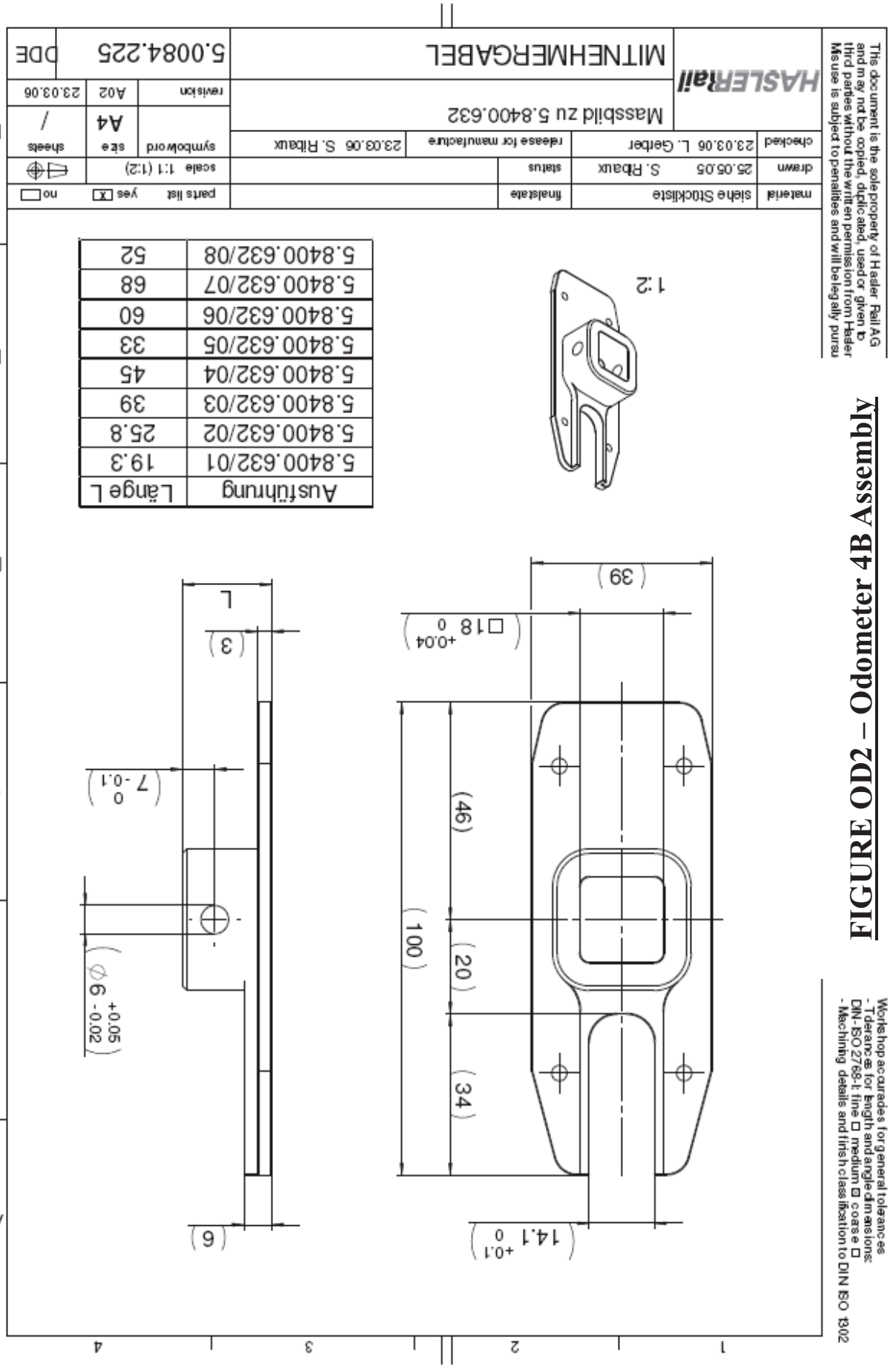
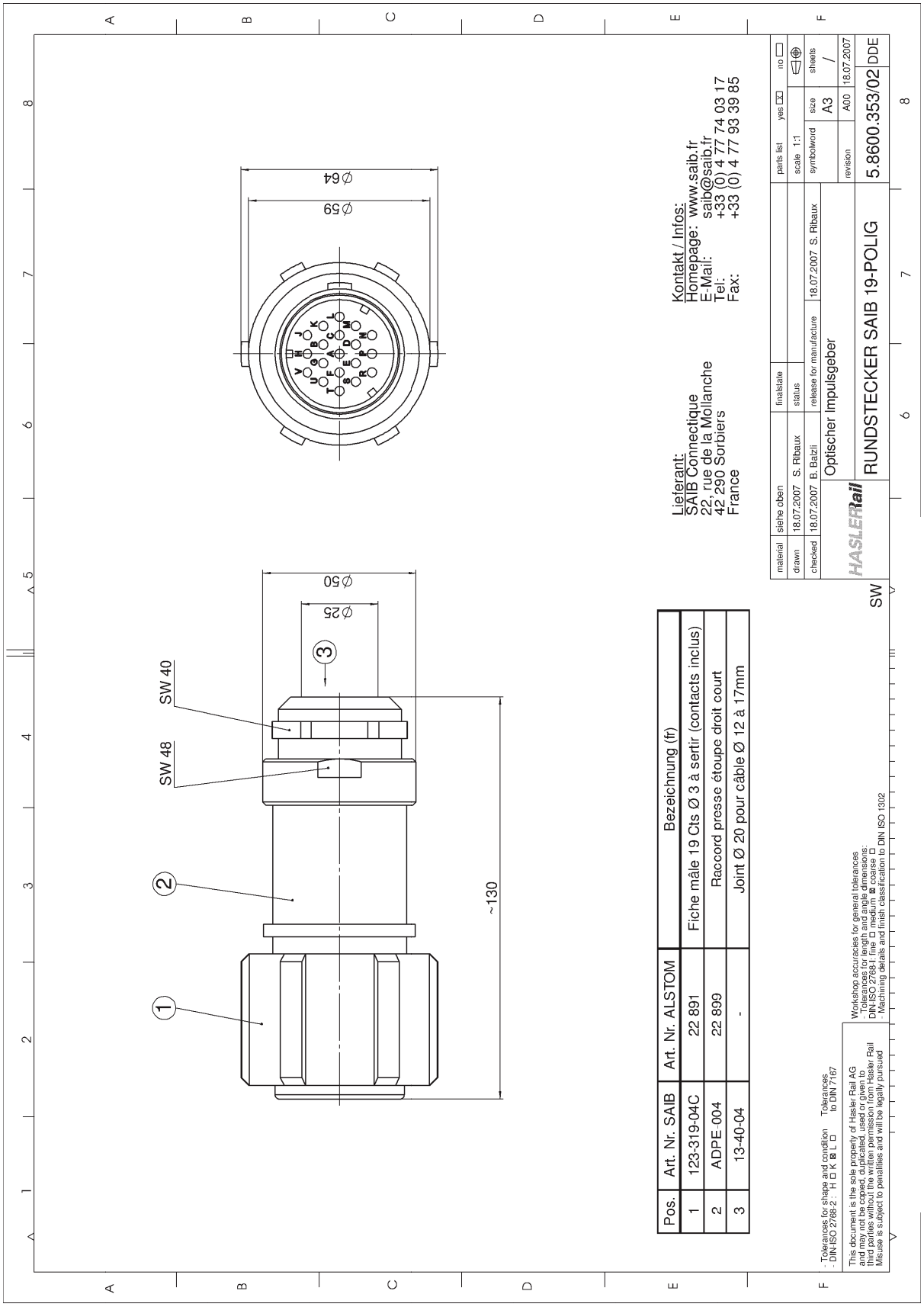


FIGURE OD2 – Odometer 4B Assembly

Annex B1 rev. 2.4
Date: 14 Jan 11

ANNEX B1 - ATC Mechanical Interface Requirement



Pos.	Art. Nr. SAIB	Art. Nr. ALSTOM	Bezeichnung (fr)
1	123-319-04C	22 891	Fiche mâle 19 Cts Ø 3 à sertir (contacts inclus)
2	ADPE-004	22 899	Raccord presse étoupe droit court
3	13-40-04	-	Joint Ø 20 pour câble Ø 12 à 17mm

FIGURE OD3 – Odometer 4B Plug

Annex B1 rev. 2.4
Date: 14 Jan 11

HASLERRail

ANNEX B1 - ATC Mechanical Interface Requirement

Security Class
EXTERN

1. Generator data

Outline drawing: *5.0086.087DEN*

Sensor location:

☒ Outer track	☒ Inner track	Sensor type *5.8600.120/..*
☒ A	☐ A	*47 rev. B00*
☒ B	☐ B	*47 rev. B00*
☒ C	☐ C	*47 rev. B00*
☐ D	☒ D	*47 rev. B00*
☐ E	☐ E	

Electrical adjustement:
(Sensor stagger)

Adjustments, connection and test according to Test Rule document 5.8602.034/05JEN
Test Protocol according to 5.8602.034/05QML
Assembly according to drawing 5.8600.010 Bl.1

No. of pulses:

	Outer track	Inner track
5.8600.809 rev. A	*100*	*special code*

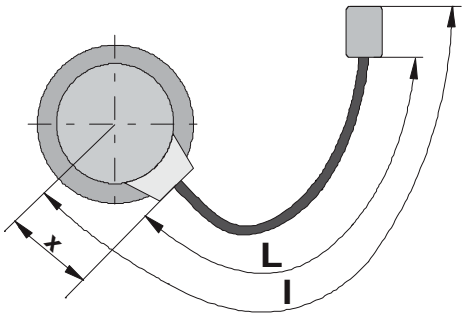
NT8540158/02

Cable set: *5.8600.271/01 rev. A* ☐ Free end cut ☒ With connector

Connector type: *5.8600.353/02* *SAIB 19 pole / pos.* Coding:

Cable length:

Customer length (l)	Free cable length (L)
1500 mm	*1255 mm*



l = Axle-center to connector output or cut end
L = Generator output to connector inlet or cut end

x = 115mm for 5.8600
135mm for 5.8604

Driver: *5.8400.632/01 rev. A*

2. Accessory data

Accessory set:

5.8600.177 rev. A	☐ fixed	☒ not fixed
	☐ fixed	☐ not fixed
	☐ fixed	☐ not fixed
	☐ fixed	☐ not fixed

3. Comments

Dielectric test 1500V/50Hz/1min
Cable length tolerance 0/+50mm
Alstom code-number “DTR211653" entered in customer number field of type plate.

FIGURE OD4 - Odometer 4B Cable Assembly

Author	S. Ribaux	06.08.2009
Reviewed	B. Messerli	03.09.2009
Released	S. Ribaux	03.09.2009
Version	**A01, 2009-09-03 SRi**	

ALSTOM **HONG KONG - HK**

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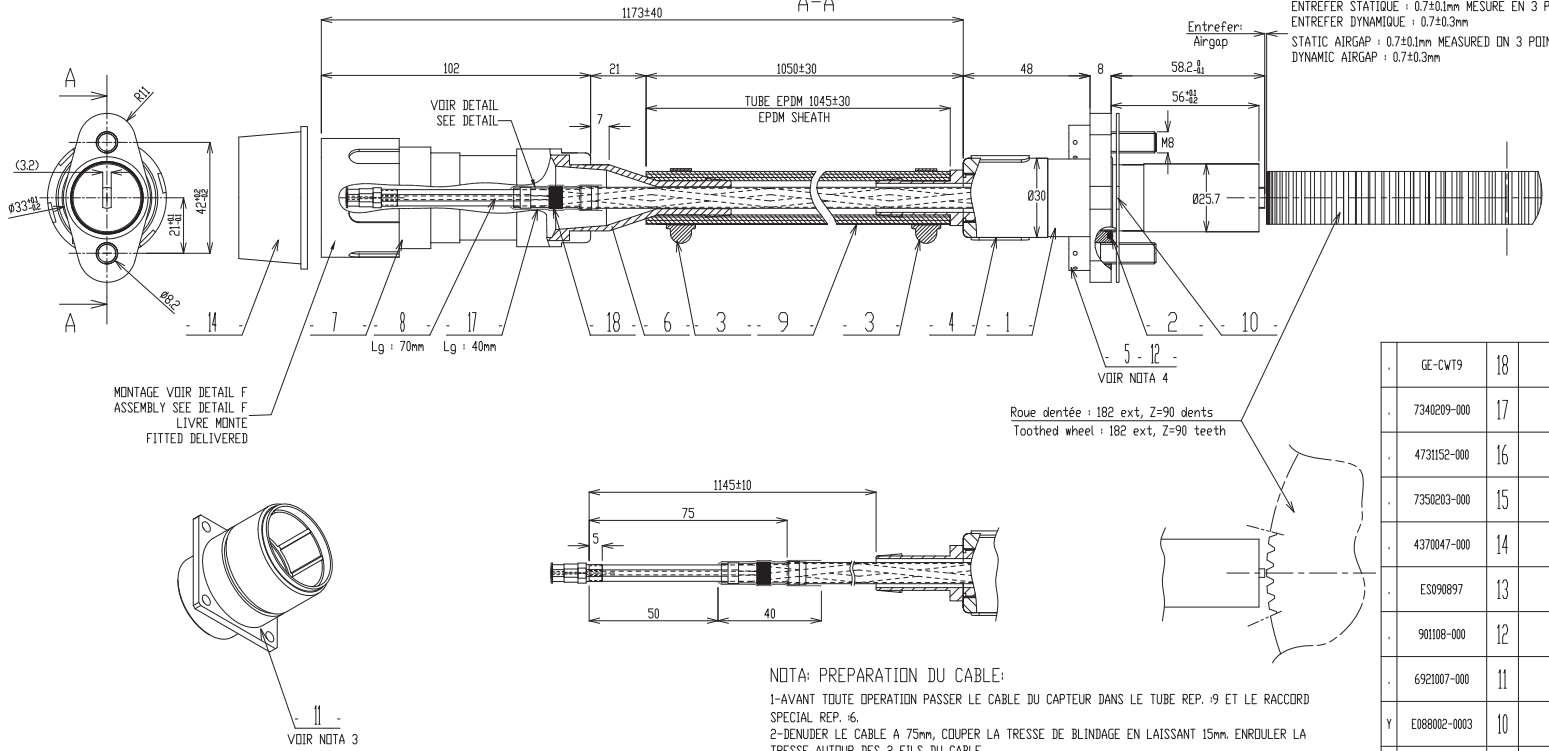
5.8600.034/29 **KEN**

Annex B1 - ATC Mechanical Interface Requirement



.	GE-CWT9	18		1	SOLDER SLEEVE MANCHON AUTOSOUDEUR	.	RAYCHEM : CWT-9	0.001
.	7340209-000	17		1	HEAT SHRINKABLE SHEATH GAINE THERMO RETRACTABLE	Lg:40mm	REF HELLERMAN HLR3050537	0.001
.	4731152-000	16		2	1.6 A 45 COLLAR COLLIER DE SERRAGE 1.6 A 45	.	PA AUTOEXT.TY-RAP-25M MIL M24693 A - 23190 B PA AUTOEXT.TY-RAP-25M MIL M24693 A - 23190 B	0.001
.	7350203-000	15		1	50-70 SHEATH GAINE PLASTIQUE A MAILLES 50a70	.	FILPACK PM15 JAUNE	0.000
.	4370047-000	14		1	CAP N100 BOUCHON N100	.	POLYETHYLENE ROUGE PLASTIMAR REF:460	0.000
.	ES090897	13		2	MALE CONTACT CONTACT MALE	.	REF KHEOPS : SMC 524 150-0083	0.000
.	901108-000	12		1	STEEL WIRE Ø0.8 FIL D'ACIER Ø0.8	Lg:150mm	SOFT STAINLESS Z2CN18 NF L 23320 INOX Z2CN18 ADOUCI NF L 23320	0.000
.	6921007-000	11		1	KHEOPS RECEPTACLE CMC 32 EA 07-13PN EMBASE KHEOPS CMC 32 EA 07-13PN	.	NF F 61-030	.
Y	E088002-0003	10		1	PELLING WEDGE CALE PELABLE	.	ALUMINUM LAMELLE JICEY	.
.	8458043-000	9		1	EPDM TUBE Ø13x20.5 TUBE EPDM Ø13x20.5	Lg:1045mm	CLIFCO REF: 13 GP 40 EPDM NOIR CLIFCO REF: 13 GP 40 EPDM NOIR	0.150
.	6831458-000	8		1	CABLE 44A0211AWG169 CABLE 44A0211AWG169	Lg:70mm	RAYCHEM	.
.	6921210-000	7		1	KHEOPS PLUG CMC 36 RD07-13SNL FICHE KHEOPS CMC 36 RD07-13SNL	.	NF F 61-030	0.156
Y	E088172-0002	6		1	SPECIAL BACKSHELL RACCORD SPECIAL		EN 10025-S235JR STEEL NF EN 10025 ACIER EN 10025-S235JR NF EN 10025	0.004
.	1870825-054	5		2	M8-25 HSHC SCREW VIS CHC A TROU DE FREINAGE M8-25	Fe/Zn8c2B Fe/Zn8c2B	8-8 STEEL NF L 22-222 ACIER CLASSE 8-8 ST1 NF L 22-222	0.015
Y	E078027-002	4		1	IDENTIFICATION LABEL PLAQUE FIRME	.	EN AW-1050A H111 ALU NF EN 485 ST 390 ALU EN AW-1050A H111 NF EN 485 ST 390	0.004
.	4740104-000	3		2	12-22 COLLAR COLLIER DIAM. 12-22	.	18-09 STAINLESS STEEL ACIER INOX 18-09 CAILLAU 082520822N	0.001
.	4542228-000	2		1	Øint 27.5-1.78 O RING JOINT TORIQUE Øint 27.5-1.78	.	CAT. 70 TR3 70 SH A LJF PD 7014 NF T 47-503 CAT. 70 TR3 70 SH A LJF	0.001
X	E088059-1006	1		1	OVERMOLDED AND EQUIPED BODY CORPS EQUIPE SURMOULE			0.5605
		.			FYCAP 88059 CAPTEUR 1CM1S (ASSEMBLY INCLUDING: FYCAP 88059 CAPTEUR 1CM1S (ENSEMBLE COMPRENANT:	VOIR NOTA		C 0.7625
Drawing supplier code Dessins ou codes constructeur	Items Repere	Symbole	Qty of part Nbre de pieces	Description of part Designation des pieces	Notes Indications particul. de fabric.	Material,norme,drawing technical specification Matiere,norme,dessin specification technique	KG unit weight Masse unitaire en KG	

NOTA: PREPARATION DU CABLE:

1-AVANT TOUTE OPERATION PASSER LE CABLE DU CAPTEUR DANS LE TUBE REP. :9 ET LE RACCORD SPECIAL REP. :6.
2-DENUDER LE CABLE A 75mm, COUPER LA TRESSE DE BLINDAGE EN LAISSANT 15mm. ENROULER LA TRESSE AUTOUR DES 2 FILS DU CABLE.
3-LE FIL REP.:8 SERA DENUDE SUR 10mm COTE MANCHON ETAME ET SOUDE SUR LA TRESSE DE BLINDAGE LORS DU RETREIND DU MANCHON AUTO-SOUDEUR REP. : 18.
4-LE MANCHON AUTO-SOUDEUR REP. : 18 EST RECOUVERT DE GAINE THERMO-RETRACTABLE REP. : 17.
5-DENUDER LES 3 FILS A 5mm ET SERTIR LES COSSES.

NOTE: CABLE PREPARE:

1-BEFORE ANY WORK PUT THE CABLE THROUGH THE EPDM SHEATH REP.:9 AND THROUGH SPECIAL BACKSHELL REP.:6.
2-STRIP THE CABLE AT 75mm LENGTH, CUT THE SHIELDING BRAID BY RESERVING 15mm LENGTH. ROLLUP THE BRAID AROUND THE 2 WIRES OF THE CABLE
3-THE WIRE REP.:8 WILL BE STRIPPED ON 10mm ON SOLDER SLEEVE SIDE AND WELDED ON SHIELDING BRAID REP.:18.
4-THE SOLDER SLEEVE REP.:18 IS COVERED WITH THERMOSHRINKABLE SHEATH REP.:17
5-STRIP THE WIRES AT 5mm AND CRIMP THE TERMINALS.

NOTE:

CE PRODUIT FAIT L'OBJET D'UN PLAN DE CONTROLE PC E088059-F103-PC

NOTE:

THIS PRODUCT IS ASSEMBLED ACCORDING TO PC E088059-F103-PC CONTROL PLAN

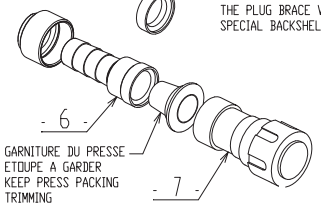
NOTA:

1-LA PLAQUE FIRME REP: 4 SERA CINTREE ET COLLEE AU TEROSTAT 33
CODE FY 9510214-000 SUIVANT INS-06011 ET REMPLIE SUIVANT INS-07095.
2-LE BOUCHON PLASTIQUE REP.:14, LA GAINE PLASTIQUE REP.15 et LES COLLIERS REP.16 SERVENT POUR L'EMBALLAGE DU CABLOT.
3-LES REP.11 ET 13 SONT LIVRES EN KIT NON MONTES
4-COUPLE DE SERRAGE 22 N.m + FREIN FILET MOYEN (EXEMPLE LOCTITE 243)
BLOQUER LES VIS AVEC UN FIL INOXYDABLE REP.: 12.

NOTE:

1-THE IDENTIFICATION LABEL REP.:4 WILL BE CURVED AND STICKED WITH TEROSTAT 33. (FY9510214-000) ACCORDING TO INS-6011 AND FULL FILLED ACCORDING TO INS-07095
2-THE PLASTIC CAP REP.:14, PLASTIC SHEATH AND COLLERS ARE USED FOR CABLET PACKING.
3-THE PARTS REP.:11 AND REP.:13 ARE DELIVERED NOT ASSEMBLIED.
4-TIGHTENING TORQUE 22N.M MEDIUM THREAD LOCKING GLUE (EX:LOCTITE 243)
LOCK THE SCREWS WITH STAINLESS WIRE REP.:12.

DETAIL F



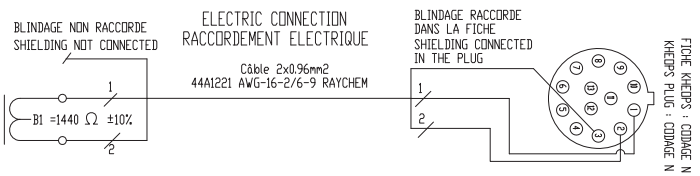


Figure OD5_1 Odometer 3A Assembly

B2	BDD N°100130	BMA			
B1	BDD N°100118	BMA	DRAWN	19-02-18	BMA
A2	BDD N°100315	BMA	DESIGNED		
A1	BDD N°100303	BMA	CHECKED	30-11-18	ANM
Modifications			APPROVED		

3 av. Léonard de Vinci PARC D'ACTIVITE DE CONDEIL 91-62 CEDEX 7 MILLEPIED - FRANCE

V E088059-2106

FYCAP 88059 CAPTEUR 1CM1S

FYCAP 88059 SENSOR 1CM1S

Specif. gene. NF F 00-037 MOYEN

Replace/Remplace

SCALE 1 : 1

A1

DETAILED INTERFACE SPECIFICATION

ANNEX B2
ATC EQUIPMENT ENCLOSURE - CAB LAYOUT

提 供 资 料 通 知 单

共 3 页 第 1 页

修改标记	处数	签名	日期

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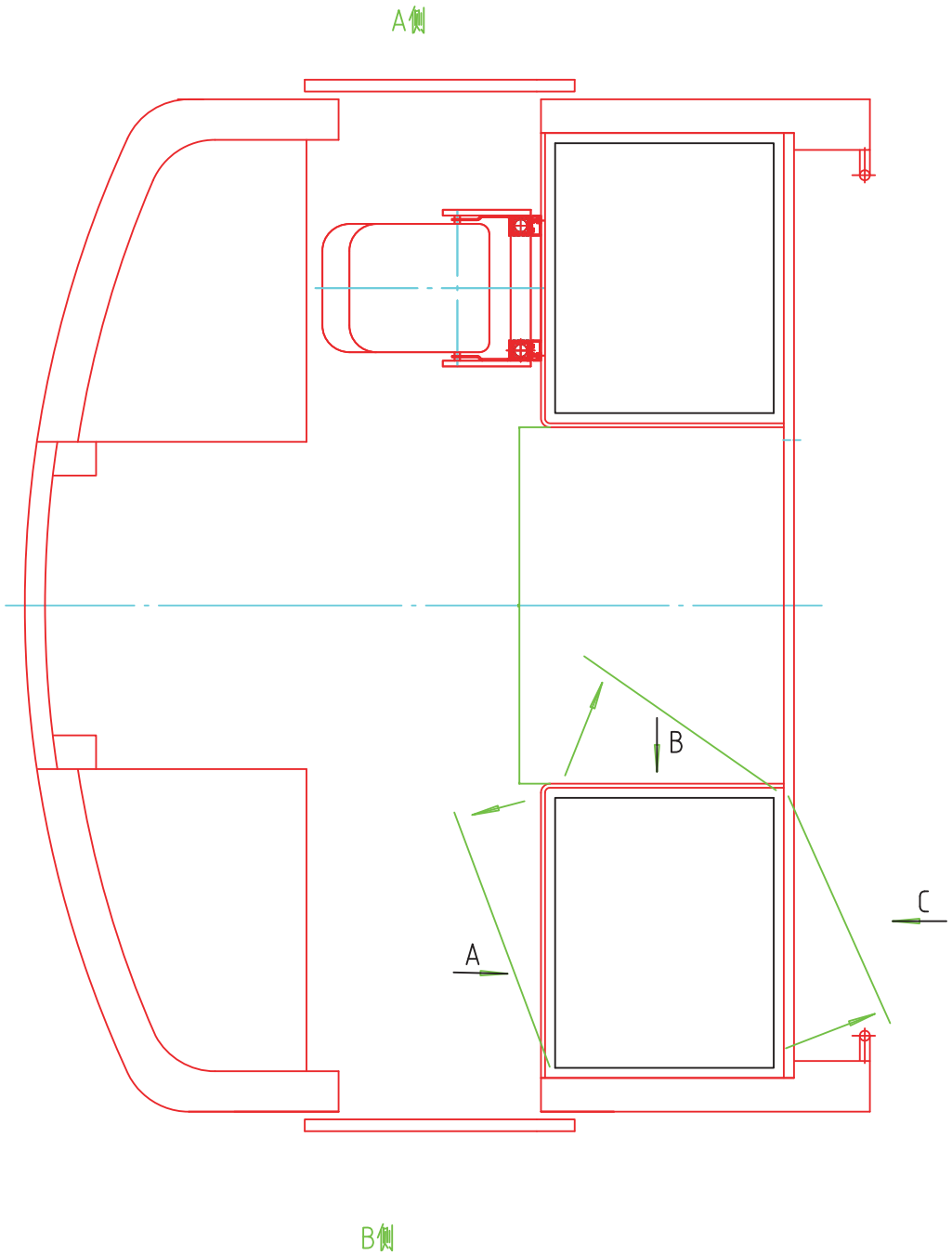


提供者	日期	资料审核	日期	接收负责者	日期	接收处理者	日期		签收
王 莉	09.8.13								
主管设计师	日期	接口经理	日期	处理意见:					

提 供 资 料 通 知 单

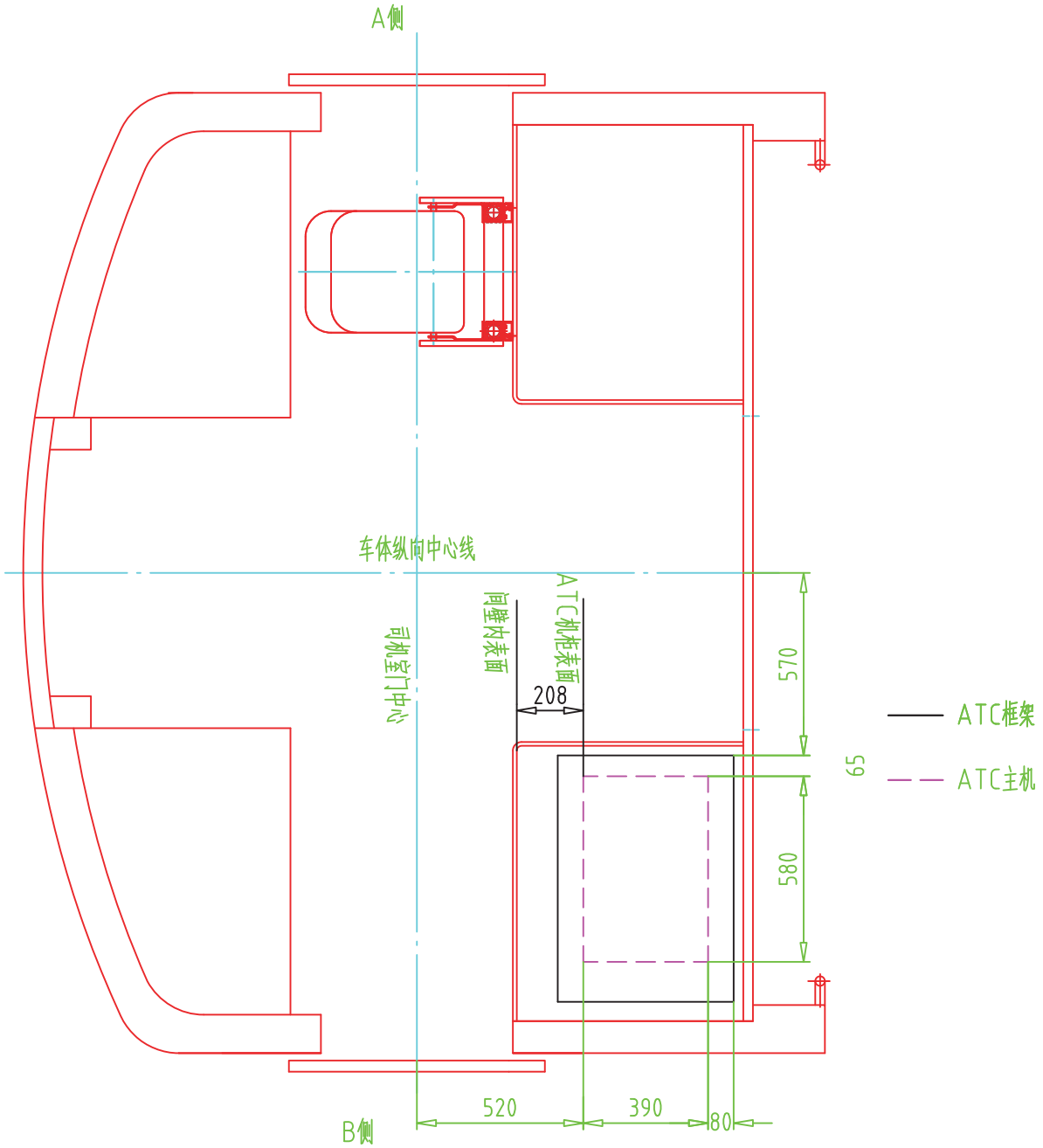
共 3 页 第 1 页

修改标记	处数	签名	日期

编号: DK108-44-0012

为开司机室电气柜检查门

1、请在司机室电气柜立罩板上开如C/D/E向视图所示的检查门,检查门尺寸均为净开度。



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王 莉	10.3.15								
主管设计师	日期	接口经理	日期	处理意见:					

提供资料通知单

修改标记	处数	签名	日期

编号：DK108-44-0012

B侧电气柜：

1）C向开如图所示的两体检查门，上部为折页门，折页靠近侧墙。下部为可摘卸的检查门。

2）D向开如图所示的两体检查门，上部与下部均为折页门，折页在靠近间壁门侧。

3）E向开如图所示的折页门，折页在靠近车体中心侧。折页门能打开130度。

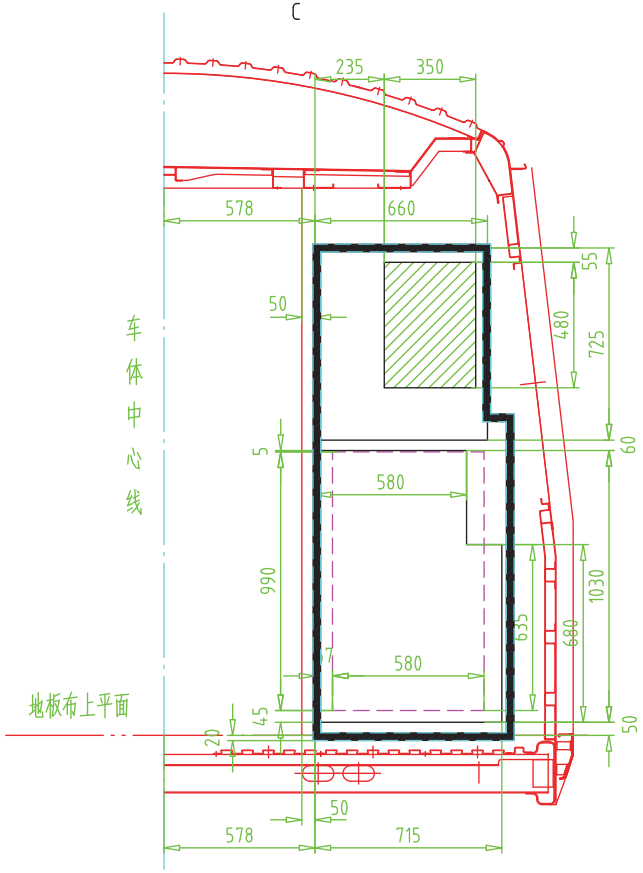
ATC 主机

ATC 框架

检查门边缘

车体及内装

C



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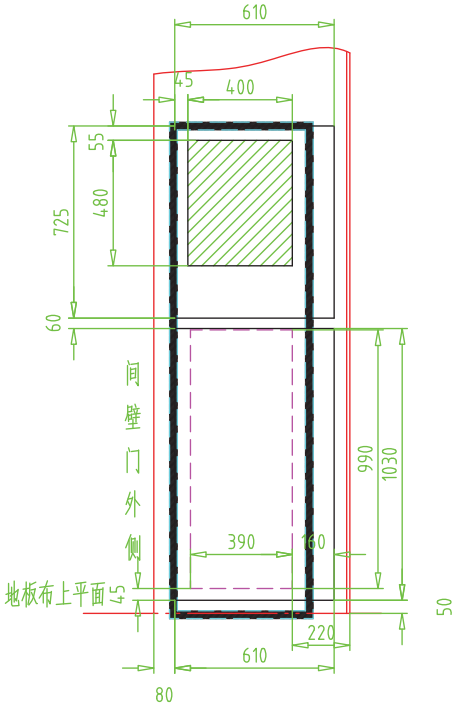
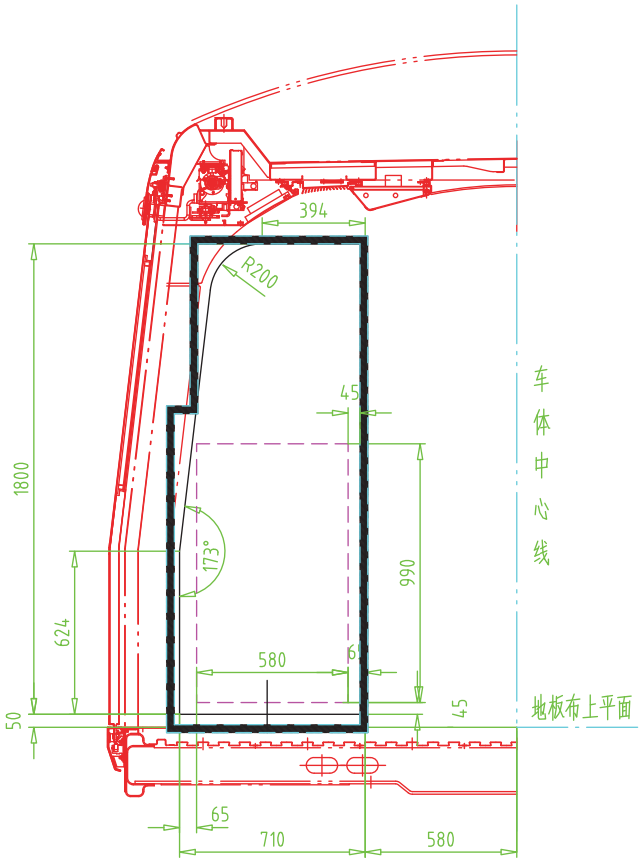


E



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主管设计师	日期	接口经理	日期	处理意见：					

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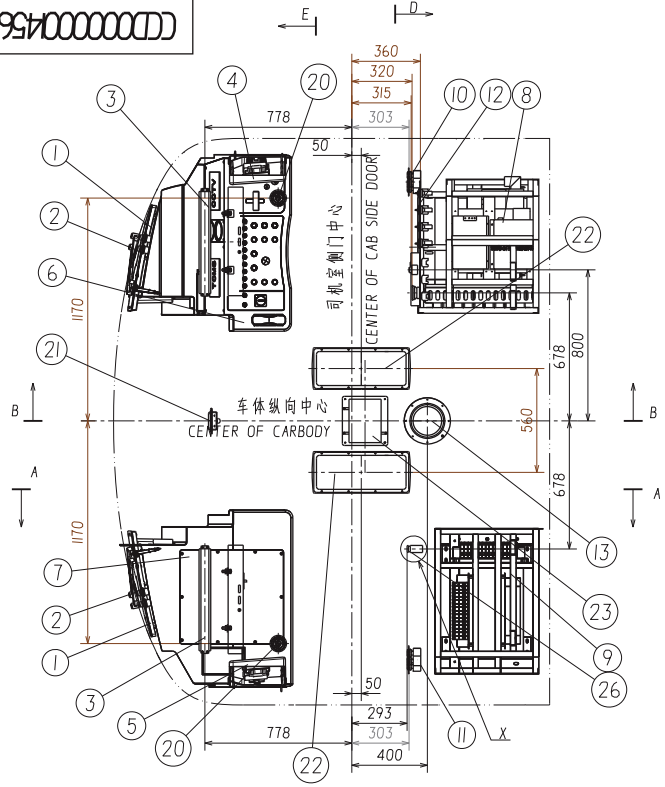

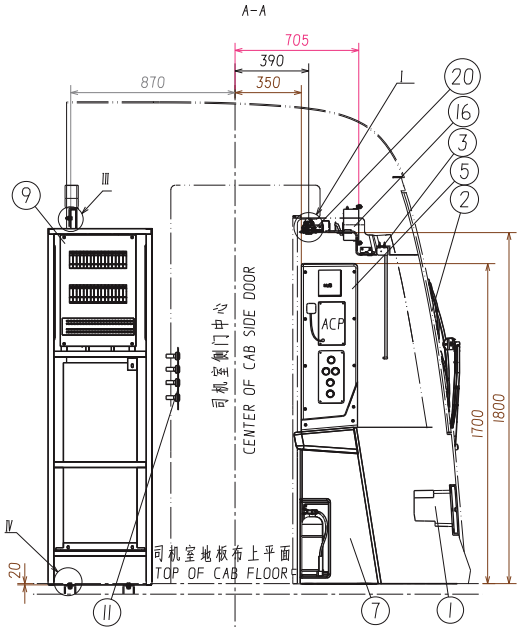

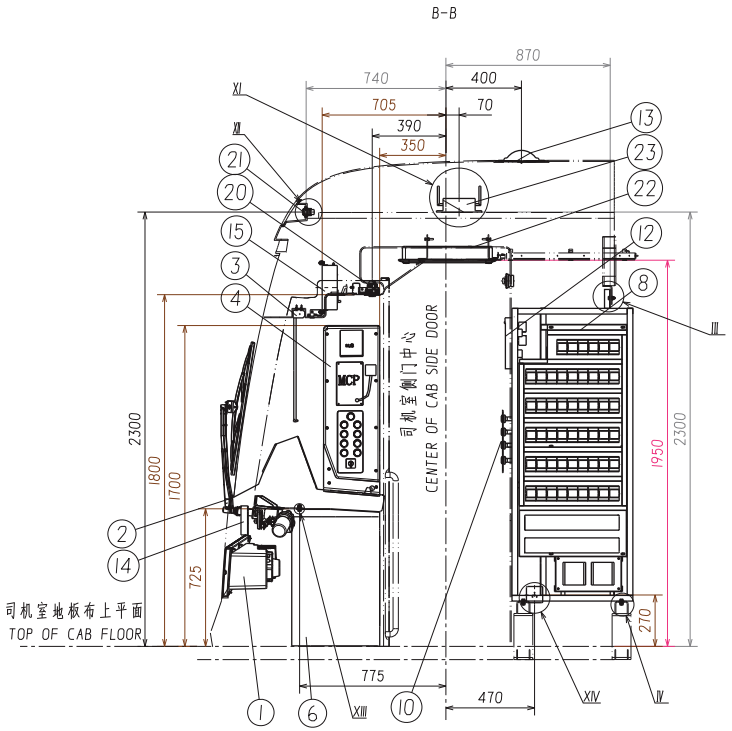

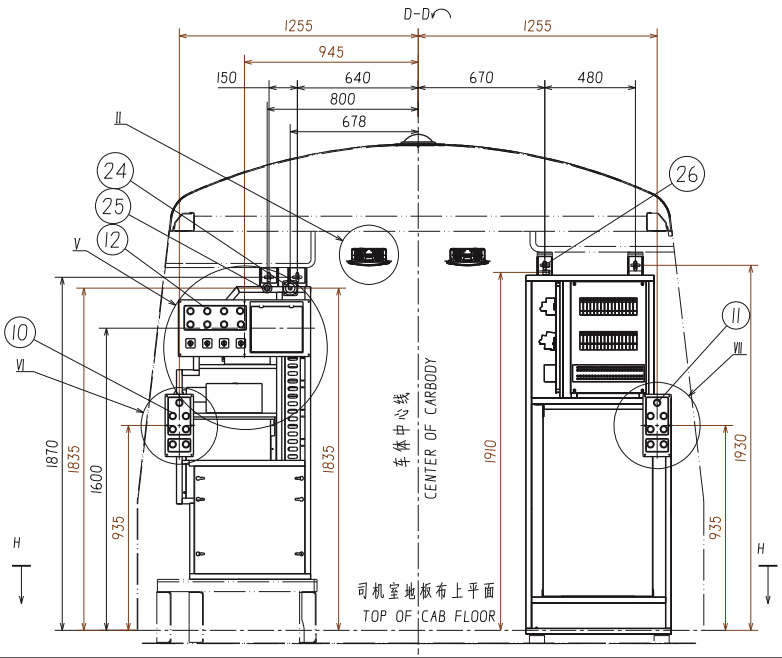

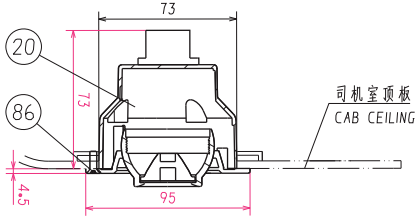

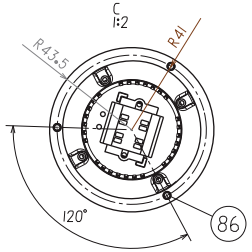

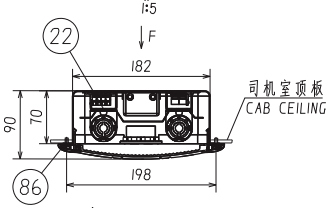

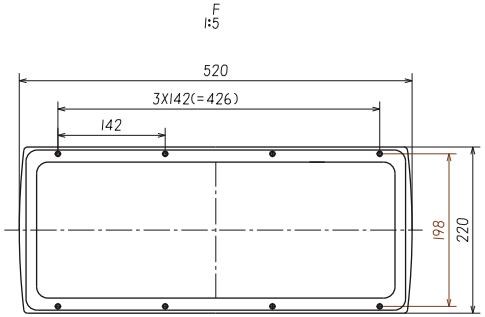

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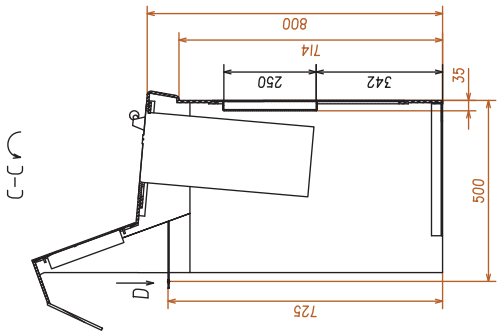
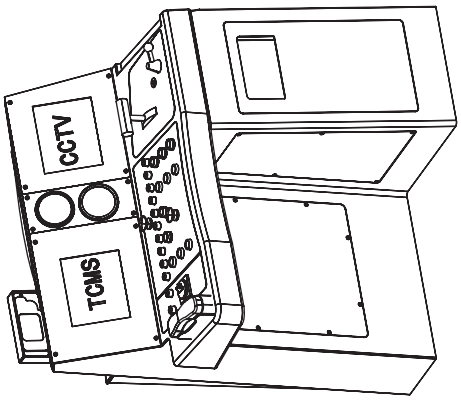
设计		焊接工程师		版本 REV	重量 WEIGHT	比例 SCALE	图幅 MAPSHEET	司机室电气安装 CAB ELECTRICAL ASSEMBLY
审核		相关工艺1			939.279	1:20	A2	
区域审核		相关工艺2						CCD00000014560
主管		审批				页次 PAGE		303845
		批准				1/4		
工艺		绘图软件 CATIA V5						

Detailed Interface Design Specification for Automatic Train Control

Appendix 3





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主司机台
MAIN CONSOLE

CCD000000015726

306432

设 计	焊接工程师	版本 REV	重 量 WEIGHT	比 例 SCALE	图幅 MAPSHEET
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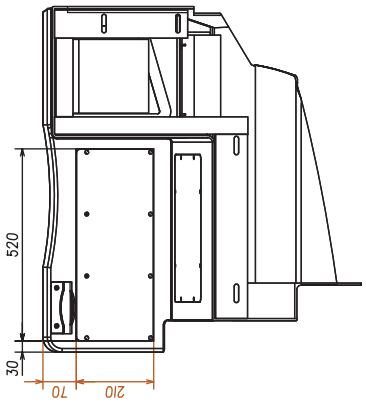

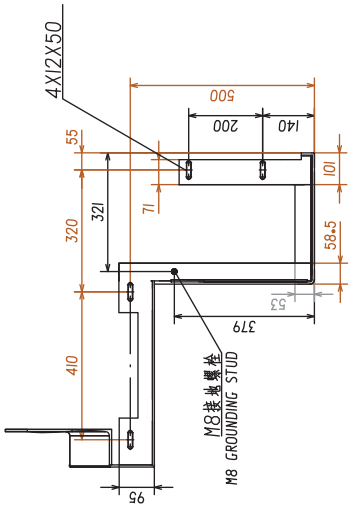

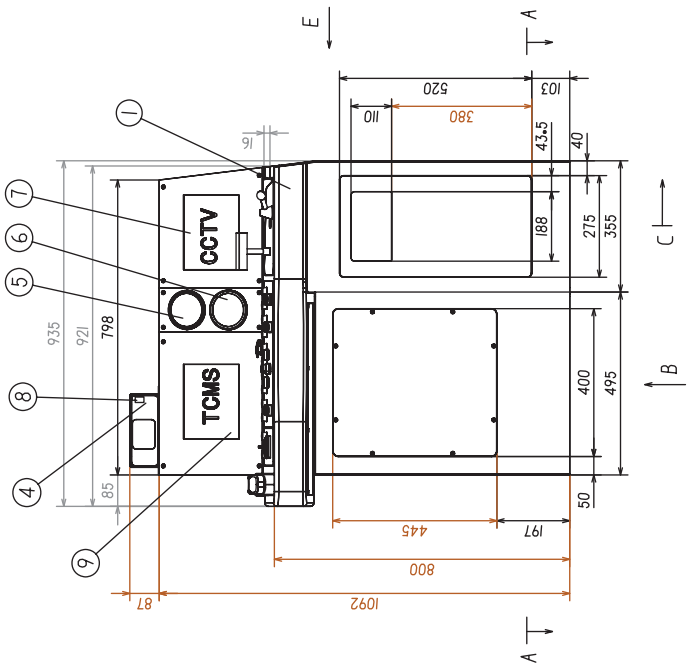

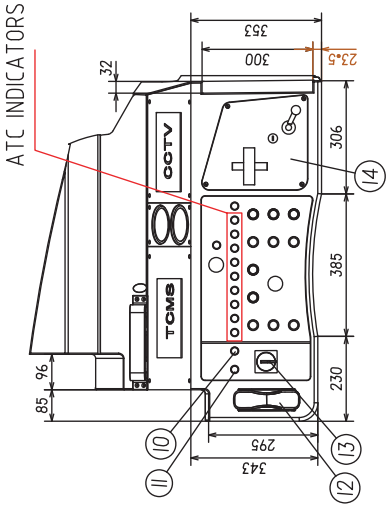

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	旧底图总号				

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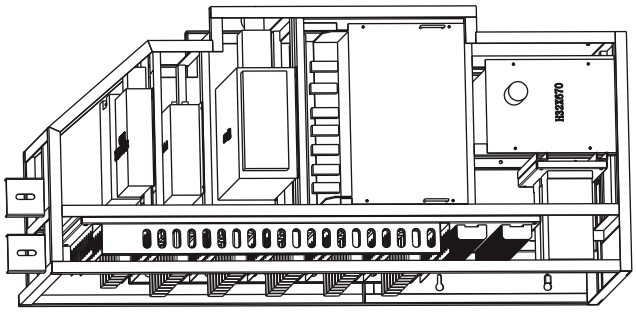
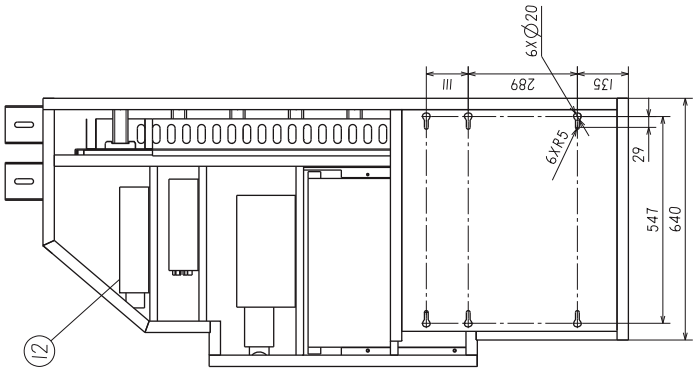
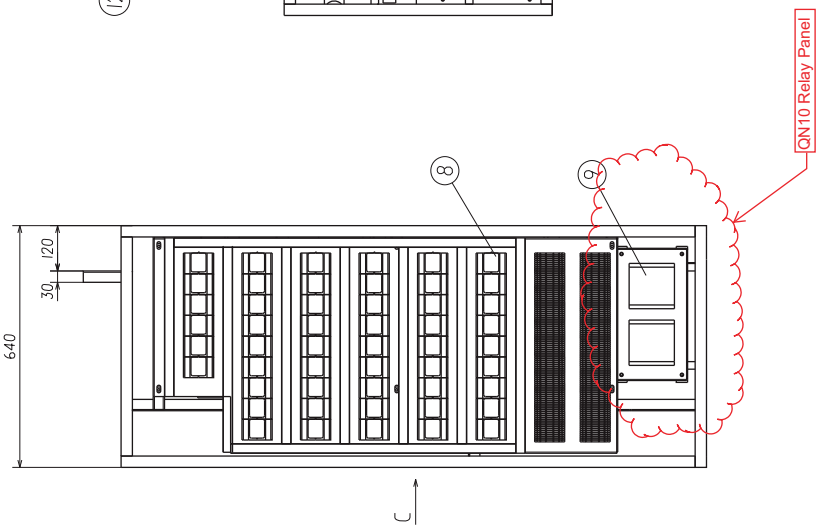
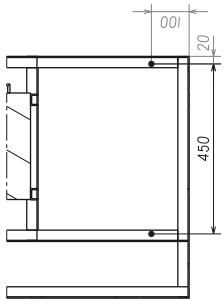
DETAILED INTERFACE SPECIFICATION

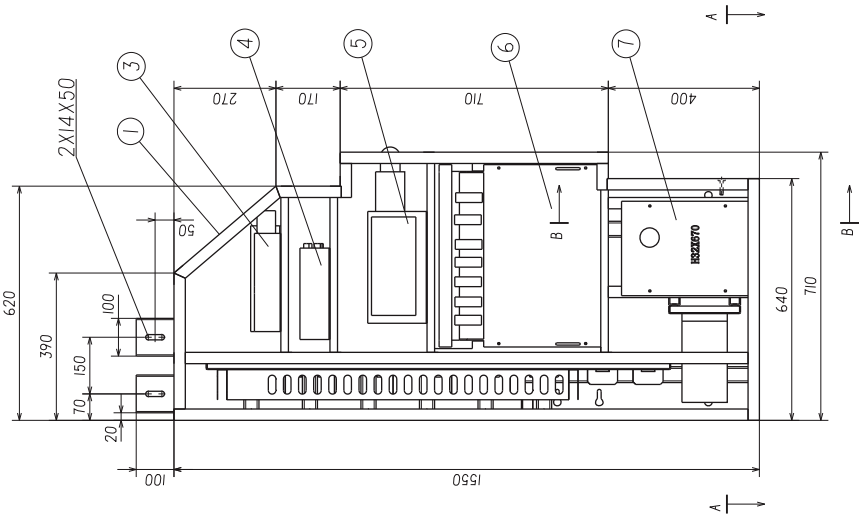
ANNEX B3
ATC RACK INSTALLATION

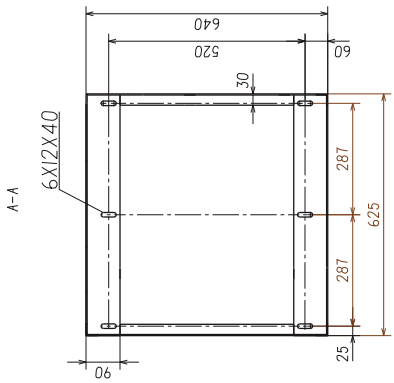












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区域审核			相关主管
主 管	周 勇	20D-3-20	审 批
工 艺	赵锋林	20D-4-30	绘图软件 CATIA V5

版本 REV	更改文件编号 MODIFIED DOC NO	日 期 DATE	签 名 SIGN

版本 REV	更改文件编号 MODIFIED DOC NO	日 期 DATE	签 名 SIGN

综合电气柜
INTEGRATED ELECTRICAL CUBICLE

CCDDOOOOOOO18633

306429

版本 REV	重 量 WEIGHT	比 例 SCALE	图幅 MAPSHEET
A	175.6	1:10	A2

页 次 PAGE 1/2

供	单位	数量
	旧底图总号	
底图总号		
字		
期		

技术要求

1、颜色见本车油漆技术条件。
2、明细表中所有设备要组成一体后整体供货。
3、件号17为接地栓，不要喷漆，保证有良好的接触面。

NOTES

1. THE COLOR SHALL COMPLY WITH THE PAINTING TECHNICAL REQUIREMENT.
2. ALL THE EQUIPMENTS IN THE LIST SHALL BE SUPPLIED AFTER BEING ASSEMBLED AS A WHOLE.
3. ITEM 17 IS GROUNDING STUD.DON'T PAINT IT TO MAKE SURE IT HAS GOOD TOUCH SURFACE.

序号 ITEM	物料码 PARTCODENUMBER	图文档码 DOC NUMBER	物料名称 DESCRIPTION	数量 QTY	材料 MATERIAL	单重 WEIGHT	附注 REMARKS
20	305644		电缆(骨连接器)PMU-102 CABLEWITH CONNECTOR	10M		1.08	用户提供 SUPPLIED BY CUSTOMER
19							
18							
17							
16	305764		PWM插针6412 16.31 PIN	30		0.001	三菱 MELCO
15	302138		PWM连接器MS05CW-24-31PN PWM CONNECTOR	1		0.01	三菱 MELCO
14							
13							
12	306695		24V直流电源模块 24VDC CONVERTER	1		3	柜体自带 SUPPLIED WITH CUBICLE
11							
10							
9	295018		ATC QN10继电器屏 ATC QN10 RELAY PANEL	1		10	用户提供 SUPPLIED BY CUSTOMER
8	295020		ATC继电器 ATC RELAY	4		0.04	用户提供 SUPPLIED BY CUSTOMER
7	295016		PWM产生器 PWM GENERATOR	1		8	三菱 MELCO
6	295014		TMS主控单元 CU	1		17	三菱 MELCO
5	295017		自动门控器 ATDC	1		13	用户提供 SUPPLIED BY CUSTOMER
4	295034		无线系统主机 TRAIN HOST UNIT	1		6	中电 CLPE
3	295015		TMS显示控制器 DC	1		2.6	三菱 MELCO
2							
1	295010		柜体组成 CUBICLE BRACKET	1		105	柜体自带 SUPPLIED WITH CUBICLE

序号 ITEM	物料码 PARTCODENUMBER	图文档码 DOC NUMBER	物料名称 DESCRIPTION	数量 QTY	材料 MATERIAL	单重 WEIGHT	附注 REMARKS

版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN

设计	王莉	2010-3-19	焊接工程师				
审核	付春风	2010-3-20	相关工艺1				
区域审核			相关工艺2				
主管	周勇	2010-3-20	审批				
			批准				
工艺	赵锡林	2010-4-30	绘图软件 CATIA V5				

版本 REV	重量 WEIGHT	比例 SCALE	图幅 MAPSHEET
A	175.6	1:10	A2

页次 PAGE 2/2

综合电气柜
INTEGRATED CUBICLE

CCD00000018633

306429

数	
协供	
单位	数量
旧底图总号	
底图总号	
字	
日期	

修改标记	处数	签名	日期

编号：DK108-44-0012

B侧电气柜：

1）C向开如图所示的两体检查门，上部为折页门，折页靠近侧墙。下部为可摘卸的检查门。

2）D向开如图所示的两体检查门，上部与下部均为折页门，折页在靠近间壁门侧。

3）E向开如图所示的折页门，折页在靠近车体中心侧。折页门能打开130度。

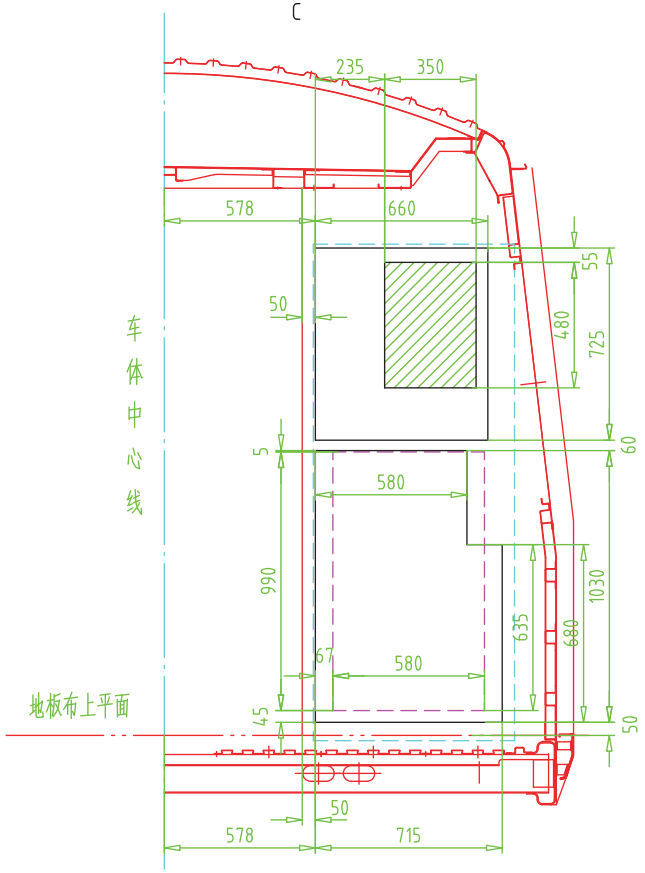
ATC 主机

ATC 框架

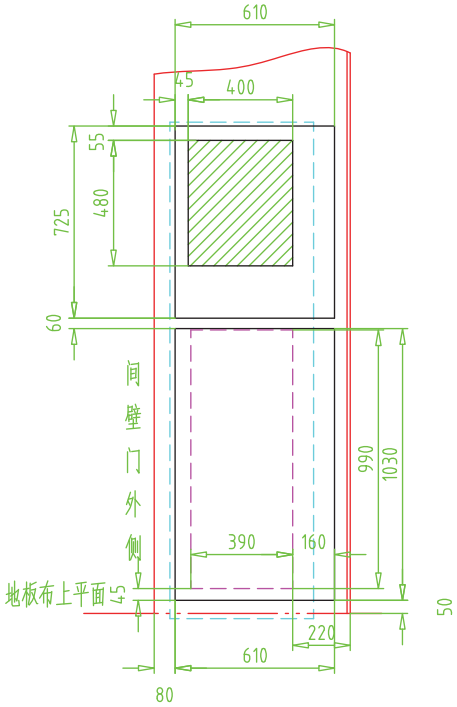
检查门边缘

车体及内装

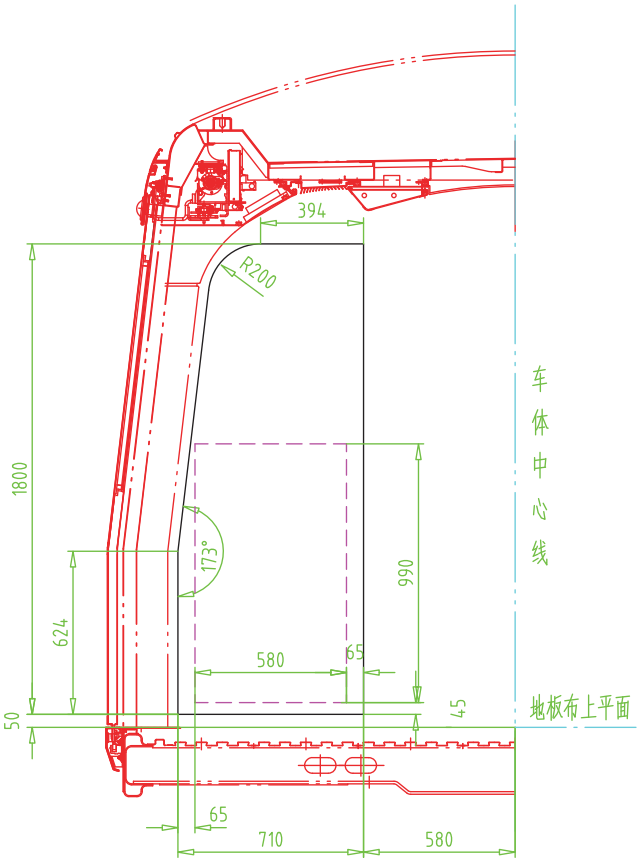
C



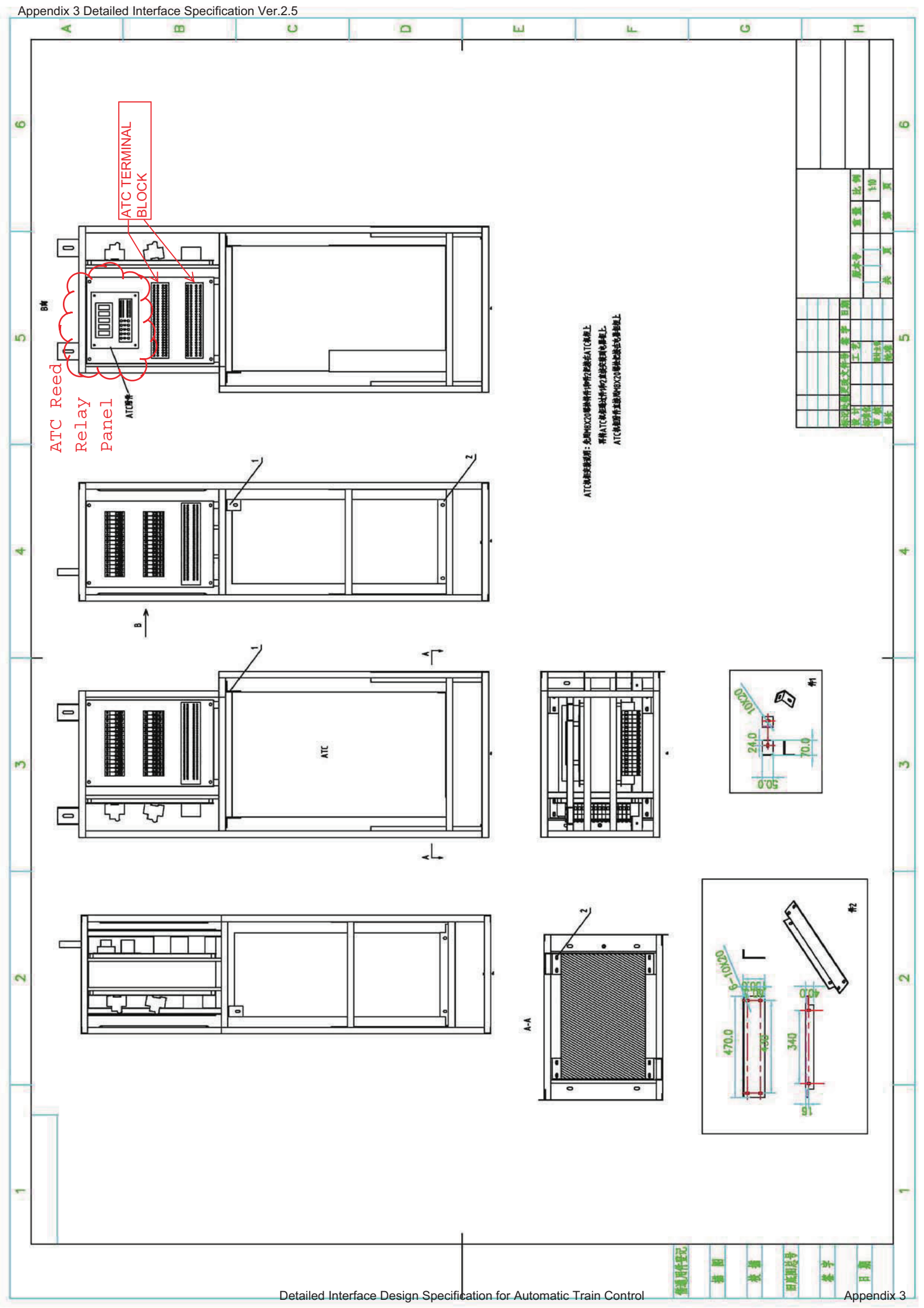
D



E

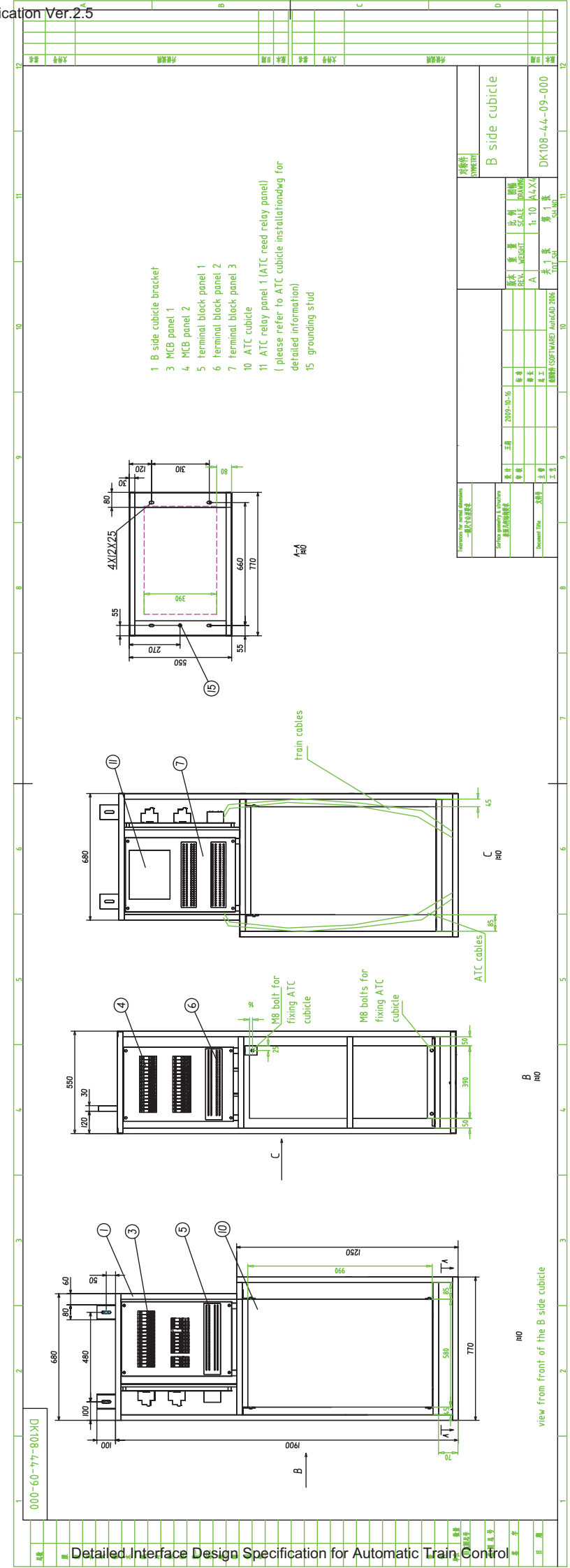


提供者	日期	资料审核	日期	接收负责者	日期	接收处理者	日期		签收
王莉	10.01.28								
主管设计师	日期	接口经理	日期	处理意见：					


ATC TERMINAL BLOCK
ATC Reed Relay Panel
ATC
A-A
B
A
1
2

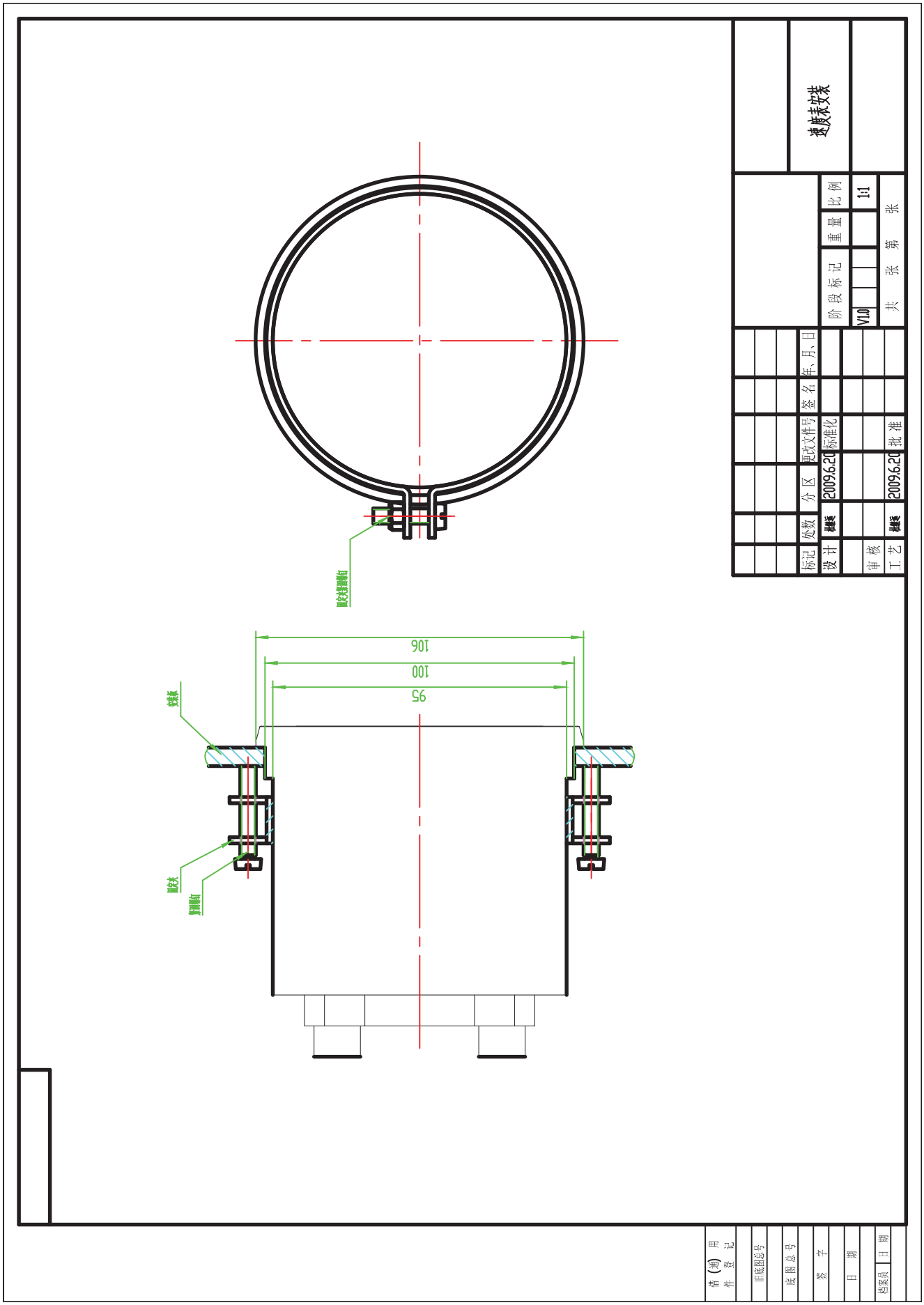
DETAILED INTERFACE SPECIFICATION

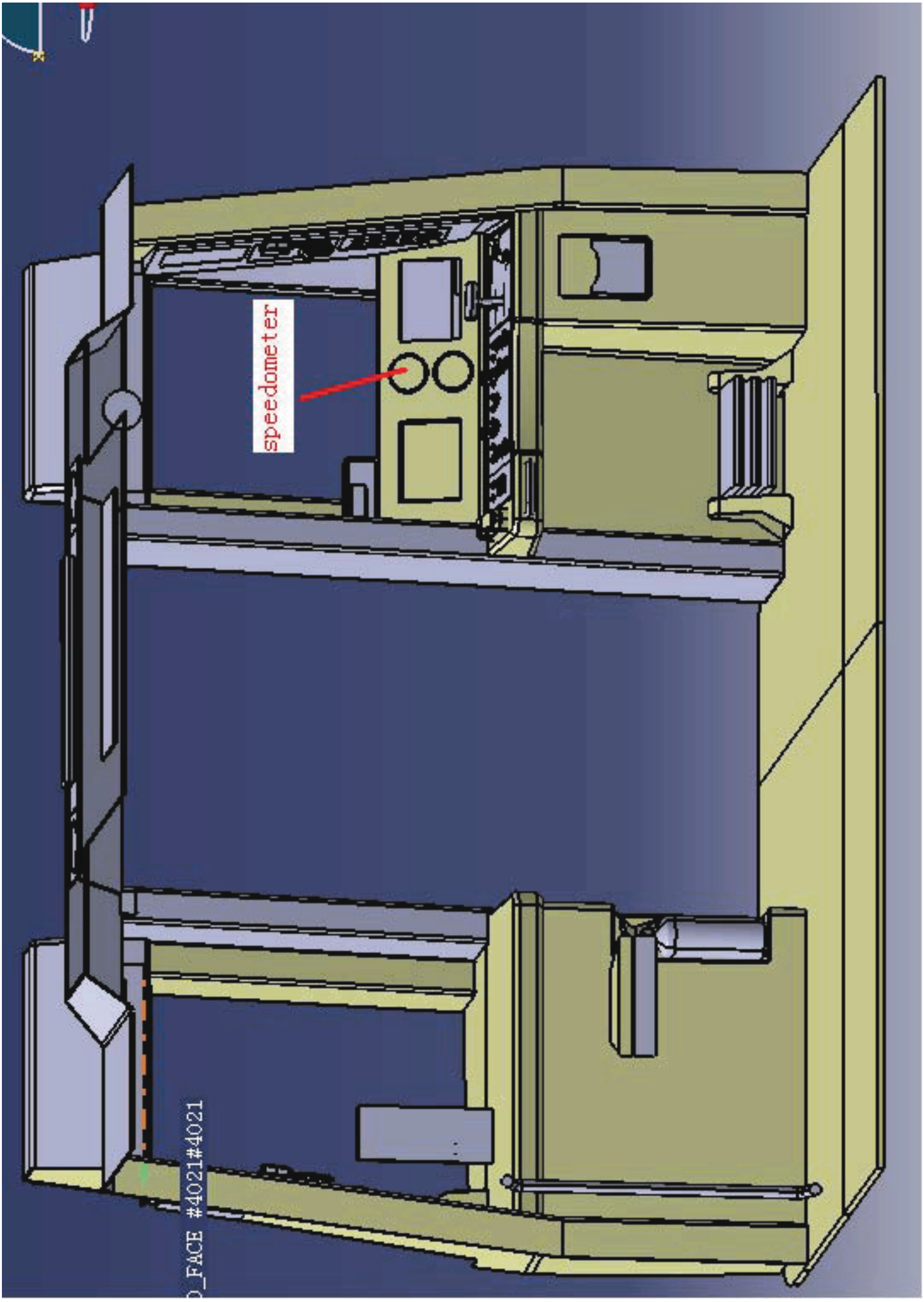
ANNEX B4
ATC RACK CABLING


B side cubicle
DK108-44-09-000
1 B side cubicle bracket
3 MCB panel 1
4 MCB panel 2
5 terminal block panel 1
6 terminal block panel 2
7 terminal block panel 3
10 ATC cubicle
11 ATC relay panel 1 (ATC reed relay panel)
(please refer to ATC cubicle installationdwg for detailed information)
15 grounding stud
4X12X25
train cables
ATC cables
M8 bolt for fixing ATC cubicle
M8 bolt's for fixing ATC cubicle
view from front of the B side cubicle

DETAILED INTERFACE SPECIFICATION

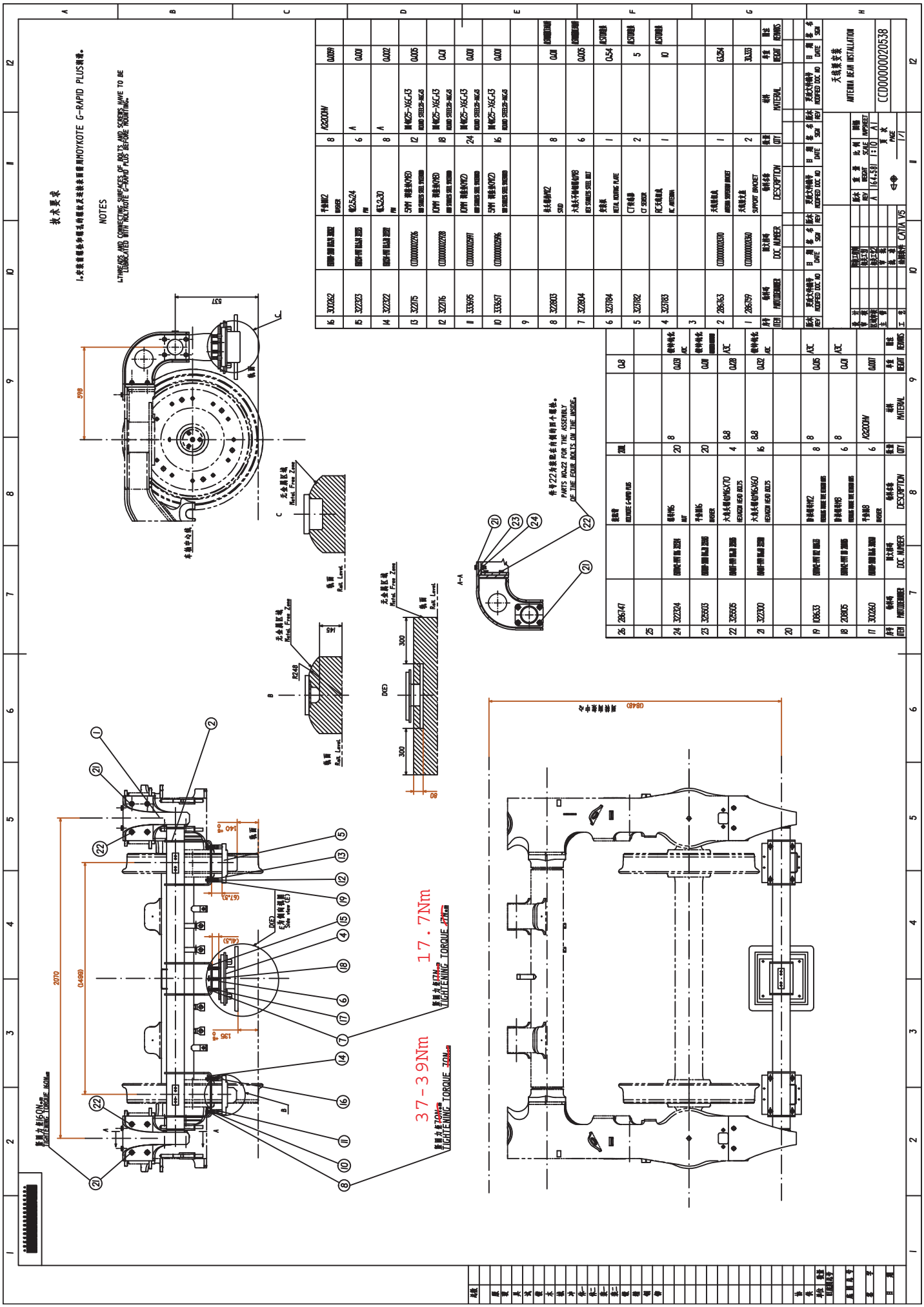
ANNEX B5
SPEEDOMETER INSTALLATION

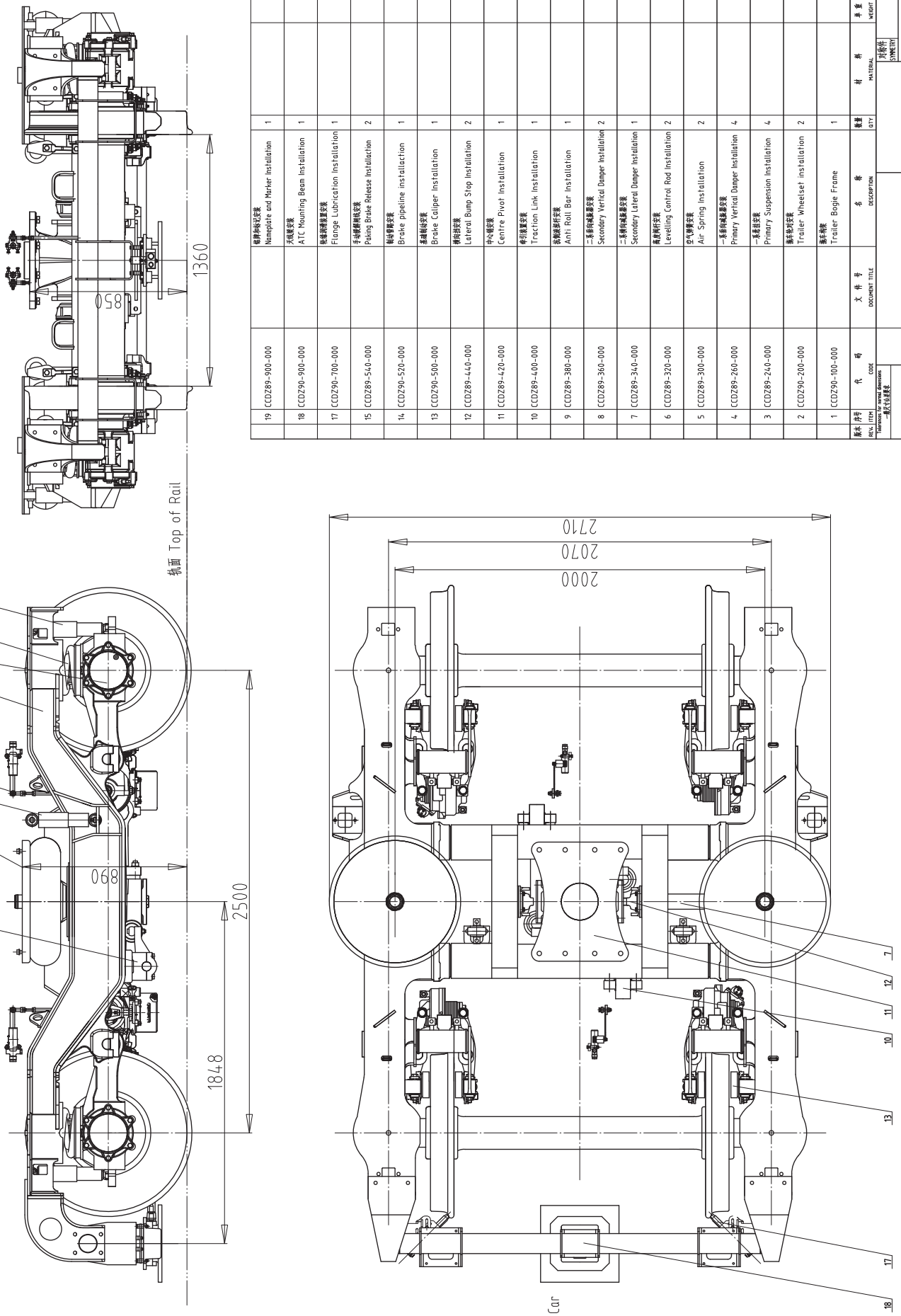

速度传感安装
比例 1:1
重量
阶段标记 V1.0
共 张 第 张
标记 处数 分区 更改文件号 签名 年、月、日
设计 2009.6.20 标准化 批准
审核 2009.6.20
工艺
106
100
95


speedometer
D_FACE #4021#4021

DETAILED INTERFACE SPECIFICATION

ANNEX B6
ANTENNA BEAM ARRANGEMENT


技术要求
1.螺纹连接表面和螺栓螺钉表面涂MOLYKOTE G-RAPID PLUS润滑。
NOTES
1.THREADS AND CONNECTING SURFACES OF BOLTS AND SCREWS HAVE TO BE LUBRICATED WITH MOLYKOTE G-RAPID PLUS BEFORE MOUNTING.
天线安装
ANTENNA BEAM INSTALLATION
CCD0000000020538
17.7Nm
37-39Nm
Metal Free Zone
Rail Level
Side view (E)
PARTS NO.22 FOR THE ASSEMBLY OF THE FOUR BOLTS ON THE INSIDE.



序号 ITEM	代号 CODE	文件号 DOCUMENT TITLE	名称 DESCRIPTION	数量 QTY	材料 MATERIAL	单重 WEIGHT	附注 REMARK
19	CCDZ89-900-000		铭牌和标记安装 Nameplate and Marker Installation	1			
18	CCDZ90-900-000		天线支架 ATC Mounting Beam Installation	1			
17	CCDZ90-700-000		轮缘润滑装置安装 Flange Lubrication Installation	1			
15	CCDZ89-540-000		手制缓解阀组安装 Pulling Brake Release Installation	2			
14	CCDZ90-520-000		制动管路安装 Brake pipeline installation	1			
13	CCDZ90-500-000		基础制动安装 Brake Caliper Installation	1			
12	CCDZ89-440-000		横向挡安装 Lateral Bump Stop Installation	2			
11	CCDZ89-420-000		中心销安装 Centre Pivot Installation	1			
10	CCDZ89-400-000		牵引拉杆安装 Traction Link Installation	1			
9	CCDZ89-380-000		抗侧滚扭杆安装 Anti Roll Bar Installation	1			
8	CCDZ89-360-000		二系垂向减振器安装 Secondary Vertical Damper Installation	2			
7	CCDZ89-340-000		二系横向减振器安装 Secondary Lateral Damper Installation	1			
6	CCDZ89-320-000		高度调整杆安装 Levelling Control Rod Installation	2			
5	CCDZ89-300-000		空气弹簧安装 Air Spring Installation	2			
4	CCDZ89-260-000		一系垂向减振器安装 Primary Vertical Damper Installation	4			
3	CCDZ89-240-000		一系悬挂安装 Primary Suspension Installation	4			
2	CCDZ90-200-000		拖车轮对安装 Trailer Wheelset installation	2			
1	CCDZ90-100-000		拖车构架 Trailer Bogie Frame	1			

Surface geometry & structure 表面几何结构要求

Tolerances for normal dimensions 一般尺寸公差要求

设计		2009-12-24	
审核			
标准			
审定			
批准			
主管			
工艺			

软件版本 SOFTWARE AutoCAD 2006

Document Title 文件名

版本 REVs	重量 WEIGHT	比例 SCALE	图幅 DRAWING
V6	6300	1:10	A1

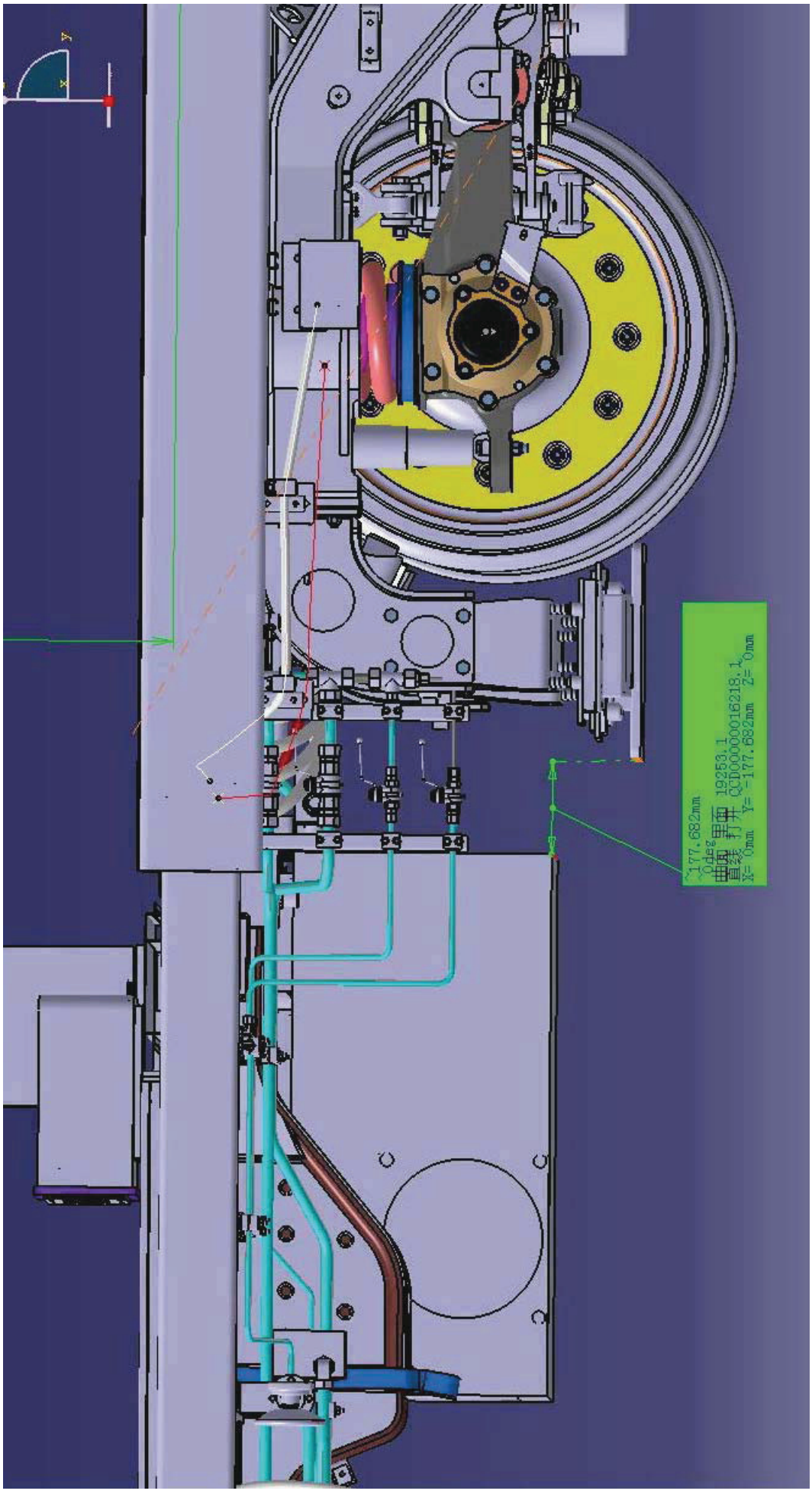
共 1 张 TOT SHT 第 1 张 SH NO

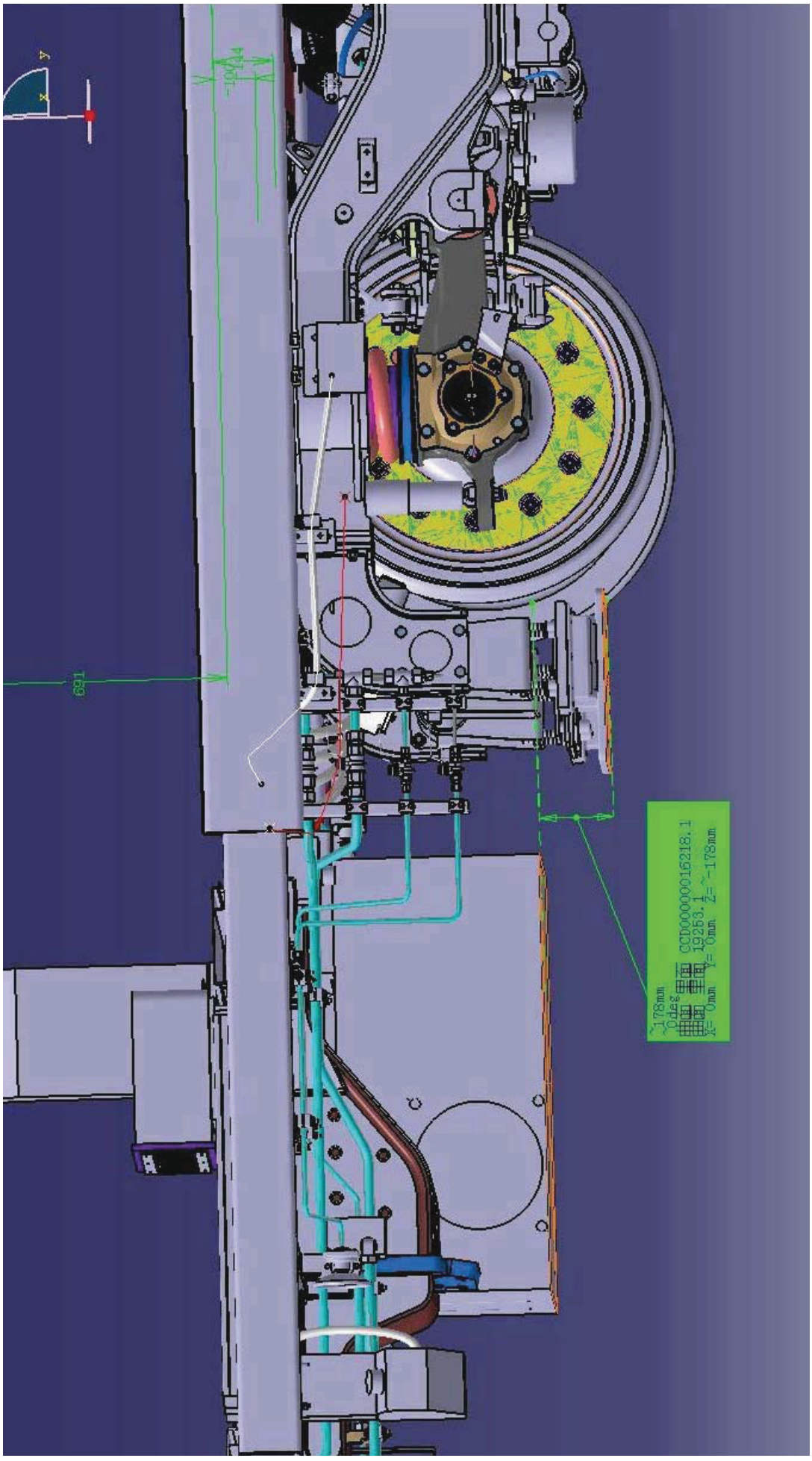
对称件 SYMMETRY

拖车转向架 Trailer Bogie

CCDZ90-000-000

CCDZ90-000-000


177.682mm
0deg
19253.1
X= 0mm Y= -177.682mm Z= 0mm


Y
X
~178mm
0deg
CCD0000016218.1
19268.1
X= 0mm Y= 0mm Z= ~-178mm

CCD000000021370

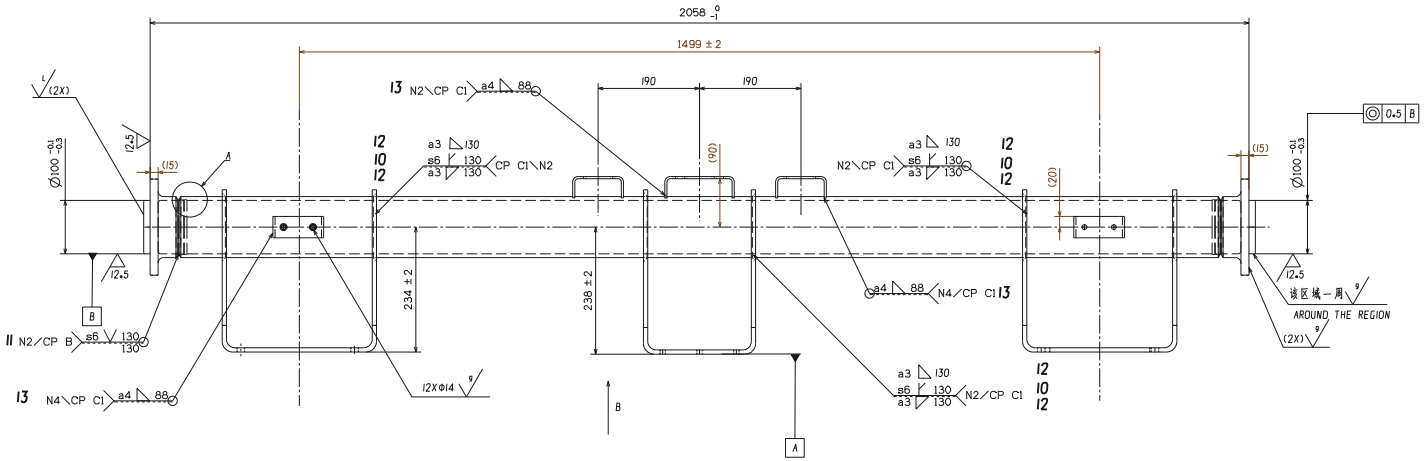
其余 OTHERS

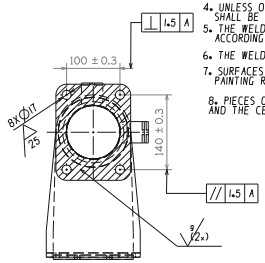
技术要求

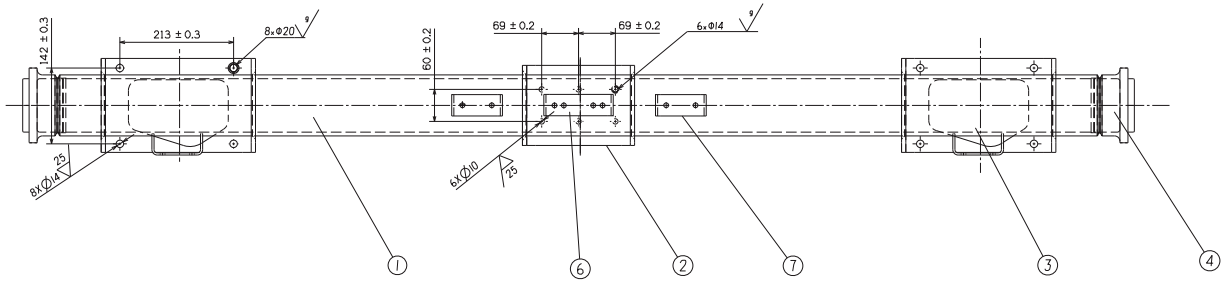
1. 企业认证等级执行 EN15085-2 中的 CLI 级。
2. 除特殊规定外，焊缝质量等级执行 EN15085-3 中的 CP CI 级。
3. 除特殊规定外，焊缝检验等级执行 EN15085-3中的 CT2 级。
4. 除特殊规定外，焊接公差执行 ISO 13920 中的 BF 级。
5. 焊缝缺陷等级执行ISO 5817:2003的B级。
6. 除特殊规定外，焊缝进行100%磁粉探伤。
7. 焊接后零件表面涂底漆及面漆，涂漆要求见CCD000000019272.JT。
8. 件号4处允许有中心孔存在，且中心孔应按照GB/T145-2001B型加工。

NOTES

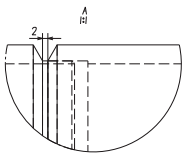
1. THE MANUFATURER'S QUALIFIED LEVEL SHALL BE EN15085-2 CLI.
2. UNLESS OTHERWISE STATED, THE WELD QUALITY LEVEL SHALL BE EN15085-3 CP CI.
3. UNLESS OTHERWISE STATED,THE WELD INSPECTION LEVEL SHALL BE EN15085-3 CT2.
4. UNLESS OTHERWISE STATED,THE WELD TOLERENCE SHALL BE ISO 13920 BF.
5. THE WELDING IMPERFECTION CLASS SHALL BE ACCORDING TO ISO 5817:2003,CLASS B.
6. THE WELD SHALL BE 100% MT, UNLESS OTHERWISE STATED.
7. SURFACES TO BE PAINTED WITH PRIMER AND TOP COAT. PAINTING REQUIREMENTS SEE CCD000000019272.JT.
8. PIECES OF NO.4 CENTER HOLE ALLOWS THE EXISTENCE , AND THE CENTER HOLE SHOULD BE IN ACCORDANCE WITH GB/T145-2001B .

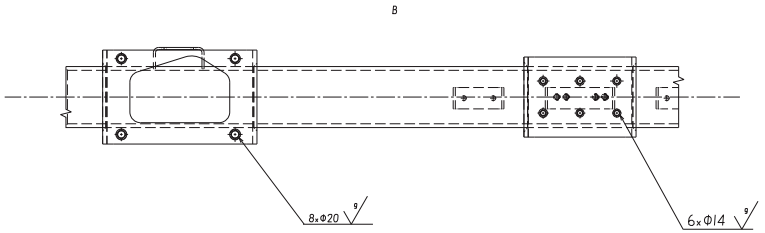






车辆端部
END OF CAR





序号 ITEM	物料号 PARTCODENUMBER	图文档号 DOC NUMBER	物料名称 DESCRIPTION	数量 QTY	材料 MATERIAL	单重 WEIGHT	附注 REMARKS
13	36487		角焊缝a4CP CI FILLET WELD a4	IM	钢	0.1256	
12	36478		角焊缝a3CP CI FILLET WELD a3	IM	钢	0.0707	
11	36738		Y型对接焊缝s6CP B Y BUTT WELD s6	IM	钢	0.1632	
10	36795		单侧Y型对接焊缝s7CP CI SINGLE-Y BUTT WELD s7	IM	钢	0.3331	
9							
8							
7	324280	CCD000000023939	线缆卡座 CABLE BRACKET	4	钢板4-S355J2W+N STEEL PLATE4-S355J2W+N	0.197	
6	324395	CCD000000023979	线缆卡座 CABLE BRACKET	1	钢板4-S355J2W+N STEEL PLATE4-S355J2W+N	0.237	
5							
4	309126	CCD000000021369	连接座 BRACKET	2	S355J2+N S355J2+N	4.188	
3	309125	CCD000000021368	CT 传感器吊座 CT SENSOR BRACKET	2	钢板8-S355J2W+N STEEL PLATE8-S355J2W+N	5.98	
2	309124	CCD000000021367	RC 天线吊座 RC BRACKET	1	钢板8-S355J2W+N STEEL PLATE8-S355J2W+N	6.408	
1	309123	CCD000000021366	端梁钢管 TUBE FOR ATC BEAM	1	无缝钢114.3X7.1-S355J2H TUBE 114.3X7.1-S355J2H	4.654	

版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN

设计	张文康	2020-10-28	焊接工程师	于传颖	2021-3-30	版本 REV	重量 WEIGHT
审核	梁云	2020-10-28	相关工艺	尹立成	2021-3-30		
区域审核			相关工艺	程志义	2021-3-29	C	33.116
主管	薛世海	2020-10-28	审批				
			批准				
工艺	杨智勇	2020-11	绘图软件	CATIA V5			

比例 SCALE	图幅 MAPSHEET
1:5	A1

页次 PAGE
1/1

天线梁组成
ANTENNA SUSPENSION BRACKET

CCD000000021370

286763

总数 | 服 | 玻 | 具 | 试 | 镀 | 木 | 机 | 冲 | 体一 | 体二 | 装一 | 装二 | 锻 | 精 | 铜 | 铆

协 | 供 | 单位 | 数量 | 旧底图总号 | 底图总号 | 签字 | 日期

CCD00000045482

总数	
服	
玻	
具	
试	
镀	
木	
械	
冲	
体一	
体二	
装一	
装二	
锻	
精	
钢	
铆	
协	
供	
单位	数量
旧底图总号	
底图总号	
签字	
日期	

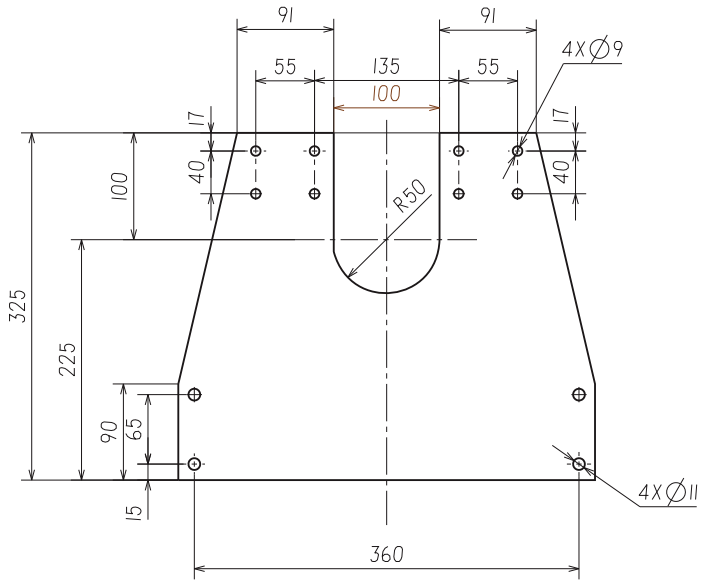
其余 50
OTHERS

技术要求

1.去除毛刺及锐楞。

NOTES

1.NO BUR AND SHARPNESS.



CT Mounting Bracket

版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN

设计	文永亮	2001-12-20	焊接工程师				
审核	米志宏	2001-12-20	相关工艺				
区域审核			标准审查				
主管			审批				
			批准				
工艺	王洋	2001-12-23	绘图软件	CATIA V5			

06Cr19Ni10
06Cr19Ni10

版本 REV	重量 WEIGHT	比例 SCALE	图幅 MAPSHEET
A	1.722	1:5	A3

页次 PAGE 1/1

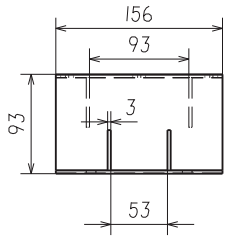
ATC电缆固定座
FIX BRACKET

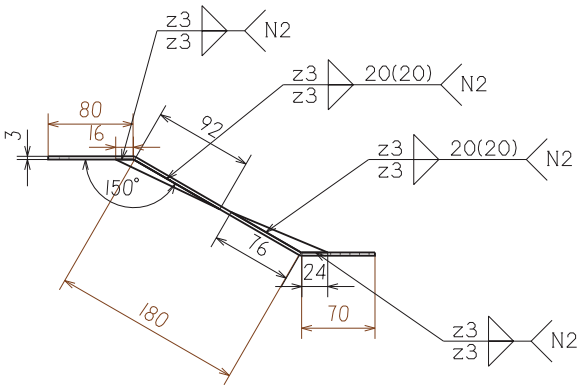
CCD00000045482

386405

CCD00000045483

总数	
服	
玻	
具	
试	
镀	
木	
械	
冲	
体一	
体二	
装一	
装二	
锻	
精	
钢	
铆	
协	
供	
单位	数量
旧底图总号	
底图总号	
签字	
日期	





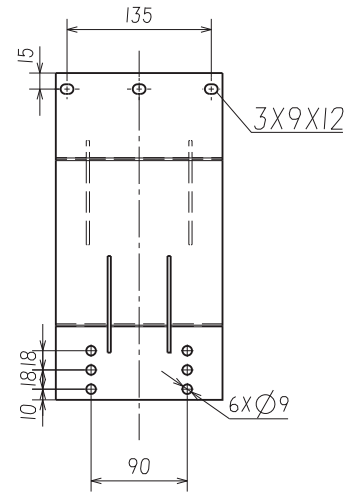
其余 50
OTHERS

技术要求

1.去除毛刺及锐楞。

NOTES

1.NO BUR AND SHARPNESS.



RC Mounting Bracket

版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN

设计	文永亮	2010-12-23	焊接工程师				
审核	米志宏	2010-12-23	相关工艺				
区域审核			标准审查				
主管			审批				
			批准				
工艺	王洋	2010-12-23	绘图软件	CATIA V5			

06Cr18Ni10
06Cr18Ni10

版本 REV	重量 WEIGHT	比例 SCALE	图幅 MAPSHEET
A	1.34	1:5	A3

页次 PAGE 1/1

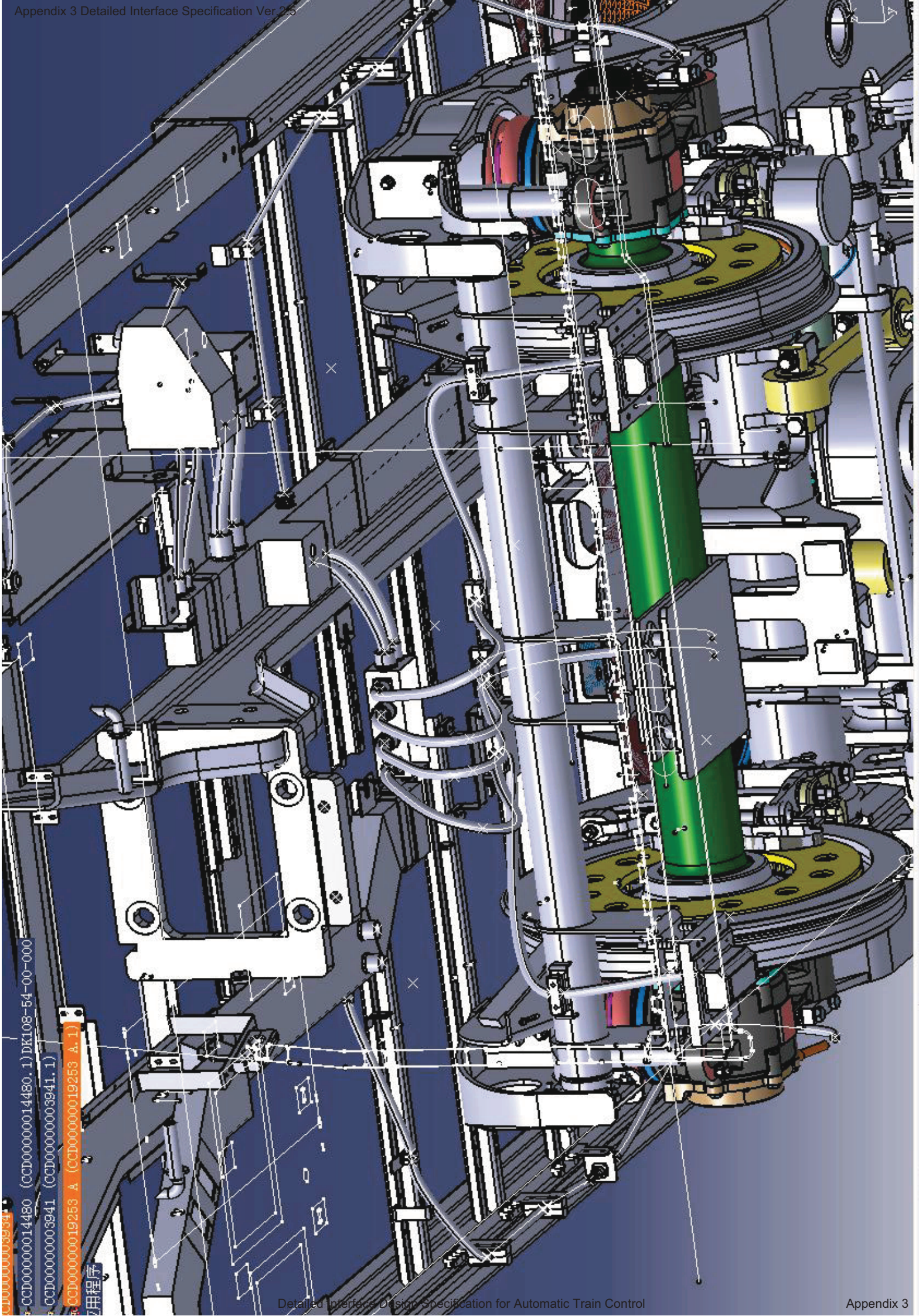
ATC电缆固定座
FIX BRACKET

CCD00000045483

386406

DETAILED INTERFACE SPECIFICATION

ANNEX B7
BOGIE CABLE ARRANGEMENT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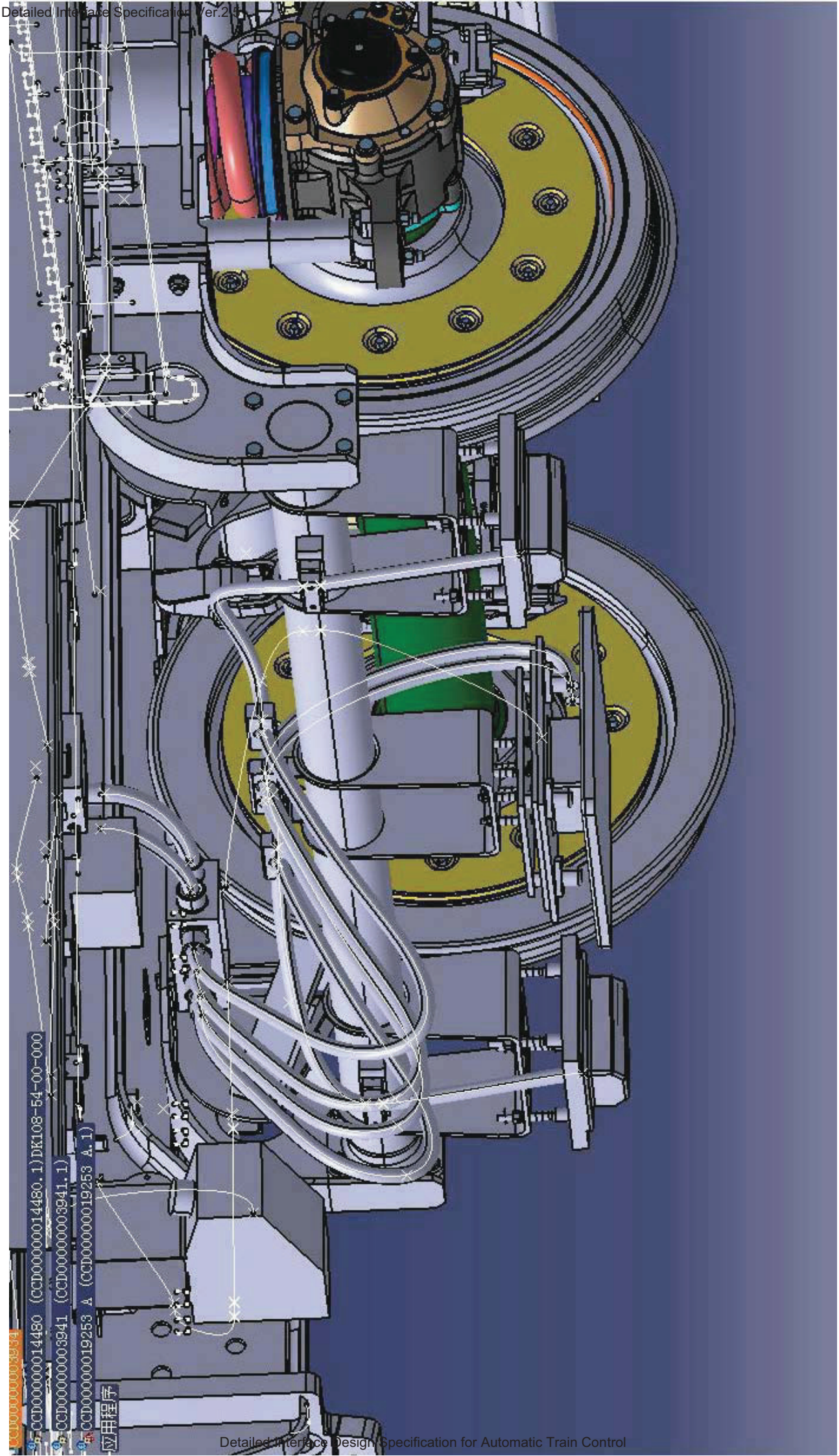
CCD000000003941 (CCD000000003941.1)
CCD000000019253 A (CCD000000019253 A.1)
应用程序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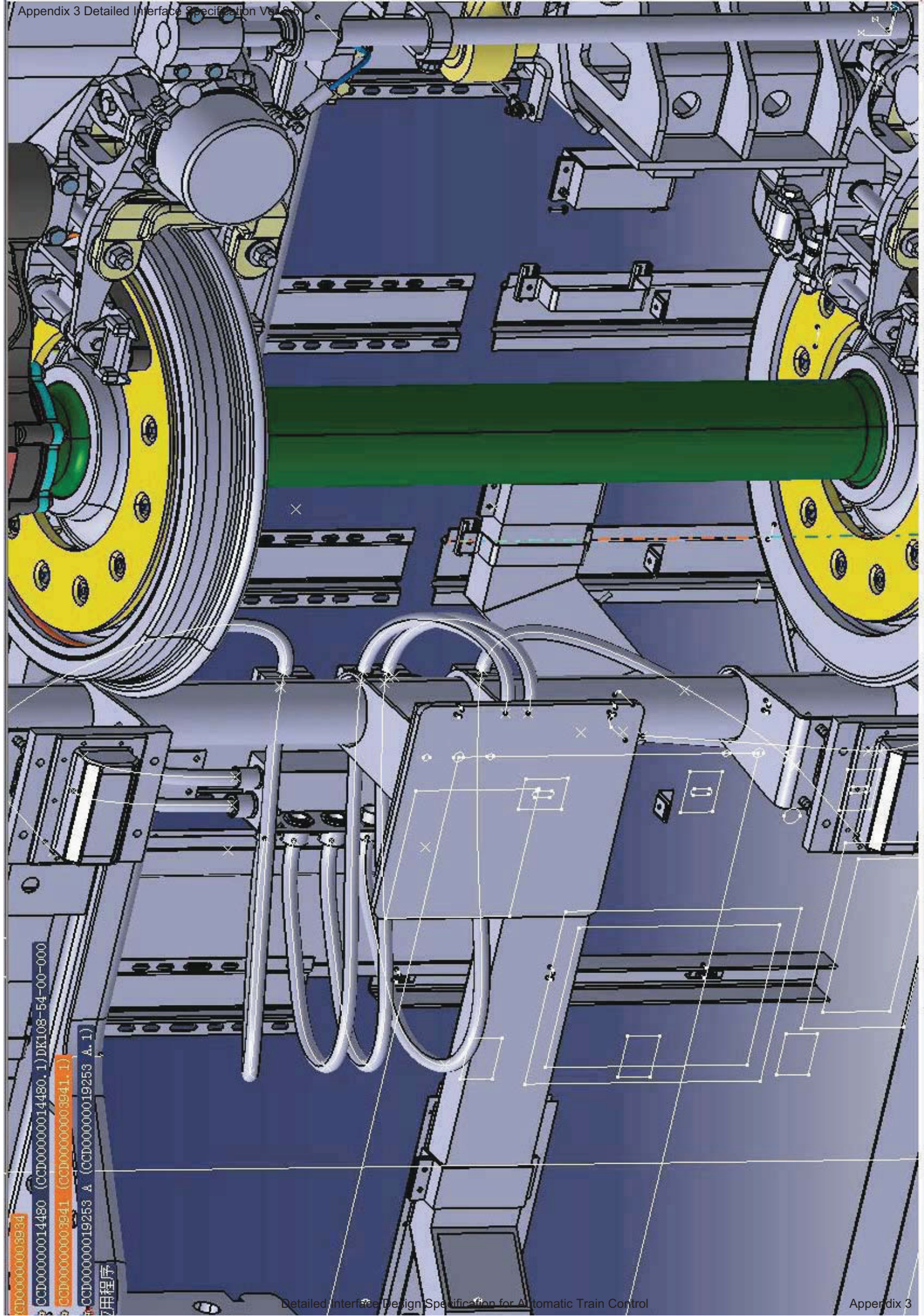
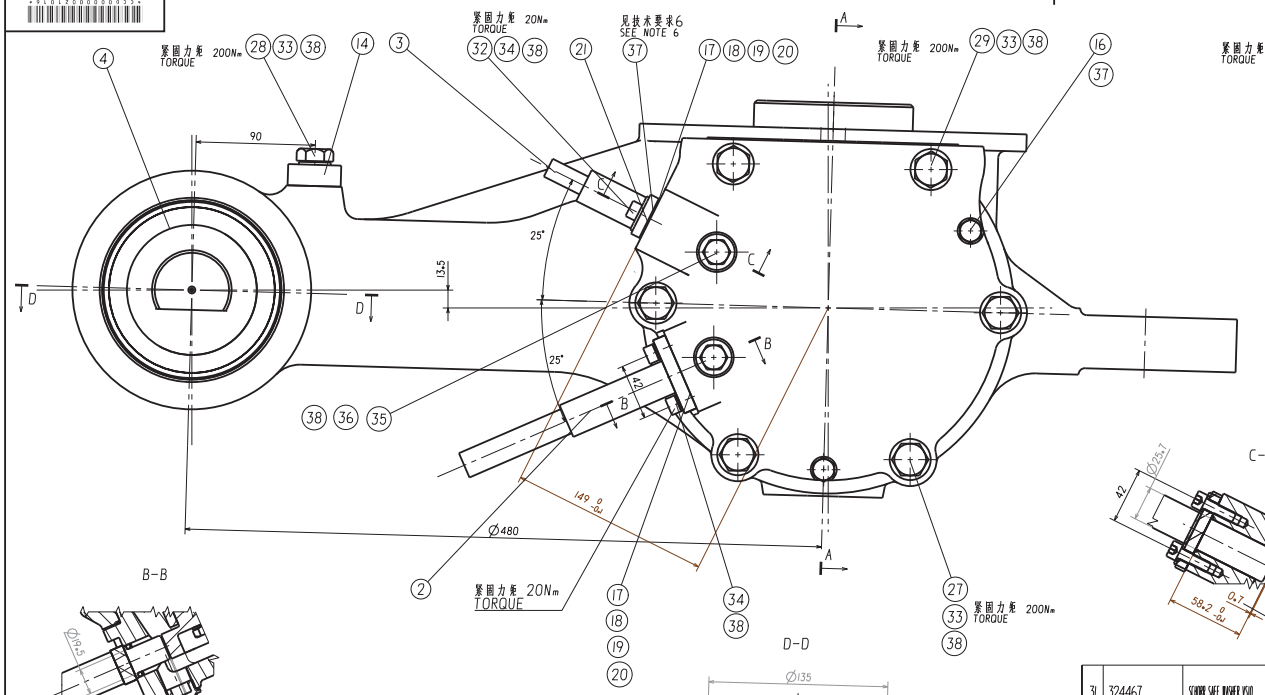
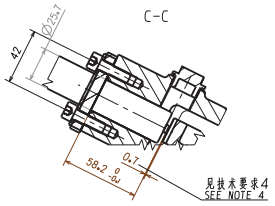
应用程序

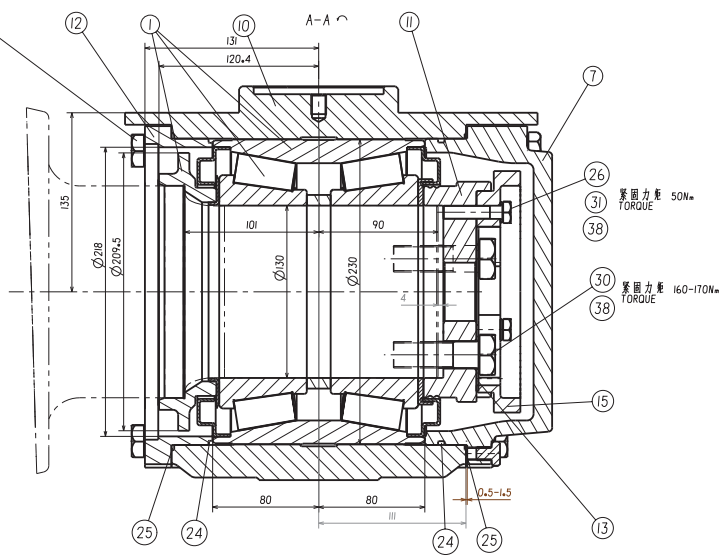

CCD0000003934
CCD0000014480 (CCD0000014480.1)DK108-54-00-000
CCD0000003941 (CCD0000003941.1)
CCD0000019253 A (CCD0000019253 A.1)
应用程序

DETAILED INTERFACE SPECIFICATION

ANNEX B8
ODOMETER INSTALLATION







技术要求

1 按照SKF轴承组装及拆卸指导书对轴承进行组装及维护。
2 在组装件号16前，在周边涂抹密封胶(件号37)。
3 在调整测速齿轮外径与防滑传感器之间的间隙时，需要对测速齿轮进行三点测量（每点之间相距120°），保证三次测量的间隙平均值公差在±0.1范围内，最大值公差在±0.5范围内。
4 在调整测速齿轮外径与信号传感器之间的间隙时，需要对测速齿轮进行三点测量（每点之间相距120°），保证三次测量的间隙平均值公差在 0.1范围内，最大值公差在±0.3范围内。
5 安装前在螺栓和螺钉的螺纹及装配表面上涂抹润滑膏 MOLYKOTE G-RAPID PLUS(件号38)。
6 在信号传感器与测速齿轮之间的间隙调整好之后，在垫圈周边涂抹密封胶（件号37）。
7 本图纸所示为AWO载荷工况。
8 轴箱节点在与构架组装完成后，外露的金属表面进行防腐保护。
9 除特殊要求外，安装完成后所有外露底漆或者没有油漆的外露表面处须按照涂漆技术要求CCD000000019272.JT进行补漆。

NOTES:

1 BEARING INSTALLATION AND MAINTENANCE PROCEDURE IN ACCORDANCE WITH BEARING INTALLATION AND MAINTENANCE INSTRUCTION.
2 APPLY SILICONE SEALANT (ITEM 37) TO RIM OF PLUG, ITEM 16, PRIOR TO FITTING INTO FRONT END COVER.
3 MEASURE THE CLEARENCE BETWEEN ANTI-SKID SENSOR AND OUTER DIAM.OF SPEED WHEEL (THREE POINTS,EQUIANGLE 120°),MAKE SURE THE AVERAGE VALUE WITHIN ±0.1, THE MAXIMUM VALUE WITHIN ±0.5.
4 MEASURE THE CLEARENCE BETWEEN SPEED SENSOR AND OUTER DIAM.OF SPEED WHEEL(THREE POINTS,EQUIANGLE 120°),MAKE SURE THE AVERAGE VALUE WITHIN 0.1, THE MAXIMUM VALUE WITHIN ±0.3.
5 THREADS AND CONNECTING SURFACES OF BOLTS AND SCREWS HAVE TO BE LUBRICATED WITH MOLYKOTE G-RAPID PLUS (ITEM 38) BEFORE MOUNTING.
6 APPLY SILICONE SEALANT (ITEM 37) AROUND THE WASHERS AFTER THE CLEARENCE BETWEEN SPEED SENSOR AND OUTER DIAM. OF SPEED WHEEL IS SETTLEED DOWN.
7 THIS DRAWING SHOWS AWO CONDITION.
8 THE BLANK SURFACES OF AXLEBOX JOINT BUSH WILL BE PRETEDCTED AFTER FITTED INTO BOGIE.
9 AFTER ASSEMBLY ALL VISIBLE SURFACES WHICH ARE BLANK OR PRIMED MUST BE PAINTED ACC. TO PAINTING SPECIFICATION CCD000000019272.JT, UNLESS SATED.

序号 ITEM	物料号 PART/CODE/NUMBER	图文档号 DOC NUMBER	物料名称 DESCRIPTION	数量 QTY	材料 MATERIAL	单重 WEIGHT	附注 REMARKS
38	286747		装配膏 MOLYKOTE G-RAPID PLUS	IML		0.8	
37	322486		硅密封胶LOCTITE 5699 SILICON SEALANT	IML		0.8	
36	322296	DIN1463-2001 R22.27-Vr	密封垫A 22.27 SEALING RING	2	Vf	0.3	
35	313899	DIN934-1997-A M22X1.5	六角头螺母A-M22X1.5 Light duty hexagon head screw drop.	2	St	0.034	A3C
34	305976	SCHORR SAFE WASHER X58	防松垫圈B SAFETY WASHER	4		0.4	SCHORR垫圈
33	305980	SCHORR SAFE WASHER VS16	防松垫圈VS16 SAFETY WASHER	14	FSr	0.002	镀锌 ZINC PLATED
32	322719	ISO4762-2004 M8X25 12.9	内六角螺钉M8X25 HEXAGON SOCKET HEAD CAP SCREWS	2	8.8	0.02	A2C
31	324467	SCHORR SAFE WASHER VS10	防松垫圈VS10 SAFETY WASHER	3	FSr	0.8	磷化 PHOSPHATED
30	300252	ISO4017-1999 M20X65 300252	六角头螺钉M20X65 HEXAGON HEAD SCREWS	3	A2-70	0.204	
29	322300	ISO4017-1999 M16X60 322300	六角头螺钉M16X60 HEXAGON HEAD BOLTS	2	8.8	0.132	A3C
28	322244	ISO4017-1999 M16X50 322244	六角头螺钉M16X50 HEXAGON HEAD BOLTS	2	8.8	0.102	A3C
27	322321	ISO4017-1999 M16X45 322321	六角头螺钉M16X45 HEXAGON HEAD BOLTS	10	8.8	0.108	A3C
26	324591	ISO4017-1999 M10X45 324591	六角头螺钉M10X45 HEXAGON HEAD BOLTS	3	A2-70	0.038	
25	322297		O型圈224.2.65-A-N O-RING	2	T腈橡胶 70 SH NITRILE 70 SH	0.004	
24	322298		O型圈218.3.55-A-N O-RING	2	T腈橡胶 70 SH NITRILE 70 SH	0.006	
23							
22							
21	335170		调整垫（1mm） WASHER (1mm)	1		0.006	ALSTOM 提供 SUPPLIED BY ALSTOM
20	324703	CCD000000024096	工艺轴 PLATE USED DURING ASSEMBLY	2	ABS	0.1	
19	322543		调整垫（0.5mm） WASHER (0.5mm)	2		0.002	KNORR 提供 SUPPLIED BY KNORR
18	322542		调整垫（0.3mm） WASHER (0.3mm)	2		0.9	KNORR 提供 SUPPLIED BY KNORR
17	322541	CCD000000023536	调整垫（0.1mm） WASHER (0.1mm)	2	钢板Q+-06C+N960 STEEL PLATE Q+-06C+N960	0.6	根据需要制作 MADE AS REQUIRED
16	321993	CCD000000023206	螺堵 PLUG	2	塑料 PLASTIC	0.003	外购 BUY
15	315740	CCD000000020016	测速齿轮 SPEED WHEEL	1	C45	4.5	
14	315734	CCD000000019749	轴箱转臂安全挡 EMERGENCY CATCH	1	钢板16-S355J2W+N STEEL PLATE 16-S355J2W+N	0.845	
13	315737	CCD000000019950	防松片 LOCKING PLATE	1	钢板2-Q195 STEEL PLATE 2-Q195	0.073	
12	315736	CCD000000019949	后盖 BACK COVER	1	EN-GJS-400-18-LT	4	外购 BUY
11	315735	CCD000000019946	轴端压板 END CAP	1	S355 J2+N	4.6	
10	315738	CCD000000020009	轴箱体（右） RIGHT AXLEBOX BODY	1	EN-GJS-400-18-LT	75.85	外购 BUY
9							
8							
7	321403	CCD000000021029	前端盖 FRONT END COVER	1	EN-GJS-400-18-LT	13.7	外购 BUY
6							
5							
4	315733	CCD000000019494	轴箱节点 AXLEBOX JOINT BUSH	1		13.2	外购 BUY
3	323718		信号速度传感器组成 SPEED SENSOR	1		4.6	ALSTOM
2	323883		防滑速度传感器FSO1B ANTI-SKID SPEED SENSOR	1		0.4	KNORR
1	322501		轴承(包括防止挡环)NJ312-E-M5-C3 AXLE BEARING	1		28.8	SKF

序号 ITEM	物料号 PART/CODE/NUMBER	图文档号 DOC NUMBER	物料名称 DESCRIPTION	数量 QTY	材料 MATERIAL	单重 WEIGHT	附注 REMARKS

版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN

设计	高建宝	2013-3-11	焊接工程师				
审核	王安国	2013-3-11	郁关工艺	尹立成	2013-3-30		
区域审核			郁关工艺2				
主管	林 勉	2013-3-29	审 批				
			批 准				
工艺	杨智勇	2013-3-30	绘图软件 CATIA V5				

ATP和防滑轴端安装（3A）
AXLEBOX ASS'Y WITH ATP AND ANTI-SKID DEVICE

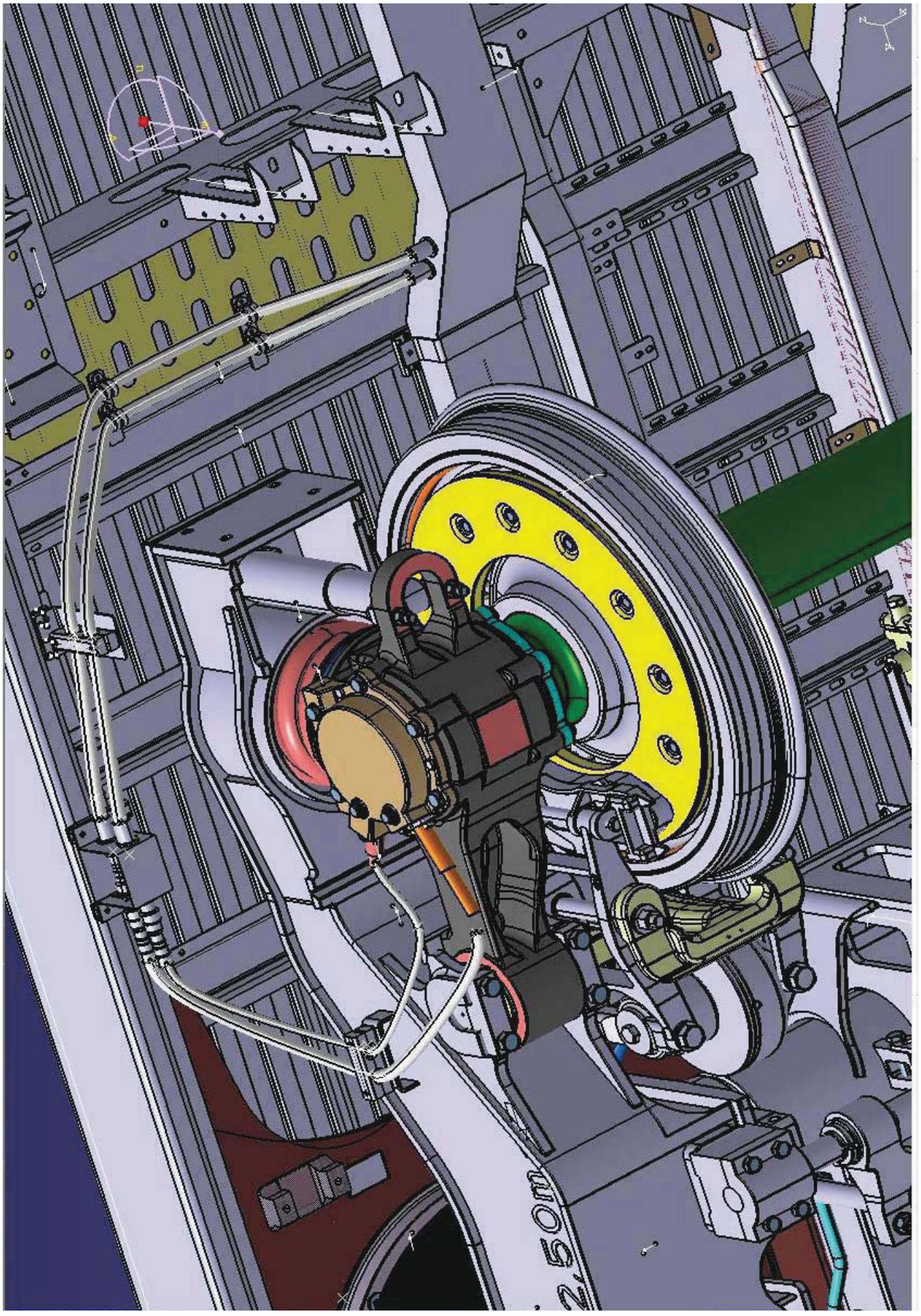
版本 REV	重量 WEIGHT	比例 SCALE	图幅 MAP/SHEET
A	159.408	1:2	A1

CCD000000021016
324816

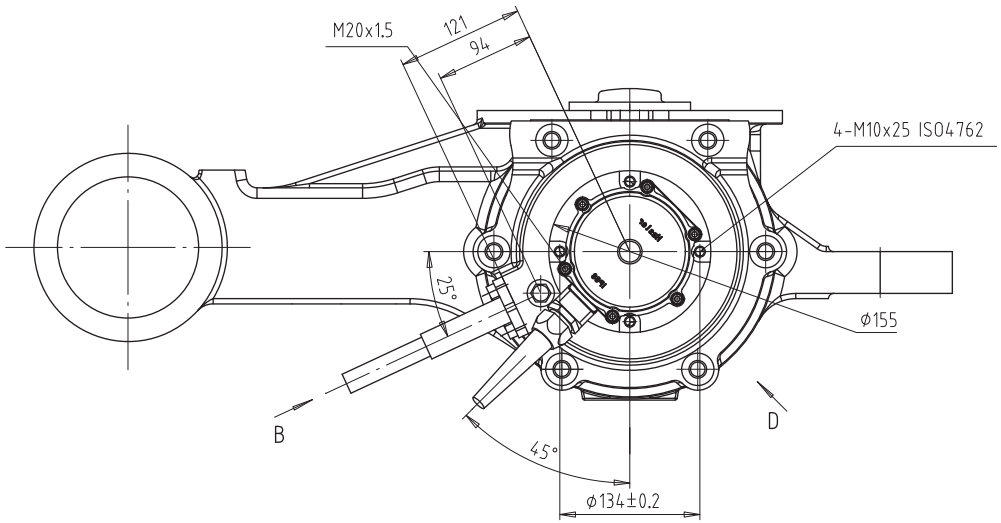
页次 PAGE 1/1

Detailed Interface Design Specification for Automatic Train Control System

Appendix 3

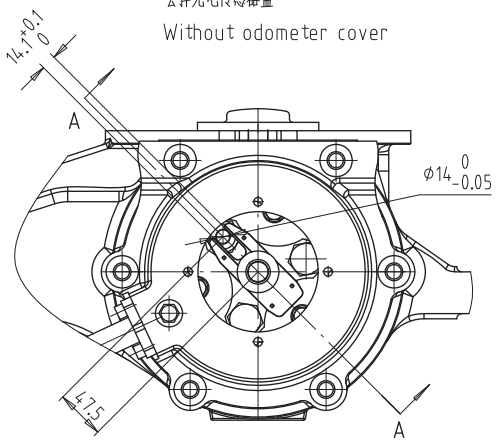


CCDZ90-215-000

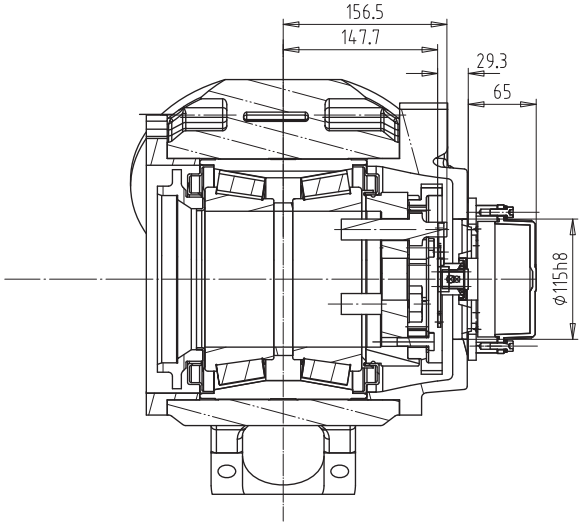


去掉光电传感器盖

Without odometer cover

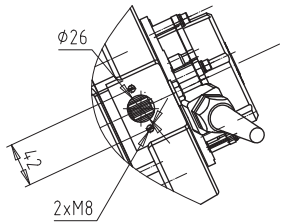


A-A



去掉防滑传感器 Without anti-skid sensor

B



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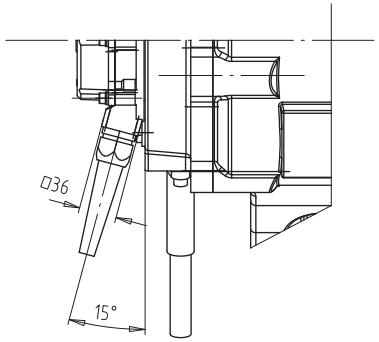


Tolerances for normal dimensions 一般尺寸公差要求					
Surface geometry & structure 表面几何结构要求					
Document Title 文件号					
设 计	高建宝	2009-10-16			
审 核			标 准		
			部 长		
主 管			总 工		
工 艺			绘图软件 (SOFTWARE) AutoCAD 2006		

版本 REV.	重 量 WEIGHT	比 例 SCALE	图幅 DRAWING
V3		1: 5	A3
共 1 张 TOT SH		第 1 张 SH NO	

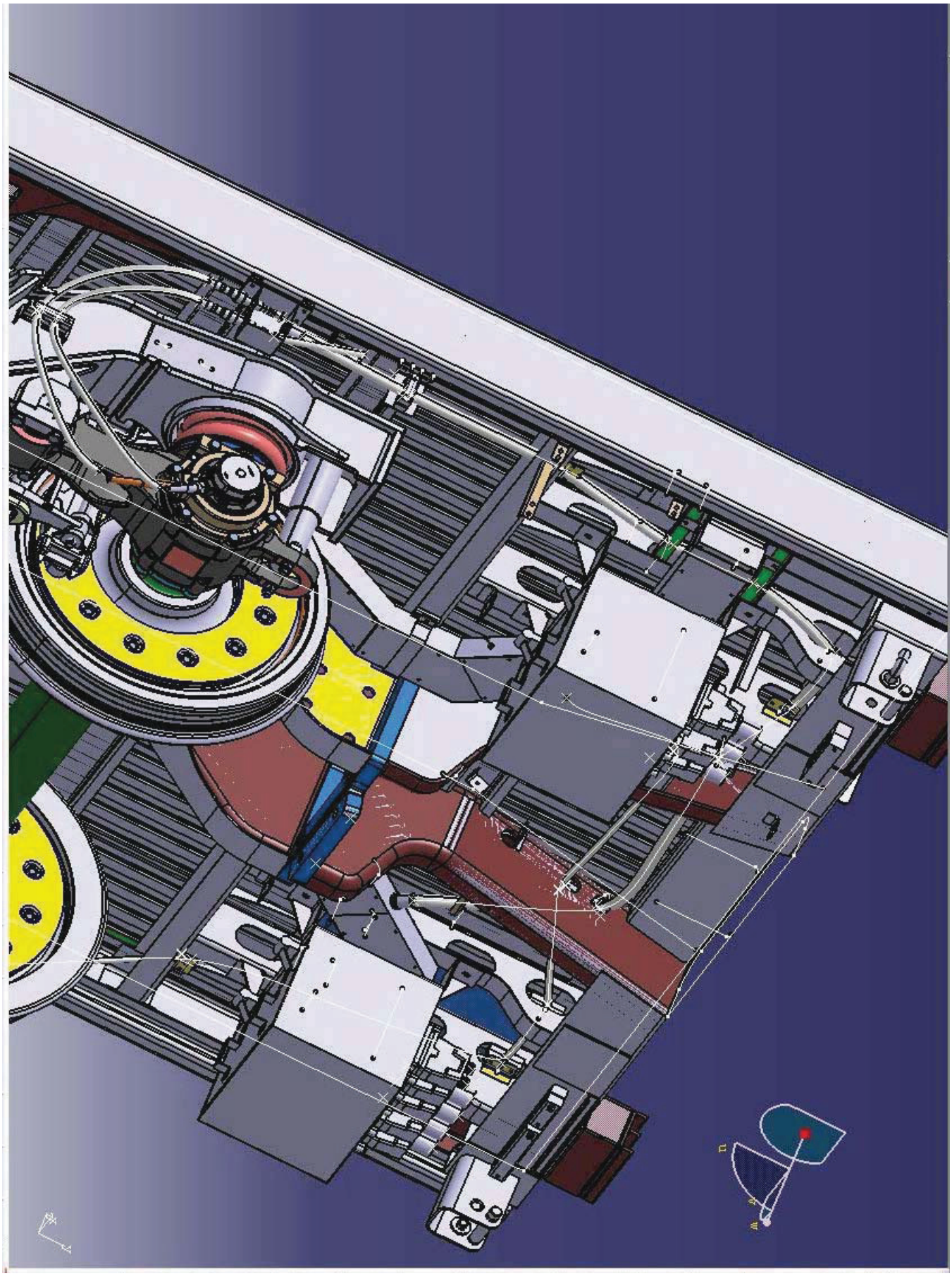
对称件 SYMMETRY

ATC轴端安装（4B）
ATC axle end ass'y(4B)

CCDZ90-215-000

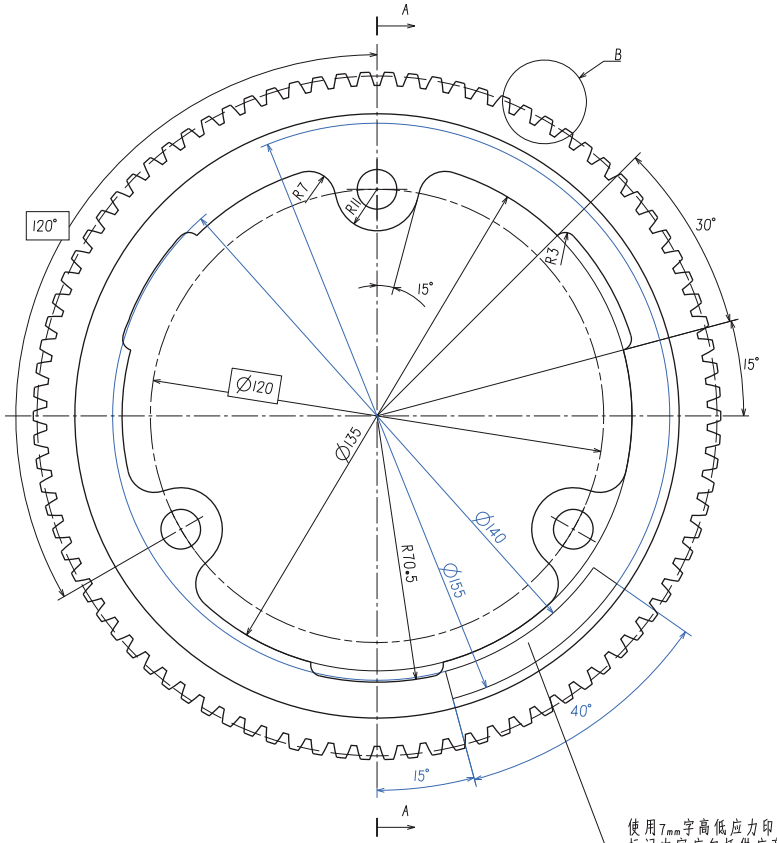
总数 | 服 | 玻 | 具 | 试 | 镀 | 木 | 械 | 冲 | 体一 | 体二 | 装一 | 装二 | 锻 | 精 | 钢 | 铆 | 协 | 供 | 单位 数量 | 旧底图总号 | 底图总号 | 签字 | 日期

签名 | 文件号 | 升级说明 | 日期 | 版本

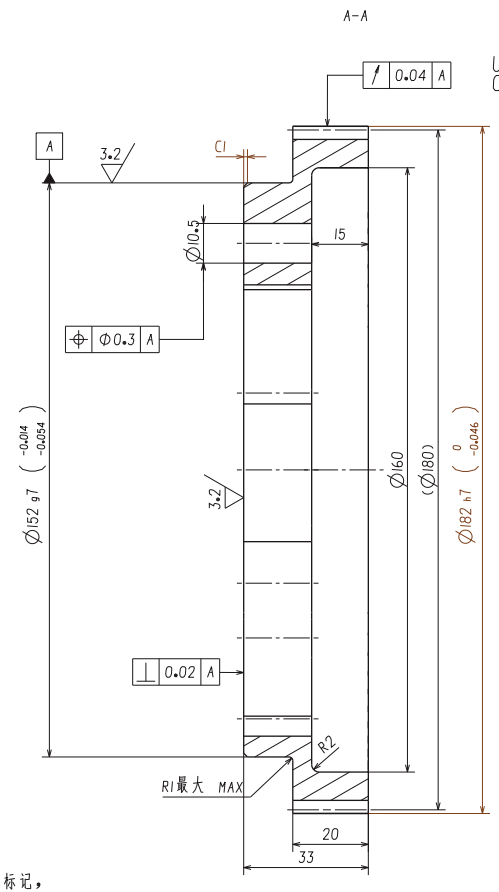


DETAILED INTERFACE SPECIFICATION

ANNEX B9
SPEED WHEEL FOR FAIVELEY SPEED SENSOR



使用7mm字高低应力印模在此区域刻打标记，标记内容应包括供应商名称、生产日期、炉次号及序列号。



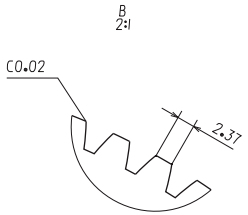
其余 6.3

UNLESS OTHERWISE STATED

技术要求

1 零件表面进行发黑处理。
2 未注锐楞倒角0.5。
3 未注尺寸公差：ISO 2768-mk。

NOTES:
1 THE SURFACES SHOULD BE BLACKENED.
2 SHARP EDGES SHOULD BE CHAMFERED TO BE 0.5mm UNLESS OTHERWISE STATED.
3 GENERAL TOLERENCE TO BE ISO 2768-mk.



齿数 NUMBER OF TEETH	Z	90
模数 MODULE	m	2
分度圆 REFERENCE CIRCLE DIAMETER	d	180
齿形标准 TOOTH FORM STANDARD	DIN 867	
齿形角 TOOTH PROFILE ANGLE	α	20°

版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN

				C45 EN 10083-2				测速齿轮 SPEED WHEEL	
设计	高建宝	2020-3-16	焊接工程师	版本 REV	重量 WEIGHT	比例 SCALE	图幅 MAPSHEET		
审核	王安国	2020-3-16	相关工艺1	A	1.5	1:1	A2		
区域审核			相关工艺2						
主管			审批			页次 PAGE		CCD00000020016	
			批准			1/1		315740	
工艺	杨智勇	2020-3-24	绘图软件 CATIA V5						

DETAILED INTERFACE SPECIFICATION

ANNEX C1
ATC ELECTRICAL INTERFACE REQUIREMENTS

Annex C1 – ATC Electrical Interface Requirements

Section C1.1 ATC Inputs and Outputs Electrical Characteristics

SACEM ATC Outputs / Inputs		Electrical Characteristics								Functions
		Type	Loads / Input Name	Connector pin number	Rated Control Circuit Voltage	Rating Current (*) [A]	Max	L/R [ms]	Relay Spec.	
ATC Mode	Non – Vital Binary Input	Opto – coupler	SCOS (NORMAL Position)	ATC/MOD HN2-J2 & J4	DC110V	2 x 0.015	130V	-	-	The on-board ATC monitors the Normal position of the SCOS.
AUTO	Non – Vital Binary Input	Opto – coupler	Mode Selector (AM Position)	MS/AUTO2 HN2-E2 MS/AUTO1 HN2-K1	DC110V	0.015	130V	-	-	The on-board ATC monitors the AUTO position of the Mode selector. 2 inputs in //
CM	Non – Vital Binary Input	Opto – coupler	Mode Selector (CM Position)	MS/CM HN2-E4	DC110V	0.015	130V	-	-	The on-board ATC monitors the CM position of the Mode selector.
Forward	Vital Binary Input	Opto – coupler	Mode Selector (RMF Position)	MS/FOR HN2-A2 OVB1 HN2-B2	DC110V	0.015	130V	-	-	The on-board ATC monitors the FOR position of the Mode selector.
Reverse	Vital Binary Input	Opto – coupler	Mode Selector (RMR Position)	MS/REV HN2/A3 OVB1 HN2-B3	DC110V	0.015	130V	-	-	The on-board ATC monitors the Reverse position of the Mode selector.

Annex C1 – ATC Electrical Interface Requirements

SB	Non – Vital Binary Input	Opto – coupler	Mode Selector (Standby Position)	MS/SB HN2-E3	DC110V	0.015	130V	-	-	The on-board ATC monitors the Standby position of the Mode selector.
__ SD	Vital Binary Input	Opto – coupler	Mode Selector (Not Shutdown Position)	MS/SD HN2-A4 OVB1 HN2-B4	DC110V	0.015	130V	-	-	The on-board ATC monitors the Mode selector is NOT at Shutdown position.
DT_SD	Vital Binary Intput	Opto – coupler	Mode Selector (Shutdown Position)	DT_SD+ DTJ3-b20 DT_SD- DTJ3-b22	DC110V	0.015	130V	-	-	The on-board ATC monitors the Shutdown position of the Mode selector.
SSIR/1	Vital Binary Output	Relay Contact	SSIR1_P SSIR1_M	DTJ3- z30 DTJ3-b32	DC110V	0.5 @ 120V	140V	15	-	Momentary signal used to reset SIR circuit in Driverless Turnaround mode
DCR/1	Vital Binary Output	Relay Contact	DCR1_M DCR1_P	DTJ2-Z8 DTJ2-Z26	DC110V	1.1 @ 120V	140V	15	-	Continuous signal: 1=DT, 0 = Not DT, used to activate the cab control circuit with MS at Shutdown position in Driverless Turnaround mode
DCR/2	Vital Binary Output	Relay Contact	DCR2_M DCR2_P	DTJ2-b8 DTJ2-b2	DC110V	2.9 @ 120V	140V	15	-	Continuous signal: 1=DT, 0 = Not DT, used to activate the cab control circuit with MS at Shutdown position in Driverless Turnaround mode
DCR/3	Vital Binary Output	Relay Contact	DCR3_M DCR3_P	DTJ2_z24 DTJ2-z28	DC110V	1.8 @ 120V	140V	15	-	Continuous signal: 1=DT, 0 = Not DT, used to activate the cab control circuit with MS at Shutdown position in Driverless Turnaround mode
DCR/4	Vital Binary Output	Relay Contact	DCR4_M DCR4_P	DTJ2-z30 DTJ2-b32	DC110V	0.5 @ 120V	140V	15	-	Continuous signal: 1=DT, 0 = Not DT, used to activate the cab control circuit with MS at Shutdown position in Driverless Turnaround mode

Annex C1 – ATC Electrical Interface Requirements

DCR/5	Vital Binary Output	Relay Contact	DCR5_M DCR5_P	DTJ2-z32 DTJ2-b30	DC110V	0.06 @ 120V	140V	15	-	Continuous signal: 1=DT, 0 = Not DT, used to activate the cab control circuit with MS at Shutdown position in Driverless Turnaround mode
Motor Demand (previous Shunt Series output)	Non - Vital Binary Output	Reed Relay Drive	MDRR	HN1-E2	DC24V	0.024	-	-		Continuous signal: 1=Powering, 0 = Braking and Coasting, used to activate the Motor Demand trainline in AUTO and DT modes.
Brake Demand	Non - Vital Binary Output	Reed Relay Drive	BDRR	HN1-F3	DC24V	0.024	-	-		Continuous signal: 1=Braking, 0 = Powering and Coasting, used to activate the Brake Demand trainline in AUTO and DT modes.
ATC Fault	Non-vital Binary Output	LED	ATO General Fault (ATX/FLT)	HN1-F2	DC24V	0.024	-	-		Continuous signal: 1=ATO Fault, 0 = Normal, used to indicate general failure of ATO.
Start Hold Fault	Non vital Binary Output	Reed Relay Drive	SHRR	HN1-E3	DC24V	0.024	-	-		Continuous signal: 1=ATO Start authorized, 0 = ATO Start not authorized, used to check the door / close sequence.
Overspeed Alarm	Non vital Binary Output	Static Output	OV/SP/AL 24VRR	HN1-E4 HN/1-F1	DC24V “1” = Buzzer ON “0” = Buzzer OFF	0.024	-	-	-	Continuous signal: 1=Buzzer on, 0 = Buzzer off, used to warn the driver when speeding.
TMS (DVAS TX)	SERIAL LINK	RS232	TX/DEST+ OV/DEST	BN-J3 BN-K3		0.010				
TMS (DVAS RX)	SERIAL LINK	RS232	RX/DEST OV/DEST	BN-M3 BN-N3		0.010				

Annex C1 – ATC Electrical Interface Requirements

ATO PWM	Non – Vital PWM Signal	Electronic	TMS / VVVF / Pneumatic Brake	LEVEL+ HN1-J4 LEVEL- HN1-K4	DC110V (DC77V to DC137.5V) (Frequency: 97.7 Hz ~ 98.3 Hz)	0.106	0.9A	-	-	PWM signal to drive the traction and brake system in AUTO and DT modes. Nominal Output Current for 8 cars: For TMS: 3.3mA x 2 cars = 6.6mA For VVVF: 3.3mA x 6 cars = 19.8mA For Pneumatic Brake: 3.3mA x 8 cars = 26.4mA Total = 52.8mA
DERA	Vital Binary Output	Relay Contact	DERA/1+ DERA/1-	LT2-N1 LT2-P1	DC110V	0.350	140V	30	-	Continuous signal: 1= A side door authorized, 0 = A side door not authorized, used to authorize door opening in AUTO, CM and RM (if localised) modes.
DERB	Vital Binary Output	Relay Contact	DERB/1+ DERB/1-	LT2-N2 LT2-P2	DC110V	0.350	140V	30	-	Continuous signal: 1= B side door authorized, 0 = B side door not authorized, used to authorize door opening in AUTO, CM and RM (if localised) modes.
DORA/1	Vital Binary Output	Relay Contact	DORA1_M DORA1_P	DTJ3-b2 DTJ2-b26	DC110V	0.25 @ 120V	140V	15	-	Momentary signal (1sec. duration): 1= A side door open, 0 = A side door not open, used to open train door in DT mode.
DORA/2	Vital Binary Output	Relay Contact	DORA2_M DORA2_P	DTJ3-b6 DTJ3-z2	DC 110V	0.25 @ 120V	140V	15	-	Momentary signal (1sec. duration): 1= A side door open, 0 = A side door not open, used to open train door in DT mode.
DORA/3	Vital Binary Output	Relay Contact	DORA3_M DORA3_P	DTJ3-b4 DTJ2-b28	DC 110V	0.25 @ 120V	140V	15	-	Momentary signal (1sec. duration): 1= A side door open, 0 = A side door not open, used to open train door in DT mode.
FB 110V			+110VB2 0VB2	HN1-N1 HN1-P1						Fall back power supply
DORB/1	Vital Binary Output	Relay Contact	DORB1_M DORB1_P	DTJ3-z12 DTJ3-z8	DC 110V	0.25 @ 120V	140V	15	-	Momentary signal (1sec. duration): 1= B side door open, 0 = B side door not open, used to open train door in DT mode.
DORB/2	Vital Binary Output	Relay Contact	DORB2_M DORB2_P	DTJ3-z14 DTJ3-z6	DC 110V	0.25 @ 120V	140V	15	-	Momentary signal (1sec. duration): 1= B side door open, 0 = B side door not open, used to open train door in DT mode.

Annex C1 – ATC Electrical Interface Requirements

DORB/3	Vital Binary Output	Relay Contact	DORB3_M DORB3_P	DTJ3-z10 DTJ3-z4	DC 110V	0.25 @ 120V	140V	15	-	Momentary signal (1sec. duration): 1= B side door open, 0 = B side door not open, used to open train door in DT mode.
DOSA	Viital Binary Input	Opto – coupler	DOSA OVDOSA	HN2-C2 HN2-D2	DC110V	0.015	130V	-	-	A Toggle input to monitor the door opening and closing commands of the train in order to open and close PSD. Requires a continuous signal input: 1=A side door is commanded to open, 0 = A side door is commanded to close.
DOSB	Vital Binary Input	Opto – coupler	DOSB OVDOSB	HN2-C1 HN2-D1	DC110V	0.015	130V	-	-	A Toggle input to monitor the door opening and closing commands of the train in order to open and close PSD. Requires a continuous signal input: 1=B side door is commanded to open, 0 = B side door is commanded to close.
AM Fault Indicator	Non – Vital Binary Output	LED	AM	HN1-C4	DC110V	0.01	-	-	-	An Indicator: 1 = Auto Mode not allowed, 0 = Auto mode is allowed.
CM Fault Indicator	Non – Vital Binary Output	LED	CM	HN1-C3	DC110V	0.01	-	-	-	An Indicator: 1 = CM Mode not allowed, 0 = CM mode is allowed.
RM Fault Indicator	Non – Vital Binary Output	LED	RM	HN1-C2	DC110V	0.01	-	-	-	An Indicator: 1 = RM Mode not allowed, 0 = RM mode is allowed.
Locked Axle Indicator	Non – Vital Binary Output	LED	AXLE/LOC	HN1-D3	DC110V	0.01	-	-	-	An Indicator: 1 = Axle locked detected, 0 = Normal.
EB Triggered Indicator	Non – Vital Binary Output	LED	EB/TRIG	HN1-D2	DC110V	0.01	-	-	-	An Indicator: 1 = EB Triggered, 0 = Normal.

Annex C1 – ATC Electrical Interface Requirements

Door Tested Indicator	Non – Vital Binary Output	LED	DOOR/FLT	HN1-D1	DC110V	0.01	-	-	-	An Indicator: 1 = Door Test Failure, 0 = Door Test Passed.
Train Hold Indicator	Non – Vital Binary Output	LED	TRAIN/HD	HN1-D4	DC110V	0.01	-	-	-	An Indicator: 1 = Train is hold, 0 = Normal.
Driverless Indicator	Non – Vital Binary Output	LED	DLI+ DLI-	DTJ3-b28 DTJ3-z28	DC24V	0.024	-	-	-	An Indicator: 1 = DT mode is engaged, 0 = DT mode is not engaged.
Driverless Control Push Button DKPB	Non-vital Binary Input	Opto – coupler	DKPB+ DKPB-	DTJ3-b24 DTJ3-b26	DC110V	0.015	130V	-	-	Momentary button input used to engage the DT mode.
AUTO Start push button	Non-vital Binary Input	Opto-coupler	SPB	HN2-P3	DC110V	0.015	-	-	-	Momentary button input used for ATO start in AUTO mode.
Door Status	Vital Binary Input	Opto – coupler	DPR/2 OVB1	HN2-A1 HN2-B1	DC110V	0.015	-	-	-	Door Loop Status input to check the door operation sequence in platform in AUTO mode and to check the door loop integrity during door test routine.
EBR1	Vital Binary Output	Relay Contact	EBR1+ EBR-	HN1-A4 HN/1-B4	DC50V	0.035	-	-	QNC10 or EN50205 compatible Relay	Continuous signal: 1= NO EB, 0 = EB applied by ATP, used to command the trains emergency brake in AUTO, CM and RM modes.
EBR2	Vital Binary Output	Relay Contact	EBR2+ EBR-	HN1-A2 HN/1-B4	DC50V	0.035	-	-	QNC10 or EN50205 compatible Relay	Continuous signal: 1= NO EB, 0 = EB applied by ATP, used to command the trains emergency brake in AUTO, CM and RM modes.
ZVR1	Vital Binary Output	Relay Contact	ZVR1+ ZVR-	HN1-A3 HN/1-B3	DC50V	0.035	-	-	QNC10 or EN50205 compatible Relay	Continuous signal: 1= Zero speed, 0 = train moves, used to reset the SIR circuit.

Annex C1 – ATC Electrical Interface Requirements

ZVR2	Vital Binary Output	Relay Contact	ZVR2+ ZVR-	HN1-B2 HN/1-B3	DC50V	0.035	-	-	QNC10 or EN50205 compatible Relay	Continuous signal: 1= Zero speed, 0 = train moves, used to reset the SIR circuit.
EBR1 Status	Non Vital Binary Input	Opto - coupler	EBR1/2	HN2-M4	DC110V	0.015	130V	-	-	The on-board ATC monitors the state NC of the EBR1. Continuous signal: 1= EB, 0 = NO EB.
EBR2 Status	Non Vital Binary Input	Opto - coupler	EBR2/2	HN2-M3	DC110V	0.015	130V	-	-	The on-board ATC monitors the state NC of the EBR2. Continuous signal: 1= EB, 0 = NO EB.
ZVR1 Status	Non Vital Binary Input	Opto - coupler	ZVR1/6	HN2-N4	DC110V	0.015	130V	-	-	The on-board ATC monitors the state NC of the ZVR1. Continuous signal: 1= moving, 0 = zero speed.
ZVR2 Status	Non Vital Binary Input	Opto - coupler	ZVR2/6	HN2-N3	DC110V	0.015	130V	-	-	The on-board ATC monitors the state NC of the ZVR2. Continuous signal: 1= moving, 0 = zero speed.
SIR1 Status	Non Vital Binary Input	Opto - coupler	SIR1/4	HN2-M2	DC110V	0.015	130V	-	-	The on-board ATC monitors the state NO of the SIR1.
SIR2 Status	Non Vital Binary Input	Opto - coupler	SIR2/7	HN2-M1	DC110V	0.015	130V	-	-	The on-board ATC monitors the state NO of the SIR1.
EMPB	Vital Binary Input	Opto - coupler	EB PB	HN2-P4	DC110V	0.015	-	-	-	The on-board ATC monitors the EB loop state to disengage the DT mode. Continuous signal: 1 = EB not applied, 0 = EB applied.

Notes:

1) For the details of MDR, BDR, SHR, DTSDR and AFRR, please refer to Annex C2 ATO I/O circuit.

2) Each safety input have it's dedicated reference input except EMPB

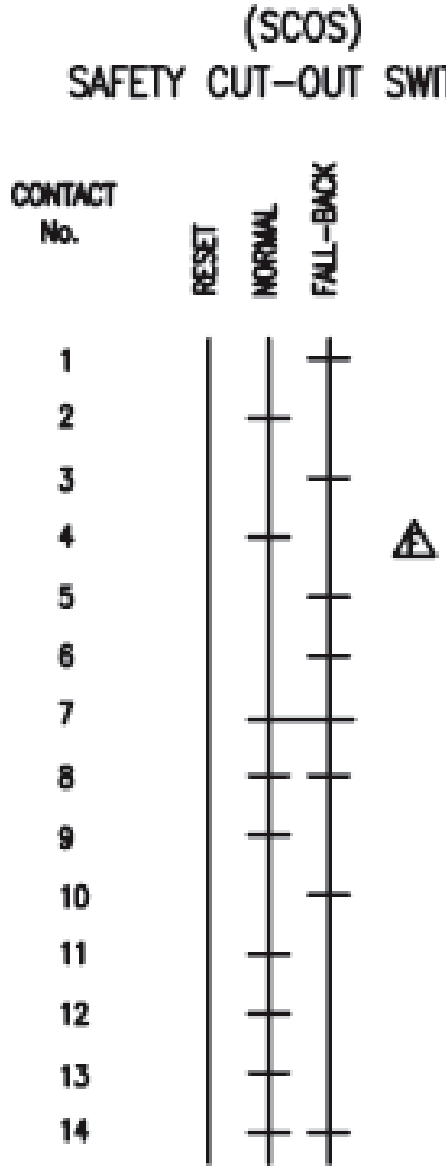
Annex C1 – ATC Electrical Interface Requirements

Section C1.2 Cable Specifications

Location	Reference	From to	Comment
Odometer	Flamex 24 16 0.6BLG	TB to underframe connection box	screened pair with solder sleeve joint
CT sensor & RC antenna	Flamex 24 16 3x1.34BLG	underframe connection box to CT sensor and RC antenna	screened pair with solder sleeve joint
	Flamex 24 16 0.6BLG	TB to underframe connection box	screened pair with solder sleeve joint
speedometer	Flamex 24 16 0.6BLG		screened pair with solder sleeve joint
speedometer bulb	Flamex 24 1.34		
ATO PWM	Flamex 24 16 0.6BLG		screened pair with solder sleeve joint
TMS	Flamex 24 1.34		
power supply	Flamex 24 10	MCB to TSE	
Others non-safety I/O	Flamex 24 1.34		unscreen
Saferty I/O	Flamex 24 2.62		unscreen

Annex C1 – ATC Electrical Interface Requirements

Section C1.3 SCOS Requirements



Annex C1 – ATC Electrical Interface Requirements

Section C1.4 ATC Power Supply Requirements

ATC Power Supply

Electrical Figures	110V DC (nominal), Max. 3A in-rush current: 170A / 40us, 8A / 40ms

Name file : Cable specification_V3.XLS 22/02/2011

Cable type for on board ATC installation						
		DESCRIPTION	WHERE	Nominal section area mm2	conductor stranding-Nominal diam mm	Cable Nominal external diameter in mm
	Type 1	Single Wire cable	see next folio	1	19x0.25- 1,21	****
	Type2	Non shielded Twisted pair cable	see next folio	2x1	19x0.25- 1,21	****
	Type 3	Shielded Twisted pair cable	see next folio	2x1	19x0.25- 1,21	*****
	Type 4	3 shielded Twisted Pairs Cable each pair individually shielded	Between BS connector to terminal block	3x2x1.34	19x0.3- 1,47	13

Cable type from Cubicle connectors to Terminal block.			
	Type 1	Single Wire cable	
	Type2	Non shielded Twisted pair cable	
	Type 3	Shielded Twisted pair cable	

HN/1	4	3	2	1
A	**EBR1+[3]**	**ZVR1+[3]**	**EBR2+[3]**	SMR6[3]
B	**EBR-[3]**	**ZVR-[3]**	**ZVR2+[3]**	C/IND
C	AM[3]	CM[3]	RM[3]	FB/UNS[3]
D	TRAIN/HD[3]	AXLE/LOC[3]	EB/TRIG[3]	DOOR/FLT[3]
E	OV/SP/AL[2]	SHRR[2]	SSRR[2]	PRR[2]
F	WFRR[2]	BDRR[2]	ATX/FLT[2]	+24VRR
G	nc	nc	nc	nc
H	nc	nc	nc	nc
J	LEVEL+[3]	TACHO1+[3]	TACHO2+[3]	+24VRR
K	LEVEL-[3]	TACHO1-[3]	TACHO2-[3]	0VRR
L	BL/M	BL/M	BL/M	EARTH
M	**SSR+[3]**	**SSR-[3]**	nc	nc
N	+110VB1	+110VB1	+110VB1	+110VB2
P	0VB1	0VB1	0VB1	0VB2

HN/2	4	3	2	1
A	**MS/SD[3]**	**MS/REV[3]**	**MS/FOR**	**DPR/2[3]**
B	**0VB1[3]**	**0VB1[3]**	**0VB1[3]**	**0VB1[3]**
C	nc	nc	**DOSA**	**DOSB**
D	nc	nc	**0VDOSA[3]**	**0VDOSB[3]**
E	MS/CM	MS/SB	MS/AUTO2	nc
F	nc	nc	nc	nc
G	nc	nc	nc	nc
H	nc	nc	nc	nc
J	ATC/MOD	nc	ATC/MOD	0VB1
K	**ZVR3/1+**	**EBR3/1+**	C/RAD	MS/AUTO1
L	**ZVR3/1-**	**EBR3/1-**	RAD/ST	0VB1[3]
M	EBR1/2	EBR2/2	SIR1/4	SIR2/7
N	ZVR1/6	ZVR2/6	+110VB2	0VB1
P	EMPB	SPB	C/R1	C/R2

BN	4	3	2	1
A	C1[2]	C3[2]	D1[2]	D3[2]
B	C2[2]	C4[2]	D2[2]	0VTEST[2]
C	BL/0V2	BL/0V2	BL/0V2	BL/0V2
D	CB1[1]	CB2[1]	RCDB[1]	RCGB[1]
E	0VCB1[1]	0VCB2[1]	0V3	0V3
F	BL/OV3	BL/OV3	BL/OV3	BL/OV3
G	nc	BL/0V2	0V2[2]	+24V2[2]
H	0V/RAD	BL/OV3	0V3	+12V3
J	T/SP+[1]	TX/DEST[1]	TX+/RAD[1]	TX/DVAS[1]
K	T/SP-[1]	0V/DEST[1]	TX-/RAD[1]	0V/DVAS[1]
L	BL/M	BL/M	BL/M	BL/M
M	A/SP+[1]	RX/DEST[1]	RX+/RAD[1]	RX/DVAS[1]
N	A/SP-[1]	0V/DEST[1]	RX-/RAD[1]	0V/DVAS[1]
P	BL/M	BL/M	BL/M	BL/M

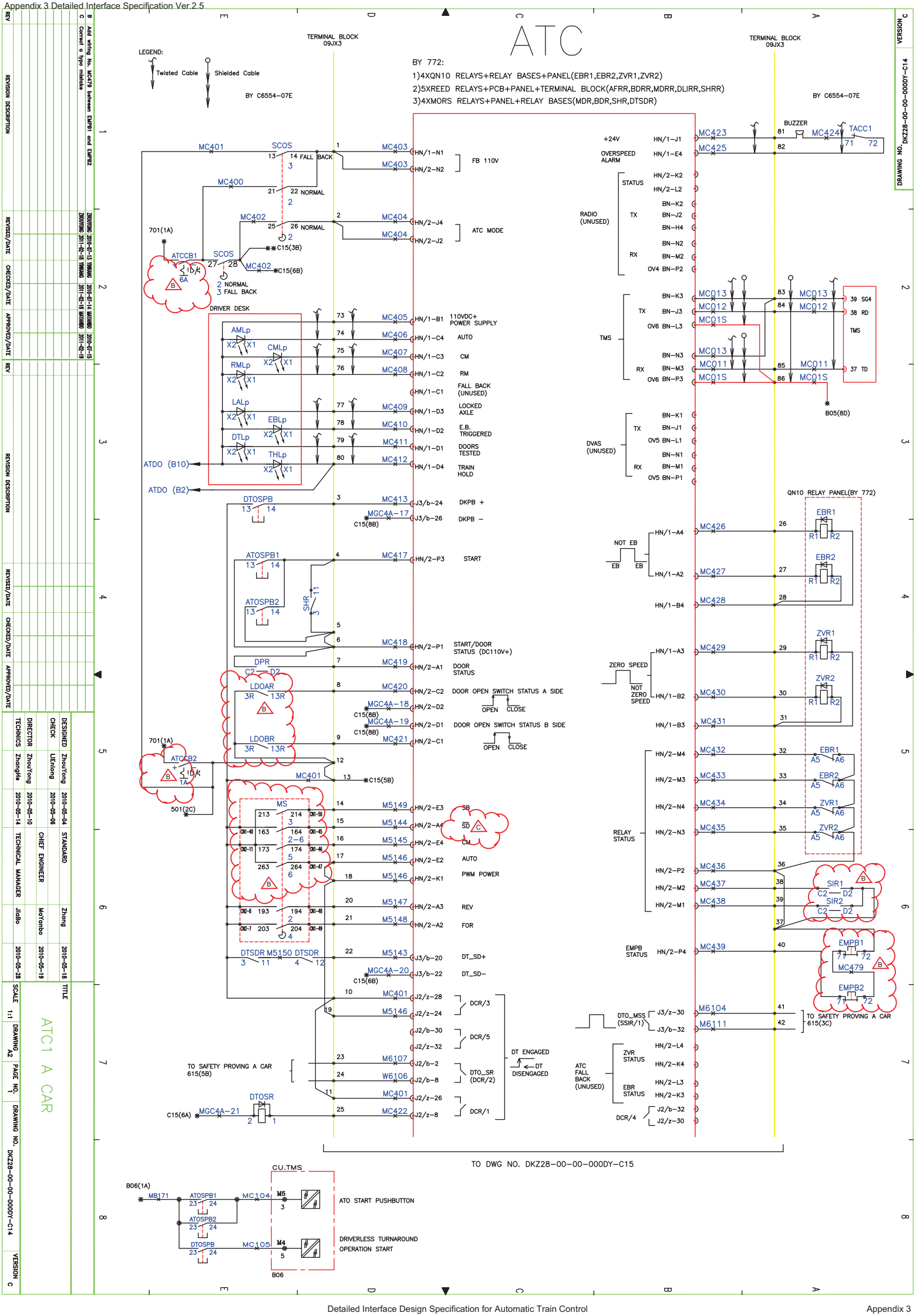
LT/1	4	3	2	1
A	AL4[3]	AL3[3]	AL2[3]	AL1[3]
B	AL8[3]	AL7[3]	AL6[3]	AL5[3]
C	AL12[3]	AL11[3]	AL10[3]	nc
D	AL16[3]	AL15[3]	AL14[3]	AL13[3]
E	AL20[3]	AL19[3]	AL18[3]	AL17[3]
F	nc	nc	nc	nc
G	nc	nc	nc	nc
H	nc	nc	nc	nc
J	nc	nc	nc	nc
K	AL24[3]	AL23[3]	AL22[3]	AL21[3]
L	AL28[3]	AL27[3]	AL26[3]	AL25[3]
M	AL32[3]	AL31[3]	AL30[3]	AL29[3]
N	0VB1	nc	nc	nc
P	0VB1	LT32	nc	nc

LT/2	4	3	2	1
A	AL36[3]	AL35[3]	AL34[3]	AL33[3]
B	AL40[3]	AL39[3]	AL38[3]	AL37[3]
C	AL44[3]	AL43[3]	AL42[3]	AL41[3]
D	AL48[3]	AL47[3]	AL46[3]	AL45[3]
E	AL52[3]	AL51[3]	AL50[3]	AL49[3]
F	nc	nc	nc	nc
G	nc	nc	nc	nc
H	nc	nc	nc	nc
J	nc	nc	nc	nc
K	AL56[3]	AL55[3]	AL54[3]	AL53[3]
L	AL60[3]	AL59[3]	AL58[3]	AL57[3]
M	AL64[3]	AL63[3]	AL62[3]	AL61[3]
N	0VB1	nc	**DERB/1+[3]**	**DERA/1+[3]**
P	0VB1	0VB1	**DERB/1-[3]**	**DERA/1-[3]**

DT J2					DT J3		
Range b		Range z		Range b		Range z	
2	**DCR2_P**	2	**SPARE13_P**	2	**DORA1_M**	2	**DORA2_P**
4	**SPARE23_M**	4	**SPARE12_P**	4	**DORA3_M**	4	**DORB3_P**
6	**SPARE13_M**	6	**SPARE11_P**	6	**DORA2_M**	6	**DORB2_P**
8	**DCR2_M**	8	**DCR1_M**	8		8	**DORB1_P**
10		10	**SPARE12_M**	10		10	**DORB3_M**
12		12	**SPARE11_M**	12		12	**DORB1_M**
14		14	**SPARE23_P**	14		14	**DORB2_M**
16		16	**SPARE22_P**	16		16	**S_ES1-**
18		18	**SPARE21_P**	18		18	**S_ES1+**
20		20	**SPARE22_M**	20	**DT_SD+**	20	**S_ES2-**
22		22	**SPARE21_M**	22	**DT_SD-**	22	**S_ES2+**
24		24	**DCR3_M**	24	DKPB+	24	**S_ES3-**
26	**DORA1_P**	26	**DCR1_P**	26	DKPB-	26	**S_ES3+**
28	**DORA3_P**	28	**DCR3_P**	28	DLI+	28	DLI-
30	**DCR5_P**	30	**DCR4_M**	30	**SPARE31_P**	30	**SSIR1_P**
32	**DCR4_P**	32	**DCR5_M**	32	**SSIR1_M**	32	**SPARE31_M**

DETAILED INTERFACE SPECIFICATION

ANNEX C2
ATC I/O CIRCUIT

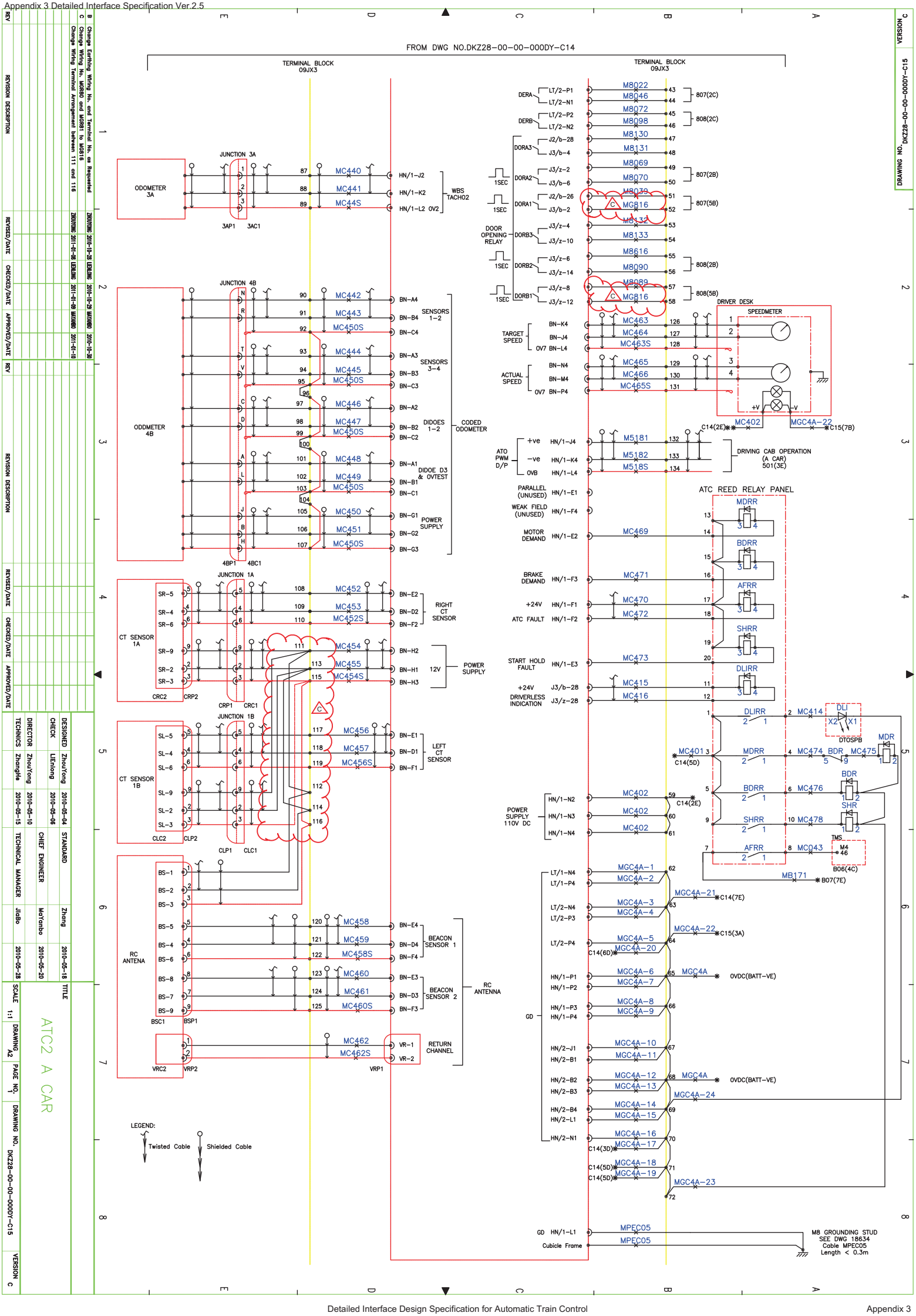


REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Add wiring No. MC479 between EMPB1 and EMPB2	ZHOUYONG 2010-07-13	TANGMG 2010-07-14	MAYANBO 2010-07-15
C	Correct a typo mistake	ZHOUYONG 2011-02-16	TANGMG 2011-02-16	MAYANBO 2011-02-19

DESIGNED	CHECK	DIRECTOR	TECHNICS
ZhouYong	LiHenlong	ZhouYong	ZhangHe
2010-05-04	2010-05-06	2010-05-10	2010-05-14
STANDARD		CHIEF ENGINEER	TECHNICAL MANAGER
Zhang		MaYanbo	JiaBo
2010-05-18		2010-05-19	2010-05-28

TITLE	SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
ATC1 A CAR	1:1	A2	1	DKZ28-00-00-000DY-C14	C

VERSION C
DRAWING NO. DKZ28-00-00-000DY-C14



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
C	Change Earthing Wiring No. and Terminal No. as Requested	ZHOUYONG 2010-10-26	LIENLONG 2010-10-29	WANGMING 2010-10-30
B	Change Wiring No. M0980 and M0981 to M0816 Change Wiring Terminal Arrangement between 111 and 116	ZHOUYONG 2011-01-06	LIENLONG 2011-01-09	WANGMING 2011-01-10

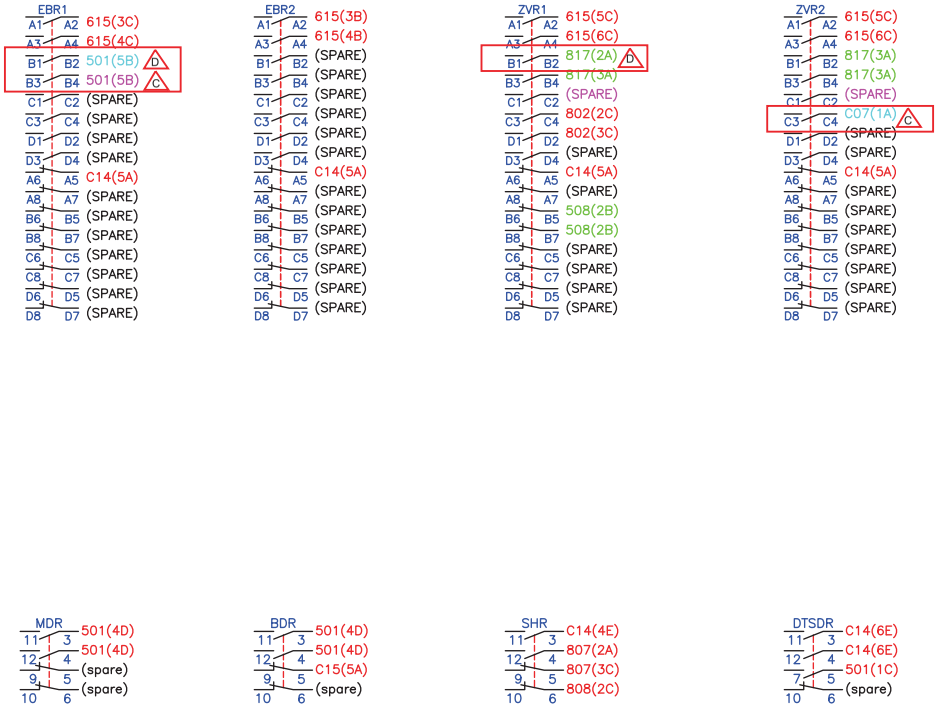
REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

DESIGNED	ZhouYong	2010-05-04	STANDARD
CHECK	LiEnlong	2010-05-06	
TECHNICS DIRECTOR	ZhouYong	2010-05-10	
TECHNICAL MANAGER	JiaBo	2010-05-15	CHIEF ENGINEER
	MoYanbo	2010-05-18	Zhang
		2010-05-20	
		2010-05-28	

TITLE	ATC2 A CAR
SCALE	1:1
DRAWING A2	
PAGE NO.	1
DRAWING NO.	DKZ28-00-00-000DY-C15
VERSION	C

VERSION C
DRAWING NO. DKZ28-00-00-000DY-C15

A CAR



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Add C07(1A) on ZVR2 C3—C4 Contact	ZHOUYONG 2011-01-09	LIENLONG 2011-01-10	MAYANBO 2011-01-11
C	Add 501(5B) on EBR1 B3—B4 Contact	ZHOUYONG 2011-01-09	LIENLONG 2011-01-10	MAYANBO 2011-01-11
D	Correct a typo mistake	ZHOUYONG 2011-02-18	LIENLONG 2011-02-18	MAYANBO 2011-02-19
	Add 501(5B) on EBR1 B1—B2 Contact			

DESIGNED	ZhouYong	2010-05-27	STANDARD	
CHECK				
			CHIEF ENGINEER	
DIRECTOR				
TECHNICS			TECHNICAL MANAGER	

TITLE: ATC3 A CAR

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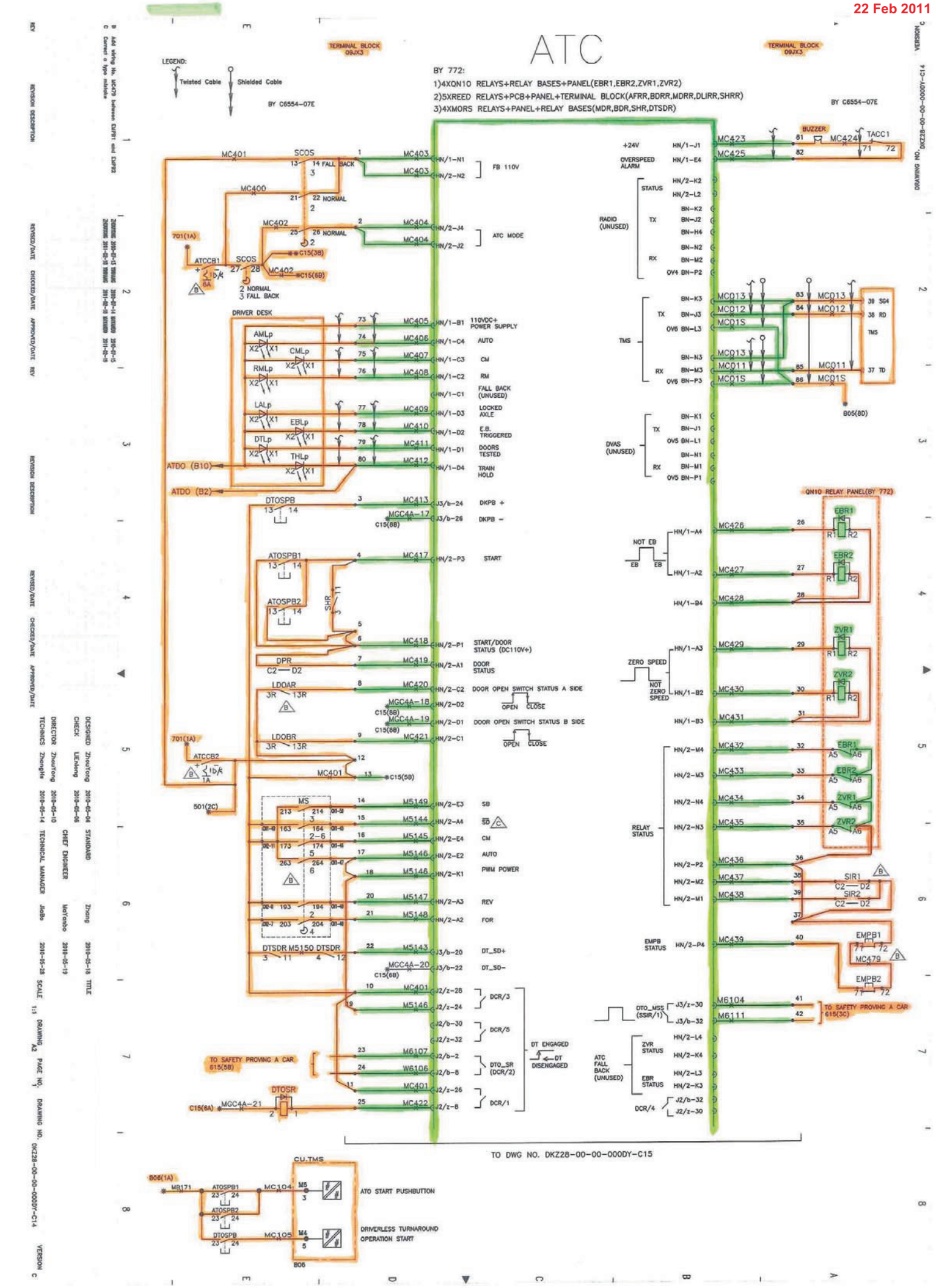
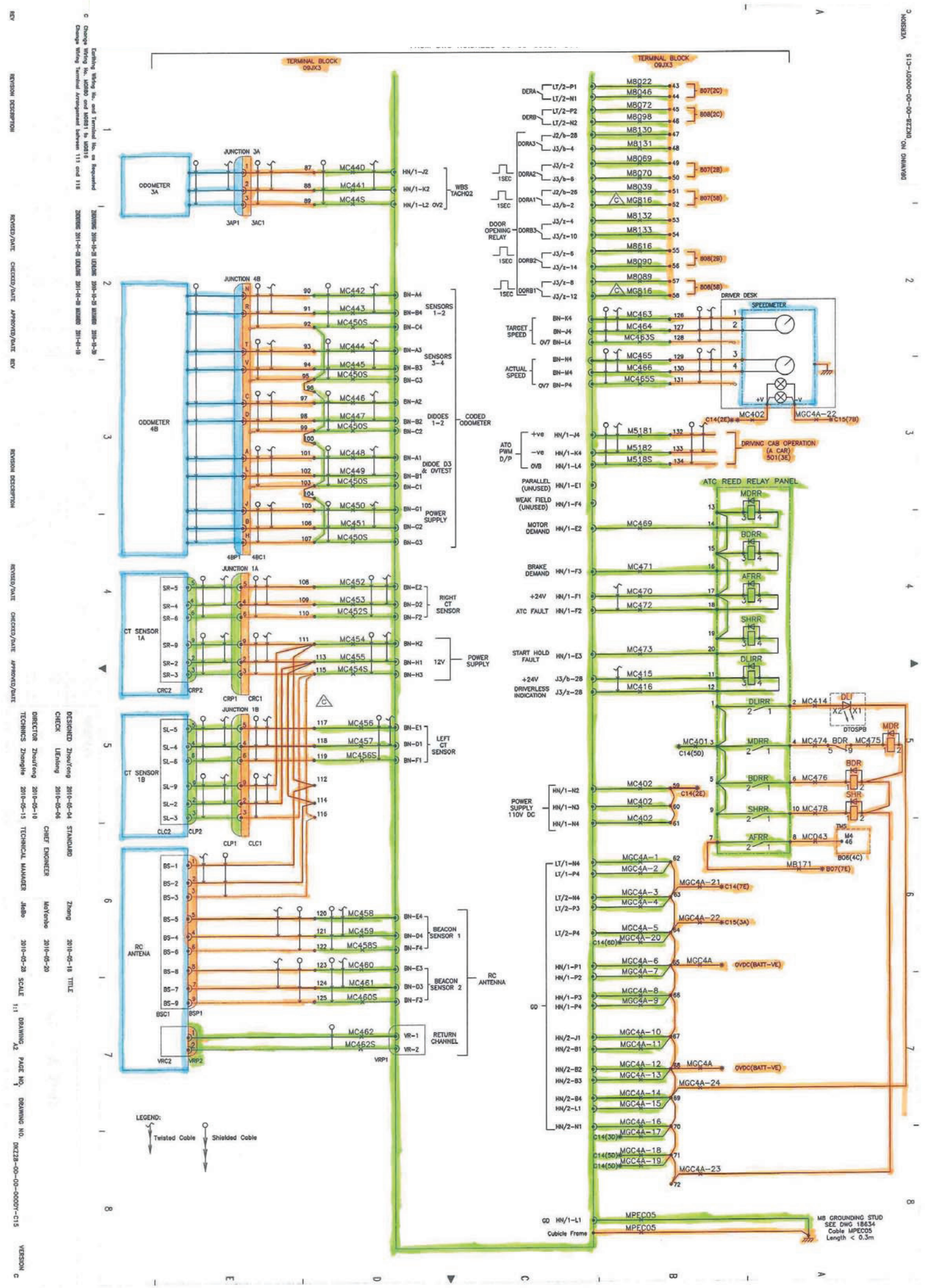
22 Feb 2011


ATC
BY 772:
1)4XQN10 RELAYS+RELAY BASES+PANEL(EBR1,EBR2,ZVR1,ZVR2)
2)5XREED RELAYS+PCB+PANEL+TERMINAL BLOCK(AFRR,BDRR,MDRR,DLIRR,SHRR)
3)4XMORS RELAYS+PANEL+RELAY BASES(MDR,BDR,SHR,DTSDR)
LEGEND:
Twisted Cable
Shielded Cable
BY C6554-07E
TERMINAL BLOCK 09JX3
DRIVER DESK
AMLp
CMLp
RMLp
LALp
EBLp
DTLp
THLp
DPR
LDOAR
LDOBR
ATOSPB1
ATOSPB2
DTOSPB
DTSDR M5150 DTSDR
MS
SCOS
ATCCB1
ATCCB2
DTOSR
110VDC+ POWER SUPPLY
AUTO
CM
RM
FALL BACK (UNUSED)
LOCKED AXLE
E.B. TRIGGERED
DOORS TESTED
TRAIN HOLD
DKPB +
DKPB –
START
START/DOOR STATUS (DC110V+)
DOOR STATUS
DOOR OPEN SWITCH STATUS A SIDE
DOOR OPEN SWITCH STATUS B SIDE
SB
CM
AUTO
PWM POWER
REV
FOR
DT_SD+
DT_SD–
DCR/3
DCR/5
DCR/2
DCR/1
DT ENGAGED
DT DISENGAGED
DTO_SR (DCR/2)
TO SAFETY PROVING A CAR 615(5B)
ATO (B10)
ATDO (B2)
FB 110V
ATC MODE
BUZZER
TACC1
+24V
OVERSPEED ALARM
RADIO (UNUSED)
TMS
DVAS (UNUSED)
QN10 RELAY PANEL(BY 772)
EBR1
EBR2
ZVR1
ZVR2
NOT EB
ZERO SPEED
NOT ZERO SPEED
RELAY STATUS
EMPB STATUS
SIR1
SIR2
EMPB1
EMPB2
MC479
DTO_MSS (SSIR/1)
ATC FALL BACK (UNUSED)
ZVR STATUS
EBR STATUS
TO SAFETY PROVING A CAR 615(3C)
TO DWG NO. DKZ28-00-00-000DY-C15
CU-TMS
ATO START PUSHBUTTON
DRIVERLESS TURNAROUND OPERATION START

22 Feb 2011


TERMINAL BLOCK 09JX3
TERMINAL BLOCK 09JX3
ODDOMETER 3A
JUNCTION 3A
3AP1
3AC1
MC440
MC441
MC445
HN/1-J2
HN/1-K2
HN/1-L2 OV2
WBS TACH02
ODDOMETER 4B
JUNCTION 4B
4BP1
4BC1
MC442
MC443
MC444
MC445
MC446
MC447
MC448
MC449
MC450
MC451
SENSORS 1-2
SENSORS 3-4
DIODES 1-2
DIDOE D3 & OVTEST
POWER SUPPLY
CODED ODOMETER
CT SENSOR 1A
JUNCTION 1A
CRC2
CRP2
CRP1
CRC1
MC452
MC453
MC454
MC455
MC454S
RIGHT CT SENSOR
12V
POWER SUPPLY
CT SENSOR 1B
JUNCTION 1B
CLC2
CLP2
CLP1
CLC1
MC456
MC457
MC456S
LEFT CT SENSOR
RC ANTENA
BSC1
BSP1
MC458
MC459
MC458S
MC460
MC461
MC460S
BEACON SENSOR 1
BEACON SENSOR 2
RC ANTENNA
VRC2
VRP2
VRP1
MC462
MC462S
RETURN CHANNEL
LEGEND:
Twisted Cable
Shielded Cable
DERA
DERB
DORA3
DORA2
DORA1
DORB3
DORB2
DORB1
DOOR OPENING RELAY
1SEC
M8022
M8046
M8072
M8098
M8130
M8131
M8069
M8070
M8039
MG816
M8132
M8133
M8616
M8090
M8089
B07(2C)
B08(2C)
B07(2B)
B07(5B)
B08(2B)
B08(5B)
DRIVER DESK
SPEEDMETER
TARGET SPEED
ACTUAL SPEED
MC463
MC464
MC463S
MC465
MC466
MC465S
MC402
MGC4A-22
C14(2E)
C15(7B)
ATO PWM D/P
+ve
-ve
OVB
M5181
M5182
M5185
DRIVING CAB OPERATION (A CAR) 501(3E)
PARALLEL (UNUSED)
WEAK FIELD (UNUSED)
MOTOR DEMAND
BRAKE DEMAND
+24V
ATC FAULT
START HOLD FAULT
DRIVERLESS INDICATION
ATC REED RELAY PANEL
MDRR
BDRR
AFRR
SHRR
DLIRR
MC469
MC471
MC470
MC472
MC473
MC415
MC416
DLI
DTOSPB
MDR
BDR
SHR
MC414
MC401
MC474
MC475
MC476
MC478
MC043
C14(5D)
POWER SUPPLY 110V DC
MC402
MGC4A-1
MGC4A-2
MGC4A-3
MGC4A-4
MGC4A-5
MGC4A-20
MGC4A-6
MGC4A-7
MGC4A-8
MGC4A-9
MGC4A-10
MGC4A-11
MGC4A-12
MGC4A-13
MGC4A-14
MGC4A-15
MGC4A-16
MGC4A-17
MGC4A-18
MGC4A-19
MGC4A-21
MGC4A-22
MGC4A-23
MGC4A-24
MB171
B07(7E)
B06(4C)
C14(7E)
C15(3A)
C14(6D)
C14(3D)
OVDC(BATT-VE)
GD
MPEC05
MB GROUNDING STUD
SEE DWG 18634
Cable MPEC05
Length < 0.3m
Cubicle Frame

DETAILED INTERFACE SPECIFICATION

ANNEX C3
ATC POWER SUPPLY CHARACTERISTICS

Annex C3: ATC Power Supply Characteristics

Cantenary Voltage Characteristics

Taction Power Supply at the Pantograph has the following Characteristics accordingly to PS Appendix I Annex 2 Overhead Line / Traction Power Supply System Interfaces:

Rated Voltage: 1,500 VDC

Operating Voltage
- Minimum: 1,000 VDC
- Maximum: 1,900 VDC

Supply Surge: subjected to surges of both polarities up to 5kV.

Auxiliary Power Supply Characteristics

Auxiliary Power Supply will be used for the control of equipment and power feed for auxiliary equipment. Voltage characteristics are defined at the input side of equipment.

1. DC 110V Power Supply

   Rated Voltage: 110VDC
   Operating Voltage
   - Maximum: 137.5VDC
   - Minimum: 77 VDC

   This power source battery is floating and it is not expected to suffer from catenary power interruption

2. AC 415V Power Supply

   Rated Voltage: 415VAC, 50Hz
   Operating Voltage
   - Maximum: 394.25 VAC
   - Minimum: 435.75 VAC

   Frequency Change: 50 Hz ± 1%

   This power source battery will be interrupted due to pantograph bounce

DETAILED INTERFACE SPECIFICATION

ANNEX C4
MCB CHARACTERISTICS

Multi 9 C65系列小型断路器

尖端技术 领先一步

产品目录

Schneider Electric

目录

C65系列介绍

概述 2
C65系列产品一览表 6

C65系列断路器

C65N断路器 8
C65H断路器 10
C65H ICB单磁式断路器 12
C65L断路器 14

C65系列直流专用断路器

C65H-DC断路器 16
C65L-DC断路器 19

C65系列剩余电流动作保护附件

Vigi C65 ELE (G) 电子式剩余电流动作保护附件（AC类） 22
Vigi C65 ELE电子式剩余电流动作保护附件（A类） 24
Vigi C65 ELM电磁式剩余电流动作保护附件（AC类） 25

C65系列电气附件

指示与脱扣附件# 26
远程控制附件# 28
重合控制附件# 30

C65系列机械辅助装置

机械辅助装置 31

附录

脱扣曲线 32
限流 35
级联和选择性 36
温度修正系数表 60
直流应用 63
尺寸 64

#进口产品

C65系列介绍

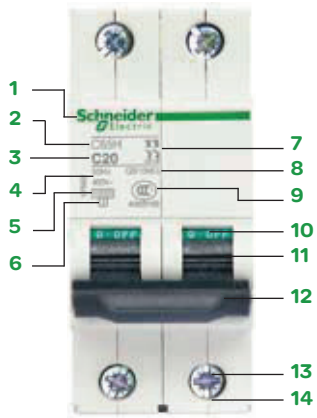
概述

继往开来，再铸辉煌

在中国低压电器的历史上，没有一种产品像施耐德电气生产的小型断路器那样拥有如此巨大的影响，它已不仅仅作为产品服务于我们，更重要的是带给我们观念的深刻改变和整个行业的彻底变革。同时也使施耐德电气成为国内低压电器行业最为耀眼和客户最为信赖的公司。

施耐德电气一直站在低压电器制造业的最前列。2001年，代表当代最新技术的C65N/H小型断路器正式推向市场，C65N/H的投产，标志着国内低压终端制造业步入新的时代。2004年4月C65L面世。随后C65N B曲线、Vigi C65 A型、100mA、100mA🅂、300mA、300mA🅂 剩余电流动作保护附件的相继推出更加充实了C65系列。现在的C65系列扩大了产品的适用范围，充分体现了施耐德电气“以客户为中心”的理念，使客户在不同的市场、不同的应用场合都可以选择适用其需求的具有最大性能价格比及最优技术的产品。我们坚信，凭借领先的技术，凭借我们不懈的追求，凭借广大客户的无比信赖，C65必将铸就新的辉煌。

认识C65



1 断路器品牌
2 断路器类型
3 脱扣曲线及额定电流
4 频率及额定电压
5 分断能力
6 限流等级
7 接线图
8 符合标准
9 CCC认证标志
10 绿色指示条指示内部触头位置状态
○ "I·ON"表示触头闭合状态位置
○ "O·OFF" 表示触头断开状态位置
11 锁定槽
12 操作手柄
13 紧固螺钉
14 热塑外壳

注：2007年7月1日起，C65全系列产品符合欧盟RoHS指令。

C65系列型号标注

C65 N - C 20A / 2P + VE + 300 mA + SD

N	C	20A	2P	VE	300 mA	SD
分断能力	脱扣曲线	额定电流	极数	可配剩余电流动作保护附件	额定剩余动作电流	可配电气附件
N: 6000A	B 型曲线	1A, 2A, 3A*	1P	VE: Vigi C65 ELE	30 mA	MX或MX+OF: 分励脱扣单元
H: 10000A	(保护短路电流较小的负载)	4A, 6A	2P	VEG: Vigi C65 ELE G	100 mA	MN: 欠压脱扣单元 (瞬动型)
L: 15000A	C 型曲线	10A, 16A	3P	VM: Vigi C65 ELM	300 mA	MN 🅂: 欠压脱扣单元 (延时型)
	(配电保护)	20A, 25A	4P	VEA: Vigi C65 ELE (A类)	100 mA🅂	MV: 过压脱扣单元
	D 型曲线	32A, 40A			300 mA🅂	SD: 报警接点
	(动力保护)	50A, 63A				OF: 辅助接点
						OF+SD/OF: 双重切换接点

*: C65N/H B曲线有3A的产品

C65 H - DC 1 C 10 MN

H	1	C	10			MN
分断能力	极数	脱扣曲线	额定电流			配电气附件
H：10000A	1：1P	B 型曲线	1:1A	10:10A	40:40A	OF
L：20000A	2：2P	(保护短路电流较小的负载)	2:2A	16:16A	50:50A	SD
			3:3A	20:20A	63:63A	OF+SD/OF
		C 型曲线	4:4A	25:25A		MX
		(保护常规负载)	6:6A	32:32A		MX+OF
						MN

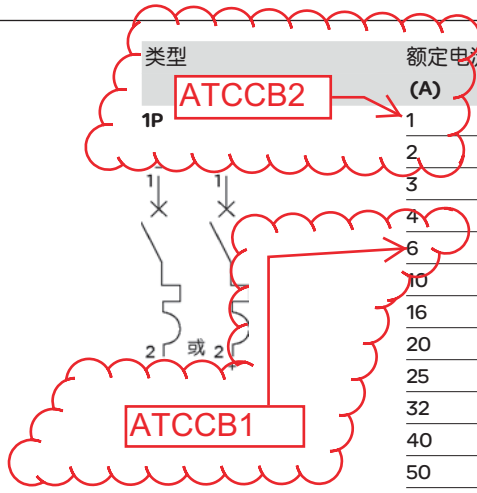
C65系列直流专用断路器

C65H-DC断路器

B型和C型脱扣曲线

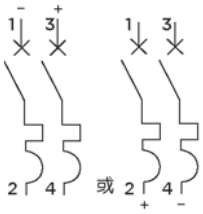
IEC 60947-2 / GB 14048·2: 10kA

MGN22056



类型	额定电流 (A)	宽度 (mm)	产品号 B型	C型
1P	1	18	MGN22000	MGN22050
	2	18	MGN22001	MGN22051
	3	18	MGN22002	MGN22052
	4	18	MGN22003	MGN22053
	6	18	MGN22004	MGN22054
	10	18	MGN22005	MGN22055
	16	18	MGN22006	MGN22056
	20	18	MGN22007	MGN22057
	25	18	MGN22008	MGN22058
	32	18	MGN22009	MGN22059
	40	18	MGN22010	MGN22060
	50	18	MGN22011	MGN22061
	63	18	MGN22012	MGN22062

MGN22076



2P	1	36	MGN22020	MGN22070
	2	36	MGN22021	MGN22071
	3	36	MGN22022	MGN22072
	4	36	MGN22023	MGN22073
	6	36	MGN22024	MGN22074
	10	36	MGN22025	MGN22075
	16	36	MGN22026	MGN22076
	20	36	MGN22027	MGN22077
	25	36	MGN22028	MGN22078
	32	36	MGN22029	MGN22079
	40	36	MGN22030	MGN22080
	50	36	MGN22031	MGN22081
	63	36	MGN22032	MGN22082

附录

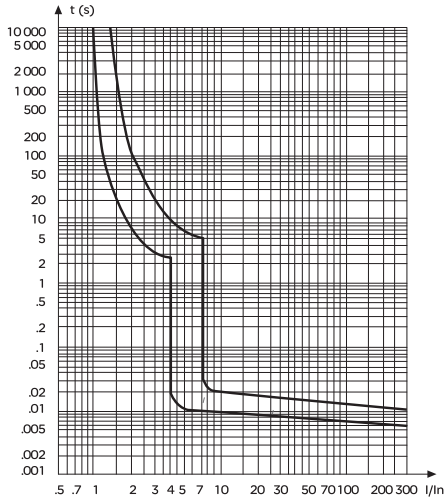
脱扣曲线

C65H-DC / C65L-DC直流小型断路器

C65系列断路器符合IEC 60947-2/GB14048.2标准，其瞬时磁脱扣动作范围如下：

B型曲线：5.5 In ± 20%

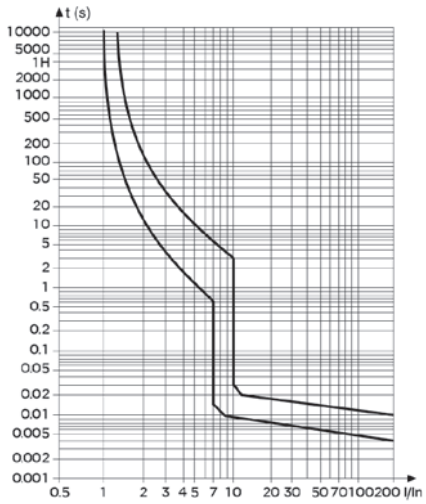
C型曲线：8.5 In ± 20%



C65H-DC

B型脱扣曲线

ATCCB1,
ATCCB2



C65H-DC / C65L-DC

C型脱扣曲线

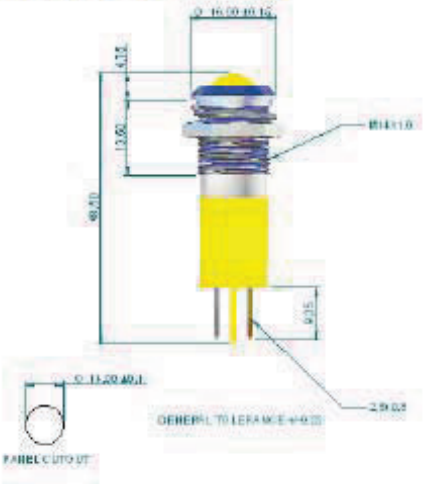
DETAILED INTERFACE SPECIFICATION

ANNEX C5
MODE SELECTION SWITCH CHARACTERISTICS
(REMOVED)

DETAILED INTERFACE SPECIFICATION

ANNEX C6
ATC INDICATORS CHARACTERISTICS

RS ITEM NO 210-169

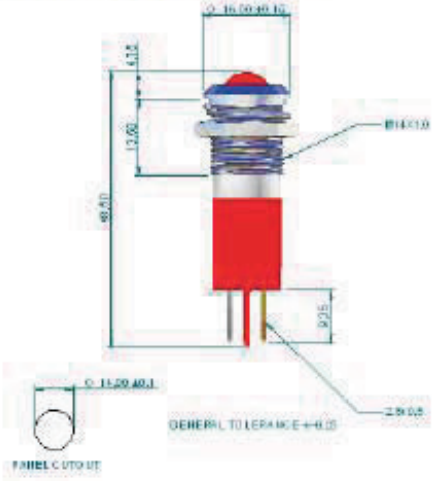


LED/Multiled	*LED*	Optimum voltage (V)	*110Vac*	Intensity	
Mounting Size	*14mm*	Rectifier	-	Reverse Voltage	*5V (max)*
Mounting Finish	*Prominent*	AC current	*6mA (max)*		
Protection	*IP67*	DC current	-		
Mount Holder	*Black Bezel*	Voltage Tolerance(%)	*10%*		
Chip Qty	*1*	Optimum temperature (°C)	*-25°C...+60°C*		
Indicator colour	*Yellow*	Storage temperature (°C)	*-25°C...+60°C*		
Wavelength (nm)	*588*	Contact Tab x 2	*2.8x0.8mm*		

RoHS

We reserve the right to make changes without further notice to this product to Improve reliability, function or design.
Dimensions in mm (typical) not to scale.

RS ITEM NO 210-175



LED/Multiled	*LED*	Optimum voltage (V)	*110Vac*	Intensity	
Mounting Size	*14mm*	Rectifier	-	Reverse Voltage	*5V (max)*
Mounting Finish	*Prominent*	AC current	*6mA (max)*		
Protection	*IP67*	DC current	-		
Mount Holder	*Black Bezel*	Voltage Tolerance(%)	*10%*		
Chip Qty	*1*	Optimum temperature (°C)	*-25°C...+60°C*		
Indicator colour	*Red*	Storage temperature (°C)	*-25°C...+60°C*		
Wavelength (nm)	*625*	Contact Tab x 2	*2.8x0.8mm*		

RoHS

We reserve the right to make changes without further notice to this product to Improve reliability, function or design.
Dimensions in mm (typical) not to scale.

DETAILED INTERFACE SPECIFICATION

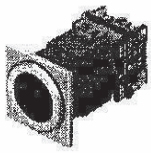
ANNEX C7
ATO DEPART BUTTON CHARACTERISTICS

Devices flush mounting

ATC START PUSH SWITCH
EAO P/N: 704.012.518
704.900.3

Pushbutton actuator, flush mounting

non-illuminative



Essential Accessories:

Switching element page 50

	Front protection	Switching action	Frontbezel/-ring	Lens	□ 35 x 35 mm Typ-Nr.	Ø 35 mm Typ-Nr.	Mounting dimensions	Technical drawing	Circuit drawing	⚖
Pushbutton actuator, flush mounting	IP 65	MA	Plastic black	Plastic black	**704.239.000**		12	22	3	0.051
				Plastic blue	**704.239.600**		12	22	3	0.051
				Plastic colourless	**704.239.700**		12	22	3	0.051
				Plastic green	**704.239.500**		12	22	3	0.051
				Plastic red	**704.239.200**		12	22	3	0.051
				Plastic yellow	**704.239.400**		12	22	3	0.051
			Plastic silver	Plastic black	**704.240.008**		12	22	4	0.051
				Plastic blue	**704.240.608**		12	22	3	0.051
				Plastic colourless	**704.240.708**		12	22	3	0.051
				Plastic green	**704.240.508**		12	22	3	0.051
				Plastic red	**704.240.208**		12	22	3	0.051
				Plastic yellow	**704.240.408**		12	22	3	0.051
		M	Plastic black	Plastic black	**704.209.000**		12	22	4	0.051
				Plastic blue	**704.209.600**		12	22	4	0.051
				Plastic colourless	**704.209.700**		12	22	4	0.051
				Plastic green	**704.209.500**		12	22	4	0.051
				Plastic red	**704.209.200**		12	22	4	0.051
				Plastic yellow	**704.209.400**		12	22	4	0.051
			Plastic silver	Plastic black	**704.210.008**		12	22	4	0.051
				Plastic blue	**704.210.608**		12	22	4	0.051
				Plastic colourless	**704.210.708**		12	22	4	0.051
				Plastic green	**704.210.508**		12	22	4	0.051
				Plastic red	**704.210.208**		12	22	4	0.051
				Plastic yellow	**704.210.408**		12	22	4	0.051
		MA	Aluminium natural	Aluminium black		**704.041.018**	7	22	3	0.051
				Aluminium blue		**704.041.618**	7	22	3	0.051
				Aluminium gold		**704.041.418**	7	22	3	0.051
				Aluminium natural		**704.041.818**	7	22	3	0.051
				Aluminium olive-green		**704.041.518**	7	22	3	0.051
				Aluminium red		**704.041.218**	7	22	3	0.051
				Plastic black		**704.042.018**	7	22	3	0.051
				Plastic blue		**704.042.618**	7	22	3	0.051
				Plastic colourless		**704.042.718**	7	22	3	0.051
				Plastic green		**704.042.518**	7	22	3	0.051
				Plastic red		**704.042.218**	7	22	3	0.051
				Plastic yellow		**704.042.418**	7	22	3	0.051

Continuation see next page

Devices flush mounting 04

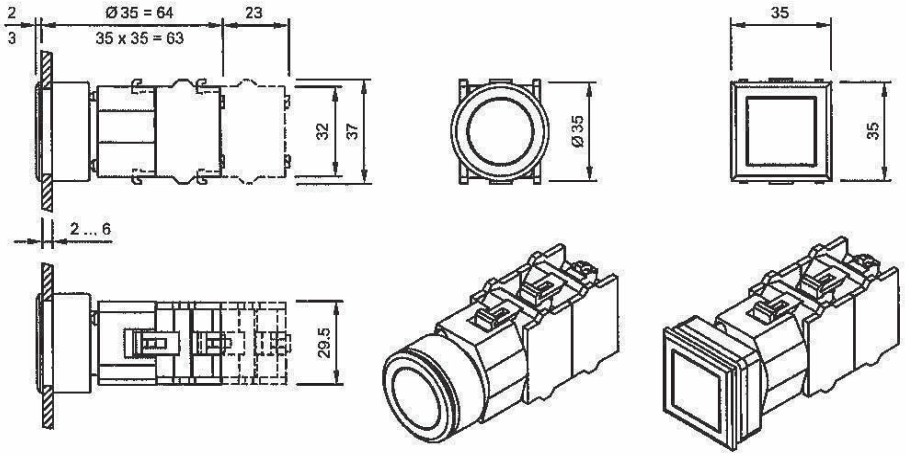
Continued from previous page

	Front protection	Switching action	Frontbezel/-ring	Lens	⌀ 35 x 35 mm Typ-Nr.	Ø 35 mm Typ-Nr.	Mounting dimensions	Technical drawing	Circuit drawing	kg
Pushbutton actuator, flush mounting	IP 65	M	Aluminium natural	Aluminium black		**704.011.018**	7	22	4	0.051
				Aluminium blue		**704.011.618**	7	22	4	0.051
				Aluminium gold		**704.011.418**	7	22	4	0.051
				Aluminium natural		**704.011.818**	7	22	4	0.051
				Aluminium olive-green		**704.011.518**	7	22	4	0.051
				Aluminium red		**704.011.218**	7	22	4	0.051
				Plastic black		**704.012.018**	7	22	4	0.051
				Plastic blue		**704.012.618**	7	22	4	0.051
				Plastic colourless		**704.012.718**	7	22	4	0.051
				Plastic green		**704.012.518**	7	22	4	0.051
				Plastic red		**704.012.218**	7	22	4	0.051
				Plastic yellow		**704.012.418**	7	22	4	0.051

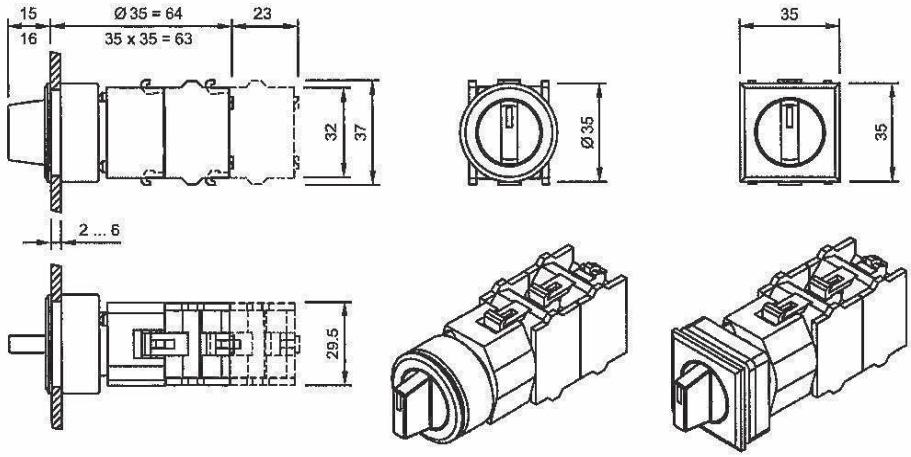
Switching action: MA = Maintained action, M = Momentary action
Mounting dimensions from page 87, Technical drawing from page 91, Circuit drawing from page 110

Drawings 04

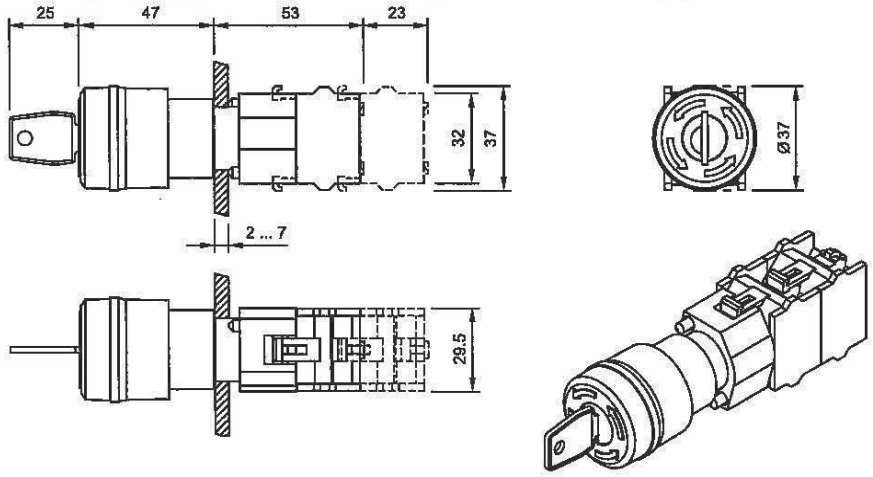
22 Pushbutton actuator, flush mounting page 33



23 Selector switch actuator 2 positions, short lever, flush mounting page 39 | **Selector switch actuator 3 positions, short lever, flush mounting** page 41 | **Selector switch actuator 3 positions, long lever, flush mounting** page 42



24 Emergency-stop pushbutton actuator, foolproof EN IEC 60947-5-5 page 21



Accessories

Switching element

	Switching system	Contacts	Contact material	Terminals	Typ-Nr.	Technical drawing	Circuit drawing	kg
Switching element	SM	1 NC	Au-Ag	ST	**704.911.2**	28	7	0.021
			Ag-Cu	D-PT 6.3	**704.915.2/D**	30	7	0.025
				PT 6.3	**704.915.2**	29	7	0.021
				ST	**704.910.2**	28	7	0.021
			Ag-Pd	ST	**704.912.2**	28	7	0.021
		1 NC + 1 NO	Au-Ag	ST	**704.911.5**	28	48	0.028
			Ag-Cu	D-PT 6.3	**704.915.5/D**	30	48	0.032
				PT 6.3	**704.915.5**	29	48	0.028
				ST	**704.910.5**	28	48	0.028
			Ag-Pd	ST	**704.912.5**	28	48	0.028
		1 NO	Au-Ag	ST	**704.911.1**	28	8	0.021
			Ag-Cu	D-PT 6.3	**704.915.1/D**	30	8	0.025
				PT 6.3	**704.915.1**	29	8	0.021
				ST	**704.910.1**	28	8	0.021
			Ag-Pd	ST	**704.912.1**	28	8	0.021
		2 NC	Au-Ag	ST	**704.911.4**	28	50	0.028
			Ag-Cu	D-PT 6.3	**704.915.4/D**	30	50	0.032
				PT 6.3	**704.915.4**	29	50	0.028
				ST	**704.910.4**	28	50	0.028
			Ag-Pd	ST	**704.912.4**	28	50	0.028
		2 NO	Au-Ag	ST	**704.911.3**	28	49	0.028
			Ag-Cu	D-PT 6.3	**704.915.3/D**	30	49	0.032
				PT 6.3	**704.915.3**	29	49	0.028
				ST	**704.910.3**	28	49	0.028
			Ag-Pd	ST	**704.912.3**	28	49	0.028
	SA	1 NC	Au-Ag	D-PT 6.3	**704.901.2/D**	30	7	0.026
				ST	**704.901.2**	28	7	0.021
			Ag-Cu	D-PT 6.3	**704.905.2/D**	30	7	0.026
				PT 6.3	**704.905.2**	29	7	0.021
				ST	**704.900.2**	28	7	0.021
			Ag-Pd	ST	**704.902.2**	28	7	0.021
		1 NC + 1 NO	Au-Ag	D-PT 6.3	**704.901.5/D**	30	48	0.033
				ST	**704.901.5**	28	48	0.028
			Ag-Cu	D-PT 6.3	**704.905.5/D**	30	48	0.033
				PT 6.3	**704.905.5**	29	48	0.028
				ST	**704.900.5**	28	48	0.028
			Ag-Pd	ST	**704.902.5**	28	48	0.028
		1 NO	Au-Ag	D-PT 6.3	**704.901.1/D**	30	8	0.026
				ST	**704.901.1**	28	8	0.021
			Ag-Cu	D-PT 6.3	**704.905.1/D**	30	8	0.026
				PT 6.3	**704.905.1**	29	8	0.021
				ST	**704.900.1**	28	8	0.021
			Ag-Pd	ST	**704.902.1**	28	8	0.021
		2 NC	Au-Ag	D-PT 6.3	**704.901.4/D**	30	50	0.033
				ST	**704.901.4**	28	50	0.028
			Ag-Cu	D-PT 6.3	**704.905.4/D**	30	50	0.033
				PT 6.3	**704.905.4**	29	50	0.028
				ST	**704.900.4**	28	50	0.028
			Ag-Pd	ST	**704.902.4**	28	50	0.028

Continuation see next page

Accessories

Continued from previous page

	Switching system	Contacts	Contact material	Terminals	Typ-Nr.	Technical drawing	Circuit drawing	g
Switching element	SA	2 NO	Au-Ag	D-PT 6.3	**704.901.3/D**	30	49	0.033
				ST	**704.901.3**	28	49	0.028
			Ag-Cu	D-PT 6.3	**704.905.3/D**	30	49	0.033
				PT 6.3	**704.905.3**	29	49	0.028
				ST	**704.900.3**	28	49	0.028
			Ag-Pd	ST	**704.902.3**	28	49	0.028

For the 3rd switching element per switch the terminal marking insert is to be ordered separately.
Switching system: SM = Slow-make switching element, SA = Snap-action switching element
Contacts: NC = Normally closed, NO = Normally open
Contact material: Au-Ag = Gold-Silver, Ag-Cu = Hard silver, Ag-Pd = Silver-Palladium
Terminals: ST = Screw terminal, D-PT 6.3 = Double plug-in terminal 6.3 mm, PT 6.3 = Plug-in terminal 6.3 mm
Technical drawing from page 91, Circuit drawing from page 110

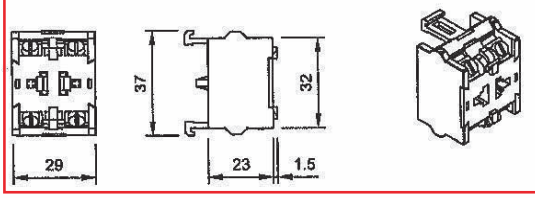
Switching element for ring cable shoe

	Switching system	Contacts	Contact material	Terminals	Typ-Nr.	Technical drawing	Circuit drawing	g
Switching element for ring cable shoe	SM	1 NC	Au-Ag	ST	**704.911.2B**	28	7	0.021
			Ag-Cu	ST	**704.910.2B**	28	7	0.021
		1 NC + 1 NO	Au-Ag	ST	**704.911.5B**	28	48	0.028
			Ag-Cu	ST	**704.910.5B**	28	48	0.028
		1 NO	Au-Ag	ST	**704.911.1B**	28	8	0.021
			Ag-Cu	ST	**704.910.1B**	28	8	0.021
		2 NC	Au-Ag	ST	**704.911.4B**	28	50	0.028
			Ag-Cu	ST	**704.910.4B**	28	50	0.028
		2 NO	Au-Ag	ST	**704.911.3B**	28	49	0.028
			Ag-Cu	ST	**704.910.3B**	28	49	0.028
	SA	1 NC	Ag-Cu	ST	**704.900.2B**	28	7	0.021
		1 NC + 1 NO	Ag-Cu	ST	**704.900.5B**	28	48	0.028
		1 NO	Ag-Cu	ST	**704.900.1B**	28	8	0.021
		2 NC	Ag-Cu	ST	**704.900.4B**	28	50	0.028
		2 NO	Ag-Cu	ST	**704.900.3B**	28	49	0.028

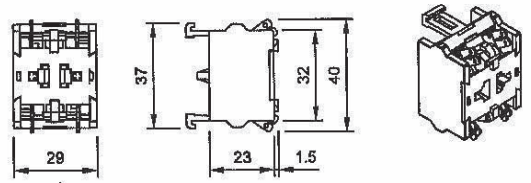
Switching system: SM = Slow-make switching element, SA = Snap-action switching element
Contacts: NC = Normally closed, NO = Normally open
Contact material: Au-Ag = Gold-Silver, Ag-Cu = Hard silver
Terminals: ST = Screw terminal
Technical drawing from page 91, Circuit drawing from page 110

Drawings 04

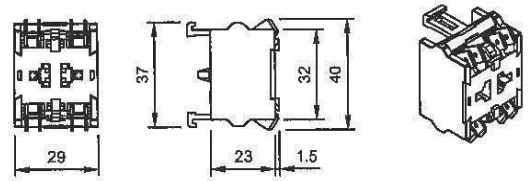
28 Switching element page 50 | **Switching element for ring cable shoe** page 51 | **Switching element for Emergency-stop pushbutton** page 52



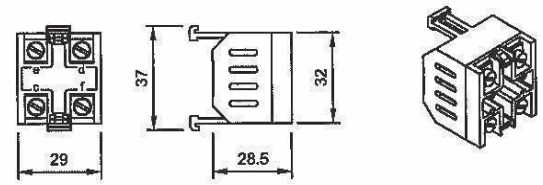
29 Switching element page 50 | **Switching element for Emergency-stop pushbutton** page 52



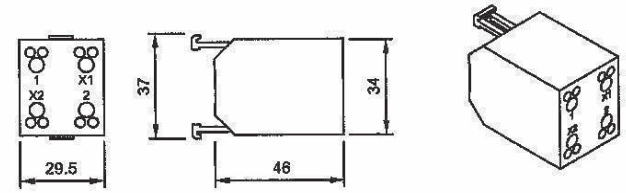
30 Switching element page 50 | **Switching element for Emergency-stop pushbutton** page 52



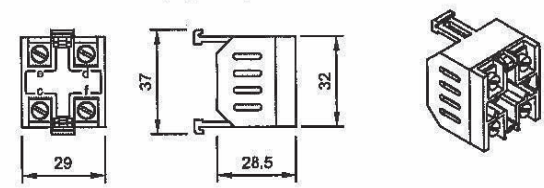
31 Flasher element page 49



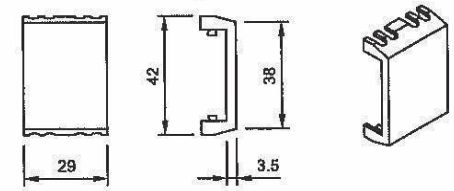
32 Lamp transformer page 57



33 Diode block page 56 | **Resistor block** page 57 | **Resistor-diode block** page 57



34 Terminal cover page 54



Technical Data 04

Snap-action switching element

Switching system

The double-break, snap-action switching element is equipped with one or two independent contact systems, acting as normally open or normally closed contact. The snap-action switching element is fitted with self-cleaning contacts.
Up to 3 switching elements can be snapped to each actuator.
Snap-action switching elements are not permissible for emergency-stop pushbuttons !

Material

Material of contact
Hard Silver, Gold-Silver, Silver-Palladium (for aggressive atmospheres)

Switch housing
Polycarbonate (PC)

Mechanical characteristics

Terminals
Screw terminals
Plug-in terminals 6.3 x 0.8 mm
max. wire cross-section 2 x 2.5 mm²
max. wire cross-section of stranded cable 2 x 1.5 mm²
For switches with plug-in terminals it is necessary to provide insulation sleeves and to maintain a spacing of 65 mm between rows (mounting dimensions)

Tightening torque
Screws at the mounting flange max. 25 Ncm
Screws at switching element max. 50 Ncm

Actuating force
1 Normally closed 1.9 N
1 Normally open 2 N

Actuating travel
5.8 mm ± 0.2 mm

Rebound time
≤3 ms

Mechanical lifetime
(with 1 switching element)

Pushbutton maintained action	1.5 million	Cycles of operation
Pushbutton momentary action	3 million	Cycles of operation
Selector switch maintained action	1.25 million	Cycles of operation
Selector switch momentary action	2.5 million	Cycles of operation
Keylock switch maintained action	25 000	Cycles of operation
Keylock switch momentary action	50 000	Cycles of operation

Electrical characteristics

Standards
The switches comply with the "Standards for low-voltage switching devices" EN IEC 60947-5-1

Rated Insulation Voltage U_i
500 VAC/600 VDC, as per EN IEC 60947-5-1

Contact resistance
New state ≤50 mΩ as per DIN IEC 60512-2-4

Conventional free air thermal current I_{th}
10 A, as per EN IEC 60947-5-1
the maximum current in continuous operation and at ambient temperature must not exceed the quoted maximum values.

Isolation resistance
≥10 MΩ between open contacts at 500 VDC, as per DIN IEC 60512-2-10

Switch rating
At switch rating AC for Gold-Silver, Silver-Palladium and Hard Silver contacts, service category AC-15, as per EN IEC 60947-5-1 (cosϕ 0.3)

Voltage	230 VAC	400 VAC	500 VAC
Current	6 A	4 A	2.5 A

At switch rating DC for Gold-, Silver- and Hard Silver contacts service category DC-13, as per EN IEC 60947-5-1

Voltage	24 VDC	60 VDC	110 VDC
Current	10 A	3 A	1 A

Recommended minimum operational data
Gold-Silver contacts :

Voltage	5 VDC	24 VDC	110 VDC
Current	15 mA	5 mA	2 mA

Hard Silver contacts :

Voltage	24 VDC	110 VDC
Current	50 mA	10 mA

Protection class
Indicators and switches, fit for mounting into devices with protection class II

Environmental conditions

Storage temperature
-40 °C ... +85 °C

Operating temperature
-40 °C ... +55 °C

Shock resistance
(single impacts, semi-sinusoidal)
300 m/s²puls width 11 ms, as per EN IEC 60068-2-27

Vibration resistance
(sinusoidal)
100 m/s² at 10 Hz ... 500 Hz, amplitude 0,75 mm, as per EN IEC 60068-2-6

Approvals

Approbations
CB (IEC 60947)
CCC
CSA
Germanischer Lloyd
GOST
SEV
UL

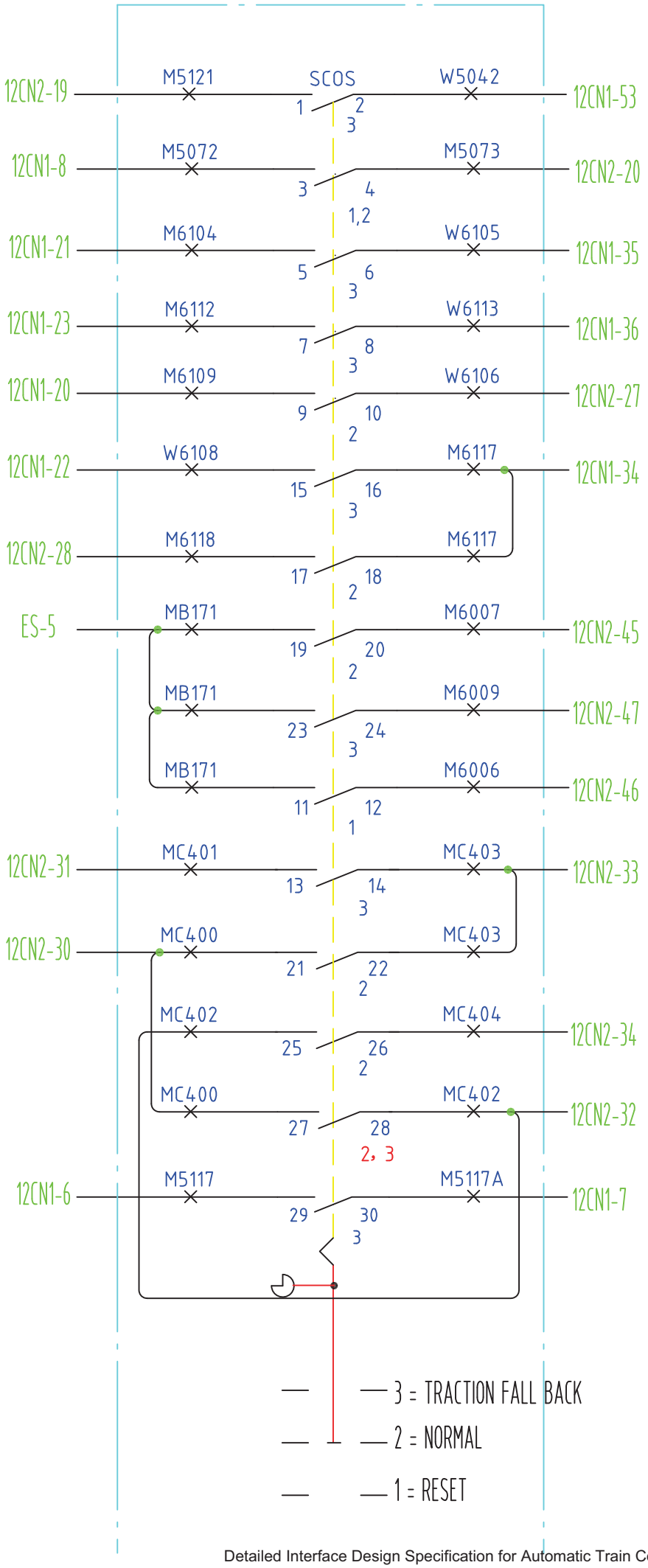
Declaration of conformity
CE

DETAILED INTERFACE SPECIFICATION

ANNEX C8
SCOS CHARACTERISTICS

XD9031-8(SCOS)New

Contact	1	2	3
	-90	0	90
1-2			X
3-4	X	X	
5-6			X
7-8			X
9-10		X	
11-12	X		
13-14			X
15-16			X
17-18		X	
19-20		X	
21-22		X	
23-24			X
25-26		X	
27-28		X	X
29-30			X
31-32			


12CN2-19
M5121
SCOS
W5042
12CN1-53
12CN1-8
M5072
M5073
12CN2-20
12CN1-21
M6104
W6105
12CN1-35
12CN1-23
M6112
W6113
12CN1-36
12CN1-20
M6109
W6106
12CN2-27
12CN1-22
W6108
M6117
12CN1-34
12CN2-28
M6118
M6117
ES-5
MB171
M6007
12CN2-45
MB171
M6009
12CN2-47
MB171
M6006
12CN2-46
12CN2-31
MC401
MC403
12CN2-33
12CN2-30
MC400
MC403
MC402
MC404
12CN2-34
MC400
MC402
12CN2-32
12CN1-6
M5117
M5117A
12CN1-7
1,2
2, 3
3 = TRACTION FALL BACK
2 = NORMAL
1 = RESET

Kraus & Naimer

BLUE LINE switchgear

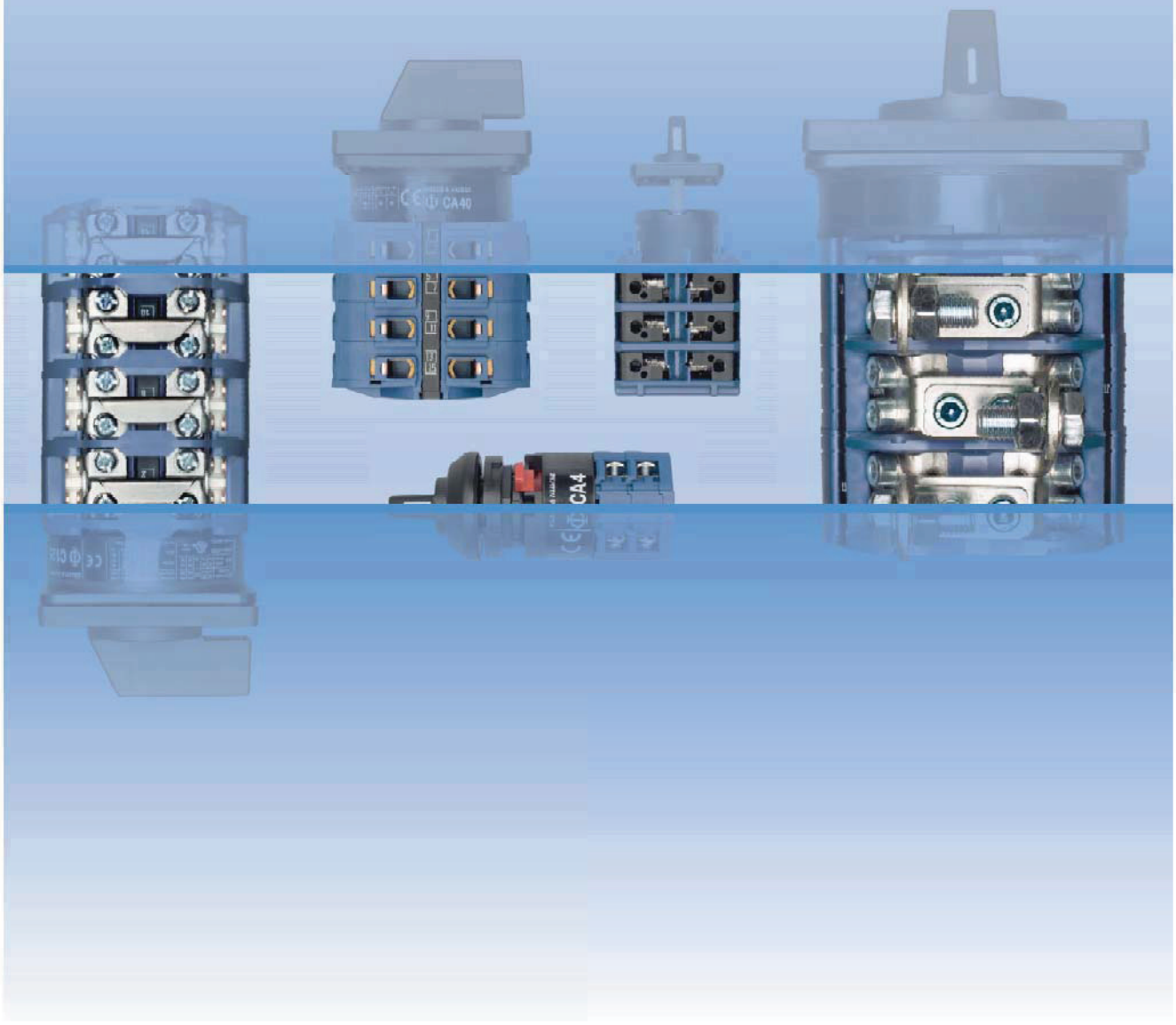
since 1907

Catalog 100

11/2008

Control and Load Switches for higher Capacities

CL type up to 20 A
CAD, CA and C type up to 315 A
L type up to 2400 A



Disconnectors and Main Switches acc. to IEC 60947-3 see Catalog 500

Contents

	Page
Construction Data	2
Dimensions and Nominal Ratings	3
How to order	4, 5
Switch Function and Configuration	
CL Switches 10 A-20 A C, CA and CAD Switches 10 A-315 A	
ON/OFF Switches	6, 7
Double-throw Switches	8-10
General Application Switches	10
Coding Switches	11
Multi-step Switches	12-14
Voltmeter Switches	15-17
Ammeter Switches	17-19
Volt-ammeter Switches	19
Control Switches	19, 20
Motor Switches	21-23
L Switches 350 A-2400 A	
ON/OFF Switches	24-26
Double-throw Switches	26, 27
Multi-step Switches	27, 28
Types of Mounting	
Panel Mounting	29-33
Base Mounting	34
Wall Mounting	35
Escutcheon Plates	36, 37
Handles	38
International Standards and Approvals	39
Technical Data	40-43
Dimensions	
Panel Mounting	44-48
Base Mounting	48, 49
Wall Mounting	50
Overall Switch Lengths	50, 51
Blue Line Switchgear: Summary	52

Construction Data

The load switches of the C, CA, CAD and CL-series offer a solution for most cam switch applications. Different contact designs, contact materials and terminals allow for their use as control switches, instrumentation switches and motor control switches, as well as in electronic circuitry and in aggressive environments according to IEC 60947-3 and VDE 0660 part 107.

The stage is the basis for all switches and can be supplied with a maximum of 2 contacts. The terminals are accessible from the side. CA and CAD switches are supplied with open terminals to facilitate wiring and are protected against accidental finger contact according to EN 50274, VDE 0660 part 514 and BGV A3. Switches up to type CA25B are supplied with captive screws with clamping plates. The switch types CA40-CA63 are supplied with box terminals. Captive plus-minus terminal screws and integrated screwdriver guides facilitate wiring.

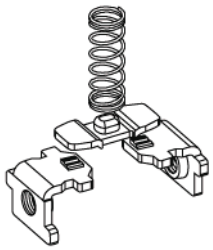
The switches of the new CL-series are supplied with rust-free and acid-resisting IDC terminals (**I**nsulation **D**isplacement **C**onnection) instead of screw type terminals. The stripping or preparation of the insulation is no longer required. Eliminate errors due to i.e., stripped end of the conductor too long or too short, incorrect sleeves used, sleeves crimped incorrectly or wrong crimping tool is used, terminal screws not tightened properly etc. The CL switches reduce installation time by 60 %-70 % compared to the screw type terminals. This translates to significant cost savings. For connecting 2 conductors to a terminal an additional screw terminal with plus-minus screw is available.

If a positive manual operation or a higher DC rating is required, many of these switches can be fitted with a snap action latching mechanism - suffix „S“ - to the switch type.

The cam-operated switches of the L-series are continuous current rated for off-load switching. They may be used to switch resistive or low inductive loads.

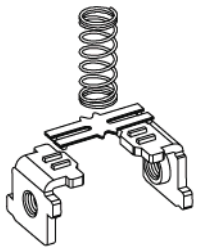
Special Contact Systems

CA4/CA4-1



High contact reliability by multiple cross-point contacts, electronic compatible, CA4 with 1 μ and CA4-1 with 35 μ gold plating.

CAD11/CAD12



H-bridge with „cross-wire“ contact system, high contact reliability also at lower voltages. CAD11 with gold-plated contacts, CAD12 with silver contact.

Type	Size	Possible Switching Angles	Max. No. of Stages
CA4, CA4-1	S00	30°, 45°, 60°, 90°	9
CL4	S00	30°, 45°, 60°, 90°	8
CA10-CA25	S0	30°, 45°, 60°, 90°	12
CA10S-CA25S	S0	60°	on request
CAD11, CAD12	S0	30°, 45°, 60°, 90°	12
CL10	S0	30°, 45°, 60°, 90°	10
CA10B-CA25B	S1	30°, 45°, 60°, 90°	12
CA40, CA50, CA63	S1	30°, 45°, 60°, 90°	12
C80, C125	S2	20°, 30°, 45°, 60°, 90°	12
C315	S3	20°, 30°, 45°, 60°, 90°	12
L350/51, L630/31, L1000/01, L1250/51	S2	30°, 45°, 60°, 90°	12
L400, L600, L800, L1200, L1600, L2000	S3	30°, 45°, 60°, 90°	12

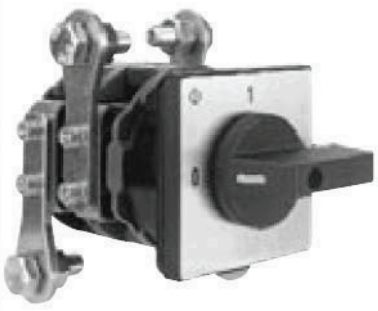
CL Switches

CA and CAD Switches (CA4-CA25B)

CA Switches (CA40-CA63)

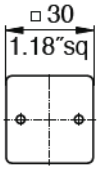
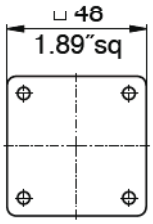
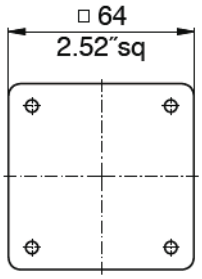
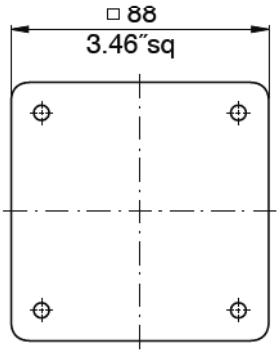
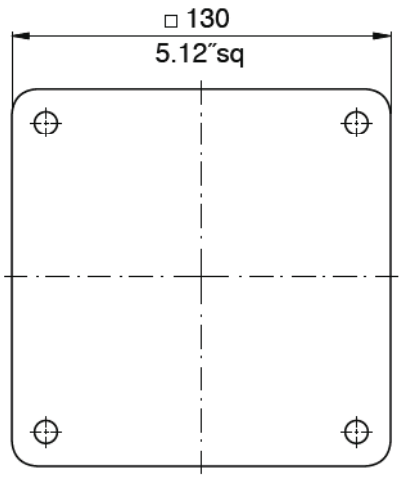
C Switches

L Switches



Above illustrates the standard terminal positions.

Nominal Ratings

Switch Size		Type	According to IEC 60947-3/VDE 0660 part 107			
			Insulation Voltage[1] U_i V	Thermal Current I_u/I_{th} A	Motor Rating 3 x 380 V-440 V AC-23 kW	AC-3 kW
S00		**CA4**	440	10	3	2,2
		CA4-1	440	10	3	2,2
		CL4	440	10	3	2,2
S0		**CA10**	690	20	7,5	5,5
		CA11	690	20	7,5	5,5
		CA20	690	25	11	7,5
		CA25	690	32	15	11
		CAD11	600	6	-	-
		CAD12	600	6	-	-
		CL10	690	20	7,5	5,5
S1		**CA10B**	690	20	7,5	5,5
		CA11B	690	20	7,5	5,5
		CA20B	690	25	11	7,5
		CA25B	690	32	15	11
		CA40	690	40	18,5	15
		CA50	690	50	22	18,5
		CA63	690	63	30	18,5
S2		**C80**	690	115	45	30
		C125	690	150	75	37
		L350	690	350	90	37
		L351	690	350	90	37
		L630	690	630[2]	90	37
		L631	690	630[2]	90	37
		L1000	690	1000[2]	90	37
		L1001	690	1000[2]	90	37
		L1250	690	1250[2]	90	37
		L1251	690	1250[2]	90	37
S3		**C315**	690	315	132	55
		C315[3]	1000	315	132	55
		L400	690	500	132	55
		L600	690	800[2]	132	55
		L800	690	1100[2]	132	55
		L1200	690	1450[2]	132	55
		L1600	690	1900[2]	132	55
		L2000	690	2400[2]	132	55

For further technical details, refer to pages 40-43.
To furnish with gold contacts and quick connects see page 4.

[1]Valid for lines with grounded common neutral termination, overvoltage category III, pollution degree 3. Values for other supply systems on request. [2]Ambient temperature 35 °C max. [3]Additional switch functions on request.

DETAILED INTERFACE SPECIFICATION

ANNEX C9
ZVR1, ZVR2, EBR1, EBR2 RELAYS SPECIFICATIONS
QN10 RELAYS P/N: B18559/1
TRAIN MOUNTING BASE P/N: C17806/7

Glossary of Terms

This glossary is divided into two parts; Part A - Relay Types and Part B – Relay terms and characteristics.

PART A – RELAY TYPES

A.C. Immune
A d.c. relay which will not operate if an a.c. voltage up to a stated value is applied to the relay coil.

Biased
A d.c. relay which will only operate with one particular polarity of supply. It will not operate if supply polarity is reversed.

Double Wound Coils
A neutral d.c. relay with two equal independent windings on the coil. Each winding will operate the relay so that relay can be operated from either of two independent sources.

Lamp Proving Relays
A neutral d.c. relay designed to operate from the current supplied to signal lamps and to release when lamp or lamps burn out. Some relays incorporate a bridge rectifier to operate from a.c. lamp currents.

Magnetically Latched
A d.c. relay which will only operate with one particular polarity of supply and remains operated when supply is removed. A second winding of the relay coil must be energised with the correct polarity supply to release the relay.

Neutral
A d.c. relay which will operate with either polarity of supply to the coil.

Sensitive Relay
Generally a neutral relay with high coil resistance and low power consumption.

Slow Acting Relays
A neutral d.c. relay with a built in copper slug to delay the operation or release action (time delay range 0-500 ms). Units incorporating various timing methods such as thermal, capacitor/resistor, electronic or synchronous motor (time delay 0-4 minutes).

Track Relay
Generally a neutral relay with low coil resistance and low power consumption.

Train Carried Relays
These relays are basically a standard design Q type relay with special relay bases to enable them to fit on anti-vibration resilient mountings.

Twin Relays
A unit having two independent relays, with up to 8 contacts each, all in a standard ‘Q’ type case. Both relays are of the same standard of construction and safety as the single ‘Q’ relays.

PART B – RELAY TERMS AND CHARACTERISTICS

Back Contact
A contact made when the relay is de-energised.

Front Contact
A contact made when the relay is energised.

Full Operate
The condition the relay assumes when its armature has complete full travel and maximum contact pressure is obtained.

Heavy Duty Front Contacts
These contacts are Sig/Sil contacts fitted with magnetic blowouts to extend the life of the contacts when switching high current loads.

Interruption Time
The time interval the supply to the relay can be interrupted without the relay releasing.

Metal to Metal Contacts
These are 'Non-Safety' contacts. Both elements are of the same material that can be silver, silver cadmium oxide or 60/40 silver palladium. The silver cadmium oxide is 'Weld Resistant' but not 'Non-Weld'.

MTBF
Mean time between failures.

MTBWSF
Mean time between wrong side failures.

Operate *(also known as Pick-Up or P.U.)*
The condition of the relay when all front contacts are just made.

Operate Time
The time interval measured between switching on the supply and the last front contact making.

Operate Transit Time
The time interval measured between the first back contact breaking and the last front contact making.

Percentage Release
The ratio of the actual release value : operate value, multiplied by 100.

Release *(also known as Drop Away or D.A.)*
The condition of the relay when all front contacts have opened.

Release Time
The time interval measured between the first front contact breaking and the last back contact making.

Vital (Safe)
Defines circuits and components that comply with stringent requirements of reliability and intrinsic safety.

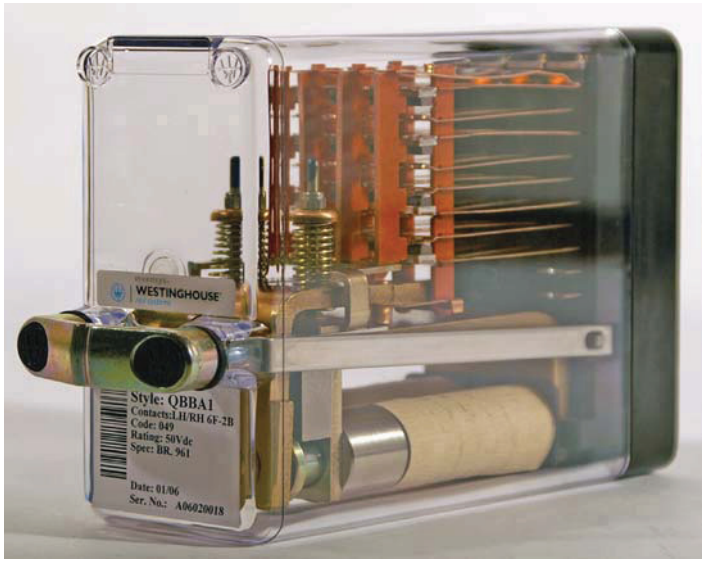
SIG/SIL Contacts
These are 'Non-weld' safety contacts. One contact is of 'silver impregnated graphite' and the other silver.

For further technical information, please contact Customer Services Dept TEL: +44(0) 1249 441420

Westinghouse Rail Systems Limited, PO Box 79, Pew Hill, Chippenham, Wiltshire, SN15 1JD UK
Tel: +44(0) 1249 441441 Email: marketing@wrsl.com
Fax: +44(0) 1249 652322 Website: www.wrsl.com

Q Series Relays

Westinghouse Rail Systems Limited Style Q-Relays are based on a series of designs for "miniature" plug in relays developed during the late 1950's



BR930 Series relays offer considerable size and cost savings when compared with the previous large plug-in and shelf type designs. Careful attention to detail design culminated in the production of a safe dependable and efficient relay, within a standardised minimum space envelope.

A method of safety interlocking was evolved such that only those units compatible with the plugboard could be mounted.

British Rail (now Network Rail) subsequently approved IRSE (Institute of Railway Signalling Engineers) designs for the relay and published them as a series of B.R specifications, starting with B.R.930.

This specified the requirements for a basic D.C, neutral, tractive-armature relay.

Style Q-Relays comply with the relevant emission requirements of EN 55014. It is considered that these relays have inherent immunity to in-service electro-magnetic disturbance

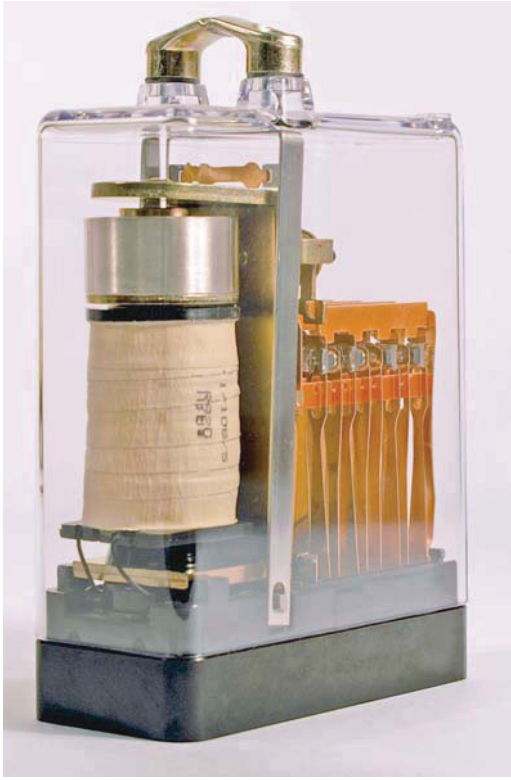
Relay Types

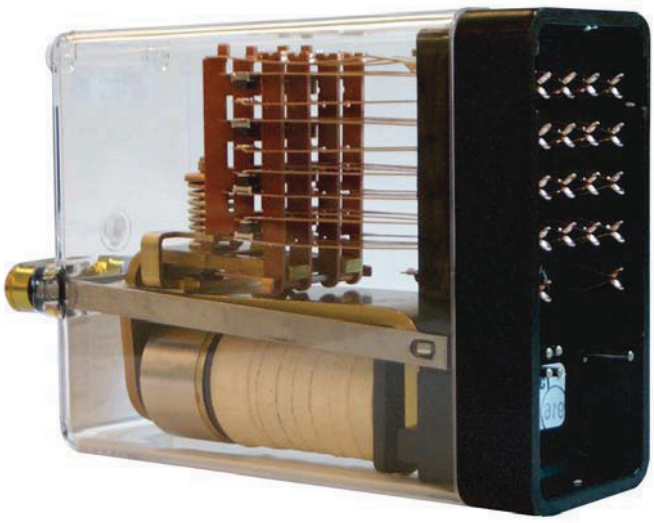
Style Q relays comprise three main categories:

- Single Relays (Most Common)
- Twin Relays (Identical to singles in size but offer cost and space advantages when less contacts required)
- Miscellaneous Relay Units (Used in conjunction with relays in signalling circuits)

Features

- Over 400 different relay variants
- Safety Interlocking system for insertion into plugboards
- Insect proofing for tropical countries
- Polycarbonate cover held in place by internal support strap
- Various Contact arrangements available
- Heavy duty contacts suitable for high current
- Weld resistant contact pairs fitted as standard





Temperature Range

Temperature Range: -20 deg C to 60 deg C

Reliability

Mean Time Between Failures: 2.56 x 10^6 hrs

Contact Ratings

Standard (Sig-Sil) contacts

Continuous Current: 4 Adc
Switching Current 12 Vdc 24W lamp load or 3 x BR930 relays rated at 3 W each.

Heavy Duty (Sig-Sil) Contacts

Continuous Rating: 7 A carrying
Switching Current: 2 A @ 110Vdc Inductive

Elkonite Weld Resistant Contacts

Continuous Rating: 6 A Adc
Switching Current 4 x 24 Vdc

Every effort has been made to ensure that the information contained in this document was correct at the time of going to press. However, the company retains the right to change any specification without notice.

For more details contact:

Westinghouse Rail Systems Limited
PO Box 79, Pew Hill, Chippenham,
Wiltshire SN15 1JD

Tel: +44 (0) 1249 441 441
Fax: +44 (0) 1249 441 442
Email: marketing@wrsl.com

www.wrsl.com

Registered Office: Portland House, Bressenden Place, London SW1E 5BF
Registered in England and Wales No. 1641421

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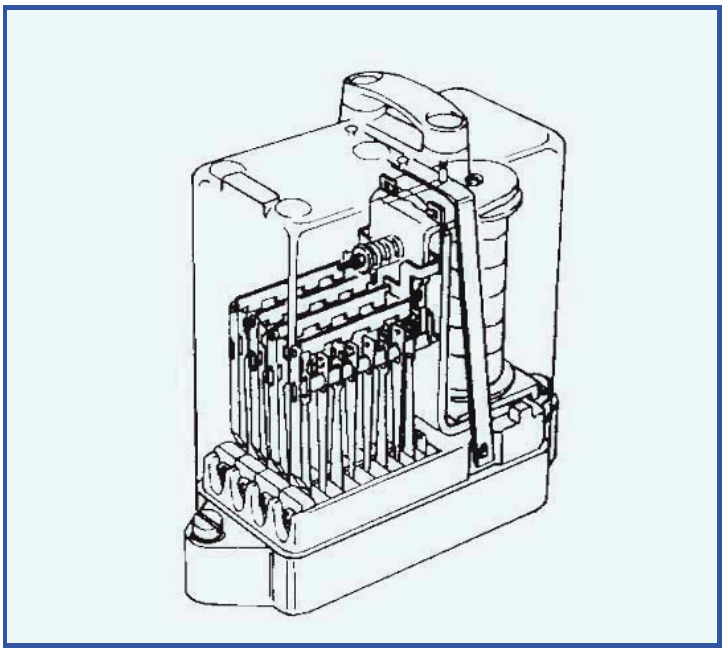
Data Sheet Part 7-2-41

Issue 3
April 2009

QN10



DESCRIPTION

A d.c. neutral, tractive armature relay designed for trainborne service.

In place of the standard securing clip the relay is attached to special anti-vibration brackets. The coil is impregnated to resist the effects of vibration to the windings.

NOTE: *This relay must not be energised from a traction control supply without surge suppression.*

GENERAL DATA

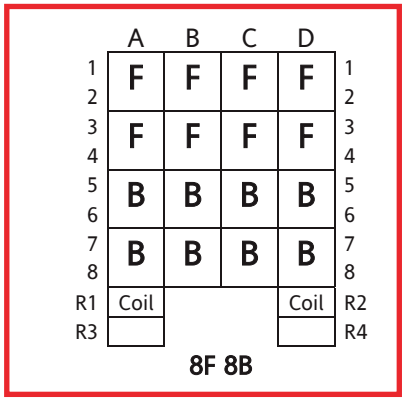
Nominal Rated Voltage:	24, 36, 40, 50, 72 and 110 V d.c.
Contact Arrangements:	8F 8B, 10F 6B
Approximate Weight:	1.2 kg

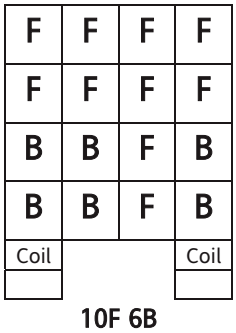
Note: *Refer to Data Sheet Part 7-1-1 for general information and contact ratings.*

Refer overleaf for specific data.

CONTACT LAYOUTS

Viewed from rear





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TECHNICAL DATA

WSL PART NUMBER	CONTACTS	RATED VOLTS d.c.	PIN CODE	COIL RES (ohms)	WDG SPEC 1/108/-	MAX FULL OP. (Vd.c.)	MIN REL (Vd.c.)	PLUGBOARD E7218/1 DRILLED TO (SEE NOTE)	REQD NO. OF CONNECTORS J4137/3	REMARKS
B18559/1	8F 8B	50	XCEFJ	1490	117	35 MIN OP 21.5	15 MAX REL 20	J4138/315	34	
B18559/2	8F 8B	40	XCEFK	1050	129	26	5	J4138/316	34	
B18559/3	8F 8B	24	XEGHK	350	155	19.2	3.6	J4138/358	34	
B18559/4	10F 6B	36	ABCDS	600	158	20.5	7.0	J4138/367	34	
B18559/5	8F 8B	110	BDEKS	5200	178	60	20	J4138/439	34	
B18559/6	8F 8B	72	BDFHS	3500	227	45 MAX OP 20 MIN OP	10	J4138/481	34	

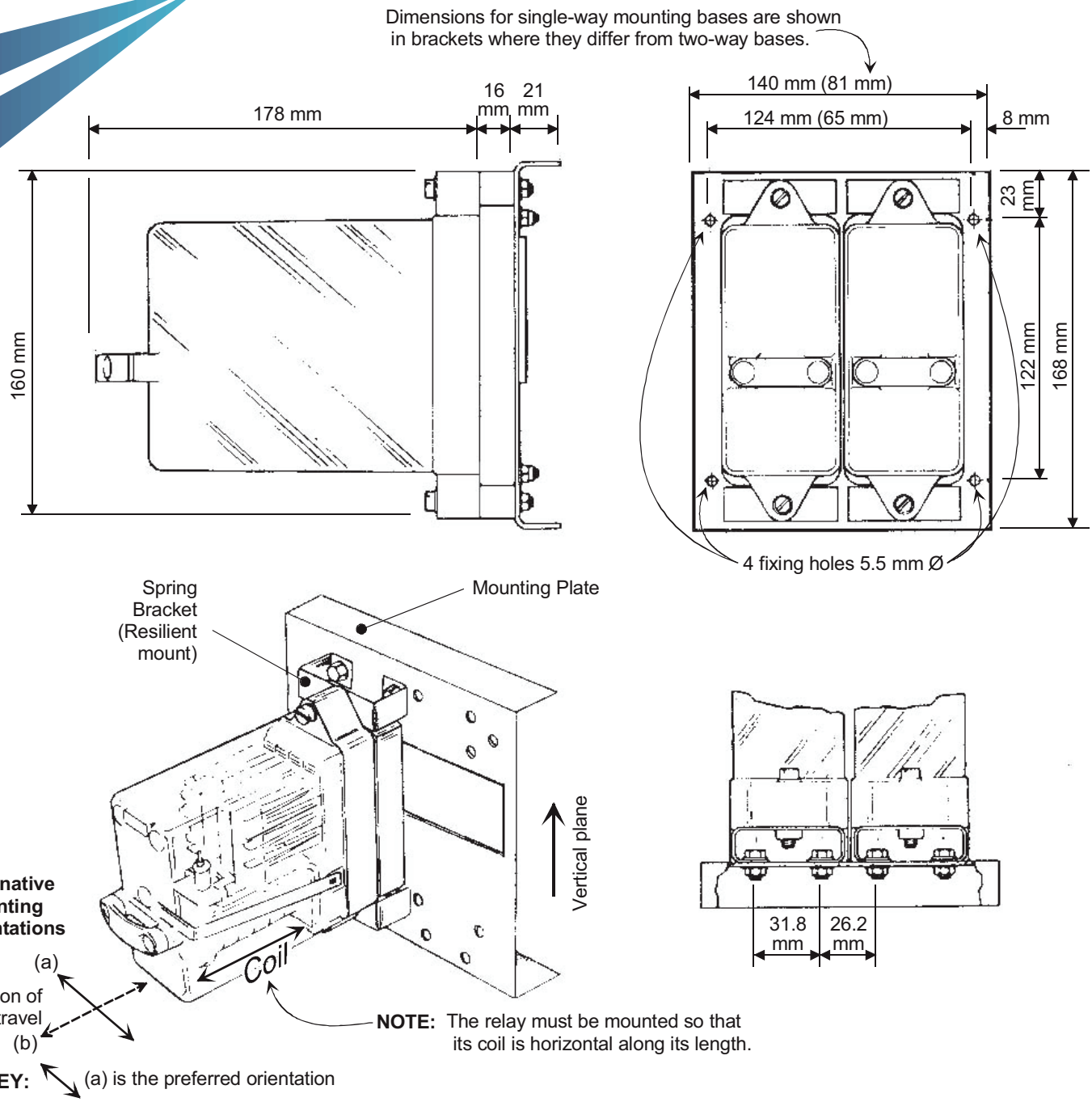
Note: *Plugboards included for reference only as they are included in special train carried mounting base, Data Sheet Part 8-1.*

For further technical information, please contact Customer Services Dept TEL: +44(0) 1249 441420

Westinghouse Rail Systems Limited, PO Box 79, Pew Hill, Chippenham, Wiltshire, SN15 1JD UK
Tel: +44(0) 1249 441441 **Email: marketing@wrsl.com**
Fax: +44(0) 1249 652322 **Website: www.wrsl.com**

Mounting Bases for Train Carried Relays

Data Sheet 8-1
Issue 4
April 2009



DESCRIPTION

The relay is screwed to two resilient mounting brackets which are screwed to the mounting plate. The mating relay plugboard is also fastened to the mounting plate but with limited movement. With the relay engaged with the plugboard both can move on the resilient mountings to a limited degree.

NOTE: *The Mounting Bases are supplied assembled and include Plugboard(s), Spring Brackets and Mounting Plate. Retaining Clips J4136/1 are not required. The 4 off 5.5 mm Ø clearance holes can be used to fix the Mounting Plate Assembly to the customer's panel using stand offs supplied by the customer.*

TECHNICAL DATA

MOUNTING BASE ASSEMBLY FOR 2-OFF TRAIN CARRIED RELAYS		
WRSL PARTNUMBER	**TO FIT RELAYS**	**MOUNTING PLATE FINISH**
C17806/1	2–Off QNC10 B18556/1	Tropical (Zinc plated and painted white)
C17806/2	2–Off QNC11 B18558/1	Tropical (Zinc plated and painted white)
C17806/3	2–Off QNC10 B18556/2	Yellow fire resistant paint to suit LUL
C17806/4	2–Off QNC10 B18556/5	Yellow fire resistant paint to suit LUL
C17806/5	1–Off QNC10 B18556/5 and 1–Off QNC11 B18558/4	Yellow fire resistant paint to suit LUL
C17806/6	1–Off QNC10 B18556/2 and 1–Off QNC11 B18558/5	Yellow fire resistant paint to suit LUL
C17806/7	2–Off QN10 B18559/1	Yellow fire resistant paint to suit LUL
C17806/8	2–Off QN10 B18559/3	Yellow fire resistant paint to suit LUL
C17806/9	2–Off QNN10 B18560/4	Yellow fire resistant paint to suit LUL
C17806/10	1–Off QNC10 B18556/2 and 1–Off QN10 B185559/5	Yellow fire resistant paint to suit LUL
C17806/11	2–Off QNC11 B18558/5	Tropical (Zinc plated and painted white)
C17806/12	2–Off QNC10 B18556/3	Tropical (Zinc plated and painted white)

MOUNTING BASE ASSEMBLY FOR 1-OFF TRAIN CARRIED RELAYS		
WRSL PARTNUMBER	**TO FIT RELAYS**	**MOUNTING PLATE FINISH**
C17821/1	1–Off QNC10 B18556/1	Tropical (Zinc plated and painted white)
C17821/2	1–Off QN10 B18559/4	Tropical (Zinc plated and painted white)
C17821/3	1–Off QNC10 B18556/2	Tropical (Zinc plated and painted white)
C17821/4	1–Off QNC11 B18558/1	Tropical (Zinc plated and painted white)
C17821/5	1–Off QN10 B18559/5	Tropical (Zinc plated and painted white)
C17821/6	1–Off QN10 B18559/6	Tropical (Zinc plated and painted white)

NOTE: *If the desired mounting base configuration is not shown in the table, consult Westinghouse Rail Systems Limited. The above mounting bases are supplied without crimp connectors J4137/3 except for C17806/7 and /8 (which are supplied with 68 connectors J4137/3) andC17806/12 (which is supplied with 44 connectors J4137/3). For bases other than C17806/7, /8 and 12, the crimp connectors must be ordered separately. For quantity of connectors required per relay see appropriate data sheet.*

Westinghouse Rail Systems Limited,
PO Box 79
Pew Hill
Chippenham,
Wiltshire SN15 1JD, UK

T +44 (0) 1249 441 441
F +44 (0) 1249 652 322
E marketing@wrsl.com
www.wrsl.com

DETAILED INTERFACE SPECIFICATION

ANNEX C10
MDR, BDR, SHR, DTSDR, MDRR, BDRR, AFRR, SHRR & DLIRR RELAYS SPECIFICATIONS

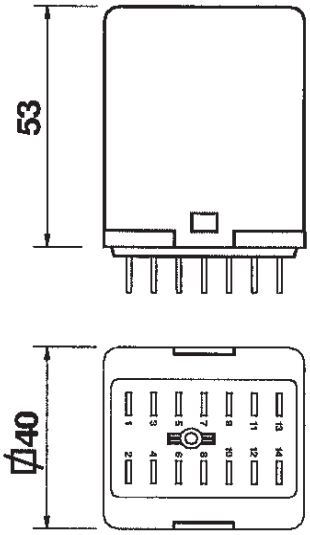
Relays: MDR, BDR, SHR & DTSDR

INSTANTANEOUS RELAY

Product D-U200 series
4 pole relay

Country of Origin: The Netherlands

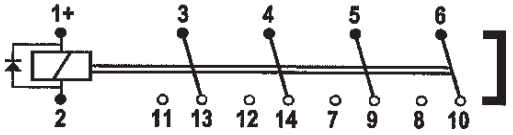
Dimensions



Company

P.O. Box 7023
3502 KA Utrecht
The Netherlands
T +31 (0)30-288 13 11
F +31 (0)30-289 88 16
E sales@nieaf-smitt.nl
I www.nieaf-smitt.nl/railway

Connection diagram



Description

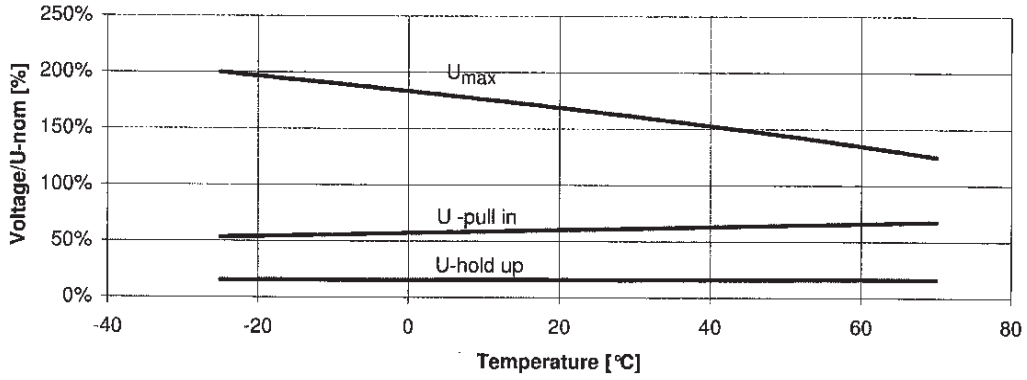
Plug-in railway relay with four change-over contacts.
Equipped with back EMF protection and magnetic arc blow out.

Coil data

Type	U_{nom}	U_{min}	U_{max}	$U_{hold-up}$	R_{coil}	$I_{coil-nom}$
D-U201	24 VDC	16.8 VDC	30 VDC	2.5 VDC	280 Ω	85.7 mA
D-U202	48 VDC	33.6 VDC	60 VDC	4.8 VDC	1110 Ω	43.2 mA
D-U203	72 VDC	50.4 VDC	90 VDC	13 VDC	2495 Ω	28.8 mA
D-U204	110 VDC	77 VDC	137.5 VDC	11 VDC	5830 Ω	18.9 mA
D-U205	96 VDC	67 VDC	120 VDC	9.5 VDC	4300 Ω	22.3 mA
D-U206	12 VDC	8.4 VDC	15 VDC	1.2 VDC	66 Ω	181 mA
D-U207	36 VDC	25.2 VDC	45 VDC	3.5 VDC	580 Ω	62 mA

Nom. Consumption	2.22 W	Inductance L/R at U_{nom} =	Energized	11 ms
			Released	8 ms
Pull-in time	20 ms	Release time		18 ms
Bounce time NO contacts	4 ms	Bounce time NC contacts		8 ms

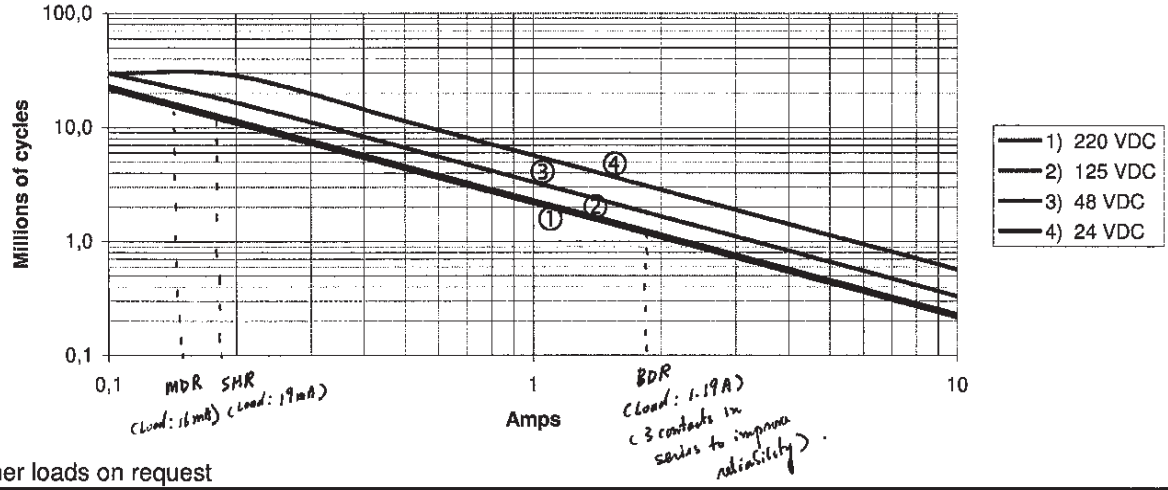
Operating range at various temperatures



Relays: MDR, BDR, SHR & DTSDR

Contact data			
Max. make current	16 A (200 A, 10 ms)	Material	silver
Max. cont. current	10 A (AC1 ; IEC 60947)	Contactgap	0.7 mm
Max. switching voltage	250 VDC, 440 VAC	Insulation between	2.5 kV; 50 Hz;
Min. switching voltage	12 V, 10mA	open contacts	1 min
Max. contact resistance	15 milli Ohm	Contactforce	> 200 mN
Max. breaking capacity			
DC	110 V, 10A (L/R<=15ms)		
AC	230 V, 10A (cos phi>=0.7)		

DC resistive current breaking capacity [D-U200-series relays]



Other loads on request

General Data		
Dielectric strength	EN 50155	
Pole-Pole	IEC 60255-5/	4 kV, 50 Hz, 1 min
Cont-Coil	IEC 60077	2.5 kV, 50 Hz, 1 min
Insulation class	IEC 60255-5	serie C 380 V 50Hz/450 VDC
Pulse withstanding	IEC 60255-5	5 kV (1.2/50 µs)
Vibration	IEC 60077	5 g at 50 Hz
	IEC 60571-1	2 g, 10-150 Hz
	EN 50155	
Shock	IEC 60077	5 g at 50 Hz
Mechanical life		$30*10^6$ ops
Max. switching frequency		1200 ops/h
Weight		125 g
Temperature	$T_{amb,max}$	+70 °C
	$T_{amb,min}$	-25 °C
Humidity		90%, temporary permitted condensation
Protection		IP 40
Materials		Makrolon
		Melamine Polyester
Electronic components		Back EMF protection diode BYW56

Options D – U200 – options according to table

C	-40 ºC, contactcurrent max 8A	Q	Double zenerdiode
E	Gold plated contacts	T	Push to test button
K	Special dust protection	X2	Coil for both DC and AC
L	LED indication on the coil	Y	Double make/ double break
N	No magnetic arc blow-out	Z	No diode

Relays: MDRR, BDRR, AFRR, SHRR & DLIRR

贝斯达系列
输出¡ 输入继电器

E25M (普通型)

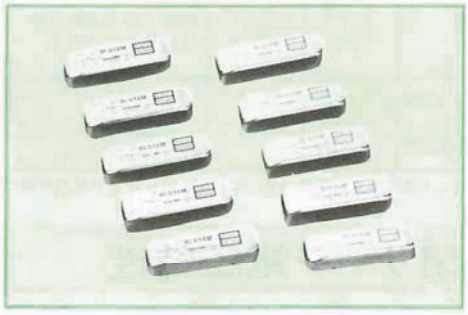
大容量型: RI - B□M、-C□M (普通型)

RI - B□MH、-C□MH (高绝缘型)

非常适合于 PC、单片机控制系统的高可靠性接口继电器

优　点

1 不但可以用于微弱电流回路，在 AC¡ DC100V 以上的回路中也能保证其出众的可靠性。
2 可以统一输出继电器。从 TTL 水准到大型电磁接触器、甚至直流电磁阀都可直接控制。
3 不需要输出继电器盘。
4 动作迅速 (5ms 以下)
5 绝缘性能好。
线圈绕组和触点间的可承受电压为 AC2000V 以上 (中容量型 AC1500V 以上)
6 可以自动焊接、自动洗净。
7 驱动功率小 (中容量型：0.4W、大容量型：0.6W)



主要用途

- 工业用编程控制器的输出¡ 输入继电器
- 微电脑应用装置的输出¡ 输入继电器
- 断路器的切断继电器
- 电力用记录传送继电器
- NC、MC 控制盘的输出¡ 输入继电器

产品规格

型号	种类	中容量型			大容量型			
	普通型	RI-D24M	RI-D25M	RI-E25M	RI-B14M	RI-B15M	RI-C14M	RI-C15M
	高绝缘型	—	—	—	RI-B14MH	RI-B15MH	RI-C14MH	RI-C15MH
触点结构		1a		1b	1a		1b	
内置贝斯达系列产品		R24	R25		R14	R15	R14	R15
额定使用电流 (感应负载)	AC	220V 0.5A			220V 1A			
	DC	110V 0.3A			220V 0.2A 、110V 0.5A			
最小使用电压¡ 电流		5V 1mA	24V 1mA *3		1V 1mA	24V 1mA *3	1V 1mA	24V 1mA *3
耐震动		98m/s² {10G} 以上 (20～1000Hz)			98m/s² {10G} 以上 (20～1000Hz)			
耐冲击	误动作	147m/s² {15G}			147m/s² {15G}			
	损坏	980m/s² {100G} 以上			980m/s² {100G} 以上			
耐电压		输出¡ 输入之间 AC1500V 1 分钟(触点之间 AC500V)			输出¡ 输入之间 AC2000V 1 分钟 (触点之间 AC800V)			
环境温度	使用时	－40～＋60℃			－40～＋60℃			
	保管时	－40～＋80℃			－40～＋80℃			
重　量		15g		20g	35g		40g	

注) 1. 关于触点规格、寿命、特性等详细内容请参照 4～7 页的贝斯达元件。
2. 大容量型也可以用于 DC110V 0.5A 以上。
详细内容请向生产厂家或代理商咨询。
*3. 光耦合器点灯回路时，可达到 5V 10mA。

Relays: MDRR, BDRR, AFRR, SHRR & DLIRR

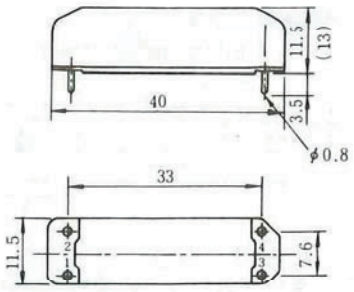
线圈绕组规格（有极性）

种 类	中 容 量 型						大 容 量 型					
型 号	RI－D			RI－E			RI－B			RI－C		
额定电压(E)	12V	24V	48V	12V	24V	48V	12V	24V	48V	12V	24V	48V
绕组电阻(Ω)	405	1520	5530	295	1160	4060	250	1020	3980	285	1080	3640
额定消费电力	0.4W		0.5W	0.5W		0.6W	0.6W			0.6W		0.7W
最大允许外加电压	170%E 约 1.2W			150%E 约 1.1W			220%E 约 3W			150%E 约 1.3W		
工作电压	75%E 以下			75%E 以下			75%E 以下			75%E 以下		
复位电压	8.5%E 以上			8.5%E 以上			8.5%E 以上			8.5%E 以上		

注) 1. 上表所记线圈绕组规格是在环境温度 20℃时的数值。
2. 线圈绕组的电阻值有¡ 10％的偏差。
3. RI－E 型以及 RI－C 型在超过最大容许电压(即使是短时间)时会发生误动作。

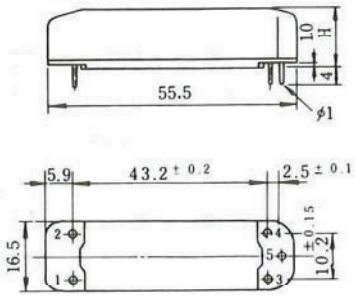
外形图 尺寸单位:mm

¡ 中容量型



注) 上图( )内的数值是 RI－E25M 型的尺寸

¡ 大容量型



尺寸 \ 型号	RI-B	RI-C
H	14.5	17

注) 只有 RI－□□M 有 5 号端子
(请参照下一页的接线图)

故障率(λ)是指¡

产品持续工作到某一时间为止所发生的故障次数与时间的比例。

(JIS Z 8115：可靠性用语)

$$故障率(\lambda)= \frac{故障次数}{使用个数¡\ 使用时间\ 10^{-9}}\ [Fit]$$

* 一般认为可靠性高的水银继电器的故障率是 50～60Fit。
而贝斯达系列继电器是它的 1/10，是半导体继电器的 1/20。

● 已经取得以下日本铁道(JR)型号

RL2606 型继电器：本厂 RI－B15MH / D24 的 JR 规格

TRL604 型继电器：本厂 RI－B15MH / D48 的 JR 规格

RL2607 型继电器：本厂 RI－C15MH / D24 的 JR 规格

TRL605 型继电器：本厂 RI－D25M 的 JR 规格

TRL606 型继电器：本厂 RI－E25M 的 JR 规格

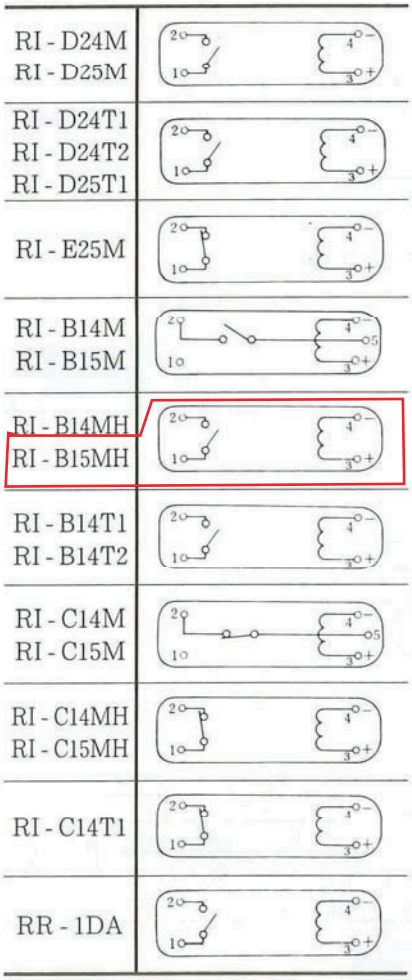
Relays: MDRR, BDRR, AFRR, SHRR, DLIRR

使用上的注意事项

(1) 关于接线

线圈绕组是有极性的、请按照下图进行接线。

请参照(2)确认接线端子的极性



*BOTTOM VIEW

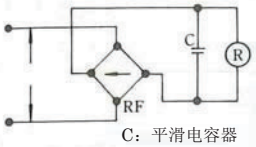
(2) 关于直流负载

使用直流负载时请按照下表进行连接。

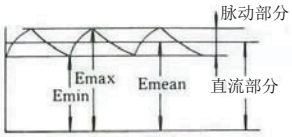
型 号	接线端子号码		
	2	5	1
RI - D24M, D25M	+		—
RI - D24T1, D24T2, D25T1	+		—
RI - E25M	+		—
RI - B14M, B15M	+	—	
RI - B14MH, B15MH	+		—
RI - B14T1, B14T2	+		—
RI - C14M, C15M	+	—	
RI - C14MH, C15MH	+		—
RI - C14T1	+		—
RR - 1DA	+		—

(3) 关于绕组的驱动电源

用于绕组的驱动电源必须是和蓄电池一样完全直流电源或者是像三相全波整流电流一样脉动率在 5%以下的电源。使用单相全波整流电源时，需要用滤波电容器将脉动率调至 5%以下。



C：平滑电容器
R：继电器绕组



$$\text{脉动率} = \frac{Emax - Emin}{Emean} \times 100\%$$

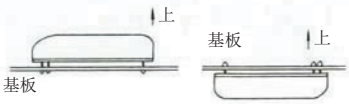
Emax：脉动部分的最大值
Emin：脉动部分的最小值
Emean：直流平均值

(4) 关于安装方向

标准的安装方向如图(a)。上下没有方向性。

如图(b)所示，将继电器的实际安装基板水平安装使用时，和标准的安装方向相比，工作电压¡ 复位电压最大有 5%左右的变化。

(a)安装基板垂直设置(标准)



(b) 安装基板水平设置

(5) 关于使用的注意事项

由于贝斯达元件是玻封式开关，需要注意以下几点。

(a) 为了维持正常性能，不得和物体强力碰撞或者落地撞击。

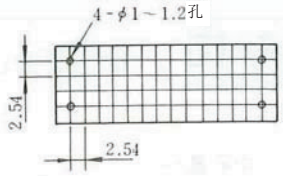
(b) 不可在继电器接线端子上施加过度的拉力（拉力 29.4N｛3kg｝以上)。

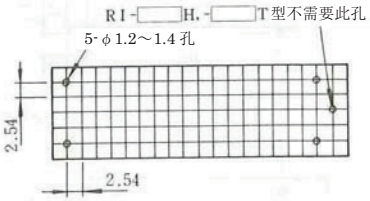
(6) 关于外部磁场

因为 RI 继电器是磁屏蔽式的，所以继电器之间可以进行密集安装。但是如果在强磁场中使用时，动作可能会发生很大的变化。

(7) 关于印刷电路基板

使用 2.54mm(0.1 英寸）导程孔的标准印刷电路基板比较方便。





(8) 关于基板安装以外的使用情况

在印刷电路基板以外的场合使用，请在安装以及接线时不要施加外力于继电器的接线端子上。

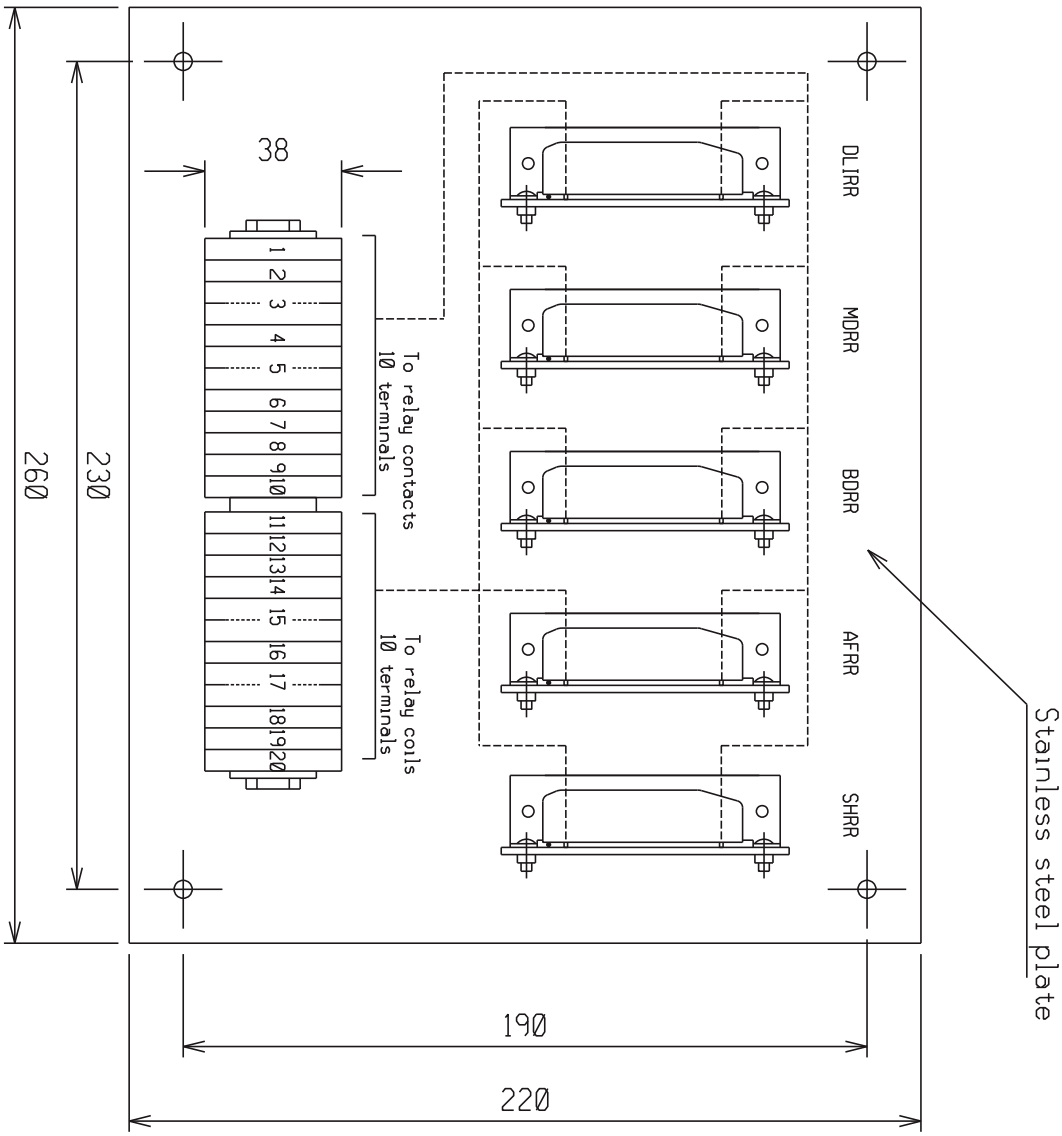
另外,要避免将接线端子根部折弯后使用。

(9) 开闭额定值

电流超过最大接入电流时，会发生触点烧结、玻壳破裂的危险。超过最大断路电流进行断路时，会发生触点烧结、触点熔断、玻壳破裂等的危险。所以请在额定开闭电压、电流以下使用。

DETAILED INTERFACE SPECIFICATION

ANNEX C11
REED RELAY PANEL

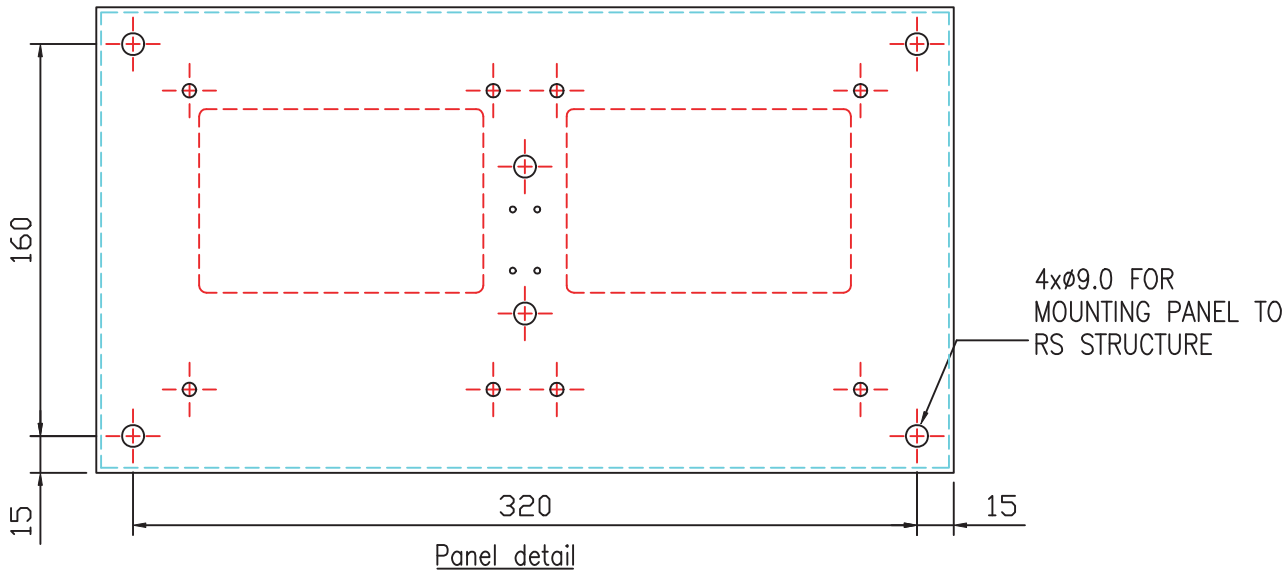


REED RELAY PANEL - Max weight 2 kg

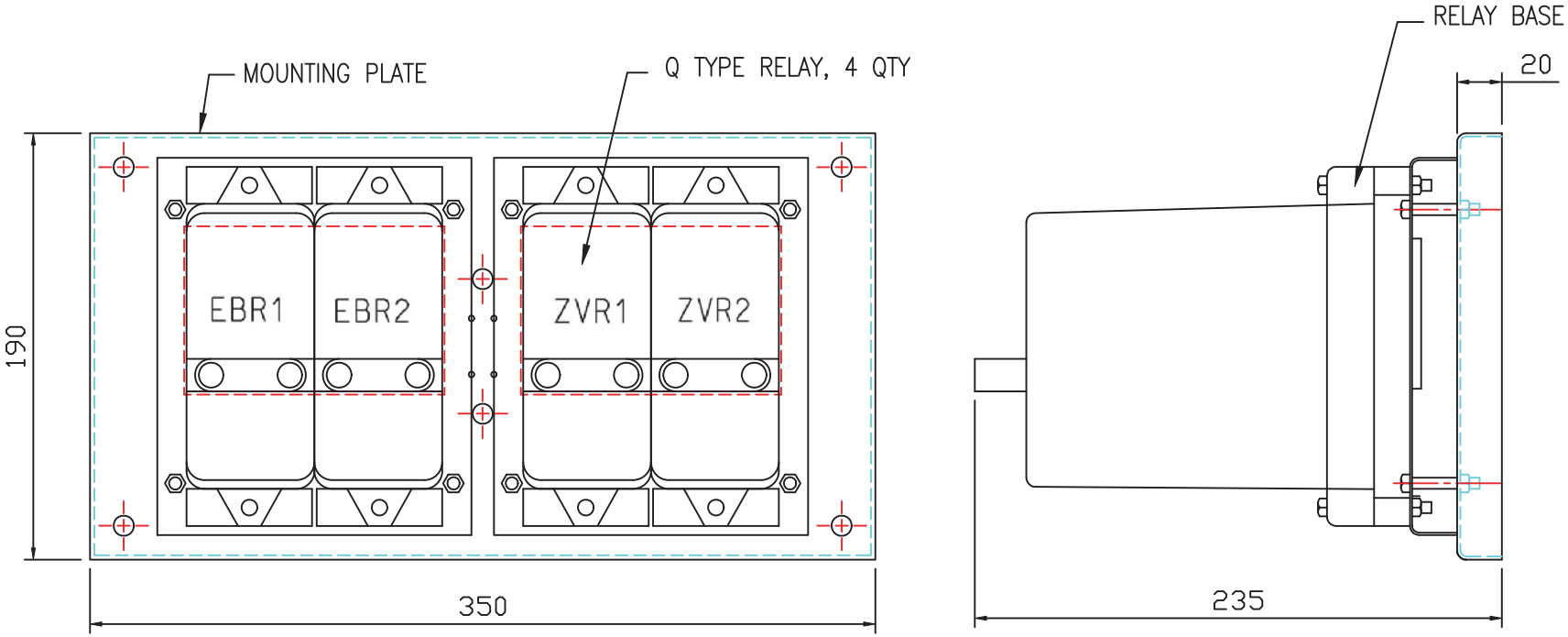
Note:
1. Self-Locking nuts are used on all screw of size M3 or above.
2. For M2 screws thread lock is used (Loctite 243).

DETAILED INTERFACE SPECIFICATION

ANNEX C12
QN10 RELAY PANEL



Panel detail



Front View
Max. weight: 10kg

Side View

GENERAL ARRAGEMENT FOR Q-TYPE RELAY PANEL

ANNEX C13
ATC CONNECOTRS & TAIL CABLES SPECIFICATIONS
REV.7

Appendix 3 Detailed Interface Specification Ver.2.5

ATC Connectors & Tail Cables Specifications

		T1 - T78	T1 - T2	T3 - T78
Item	Description	Supplied By	Installed By	
A	Speedometer	Signalling Contractor	RS Contractor	Signalling Contractor
B	QN10 Relay Panel + 4 x QN10 Bases + Terminals	Signalling Contractor	RS Contractor	Signalling Contractor
	4 X QN10 Relays + Assistance on Wire Terminations	Signalling Contractor	RS Contractor	Signalling Contractor
C	Reed Relay Panel	Signalling Contractor	RS Contractor	Signalling Contractor
D	ATC Cubicle	Signalling Contractor	RS Contractor	Signalling Contractor
E	DT Rack + Electronic Boards	Signalling Contractor	RS Contractor	Signalling Contractor
F	PAV Rack + Electronic Boards	Signalling Contractor	RS Contractor	Signalling Contractor
G	PCE Rack + Electronic Boards	Signalling Contractor	RS Contractor	Signalling Contractor
H	4 x DU204 Relays with V29 relay bases for MDR, BDR, SHR and DTSDR	Signalling Contractor	RS Contractor	Signalling Contractor
CA2, CA3, CA4, CA5	Train Interface Wires, Shielded Cable, etc. Refer to ATC1 A CAR and ATC2 A CAR drawings for detail.	RS Contractor	RS Contractor	RS Contractor
CA6, CA7, CA8, CA9, CA10	Shielded Twisted Cables and metallic cable conduits (CA6, CA7, CA8 and CA10) and PMA conduit (CA9). Refer to ATC1 A CAR and ATC2 A CAR drawings for detail.	RS Contractor	RS Contractor	RS Contractor
CA11	Coaxial Cable Maximum 6m long & Metallic & PMA cable conduit.	Coaxial Cable & PMA Cable Conduit - Signalling Contractor Metallic Cable Conduit - RS Contractor	RS Contractor	Coaxial Cable & PMA Cable Conduit - Signalling Contractor Metallic Cable Conduit - RS Contractor
CRP1-CA14-CRP2, CLP1-CA15-CLP2	CT Cords with plugs	Signalling Contractor	RS Contractor	Signalling Contractor
CA16, CA17, CA18, CA19, CA20, CA21, CA1	ATC Interface Wires, Shielded Cable, etc.	Signalling Contractor	RS Contractor	Signalling Contractor
HN/1, HN/2, LT/1, LT/2, J2, J3, BN, VRP1	ATC Connectors	Signalling Contractor	RS Contractor	Signalling Contractor
J1A, J1B, J3A, J4B	Junction Boxes	RS Contractor	RS Contractor	RS Contractor
CLC1, CRC1, 3AC1, 4BC1	Sockets	Signalling Contractor	RS Contractor	Signalling Contractor
VRP2	Plug	Signalling Contractor	RS Contractor	Signalling Contractor
BSP1	Plug + PMA adaptor	Signalling Contractor	RS Contractor	Signalling Contractor
4BP1, CA12, Odometer 4B	Integrated Coded Odometer 4B Assembly	Signalling Contractor	RS Contractor	Signalling Contractor
3AP1, CA13, Odometer 3A	Integrated Odometer Tacho 3A Assembly	Signalling Contractor	RS Contractor	Signalling Contractor
VRC2-RC Antenna	RC Antenna	Signalling Contractor	RS Contractor	Signalling Contractor
CRC2-CT Sensor 1B, CRC2-CT Sensor 1A	CT Sensors	Signalling Contractor	RS Contractor	Signalling Contractor
TB1	Terminal Block	RS Contractor	RS Contractor	RS Contractor

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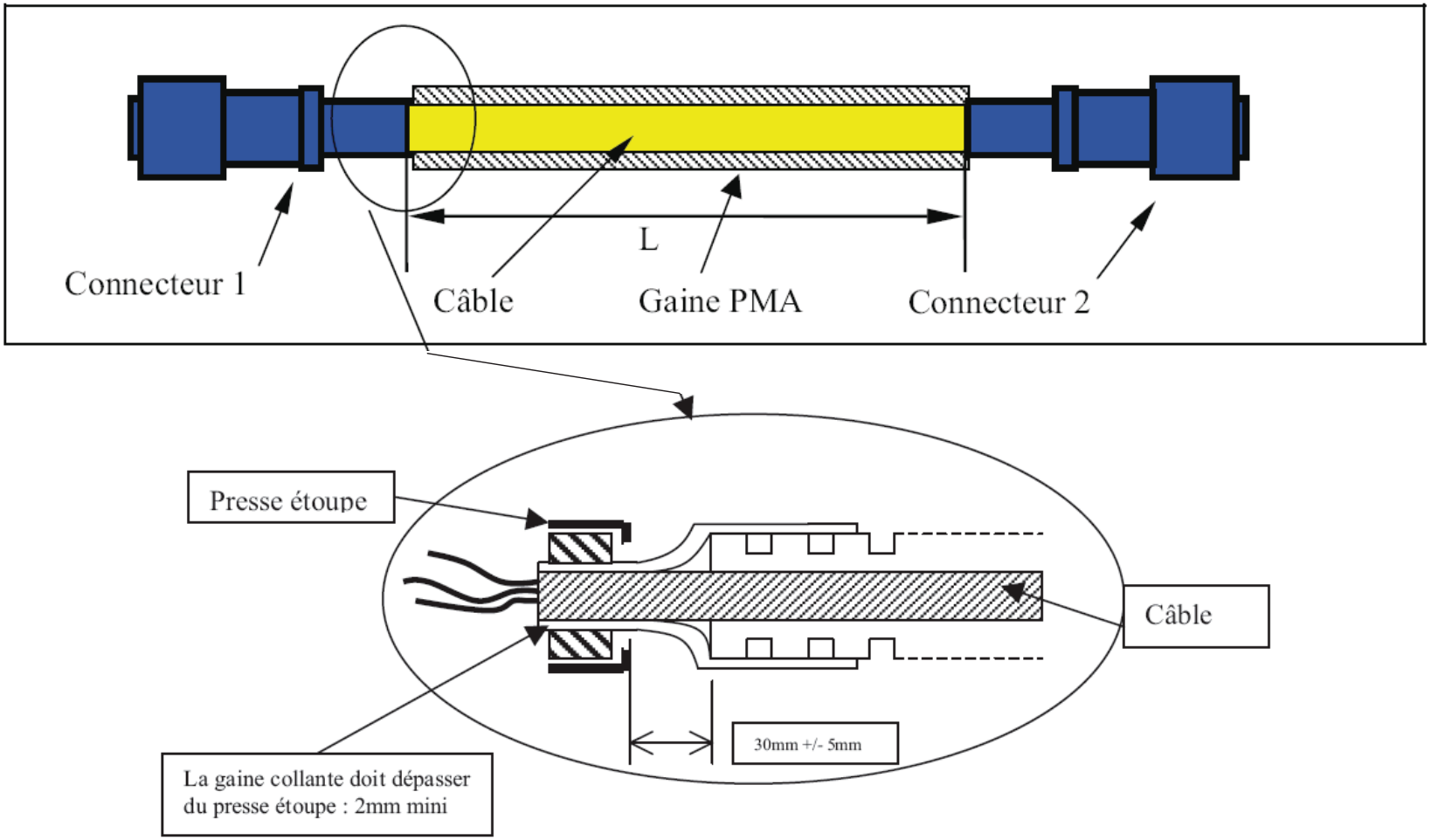
ATC Connectors & Tail Cables Specifications

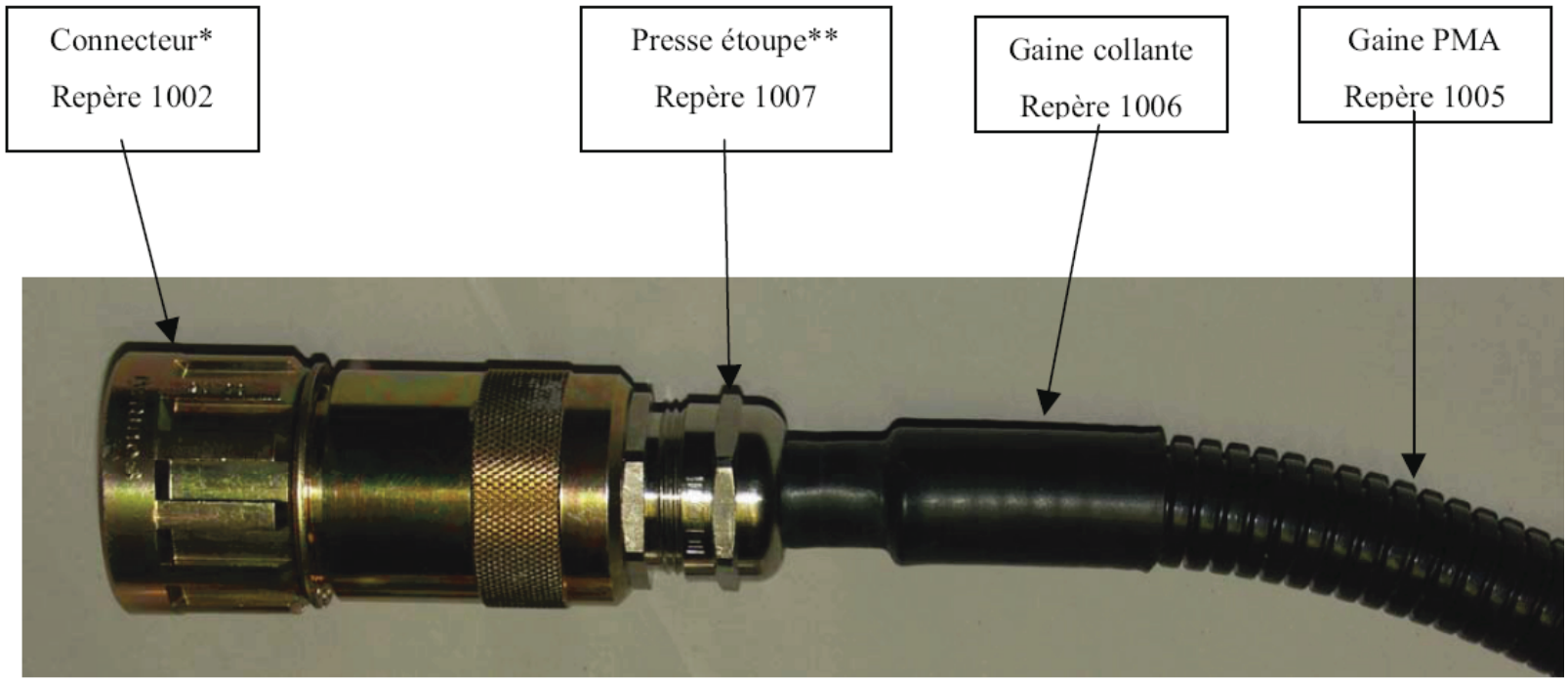
Item: CRP1-CA14-CRP2 & CLP1-CA15-CLP2 (CT Cords with plugs)

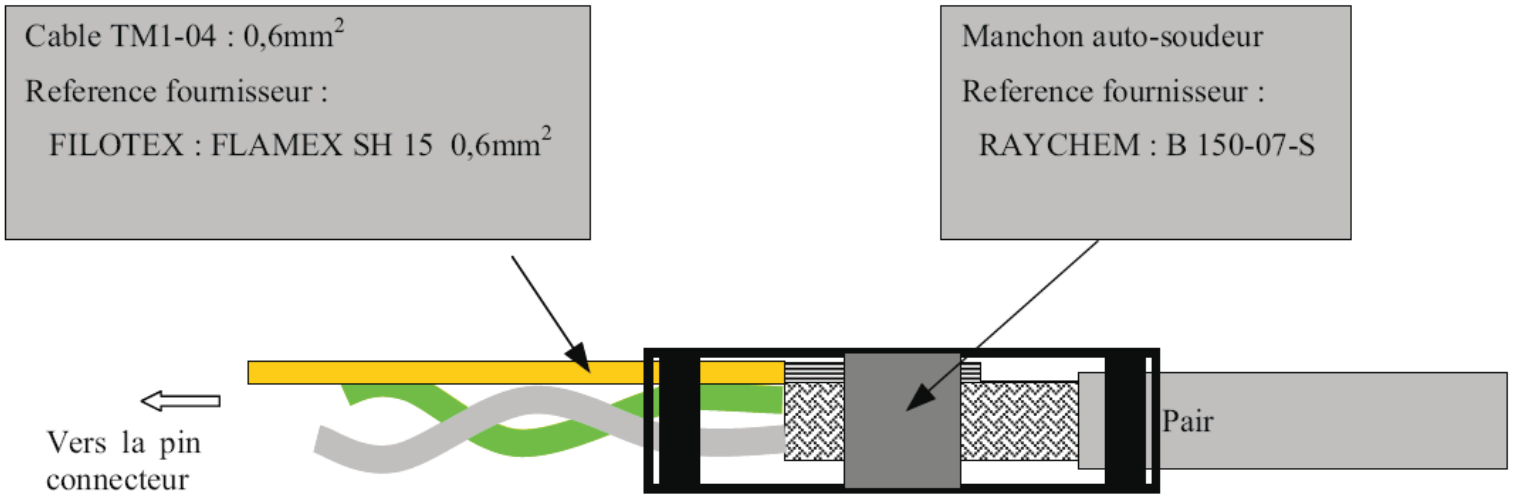


CA14 and CA15 are in the same length which is usually 2.2 metres (L).

ATC Connectors & Tail Cables Specifications

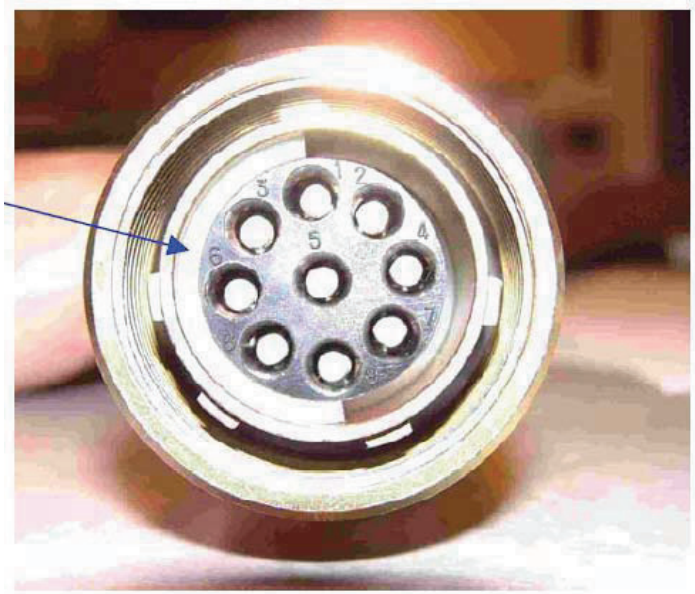
Item: CRP1-CA14-CRP2 & CLP1-CA15-CLP2 (CT Cords with plugs) (Cont.)





ATC Connectors & Tail Cables Specifications

Item: CRP1-CA14-CRP2 & CLP1-CA15-CLP2 (CT Cords with plugs) (Cont.)



Number of Pin	Number of cables	Signal	Comments
1	Lead 2 Pair 3	--	Connected but not used
2	Lead 2 Pair 1	12V	+Power Supply
3	Shield Pair 1	BL	Power supply shield
4	Lead 1 Pair 2	SL	Sensor Output
5	Lead 2 Pair 2	0V	0V ref loop sensor
6	Shield Pair 2	BL	Loop sensor signal shielding
7	Lead 1 Pair 3	--	Connected but not used
8	Shield Pair 3	--	Connected but not used
9	Lead 1 Pair 1	0V	0V Power supply

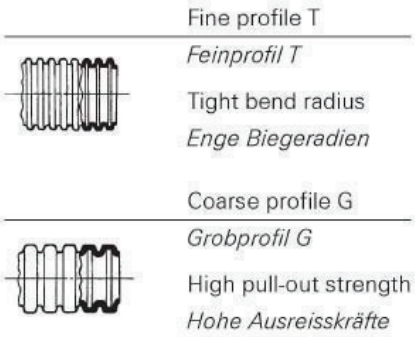
ATC Connectors & Tail Cables Specifications

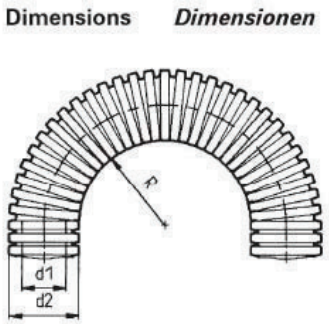
Item: CRP1-CA14-CRP2 & CLP1-CA15-CLP2 (CT Cords with plugs) (Cont.)

Câble 4 paires blindées plus 2 conducteurs avec blindage général : Ref. ALSTOM 24419.

Cord Static Bending radius	Cord Dynamic Bending Radius	Cord External diameter
35 mm	85 mm	21.2 mm

Order No	Conduit Size		Fits to threads		Dimensions in mm (nom.)				weight	Packing unit
(BLACK)	NW	metr.	metric	PG	D1	D2 (External Diameter)	Static Bending Radius	Dynamic Bending Radius	Kg/100 m	PU/m
PCSG-17B	17	20	M20 X 1.5	16	15.2	21.2	35	85	7.5	50



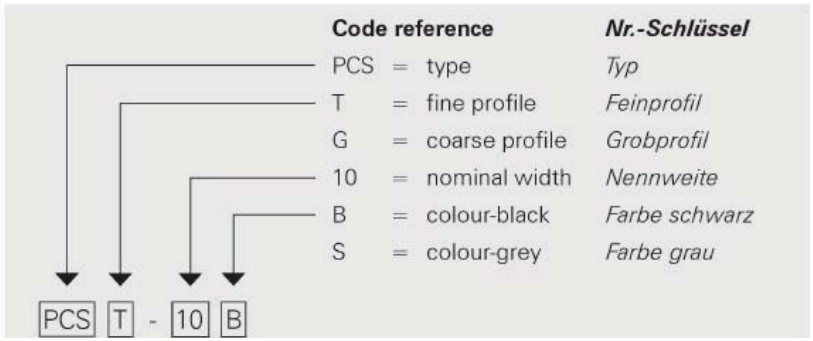


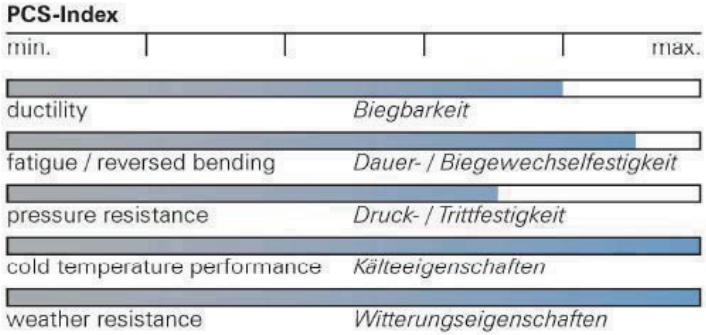
stat. R. = lowest recommended bending radius for static (fixed) installation

kleinster empfohlener Biegeradius für statische (feste) Verlegung

dyn. R. = lowest recommended bending radius for dynamic (flexible) installation

kleinster empfohlener Biegeradius für dynamische (flexible) Verlegung



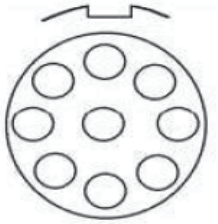


ATC Connectors & Tail Cables Specifications

Item: CLC1 & CRC1 (CT Underframe socket)

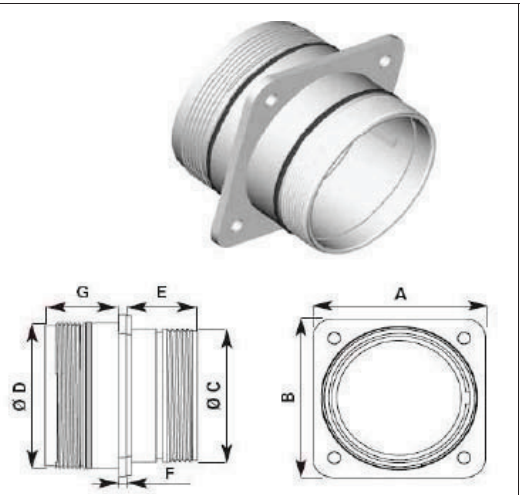
Item	ALSTOM ref	Manufacturer ref	Manuf.
Socket underframe	24182	8380E1E091BM0B	FCI

Shell Size E	Type M Receptacle without backshell	Panel cutout

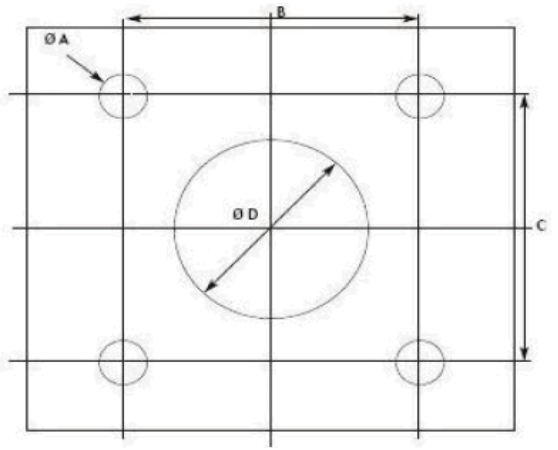


9 contacts ø 2 mm type B
09

Size	E (mm)
A	42
B	42
øC	35
øD	38
E	25
F	4
G	27
Indice	0



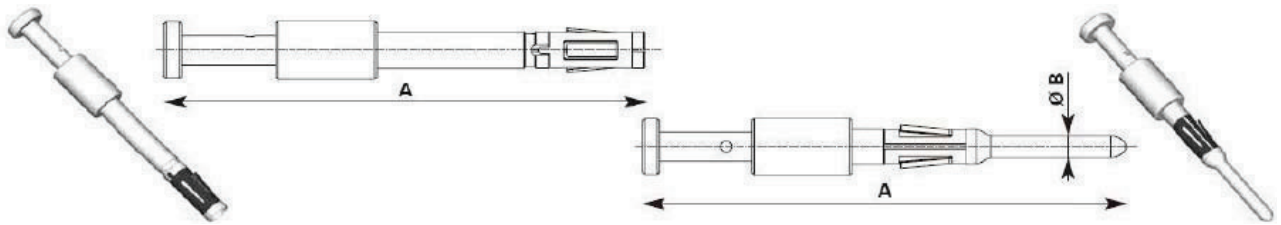
Size	E (mm)
øA	4.3
B	34
C	34
øD	36.5
øD*	40



*** Receptacle fixed behind the panel.**

Pin

Active part Ø Ø B (mm)	Contact type	Male or Female	Dimensions A	Part number	Protection Plating	Cable size	
						mini (mm^2)	maxi (mm^2)
Ø 2	B	F	41	8380-725	Passivated silver	0.6	1.5
Contact Ø 2 mm / Ø 3 mm							



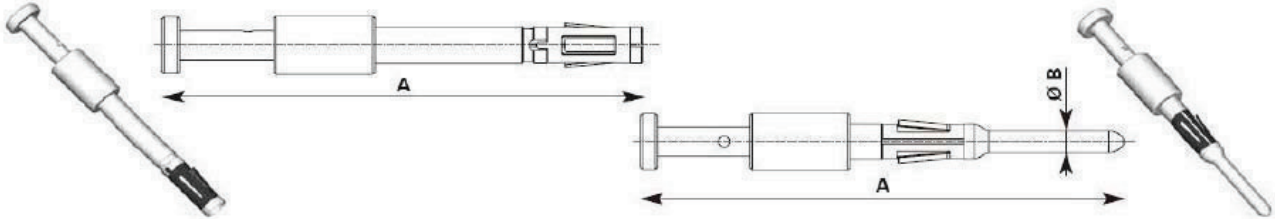
ATC Connectors & Tail Cables Specifications

Item: CA9 (Shielded Twisted Cables)

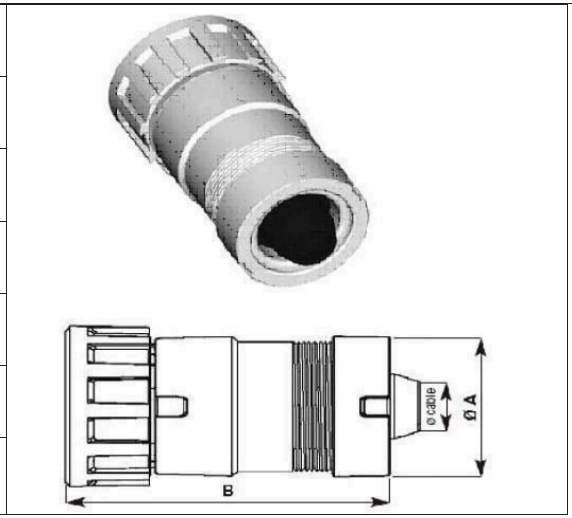
Description	Nominal section area mm^2	Conductor stranding-Nominal diam. mm	Cable Nominal external diameter in mm
3 shielded Twisted Pairs Cable each pair individually shielded	3 x 2 x 1.34	19 x 0.3-1.47	13

ATC Connectors & Tail Cables Specifications

Item: BSP1 (Plug)

Active part Ø Ø B (mm)	Contact type	Male or Female	Dimensions A	Part number	Protection Plating	Cable size	
						mini (mm^2)	maxi (mm^2)
Ø 2	B	M	42	8380-722	Passivated silver	0.6	1.5
Contact Ø 2 mm / Ø 3 mm							
							
Item		**ALSTOM ref**		**Manufacturer ref**		**Manufacturer**	
Plugs		11442		838 0 F 1 E 09 5 B W 0 A		SOURIAU	
Type W (Plug straight backshell with sealing gland and cable clamp)							

Size	**E**	
Ø A	39	
B	118	
Indice	**Ø Cable**	
	mini	**maxi**
0	14.5	17
1	10.1	13.3



ATC Connectors & Tail Cables Specifications

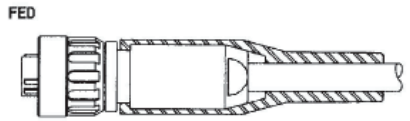
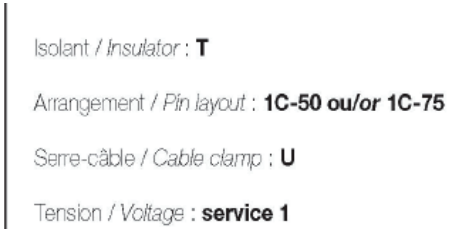
Item: CA11 (Coaxial Cable Maximum 6m long)

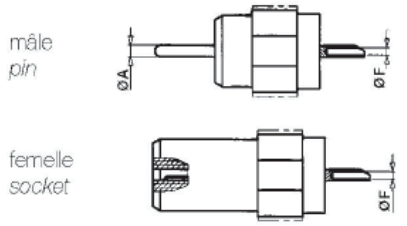
Cable Type	Static Bending radius	Dynamic Bending Radius	External diameter
COAXIAL KX 4 50 OHMS	100 mm	200 mm	10.3 mm

ATC Connectors & Tail Cables Specifications

Item: VPR1 & VPR2 (Plugs)

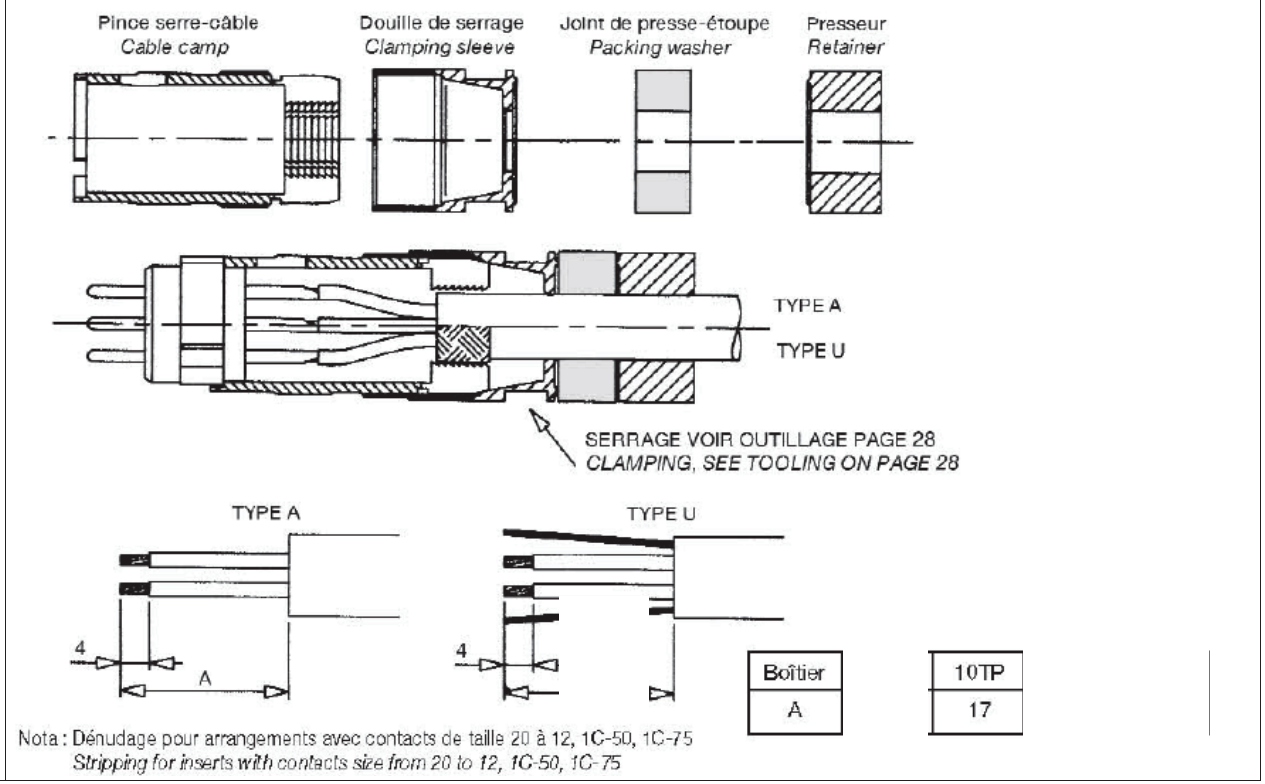
Plug Name	Type of Plug	Coaxial Connectors
VPR2	**Female Plug**	FED F 10 TP T 1C-50 H 103
VPR1	**Male Plug**	FED M 10 TP T 1C-50 H 103

FED	M / F	10TP	T	1C-50	H	103
FED: Straight plug 	Type of contacts: M: male F: female	Shell size	Insulating material T: Teflon (PTEE) 1 coax. 50Ω ou/or 75Ω 	Pin layouts	Cable clamp accessory U: Cable Clamp Ground braid linked to shell Max. diameter acceptable with grounding braid: with braid diameter turned down cable external sheath: **Ø 5 to Ø 11**	Max. diameter of the cable's cable external sheath (in 0.1mm) or cable code for coaxials, triaxials and high voltage

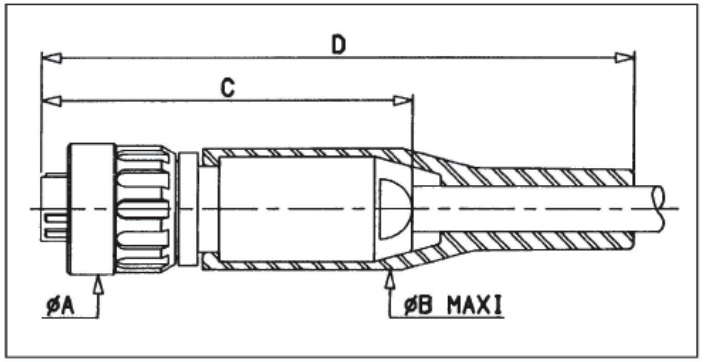
Shell Size	Size of contact	Ø A (mm) Front of contact	Ø F (mm) Inside the solder bucket	Acceptable cable and specifications	Removable contact	Definition
10TP	Coaxial 50Ω	1,93	2,4	KX4 – KX15 – NFC 93550 RG213U – RG58 CU – NIL C 17F	No	

ATC Connectors & Tail Cables Specifications

Item: VPR1 & VPR2 (Plugs) (cont.)

Shell Size	**10 TP**
Accessory U	

Shell Size	10TP
Ø A	25
Ø B maxi	23
C	72
D	110
Reference – P/N	FEDΔ10TP▲□□-□□■ooo



Δ = M (Male) for 01-HT and 04-HT pin layouts

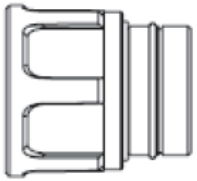
ATC Connectors & Tail Cables Specifications

Item: CA13

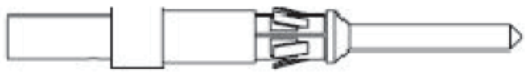
Cord static bending radius	Cord dynamic bending radius	Cord external diameter
50 mm	100 mm	20.5 mm

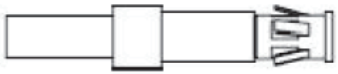
ATC Connectors & Tail Cables Specifications

Item: 3AP1 (Plug)

KHEOPS CMC36RD07-13SNM		
36  **Fiche à visser sans cliquet** *Screw plug without clicker*	**RD** **Raccord droit étanche** *Environmental straight backshell*	**13** 13 contacts Ø 1,6 mm Contact avancé / ***Advanced contact*** **Tension de service** / *Service voltage* - NF C 20-040 cat. B ..... 380 V eff. - NF F 61-030 ..... 72 V **Tension de tenue** / *Withstanding voltage* **> 1500 V eff.**

CRIMP Contacts			WIRE		SEALING PLUG	CRIMPING TOOL		EXTRACTING TOOL	INSERTION TOOL
Contact diam.	**Type**	**Part number**	**Cross section**	**AWG wire**	**Part number**	**Part number**	**Locator**	**Part number**	**Part number**
Ø1,6 mm	P S	DMC S24150-00B3 DMC S24151-00B3	0,6 to 1,82 mm^2	20 to 15	-	FT8 or M2 2520/1-01	- TP1012	OUTS1675-0003	OUT31748-000A2

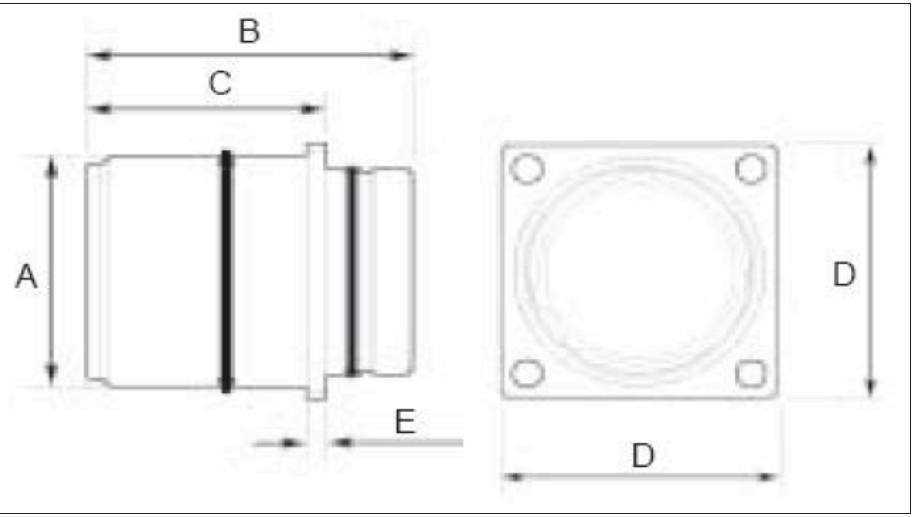
P  Mâle / *Male*

S  Femelle / *Female*

ATC Connectors & Tail Cables Specifications

Item: 3AC1 (Socket)

Size	07
A	37,9 (1.49)
B	48,7 (1.92)
C	36 (1.42)
D	42 (1.65)
E	3 (0.12)

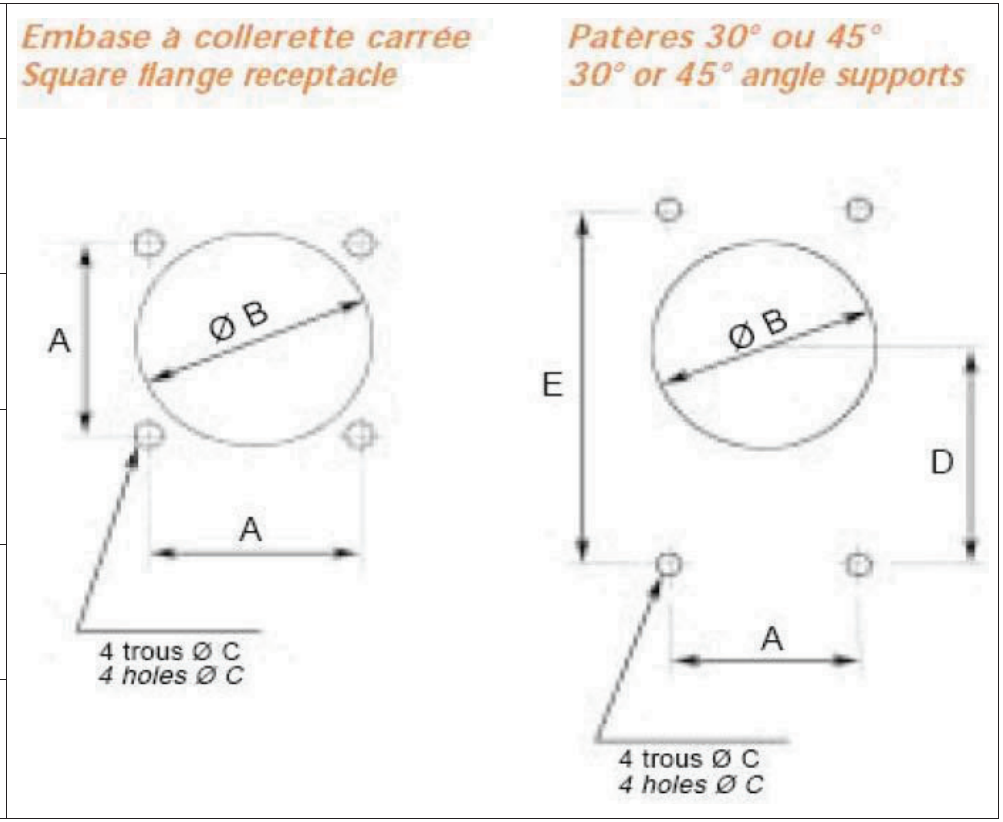


mm / (inches)

ATC Connectors & Tail Cables Specifications

Item: 3AC1 (Socket) (Cont.)

Size	07
A	34 (1.34)
B	39,5 (1.55)
C	4,5 (0.18)
D	45 (1.77)
E	72 (2.83)



mm / (inches)

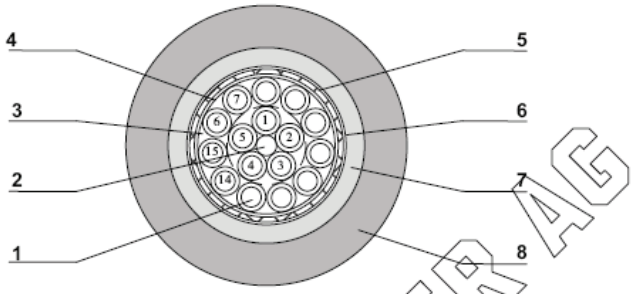
Note: Front mounted

ATC Connectors & Tail Cables Specifications

Item: CA12

Cable Type	Cord static bending radius	Cord dynamic bending radius	Cord external diameter
24264: CABLE DIVERS GKW-TM ZERO HALOGEN POLYESTER 15c NOIR 0,5mm^2 19 X 0.18	50 mm	150 mm	13 mm

System cable screened
15x0.5 mm² / MA12 / Radox Elastomer S FH



1.	15 cores 0.5 mm² type MA12–A1–0.5	Conductor : stranded tin plated copper Insulation : Polyester based insulation Colours : white–numbered	19 x 0.18 Ø : 1.3	mmØ mm
2.	Filler	Radox		
3.	Identification thread	H + S		
4.	Wrapping	Plastic tape		
5.	EMC – Screen optimised	Tin plated copper braid	Ø : 6.8	mm
6.	Wrapping	Plastic tape		
7.	Inner–Sheath	Radox Elastomer S FH, black		
8.	Outer–Sheath	Radox Elastomer S FH, black	**Ø : 13.0** +0.2/–0.3 mm	

Sheath–Marking: HUBER+SUHNER SWITZERLAND 12551839–XXXXXX / SECHERON 5.8604.220
Order number
Part number

HUBER+SUHNER AG

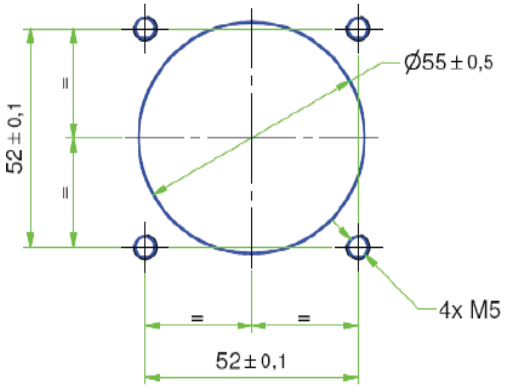
Size of cable between 0.5 mm^2 to 1.5 mm^2

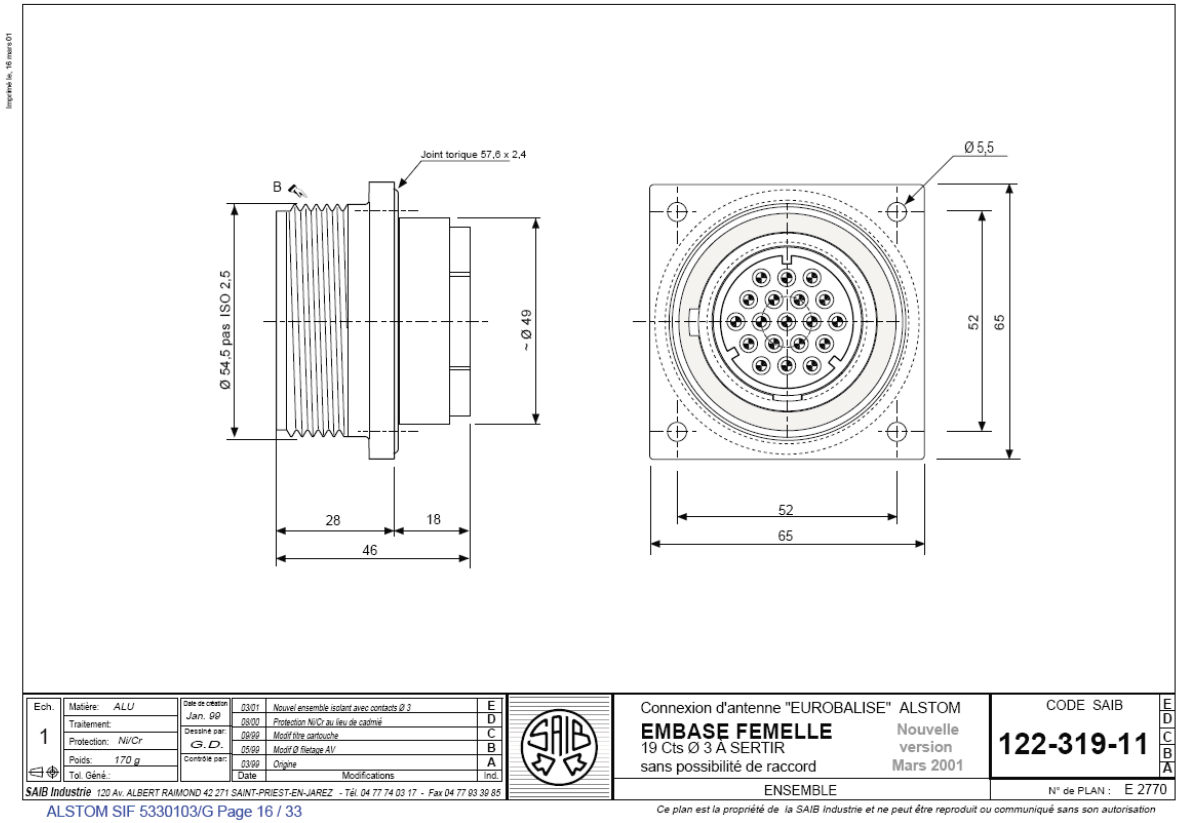
ATC Connectors & Tail Cables Specifications

Item: 4BC1 (Socket)

22278: CONNECTEUR CYLINDRIQUE; EMBASE FEMELLE; 19pts; A SERTIR; SANS REPRISE MASSE

Contact	Code	Code ALSTOM	
Ø 3 long. 33,5	13-11-01	24513	





838 series
8038 series (Fiber optics)
Intercoach Connectors

Qualified according to NFF 61030

SOURIAU
Connection Technology

838/8038 Series

SOURIAU

Connectors and interconnected systems for severe environments

The company designs, manufactures and markets high performance interconnected solutions for severe environments from industrial broadline and universal ranges to complex system with integrated functions :

filtering, high data transmission, hermicity, separation mechanism, remote handling, underwater mating,...

Industrial broadline

Circular and rectangular ranges

Umbilical system

The dedicated and markets for SOURIAU's products are aerospace, defense-space and industrial.

Railway
Geophysics
Manufacturing environment
Instrumentation
Automation & Process

Cilvil & Military aircraft
Helicopter
Weapon delivery system
Avionics

Military marine
Communication
Satellites
Launcher & Missile

SOURIAU was established in 1917 and has been created by successive acquisitions of the industrial, aeronautical, defense, and space activities of SOURIAU, JUPITER and BURNDY.

The Group's products are engineered and manufactured in the USA and Dominican Republic, Europe and Marocco, Japan and India, and sold by a worldwide sales and marketing organization, and in addition to SOURIAU's offices, a large network of licensed distributors and agents.

SOURIAU complies with most of national and international Quality Assurance standards, production unit with ISO 14001.

AFAQ ISO 9001 VERSION 2000

RN 23 F-72470 CHAMPAGNE
ZI des Ajeux F-72400 LA FERTE-BERNARD

a été évalué et jugé conforme aux exigences de la norme :
has been assessed and found to conform to the requirements of the standard :

ISO 14001 (1996)

Le certificat correspondant a été délivré dans les conditions fixées par AFAQ, le :
The corresponding certificate has been delivered under AFAQ application rules, on :

2004-03-18

Il est valable jusqu'au"
It is valid until"

2007-01-29

QUALITY ASSURED FIRM EN 9001 SGS

838 Series

Série 838 / *838 series*

Page 4 à/*to* page 24

Série 8038 / *8038 series*

Page 26 à/*to* page 42

838 Series

Sommaire

	page
• Caractéristiques techniques	6
• Synoptique	7
• Référencement	8
• Synoptique embase + raccord et fiche + raccord	9
• Arrangements	10
• Détrompage	11
• Dimensions	12
• Accessoires	19
• Contacts	20
• Outillage	22
• Perçage cloison	24

Présentation

Le connecteur 838 assure les connexions électriques sous moyenne et basse tension en ambiance industrielle sévère, où les astreintes mécaniques et climatiques sont particulièrement contraignantes.

Il équipe le matériel roulant ferroviaire (lignes de trains, liaisons sous caisses, raccordements d'appareillages) ainsi que les équipements de réseau et de signalisation (en accord avec la norme NFF 61030).

Le connecteur 838 dispose d'un boîtier en alliage d'aluminium protection sans Cadmium assurant un bon compromis poids/robustesse.

Le verrouillage à vis à filets carrés assure une haute tenue mécanique. Un système de détrompage amovible à 12 positions permet à l'opérateur d'effectuer la polarisation lors du câblage.

Le connecteur 838 est équipé d'isolants en matériau thermoplastique qui se caractérisent par :

- un haut niveau de performances mécaniques et électriques,
- une mise en œuvre simplifiée, rapide et efficace,
- une sécurité d'emploi garantie par :
  - un guidage constant et un alignement précis des contacts mâles et femelles dans leurs logements,
  - une rétention mécanique éprouvée et endurante des contacts dans leurs alvéoles,
- un respect des exigences de tenue feu-fumée définies dans les standards NFF 16101 et NFF 16102,
- la protection des mécaniques est sans cadmium répondant ainsi aux nouvelles réglementations.

Content

	page
• *Technical features*	*6*
• *Synoptic*	*7*
• *Ordering information*	*8*
• *Synoptic receptacle + backshell and plug + backshell*	*9*
• *Layouts*	*10*
• *Keying system*	*11*
• *Dimensions*	*12*
• *Accessories*	*19*
• *Contacts*	*20*
• *Tools*	*22*
• *Panel cutout*	*24*

Presentation

The 838 connector series is used for LV and MV electrical connections in harsh environmen, with especially very strong mechanical and climatic constraints.

The typical applications of 838 connector series include rolling stock (intercoach connections, undercoach connections, equipment connections) as well as signalling and fixed electrical equipments (complying with NFF 61030 standard).

The 838 connectors are designed in aluminium alloy to enable a good compromise weight / robustness.

The square threads screw coupling withstand very strong mechanical endurance. A removable coding system allows the operator to choose between 12 positions for the cabling.

The 838 connector series is equipped with thermoplastic insulators enabling:

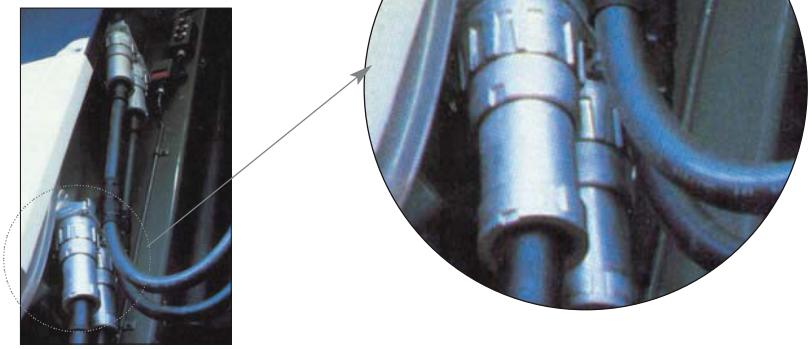
- *a high mechanical and electric performance level,*
- *user friendly installation,*
- *a safe application guaranteed by:*
  - *constant guiding and accurate alignment of male and female contacts in their cavities,*
  - *a proven and robust mechanical retention of contacts in their cavities,*
- *respect of the fire and fumes demands conform to the NFF 16101 and NFF 16102 standards,*
- *shell plating is cadmium free therefore complying with environmental rules.*

838 Series

Technical features & benefits

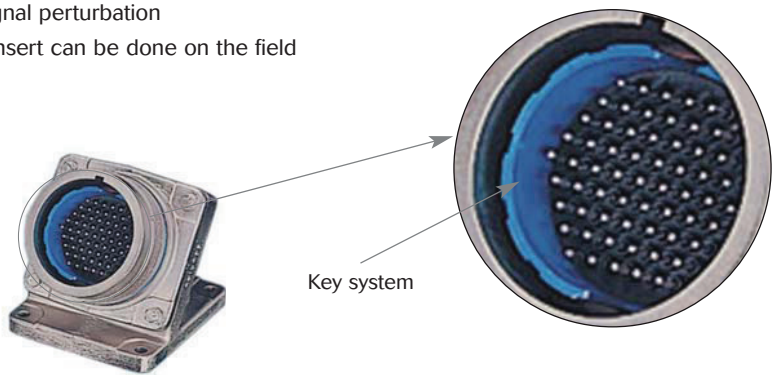
Ruggedized circular connector to matching intercoach environment

- Enabling 500 mating-unmating without wear out
- Screw coupling with thin square thread for secure mating under vibration
- Traction force withstanding
- 30° panel mounting



Versatile series

- Versatile insert with reverse gender
- 360° shell shielding permit to reduce signal perturbation
- Polarization system enabling: keying of insert can be done on the field



RoHS compliancy

- Shells plating are cadmium free: Alodine 1200
- Inserts are halogen free: PBB & PBDE

838 Series

Caractéristiques / *Technical features*

Mécaniques

- **Boîtier :**
  alliage d'aluminium
- **Protection :**
  conversion chimique sans cadmium
- **Système de verrouillage :**
  - à vis sans cliquet (boîtiers B, J, C et E)
  - à vis avec cliquet (boîtiers C et E).
- **Isolant :**
  thermoplastique renforcé fibre de verre conforme aux spécifications feu-fumée NFF 16101-16102 (exigence 3), classé V0 suivant la norme UL94.
- **Joint interfacial :**
  élastomère
- **Système de codage amovible** offrant 12 possibilités différentes de détrompage (livré en position 1).
- **Les isolants mâles et femelles** peuvent équiper indifféremment les fiches ou les embases.
- **Contacts :**
  - alliage cuivreux, argenté ou doré
  - à sertir, muni de clips et démontable de la face avant de l'isolant.
- **Endurance mécanique :**
  500 manœuvres (verrouillage + déverrouillage).

Mechanical

- ***Shell:***
  aluminium alloy
- ***Plating:***
  chemical conversion cadmium free
- ***Locking system:***
  - *screw without clicker (shell sizes B, J, C and E)*
  - *screw with clicker (shell sizes C and E).*
- ***Insulator:***
  thermoplastic: polyamide I2-F3 in accordance with NFF 16101-16102 (exigence 3) (fire and smoke emissions) for installations on equipments category A1 UL94-V0.
- ***Interfacial seal:***
  elastomeric
- ***Removable coding system** enables the operator to choose between 12 different key orientations (delivered in position 1).*
- ***Both male and female insulators** can fit in either the plugs or the receptacles.*
- ***Contacts:***
  - *copper alloy, silver or gold plating*
  - *crimp type, with clips removable from the front of the insulator.*
- ***Endurance:***
  500 mating-unmating cycles.

Climatiques

- **Température d'utilisation :**
  - thermoplastique : -40°C à +100°C
- **Etanchéité :**
  - IP66 et IP67 (avec raccord adapté)
- **Chaleur humide :**
  21 jours à +40°C ; 90% d'humidité relative (NFC 20703)
- **Brouillard salin :**
  96 heures (NFC 20711)
  (Pour d'autres exigences, nous consulter).

Environmental

- ***Temperature range:***
  - thermoplastic: -40°C to +100°C
- ***Sealing:***
  - IP66 and IP67 (with adapted backshell)
- ***Damp heat:***
  21 days to +40°C ; 90% relative humidity (NFC 20703)
- ***Salt spray:***
  96 hours (NFC 20711)
  (For other requirements, consult us)

Electriques

- **Tension de tenue :**
  - 3250 Veff
- **Résistance d'isolement :**
  ≥ 5000 MΩ sous 500 Vcc
- **Résistance de contact :**
  ≤ 2 mΩ
- **Tension de service par arrangement :**
  380 Veff
- **Intensité admissible par contact :**

Ø 1.6 mm (Trim-Trio)	13 A
Ø 2 mm	15 A
Ø 3 mm	30 A
Ø 5 mm	40 A
Ø 12 mm	180 A

Electrical

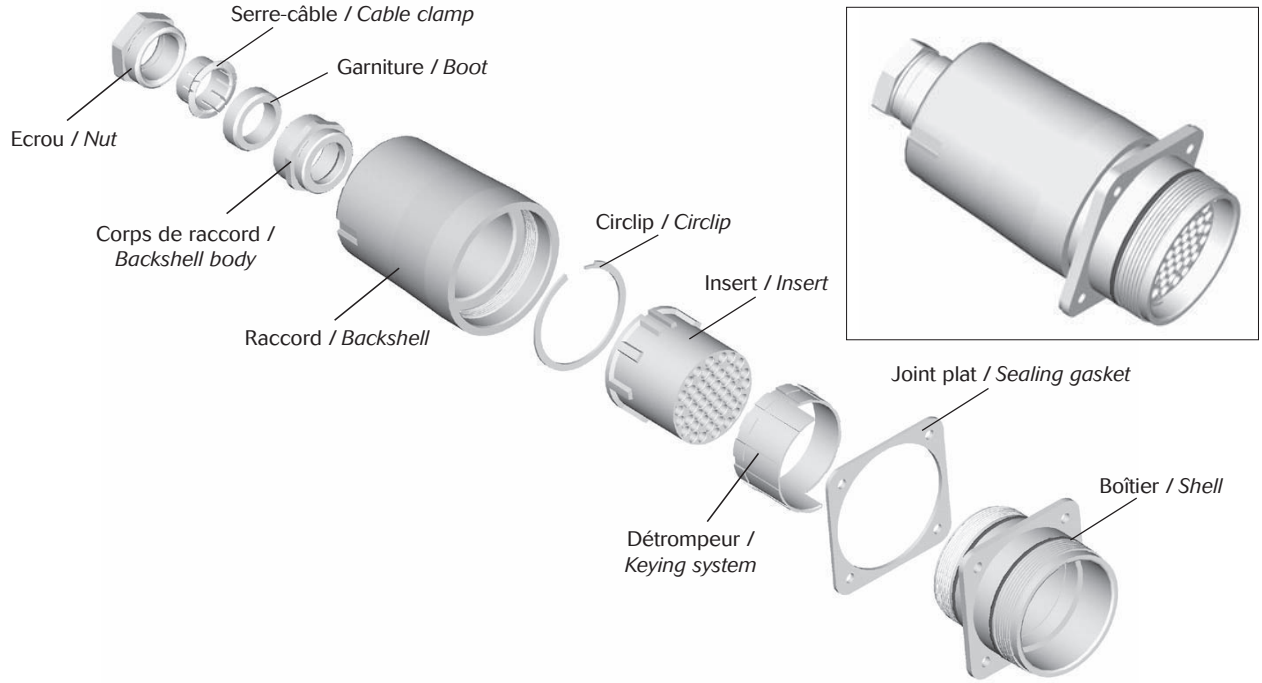
- ***Test voltage:***
  - 3250 Vrms
- ***Insulation resistance:***
  ≥ 5000 MΩ under 500 Vdc
- ***Contact resistance:***
  ≤ 2 mΩ
- ***Maximum voltage per layout:***
  380 Vrms
- ***Maximum rating per contact:***

Ø 1.6 mm (Trim-Trio)	*13 A*
Ø 2 mm	*15 A*
Ø 3 mm	*30 A*
Ø 5 mm	*40 A*
Ø 12 mm	*180 A*

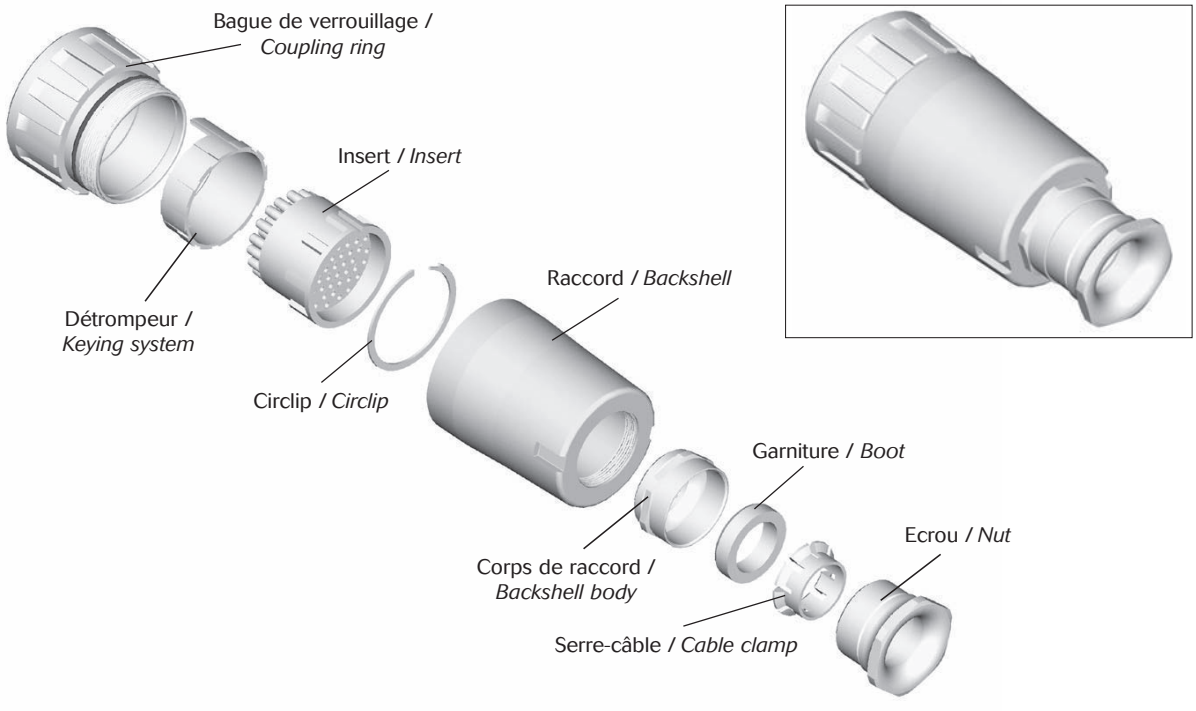
838 Series

Synoptique / *Synoptic*

Embase / *Receptacle*



Fiche / *Plug*



838 Series

Référencement / *Ordering information*

Racine / *Basic series*	**838**	**0**	**E**	**1**	**C**	**19**	**5**	**B**	**N**	**0**	**A**

0 verrouillage à vis avec possibilité de détrompage
screw coupling with coding option
2 verrouillage à vis sans possibilité de détrompage (boîtier B seulement)
screw coupling without coding option (shell size B only)

E embase / *receptacle*
F fiche / *plug*

0 embase à collerette carrée sans joint d'étanchéité
square flange receptacle without seal
1 embase à collerette carrée avec joint d'étanchéité
square flange receptacle with seal
0 fiche sans verrouillage à cliquet
plug without clicker locking
1 fiche avec verrouillage à cliquet (boîtiers E et C seulement)
plug with clicker locking (shell sizes E and C only)

taille de boîtier / *shell size*
B - J - C - E

arrangements de contacts / *contacts layouts*
(voir pages 10 et 11 / *see pages 10 and 11*)

1 contact mâle à sertir / *male crimp contact*
5 contact femelle à sertir / *female crimp contact*

L connecteur livré sans contact / *connector supplied without contact*
B à/*to* U type de contact (voir pages 20 à 21) / *contact type (see pages 20 and 21)*

G raccord droit pour gaine annelée PMA (boîtiers C et E)
straight backshell for PMA flexible tube (shell sizes C and E)
M sans raccord, sans accessoire */ without backshell or accessory*
N coiffe (boîtiers C et E) */ boot (shell sizes C and E)*
R raccord avec orientation 30° */ receptacle assembled on 30°*
S raccord droit avec presse-étoupe et raccord pour gaine annelée PMA (boîtier B seulement)
straight backshell with sealing gland and backshell for PMA flexible tube (shell size B only)
V raccord droit à presse-étoupe (boîtiers C et E) / *straight backshell with sealing gland (shell sizes C and E)*
W raccord droit avec serre-câble et presse-étoupe / *straight backshell with cable clamp and sealing gland*
T raccord à presse-étoupe et serre-câble à faible encombrement / *backshell with low profile sealing gland*
U raccord type T avec reprise de tresse / *backshell T type with shielding termination*
Z raccord pour reprise de tresse / *backshell for shielding termination*

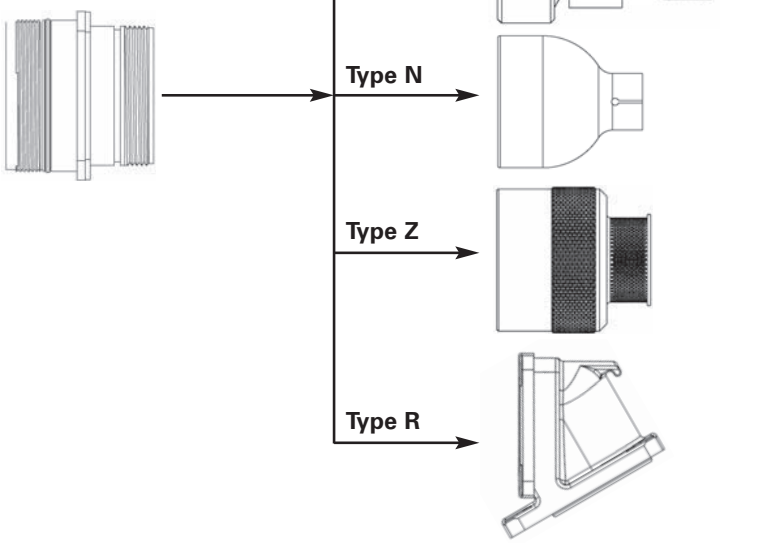
indice / *index*
0 à/*to* 16 obligatoire, voir tableau pages 12 à 19 / *mandatory, see table pages 12 to 19*

A thermoplastique / *thermoplastic*

B thermoplastique et boîtier 500 heures (nous consulter) / *thermoplastic and shell 500 hrs salt spray (consult us)*

838 Series

Embase / *Receptacle*



V : Raccord droit avec presse-étoupe
Straight backshell with sealing gland

W : Raccord droit avec presse-étoupe et serre-câble
Straight backshell with sealing gland and cable clamp

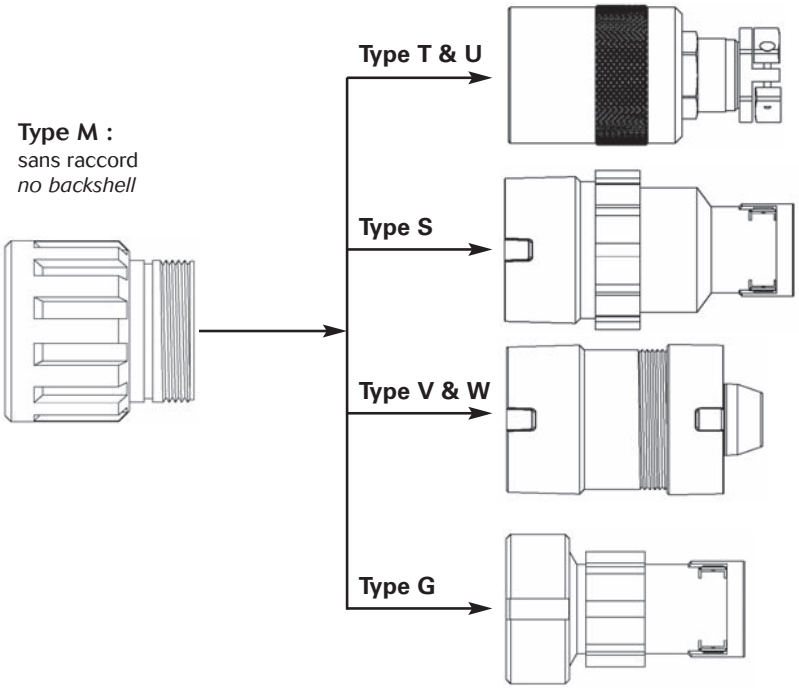
G : Raccord droit pour tube PMA
Straight backshell for PMA

N : Coiffe
Boot

Z : Raccord pour reprise de tresse
Backshell for shielding termination

R : Raccord avec orientation de 30°
Receptacle assembled on 30°

Fiche / *Plug*



T : Serre-câble avec presse-étoupe de faible encombrement
Cable clamp with low profile sealing gland

U : Type T avec reprise de tresse
Type T with shielding termination

S : Raccord droit pour tube PMA avec presse-étoupe
Straight backshell with sealing gland + backshell for PMA

V : Raccord droit avec presse-étoupe
Straight backshell with sealing gland

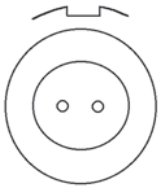
W : Raccord droit avec presse-étoupe et serre-câble
Straight backshell with sealing gland and cable clamp

G : Raccord droit pour tube PMA
Straight backshell for PMA

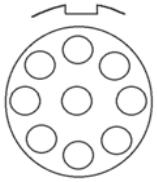
838 Series

Arrangements / *Layouts*

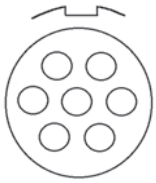
Boîtier E / *Shell size E*



1 twinax contact 120 Ω
01

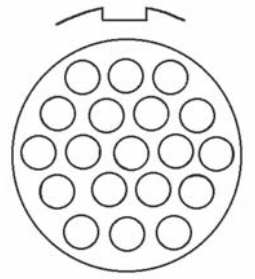


9 contacts Ø 2 mm type B ou/*or* H
09

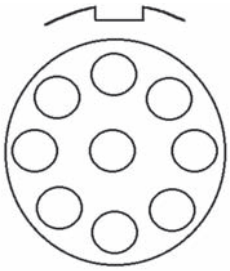


7 contacts Ø 2 mm type B ou/*or* H
07

Boîtier C / *Shell size C*

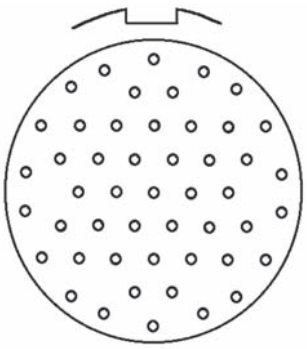


19 contacts Ø 2 mm type B ou/*or* H
19

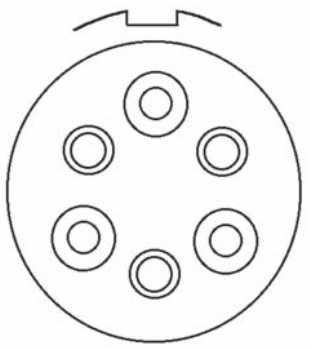


9 contacts Ø 3 mm type E ou/*or* F
09

Boîtier J / *Shell size J*



49 contacts Ø 1,6 mm Trim-Trio
49

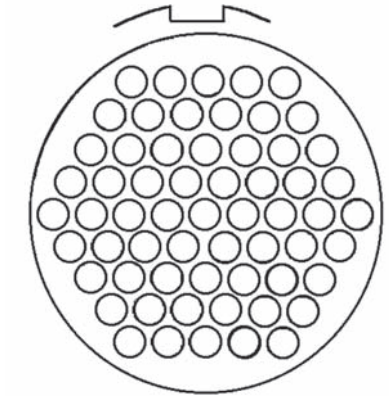


3 contacts Ø 3 mm type F ou/*or* E
3 contacts Ø 5 mm type G
06

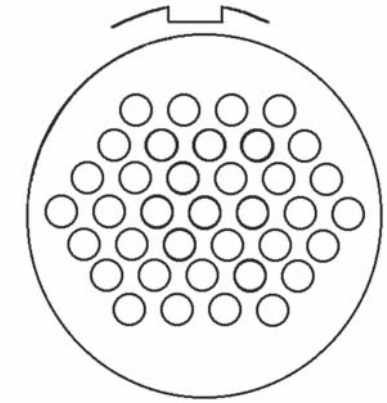
838 Series

Arrangements / *Layouts*

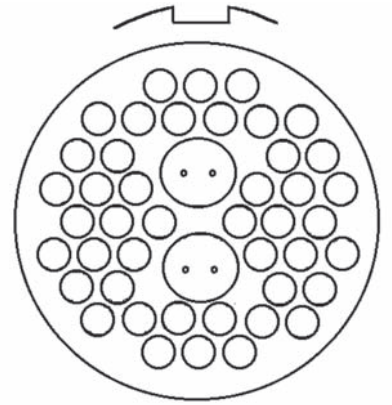
Boîtier B / *Shell size B*



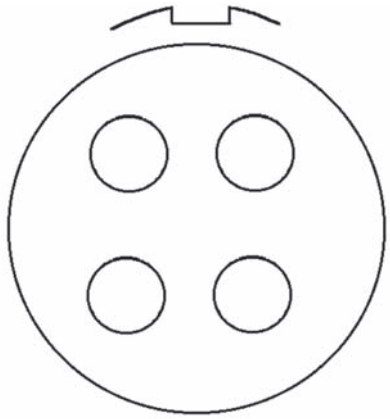
61 contacts Ø 2 mm type B ou/*or* H
61



37 contacts Ø 3 mm type E ou/*or* F
37

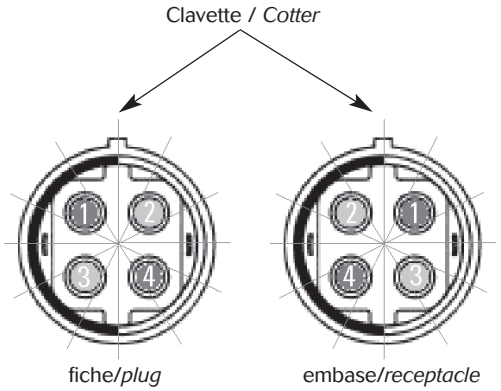


44 contacts Ø 2 mm type B ou/*or* H
+ 2 twinax 105 Ω
45

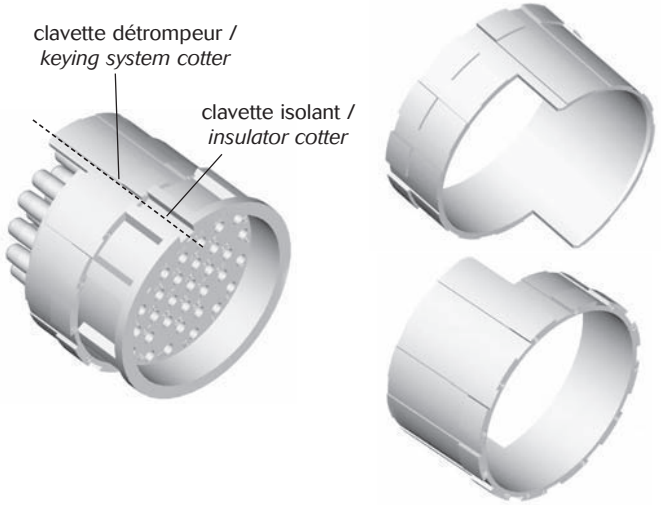


4 contacts Ø 12 mm
04

Détrompage / *Keying system*



Exemple de détrompage pour
un arrangement 4 contacts
Keying system 4 contacts layouts

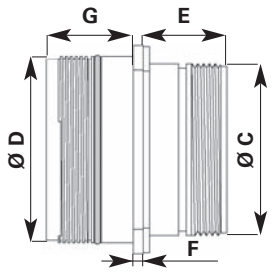


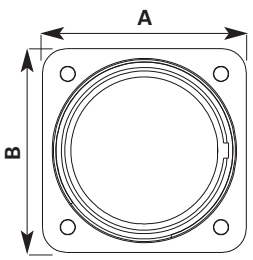
838 Series

Dimensions fiche et embase / *Plug and receptacle dimensions*

Type M
Embase sans raccord / *Receptacle without backshell*

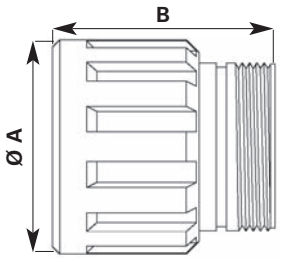
Taille/*Size*	E	C	J	B
A	42	70	85	121
B	42	70	85	110
Ø C	35	52	70	86
Ø D	38	58	76	96
E	25	24	34	21
F	4	4	4	11
G	27	28	35,5	52
Indice	0			





Type M
Fiche sans raccord / *Plug without backshell*

Taille/*Size*	E	C	J	B
Ø A	45	68	85	111
B	59	57	64	94
Indice	0			



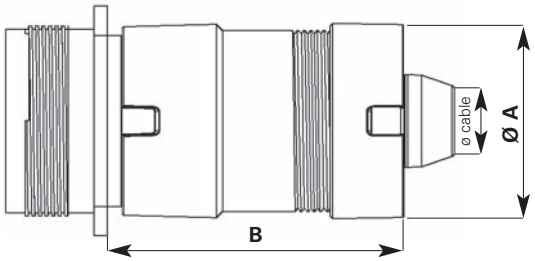
Note : Ces dimensions ne sont pas contractuelles et peuvent être modifiées / Ces dimensions sont en millimètres.
Dimensions are not contractual and may be subject to change / Dimensions are in millimeters.

838 Series

Dimensions raccords presse-étoupe / *Sealing gland backshells dimensions*

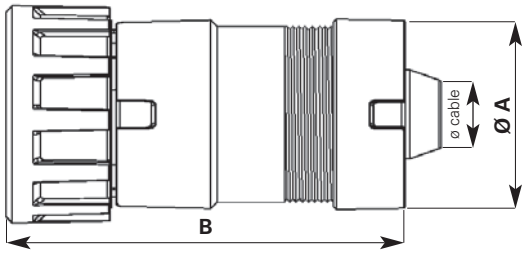
Type V
Raccord droit presse-étoupe pour embase / *Receptacle straight backshell with sealing gland*

Taille / *Size*	E		C		J		B	
Ø A	39		60		-		-	
B	84		98		-		-	
Indice	Ø cable							
	mini	maxi	mini	maxi	mini	maxi	mini	maxi
0	-	-	17	23	-	-	-	-
1	-	-	23	30	-	-	-	-
4	14,5	17	-	-	-	-	-	-



Type V
Raccord droit presse-étoupe pour fiche / *Plug straight backshell with sealing gland*

Taille/*Size*	E		C		J		B	
Ø A	39		60		-		-	
B	118		131		-		-	
Indice	Ø cable							
	mini	maxi	mini	maxi	mini	maxi	mini	maxi
0	-	-	17	23	-	-	-	-
1	-	-	23	30	-	-	-	-
4	14,5	17	-	-	-	-	-	-



Note : Ces dimensions ne sont pas contractuelles et peuvent être modifiées / Ces dimensions sont en millimètres.
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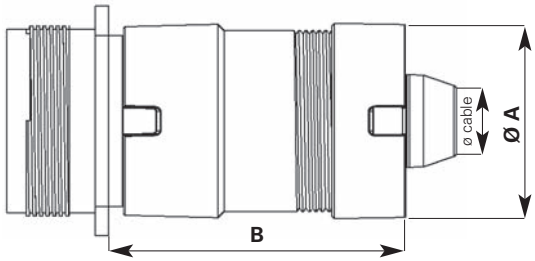
838 Series

Dimensions raccords presse-étoupe / *Sealing gland backshells dimensions*

Type W

Raccord droit presse-étoupe pour embase avec serre-câble / *Receptacle straight backshell with sealing gland and cable clamp*

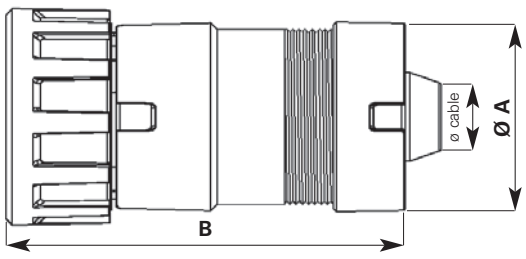
Taille/*Size*	E		C		J		B	
Ø A	39		60		-		-	
B	84		98		-		-	
Indice			Ø cable					
	mini	maxi	mini	maxi	mini	maxi	mini	maxi
0	14,5	17	14,5	17	-	-	-	-
1	10,1	13,3	10,1	13,3	-	-	-	-
2	8	11	8	11	-	-	-	-
3	6	9	6	9	-	-	-	-



Type W

Raccord droit presse-étoupe pour fiche avec serre-câble / *Plug straight backshell with sealing gland and cable clamp*

Taille/*Size*	E		C		J		B	
Ø A	39		60		-		91	
B	118		131		-		240	
Indice			Ø cable					
	mini	maxi	mini	maxi	mini	maxi	mini	maxi
0	14,5	17	14,5	17	-	-	36,6	44,8
1	10,1	13,3	10,1	13,3	-	-	32	38
2	8	11	8	11	-	-	44,8	48,5
3	6	9	6	9	-	-	28	32



Note : Ces dimensions ne sont pas contractuelles et peuvent être modifiées / Ces dimensions sont en millimètres.
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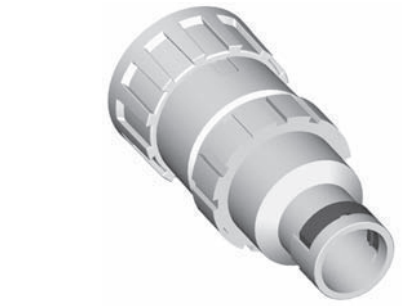
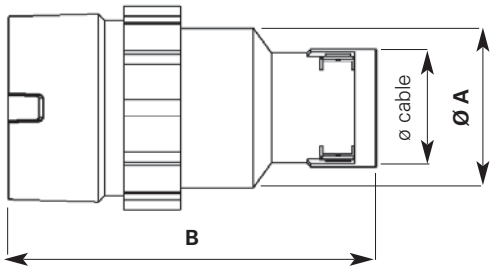
838 Series

Dimensions raccords pour gaine PMA / *PMA tube backshells dimensions*

Type S
Raccord droit presse-étoupe PMA pour fiche / *Plug straight backshell with sealing gland for PMA*

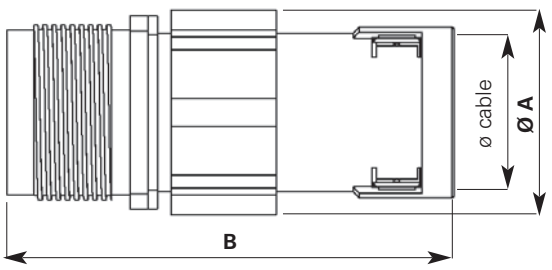
Taille/*Size*	Gaine **PMA**	**E**		**C**		**J**		**B**	
Ø A		39		-		-		106	
B	NW12	55		-		-		-	
	NW17	111		-		-		-	
	NW19	64		-		-		-	
	NW23	67		-		-		-	
Indice	Gaine PMA	Ø cable							
		mini	maxi	mini	maxi	mini	maxi	mini	maxi
2	NW12								
3	NW17	12,5	20						
7	NW19								
9	NW23								





Type G
Raccord droit PMA pour embase / *Receptacle straight backshell for PMA*

Taille/*Size*	Gaine **PMA**	**E**		C_3	C_9 *	**J**		**B**	
Ø A		45		45	62	-		-	
B	NW12	55		-	-	-		-	
	NW17	62		87**	-	-		-	
	NW23	67		-	-	-		-	
	NW29	-		-	64	-		-	
Indice	Gaine PMA	Ø cable							
		mini	maxi	mini	maxi	mini	maxi	mini	maxi
2	NW12	-	12	-	-	-	-	-	-
3	NW23	-	22	-	22	-	-	-	-
7	NW17	-	16	-	-	-	-	-	-
9	NW29	-	-	-	29	-	-	-	-



* 3 et 9 sont les indices / *3 and 9 are the index.*

** Pour le boîtier C, l'indice 3 correspond à la référence NW17
For C shell index 3 is for NW17 reference

Note : Ces dimensions ne sont pas contractuelles et peuvent être modifiées / Ces dimensions sont en millimètres.
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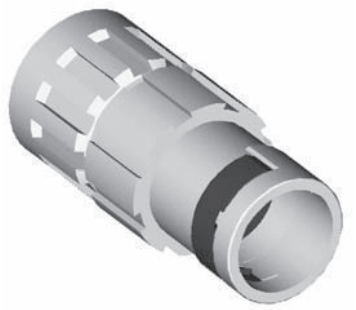
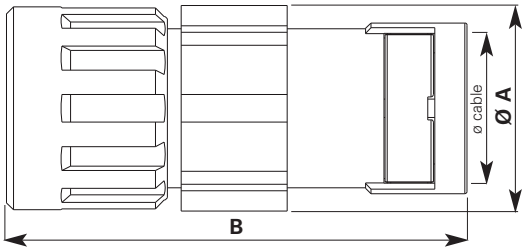
Dimensions raccords pour gaine PMA / *PMA tube backshells dimensions*

Type G
Raccord droit PMA pour fiche / *Plug straight backshell for PMA*

Taille/*Size*	Gaine **PMA**	**E**		C_7	C_9 *	**J**		**B**	
Ø A		45		45	62	-		-	
B	NW12	89		-	-	-		-	
	NW17	96		122	-	-		-	
	NW23	111		-	-	-		-	
	NW29	98		98	-	-		-	
Indice	Gaine PMA	Ø cable							
		mini	maxi	mini	maxi	mini	maxi	mini	maxi
2	NW12	-	12	-	-	-	-	-	-
3	NW23	-	22	-	-	-	-	-	-
7	NW17	-	16	-	16	-	-	-	-
9	NW29	-	28	-	28	-	-	-	-

* 7 et 9 sont les indices / *7 and 9 are the index*





Note : Ces dimensions ne sont pas contractuelles et peuvent être modifiées / Ces dimensions sont en millimètres.
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838 Series

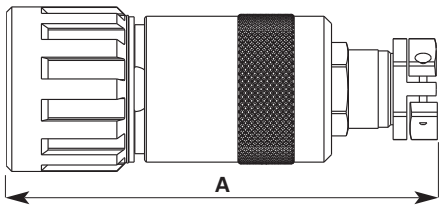
Dimensions raccords type T&U presse-étoupe avec serre-câble
Type T sealing gland with cable clamp backshells dimensions

Type T_{0-6}
Presse-étoupe avec serre-câble type ZA SIB-ADR
Sealing gland with ZA SIB-ADR cable clamp

Type U_{0-6}
Presse-étoupe avec serre-câble type ZA SIB-ADR et reprise de tresse
Sealing gland with ZA SIB-ADR cable clamp and shielding

Taille/*Size*		E	C	J	B
A	PG13	111	-	-	-
	PG16	-	-	-	-
	PG21	124	-	-	-
	PG29	-	-	-	-
	PG36	-	-	-	230
	PG42	-	-	-	-
	PG48	-	-	-	244

Indice		Ø cable							
		mini	maxi	mini	maxi	mini	maxi	mini	maxi
0	PG13	8,5	12	-	-	-	-	-	-
1	PG16	-	-	-	-	-	-	-	-
2	PG21	8	19	-	-	-	-	-	-
3	PG29	-	-	-	-	-	-	-	-
4	PG36	-	-	-	-	-	-	22	33
5	PG42	-	-	-	-	-	-	-	-
6	PG48	-	-	-	-	-	-	30	45

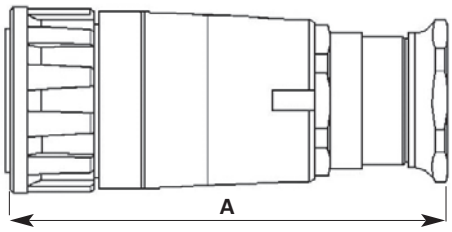


Type T_{10-16}
Presse-étoupe avec griffe type EEXe SIB-ADR
Sealing gland with EEXe SIB-ADR "claw"

Type U_{10-16}
Presse-étoupe avec griffe type EEXe SIB-ADR et reprise de tresse
Sealing gland with EEXe SIB-ADR "claw" and shielding

Taille/*Size*		E	C	J	B
A	PG13	-	-	-	-
	PG16	-	-	-	-
	PG21	-	-	-	-
	PG29	-	-	-	-
	PG36	-	-	213	-
	PG42	-	-	-	-
	PG48	-	-	223	-

Indice		Ø cable							
		mini	maxi	mini	maxi	mini	maxi	mini	maxi
10	PG13	-	-	-	-	-	-	-	-
11	PG16	-	-	-	-	-	-	-	-
12	PG21	-	-	-	-	-	-	-	-
13	PG29	-	-	-	-	-	-	-	-
14	PG36	-	-	-	-	22	30	-	-
15	PG42	-	-	-	-	-	-	-	-
16	PG48	-	-	-	-	32	40	-	-



Note : Ces dimensions ne sont pas contractuelles et peuvent être modifiées / Ces dimensions sont en millimètres.
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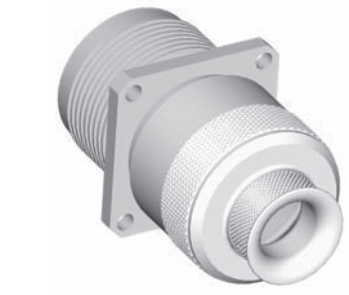
838 Series

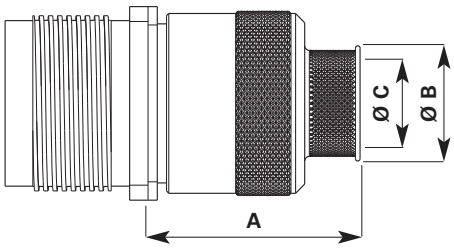
Dimensions de raccords spécifiques / *Specifics backshells dimensions*

Type Z

Raccord droit avec reprise de tresse pour embase / *Receptacle straight backshell for shielding termination*

Taille/*Size*	E	C	J	B
A	46	-	34	-
Ø B	25	-	74	-
Ø C		-		-
Indice	**0**			

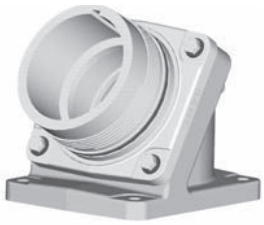


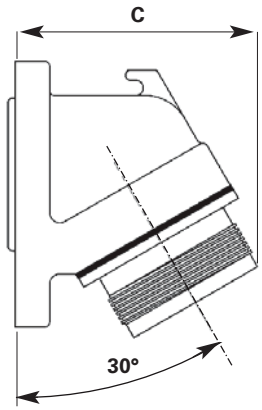


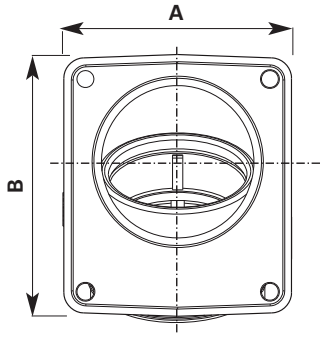
Type R

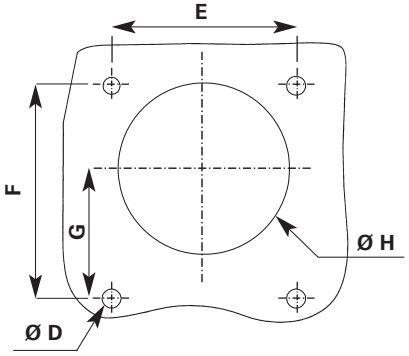
Raccord coudé / *Elbow backshell*

Taille/*Size*	E	C	J	B
A	53	71	-	98
B	95	109	-	108
C	77	95	-	138
Ø D	4,3	4,3	-	9
E	34	52	-	98
F	72	87	-	113
G	45	51	-	69
Ø H	39,5	54,5	-	94
Indice	**0**			









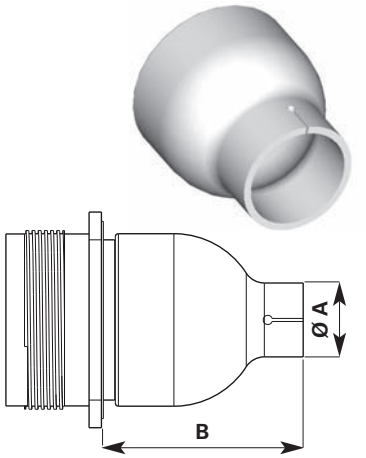
Note : Ces dimensions ne sont pas contractuelles et peuvent être modifiées / Ces dimensions sont en millimètres.
Dimensions are not contractual and may be subject to change / Dimensions are in millimeters.

838 Series

Dimensions accessoires / *Accessories dimensions*

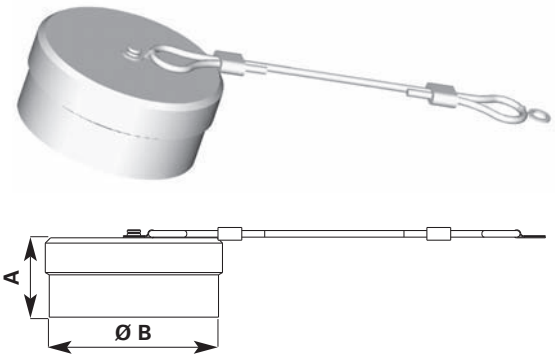
Type N
Coiffe / *Boot shell*

Taille/*Size*	E	C	J	B
Ø A	22	24	-	-
B	70	70	-	-
Indice	**0**			



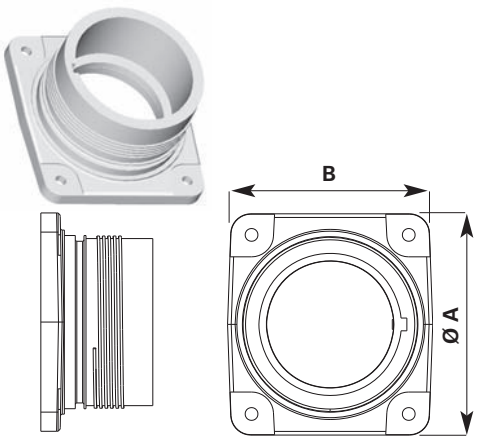
Bouchon d'embase / *Cap for receptacle*

Taille/*Size*	E	C	J	B
A	35	33	-	53
Ø B	45	68	-	110
Reference	**8038-0141A**	**8038-0140**	**-**	**8380-777**



Embase de repos / *Dummy receptacle*

Taille/*Size*	E	C	J	B
A	42	70	-	121
B	42	70	-	110
Reference	**8038-0133**	**8038-0131**	**-**	**8380-983**

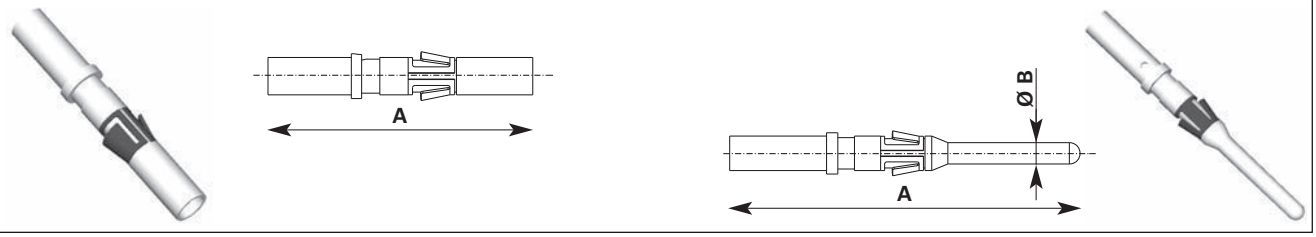


Note : Ces dimensions ne sont pas contractuelles et peuvent être modifiées / Ces dimensions sont en millimètres.
Dimensions are not contractual and may be subject to change / Dimensions are in millimeters.

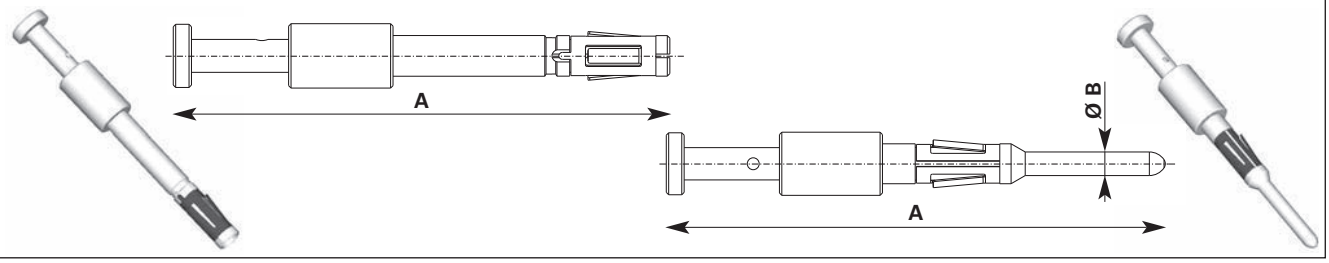
838 Series

Contacts / *Contacts*

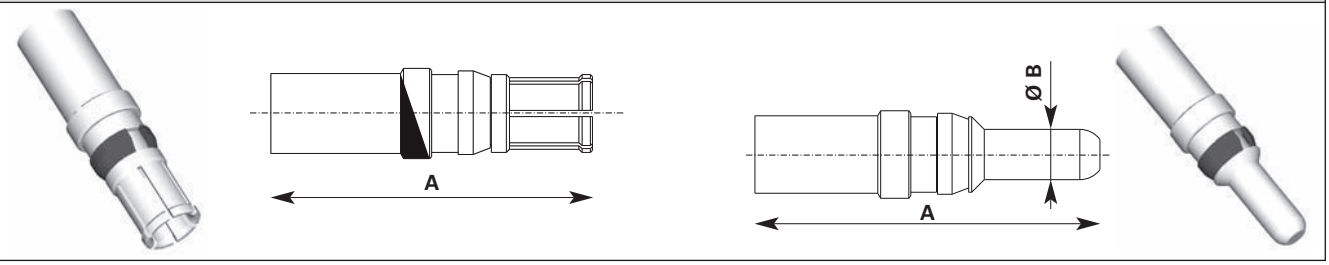
Contact Trim-Trio # 16



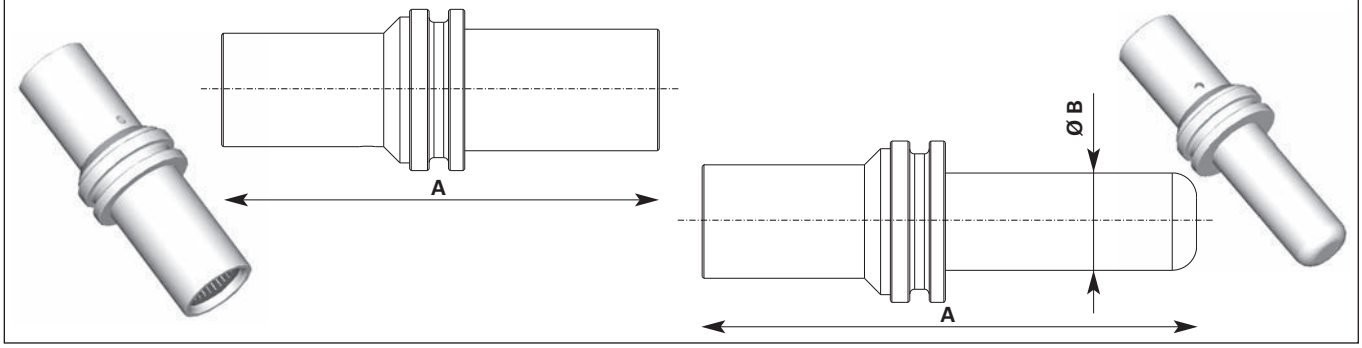
Contact Ø 2 mm / Ø 3 mm



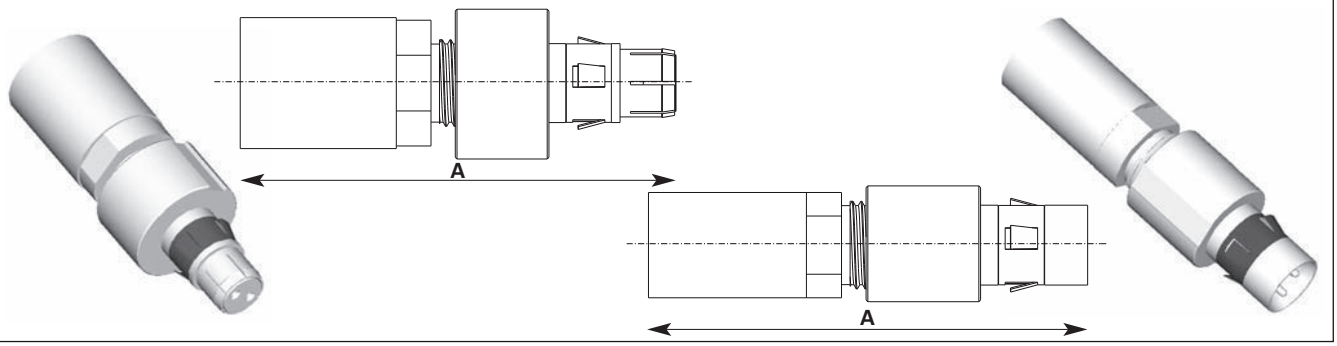
Contact Ø 5 mm



Contact Ø 12 mm



Twinax



838 Series

Contacts / *Contacts*

Ø partie active *Active part Ø* Ø B (mm)	Type de contact *Contact type*	Mâle ou femelle *Male or female*	Dimensions A	Référence *Part number*	Protection *Plating*	Section de câble *Cable size* mini (mm²)	Section de câble *Cable size* maxi (mm²)
Ø 1,6	T (Trim-Trio)	M	26,2	RM16M23K	doré *gold*	0,52	1,5
		F	18,2	RC16M23K			
Ø 2	B	M	42	8380-722	argenté passivé *passivated silver*	0,6	1,5
		F	41	8380-725			
Ø 2	B	M	42	8380-726	doré *gold*	0,6	1,5
		F	41	8380-727			
Ø 2	H	M	42	8380-970	argenté passivé *passivated silver*	1,34	2,61
		F	41	8380-973			
Ø 3	F	M	45	8380-716	argenté passivé *passivated silver*	1,34	2,61
		F	41	8380-719			
Ø 3	F	M	45	8380-717	doré *gold*	1,34	2,61
		F	41	8380-723			
Ø 3	E	M	45	8380-1365	argenté passivé *passivated silver*	4	4,78
		F	41	8380-1366			
Ø 3	E	M	45	8380-730	doré *gold*	4	4,78
		F	41	8380-731			
Ø 5	G	M	34,5	8380-728	argenté passivé *passivated silver*	10	10
		F	31	8380-729			
Ø 12	J	M	61	8380-1020A	argenté passivé *passivated silver*	50	50
		F	54	8380-1021A			
Twinax 105 Ω cable Arrangement / *Layout* 45	-	M	-	8380-951	doré / argenté *gold / passivated silver*	0,2 (250BLG)	0,6
		F	-	8380-950			
Twinax 120 Ω cable Arrangement / *Layout* 45	U	M	50	8380-994	doré / argenté *gold / passivated silver*	0,2 ROCKBEST05 2/C AWG20	0,6
		F	50	8380-995			
Twinax 120 Ω cable Arrangement / *Layout* 01	S	M	50	8380-1009	contact doré / corps argenté *gold contact / passivated silver body*	0,2	0,6
		F	50	8380-1010 8380-1012			

Note : Notice de câblage du Twinax disponible sur demande : ref. BT105 et NC132 / *Twinax wiring instructions are available upon request: ref BT105 and NC132.*

838 Series

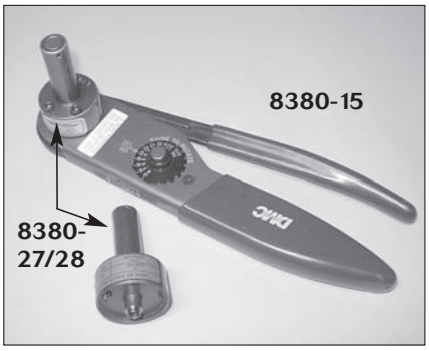
Outillage / *Tooling*

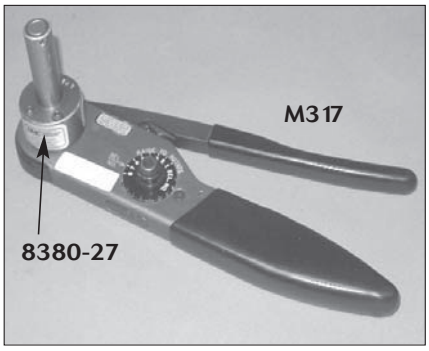
Ø partie active (mm) *Active part Ø* (mm)	Type de contact *Contact type*	Mâle ou femelle *Male or female*	Référence *Part number*	Pince de sertissage *Crimping tool*	Positionneur *Locator*	Outil d'extraction de la cavité *Extraction tool*
Ø 1,6	T (Trim-Trio)	M	RM16M23K	MH860 (M22520/7-01)	MH86164G	RX2025GE1
		F	RC16M23K			
Ø 2	B	M	8380-722	8380-15	8380-28	8380-740
		F	8380-725			
Ø 2	B	M	8380-726	8380-15	8380-28	8380-740
		F	8380-727			
Ø 2	H	M	8380-970	8380-15	8380-28	8380-740
		F	8380-973			
Ø 3	F	M	8380-716	8380-15	8380-27	8380-741
		F	8380-719			
Ø 3	F	M	8380-717	8380-15	8380-27	8380-741
		F	8380-723			
Ø 3	E	M	8380-1365	M317	8380-27	8380-741
		F	8380-1366			
Ø 3	E	M	8380-730	M317	8380-27	8380-741
		F	8380-731			
Ø 5	G	M	8380-728	MECATRACTION PMM1	D5HCU10-50	5106.021.09.50
		F	8380-729		D5HCU10-50	5106.021.06.50
Ø 12	J	M	8380-1020A	MECATRACTION TR461R	MECATRACTION TN50-460	
		F	8380-1021A			
Twinax 105 Ω cable Arrangement / *Layout* 45	-	M	8380-951	pour contact *for contact* M22520/2.01	M22520/2.08	8532-01
		F	8380-950	pour ferrule *for ferrule* M22520/5.01	Y116	
Twinax 120 Ω cable Arrangement / *Layout* 45	U	M	8380-994	pour contact *for contact* M22520/2.01	M22520/2.08	8532-01
		F	8380-995	pour ferrule *for ferrule* M22520/5.01	Y116	
Twinax 120 Ω cable Arrangement / *Layout* 01	S	M	8380-1009	pour contact *for contact* M22520/2.01	M22520/2.08	8532-01
		F	8380-1000 8380-1012	pour ferrule *for ferrule* M22520/5.01	Y116	

838 Series

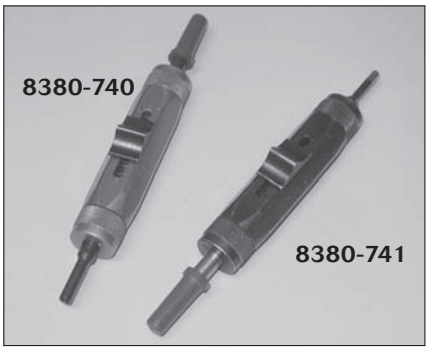
Photographies outillages / *Tools photographies*

Pinces de sertissages avec positionneur / *Crimping tools with locator*



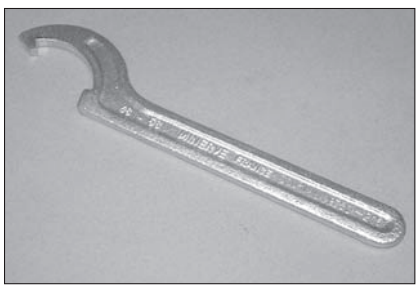


Outils d'extractions / *Extraction tools*



- L'insertion des contacts dans leur cavité ne nécessite aucun outil
  No tool needed for contact insertion.
- L'insertion de l'outil se fait par l'avant et l'extraction du contact par l'arrière de l'insert
  Front remove, rear release.

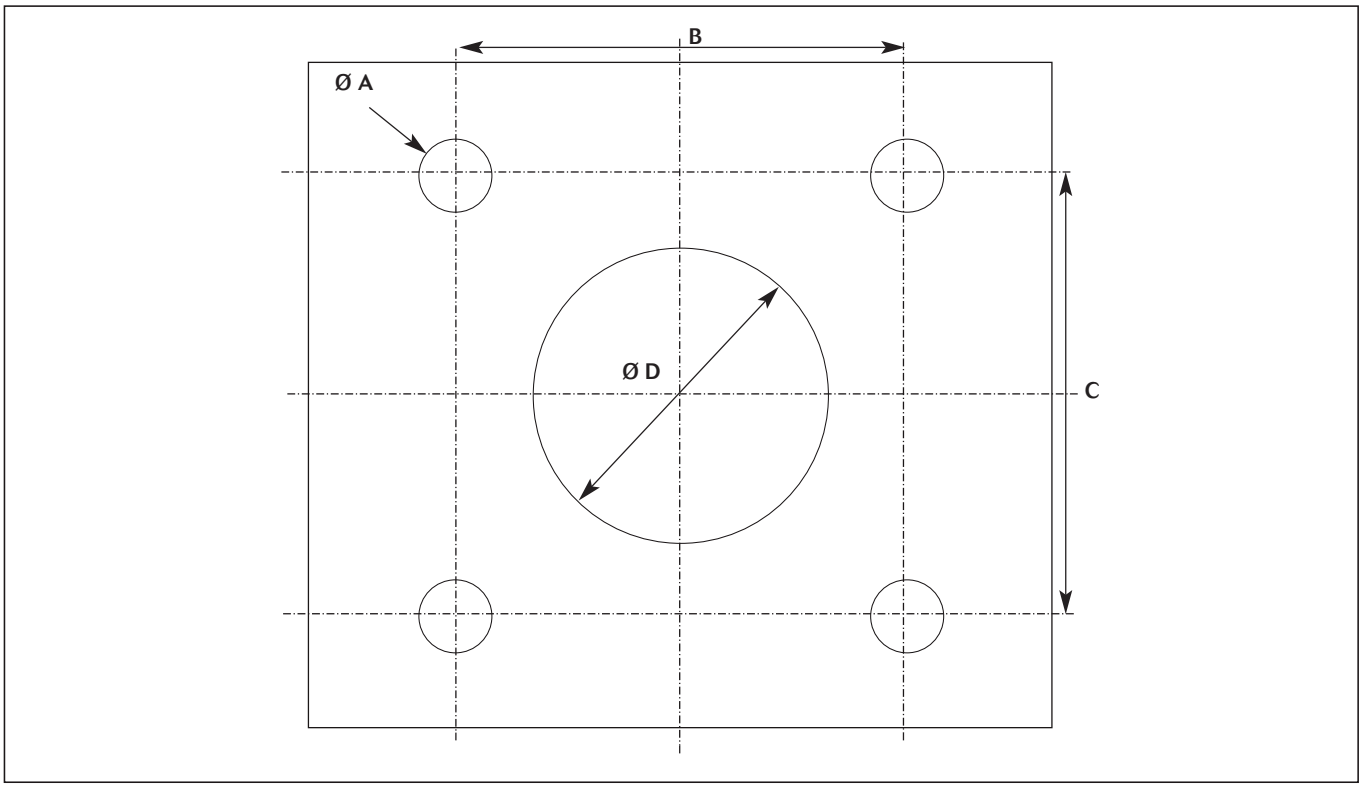
Clé à ergot / *Pin wrench*



Boîtier *Shell*	Clé à ergot *Pin wrench*	Couple de serrage / *Coupling torque* (daN.m)	
		mini	maxi
E	8380-216	0,4	1
C	8380-216	0,6	1,5
J	8380-216	0,6	1,5
B	8380-213	0,7	2

838 Series

Perçage de cloison / *Panel cutout*



Taille / *Size*	E	C	J	B
Ø A	4,3	4,3	6,5	7
B	34	52	64	98
C	34	52	64	86
Ø D	38,5	54	77	88
Ø D*	44,5	60	77	88

* Fixation de l'embase par l'avant de la cloison
Receptacle fixed from front of the panel.

Ces dimensions sont en millimètres.
Dimensions are in millimeters.

838 Series

Notes

8038 Series

Sommaire

	page
• Caractéristiques techniques	28
• Synoptique	29
• Référencement	30
• Arrangement et détrompage	31
• Séries 8011 : contacts et connecteur	32
• Disponibilité 8011	33
• Bretelle optique	34
• Dimensionnement	35
• Contacts	39
• Outillage	40
• Perçage cloison	40
• Mise en œuvre	41
• Famille optique	42
• Index gamme ferroviaire	43

Content

	page
• *Technical features*	*28*
• *Synoptic*	*29*
• *Ordering information*	*30*
• *Layouts and Keying system*	*31*
• *8011 series : contacts and connector*	*32*
• *8011 Availability*	*33*
• *Patchcords*	*34*
• *Dimensioning*	*35*
• *Contacts*	*39*
• *Tools*	*40*
• *Panel cutout*	*40*
• *Fiber termination*	*41*
• *Optical family*	*42*
• *Railways sheet*	*43*

Présentation

Les apports de la fibre optique sont considérables en milieu dit « perturbé » :

- insensibilité aux perturbations électriques des liaisons,
- accroissement du débit des informations transmises,

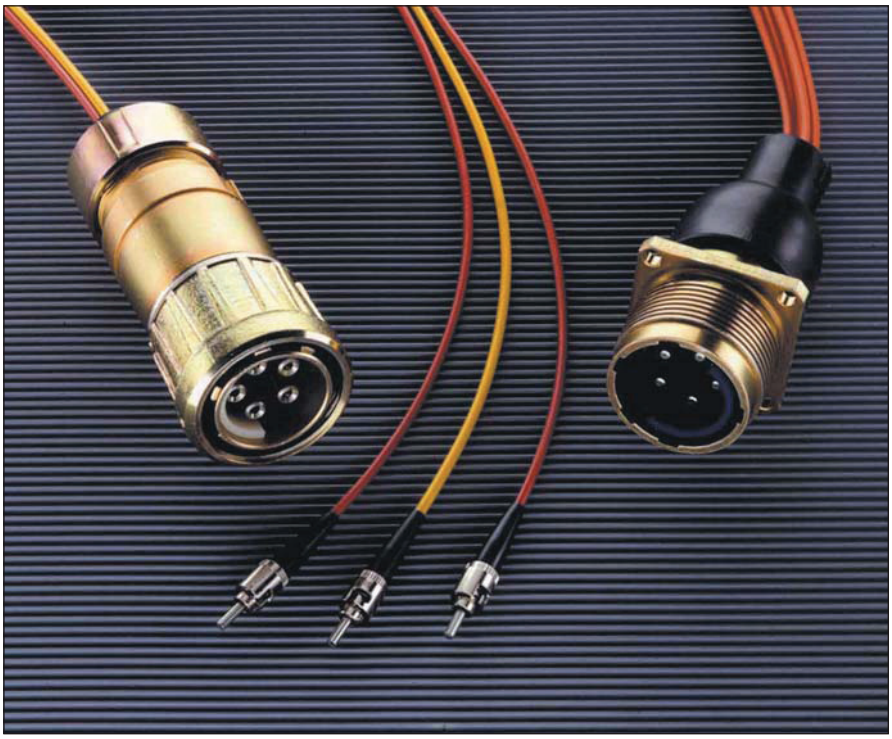
c'est pourquoi la division fibre optique a développé à partir du connecteur 838, un connecteur optique 8038, homologué par ABB (Asea Brown Boveri) en accord avec la norme allemande BN 411 012 et les normes IEC 77 et 571.

Presentation

The optical fiber optics has lot of advantages in disturbe areas:

- *insensitivity to the electric disturbances,*
- *increase in transmitted information flow,*

this is why, fiber optics division has developed the optical connector 8038, based on the 838 series connector, approved by ABB (Asea Brown Boveri) according to the German standard BN 411 012 and the IEC 77 and 571 standards.

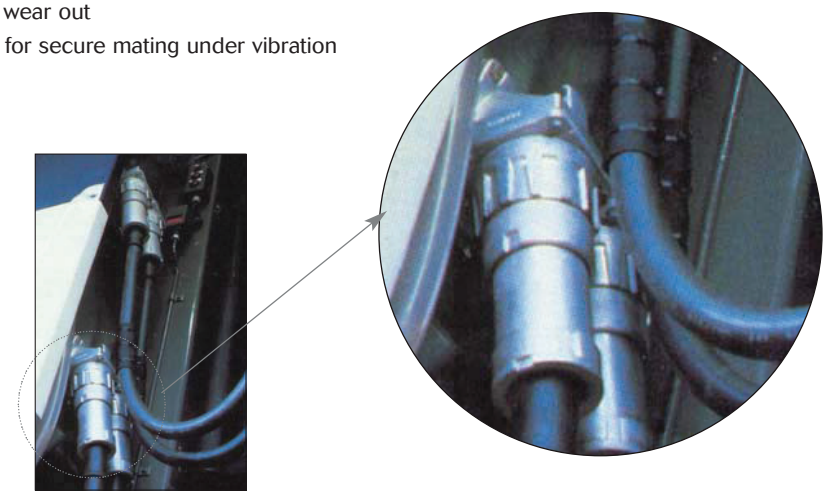


8038 Series

Technical features & benefits

Ruggedized circular connector to matching intercoach environment

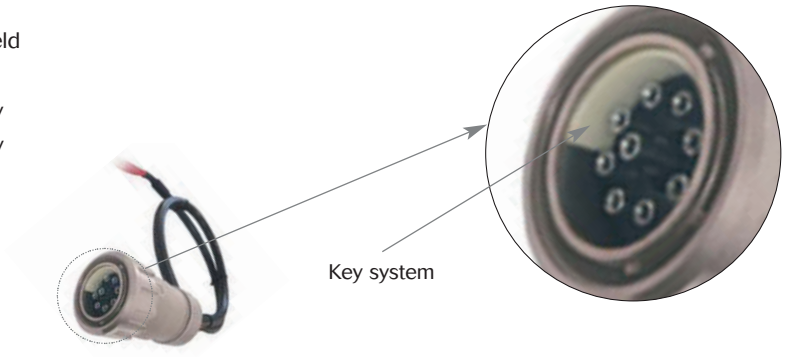
- Enabling 500 mating-unmating without wear out
- Screw coupling with thin square thread for secure mating under vibration
- Traction force withstanding
- 30° panel mounting



Versatile series

- Versatile insert with reverse gender
- Polarization system enabling
- Keying of insert can be done on the field
- Optical contact :

- Electro Magnetic Interference immunity
- Radio Frequency Interference immunity



RoHS compliancy

- Shells plating are cadmium free: Alodine 1200
- Insert are halogen free: PBB & PBDE

8038 Series

Caractéristiques / *Technical features*

Mécaniques

- **Boîtier :** alliage d'aluminium
- **Protection :** alodine (1200)
- **Système de verrouillage :** à vis avec cliquet
- **Isolant :** thermoplastique : polyamide I2-F3 conforme aux spécifications feu-fumée NFF 16101-16102 (exigence 3) pour installations sur matériel catégorie A1 et conforme à UL94-V0
- **Système de codage amovible** offrant 12 possibilités différentes de détrompage à l'opérateur (livré en position 5 pour le boîtier E et 9 pour le boîtier C)
- **Endurance mécanique :** 500 manœuvres (verrouillage + déverrouillage).

Mechanical

- ***Shell:*** *aluminium alloy*
- ***Plating:*** *alodine (1200)*
- ***Locking system:*** *screw with clicker*
- ***Insulator:*** *thermoplastic: polyamide I2-F3 in accordance with NFF 16101-16102 (exigence 3) (fire and smoke emissions) for installations on equipments category A1 UL94-V0*
- ***Removable coding system*** *enable 12 different key orientations to be selected by the operator (delivered in position 5 for the shell and 9 for the shell).*
- ***Endurance:*** *500 mating-unmating cycles.*

Climatiques et environnementales

- **Température d'utilisation :** - thermoplastique : -40°C à +85°C
- **Etanchéité :**
  - A la lance (NFC 20010)
  - IP67
- **Chaleur humide :** 21 jours à +40°C ; 90% d'humidité relative (NFC 20703, sévérité 5)
- **Brouillard salin :** 96 heures (NFC 20711)
- **Chocs :** +/-3g selon IEC 68-2-27
- **Test de vibration :**
  - A = 25/f - 1 Hz < f < 10 Hz
  - A = 250/f - 10 Hz < f < 100 Hz

(Pour d'autres exigences, nous consulter).

Climatic and environmental

- ***Temperature range:*** *- thermoplastic: -40°C to +85°C*
- ***Sealing:***
  - *Jet proof (NFC 20010)*
  - *IP 67*
- ***Damp heat:*** *21 days to +40°C ; 90% relative humidity (NFC 20703, severity 5)*
- ***Salt spray:*** *96 hours (NFC 93422)*
- ***Chocks:*** **:** +/-3g IEC 68-2-27
- ***Vibration test :***
  - *A=25/f - 1 Hz < f < 10 Hz*
  - *A=250/f - 10 Hz < f < 100 Hz*

(For other requirements, consult us)

Electriques

- **Tension de tenue :** 3250 Veff
- **Résistance d'isolement :** ≥ 5000 MΩ sous 500 Vcc
- **Résistance de contact :** ≤ 2 mΩ
- **Tension de service par arrangement :** 380 Veff
- **Intensité admissible par contact :** 30 A pour Ø 3 mm

Electrical

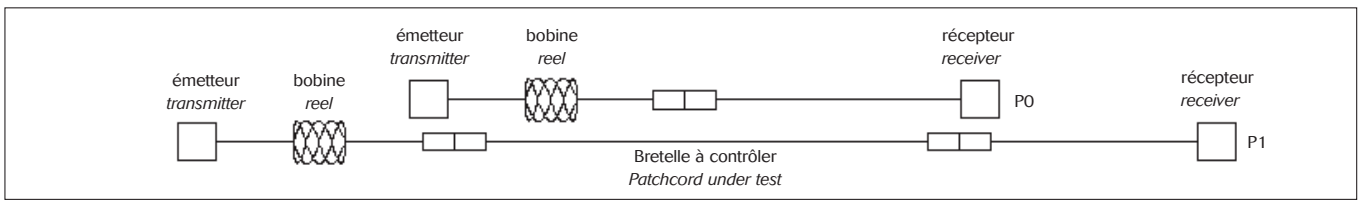
- ***Test voltage:*** *3250 Vrms*
- ***Insulation resistance:*** *≥ 5000 MΩ under 500 Vdc*
- ***Contact resistance:*** *≤ 2 mΩ*
- ***Maximum voltage per layouts:*** *380 Vrms*
- ***Maximum rating per contact:*** *30 A for Ø 3 mm*

Optiques

La 8038 utilise des contacts optiques de type 8011.

Optical

8038 use 8011 optical contacts



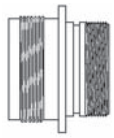
- **Atténuation :** méthode normalisée (IEC 874.1 § 27,1 méthode 6) =10 log (P1/P0).
- **Pertes d'insertion :**
  - 0,4 dB par voie avec fibre HCS 62,5 /125 et l = 820 nm
  - 0,7 dB par voie avec fibre HCS 200 /230 et l = 820 nm
  - 1,2 dB par voie avec fibre plastique 1 mm et l = 670 nm

- ***Attenuation :*** *standard test method (IEC 874.1 § 27,1 method 6) = 10 log (P1/P0).*
- ***Insertion lost :***
  - *< 0,4 dB / way with fiber 62,5 /125 HCS and l = 820 nm*
  - *< 0,7 dB / way with fiber 200 /230 HCS and l = 820 nm*
  - *< 1,2 dB / way with plastic fiber 1 mm and l = 670 nm.*

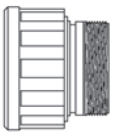
8038 Series

Boîtier E / *Shell E*

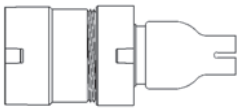
Type A :
embase sans raccord
receptacle without backshell



Type B :
fiche sans raccord
plug without backshell

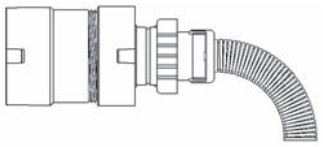


Type C



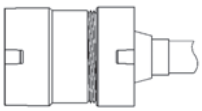
Raccord sortie libre
Backshell for single outlet

Type D



Raccord avec PMA
Backshell with PMA

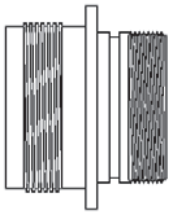
Type E



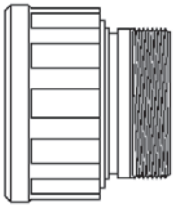
Raccord câble constitué
Backshell for multiway cable assembly

Boîtier C / *Shell C*

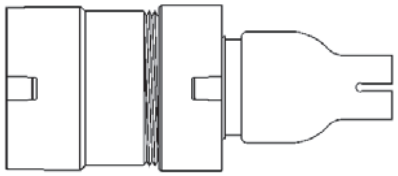
Type A :
embase sans raccord
receptacle without backshell



Type B :
fiche sans raccord
plug without backshell

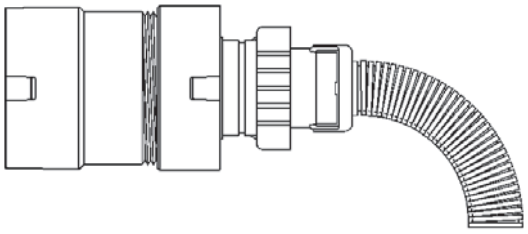


Type C



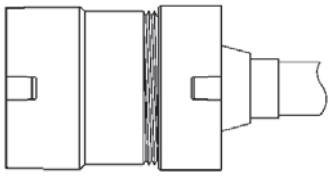
Raccord sortie libre
Backshell for single outlet

Type D



Raccord avec PMA
Backshell with PMA

Type E



Raccord câble constitué
Backshell for multiway cable assembly

8038 Series

Système de référence / *Cross-reference list*

Boîtier E / *Shell size E*	
Désignation / *Designation*	**SOURIAU**
Embase avec tétine / *Plug with boot*	8038-0006
Fiche avec raccord de sortie libre / *Plug with single cable outlet backshell*	8038-0005
Fiche avec raccord pou tube PMA / *Plug with PMA backshell*	8038-0015
Fiche avec raccord pour câble constitué / *Plug with multiway cable assembly backshell*	8038-0018
Embase de repos / *Dummy stowage receptacle*	8038-0133
Raccord coudé 30° / *30° angle support*	8038-0146
Bouchon d'embase / *Protective cap for receptacle*	8038-0141A

Boîtier C / *Shell size C*	
Désignation / *Designation*	**SOURIAU**
Embase avec tétine / *Plug with boot*	8038-0002
Fiche avec raccord de sortie libre / *Plug with single cable outlet backshell*	8038-0003
Fiche avec raccord pou tube / *PMA Plug with PMA backshell*	8038-0019
Fiche avec raccord pour câble constitué / *Plug with multiway cable assembly backshell*	8038-0017
Embase de repos / *Dummy stowage receptacle*	8038-0131
Raccord coudé 30° / *30° angle support*	8038-0145
Bouchon d'embase / *Protective cap for receptacle*	8038-0140

Système d'obturation / *Sealing system*	
Désignation / *Designation*	**SOURIAU**
Sous-ensemble - Obturateur de fiche / *Filler plug for 8038 plug* - **1**	8038-0127
Sous-ensemble - Obturateur d'embase / *Filler plug for 8038 receptacle* - **2**	8038-0126
Obturateur de raccord - Arrière boîtier C / *Filler plug for C backshell* - **3**	8380-2960LM
Obturateur de raccord - Arrière boîtier E / *Filler plug for E backshell* - **4**	8038-0161NZ

Obturateur de fiche **- 1**
Filler receptacle

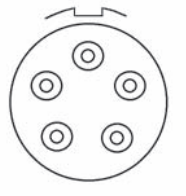
Obturateur d'embase **- 2**
Filler plug

Obturateur de raccord **- 3/4**
Filler backshell

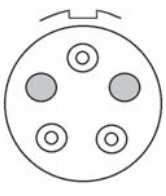
8038 Series

Arrangements / *Layouts*

Boîtier E / *Shell size E*

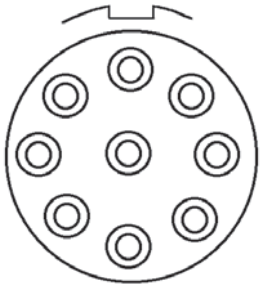


5 contacts optiques
5 optical contacts



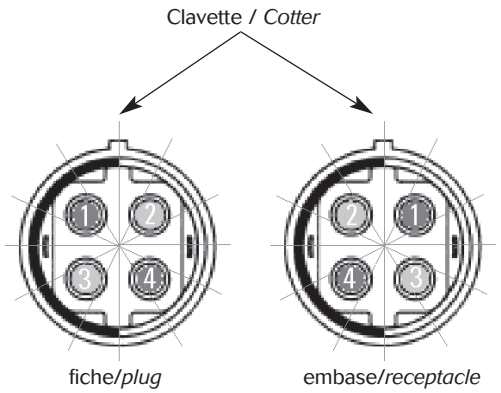
3 contacts optiques + 2 électriques
3 optical contacts + 2 electrical

Boîtier C / *Shell size C*

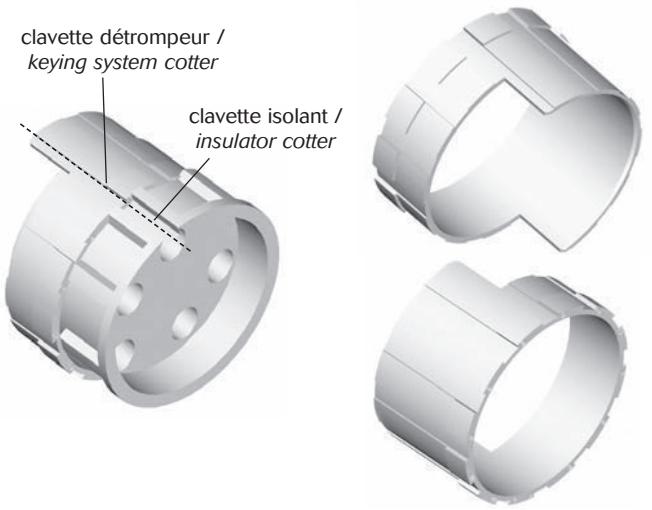


9 contacts optiques
9 optical contacts

Détrompage / *Keying system*



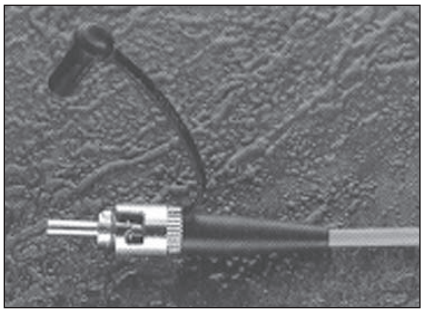
Exemple de détrompage
Keying system



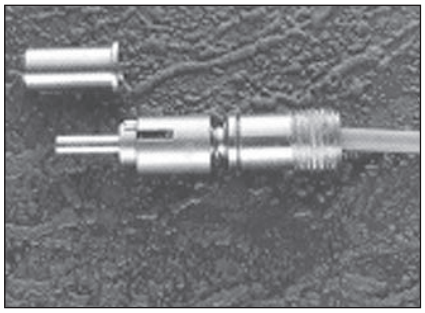
8038 Series

Séries 8011 : contacts et connecteurs / *8011 series : contacts and connectors*

Connecteur optique 8011 compatible ST
Optical connector 8011 (ST compatible)



Connecteur optique 8011 de fiche
Optical connector 8011 for plug



Connecteur optique 8011 d'embase
Optical connector 8011 for receptacle

Système de référence : contact et connecteur 8011
Ordering system : 8011 contacts and connector

Famille / *Basic series*	**8011**	**xx**	**x**	**x**	**xx**
15 Connecteur / *Plug*					
55 Contact d'embase / *Contact for receptacle*					
56 Contact de fiche / *Contact for plug*					
Fibre / *Fiber*					
R 200 / 230 µm					
G 50 / 125 µm - 62,5 / 125 µm					
H 100 / 140 µm					
I 500 µm fibre plastique / *Plastic fiber*					
J 1000 µm fibre plastique / *Plastic fiber*					
Autres fibres, nous consulter / *Other fibers, on request*					
Code de modification / *Modification index*					
0 Version sertissage - fracture pour réparation sur site *Crimping - cleaving version for field repair*					
1 Version standard collage - polissage *Glueing - polishing standard version*					
27 Câble / *cable* Ø 2,8 mm					
63 Câble / *cable* Ø 2,6 mm					
62 Câble / *cable* Ø 2,2 mm					
52 Câble / *cable* Ø 1 mm					

8038 Series

Références disponibles / *Available part numbers*

Designation / *Designation*		Références complètes / *Complete part numbers*										
		8011 **12G163D**	8011 **12G180D**	8011 **72G163D**	8011 **15H163D**	8011 **15R063D**	8011 **15R163D**	8011 **75R163D**	8011 **15J062D**	8011 **22Z01D**	8011 **22Z01C**	8011 **0076**
Fiche ***Plug***	ST	●	●		●	●	●		●			
	ST II			●				●				
Fibre ***Fiber***	50/125 µm + 62,5/125 µm	●	●	●								
	100/140 µm				●							
	200/230 µm					●	●	●				
	Plastique 1 mm *Plastic 1 mm*								●			
Raccordement ***Termination***	Sertissage / clivage *Crimping / cleaving*					●						
	Sertissage / polissage *Crimping / polishing*								●			
	Collage / polissage *Gluing / polishing*	●	●	●	●		●	●				
Câble ***Cable***	Câble 2,2 mm *Cable 2,2 mm*								●			
	Câble 2,4 à 3 mm *Cable 2,4 to 3 mm*	●		●	●	●	●	●				
Accessoires ***Accessories***	Bouchon de protection *Protection cap*											●
	Réducteur câble 1,1 mm *Hole adaptor cable 1,1 mm*		●									
	Réducteur câble 1,6 mm *Hole adaptor cable 1,6 mm*		●									
Matériaux ***Material***	Embout métallique *Metallic ferule*				●	●	●	●	●			
	Embout céramique *Ceramic ferule*	●	●	●								
	Centreur métallique *Metallic sleeve*									●	●	
Raccord ***Adaptor***	Raccord *Thru-bulkhead adaptator*									●	●	
Emballage ***Packaging***	Emballage par 10 *10 pieces packaging*	●	●	●	●	●	●	●	●	●		●
	Emballage par 100 *100 pieces packaging*										●	

Ferrule de rétention / *Retention ferule :* **8038-0124NZ**

8038 Series

Bretelles optiques

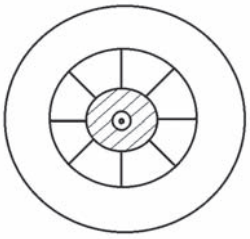
SOURIAU fournit des cordons équipés de connecteurs ou contacts optiques 8011 répondant aux spécifications de l'utilisateur.

Patchcords

SOURIAU provides jumpers and patchcords equipped with 8011 series connectors and optical contacts. Production acc. to customer specification on request.

Structure des câbles optiques

Cable optical structure



Fibre / Fiber HCS 200/230/500 - Ø 100/140/500 µm

Kevlar 491580 Dtex Ø 1,20 mm

Gaine Zéro halogène, faible émission de fumée Ø 2,6 mm
Halogenfree jacket, Ø 2,6 mm

Système de référence : Bretelles optiques
• Réf ABB câble monovoie : HESN 454 384 XXXX
• Réf ABB câble duplex : HESN 454 392 XXXX

***Ordering system** : Patchcords*
• P/N ABB jumper : HESN 454 384 XXXX
• P/N ABB duplex jumper : HESN 454 392 XXXX

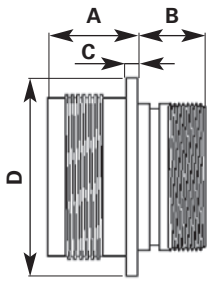
Famille / *Basic series*	8011	90	R	2	XX	X
90 bretelle monovoie / *jumper* **91** bemi-bretelle monovoie / *pigtail* **92** bretelle duplex / *duplex jumper* **93** bemi-bretelle duplex / *duplex pigtail*						
Fibre / *Fiber* **G** 50 / 125 µm - 62,5 / 125 µm **H** 100 / 140 µm **J** 1000 µm fibre plastique / *Plastic fiber* **R** 200 / 230 µm HCS Autres fibres, nous consulter / *Other fibers, on request*						
2 bretelle équipée de 8011-15-R-163 / *jumper with two plugs* **5** bretelle d'embase 8038-8011-5-R-163 / *jumper with optical contact for 8038* **6** bretelle de fiche 8038-8011-5-R-163 / *jumper with optical contact for 8038 plug*						
Longueur bretelle nous consulter / *Jumper length on request*						
Câble / *Cable* **A** Orange H & S / *jumper length : on request* **S** Orange Métallurgie Bresciance zéro halogène / *Métallurgie Bresciance cable-halogen free jacket* **D** Orange Duplex (jaune et orange) H & S / *H & S Orange Duplex cable (yellow and orange)* Autres câbles, nous consulter / *Other cables, on request*						

8038 Series

Dimensions / *Dimensions*

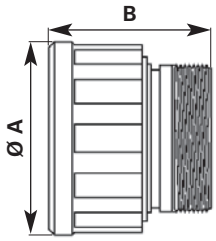
Type A
Embase sans raccord / *Receptacle without backshell*

Taille/*Size*	E	C
A	31	31
B	25	24
C	4	4
D	42	70



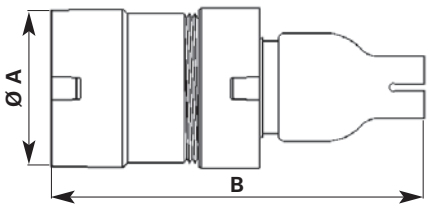
Type B
Fiche sans raccord / *Plug without backshell*

Taille/*Size*	E	C
Ø A	43	68
B	58	57



Type C
Raccord sortie libre / *Backshell for single cable outlet*

Taille/*Size*	E	C
Ø A	40	59
B	82	148



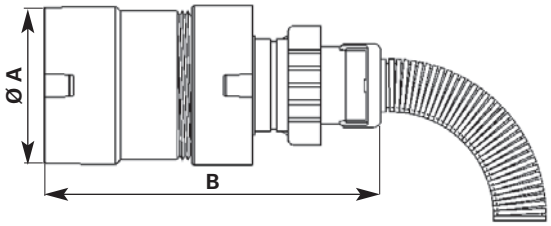
Note : Ces dimensions ne sont pas contractuelles et peuvent être modifiées / Ces dimensions sont en millimètres.
Dimensions are not contractual and may be subject to change / Dimensions are in millimeters.

8038 Series

Dimensions / *Dimensions*

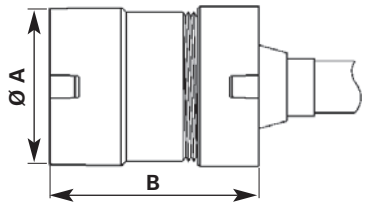
Type D
Raccord avec PMA / *Backshell with PMA*

Taille/*Size*	E	C
Ø A	40	59
B	124	126



Type E
Raccord pour câble constitué / *Backshell for multiway cable assembly*

Taille/*Size*	E	C
Ø A	40	59
B	82	89



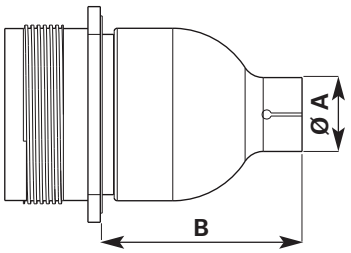
Note : Ces dimensions ne sont pas contractuelles et peuvent être modifiées / Ces dimensions sont en millimètres.
Dimensions are not contractual and may be subject to change / Dimensions are in millimeters.

8038 Series

Dimensions / *Dimensions*

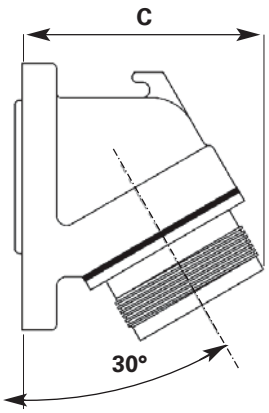
Coiffe / *Boot shell*

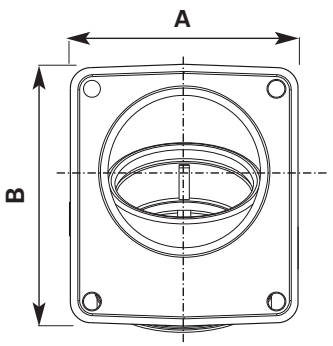
Taille/*Size*	E	C
Ø A	21,3	24
B	62	62

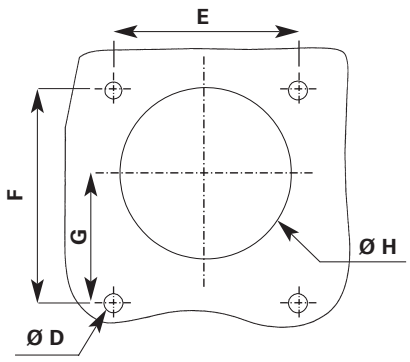


Raccord coudé / *Elbow backshell*

Taille/*Size*	E	C
A	53	71
B	95	109
C	77	95
Ø D	4,3	4,3
E	34	52
F	72	87
G	45	51
Ø H	39,5	54,5







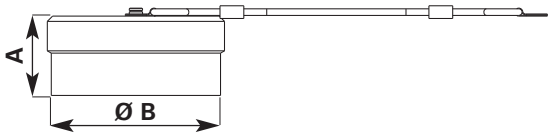
Note : Ces dimensions ne sont pas contractuelles et peuvent être modifiées / Ces dimensions sont en millimètres.
Dimensions are not contractual and may be subject to change / Dimensions are in millimeters.

8038 Series

Dimensions accessoires / *Accessories dimensions*

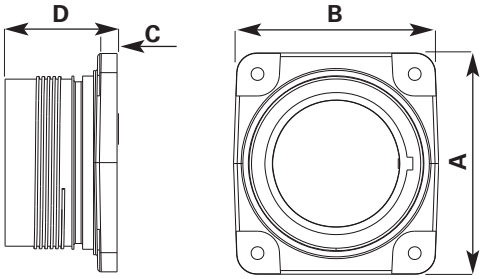
Bouchon d'embase / *Cap for receptacle*

Taille/*Size*	E	C
A	35	33
Ø B	45	68
Reference	**8038-0141A**	**8038-0140**



Embase de repos / *Dummy receptacle*

Taille/*Size*	E	C
A	42	70
B	42	70
C	4	4
D	31	31



Note : Ces dimensions ne sont pas contractuelles et peuvent être modifiées / Ces dimensions sont en millimètres.
Dimensions are not contractual and may be subject to change / Dimensions are in millimeters.

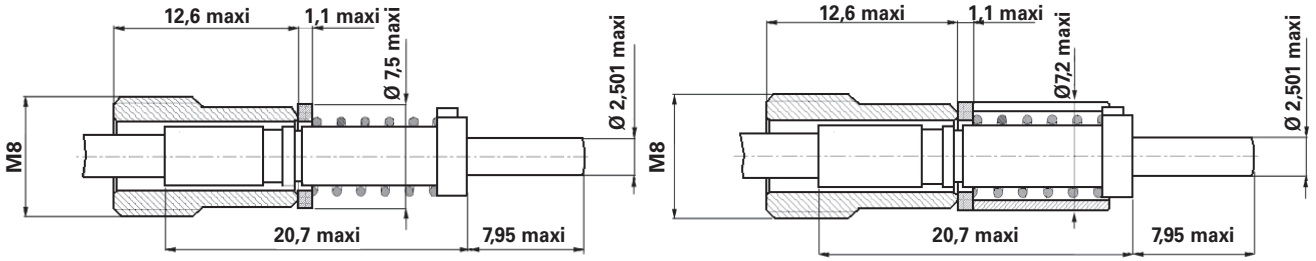
8038 Series

Contacts / *Contacts*

Contact électrique / *Electrical contact*

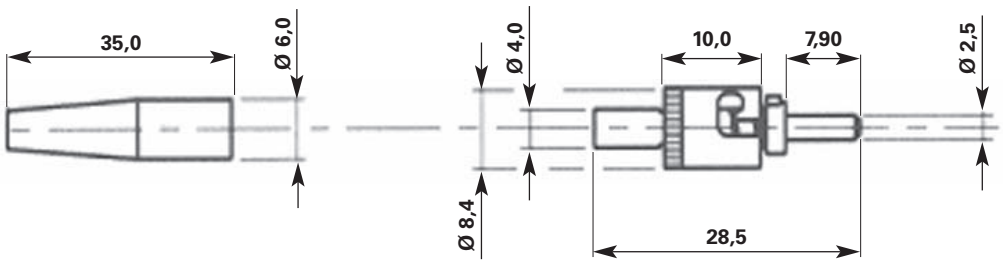
Ø partie active *Active part Ø* (mm)	Type de contact *Contact type*	Mâle ou femelle *Female or male*	Référence unitaire *Unit reference*	Protection *Plating*	Section de câble / *Cable size*	
					mini (mm²)	maxi (mm²)
Ø 3	F	M	8380-716	argenté passivé *passivated silver*	1,34	2,61
		F	8380-719			
Ø 3	F	M	8380-717	doré *gold*	1,34	2,61
		F	8380-723			
Ø 3	E	M	8380-1365	argenté passivé *passivated silver*	4	4,78
		F	8380-1366			
Ø 3	E	M	8380-730	doré / *gold*	4	4,78
		F	8380-731			

Contact optique / *Optical contact*



Connecteur / *Connector*

8011 ST

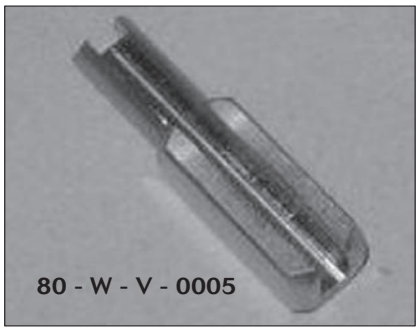


Dimensions en millimètres - *Dimensions are millimeters*

8038 Series

Outillage spécifique / *Specific tools*

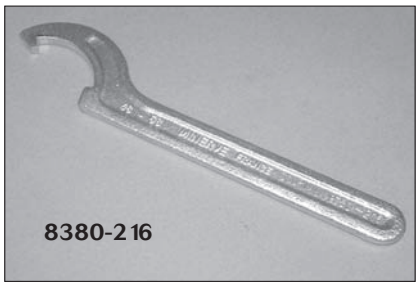
Outils de serrage des contacts 8011 / *Screw driver for 8011 contacts*



Nous nous réservons le droit d'apporter à nos matériels toutes modifications que nous jugerions utiles dans un but d'amélioration. Les cotes portées dans nos catalogues sont donc susceptibles de subir de légères variations. Nous donnerons sur demande toutes cotes de détail nécessaires.

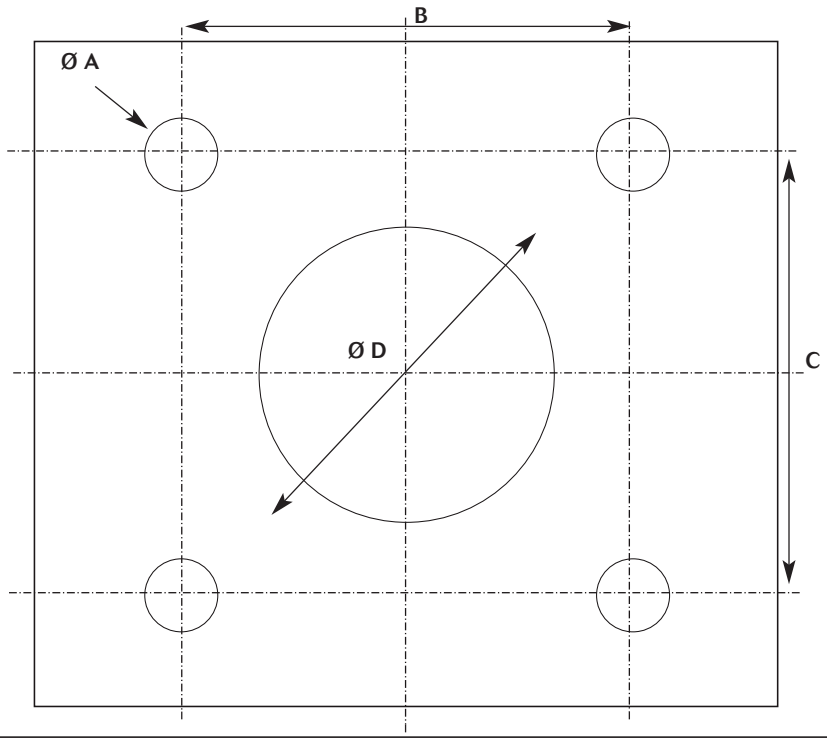
Souriau reserves the right to make any engineering refinements, alterations or improvements deemed necessary on its products. The dimensions appearing in this catalogue are thus subject to change without notice. When dimensions are critical detailed drawings should be requested.

Clé à ergot / *Pin wrench*



Boîtier *Shell*	Clé à ergot *Pin wrench*	Couple de serrage / *Coupling torque* (daN.m)	
		mini	maxi
E	8380-216	0,4	1
C	8380-216	0,6	1,5
B	8380-213	0,7	2

Perçage de cloison / *Panel cutout*



Taille / *Size*	E	C
Ø A	4,3	4,3
B	34	52
C	34	52
Ø D	38,5	54
Ø D*	44,5	60

* Fixation de l'embase par l'avant de la cloison
Receptacle fixed from front of the panel

Dimensions en millimètres - *Dimensions are millimeters*

8038 Series

Mise en œuvre

• **Technologie :**
- collage / polissage pour fibre de type G, H, R
- sertissage / clivage pour fibre type R (field cabling).

• **Valise de mise en œuvre : P/N: 80-MG0011**
Cette valise comprend les outillages nécessaire à la mise en œuvre des fiches de type ST* pour la technique de collage / polissage (pince à sertir ou à dénuder, …).

• **Valise de mise en œuvre : P/N: 80-MF0002**
Cette valise comprend les outillages nécessaire à la mise en œuvre des fiches de type ST* pour la technique de sertissage / clivage, surtout utilisé sur le terrain.

• **Valise de mise en œuvre : P/N: 80-MS0003**
Cette valise comprend les outillages nécessaire à la mise en œuvre des fiches de type ST* avec fibres plastiques, tel que:
- pince à dénuder,
- pince à sertir,
- outil de polissage.

• **Certaines options sont disponibles séparément pour les valise de mise en œuvre 80-MG0011 et 80-MS0003**
- microscope / haut grossissement
  - (*200) P/N : 80-WL0007
  - (*400) P/N : 80-WL0001

- adaptateur pour microscope : P/N: 80-WL0002

• **Kit des consommables : P/N: 80-KG0009**
Le kit de consommables comprend tout le matériel nécessaire pour la mise en œuvre des fiches :
- disques à polir
- colle
- seringues + aiguilles
- éthanol
- bombe à air sec.

• **Kit de nettoyage: P/N: 80-KN0002**
Le kit de nettoyage comprend tout le matériel nécessaire au nettoyage des fiches, coupleurs, l'emballage extérieur, tel que :
- spray nettoyant écologique
- bombe à air sec
- éthanol
- pointe papier
- papier Joseph.

Fiber termination

• ***Technology*:**
- *gluing / polishing for fiber type G, H, R*
- *crimping / cleaving for fiber type R (field cabling).*

• ***Tool kit: P/N: 80-MG0011***
The tool kit contains all necessary tools to terminates ST plugs in gluing / polishing technic (stripping tools for cable and fiber, crimping tool, …).*

• ***Tool kit: P/N: 80-MF0002***
The tool kit contains all necessary tools required to terminate ST plug in crimping / cleaving technic, particularly used in case of field cabling.*

• ***Tool kit: P/N: 80-MS0003***
The tool kit contains all necessary tools to terminates ST plugs in plastic fiber, such as:*
- *stripping plier*
- *crimping tool*
- *polishing tool.*

• ***Option can be ordered separately for tool kits 80-MG0011 and 80-MS0003***
- *microscope / high magnification*
  - *(*200) P/N: 80-WL0007*
  - *(*400) P/N: 80-WL0001*

- *ST* adaptor for microscope : P/N: 80-WL0002*

• ***Consumable: P/N: 80-KG0009***
The consumable kit contains all necessary materials to terminate about so plugs such as:
- *polishing disks*
- *glue*
- *syringes and needles*
- *ethanol*
- *dry air canned.*

• ***Cleaning kit: P/N: 80-KN0002***
The cleaning kit contains all necessary items to clean either plugs, couplers or device housings, such as:
- *ecological cleaning spray*
- *dry air canned*
- *ethanol*
- *paper sticks*
- *cleaning paper.*

8038 Series

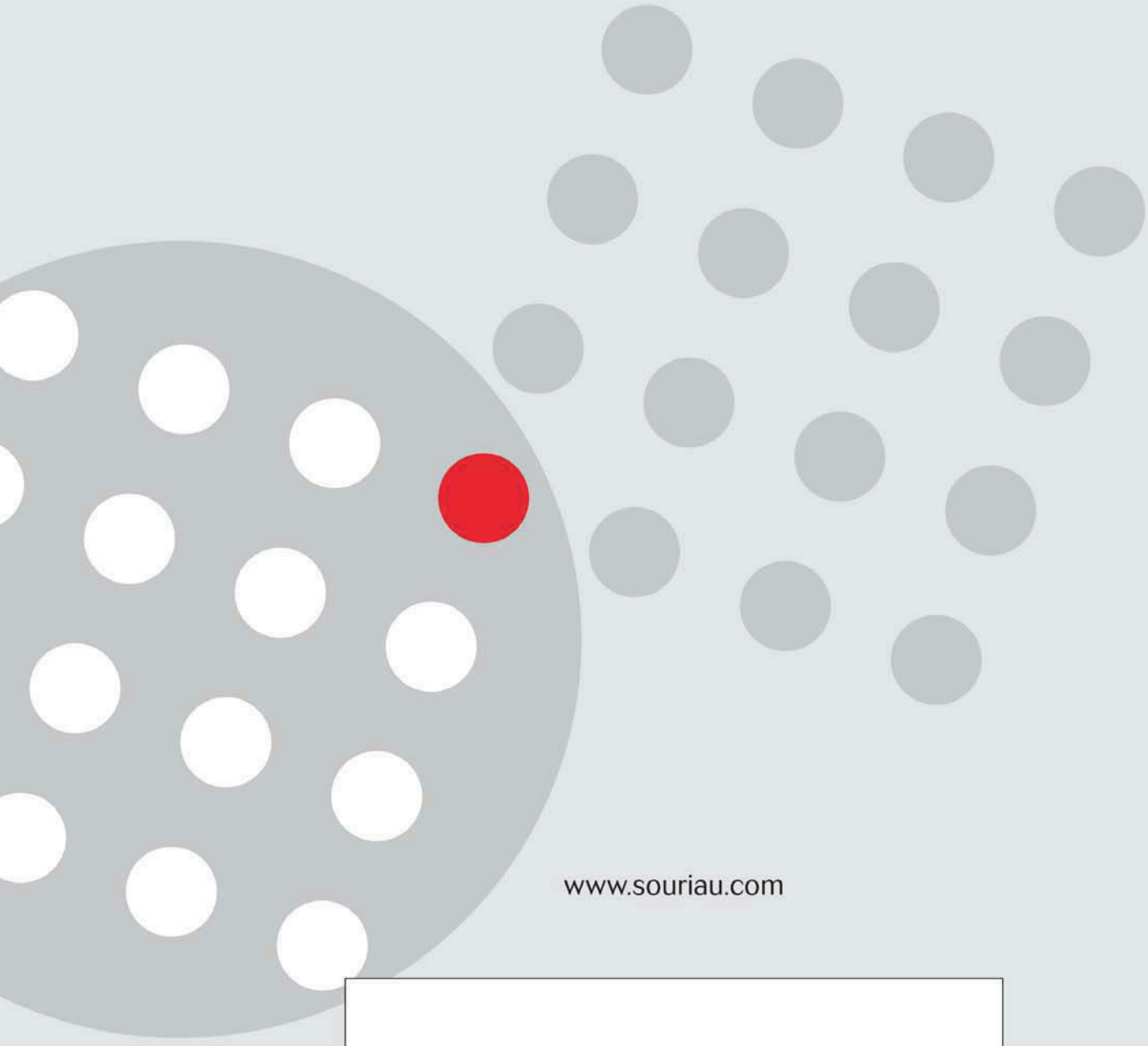
Famille optique
Optical family

Produits standards optiques / ***Optic standard products***	**Désignation** ***Designation***
Séries PER 1 ***PER 1 series***	Connecteur 6 voies compatible ST II, utilisations intérieures *6 ways connector compatible with ST II for interior applications*
Séries 8038 ***8038 series***	Connecteur 5 ou 9 voies, utilisations ferroviaires *5 or 9 ways connector for railways applications*
Série HYB 1 ***HYB 1 series***	Connecteur mixte, utilisations extérieures *Mixed connector for exterior applications*
Série GEO 1 ***GEO 1 series***	Connecteur 2 voies à faisceaux expansés, environnements sévères *2 ways connector with expanded beams for harsh environments*
Série 8005 SMA ***8005 SMA series***	Environnement industriel, applications militaires, aéronautiques *Industrial environment, applications aeronautical, military*
Séries 8011 ***8011 series***	Compatible ST et ST II, environnement industriel *Compatible ST and ST I, industial environment*
Série 8012 SUB-D ***8012 series SUB-D***	Connecteur de carte multi voies, utilisation dans alvéoles coaxiales *Multiways rackable connector, to be fit in coaxial cavities*
Série 8012 DIN 41612 ***8012 series DIN 41612***	Connecteur de carte, utilisation dans alvéoles coaxiales *Rackable connector, to be fit in coaxial cavities*
Série 8012 38999 ***8012 38999 series***	Contacts pour connecteur multi voies 38999 *Contacts for 38999 multiways connector*
Série 8012 TRIM-TRIO ***8012 TRIM-TRIO series***	Contacts pour connecteur multi voies TRIM-TRIO *Contacts for TRIM-TRIO multiways connector*
Série 8012 embases actives et pig tails ***8012 series active and pig tailled receptacle***	Compatible DIN 42612, SUB-D,SMA et ST II pour composants boîtier TO 18 *Compatible DIN 42612, SUB-D,SMA and ST II for shell components TO 18*
Kit fibre optique ***Optical fiber kit***	Outils de câblage *Tool kit*
Series ELIO ***ELIO series***	Contact fibre optique dernière génération *Fiber optic contact last generation*

838/8038 Series

Autres gammes pour les applications ferroviaires
Other product lines for the railways market

	Matériel roulant / *Rolling Stock Equipments*			Signalisation *Signaling*	Systèmes d'information des passagers *Passenger information systems*
	Inter-caisse *Intercoach*	Sous-caisse *Undercoach*	Equipements *On board equipments*		
DSub series			X	X	X
Elio® Fiber optics			X	X	X
FY series		X	X		
Junction connectors				X	
Metro series	X	X			
MSH / MPH	X	X			
SN 2581 series	X	X			
TP series	X	X			
Trim-Trio (circular)			X	X	X
Trim-Trio (MSM, SMS)			X	X	X
Trim-Trio (MSG, MB52)			X	X	X
Trim-Trio specials fitered/shielding			X		
VGE1 series (5015 derivated)		X	X		
8ST / 8D (MIL-DTL-38999)		X	X		
8038 series	X	X			
8525 (MIL-DTL-26482 SII)		X	X		
838 series	X	X			



www.souriau.com

SOURIAU
Connection Technology

FSOURIAU838/80380305FE

Americas
Tel. : 1 (717) 767 67 05

Europe
Tel. : 33 1 30 84 77 99

Japon
Tel. : (81) 442 101 147

Asia/Pacific
Tel. : 33 1 30 84 77 99

COMPAGNIE DEUTSCH®

Division Connecteurs Industriels

Gammes / Series CMC-CMB-CPP

- Verrouillage à vis ou à baïonnette / *Screw or bayonet locking*
- Connecteur de signal ou de puissance / *Signal or power connector*
- Continuité de blindage / *Shielding EMI - RFI*
- Environnement sévère / *Severe environment*

Présentation
Presentation

Les gammes CMC/CMB/CPP sont appréciées par un grand nombre d'utilisateurs en milieux ferroviaire et industriel sévères. La sécurité d'accouplement et de verrouillage, la fiabilité des contacts, la bonne tenue aux vibrations et à la corrosion, l'exigence feu-fumée, le faible entretien, la longévité sont les performances atteintes et maîtrisées par ces connecteurs.

Ces familles de produits ont été conçues pour différentes applications :

- Les applications standard
  CMC de signal en aluminium (96 h BS)
- Les applications spécifiques
  Fibre optique, cellules coax/twinax, reprise et continuité de blindage
- Les applications de puissance
  Produits CPP intégrant des blocs isolants et contacts de puissance
- Les environnements extrêmes
  Produits CMB bronze - 500 h BS et au-delà

Les séries bronze CMB acceptent tous les arrangements des isolants et contacts des CMC/CPP, et respectent les mêmes encombrements.

Chaque ligne de produits propose un verrouillage à vis ou à baïonnette.

The CMC/CMB/CPP series are recognised by many users as suitable for severe railway and industrial environments. With secure coupling and locking, the reliability of contacts. Meeting vibration, corrosion resistance and low smoke specifications, along with low maintenance and durability, these performances are all achieved by these connectors.

The series has been developed for use in :

- *Standard applications*
  Signal aluminium CMC (96 hours salt spray)
- *Specific applications*
  Fiber optic, coax/twinax contacts, shielding continuity maintained
- *Power applications*
  CPP products use the CMC shell for power contacts and inserts
- *Extreme environments*
  CMB bronze products - 500 hours salt spray and over

The CMB bronze series can be adapted to every CMC/CPP insert and contact configuration and uses the same dimensions.

Each product lines permits a screw or bayonet locking.

CMC twinax

CMC à visser / *Screw CMC*

CMC à baïonnette / *Bayonet CMC*

CPP

Sommaire
Table of contents

Sommaire

Présentation

CMC - Standard 96 h BS
Vue isométrique 4
Caractéristiques 5
Système de référence 6
Synoptique 7
Arrangements 8-9
Contacts 10
Optique 11

CMC - Coax & Twinax 96 h BS
Système de référence 12
Synoptique 12
Arrangements 13
Cellules 13

CMC - Continuité de blindage 96 h BS
Système de référence 14
Synoptique 14
Principe de reprise de blindage 15

CMB 500 h BS et au-delà
Système de référence 16
Synoptique 17

CPP
Système de référence & arrangements 18
Contacts et outillages 19

CMC/CMB/CPP
Encombrements 20-21
Perçage 22
Passage de câble 23
Accessoires 24-25

Table of contents

Presentation

CMC *- Standard* *96 h BS*
Scheme 4
Characteristics 5
Part numbering system 6
Styles 7
Configurations 8-9
Contacts 10
Optical contacts 11

CMC *- Coax & Twinax* *96 h BS*
Part numbering system 12
Styles 12
Configurations 13
Coax or Twinax contacts 13

CMC *- Shielding* *96 h BS*
Part numbering system 14
Styles 14
Shield attachment 15

CMB *500 h BS and over*
Part numbering system 16
Styles 17

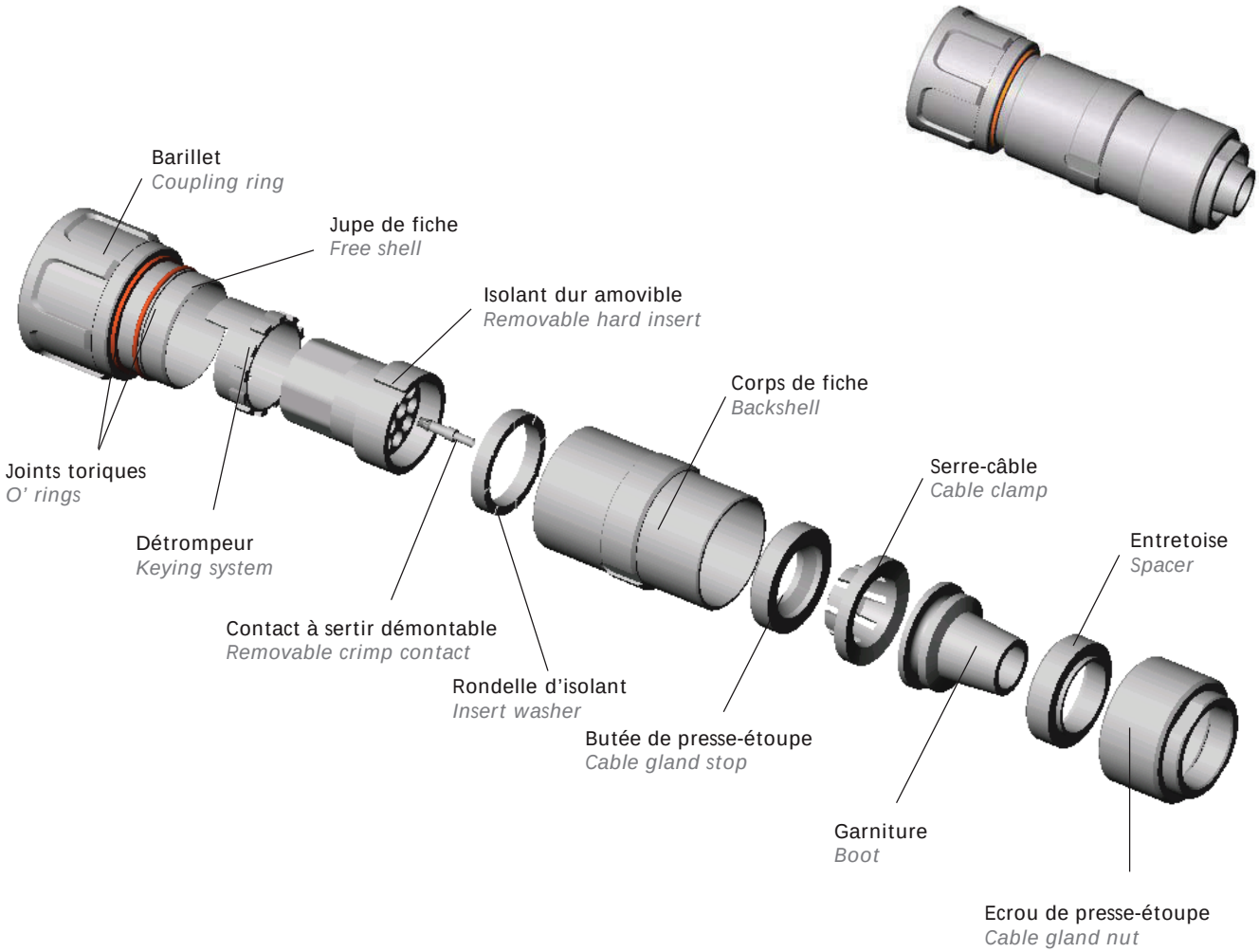
CPP
Part numbering system & config. 18
Contacts and tools 19

CMC/CMB/CPP
Dimensions 20-21
Cut out 22
Cable dimensions 23
Accessories 24-25

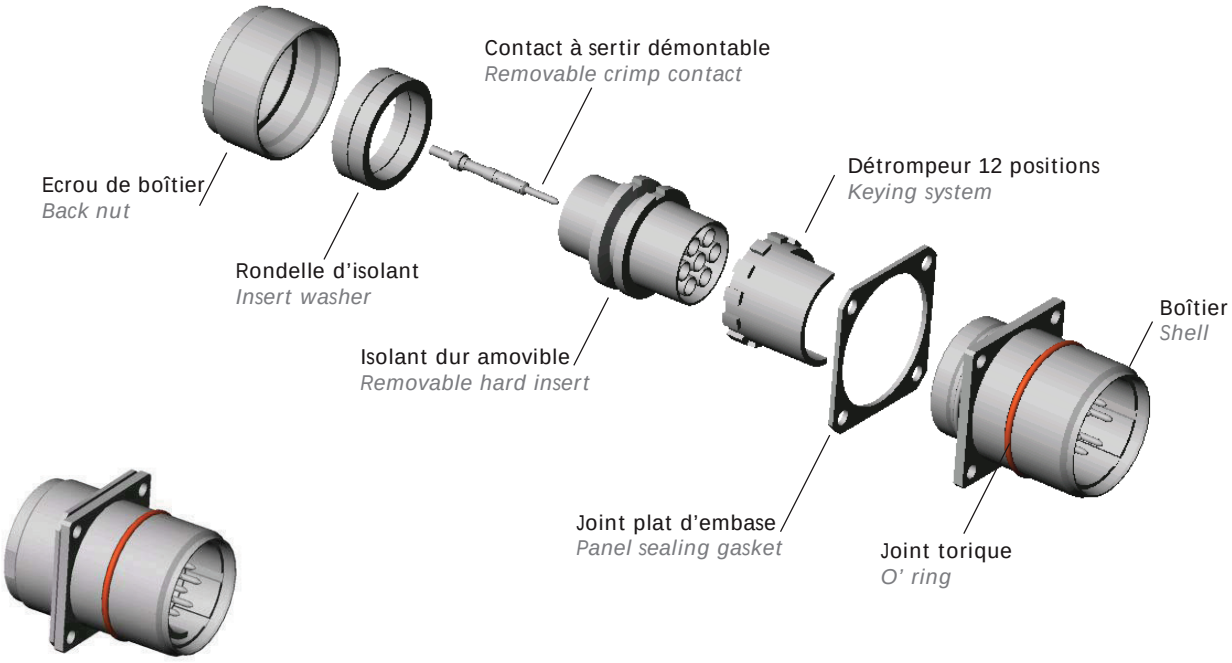
Standard
96 h brouillard salin / *96 h salt spray*

CMC

Fiche avec raccord droit étanche / *Plug with environmental straight backshell*



Embase semi-encastrée avec écrou arrière / *Semi-recessed receptacle with back nut*



CMC

Standard
96 h brouillard salin / 96 h salt spray

Caractéristiques mécaniques
Mechanical characteristics

Boîtier / *Shell*

Matière : alliage d'aluminium
Material : aluminium alloy

Protection : oxydation chimique
Plating : chemical oxydation

Contact / *Contact*

Raccordement : à sertir
Connection : crimp type

Matière : laiton argenté
Material : silver plated brass

Isolant / *Insulator*

Matière : polyamide
Material : polyamid

Conforme aux spécifications feu fumée :
In accordance with fire and smoke specifications :

NF F 16-102 exigence 2
UL94 5V

Endurance / *Durability*

500 manoeuvres
500 mating cycles

Vibration, tenue aux chocs
Vibration, shock resistance

Conforme aux normes / *In accordance with :*

NF F 60-002 sévérité 2 (CEI 68-2-6 Sept. 1985)
NF C 20-706

Résistance aux fluides / *Fluid resistance*

Tenue aux huiles minérales, aux acides et aux bases suivant NF F 61-030.
Withstands mineral oil, acids in accordance with NF F 61-030.

Caractéristiques électriques
Electrical characteristics

Intensité admissible sur contact standard
Max. rating per standard contact

Calibre *Caliber*	Intensité de service permanent *Continious service current**	Section de câble admissible (mm^2) *Cable cross section*	
		mini.	maxi.
Ø 1 mm	10 A	0,22	0,93
Ø 1,6 mm	16 A	0,6	1,82
Ø 2 mm	20 A	0,6	1,82
Ø 3 mm	35 A	1,34	6
Ø 5 mm	80 A	6	6
Ø 7 mm	150 A	35	35
Ø 7,9 mm	200 A	50	50
Ø12 mm	260 A	50	95

* Ces valeurs sont données pour les utilisations avec sections maxi
Current values are for the max. cable cross section

Tension de service par arrangement
Service voltage per configuration

Voir tableau pages 8 et 9 / *See table pages 8 and 9*

Résistance de contact / *Contact resistance*

< 2 mΩ

Résistance d'isolement / *Insulation resistance*

> 5000 MΩ

Caractéristiques climatiques
Climatic characteristics

Température d'utilisation / *Temperature range*

-40 °C, +120 °C

Indice de protection / *Protection index*

EN 60529 (CEI 529 - NF C 20-010) - Oct. 1992

IP 67
Boîtier équipé d'un raccord droit étanche
Shell fitted with environmental straight backshell

IP 43
Boîtier équipé d'un raccord PG + serre-câble à bride
Shell fitted with PG backshell with cable clamp

Brouillard salin / *Salt spray*

96 heures / *96 hours*

Standard
96 h brouillard salin / *96 h salt spray*

CMC

Système de référence / *Part numbering system*

CMC 36 RD 07 - 13 S N A ***

GAMME / *SERIES*

TYPES DE BOITIERS
SHELL TYPES

32 Embase carrée à visser
Screw square receptacle

52 Embase carré à baïonnette (sauf taille 61)
Square receptacle with bayonet (except size 61)

35 Fiche à visser avec cliquet (nous consulter)
Screw plug with clicker (consult us)

36 Fiche à visser sans cliquet
Screw plug without clicker

56 Fiche à baïonnette (sauf taille 61)
Plug with bayonet (except size 61)

TYPES DE RACCORDS
BACKSHELL TYPES

EA Ecrou arrière
Back nut

PG Raccord sortie filetée PG suivant NF C 68-312 et DIN 40430
Backshell for PG outlet

RD Raccord droit étanche
Environmental straight backshell

TAILLES DE BOITIERS
SHELL SIZES

02 - 04 - 07 - 19 - 27 - 61

ARRANGEMENTS
CONFIGURATIONS

Défini par le nombre d'alvéoles de l'isolant
Defined by the insert number of cavity
Pages 8-9

TYPES DE CONTACTS
CONTACT TYPES

P Mâle / *Male*
S Femelle / *Female*

MODIFICATIONS SPÉCIALES
SPECIAL MODIFICATIONS

****
Connecteur équipé de contacts standard
Connector equipped with standard contacts

090
Connecteur sans contact
Connector without contact

Les contacts "non standard" sont à commander séparément
"Non standard" contacts have to be ordered separately

Pages 10-11

Note : pour d'autres modifications, nous consulter
for other modifications, consult us

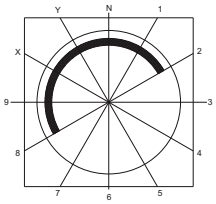
CODES CABLES
CABLE INDEXES

Voir tableaux passage de câble
See accepted cable characteristics
Page 23

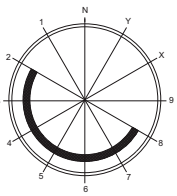
Vues de face
Front views

DÉTROMPAGES
KEYING SYSTEMS

Tailles / *Sizes* 02 - 04 - 07 - 19 - 27
N - 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - X - Y



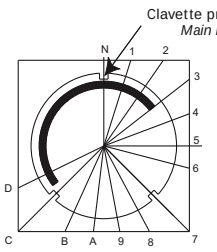
Embase / *Receptacle*



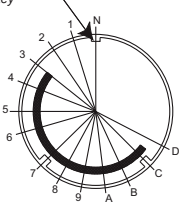
Fiche / *Plug*

Taille 02 : intégré à l'isolant
Size 02 : integrated to insert

Taille / *Size* 61
N - 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - A - B - C - D



Embase / *Receptacle*



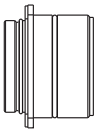
Fiche / *Plug*

CMC

Standard
96 h brouillard salin / *96 h salt spray*

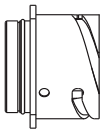
Synoptique des boîtiers et des raccords / *Shell and backshell styles*

32



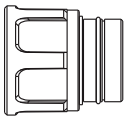
Embase carrée à visser
Screw square receptacle

52



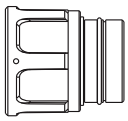
Embase carrée à baïonnette
Square receptacle with bayonet
(sauf taille 61 / *except size 61*)

36



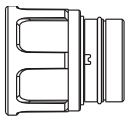
Fiche à visser sans cliquet
Screw plug without clicker

56



Fiche à baïonnette
Plug with bayonet
(sauf taille 61 / *except size 61*)

35



Fiche à visser avec cliquet
Screw plug with clicker
(nous consulter / *consult us*)

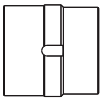
EA

Ecrou arrière
Back nut

RD

Raccord droit étanche
Environmental straight backshell

PG



Raccord pour PG
Backshell for PG outlet

Standard
96 h brouillard salin / *96 h salt spray*

CMC

Arrangements / *Configuration*

Taille / *Size* 02

04 4 contacts Ø 1,6 mm
Contact avancé / *Advanced contact*

Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 380 V eff.
- NF F 61-030 ..... 72 V

Tension de tenue / *Withstanding voltage*
> 2550 V eff.

07 7 contacts Ø 1 mm
Contact avancé / *Advanced contact*

Nous consulter
Consult us

Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 250 V eff.
- NF F 61-030 ..... 72 V

Tension de tenue / *Withstanding voltage*
> 1250 V eff.

Taille / *Size* 04

04 4 contacts Ø 2 mm
Contact avancé / *Advanced contact*

Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 500 V eff.
- NF F 61-030 ..... 380 V eff.

Tension de tenue / *Withstanding voltage*
> 3250 V eff.

07 7 contacts Ø 1,6 mm
Contact avancé / *Advanced contact*

Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 380 V eff.
- NF F 61-030 ..... 72 V

Tension de tenue / *Withstanding voltage*
> 2550 V eff.

Taille / *Size* 07

05 5 contacts Ø 3 mm
Contact avancé / *Advanced contact*

Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 500 V eff.
- NF F 61-030 ..... 380 V eff.

Tension de tenue / *Withstanding voltage*
> 3250 V eff.

07 7 contacts Ø 2 mm

Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 500 V eff.
- NF F 61-030 ..... 380 V eff.

Tension de tenue / *Withstanding voltage*
> 3250 V eff.

09 9 contacts Ø 2 mm
Contact avancé / *Advanced contact*

Nous consulter
Consult us

Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 750 V eff.
- NF F 61-030 ..... 380 V eff.

Tension de tenue / *Withstanding voltage*
> 3250 V eff.

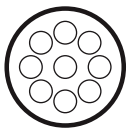
13 13 contacts Ø 1,6 mm
Contact avancé / *Advanced contact*

Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 380 V eff.
- NF F 61-030 ..... 72 V

Tension de tenue / *Withstanding voltage*
> 1500 V eff.

Taille / *Size* 19

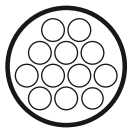
09 9 contacts Ø 3 mm



Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 500 V eff.
- NF F 61-030 ..... 380 V eff.

Tension de tenue / *Withstanding voltage*
> 3250 V eff.

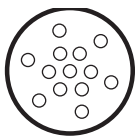
12 12 contacts Ø 3 mm
Contact avancé / *Advanced contact*



Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 500 V eff.
- NF F 61-030 ..... 380 V eff.

Tension de tenue / *Withstanding voltage*
> 3250 V eff.

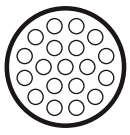
13 13 contacts Ø 2 mm



Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 500 V eff.
- NF F 61-030 ..... 380 V eff.

Tension de tenue / *Withstanding voltage*
> 3250 V eff.

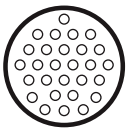
19 19 contacts Ø 2 mm



Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 500 V eff.
- NF F 61-030 ..... 380 V eff.

Tension de tenue / *Withstanding voltage*
> 3250 V eff.

28 28 contacts Ø 1,6 mm
Contact avancé / *Advanced contact*

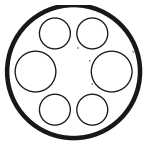
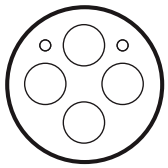
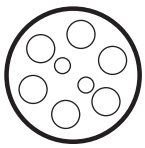
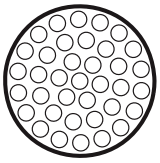
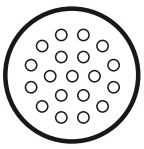
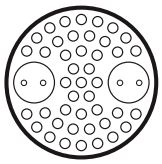
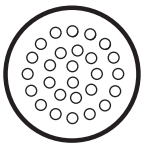
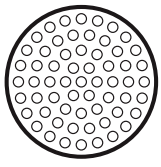
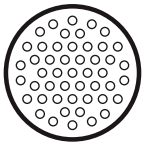
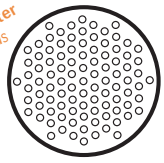


Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 380 V eff.
- NF F 61-030 ..... 72 V

Tension de tenue / *Withstanding voltage*
> 2550 V eff.

CMC

Standard
96 h brouillard salin / *96 h salt spray*

Taille / *Size* 27	Taille / *Size* 61
06 — 4 contacts Ø 5 mm + 2 contacts Ø 7,9 mm	06 — 4 contacts Ø 12 mm + 2 contacts Ø 3 mm
	
Tension de service / *Service voltage* - NF C 20-040 cat. B ..... 500 V eff. - NF F 61-030 ..... 380 V eff. **Tension de tenue** / *Withstanding voltage* **> 3250 V eff.**	**Tension de service** / *Service voltage* - NF C 20-040 cat. B ..... 1000 V eff. - NF F 61-030 ..... >380 V eff. **Tension de tenue** / *Withstanding voltage* **> 3250 V eff.**
08 — 6 contacts Ø 7 mm + 2 contacts Ø 3^{-B} mm	37 — 37 contacts Ø 3^{-A} mm
	
Tension de service / *Service voltage* - NF C 20-040 cat. B ..... 500 V eff. - NF F 61-030 ..... 380 V eff. **Tension de tenue** / *Withstanding voltage* **> 3250 V eff.**	**Tension de service** / *Service voltage* - NF C 20-040 cat. B ..... 500 V eff. - NF F 61-030 ..... 380 V eff. **Tension de tenue** / *Withstanding voltage* **> 3250 V eff.**
19 — 19 contacts Ø 3 mm	45 — 43 contacts Ø 2 mm + 2 coax ou twinax
	
Tension de service / *Service voltage* - NF C 20-040 cat. B ..... 500 V eff. - NF F 61-030 ..... 380 V eff. **Tension de tenue** / *Withstanding voltage* **> 2500 V eff.**	**Tension de service** / *Service voltage* - NF C 20-040 cat. B ..... 500 V eff. - NF F 61-030 ..... 380 V eff. **Tension de tenue** / *Withstanding voltage* **> 3250 V eff.**
27 — 27 contacts Ø 2 mm	61 — 61 contacts Ø 2 mm
	
Tension de service / *Service voltage* - NF C 20-040 cat. B ..... 500 V eff. - NF F 61-030 ..... 110 V **Tension de tenue** / *Withstanding voltage* **> 3250 V eff.**	**Tension de service** / *Service voltage* - NF C 20-040 cat. B ..... 500 V eff. - NF F 61-030 ..... 380 V eff. **Tension de tenue** / *Withstanding voltage* **> 3250 V eff.**
49 — 49 contacts Ø 1,6 mm	97 — 97 contacts Ø 1,6 mm
	Nous consulter / *Consult us* 
Tension de service / *Service voltage* - NF C 20-040 cat. B ..... 380 V eff. - NF F 61-030 ..... 72 V **Tension de tenue** / *Withstanding voltage* **> 2550 V eff.**	**Tension de service** / *Service voltage* - NF C 20-040 cat. B ..... 380 V eff. - NF F 61-030 ..... 72 V **Tension de tenue** / *Withstanding voltage* **> 2550 V eff.**

Les contacts et les cellules sont à commander séparément. Arrangement à prévoir dans la référence avec le code **090**. Voir page 13.
Contacts have to be ordered separately. Use code 090 in the part number to indicate this. See page 13.

Possibilité d'intégrer le contact optique / *Possibility to integrate the optical contact*

Diamètre maxi. des conducteurs dans l'arrière d'isolant
Maxi diameter of conductors in the rear insert

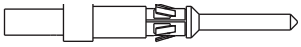
Arrangement d'isolant *Insert configuration*		Ø maxi. dans l'alvéole *Ø maxi. in cavity*
02	**04**	4,5 / *(0.177)*
	07	Nous consulter *Consult us*
04	**04**	5,7 / *(0.224)*
	07	4,5 / *(0.177)*
07	**05**	7,85 / *(0.309)*
	07 - 09	5,7 / *(0.224)*
	13	4,5 / *(0.177)*
19	**09**	7 / *(0.275)*
	12	7,85 / *(0.309)*
	13 - 19	5,7 / *(0.224)*
	28	4,5 / *(0.177)*
27	**06**	16,3 / *(0.64)* - 8,6 / *(0.34)*
	08	13,5 / *(0.53)* - 5,1 / *(0.20)*
	19	7,85 / *(0.309)*
	27	5,7 / *(0.224)*
	49	4,5 / *(0.177)*
61	**06**	21,5 / *(0.84)* - 6,4 / *(0.25)*
	37	6 / *(0.236)*
	45 - 61	5,7 / *(0.224)*
	97	Nous consulter *Consult us*

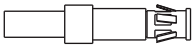
mm / *(inches)*

Standard
96 h brouillard salin / *96 h salt spray*

CMC

Contacts

P  Mâle / *Male*

S  Femelle / *Female*

CONTACTS A SERTIR *CRIMP CONTACTS*			CABLE *WIRE*		OBTURATEUR *SEALING PLUG*	PINCE A SERTIR *CRIMPING TOOL*		OUTIL DE DÉMONTAGE *EXTRACTING TOOL*	OUTIL DE MONTAGE *INSERTION TOOL*
Calibre *Contact diam.*	Type	Référence *Part number*	Section *Cross section*	Gauge *AWG wire*	Référence *Part number*	Référence *Part number*	Positionneur *Locator*	Référence *Part number*	Référence *Part number*
Ø1 mm	P S	DCI CCI000A0 M000 DCI CCI000A0 F000	0,22 à/*to* 0,93 mm²	24 à/*to* 18	-	FT8 ou/*or* M22520/1-01	- M22520/1-04	OUTCCIEXTA0000	-
Ø1,6 mm	P S	DMC S24150-00B3 DMC S24151-00B3	0,6 à/*to* 1,82 mm²	20 à/*to* 15	-	FT8 ou/*or* M22520/1-01	- TP1012	OUTS1675-0003	OUT31748-000A2
Ø2 mm	P S	DMC S1545-0008-B DMC S1545-0009-B	0,4 à/*to* 0,6 mm²	22 à/*to* 20	STD 0391-0104A3	FT8 ou/*or* M22520/1-01	- TP900-1	OUTS1545-0023	OUTS1545-0002
Ø2 mm	P S	DMC S1545-0007-B DMC S1545-0005-B	0,6 à/*to* 1,82 mm²	20 à/*to* 15	STD 0391-0104A3	FT8 ou/*or* M22520/1-01	- TP900-1	OUTS1545-0023	OUTS1545-0002
Ø2 mm	P S	DMC S1545-0006-B DMC S1545-0004-B	1,5 à/*to* 2,61 mm²	15 à/*to* 14	STD 0391-0104A3	FT8 ou/*or* M22520/1-01	- TP900-1	OUTS1545-0023	OUTS1545-0002
Ø3 mm	P S	DMC S24578-0003 DMC S24577-0003	1,34 à/*to* 2,61 mm²	16 à/*to* 14	-	M317	OUT S24823-0003	OUTCCIEXT-C0000	OUT18990-0004
Ø3 mm	P S	DMC S19554-0004 DMC S19555-0004	2,07 à/*to* 4 mm²	14 à/*to* 12	-	M317	OUT S24823-0003	OUTCCIEXT-C0000	OUT18990-0004
Ø3 mm	P S	DMC S24750-0003 DMC S24747-0003	3,8 à/*to* 6 mm²	12 à/*to* 10	-	M317	OUT S24823-0003	OUTCCIEXT-C0000	OUT18990-0004
Ø3-A mm	P S	DAM S0692-0130 DMC S1239-0007	1,34 à/*to* 2,61 mm²	16 à/*to* 13	-	M317	TP1065	-	-
Ø3-B mm	P S	DLN S18970-0004 DLN S18971-0004	2,07 à/*to* 4 mm²	14 à/*to* 12	-	MS 3191-1	Jaune/*Yellow* 12A	OUTCCIEXT-C0000	OUT18990-0004
Ø5 mm	P S	DLN S24149-0003 DLN S24146-0003	6 mm²	-	-	PMM1CF	H1 35-6	OUTCCIEXT-D0200	-
Ø5 mm	P S	DMS S18879-0004 DMS S18880-0004	13,4 mm²	6	-	PMM1CF	H1 6AWG	OUTCCIEXT-D0200	-
Ø5 mm	P S	DMS S24482-0004 DMS S24481-0004	16 mm²	-	-	PMM1CF	H1 16-50F	OUTCCIEXT-D0200	-
Ø7 mm	P S	DMS S18889-0004 DMS S18890-0004	35 mm²	2	-	PMM1CF	H1 10-35F	OUTCCIEXT-G0100	-
Ø7 mm	P S	DMS S18891-0004 DMS S18892-0004	50 mm²	0	-	PMM1CF	H1 16-50F	OUTCCIEXT-G0100	-
Ø7,9 mm	P S	DLN S24817-0003 DLN S24164-0003	50 mm²	0	-	PMM1CF	H1 16-50F	OUTCCIEXT-H0100	-
Ø7,9 mm	P S	DLN S24163-0003 DLN S24818-0003	70 mm²	00	-	PMM1CF	H1 25-70F	OUTCCIEXT-H0100	-
Ø12 mm	P S	DMC S25463-0003 DMC S25464-0003	50 mm²	0	19947-0004 19948-0004	PMM1CF	H1 16-50F	-	-
Ø12 mm	P S	DMC S25461-0003 DMC S25462-0003	70 mm²	00	19947-0004 19948-0004	PMM1CF	H1 25-70F	-	-
Ø 12 mm	P S	DMC S25564-0003 DMC S25565-0003	95 mm²	000	19947-0004 19948-0004	PMM1CF	H1 95F	-	-

Nota : Utilisation possible d'outillages hydrauliques / *Possibility of hydraulic tools*

Contacts standard livrés avec le connecteur
Standard contacts supplied with connector

CMC

Standard
96 h brouillard salin / *96 h salt spray*

Contacts optiques / *Optic contacts*

Ces contacts optiques ont été étudiés pour s'intégrer dans les alvéoles Ø 3 mm des isolants standard CMC (pages 8 et 9). Arrangements : 07-15, 19-09, 19-12, 27-19.
These optical contacts have been designed to fit in the Ø 3 mm cavities of standard CMC inserts (pages 8 and 9). Configurations : 07-15, 19-09, 19-12, 27-19.

Caractéristiques / *Characteristics*

Technologie Fibre à Fibre / *Fiber to Fiber technology*

Perte d'insertion / *Insertion loss* : à 850 nm < 0,7 dB

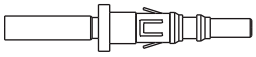
Température de fonctionnement / *Temperature* : - 55°C, + 125°C

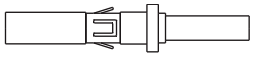
Vibrations / *Vibrations* : 20 à/*to* 2000 Hz - 20 g

Endurance / *Durability* : 1000 h à/*to* 125°C

Rétention du câble / *Cable retention* : 6 daN

Durée de mise en oeuvre / *Installation time* : 10 min.

P  Mâle / *Male*

S  Femelle / *Female*

Cellule ou contact *Contact*	Type	Référence *Part number*	Montage *Mounting*	Pince à sertir Positionneur *Crimping tool Locator*	Outil de démontage *Extracting tool*	Fibre *Fiber*
OPTIQUE	P S	DWS 75P 78.** DWS 75S 78-**	Se monte en lieu et place du contact Ø 3 mm *Use this contact instead of contact Ø 3 mm*	Nous consulter *Consult us*	OUT S1545-0024	200 / 230

** Référence suivant spécification du câble / *Part number following the cable specification*

Les contacts sont à commander séparément du connecteur.
The contacts have to be ordered separately in addition to the connector.

Bretelles optiques / ***Patchcords***

La réalisation de cordons équipés de connecteurs ou contacts optiques est possible sur demande et en respectant les spécifications de l'utilisateur. Veuillez nous consulter.
Patchcords using connectors with optical contacts can be made on request. Please, consult us.

COAX & TWINAX
96 h brouillard salin / *96 h salt spray*

CMC

Système de référence / *Part numbering system*

CMC 36 RD 07 - T2 S N E 090

GAMME / *SERIES*

TYPES DE BOITIERS
SHELL TYPES

32 - 52 - 36 - 56

Excepté pour la taille 61 / *Excepted for the size 61*

TYPES DE RACCORDS
BACKSHELL TYPES

EA - PG - RD

TAILLES DE BOITIERS
SHELL SIZES

07 - 61

ARRANGEMENTS
CONFIGURATIONS

C1 Coax : 50 Ω
C2 Coax : 75 Ω

T1 Twinax : 105 Ω
T2 Twinax : 120 Ω

45 Coax/twinax : 43 contacts Ø 2 mm
+ 2 cellules/*contacts* 50, 75, 105 ou/*or* 120 Ω

MODIFICATIONS SPÉCIALES
SPECIAL MODIFICATIONS

090
Ce code est à indiquer impérativement
Use as part of main code

Les carcasses sont gérées sans les cellules.
Les cellules mâles et femelles
sont à commander séparément.

Coax, twinax contacts are not includes
with shells codification
Male and female contacts
have to be ordered separately.

Page 13

CODES CABLES
CABLE INDEXES

Voir tableaux de passage de câble
See tables for accepted cable characteristics
Page 23

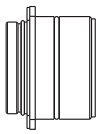
DÉTROMPAGES
KEYING SYSTEMS

Page 6

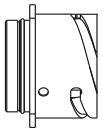
TYPES DE CONTACTS
CONTACT TYPES

P Mâle / *Male* - S Femelle / *Female*

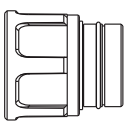
Synoptique des boîtiers et des raccords / *Shells and backshells styles*

32 

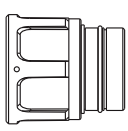
Embase carrée à visser
Screw square receptacle

52 

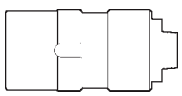
Embase carrée à baïonnette
Square receptacle with bayonet
(Sauf taille 61 / *Except size 61*)

36 

Fiche à visser sans cliquet
Screw plug without clicker

56 

Fiche à baïonnette
Plug with bayonet
(Sauf taille 61 / *Except size 61*)

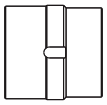
RD 

Raccord droit étanche
Environmental straight backshell

Pour taille 61 uniquement
Only for size 61

EA

Ecrou arrière
Back nut

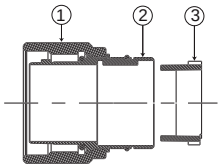
PG 

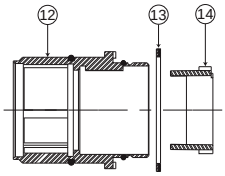
Raccord pour PG
Backshell for PG outlet

CMC

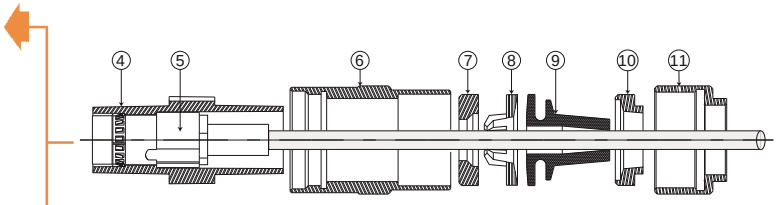
COAX & TWINAX
96 h brouillard salin / *96 h salt spray*

Fiche avec raccord RD
Plug with RD backshell



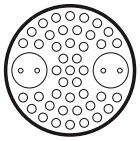


Embase avec raccord RD
Receptacle with RD backshell



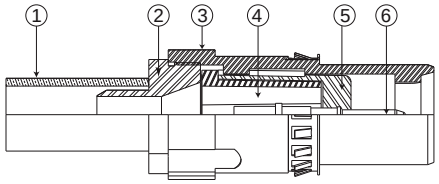
1 Barillet / *Coupling ring*
2 Jupe de fiche / *Shell*
3 Détrompeur / *Keying system*
4 Isolant de cellule / *Insert*
5 Cellule/*Contact* coax ou/*or* twinax
6 Corps arrière / *Backshell*
7 Butée de presse-étoupe *Cable gland stop*
8 Serre-câble / *Cable clamp*
9 Garniture / *Boot*
10 Entretoise / *Spacer*
11 Ecrou arrière / *Back nut*
12 Embase / *Receptacle*
13 Joint d'embase / *Sealing gasket*
14 Détrompeur / *Keying system*

Arrangements / *Configurations*

Taille / *Size* 07				Taille / *Size* 61	
C1	Impédance 50 Ω	T1	Impédance 105 Ω	45	43 contacts Ø 2 mm + + 2 cellules 50, 75, 105 ou/*or* 120 Ω
C2	Impédance 75 Ω	T2	Impédance 120 Ω		
Cellule / *Contact* COAX		Cellule / *Contact* TWINAX		 Cellule / *Contact* COAX-TWINAX	

IMPORTANT
Les contacts et les cellules sont à commander séparément.
Contacts and coax,twinax contacts have to be ordered separately.

Cellules / *Coax, twinax contact arrangement*



1 Ferrule / *Ferrule*
2 Ecrou de tresse / *Braid nut*
3 Corps d'isolant / *Insert shell*
4 Isolant mixte / *Mixed insert*
5 Isolant / *Insert*
6 Contact / *Contact*

Cellule ou contact *Contact*	Type	Référence *Part number*	Référence du câble *Wire part number*	Outil de sertissage *Crimping tool*	Positionneur *Locator*	Outil de démontage *Extracting tool*
COAX **50** Ω	P S	DMC 1698-0003-A0001 DMC 1698-0004-A0001	RG 214 14 à/*to* 12	Contact → FT8 Ferrule → PMM1	→ M22520/1-05 → H1 16-50	OUT S1677-0003
COAX **75** Ω	P S	DAMS 1681-0130-00000 DAMS 1681-0131-00000	KX8 RSS	Contact → FT8 Ferrule → PMM1	→ M22520/1-05 → H1 25-70F	OUTS1677-0003
TWINAX **105** Ω	P S	DMC 1637-0002-B0001 DMC 1637-0001-B0001	DTRF150 002	Contact → FT8 Ferrule → PMM1	→ M22520/1-05 → H1 16-50	OUT S1677-0003
TWINAX **120** Ω	P S	DMC 1713-0100-A0001 DMC 1713-0101-A0001	DTRF 150 046 DTRF 150 047	Contact → FT8 Ferrule → PMM1	→ M22520/1-05 → H1 16-50	OUT S1677-0003
TWINAX **120** Ω	P S	DMC 1713-0104-00000 DMC 1713-0105-00000	DDF 2630-80-121	Contact → FT8 Ferrule → PMM1	→ M22520/1-05 → H1 35-50	OUT S1677-0003

Nota
Possibilité d'adapter la cellule avec d'autres types de câble, à partir de la fiche technique du câble. Nous consulter.
Following the technical data sheet, cell adaptation is possible with other type of cables. Consult us.

Continuité de blindage / *RFI Shielding*
96 h brouillard salin / *96 h salt spray*

CMC

Système de référence / *Part numbering system*

CMC 36 RD 07 - 13 P N A ***

GAMME / *SERIES*

TYPES DE BOITIERS / *SHELL TYPES*

32 - 52 Standard
33 - 53 - 38 - 58 Reprise de blindage / *RFI*

TYPES DE RACCORDS / *BACKSHELL TYPES*

EA - RD - PG

TAILLES DE BOITIERS / *SHELL SIZES*

04 - 07 - 19 - 27

ARRANGEMENTS / *CONFIGURATIONS*

Défini par le nombre d'alvéoles de l'isolant
Defined by the insert number of cavity
Pages 8-9

TYPES DE CONTACTS / *CONTACT TYPES*

P Mâle / *Male* - S Femelle / *Female*

MODIFICATIONS SPÉCIALES
SPECIAL MODIFICATIONS

***
Connecteur équipé de contacts standard
Connector equipped with standard contacts

090
Connecteur sans contact
Connector without contact

Les contacts "non standard"
sont à commander séparément
"Non standard" contacts
have to be ordered separately

Pages 10-11

Note : pour d'autres modifications, nous consulter
for other modifications, consult us

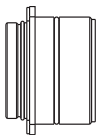
CODES CABLES / *CABLE INDEXES*

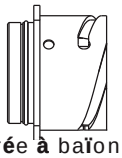
Voir tableaux de passage de câble
See accepted cable characteristics
Page 23

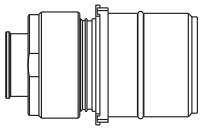
DÉTROMPAGES / *KEYING SYSTEMS*

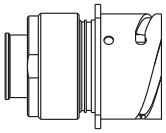
Page 6

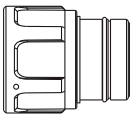
Synoptique des boîtiers et des raccords / *Shells and backshells styles*

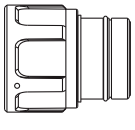
32

Embase carrée à visser
Screw square flange receptacle

52

Embase carrée à baïonnette
Square flange receptacle with bayonet

33

Embase à visser carrée
avec reprise de tresse
Screw square receptacle with shielding

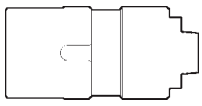
53

Embase carrée à baïonnette
avec reprise de tresse
Square bayonet receptacle with shielding

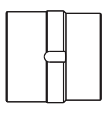
38

Fiche à visser sans cliquet
avec reprise de tresse
Screw plug without clicker with shielding

58

Fiche à baïonnette
avec reprise de tresse
Bayonet plug with shielding

EA

Ecrou arrière
Back nut

RD

Raccord droit étanche
Environmental straight backshell

PG

Raccord pour PG
Backshell for PG outlet

CMC

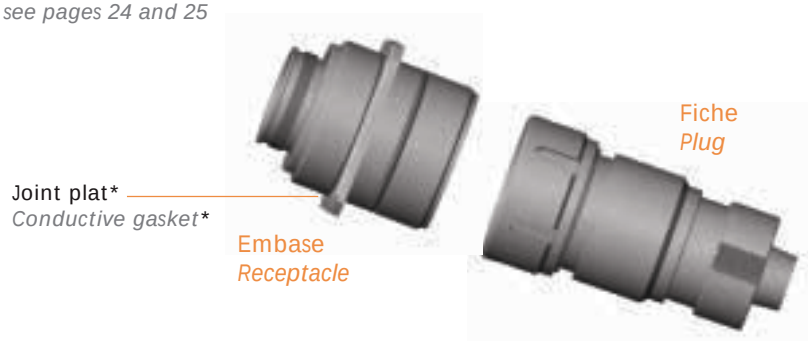
Reprise de blindage / *RFI Shielding*
96 h brouillard salin / *96 h salt spray*

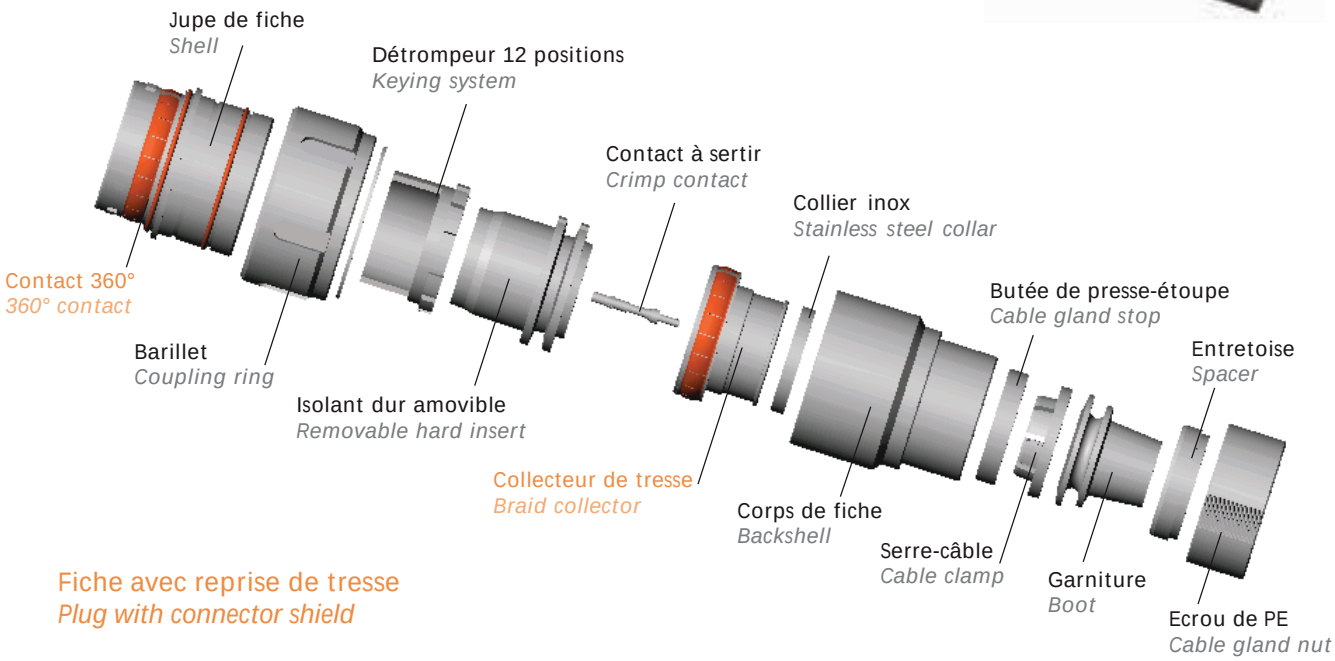
La reprise de blindage s'effectue sur 360° à l'aide d'un collecteur multi-tresses intégré sur la jupe de fiche (et/ou sur l'arrière de l'embase) constituant de ce fait une parfaite cage de Faraday.
La continuité de blindage fiche/embase est réalisée par contact électrique périphérique à 360° sur la tête de fiche. L'embase semi-encastrée peut être équipée d'un joint plat conducteur.

360° shielding is achieved using the braid collector within the connector making a complete Faraday cage. The plug/receptacle shielding is realized by 360° circular electrical contact on the plug head. The semi-recessed receptacle can be equiped with a conductive gasket.

Reprise de blindage / *Shield attachment*

* Le joint plat conducteur est à commander séparément, voir pages 24 et 25
Conductive gaskets are ordered separately, see pages 24 and 25





Fiche avec reprise de tresse
Plug with connector shield

Collier de tresse / *Braid collar*

Fourni avec le collecteur de tresse
Included with the connector shield

Standard
500 h brouillard salin / *500 h salt spray*

CMB

Système de référence / *Part numbering system*

CMB 36 PG 07 - 13 P N A ***

GAMME / *SERIES*

TYPES DE BOITIERS
SHELL TYPES

32 Embase carrée à visser
Screw square receptacle

33 Embase carrée à visser avec rep. de tresse
Screw square receptacle with shielding

52 Embase carrée à baïonnette
Screw square receptacle with bayonet

53 Embase carrée à baïonnette avec reprise de tresse
Square bayonet receptacle with shielding

36 Fiche à visser sans cliquet
Screw plug without clicker

38 Fiche à visser sans cliquet avec reprise de tresse
Screw plug without clicker with shielding

56 Fiche à baïonnette
Plug with bayonet

58 Fiche à baïonnette avec reprise de tresse
Plug with bayonet with shielding

Excepté pour la taille 61 / *Excepted for the size 61*

TYPES DE RACCORDS
BACKSHELL TYPES

EA Ecrou arrière
Back nut

PG Raccord sortie filetée PG suivant NF C 68-312 et DIN 40430
Backshell for PG outlet

RD Raccord droit étanche
Environmental straight backshell

TAILLES DE BOITIERS
SHELL SIZES

02 - 04 - 07 - 19 - 27 - 61

ARRANGEMENTS
CONFIGURATIONS

Défini par le nombre d'alvéoles de l'isolant
Defined by the insert number of cavity
Pages 8- 9

TYPES DE CONTACTS
CONTACT TYPES

P Mâle / *Male*

S Femelle / *Female*

MODIFICATIONS SPÉCIALES
SPECIAL MODIFICATIONS

***
Connecteur équipé de contacts standard
Connector equipped with standard contacts

090
Connecteur sans contact
Connector without contact

Les contacts "non standard" sont à commander séparément
"Non standard" contacts have to be ordered separately

Pages 10-11

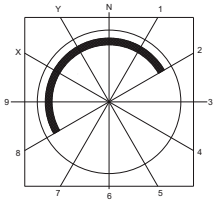
Note : pour d'autres modifications, nous consulter
for other modifications, consult us

CODES CABLES
CABLE INDEXES

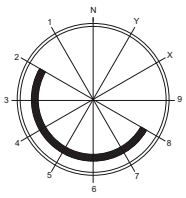
Voir tableaux «passage de câble»
See cable dimensions
Page 23

DÉTROMPAGES
KEYING SYSTEMS

Taille / *Sizes* 02 - 04 - 07 - 19 - 27
N - 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - X - Y



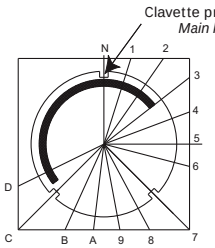
Embase / *Receptacle*



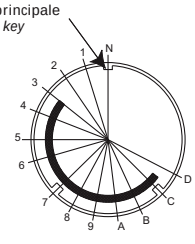
Fiche / *Plug*

Taille 02 : intégré à l'isolant
Size 02 : integrated to insert

Taille / *Size* 61
N - 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - A - B - C - D



Embase / *Receptacle*



Fiche / *Plug*

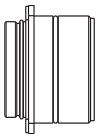
CMB

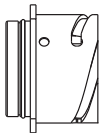
Standard
500 h brouillard salin / *500 h salt spray*

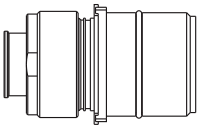
Caractéristiques / *Characteristics*

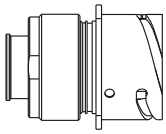
Boîtier / *Shell* : Pièces d'accouplement en bronze / *Bronze mating pieces*
Contacts / *Contacts* : Laiton argenté, à sertir / *Silver plated brass, crimp*
Isolants / *Inserts* : Polyamide / *Polyamid*
Tenue feu-fumée / *Fire and smoke withstand* : NF F 16-102 exigence 2 & UL95 5V
Endurance / *Durability* : > 500 manoeuvres/*matings*
Température d'utilisation / *Temperature* : - 40°C + 120°C
Indice de protection / *Protection index* : IP67 avec raccord droit étanche
IP67 with environmental straight backshell
IP43 avec raccord PG + presse-étoupe
IP43 with backshell with PG outlet + cable gland
Brouillard salin / *Salt spray* : 500 h
Etude spécifique pour les environnements extrêmes > 500 h brouillard salin, nous consulter.
More 500 hours salt spray, specifical assessment for the severe environments, consult us.
Reprise de blindage / *RFI shielding* : Page 15

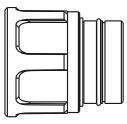
Synoptique des boîtiers et des raccords / *Shells and backshells styles*

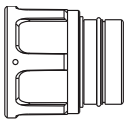
32

Embase carrée à visser
Screw square receptacle

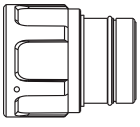
52

Embase carrée à baïonnette
Square bayonet receptacle

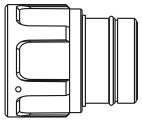
33

Embase carrée à visser
avec reprise de tresse
Screw square receptacle with shielding

53

Embase carrée à baïonnette
avec reprise de tresse
Square bayonet receptacle with shielding

36

Fiche à visser sans cliquet
Screw plug without clicker

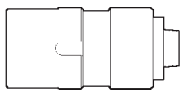
56

Fiche à baïonnette
Bayonet plug

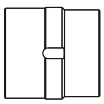
38

Fiche à visser sans cliquet
avec reprise de tresse
Screw plug without clicker with shielding

58

Fiche à baïonnette
avec reprise de tresse
Bayonet plug with shielding

EA

Ecrou arrière
Back nut

RD

Raccord droit étanche
Environmental straight backshell

PG

Raccord pour PG
Backshell for PG outlet

Standard CPP

Les connecteurs CPP proposent des arrangements pour des applications de puissance.

Cette gamme est directement dérivée de la CMC 96 h BS. Elle reprend les mêmes boîtiers, raccords et accessoires. Seuls les blocs isolants et les contacts sont spécifiques.

Un code de modification spécifique sera attribué pour une configuration supérieure à 96 h BS.

The CPP connectors have been designed for power applications.

The metal shells and coupling are the same for CMC and CPP ranges. Only contacts and inserts are specific.

A specific modification code will be given for a salt spray withstand more than 96 hours .

Système de référence / *Part numbering system*

CPP 36 RD 19 - 4A P N A ***

GAMME / *SERIES*

TYPES DE BOITIERS *SHELL TYPES* (p. 6)

TYPES DE RACCORDS *BACKSHELL TYPES* (p. 6)

TAILLES DE BOITIERS *SHELL SIZES*
19 - 61

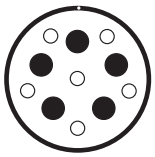
(p. 6) MODIFICATIONS SPÉCIALES *SPECIAL MODIFICATIONS*

(p. 23) CODES CABLES *CABLE INDEXES*

(p. 6) DÉTROMPAGES *KEYING SYSTEMS*

(p. 6) TYPES DE CONTACTS *CONTACT TYPES*

ARRANGEMENTS / *CONFIGURATIONS*

Taille 19						Taille 61	
4A	2 contacts Ø6 + 2 pilotes Ø3	5A	3 contacts Ø5 + 2 pilotes Ø3	7A	5 contacts Ø5 + 2 pilotes Ø3	11	4 contacts Ø9 + Terre + 6 contacts Ø4
4B	2 contacts Ø7 + 2 pilotes Ø3	5B	3 contacts Ø6 + 2 pilotes Ø3	7B	5 contacts Ø6 + 2 pilotes Ø3		
4C	2 contacts Ø8 + 2 pilotes Ø3	5C	3 contacts Ø7 + 2 pilotes Ø3				
Un 500 V - In 80 à/*to* 100 A		Un 500 V - In 80 à/*to* 100 A		Un 500 V - In 80 à/*to* 100 A		 Un 500 V - In 200 A	
		6A	4 contacts Ø5 + 2 pilotes Ø3				
		6B	4 contacts Ø6 + 2 pilotes Ø3				
		Un 500 V - In 80 à/*to* 100 A					

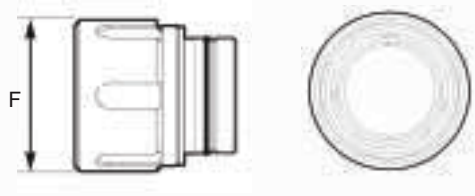
CPP Standard

Arrangements MULTIPOLAIRES / *MULTIPOLE configurations*

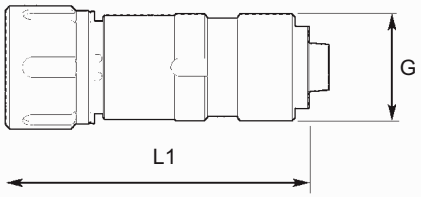
CONTACTS		CABLE		CONTACT		OUTILLAGE / *TOOLS*		
Calibre *Diameter* (mm)	Ampérage *Rating*	Section *Cross section* (mm^2)	Gauge *AWG*	Type	Référence *Part number*	Pince ou vérin *Crimping tool or actuator*	Tourelle ou matrice *Positionner or die*	Outil d'extraction *Extraction tool*
Ø 3	-	0.6	20	P	S18877-0004	Pince / *Crimping tool* Océta M22520/1-01	Tourelle / *Positionner* E18994-0004	CCIEXT-C0000
				S	S18878-0004			
Ø 3	-	2.5	-	P	S24480-0004	Pince / *Crimping tool* Océta M22520/1-01	Tourelle / *Positionner* E18994-0004	CCIEXT-C0000
				S	S24479-0004			
Ø 4	-	6	-	P	18260-000A4	Pince / *Crimping tool* Sertilec PN4E	Nous consulter *Consult us*	CCIEXT-V0100 CCIEXT-D0100
				S	S18325-0004			
Ø 5	80 A	13.4	# 6	P	S18879-0004	Pince / *Crimping tool* Océta D31	Matrice / *Die* Océta 02607	CCIEXT-D0100
				S	S18880-0004			
Ø 5	80 A	16	-	P	S24482-0004	Pince / *Crimping tool* Océta D31	Matrice / *Die* Océta 02607	CCIEXT-D0100
				S	S24481-0004			
Ø 6	80 A	13.4	# 6	P	S19069-0004	Pince / *Crimping tool* Océta D31	Matrice / *Die* Océta 02607	CCIEXT-D0100
				S	S19070-0004			
Ø 6	70 A	16	-	S	S25467-0003	Pince / *Crimping tool* Océta D31	Matrice / *Die* MP2RH16	CCIEXT-F0100
Ø 6	100 A	21.4	# 4	P	S18887-0004	Pince Océta D31 ou/*or* Vérin Mécatraction	Matrice 19243-000A4 Matrice 19004-000A4	CCIEXT-F0100
				S	S18888-0004			
Ø 6	100 A	25	-	P	S23547-00B3	Pince Océta D31 ou/*or* Vérin Mécatraction	Matrice 19243-000A4 Matrice 19004-000A4	CCIEXT-F0100
Ø 7	120 A	33.6	# 2	P	S18889-0004	Pince / *Crimping tool* Mécatraction PMM1	Matrice / *Die* H1 10-35F	CCIEXT-G0100
				S	S18890-0004			
Ø 7	180 A	53.5	# 0	P	S18891-0004	Pince / *Crimping tool* Mécatraction PMM1	Matrice / *Die* H1 16-50F	CCIEXT-G0100
				S	S18892-0004			
Ø 8	200 A	67.2	# 00	P	S18895-0004	Vérin Mécatraction	Matrice / *Die* TN 70-20	CCIEXT-H0100
				S	S18896-0004			
Ø 9	200 A	50	-	P	18260-000A4	Pince / *Crimping tool* Mécatraction TN	Nous consulter *Consult us*	Nous consulter *Consult us*
				S	S18264-0004			

Contacts standard livrés avec le connecteur/ *Standard contacts supplied with connector*

Encombrement de la fiche / *Plug dimensions*



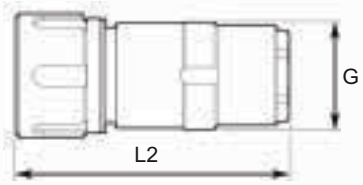
avec raccord droit étanche
with environmental straight backshell



Taille *Size*	02	04	07	19	27	61
F	28 *(1.10)*	36 *(1.42)*	45 *(1.77)*	63 *(2.48)*	81 *(3.19)*	106 *(4.17)*
G	24 *(0.94)*	32 *(1.26)*	39 *(1.53)*	56 *(2.20)*	74 *(2.91)*	94 *(3.70)*
L1	83 *(3.27)*	87 *(3.42)*	110 *(4.33)*	110 *(4.33)*	137 *(5.39)*	255 *(10.04)*
L1 blindé *shielded*	-	93 *(3.66)*	115 *(4.53)*	115 *(4.53)*	140 *(5.51)*	-
L2	69 *(2.78)*	78 *(3.07)*	95 *(3.74)*	95 *(3.74)*	107 *(4.21)*	173 *(6.81)*
L2 blindé *shielded*	-	84 *(3.30)*	100 *(3.94)*	100 *(3.94)*	110 *(4.33)*	-

mm / *(inches)*

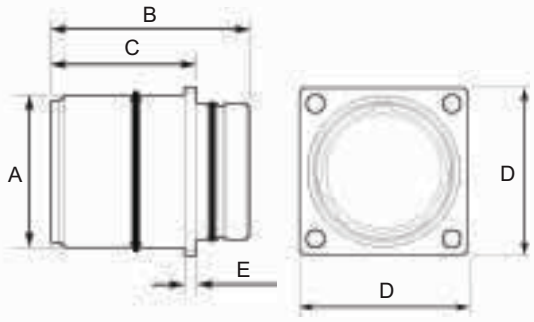
avec raccord sortie filetée PG
with backshell for PG outlet



Encombrement de l'embase à collerette carrée / *Square flange receptacle dimensions*

Taille *Size*	02	04	07	19	27	61
A	24 *(0.94)*	32 *(1.26)*	37,9 *(1.49)*	56 *(2.20)*	74 *(2.91)*	96 *(3.78)*
B	44 *(1.73)*	46 *(1.81)*	48,7 *(1.92)*	48,7 *(1.92)*	56,4 *(2.22)*	85 *(3.34)*
C	31 *(1.22)*	35 *(1.38)*	36 *(1.42)*	36 *(1.42)*	36 *(1.42)*	56 *(2.20)*
D	25 *(0.98)*	35 *(1.38)*	42 *(1.65)*	67 *(2.64)*	79 *(3.11)*	112 *(4.41)*
E	3 *(0.12)*	3 *(0.12)*	3 *(0.12)*	3 *(0.12)*	5 *(0.20)*	9 *(0.35)*

mm /*(inches)*

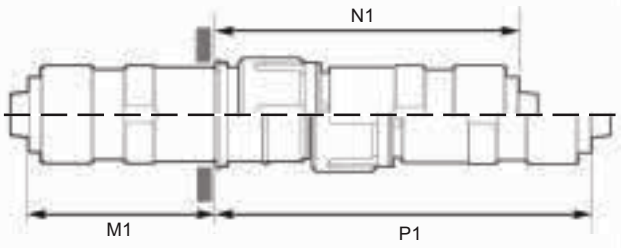


Encombrement à l'accouplement / *Mating dimensions*

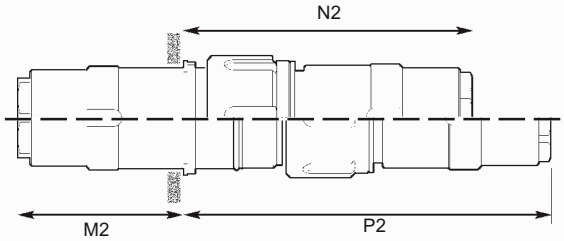
Taille *Size*	02	04	07	19	27	61
M1 max.	55 *(2.16)*	55 *(2.16)*	70 *(2.75)*	70 *(2.75)*	103 *(4.05)*	215 *(8.46)*
M1 max. blindé *shielded*	-	61 *(2.40)*	75 *(2.95)*	75 *(2.95)*	106 *(4.17)*	-
M2 max.	40 *(1.57)*	46 *(1.81)*	57 *(2.24)*	57 *(2.24)*	73 *(2.87)*	133 *(5.24)*
M2 max. blindé *shielded*	-	52 *(2.04)*	62 *(2.44)*	62 *(2.44)*	76 *(2.99)*	-
N1 max.	92 *(3.62)*	98 *(3.86)*	123,5 *(4.86)*	123,5 *(4.86)*	153 *(6.02)*	275 *(10.83)*
N1 max. blindé *shielded*	-	104 *(4.09)*	128,5 *(5.06)*	128,5 *(5.06)*	156 *(6.14)*	-
N2 max.	78 *(3.07)*	89 *(3.50)*	108,5 *(4.27)*	108,5 *(4.27)*	123 *(4.84)*	193 *(7.06)*
N2 max. blindé *shielded*	-	95 *(3.74)*	113,5 *(4.46)*	113,5 *(4.46)*	126 *(4.96)*	-
P1 max.	114 *(4.49)*	122 *(4.80)*	146 *(5.75)*	146 *(5.75)*	175 *(6.89)*	311 *(12.24)*
P1 max. blindé *shielded*	-	128 *(5.04)*	151 *(5.94)*	151 *(5.94)*	178 *(7.00)*	-
P2 max.	100 *(3.94)*	113 *(4.45)*	131 *(5.16)*	131 *(5.16)*	148 *(5.83)*	229 *(9.02)*
P2 max. blindé *shielded*	-	119 *(4.68)*	136 *(5.35)*	136 *(5.35)*	151 *(5.94)*	-

mm / *(inches)*

avec raccord droit étanche
with environmental straight backshell



avec raccord sortie filetée pour PG
with backshell for PG outlet



Couple de blocage des connecteurs / *Coupling torque*

Taille Size	02	04	07	19	27	61
N.m (0/-10%)	10	15	20	50	70	100

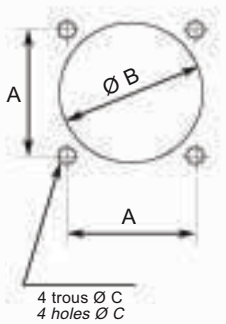
Standard CMC-CMB-CPP

Perçage cloison / *Panel cut out*

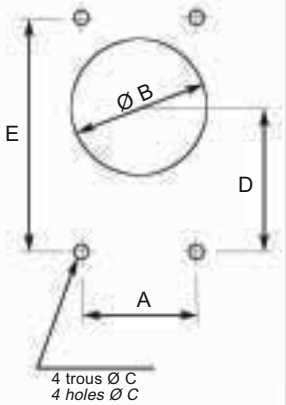
Taille *Size*	02	04	07	19	27	61
A	19,8 *(0.78)*	27 *(1.06)*	34 *(1.34)*	52 *(2.04)*	64 *(2.52)*	88 *(3.46)*
B	24,5 *(0.96)*	31,5 *(1.24)*	39,5 *(1.55)*	56,5 *(2.22)*	75 *(2.95)*	96 *(3.78)*
C	2,6 *(0.10)*	3,5 *(0.14)*	4,5 *(0.18)*	4,5 *(0.18)*	7 *(0.27)*	9,5 *(0.37)*
D	30 *(1.18)*	35 *(1.38)*	45 *(1.77)*	41,5 *(1.63)*	-	69 *(2.72)*
E	48 *(1.89)*	55 *(2.16)*	72 *(2.83)*	70 *(2.75)*	-	113 *(4.45)*

mm / *(inches)*

Embase à collerette carrée
Square flange receptacle



Patères 30° ou 45°
30° or 45° angle supports

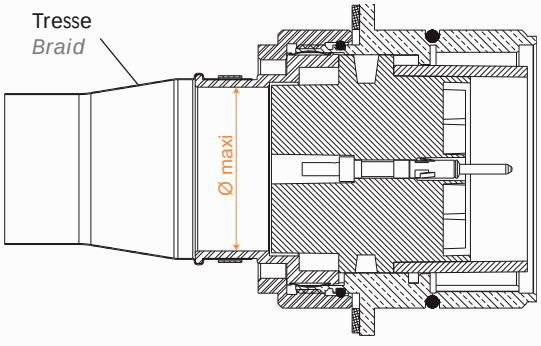


Note : Montage par l'avant / *Front mounted*

Entrée de faisceau de câbles dans le collecteur de tresse blindée
Cable bundle entry for shielded connectors

Taille *Size*	Ø maxi
04	13 *(0.51)*
07	18,50 *(0.73)*
19	31 *(1.22)*
27	46,5 *(1.83)*

mm / *(inches)*

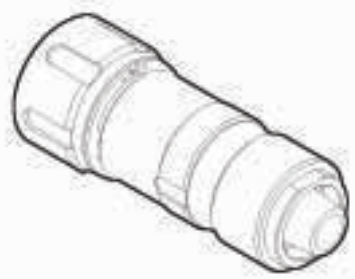


CMC-CMB-CPP Standard

Code de référence - Sortie des raccords droits étanches
Part number code - Environmental straight backshells outlet

CABLE Ø ext. sur gaine (mm) *INSULATION O.D.*		TAILLE DE BOITIER *Shell size*					
min.	max.	02	04	07	19	27	61
4	6	Nous consulter *Consult us*					
5.5	8			D			
7.5	10			E			
9.5	11.5			F			
12	13			H			
13.5	15.5						
13.5	17			L			
16	21			M			
16.5	20				N		
19.5	23.5				P		
22	28				Q		
30	36					W	W
31	33				T		
36	40						X
42	46						Z
44	48						Y

CODE CABLE / *CABLE INDEX* RD
Raccords droits étanches
Environmental straight backshells

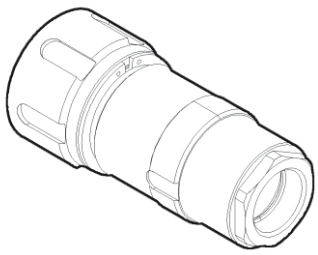


Fiche équipée d'un raccord droit étanche
Plug with environmental straight backshell

Code de référence - Sortie des raccords PG
Part number code - PG outlet backshells

PAS ELECTRIQUE P.G.	TAILLE DE BOITIER *SHELL SIZE*					
	02	04	07	19	27	61
9	D	D				
16		G	G			
21			H			
29				K	K	
36				L		
42					M	
48 DIN					N	N
48					P	P

Raccord sortie filetée
pas électrique PG PG
Backshell for PG outlet



Fiche équipée d'un raccord pour PG
Plug with backshell for PG outlet

Accessoires
Accessories

CMC-CPP-CMB

Système de référence des accessoires CMC-CPP / *CMC-CPP accessories part number*

CPP PT30 61 ***

GAMMES / *SERIES*

CMC - CPP

TYPES D'ACCESSOIRES
ACCESSORIE TYPES

PT30	Patère 30° / *30° angle support*
PT45	Patère 45° / *45° angle support*
PT90	Patère 90° / *90° angle support*
SD	Socle droit à 2 entrées *Wall mounting base with 2 entries*
BE	Bouchon pour embase à visser *Cover for receptacle*
BEB	Bouchon pour embase à baïonnette *Cover for receptacle with bayonet*
BF	Bouchon de fiche à visser *Cover for screw plug*
BFB	Bouchon de fiche à baïonnette *Cover for plug with bayonet*
BR	Boîte de repos / *Dummy socket*
BRB	Boîte de repos à baïonnette / *Bayonet dummy socket*
T	Tétine / *Hood*
JPC	Joint plat conducteur / *Conductive gasket*

MODIFICATIONS SPÉCIALES
SPECIAL MODIFICATIONS

***
Accessoires standard
Standard accessories

Note : Pour toutes modifications, nous consulter
For all modifications, consult us
Exemple : bouchons en polyamide
Example : Cover in polyamid

TAILLES DE BOITIERS
SHELL SIZES

02 - 04 - 07 - 19 - 27 - 61

Système de référence des accessoires CMB / *CMB accessories part number*

CMB BE 19 ***

GAMME / *SERIES*

CMB

TYPES D'ACCESSOIRES
ACCESSORIE TYPES

BE	Bouchon pour embase à visser *Cover for screw receptacle*
BEB	Bouchon pour embase à baïonnette *Cover for bayonet receptacle*
BF	Bouchon de fiche à visser *Cover for screw plug*
BFB	Bouchon de fiche baïonnette *Cover for bayonet plug*
BR	Boîte de repos / *Dummy socket*
BRB	Boîte de repos baïonnette / *Bayonet dummy socket*

MODIFICATIONS SPÉCIALES
SPECIAL MODIFICATIONS

***
Accessoires standard
Standard accessories

Note : Pour toutes modifications, nous consulter
For all modifications, consult us

TAILLES DE BOITIERS
SHELL SIZES

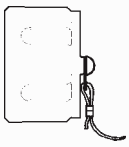
02 - 04 - 07 - 19 - 27 - 61

CMC-CMB-CPP

Accessoires
Accessories

Accessoires / *Accessories*

BE

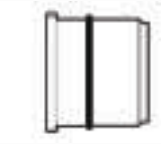


Bouchon pour embase
visser
Cover for receptacle

BEB

Bouchon pour embase
ba onnette
Cover for bayonet receptacle

BR



Bo te de repos
Dummy socket

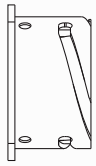
BF

Bouchon pour fiche
visser
Cover for plug

BFB

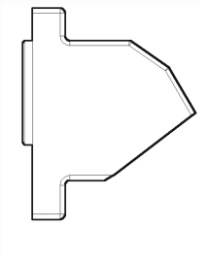
Bouchon pour fiche
ba onnette
Cover for bayonet plug

BRB



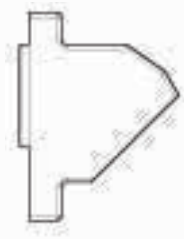
Bo te de repos
pour ba onnette
Bayonet dummy socket

PT30



Pat re 30
30° angle support

PT45



Pat re 45
45° angle support

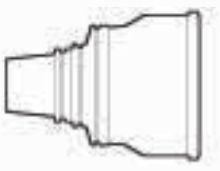
PT90

Patère 90°
90° angle support

JPC

Joint plat conducteur
Conductive gasket

T



T tine
Hood

Autre accessoire possible
Other accessories possible

SD

Socle droit 2 entr es
oppos es verticalement
Wall mounting base
with 2 entries

Carrier Kheops Bac

Boulevard Pierre Lefaucheux - ZI Sud - 72027 LE MANS CEDEX 2 (FRANCE)
Tél : +33 (0)2 43 61 45 45 - Fax : +33 (0)2 43 61 45 00

E-mail : ckb@compagnie-deutsch.com - Web : www.compagnie-deutsch.com

Edition Janvier 2000

Photo JM2 - Impression Renard, Le Mans

DETAILED INTERFACE SPECIFICATION

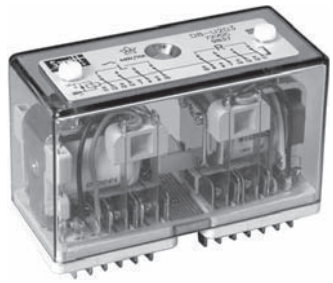
ANNEX C14
DZVR RELAY SPECIFICATION

DZVR Relay

MORS SMITT RELAIS
INSTANTANEOUS RELAYS - D8-U200

FEATURES:

- Conforms with IEC 571, IEC 77, EN 50155.
- Ultra compact space saving package size.
- Plug-in design with SNAPLOCK (built-in space saving locking feature so no retaining clip is needed) for maximum ease of maintenance - i. e. - no wires need to be disconnected or other hardware removed for relay inspection or replacement.
- Resistance to impact and vibration conform to standards in force for Railway Transported Equipment.
- Positive mechanical keying of relay to socket is accomplished by an integrated locking pin.
- Terminal identifications are clearly marked on the relay cover.
- Equipped with magnetic arc blow out for inductive loads
- Equipped with surge protection diode.



INSULATION MATERIALS

COVER	Polycarbonate
BASE	Polyester

Note: These materials have been tested for fire propagation and smoke emission .

GENERAL SPECIFICATIONS - ELECTRICAL

DESCRIPTION	Relay has 8 changeover contacts (Form C).
ACTION	Nominal load current: 10 Amps Instantaneous contact changeover with contact wiping action in both positions and magnetic arc blow-out.
CONTACT MATERIAL	Silver .
CONTACT RESISTANCE	Initial: 15 milliohms max. at 10 milliAmps.
DIELECTRIC STRENGTH	4000 VAC / 50 Hz for 1 minute between contacts. 2500 VAC / 50 Hz for 1 minute between contacts and coil.
INSULATION RESISTANCE	≥ 1000 Megohms at 500 VDC
COIL OVERVOLTAGE PROTECTION	Equipped with surge protection diode (standard).

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS
INSTANTANEOUS RELAYS - D8-U200

GENERAL SPECIFICATIONS - - MECHANICAL & ENVIRONMENTAL

OPERATING TEMPERATURE RANGE — -25°C TO 70°C.

OPERATING POSITION — May be mounted in any attitude.

CONTACT LIFE (MECHANICAL) — 30 million cycles.

WEIGHT — Relay: 330 grams (11.63 ounces).

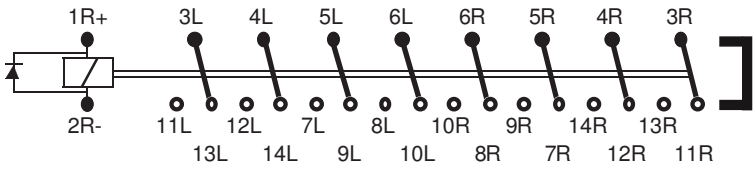
VIBRATION — Sine wave:
Frequency range 1-100 Hz, 2g, 2 hours in X,Y and Z direction
Random:
Frequency range 10-150 Hz, ASD level 0.005g²/Hz
(0.84 g RMS), 30 hours in X,Y and Z direction.

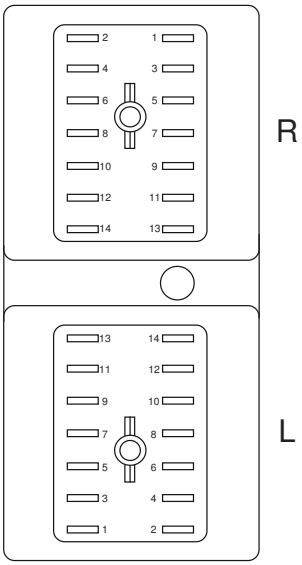
SHOCK — 3 shocks half sine wave 5g, 30ms, X,Y and Z direction.
(upwards and downwards)

SALT MIST — 5% NaCl, 35°C for 4 days (IEC68, test Ka).

HUMIDITY — 90%

SCHEMATIC AND RELAY PIN CORRESPONDANCE





Relay pin correspondence
(rear view of relay shown)

MECHANICAL OUTLINE & MOUNTING HOLE LAYOUTS — REFERENCE "LD8-U"

DYNAMIC RELAY SELECTION CURVES — REFERENCE "CD-U"

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS
INSTANTANEOUS RELAYS - D8-U200

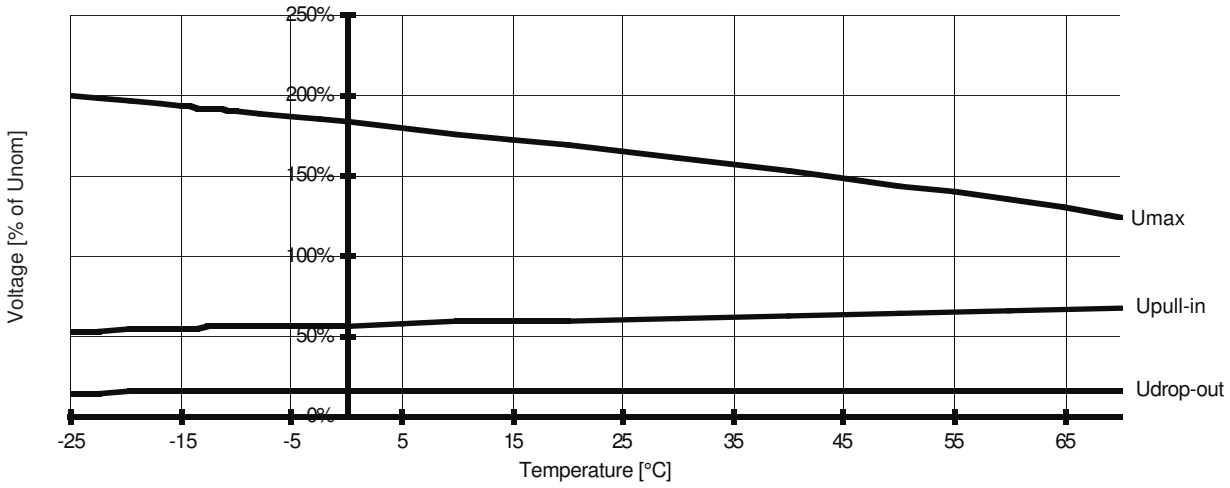
STANDARD MODELS WITH COIL DATA & CONTACT DATA

	TYPE	D8-U201	D8-U202	D8-U203	D8-U204	D8-U205	D8-U206	D8-U207
COIL DATA	NOMINAL VOLTAGE‡	24 VDC	48 VDC	72 VDC	110 VDC	96 VDC	12 VDC	36 VDC
	VOLTAGE RANGE	16.8 - 30	33.6 - 60	50.4 - 90	77 - 137.5	67.2 - 120	8.4 - 15	25.2 - 45
	NOMINAL POWER	2.8 Watts						
	PULL IN & DROP OUT VOLTAGES	SEE DIAGRAM "COIL VOLTAGE VS ENVIRONMENTAL TEMPERATURE DIAGRAM"						
	RESISTANCE (OHMS)	222	680	1500	3790	3790	100	500
	TIME CONSTANT (L/R)	8 ms						
CONTACT DATA	NOMINAL CURRENT	10 Amps AC Resistive, according to IEC 947 (AC1)						
	SPECIFIED BREAKING CAPACITY & LIFE	1 Amp @24VDC	L/R = 0 ms	Electrical life: 5.5 million ops				
		0.5 Amp @ 110VDC	L/R = 40 ms	Electrical life: 1 million ops				
		1 Amp @ 220V, 50Hz	PF = 1	Electrical life: 3.5 million ops				
	PULL-IN TIME	20 ms						
	RELEASE TIME	12 ms						
	MINIMUM CONTACT CONTINUITY	12 V, 10 mA						
	NO. OF CONTACTS	8 changeover contacts (Form C)						
	CONTACT MATERIAL	Silver						

‡ - other voltages on request

COIL VOLTAGE VS ENVIRONMENTAL TEMPERATURE DIAGRAM

Use this curve to assess voltage range limits in function of environmental temperature.

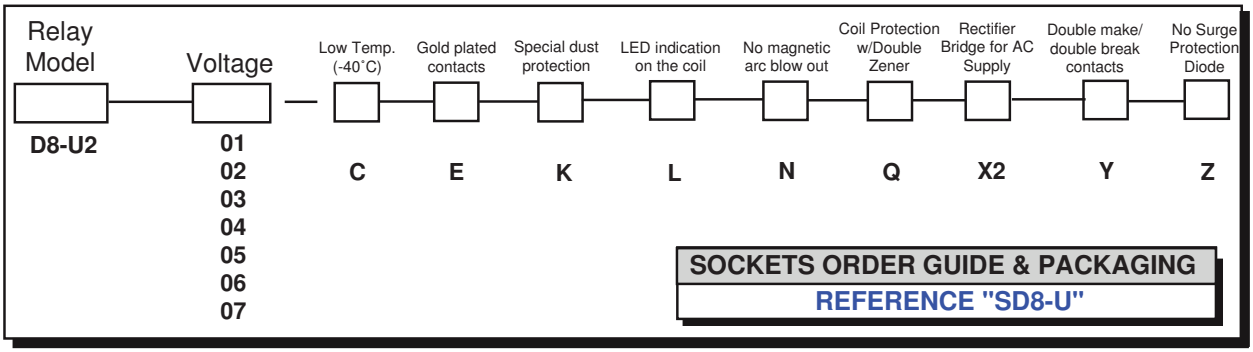


SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS
INSTANTANEOUS RELAYS - D8-U200

MODEL D8-U200 - RELAY ORDER GUIDE

To specify a relay, a complete part number must first be determined.
The boxes below have brief descriptions of the options above and the allowable option suffixes beneath.
Complete descriptions of the options are listed below.
Simply fill in all boxes with selected option suffixes for the complete part number.



SOCKETS ORDER GUIDE & PACKAGING
REFERENCE "SD8-U"

- Relay Model:	**D8-U2**		Specify for all part numbers.
- Voltage:	**01**	=	**24 VDC**
	02	=	**48 VDC**
	03	=	**72 VDC**
	04	=	**110 VDC**
	05	=	**96 VDC**
	06	=	**12 VDC**
	07	=	**36 VDC**
			(Select one from above and specify)
- Low Temperature (-40˚C):			option not selected
	C		option selected
			(Select one from above and specify)
- Gold plated contacts:			option not selected
	E		option selected
			(Select one from above and specify)
- Special dust protection:			option not selected
(unremovable cover)	**K**		option selected
			(Select one from above and specify)
- LED indication on the coil:			option not selected
	L		option selected
			(Select one from above and specify)
- No magnetic arc blow out:			option not selected
	N		option selected
			(Select one from above and specify)
- Coil Protection with Double Zener:			option not selected
	Q		option selected
			(Select one from above and specify)
- Rectifier Bridge for AC Supply:			option not selected
	X2		option selected
			(Select one from above and specify)
- Double make/double break:			option not selected
(only 4z contact will remain)	**Y**		option selected
			(Select one from above and specify)
- No Surge Protection Diode:			option not selected
	Z		option selected
			(Select one from above and specify)

Examples of complete relay part numbers:
D8-U201-CE
D8-203-LY

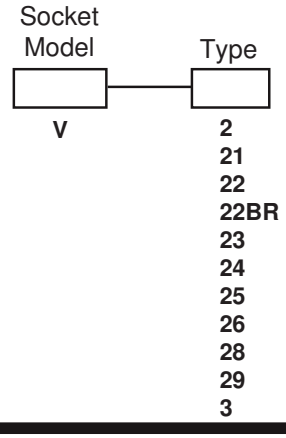
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS

SOCKET ORDER GUIDE AND PACKAGING - SD-U

SOCKET ORDER GUIDE

To specify a socket, a complete part number must first be determined.
The boxes below have brief descriptions of the options above and the allowable option suffixes beneath.
Complete descriptions of the options are listed below.
Simply fill in all boxes with selected option suffixes for the complete part number.



- Socket Model:	**V**	Specify for all part numbers.
- Type :	**2**	Front mount - for bare wire or pin terminals or one wire 2.5 mm²
	21	DIN-rail mount - for bare wire or pin terminals or one wire 2.5 mm²
	22	Front mount - for ring or fork terminals 7.5 mm or two wires 2.5 mm²
	22BR	Front mount - for ring or fork terminals 9 mm or two wires 2.5 mm²
	23	DIN-rail mount - for ring or fork terminals 7.5 mm or two wires 2.5 mm²
	24	Front mount - for faston 6.3 mm or 2 fastons 2.8 mm
	25	DIN-rail mount - for faston 6.3 mm or 2 fastons 2.8 mm
	26	Panel mount - with direct crimp-on contacts A260
	28	Front mount - cage clamp connection for 2 wires up to 2.5 mm²
	29	DIN-rail mount - cage clamp connection for 2 wires up to 2.5 mm²
	3	Panel mount / PCB mount - with solder contacts (Select one from above and specify)

Examples of complete socket part numbers:
V21
V22BR

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS

SOCKET ORDER GUIDE AND PACKAGING - SD-U

PACKAGING & MISCELLANEOUS

All relays are packaged in batches of 5 in a transparent plastic container.

V2/V21 socket	Shrink wrap in package of 5
V22/V23 socket	Shrink wrap in package of 5
V22BR socket	Bulk
V24/V25 socket	Shrink wrap in package of 5
V28/V29 socket	Shrink wrap in package of 5
V3 socket	Bulk
V26 socket	Bulk
A260 contact	Bulk in bag of 100 pieces

V2 SOCKET
(PA 66, 6% GF)

V21 SOCKET
(PA 66, 6% GF)

V22 SOCKET
(PA 66, 30% GF)

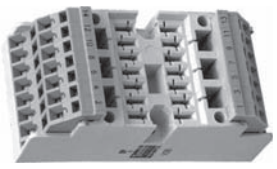
V22BR SOCKET
(PPS)

V23 SOCKET
(PA 66, 30% GF)

V24 SOCKET
(PA 66, 30% GF)

V25 SOCKET
(PA 66, 30% GF)

V26 SOCKET
(PA 66, 30% GF)



V28 SOCKET
(PA 66, 35% GF, class 2 according to NFF16102)

V29 SOCKET
(PA 66, 35% GF, class 2 according to NFF16102)

V3 SOCKET
(MF)

A260 CONTACTS

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

DETAILED INTERFACE SPECIFICATION

ANNEX C15
SIR RELAY SPECIFICATION

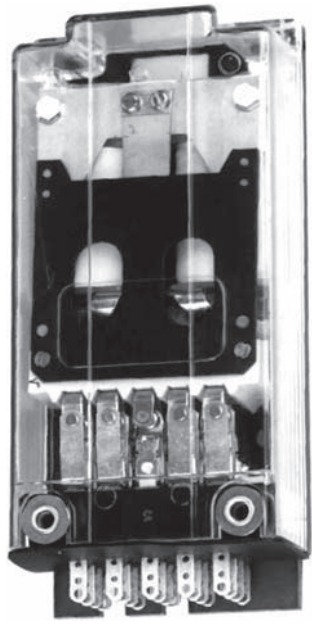
SIR Relay

MORS SMITT RELAIS

INSTANTANEOUS RELAYS - C

FEATURES:

- Conforms with French Railway Standard CF 62 - 002.
- Ultra-compact space saving package size.
- Plug-in design with secure locking feature for maximum ease of maintenance - i. e. - no wires need to be disconnected or hardware removed for relay inspection or replacement.
- Resistance to impact and vibration conform to standards in force for Railway Transported Equipment.
- Positive mechanical keying of relay to socket.
- For safe installation or replacement, key combination is different according to voltage or function (instantaneous, latching, timer...).
- Terminal identifications are clearly marked on identification plate that is permanently attached to the relay.
- Weld no transfer safety contacts are standard.



INSULATION MATERIALS

COVER	Polycarbonate Resin
BASE	Phenalic Compound

Note: These materials have been tested for fire propagation and smoke emission according to Standards NFF16101 and NFF16102 and have been approved to go on the English/French Train Channel Shuttle.

GENERAL SPECIFICATIONS - ELECTRICAL

DESCRIPTION	Relay has 9 double break contacts (Forms X & Y - per customers specification) in all NO and NC combinations.
ACTION	Nominal load current: 8 Amps. (according to CF 62-002) Instantaneous contacts with contact wiping action in both positions.
CONTACT MATERIAL	Hard silver overlay laminated to copper.
CONTACT RESISTANCE	Initial: 10 milliohms max. at 8 Amps. End of life: 40 milliohms max. at 8 Amps.
DIELECTRIC STRENGTH	2200 VAC for 1 minute between contacts. 2600 VAC for 1 minute between contacts, coil and frame.
INSULATION RESISTANCE	≥ 1000 Megohms at 500 VDC.
CONTACT OVERLOAD WITHSTAND	At 24 VDC contacts will withstand 160 Amps at L/R = 0 for 10 ms duration for 10 operations at the rate of 1 operation per minute.
COIL OVERVOLTAGE PROTECTION	To reduce or eliminate spurious EMI interference, an optional double zener diode (Transil) can be supplied connected to the coil.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS
INSTANTANEOUS RELAYS - C

GENERAL SPECIFICATIONS - - MECHANICAL & ENVIRONMENTAL

OPERATING TEMPERATURE RANGE — -40°C TO 80°C.

OPERATING POSITION — May be mounted in any attitude, however, we recommend the following: If relay is mounted vertically,the direction of contact closure should be oriented transverse to the direction of forward motion. If relay is mounted horizontally, it should be oriented so that gravity will cause the contacts to revert to their de-energized position.

CONTACT LIFE (MECHANICAL) — 100 million cycles.

WEIGHT — Relay: 400 grams (14.1 ounces).

VIBRATION — Tests are conducted in the X, Y & Z planes at resonant frequency between 5 & 50 cycles at 1 g, or if indeterminate at 10 HZ (sinusoidal).

SHOCK — Tests are applied in both directions in the X, Y & Z planes. Three successive shocks are administered consisting of the positive component of sinusoidal with a value of 30 g, 11 milliseconds.

HUMIDITY — 93% RH, 40° C for 4 days.

SALT MIST — 5% NaCl, 35° C for 4 days.

MECHANICAL OUTLINE & MOUNTING HOLE LAYOUTS — REFERENCE "LC"

DYNAMIC RELAY SELECTION CURVES — REFERENCE "CC"

COIL DATA & CONTACT DATA

COIL DATA	NOMINAL VOLTAGE	24 VDC	36 VDC	48 VDC	72 VDC	110 VDC	220 VAC
	OP. VOLTAGE RANGE	16/33	25/45	33./60	48/90	77/138	176/242
	NOMINAL POWER	4.8 Watts	4.8 Watts	4.6 Watts	5.2 Watts	5 Watts	4 VA
	HOLD SPECIFIED	13.5 VDC	21 VDC	28.5 VDC	40.5 VDC	60 VDC	129 VDC
	DROPOUT SPECIFIED	2.5 VDC	3.5 VDC	4.5 VDC	6.5 VDC	11.5 VDC	21 VDC
	RESISTANCE (OHMS)†	120	270	500	1000	2400	12000
	TIME CONSTANT (L/R)‡	25 ms	25 ms	25 ms	25 ms	25 ms	25 ms

CONTACT DATA	NOMINAL CURRENT	8 Amps (Resistive)		
	SPECIFIED BREAKING CAPACITY & LIFE	2.4 Amps at 72 VDC	Time constant: 0 ms	Electrical life: 5,000,000 operations
		0.8 Amps at 72 VDC	Time constant: 30 ms	Electrical life: 2,000,000 operations
		2.4 Amps at 220 VAC, 50 Hz.	Power factor=1	Electrical life: 2,500,000 operations
		Lamp filament circuit: 160 watts at 72 VDC		Electrical life: 500,000 operations

	Pick-up	Drop-out*
CONTACT CLOSURE TIME	NO: less than 45 ms.	NC: less than 35 ms
CONTACT OPENING TIME	NC: less than 30 ms	NO: less than 8 ms

MINIMUM CONTACT CONTINUITY	20 milliamps at 24 VDC
NO. OF CONTACTS	9 double break contacts (Form X & Y)
CONTACT MATERIAL	Hard silver overlay laminated to copper

* = with P option less than 70 ms † = Coil resistance tol.: ± 8% at 20° C ‡ = valid for closed relay

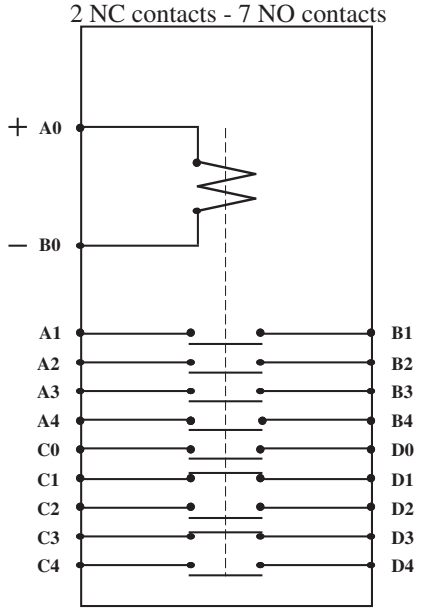
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS

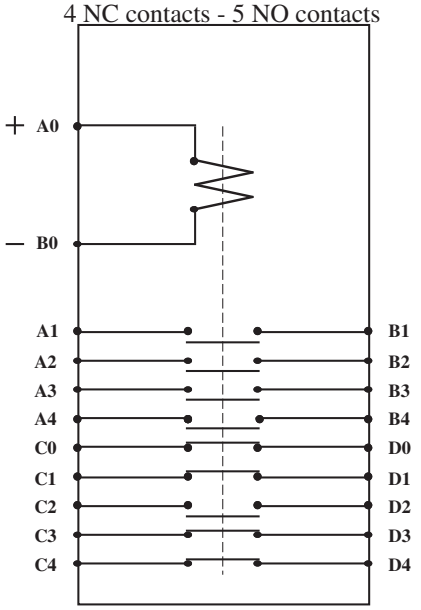
INSTANTANEOUS RELAYS - C

SCHEMATICS AND RELAY PIN CORRESPONDENCE

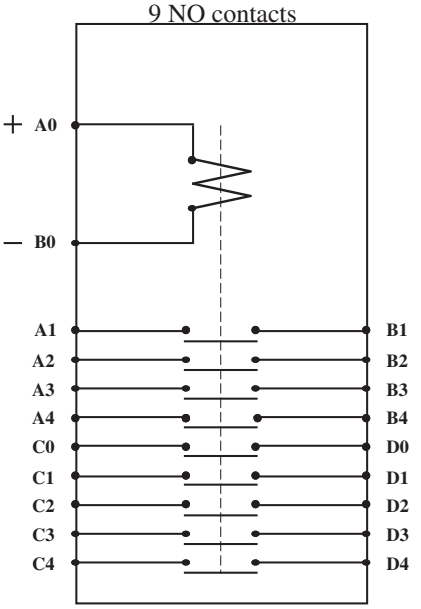
Schematic #1
2 NC contacts - 7 NO contacts



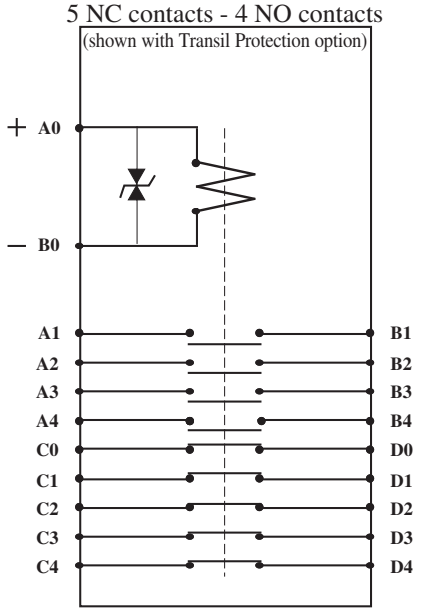
Schematic #2
4 NC contacts - 5 NO contacts



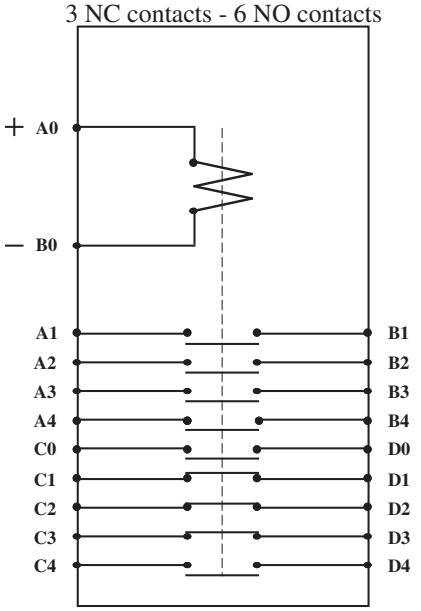
Schematic #3
9 NO contacts



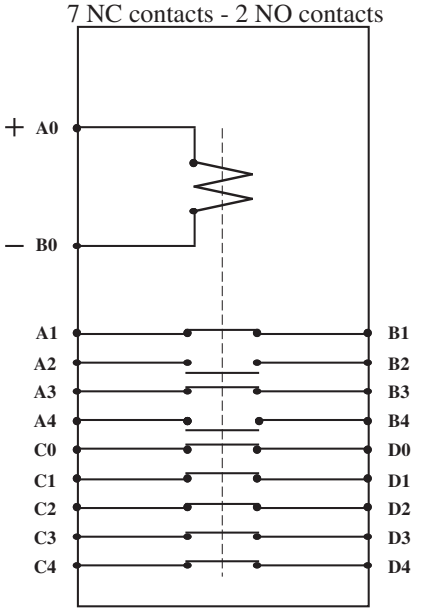
Schematic #4
5 NC contacts - 4 NO contacts
(shown with Transil Protection option)



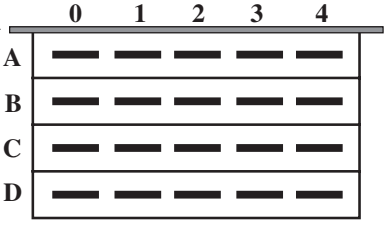
Schematic #5
3 NC contacts - 6 NO contacts



Schematic #6
7 NC contacts - 2 NO contacts



Keying Plate



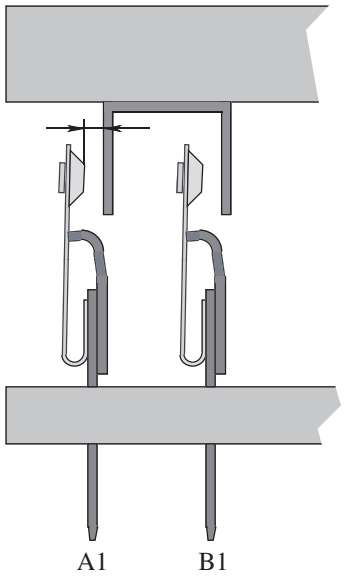
Relay pin correspondence
(rear view of relay shown)

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS
INSTANTANEOUS RELAYS - C

DOUBLE BREAK CONTACTS DESIGN

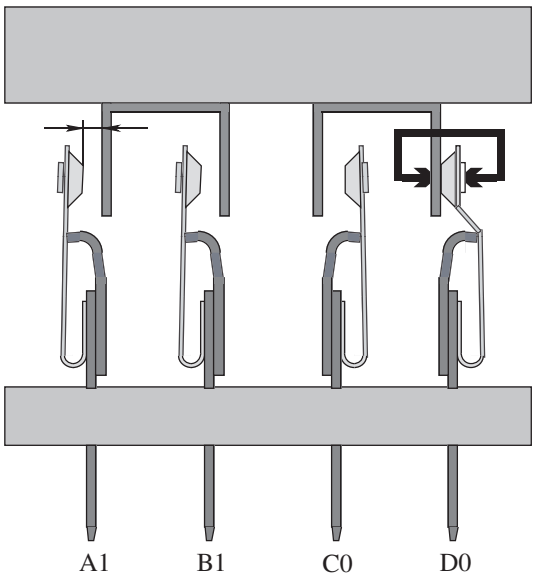
Double break contacts extend the contact life on highly inductive DC currents.



WELD NO TRANSFER CONTACTS DESIGN

WELD NO TRANSFER FUNCTION:

If one NO contact welds, no NC contact can close (and visa versa) and cause an overlapping of functions. All relays are factory tested to insure they meet this important safety requirement. 150% of max. operating voltage is applied to the relay while holding 1 NC contact closed by mechanical means. Under these conditions, it is verified that no NO contact makes.

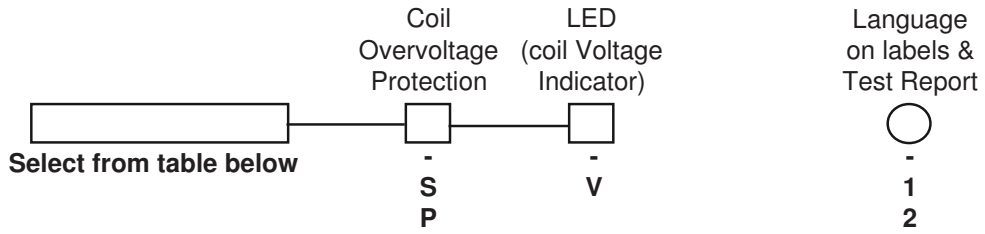


SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS
INSTANTANEOUS RELAYS - C

MODEL C - RELAY ORDER GUIDE

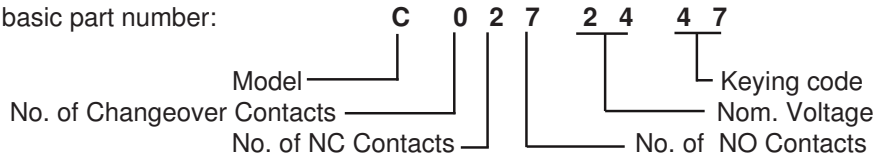
To specify a relay, a complete part number must first be determined.
The boxes below have brief descriptions of the options above and allowable option suffixes beneath.
Complete descriptions of the options are listed below.
Simply fill in all boxes with selected option suffixes for the complete part number.



Relay basic part number: Note - table shows standard part no's. - others available on request.

Nom. Voltage	Schematic #1	Schematic #2	Schematic #3	Schematic #4	Schematic #5	Schematic #6
24 VDC	**C 027 24 47**	**C 045 24 45**	**C 009 24 3D**	**C 054 24 49**	**C 036 24 811**	**C 072 24 68**
36 VDC	**C 027 36 16**	**C 045 36 35**	**C 009 36 46**	**C 054 36 48**	**----**	**C 072 36 511**
48 VDC	**C 027 48 89**	**C 045 48 19**	**C 009 48 6C**	**C 054 48 711**	**C 036 48 410**	----
72 VDC	**C 027 72 11B**	**C 045 72 69**	**C 009 72 15**	**C 054 72 8D**	**C 036 72 2E**	**C 072 72 1F**
110 VDC	**C 027 110 4F**	**C 045 110 38**	**C 009 110 1J**	**C 054 110 14**	**----**	**C 072 110 7F**
220 VAC	**C 027 220 1011**	**C 045 220 4C**	**C 009 220 5C**	**C 054 220 611**	**C 036 220 4E**	**----**

Explanation of relay basic part number:



Coil Overvoltage protection:
- **-** Indicates no coil protection.
- **S** Indicates Transil coil protection.
- **P** Indicates controlled avalanche diode coil protection.

(Select one from above)

LED (coil voltage indicator)
- **-** Indicates without LED.
- **V** Indicates with LED.

(Select one from above)

Language used on labels Parameters Test Report
- **-** French
- **1** English
- **2** Spanish

(Select one from above)

Example of complete relay part number: C 027 24 47 S V - 1

SOCKETS ORDER GUIDE & PACKAGING
REFERENCE "SC"

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Notes...

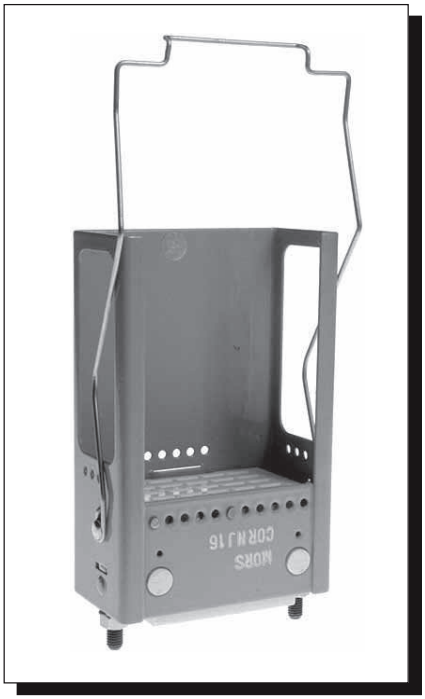
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS

SOCKET ORDER GUIDE AND PACKAGING - SC

SOCKET AND LOCKING MECHANISM ORDER GUIDE

- Base, socket & frame assembly with locking spring:



SOCKET
(Alkyde Compound)

For Model C Relay:
Part Number: 153879 TYPE COR NJ ☐
(indicate keying code from (relay) table) ⌐T
For Model C 1019 Relay:
Part Number: 153879 TYPE COR NJ5F or COR NJ311
For Model CM Relay:
Part Number: 926913 TYPE COR NJ37
For Model C 1020 B Relay:
Part Number: 153879 TYPE COR NJ11B
For Model C 1022 B Relay:
Part Number: 153879 TYPE COR NJ47

PACKAGING & MISCELLANEOUS

Each relay is packaged in an individual sealed bag with Parameters Test Report for shipment. Prior to packaging, each relay is keyed by the factory with orientation codes for the keys.

Each socket (153879 TYPE COR NJ and 926913 TYPE COR NJ) is packaged in a box. Prior to packaging, each socket is keyed by the factory with orientation codes for the keys.

Panel mounting hardware for the M5 threaded studs, which are part of the socket, consists of 2 each nuts and lockwashers and are hand tightened to the studs prior to bagging for shipment. The recommended installation torque is 1.7 Nm (1.25 ft-lbs.).

Note that exact quantity of hardware is provided. Additional spare parts kits are available and may be ordered separately.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS

SOCKET ORDER GUIDE AND PACKAGING - SC

Notes...

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS

SOCKET ORDER GUIDE AND PACKAGING - S300

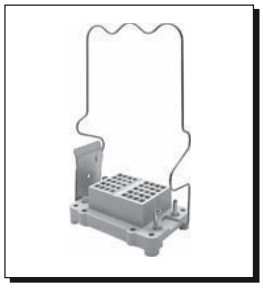
SOCKET AND LOCKING MECHANISM ORDER GUIDE

Sockets with locking spring:

153913 TYPE COR NK 58D ☐ _____ Indicates socket without guide.

(Polyester Melamine)

(Indicate keying code from relay table)



907983 TYPE COR PA 58D ☐ _____ Indicates socket with guide.

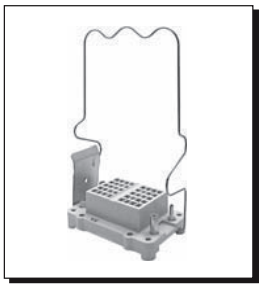
(Polyester Melamine)

(Indicate keying code from relay table)

To use with standard 303 Relays

160967 TYPE COR SA _____ Indicates socket without guide.

(Polyester Melamine)



To use with Relay 303S

(Select one from above and specify)

PACKAGING & MISCELLANEOUS

Each Model serie 300 relay is tested and individually packaged in a sealed bag. Prior to packaging, each relay is keyed by the factory. A Test Report for each lot of relays is provided with shipment.

Each COR NK, COR PA and COR SA socket with Spring Lock assembled is packaged in a box. Prior to packaging, each socket is keyed by the factory.

All sockets include 4 holes for M5 Threaded mounting bolts. Mounting hardware is not supplied.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

DETAILED INTERFACE SPECIFICATION

ANNEX C16
ATC-TMS COMMUNICATION PROTOCOLS REV.F

81-7271-1A

MITSUBISHI ELECTRIC CORPORATION

TITLE: INTERFACE BETWEEN TMS AND ATC

CUSTOMER: **MTR CORPORATION LIMITED**

PROJECT:

MODEL NO. :**TRAIN MANAGEMENT SYSTEM (TMS)**

ORDER NO.:

FR. NO.OF	R.DATE	DWG.SEC	2 SYM.	K.	S.	PRINT	DUP.DIST
SKIP	DUP	8 3 2	7 C		4		

CHANGE [DATE]											
	A	28 Jun. 2008	F	01 Feb. 2010							
	B	31 Aug.2009									
	C	24 Sep. 2009									
	D	26 Oct. 2009									
	E	13 Nov. 2009									

release of drawing	MITSUBISHI ELECTRIC CORPORATION., JAPAN			
	DRAWN	CHECKED	APPROVED	DOCUMENT NO.
	H.Kusaka Apr., 21, 2008	Y. Fujimoto	Y. Fujimoto	JHAV431

81-7271-3

CHANGED

REV.	CONTENTS	DRAWN DATE	CHECKED	APPROVED
A	All pages were reviewed and modified.	H. Kusaka 27 Jun. 08	E. Fushimi	E. Fushimi
B	- According to PS Annex 3 Attachment, AF15-AF0 were added to detect the ATC failures. (p. 9, 10-1, 10-2) - According to MTRC's information, Destination code list and Station code list were updated. (p. 12, 13)	H. Kusaka 31 Aug. 09	Y. Fujimoto	Y. Fujimoto
C	- According to MTRC's information(e-mail on 24 Sep. 2009), fault name of AF4 and AF5 were changed.(p. 10-2)	H. Kusaka 24 Sep. 09	Y. Fujimoto	Y. Fujimoto
D	- According to MTRC's information(e-mail on 19 Oct. 2009), ATC failure code table were changed.(p. 10-2)	Y. Tanaka 26.Oct. 09	H. Kusaka	M. Takeyama
E	- According to MTRC's information(e-mail on 9 Nov. 2009), fault name of AF0 and AF1 were changed.(p. 10-2)	M. Iida 13.Nov. 09	H. Kusaka	Y. Fujimoto
F	- According to MTRC's information(e-mail on 26 Jan. 2010), fault name of AF3 was changed.(p. 10-2E) - The error in writing of station name was corrected from "TKS" to "LHP".(p. 13)	M. Iida 13.Nov. 09	H. Kusaka	M. Fujimoto

MITSUBISHI ELECTRIC CORPORATION., JAPAN

CHANGE								DOCUMENT NO.	
A	27 Jun. 08	C	24 Sep. 09	E	13 Nov. 09			JHAV431	2 /
B	31 Aug. 09	D	26 Oct. 09	F	01 Feb. 10				

81-7271-4

CONTENTS

NO.	TITLE	PAGE
1	Application	4
2	Configuration	4
3	Transmission Specification	5
	3.1 Physical Interface	5
	3.2 Package format	5
4	Data Explanation	7
	4.1 From TMS to ATC	7
	4.2 From ATC to TMS	9
5	Communication Procedure	14

1. Application

This document details the interface specification between TMS(Train Management System) and ATC(Automatic Train Control) system.

2. Configuration

The interface configuration is shown as follows.

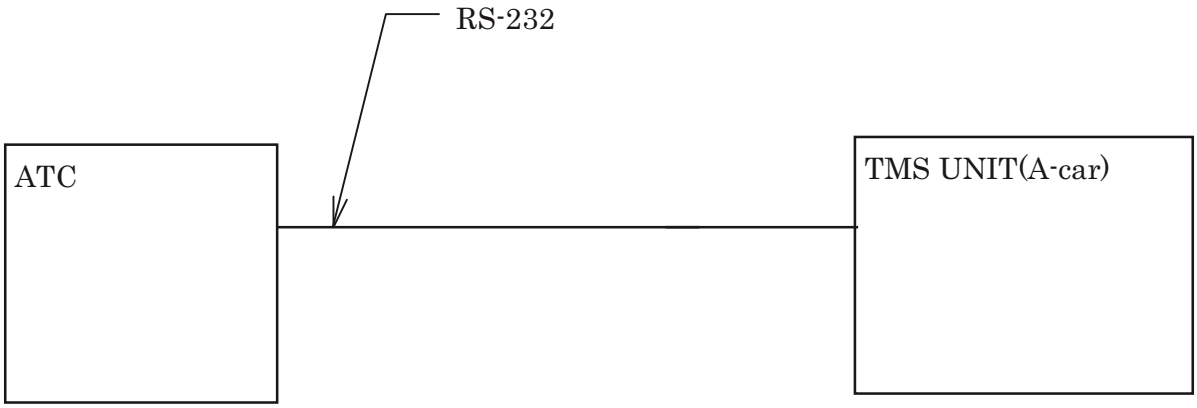


Fig. 2 Interface configuration between TMS and ATC

3. Transmission Specification

3.1 Physical Interface

(1) Wire	Shielded twisted cable (3 signals Tx, Rx and GND)
(2) Network topology	Point-to-point connection
(3) Transmission method	Asynchronous
(4) Protocol	Compliant with NF F 72010 standard
(5) Baud rate	9600 bps
(6) Transmission signal	RS-232C(full-duplex)
(7) Character format	Start bit : 1 bit Data bit : 7 bit Parity bit : 1 bit(Even parity) Stop bit : 1 bit

(8) The bits are sent from the LSB to the MSB

3.2 Package Format

(1) Message Structure

STX	Message Number	Repeat number	Useful Characters	LP	Number of Char 1	Number of Char 2	CR
Characters of service				Characters of service			

- STX : Start of message [STX = 02H]
- Message Number:
  ASCII Character from " 0" to " 3" means 30H, 31H, 32H or 33H.
  The first message starts at " 0".
  For a new message the value is increased by 1 modulo 4.
  The message is not increased when the message is repeated.
  The message is repeated when the ACK character is not replied within the acknowledge delay ΘA (maximum delay).
- Repeat Number:
  ASCII Character from " 1" to " 3" means 31H, 32H or 33H.
  The first message starts at " 1".
  For a repeated message the value is increased by 1 up to " 3".
  If the ACK message is not received the message is transmitted again with an increased repeat number.
  Maximum repeat number is 3.

The repetition delay is ΘA (maximum delay).

- Useful characters:
  DATA size (N) : from TMS to ATC : 7 useful characters
  : from ATC to TMS : 17 useful characters

- LP (Longitudinal parity):
  The longitudinal parity is a XOR of bytes of the message excluding STX, Parity (LP), the number of characters (Nb char) and CR.
  Bit 7 is set to 1.
  The XOR is applied to Message Number, Repeat number and the useful characters.

- Number of characters 1 & 2:
  The number of characters include all the characters from STX to LP.
  from TMS to ATC : 7+4 (0BH)
  Nb 1: 30H (“ 0”)
  Nb 2: 42H (“ B”)

  from ATC to TMS : 17+4 (15H)
  Nb 1: 31H (“ 1”)
  Nb 2: 35H (“ 5”)

- CR: End of message character: CR=0DH

The time delay STX to CR is within 200ms.

- ACK: Acknowledge character: ACK=06H
  The time delay from CR reception to ACK send is within 1 sec.

4. Data Explanation

4.1 From TMS to ATC

a) Data Structure (unoccupied cab)

Char.	Description	Bit number						
		7	6	5	4	3	2	1
1	Equipment failures	1	1	1	FC9	FC8	FC7	FC6
2		1	1	1	FC5	FC4	FC3	FC2
3		1	1	1	FC1	FC0	CT1	CT0
4		1	1	1	FN8	FN7	FN6	FN5
5		1	1	1	FN4	FN3	FN2	FN1
6		1	1	1	FN0	FS	FR	0
7	Fault identification	1	1	1	1	0	1	0

b) Code explanation

(1) Equipment failures

Equipment failures consists of the Fault car number, Fault car type, Fault number and Fault Set/Reset status.

- Fault car number(FC9 - FC0)

  This is 10 bit number with range of (0 to 1023) indicating car number the fault/event detected by the TMS.

- Fault car type(CT1 - CT0)

  This is a 2 bit number with range 0f (0 to 3) indicating the car type the fault/event detected by the TMS.

A-car : 0

B/B1-car : 1

C/C1-car: 2

- Fault number(FN8 to FN0)

This is a 9 bit number with range of (0 to 511) indicating fault number the fault/event detected by the TMS.

- Fault set/reset status(FS and FR)

This is a 2 bit data indicating the set/reset status of a fault.

A fault/event is detected : FS=1, FR=0

A fault/event is cleared : FS=0, FR=1

(4) Fault identification

The fault identification with fixed value(7AH) is set by the TMS.

4.2 From ATC to TMS

a) Data format (occupied cab)

Char.	Description		Bit number						
			7	6	5	4	3	2	1
1	Train Run Number	Destination code	1	1	1	D7	D6	D5	D4
2			1	1	1	D3	D2	D1	D0
3		Time table code	1	1	1	TT7	TT6	TT5	TT4
4			1	1	1	TT3	TT2	TT1	TT0
5		Train number	1	1	1	TN15	TN14	TN13	TN12
6			1	1	1	TN11	TN10	TN9	TN8
7			1	1	1	TN7	TN6	TN5	TN4
8			1	1	1	TN3	TN2	TN1	TN0
9	Station identification		1	1	1	L2	L1	L0	S4
10			1	1	1	S3	S2	S1	S0
11	Station characteristic		1	1	1	PS1	PS0	0	PT
12	System identification		1	1	1	NR3	NR2	NR1	NR0
13	Special message code		1	1	1	MC3	MC2	MC1	MC0
14	On board ATC		1	1	1	AF15 B ~~0~~	AF14	AF13	AF12
15	equipment failures		1	1	1	AF11	AF10	AF9	AF8
16			1	1	1	AF7	AF6	AF5	AF4
17			1	1	1	AF3	AF2	AF1	AF0

b) Code explanation

(1) Destination code(D7 to D0)

This is an alphabetical character in ASCII format. The meaning of the code are shown in Table 4.2.1.

(2) Time table code(TT7 to TT0)

Time table code is not used by TMS.

(3) Train number(TN15 to TN0)

This is a 16 bit code which consist of two numerical code in ASCII format.
TN0 to TN7 is the unit digit and TN8 to TN15 is tens digit.
The range of train number are shown in Table 4.2.1.

(4) Station identification

The station identification consists of the Station number and Line number .

- Station number(S4 - S0)

This is a 5 bit code indicating the next station to which the train travel or is traveling.
The station code is updated once the train depart from the station.
The meaning of the station number are shown in Table 4.2.2.

- Line number(L2 to L0)

This is a 3 bit code indicating the line the train is currently running.

Island line - up track : 1
Island line - down track : 2
Kwun Tong Line - up track : 3
Kwun Tong Line - down track : 4
Tsuen Wan Line - up track : 5
Tsuen Wan Line - down track : 6
Tseung Kwan O Line - up track : 7
Tseung Kwan O Line - down track : 0

(5) Station characteristics

The station characteristics consists of the Platform side and Platform screen door.
These data is set to "0" once the train start from station, and is set to correct status before the train enter the next station.

- Platform side(PS1 and PS0)

This is a 2 bit code indicating the platform side in the next station.

Undefined : PS1=0, PS0=0
Left side : PS1=1, PS0=0
Right side : PS1=0, PS0=1
Both left and right : PS1=1, PS0=1

- Platform screen door(PT)

Platform screen door is not used by the TMS.

(6) System Identification (NR3, NR2, NR1, NR0)

The 4 bits are used in conjunction with line number (5 bits) to represent expansion possibilities.

(7) Special message code (MC0,MC1,MC2,MC3)

The Special message code is used for change operation and driverless turnaround operation.
TMS transmits this code to DVAS.

(8) On board ATC equipment failures

TMS is B ~~not~~ required to store and display these fault codes.

[Remark]

For sending DTO message,
Char.1 to 12 = [70H]
Char.13 = [71H]

For sending other PA message,
Char.1 to 12 = [contents as demanded]
Char.13 = [70H]

B This page added.

Table 4.20 ATC failure code table

CODE	Failure abbreviation	Failure meaning	Level	Remarks
AF0	AF0	ATC is halt ~~ATC PCE Failure~~	1 ~~3~~	SACEM COMPUTER LOCKED UP E ~~PCE_FAILURE~~
AF1	AF1	ATC is delocalized ~~ATC PS Failure~~	1 ~~3~~	SACEM DELOCALIZED E ~~PAV_PS_FAILURE~~
AF2	AF2	PSD Failed to Open ~~ATC Fallback Failure~~	1 ~~3~~	PSD FAILED TO OPEN ~~PAV_FB_FAILURE~~
AF3	AF3	PSD Closed F ~~PSD Opened~~ ~~ATC RC Failure~~	3	PSD CLOSED F ~~PSD OPENED~~ D ~~PAV_RC_FAILURE~~
AF4	AF4	~~ATC Odometer 4A Failure~~	~~3~~	~~ODO_3A C 4A_FAILURE~~
AF5	AF5	~~ATC Odometer 3B Failure~~	~~3~~	~~ODO_4B C 3B_FAILURE~~
AF6	AF6	~~ATC CT Sensors Failure~~	~~3~~	~~CT_SENSOR_FAILURE~~
AF7	AF7	~~ATC Antenna Failure~~	~~3~~	~~ANTENNA_FAILURE~~
AF8	AF8	~~Speedometer Failure~~	~~3~~	~~SPEEDO_FAILURE~~
AF9	AF9	~~ATC Indicator Failure~~	~~3~~	~~LAMP_FAILURE~~
AF10	AF10	~~SACEM Localisation Fault~~	~~3~~	~~SACEM_LOC_FAULT~~
AF11	AF11	~~ATC EB Fault~~	~~3~~	~~EB_FAULT~~
AF12	AF12	~~PSD Fault~~	~~3~~	~~PSD_FAULT~~
AF13	AF13	~~DTO Fault~~	~~3~~	~~DTO_FAULT~~
AF14		(Speed signal for DVAS only)	N.A.	COMPLETE_STOP
AF15		(Spare)		D

Table 4.2.1 Train number / Destination code table

LINE	TRAIN No. RANGE	TRACK	DESTINATION CODE		
			MEANING	CHAR.	CODE
Kwun Tong Line (KTL)	01 - 39	Up track	Choi Hung reversing	E	45H
			Choi Hung for Depot	K	4BH
			Kwun Tong Centre Siding	Y	59H
			QUB Reversing	Q	51H
			Kwun Tong Reversing	F	46H
			Shek Kip Mei Revering	M	4DH
			North Point reversing	V	56H
			Tiu Keng Leng reversing	G	47H
		Down track	KBD South End	H	48H
			CHH for Depot	J	4AH
			Shek Kip Mei Reversing	L	4CH
			Yau Ma Tei Reversing	N	4EH
			Yau Ma Tei Siding	O	4FH
			Kwun Tong for South End	X	58H
Tsuen Wan Line (TWL)	31 - 79	Up track	Tsim Sha Tsui Reversing	D	44H
			Tsuen Wan Reversing	R	52H
			Tsuen Wan for Depot	S	53H
			Kwai Hing Reversing	T	54H
			Lai King Reversing	U	55H
			Mei Foo for Siding	W	57H
		Down track	Central Reversing	A	41H
			Admiralty or Siding	B	42H
			Tsim Sha Tsui Reversing	C	43H
			Kwai Hing Reversing	G	47H
			Lai King Reversing	P	50H
			Yau Ma Tei Reversing	N	4EH
			Yau Ma Tei for lower level Siding	O	4FH
Island line (ISL)	11 - 49	Up track	Admiralty for Siding	Q	51H
			Causeway Bay Reversing	O	4FH
			Tai Koo Reversing	M	4DH
			Shau Kei Wan for Depot	E	45H
			Heng Fa Chuen Reversing	G	47H
			Chai Wan Reversing	H	48H
		Down track	Depot East End	R	52H
			Tai Koo for Siding	A	41H
			Causeway Bay Reversing	F	46H
			Admiralty for Siding	B	42H
			Sheung Wan Reversing	J	4AH
			Heng Fa Chuen for Depot	K	4BH
			Wan Chai Reversing	P	50H

Table 4.2.1 Train number / Destination code table

LINE	TRAIN No. RANGE	TRACK	DESTINATION CODE		
			MEANING	CHAR.	CODE
Tseung Kwan O line (TKL)		Up track	Yau Tong reversing	I	49H
			Tseung Kwan O reversing	C	43H
			Lohas Park (LHP) reversing B ~~Tseung Kwan O south reversing~~	P	50H
			Po Lam reversing	J	4AH
			Tseung Kwan O Depot	D	44H
			B Po Lam for Depot	A	41H
			B Lohas Park (LHP) for Depot	B	42H
		Down track	Tseung Kwan O reversing	W	57H
			Tiu Keng Leng reversing	Z	5AH
			North Point reversing	V	56H
			Tseung Kwan O Depot via shunt neck	S	53H
Special/ Engineer's Train	80 - 96	-	-	-	-

Table 4.2.2 Station number table

No.	Station number	Line - Track							
		ISL Up	ISL down	KTL up	KTL Down	TWL Up	TWL Down	TKL Up	TKL down
1	01	CEN	HFC	MOK	LAT	ADM	TWH	NOP	~~TKS~~ F LHP
2	02	ADM	SKW	PRE	KWT	ADM_PLT	KWH	QUB	POA
3	03	ADM_PLT	SWH	SKM	NTK	TST	KWF	YAT	HAH
4	04	WAC	TAK	KOT	KOB	JOR	LAK	TIK	HAH_PLT
5	05	CAB	QUB	LOF	CHH	YMT	MEF	TKO	TKO
6	06	TIH	NOP	WTS	DIH	MOK	LCK	HAH	TIK
7	07	FOH	FOH	DIH	WTS	PRE	CSW	HAH_PLT	YAT
8	08	NOP	TIH	CHH	LOF	SSP	SSP	POA	QUB
9	09	QUB	CAB	KOB	KOT	CSW	PRE	POA_PLT	NOP
10	0A	TAK	WAC	NTK	SKM	LCK	MOK	~~TKS~~ F LHP	NOP_PLT
11	0B	SWH	ADM	KWT	PRE	MEF	YMT	LHP_PLT F ~~TKS_PLT~~	NOP_SDG
12	0C	SKW	ADM_PLT	LAT	MOK	LAK	JOR	BHT_SDG	BHT_SDG
13	0D	HFC	CEN	QUB	YMT	KWF	TST	YAT_PLT	TKO rev
14	0E	CHW	SHW	QUB_PLT	YMT_PLT	KWH	ADM	TKO rev	TIK rev
15	0F	CHW_PLT	SHW_PLT	YMT	QUB	TWH	ADM_PLT	TIK rev	POA_SDG
16	10	SHW	CHW	KOT rev	PRE rev	TSW	CEN	NOP rev	DEP_DN
17	11	ADM rev	WAC rev	CHH rev	-	TSW_PLT	CEN_PLT	NOP_SDG	LHP rev F ~~TKS rev~~
18	12	CAB rev	HFC rev	KWT rev	CHH rev	CEN	TSW	DEP_UP	TIK_PLT
19	13	TAK rev	QUB rev	LAT rev	CHH cen	JOR rev	KWH rev	DEP_SN	
20	14	CHW rev		CHH cen	YMT rev	LAK rev	MEF rev	TKO_PLT tks	
21	15			TTT	TTT	MEF rev	TST rev	TKO_PLT hah	
22	16			SKM rev	NOP		CEN rev	LHP rev F ~~TKS rev~~	
23	17			NOP	NOP_rev		TSW rev	TKO tks	
24	18			NOP_PLT	TIK		LAK rev	DVAS	
25	19			YAT	YAT				
26	1A			TIK	YAT_PLT				
27	1B			TIK_SDG	NOP_SDG				
28	1C			NOP_SDG					
29	1D			TIK_PLT					
30	1E								
31	1F								

B

5. Communication Procedure

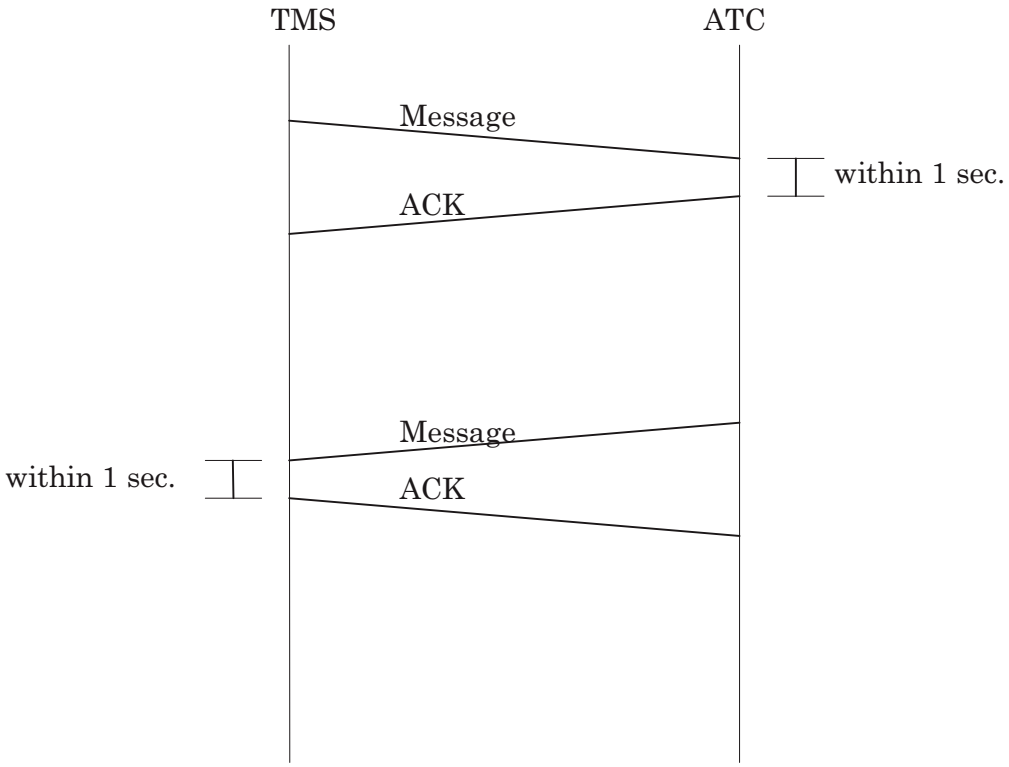


Fig. 5.1 Transmission timing(normal case)

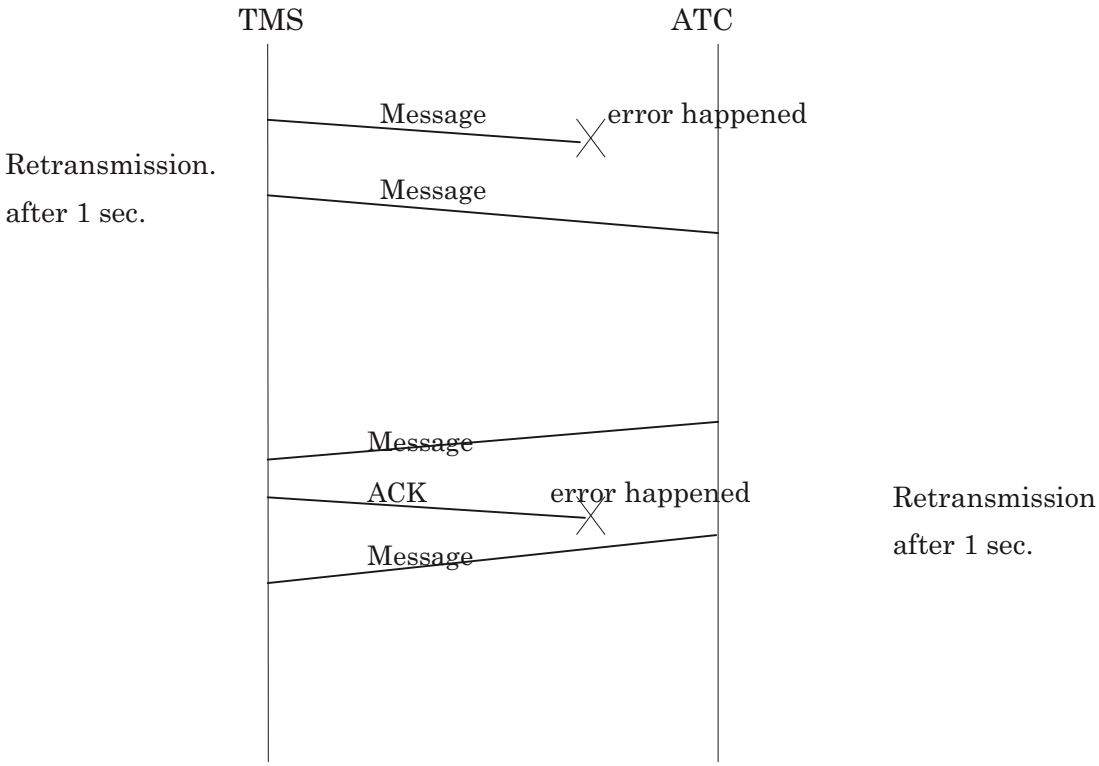


Fig. 5.2 Transmission timing(error case)

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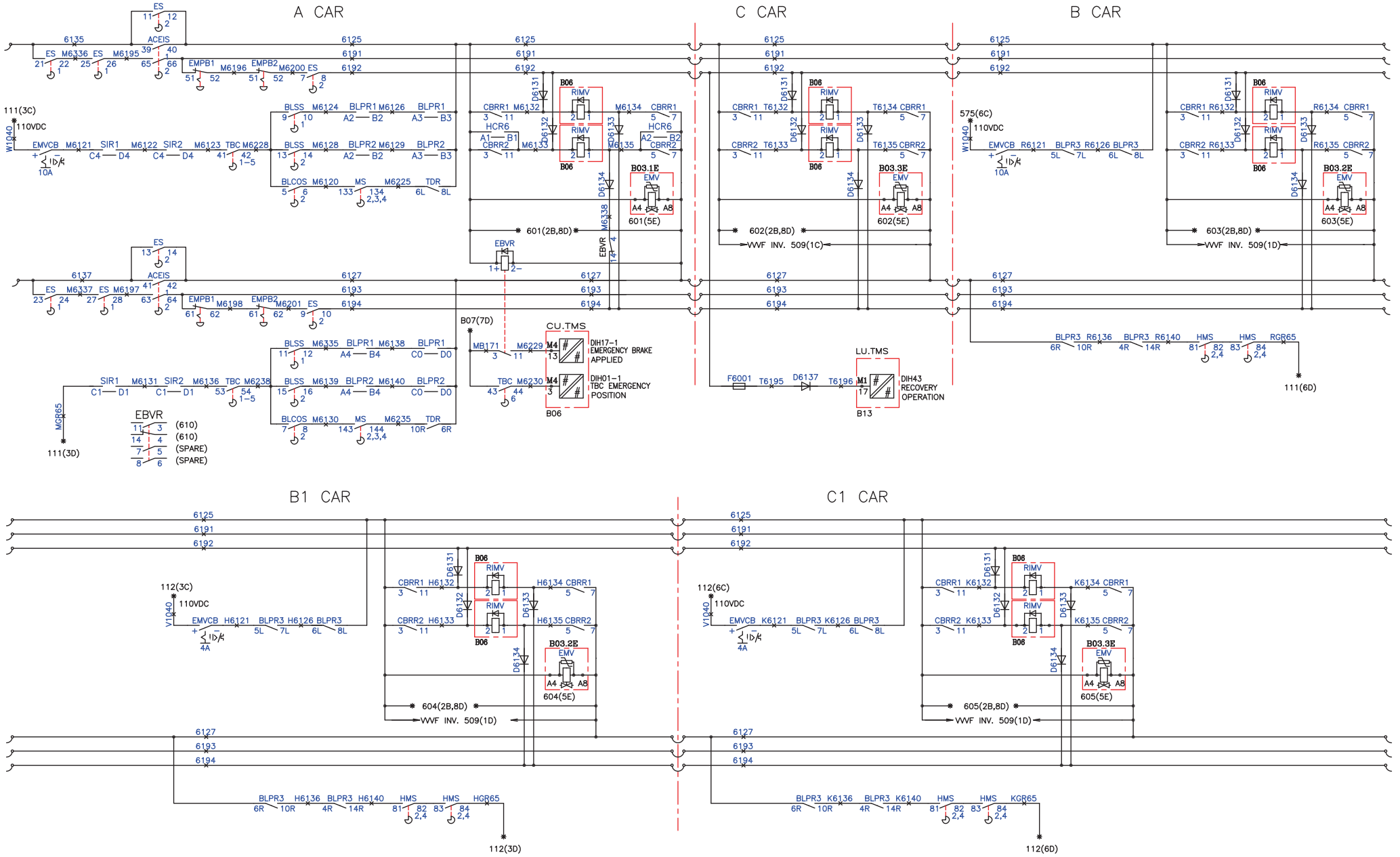
CHANGE	DOCUMENT NO.	
	JHAV431	15 / 15

DETAILED INTERFACE SPECIFICATION

ANNEX C17
EMERGENCY BRAKE CIRCUIT



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

DESIGNED	ZhouYong	2010-04-15	STANDARD	Zhang	2010-05-10	TITLE
CHECK	LIEnlong	2010-04-25				EMERGENCY VALVE A,C,B,B1,C1 CAR
			CHIEF ENGINEER	MaYanbo	2010-05-16	
DIRECTOR	ZhouYong	2010-04-30				
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28	

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-610	A

DETAILED INTERFACE SPECIFICATION

ANNEX C18
SAFETY INTERLOCK CIRCUIT

DRAWING NO. DKZ28-00-00-000DY-615 VERSION B

A CAR C CAR

111(3C)
110VDC
W1040 EMPB1 31 32 M6102 EMPB2 31 32 M6103 BSR 5 7 B M6104 SCOS 5 6 3 W6105
DSD B
ATC EBR2 A1 A2 C14 M6125 EBR2 A3 A4 M6109 SCOS 9 10 2
ATC DTO_SR 09JX3-24 C14 09JX3-23
MS 113 114 2,4,5,6 M6107 SIR1 A3 B3 W6108 SIR2 A0 B0
W6106
MS 12a 12b 2,4 M6110 TBC 83 84 6 M6111
B36 BCPS 3 4 1 1 2 2 M6112 SCOS 7 8 3 W6113
CU. TMS B M5 12 # # SET SIR B06
W6108
ATC DTO_MSS 09JX3-41 09JX3-42 C14
ATC ZVR2 A1 A2 C14 M6123 ZVR2 A3 A4 SCOS 15 16 3
CU. TMS M5 14 SAFETY INTERLOCK RELAY 2 B06
SIR1 A4 B4 M6114 SIR2 A4 B4 M6116
ATC ZVR1 A1 A2 C14 M6922 ZVR1 A3 A4
6 4 1 4 5 2 P 2bar 1bar 601(4E)
ATC EBR1 A1 A2 C14 M6124 EBR1 A3 A4 M6119 SIR2 A3 B3 M6118 SCOS 17 18 2 M6117 SIR1 A0 B0 MGR64
CU. TMS M5 13 SAFETY INTERLOCK RELAY 1 B06
W1040 TBC 63 64 5,6 M6921 B BSR A1 A2
111(3D)

VVVF INVERTER
W6105 6105 TOSR
W6106 6106
W6113 6113 TZVR
W6108 6108
509

B07
CU. TMS
MB171 SCOS 11 12 1 M6006 M4 40 # # SAFETY CUTOUT (RESET)
M6007 19 20 2 M4 41 # # SAFETY CUTOUT (NORMAL)
M6009 23 24 3 M4 43 # # SAFETY CUTOUT (TRACTION FALL BACK)
EMPB1 43 44
EMPB2 43 44 M6115 M5 2 # # EMERGENCY PUSHBUTTON
B07

SIR1
A1 B1 (401)
A2 B2 (501)
A3 B3 (615)
A4 B4 (615)
C0 D0 (106) B
C1 D1 (610)
C2 D2 (C14)
C3 D3 (508)
C4 D4 (610) B

SIR2
A1 B1 (401)
A2 B2 (501)
A3 B3 (615)
A4 B4 (615)
C0 D0 (106) B
C1 D1 (610)
C2 D2 (C14)
C3 D3 (508)
C4 D4 (610) B

BSR
11 3 (807)
12 4 (808)
7 5 (615)
8 6 (SPARE)

SCOS
1=RESET
2=NORMAL
3=TRACTION FALL BACK

MS
1=SHUT DOWN
2=REVERSE
3=STANBY
4=FORWARD
5=CODED MANUAL
6=AUTO

TBC
1=FULL MOTORING
2=LIMITED MOTORING
3=COASTING
4=MINIMUM BRAKING
5=FULL SERVICE BRAKING
6=EMERGENCY

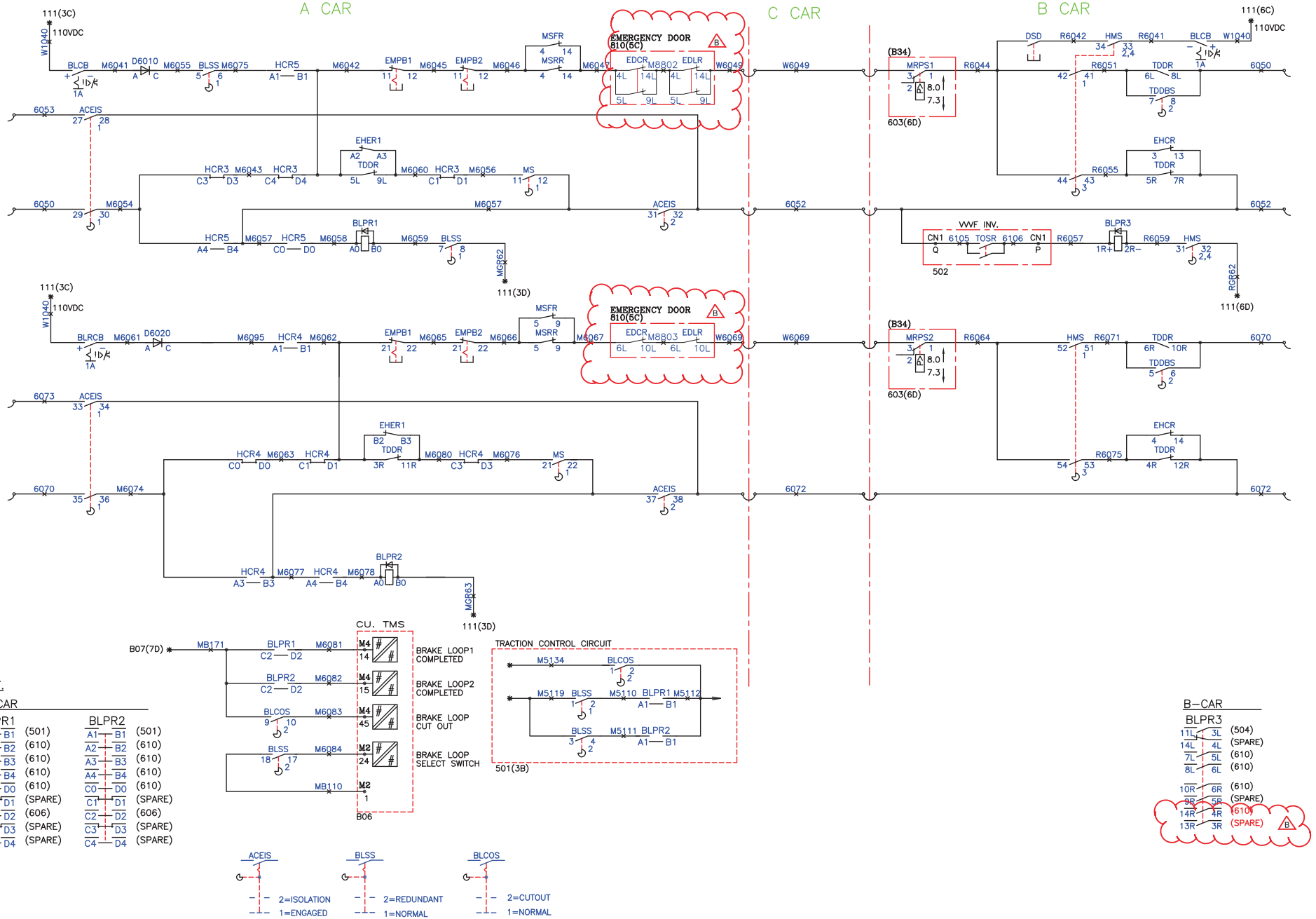
REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Remove DSD Time Delay Function	ZHOUYONG 2010-09-05	LIENLONG 2010-09-07	MAYANBO 2010-09-09

DESIGNED	ZhouYong	2010-04-20	STANDARD	Zhang	2010-05-10	TITLE
CHECK	LIEnlong	2010-04-25				SAFETY PROVING A, C CAR
			CHIEF ENGINEER	MaYanbo	2010-05-16	
DIRECTOR	ZhouYong	2010-04-30				
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28	

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-615	B

DETAILED INTERFACE SPECIFICATION

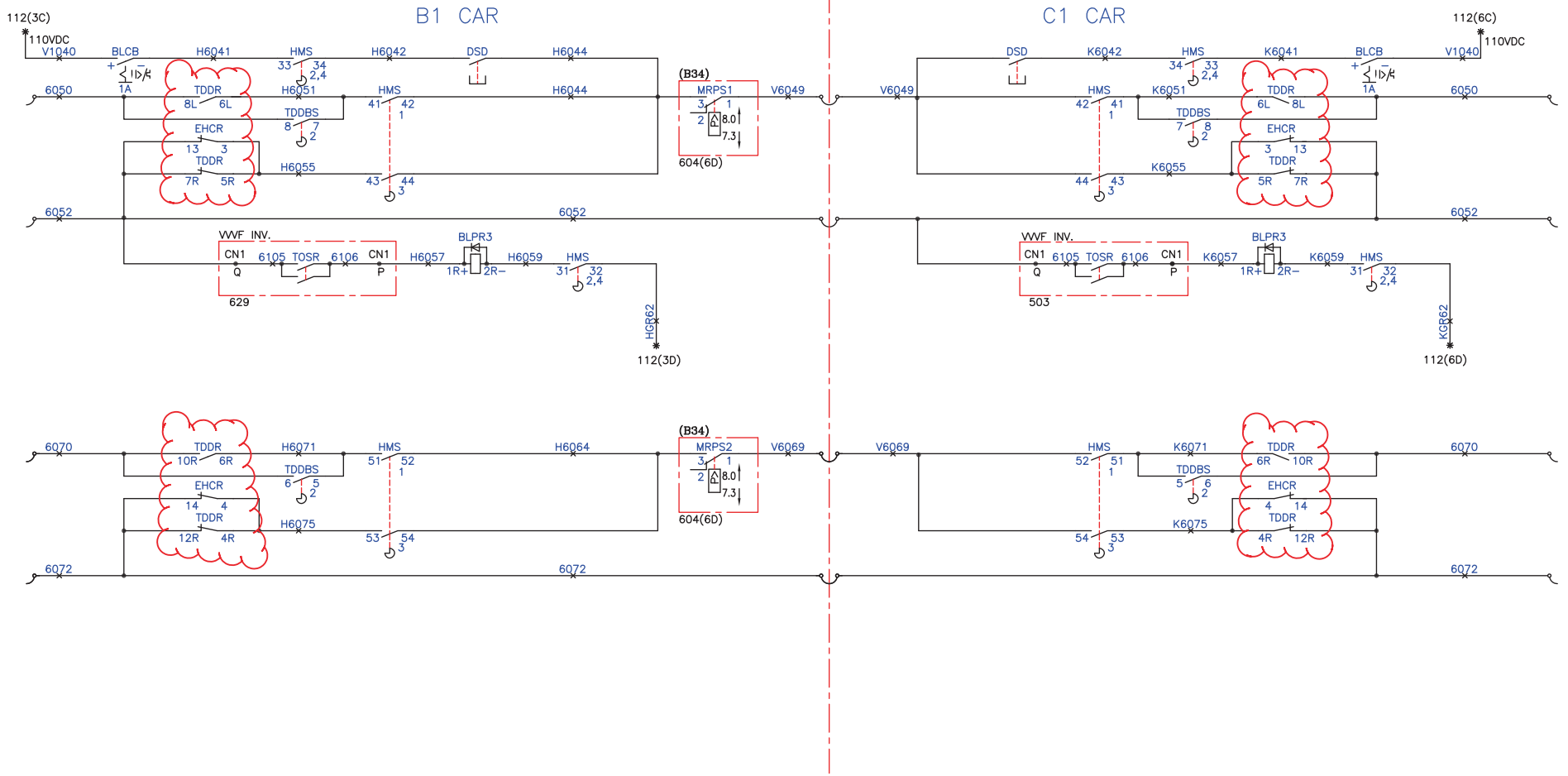
ANNEX C19
BRAKE CIRCUIT



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Revise emergency door contacts	ZHOUYONG 2010-07-13	YINHANG 2010-07-14	MAYANBO 2010-07-15

DESIGNED	ZhouYong	2010-04-15	STANDARD	Zhang	2010-05-10	TITLE
CHECK	LIEnlong	2010-04-25				BRAKE LOOP A,C,B CAR
			CHIEF ENGINEER	MaYanbo	2010-05-16	
DIRECTOR	ZhouYong	2010-04-30				
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28	

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-606	B



REF.

B1—CAR

BLPR3

11L	3L	(504)
14L	4L	(SPARE)
7L	5L	(610)
8L	6L	(610)
10R	6R	(610)
9R	5R	(SPARE)
12R	4R	(610)
13R	3R	(SPARE)

C1—CAR

BLPR3

11L	3L	(505)
14L	4L	(SPARE)
7L	5L	(610)
8L	6L	(610)
10R	6R	(610)
9R	5R	(SPARE)
14R	4R	(610)
13R	3R	(SPARE)

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

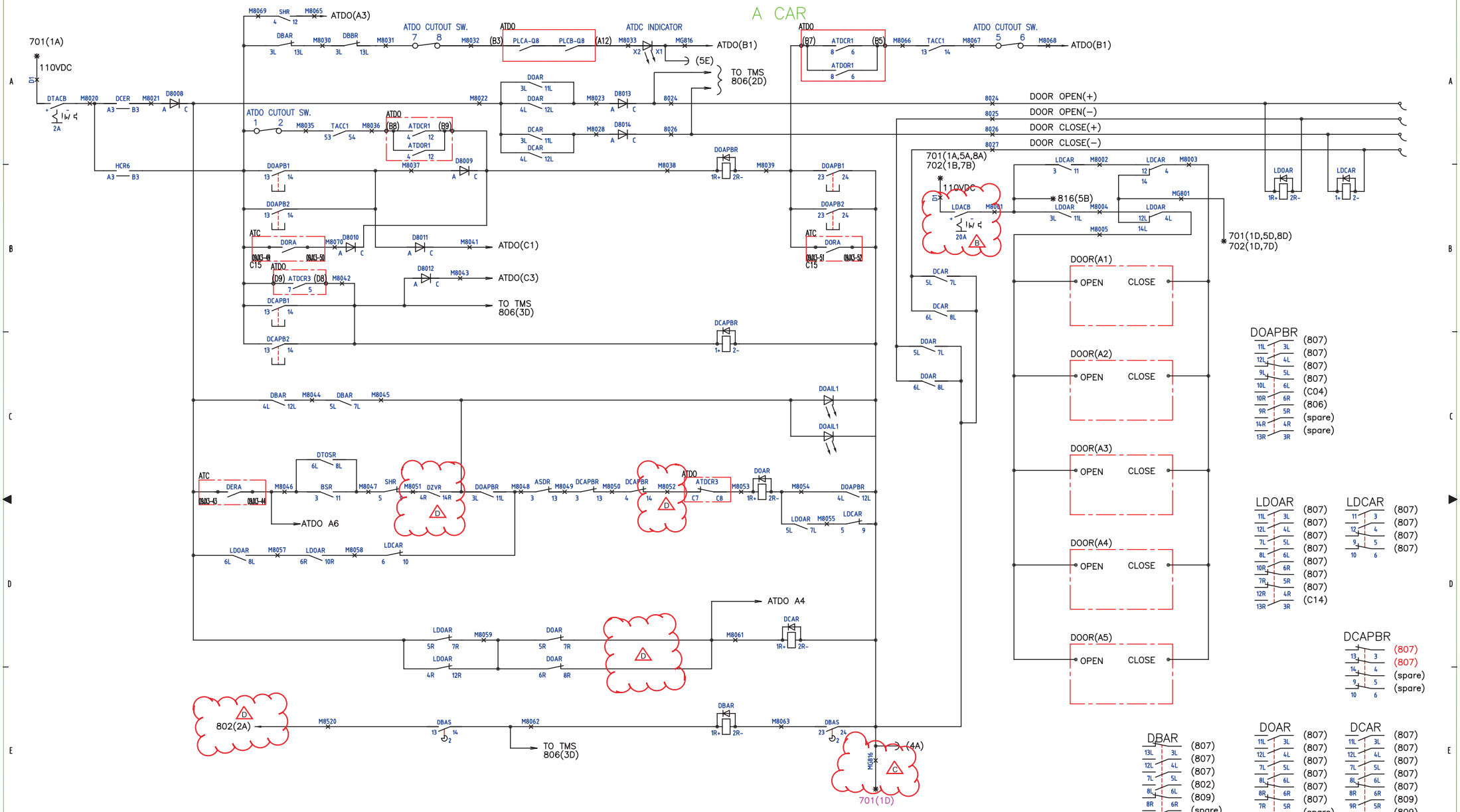
REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

DESIGNED	ZhouYong	2010-04-15	STANDARD	Zhang	2010-05-10	TITLE
CHECK	LIEnlong	2010-04-25				BRAKE LOOP B1,C1 CAR
			CHIEF ENGINEER	MaYanbo	2010-05-16	
DIRECTOR	ZhouYong	2010-04-30				
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28	

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-607	A

DETAILED INTERFACE SPECIFICATION

ANNEX C20
DOOR CONTROL CIRCUIT



NOTES:

1. WIRING NUMBER SHOWN AS "ATDO(A1)" DENOTES THE WIRING CONNECTED TO THE CONTACT PIN OF ATDO BOX.
2. STATUS OF ATDO CUTOUT SWITCH SHOWN AT "NORMAL" POSITION

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Change LDACB from 16A to 20A	ZHOUYONG 2010-07-13	YIMIANG 2010-07-14	MAYANBO 2010-07-15
C	Change Wiring No. MGR80 to MG816	ZHOUYONG 2010-11-05	YIMIANG 2010-11-06	MAYANBO 2010-11-08
D	Remove DOAPBR Contacts:5L&9L,6L&10L			
	Remove DCAR contacts:6R&8R.Add DZVR contact:4R&14R	ZHOUYONG 2011-02-02	YIMIANG 2011-02-02	MAYANBO 2011-02-03

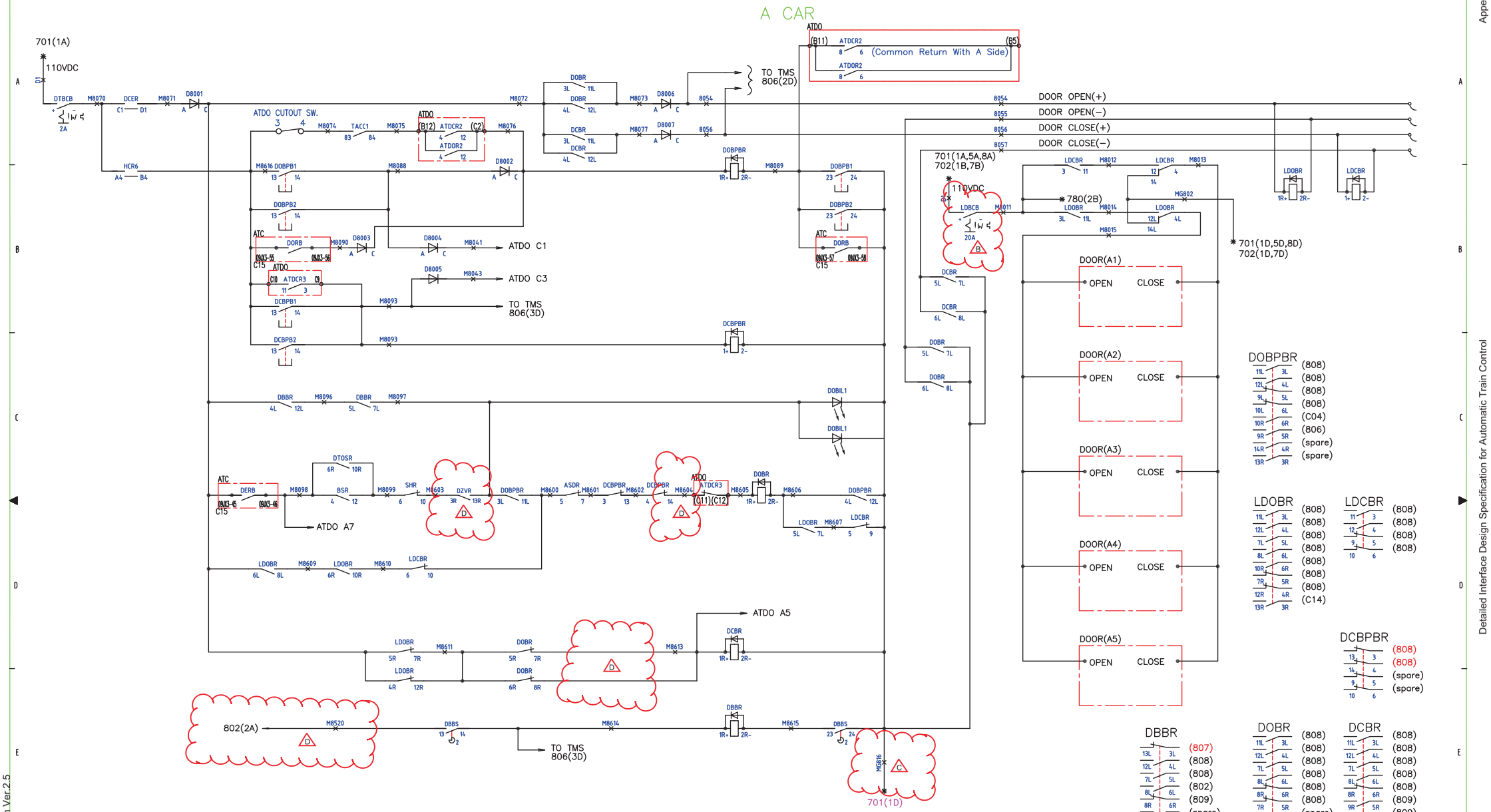
DESIGNED	ZhouYong	2010-04-21	STANDARD	Zhang	2010-05-10	
CHECK	LIEnlong	2010-04-25				
			CHIEF ENGINEER	MaYanbo	2010-05-16	
DIRECTOR	ZhouYong	2010-04-30				
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28	

TITLE: DOOR OPERATION A SIDE A CAR

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-807	D

Appendix 3 Detailed Interface Specification Ver.2.5

Appendix 3 Detailed Interface Design Specification for Automatic Train Control



NOTES:

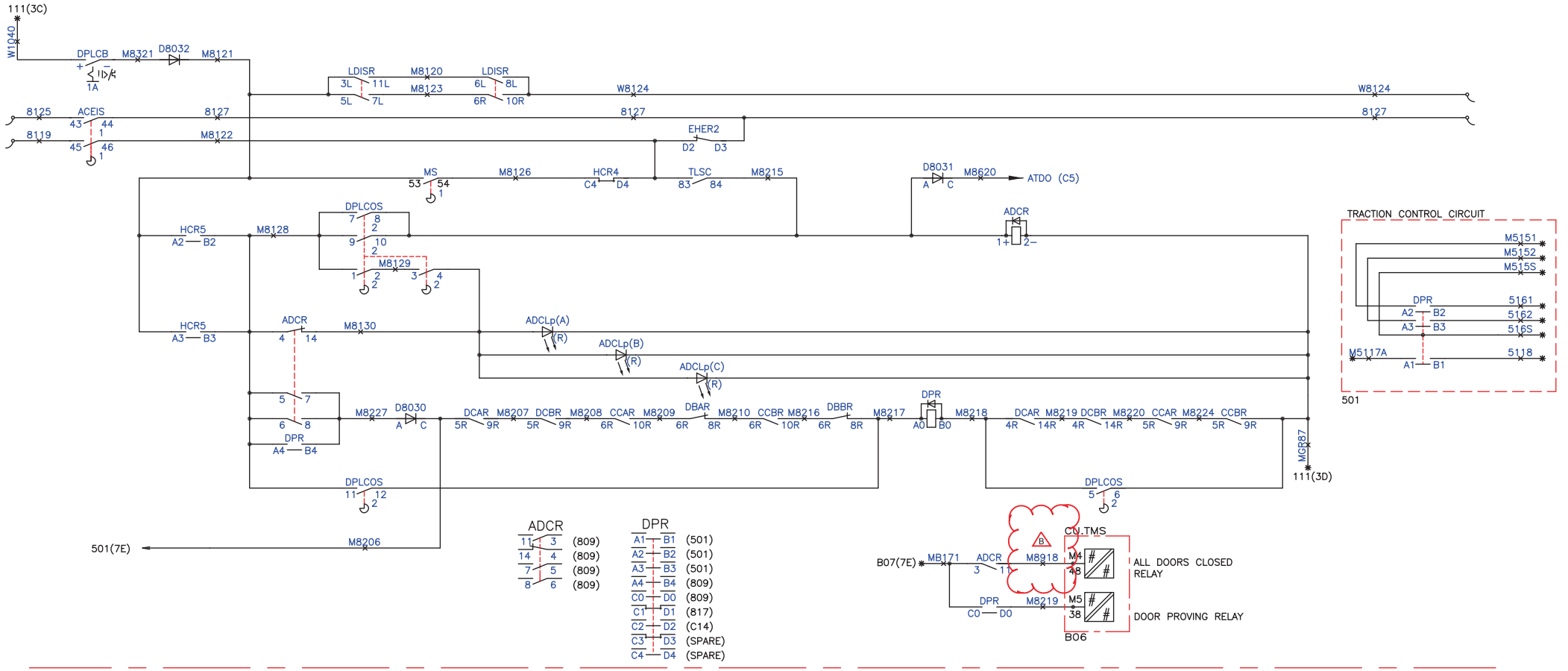
WIRING NUMBER SHOWN AS "ATDO(A1)" DENOTES THE WIRING CONNECTED TO THE CONTACT PIN OF ATDO BOX.

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Change LDACB from 16A to 20A	ZHOUYONG 2010-07-13	YINHANG 2010-07-14	MAYANBO 2010-07-15
C	Change Wiring No. MGR81 to MG816	ZHOUYONG 2010-11-05	YINHANG 2010-11-06	MAYANBO 2010-11-08
D	Remove DOBPBR Contacts:5L&9L,6L&10L			
	Remove DCBR contacts:6R&8R.Add DZVR contact:3R&13R	ZHOUYONG 2011-02-02	YINHANG 2011-02-02	MAYANBO 2011-02-03

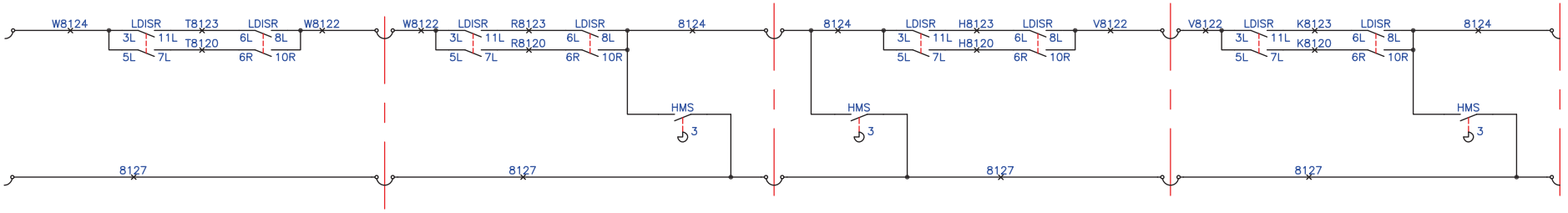
DESIGNED	ZhouYong	2010-04-21	STANDARD	Zhang	2010-05-10	TITLE
CHECK	LIEnlong	2010-04-25				DOOR OPERATION B SIDE A CAR
			CHIEF ENGINEER	MaYanbo	2010-05-16	
DIRECTOR	ZhouYong	2010-04-30				
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28	

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-808	D

A CAR



C CAR



B CAR

B1 CAR

C1 CAR

NOTES:
1. WIRE NUMBER SHOWN AS "ATDO(A1)" DENOTES THE WIRING CONNECTED TO THE CONTACT PIN OF ATDO BOX.

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Change wiring No. 8218 TO 8918	ZHOUYONG 2010-07-13	YINHANG 2010-07-14	MAYANBO 2010-07-15

DESIGNED	ZhouYong	2010-04-15	STANDARD	Zhang	2010-05-10	TITLE: DOOR LOOP A,C,B,B1,C1 CAR
CHECK	LIEnlong	2010-04-25				
			CHIEF ENGINEER	MaYanbo	2010-05-16	
DIRECTOR	ZhouYong	2010-04-30				
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28	

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-809	B

DRAWING NO. DKZ28-00-00-000DY-817 VERSION B

A CAR

C/B/B1/C1 CAR

701(1A)
110VDC
D1
ZVCCB
1A
M8350
DCER
A2 B2
M8351
D8044
A C

DPR C1 D1 M8362 DZVR 3L 11L DZVR MG816 A1 A2 701(1D)

ZVR1 M8361 B1 B2 ZVR1 M8361A B3 B4 ZVR2 M8361B B1 B2 ZVR2 M8363 B3 B4

M8352 DZVR 5L 7L M8353 DZVR 6L 8L

DBAR 4R 14R M8354 DBAR 3R 13R W8175 502(2C)

DBBR 4R 14R M8355 DBBR 3R 13R

DCER C3 D3

816(2B) Y8011 ZVR 12 4 14 YG802 Y8016

816(5B) Y8001 ZVR 11 3 13 YG801 Y8006

8174

8175

ZERO SPEED SIGNAL ZVR 1 2

B-CAR ONLY 502(5C)

DOOR(B1) DOOR(B2) DOOR(B3) DOOR(B4) DOOR(B5)

DOOR(A1) DOOR(A2) DOOR(A3) DOOR(A4) DOOR(A5)

MG816

701(1D)

ZVR
11 3 (817)
12 4 (817)
7 5 (817) B
8 6 (SPARE)

DZVR
11L 3L (817)
12L 4L (SPARE)
7L 5L (817)
8L 6L (817)
10R 6R (SPARE)
9R 5R (SPARE)
14R 4R (807) B
13R 3R (808)

Cu. TMS
M8360
ZVR 5 7
MB110
M2 38
M2 1
N24-1
B07
DOOR ZERO VELOCITY TRAINLINE

ZVR
11 3 (817)
12 4 (817)
7 5 (SPARE)
8 6 (SPARE)

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Change DZVR spare contacts:3R&13R(807) and 4R&14R(808)	ZHOUYONG 2011-02-02	LIENLONG 2011-02-02	MAYANBO 2011-02-03

DESIGNED	ZhouYong	2010-04-15	STANDARD	Zhang	2010-05-10
CHECK	LIEnlong	2010-04-25			
			CHIEF ENGINEER	MaYanbo	2010-05-16
DIRECTOR	ZhouYong	2010-04-30			
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28

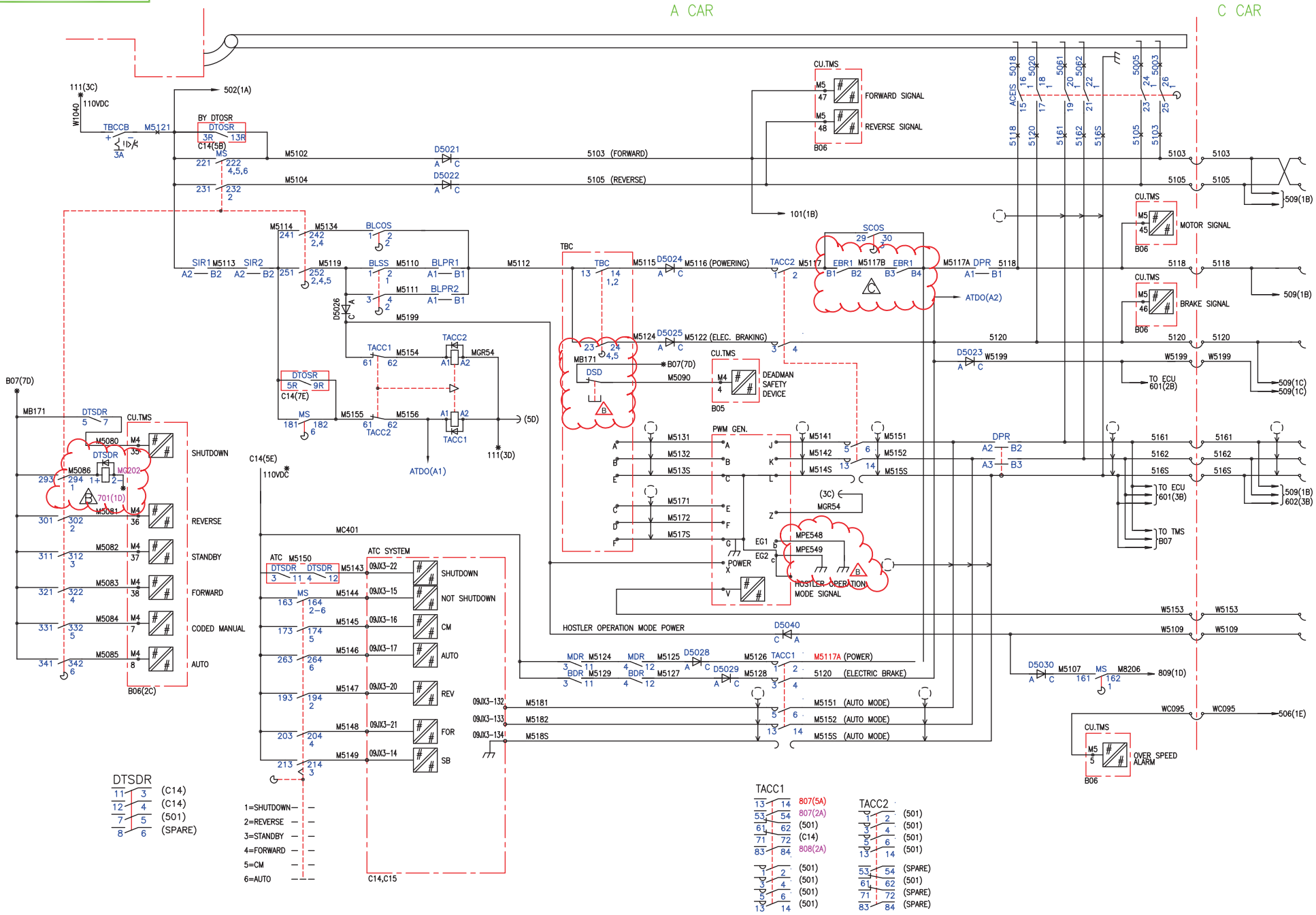
TITLE

ZERO SPEED SIGNAL A,C,B,B1,C1 CAR

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-817	B

DETAILED INTERFACE SPECIFICATION

ANNEX C21
CAB CONTROL CIRCUIT

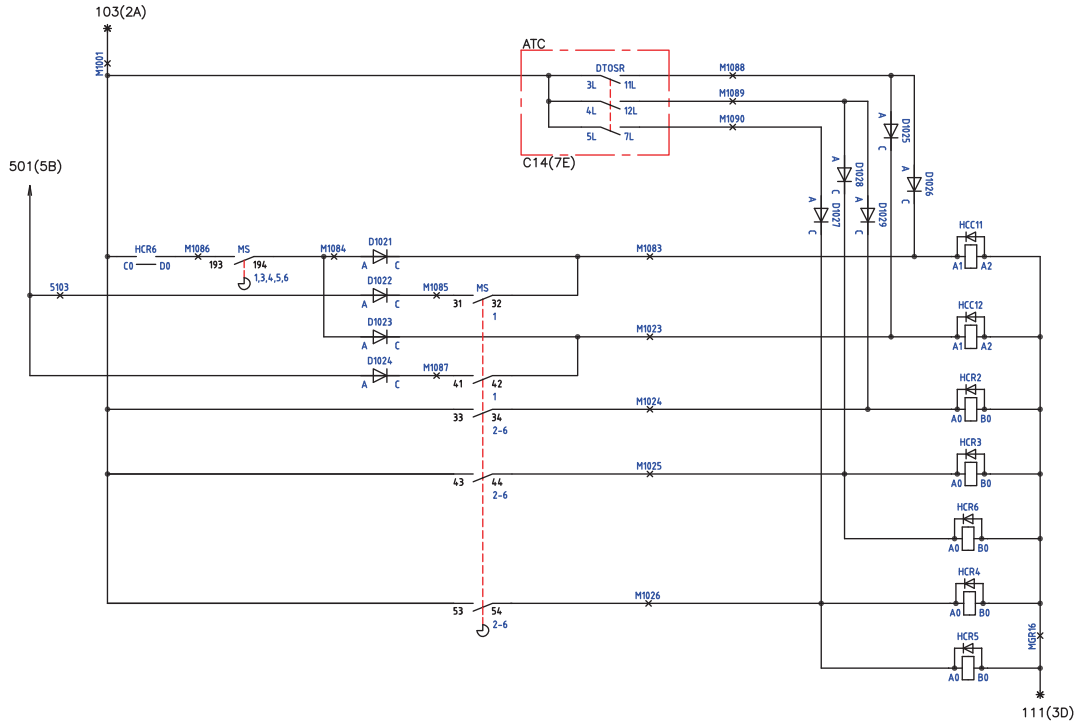


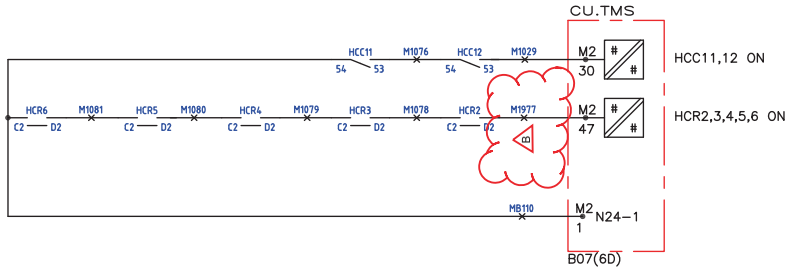
REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Change DTSDR Earthing	ZHOUYONG 2010-11-05	YINHANG 2010-11-06	MAYANBO 2010-11-08
C	Add EBR1 B1&B2 contact	ZHOUYONG 2011-02-16	LIENLONG 2011-02-16	MAYANBO 2011-02-17

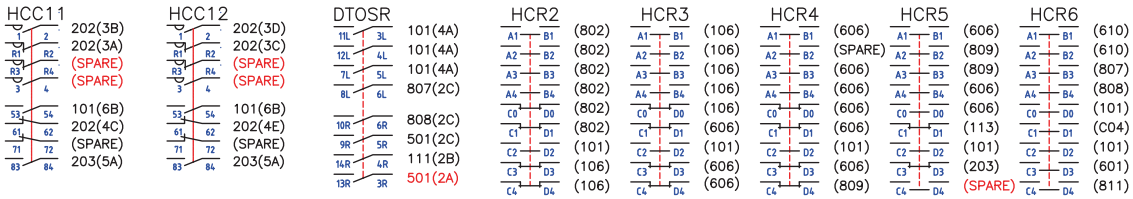
DESIGNED	ZhouYong	2010-03-17	STANDARD	Zhang	2010-05-10	TITLE
CHECK	LIEnlong	2010-04-25				DRIVING CAB OPERATION A,C CAR
			CHIEF ENGINEER	MaYanbo	2010-05-16	
DIRECTOR	ZhouYong	2010-04-30				
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28	

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-501	C

A CAR







REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Change Wiring No. M1077 to M1977	ZHOUYONG 2010-07-13	YINHANG 2010-07-14	MAYANBO 2010-07-15

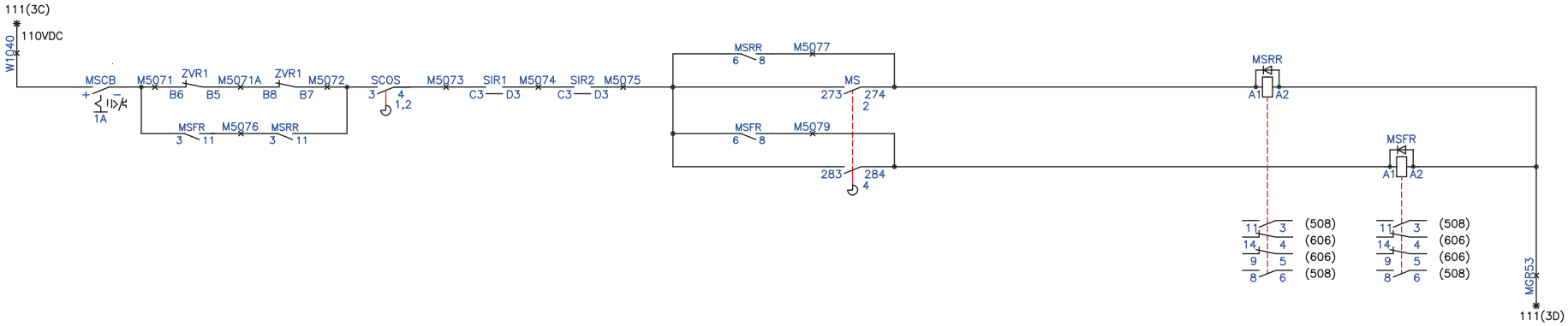
DESIGNED	ZhouYong	2010-04-18	STANDARD	Zhang	2010-05-10
CHECK	LIEnlong	2010-04-25			
			CHIEF ENGINEER	MaYanbo	2010-05-16
DIRECTOR	ZhouYong	2010-04-30			
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28

TITLE: CAB ACTIVATION(A CAR)

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-101	B

DRAWING NO. DKZ28-00-00-000DY-508 VERSION A

A CAR



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

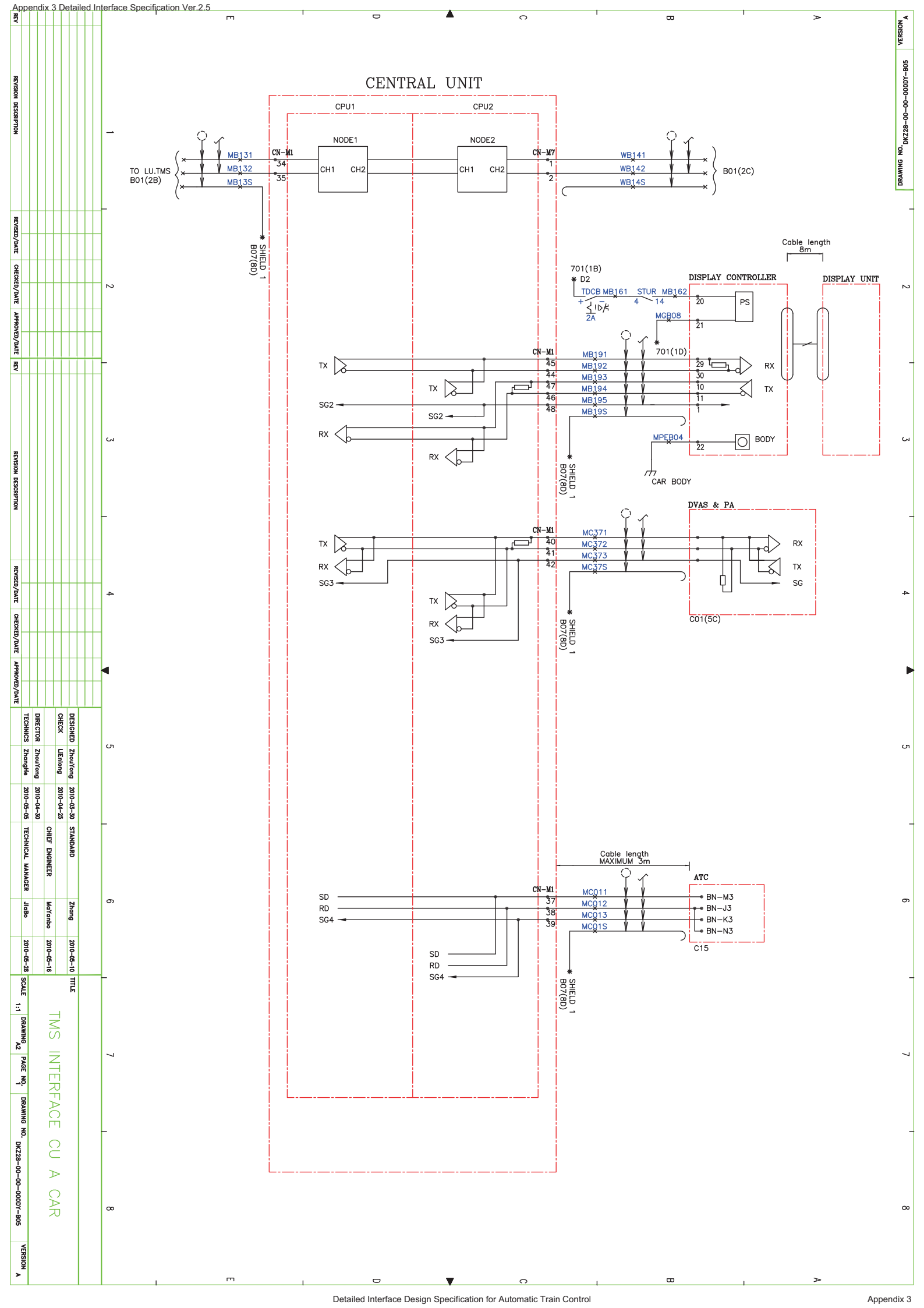
REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

DESIGNED	ZhouYong	2010-04-20	STANDARD	Zhang	2010-05-10	TITLE
CHECK	LIEnlong	2010-04-25				MODE CHANGE AT SPEED A CAR
			CHIEF ENGINEER	MaYanbo	2010-05-16	
DIRECTOR	ZhouYong	2010-04-30				
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28	

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-508	A

DETAILED INTERFACE SPECIFICATION

ANNEX C22
TMS CIRCUIT



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

DESIGNED	ZhouYong	2010-03-30	STANDARD	
CHECK	LiHong	2010-04-23		
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo
DIRECTOR	ZhouYong	2010-04-30	CHIEF ENGINEER	MaYanbo
				Zhang
		2010-05-16		2010-05-10

SCALE	1:1	TITLE	TMS INTERFACE CU A CAR	
DRAWING	A2			
PAGE NO.	1			
DRAWING NO.	DKZ28-00-00-0000Y-B05			
VERSION	A			

REV.	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Change wiring No. 8218 to 8918	ZHOUYONG 2010-04-15	LIEHONG 2010-04-14	ZHONG 2010-05-15

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

DESIGNED	ZhouYong	2010-04-15	STANDARD
CHECK	LiEnlong	2010-04-23	
TECHNICS	ZhongHe	2010-04-30	
DIRECTOR	ZhouYong	2010-05-05	CHIEF ENGINEER
TECHNICAL MANAGER	JiaBo	2010-05-28	MaYanbo 2010-05-16
			Zhong 2010-05-10

TITLE	TMS INTERFACE CU A CAR
SCALE	1:1
DRAWING	A2
PAGE NO.	1
DRAWING NO.	DKZ28-00-00-0000Y-B06
VERSION	B

VERSION	DRAWING NO.
B	DKZ28-00-00-0000Y-B06

DETAILED INTERFACE SPECIFICATION

ANNEX C23
CAB DOOR OPERATION A CAR

A CAR

701(1A)
110VDC
D1
CDCB
6A
M8520

807(2E)
808(2E)
803(5B)
803(5D)

CAB DOOR(A)
M8520 DC110V
M8531 OPEN
ZERO VELOCITY
M8532 CLOSE
MPE801 EARTHING
MG805
803(2B)

CCAPB M8524 COAPB
M8525 HCR2 M8526 CCAR M8527 CCAPB
HCR2
CDCATR
TTPOR
CCAR
CDCATR
HCR2 M8528
ON DELAY(10SEC)

LU.TMS
M1 23 B09
A-SIDE CAB DOOR CLOSE
M8546
LU.TMS
M1 39 B09
A-SIDE CAB DOOR OPEN
M8545

CU.TMS
M2 41 A-SIDE CAB DOOR CLOSE RELAY
M2 5 B-SIDE CAB DOOR CLOSE RELAY
M2 1
B07
CCAR M8398
CCBR M8399
MB110

DBBR
DBAR
ZVR1 M8550 ZVR1
STUR
M8551
D8050
COAPB M8521 CCAR M8522 COAR M8523 COAPB
COAR
COBPB M8533 CCBR M8534 COBR M8535 COBPB
COBR

CCBPB M8536 COBPB M8537 HCR2 M8538 CCBR M8539 CCBPB
HCR2
CDCBTR
TTPOR
CCBR
CDCBTR
HCR2 M8540
ON DELAY(10SEC)
MG805

LU.TMS
M1 41 B09
B-SIDE CAB DOOR CLOSE
M8548
LU.TMS
M1 24 B09
B-SIDE CAB DOOR OPEN
M8547

CAB DOOR(B)
M8520 DC110V
M8542 OPEN
ZERO VELOCITY
M8543 CLOSE
MPE802 EARTHING
MG805
803(2D)

0VDC
701(1D)
0VDC
701(1D)

COAR (802) (802) (802) (802)
COBR (802) (802) (802) (802)
CCAR (802) (802) (802) (809) (809) (802) (802)
CCBR (802) (802) (802) (809) (809) (802) (802)
CDCATR (802) (802) (802) (802)
CDCBTR (802) (802) (802) (802)

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Add Wiring No. 8550 between Two ZVR1 Contacts	ZHOUYONG 2010-12-15	LIENLONG 2010-12-17	MAYANBO 2010-12-18
C	Move Door Open Circuit in Series with ZVR1			
	Add CDCATR&CDCBTR,CCAR&CCBR Contacts in Parallel with HCR	ZHOUYONG 2011-01-06	LIENLONG 2011-01-09	MAYANBO 2011-01-10
D	Add M8520 to 807(2E) and 808(2E)	ZHOUYONG 2011-02-02	LIENLONG 2011-02-02	MAYANBO 2011-02-03

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

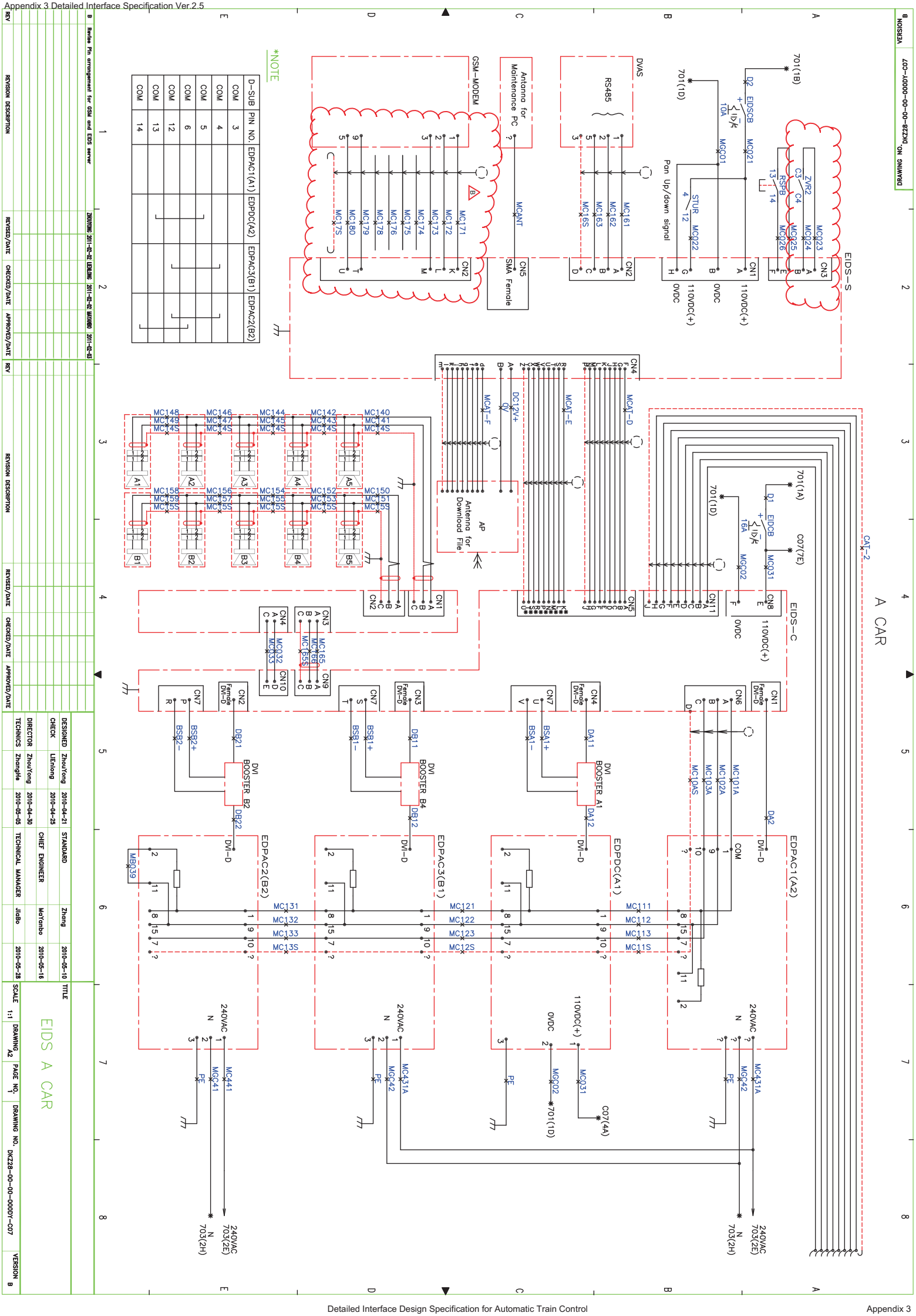
DESIGNED	ZhouYong	2010-04-15	STANDARD	Zhang	2010-05-10
CHECK	LIEnlong	2010-04-25			
			CHIEF ENGINEER	MaYanbo	2010-05-16
DIRECTOR	ZhouYong	2010-04-30			
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28

TITLE: CAB DOOR OPERATION A CAR

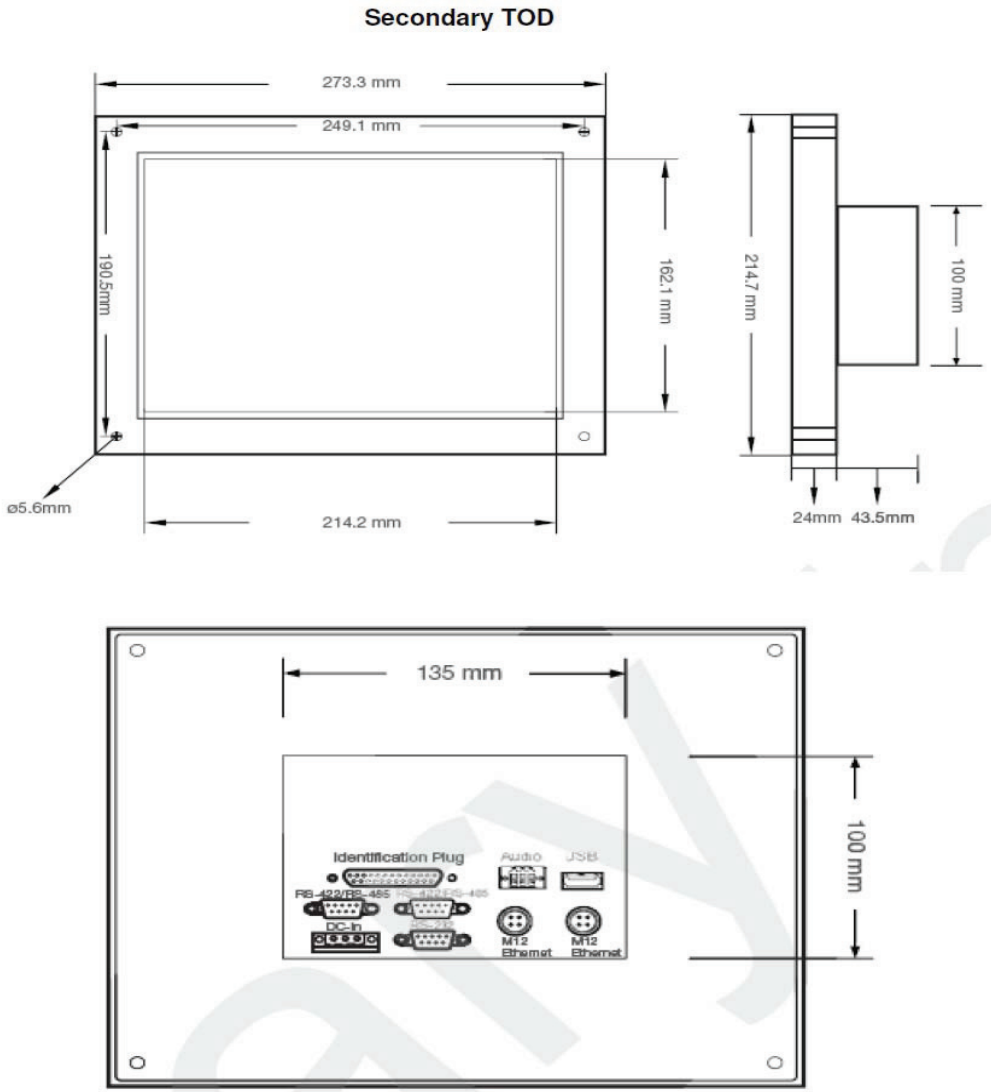
SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-802	D

DETAILED INTERFACE SPECIFICATION

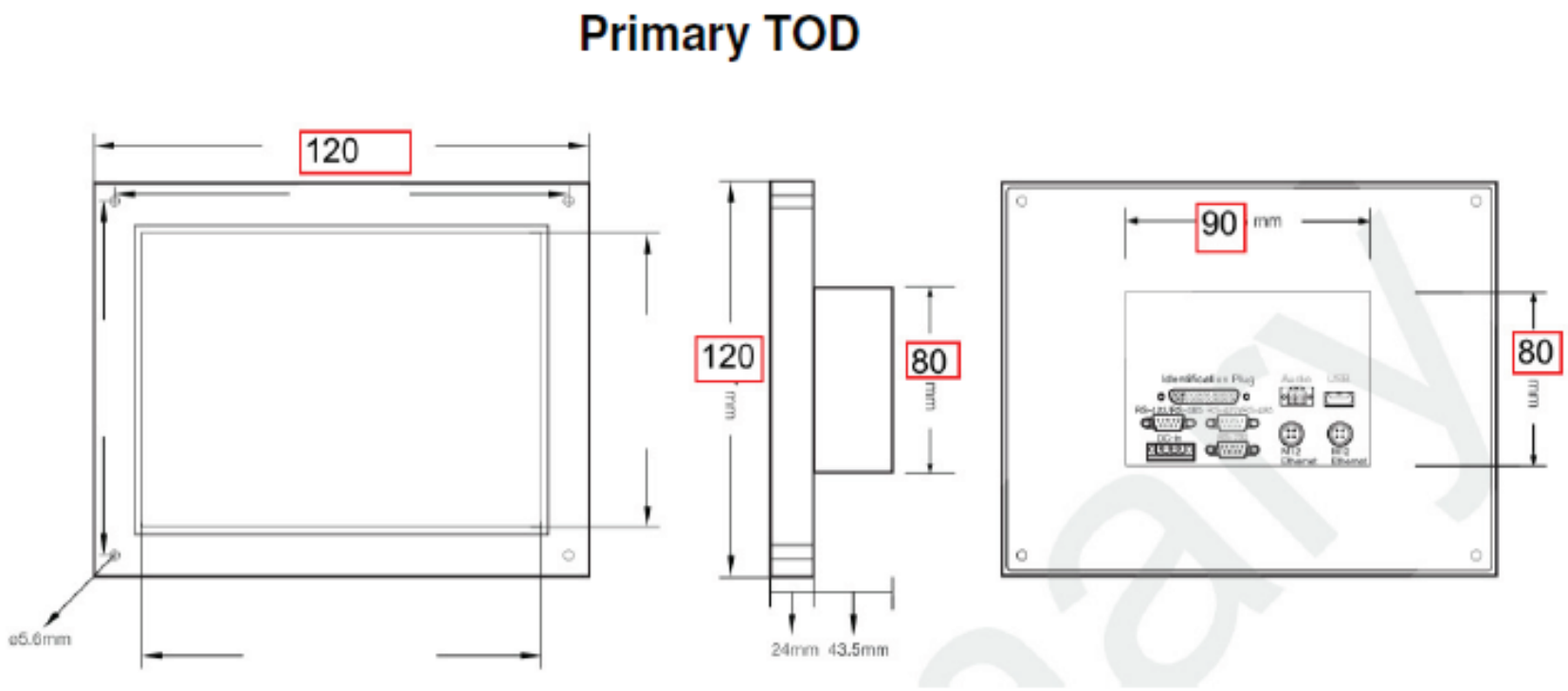
ANNEX C24
EIDS CIRCUIT


EIDS-S
EIDS-C
A CAR
EDPAC1(A2)
EDPDC(A1)
EDPAC3(B1)
EDPAC2(B2)
701(1B)
701(1D)
701(1A)
C07(7E)
C07(4A)
110VDC(+)
0VDC
240VAC
Pan Up/down signal
RS485
DVAS
GSM-MODEM
Antanna for Maintenance PC
SMA Female
Antenna for Download File
AP
DVI BOOSTER A1
DVI BOOSTER B2
DVI BOOSTER B4
703(2E)
703(2H)
*NOTE
D-SUB
PIN NO.
EDPAC1(A1)
EDPDC(A2)
EDPAC3(B1)
EDPAC2(B2)
COM
TITLE
EIDS A CAR
SCALE
1:1
DRAWING A2
PAGE NO. 1
DRAWING NO. DKZ28-00-00-0000Y-C07
VERSION B

Attachment H – Secondary TOD



Attachment I – Primary TOD



APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 4 COMMUNICATIONS INTERFACES

1 Introduction

2 Trainborne Radio

3 In-Cab CCTV

4 Electronic Information Display System (EIDS)

5 Door Chime System (DCS)

6 Trainborne Video Display

7 In-Saloon CCTV

8 RFID Tags

9 RFID Axle Box Temperature Detection System

Attachment App-I-Annex-4 Detailed Interface Specification for Communications

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 4 COMMUNICATIONS INTERFACES

1 Introduction

1.1 This document defines the interface requirements for all the trainborne communications equipment and the train system.

1.2 Each car with driving cab will be equipped with all the trainborne communications equipment as defined in PS 18.1.2.

1.3 The Contractor shall install all the communications equipment as stipulated in PS 18. All the required connectors, interfacing plugs and sockets, earthing connections and all associated mounting materials shall be provided by the Contractor.

1.4 The Contractor shall provide accommodation including mountings, equipment cabinets and cable access for the installation of all the communications equipment as stipulated in PS 18.

1.5 The Contractor shall provide the appropriate power supply, including the power supply interface and the protection device to all the communications equipment as stipulated in RS/C6014/02.

1.6 The Contractor shall provide all required EMI protective measures, such as special EMC cubicle, to protect the communications equipment in order to fulfil the EMC requirements as stipulated in RS/C6014/04.

1.7 The Contractor shall incorporate appropriate interfaces, power supply, delivery schedule, installation, testing and setting to work. The Contractor shall ensure that the equipment can be easily operated, removed and replaced.

1.8 The Contractor shall be responsible for the test and commissioning of all communications equipment that are supplied by the Contractor and those purchased from the Named Suppliers.

1.9 EMC Consideration and Constraints

1.9.1 The Contractor shall ensure that all train equipment is designed and constructed in accordance with RS/C6014/04 or equivalent, to ensure proper functioning of all the communications equipment.

1.9.2 The Contractor shall interface with all the Named Suppliers to ensure that EMC is achieved between all the communications equipment and train

systems. Special consideration shall be given on the positioning and protection of the Trainborne Radio antenna, In-Cab CCTV receivers, real time data receivers and trainborne transceivers for EIDS in order to ensure that each communication equipment shall be fully functional without suffering interference from any other communications equipment.

1.9.3 The Contractor shall, through this interface, develop a Communication Compatibility Specification which shall identify the possible interference sources and define the levels of susceptibility and emissivity for all the trainborne communications equipment that will guarantee compatibility in SEMP Stage 2. A Communication Compatibility Study shall be developed in SEMP Stage 3 to document the steps taken to ensure that the defined level of susceptibility and emissivity is achieved for all communications equipment and train systems.

1.9.4 Train systems and equipment shall be EMC tested in SEMP Stage 4 in accordance with RS/C6014/04 to demonstrate compliance with the PS. An appropriate technical construction file shall be developed in accordance with the EC EMC Directives and be certified by an appropriate Competent Body for the compliance of the EMC Directives.

2 Trainborne Radio

2.1 The Named Supplier of Trainborne Radio shall be in accordance with Appendix Q. The Contractor shall purchase from the Named Supplier all trainborne radio equipment as stipulated in clause 2.3 below.

2.2 Mobile unit consists of a train mobile radio unit (transceiver), a Train Control Interface Unit, a radio control head, a handset with PTT and volume control function, a loudspeaker, a power supply unit together with all associated cables to be installed in the train cab.

Trainborne Radio Set consists of a Mobile Unit, a trainborne antenna and all associated cables together with all associated interface with other trainborne systems.

2.3 Each driving cab shall be fitted with the following trainborne radio set:

(a) a mobile unit as stipulated in clause 2.2;
(b) a trainborne antenna; and
(c) all interconnection cables together with all associated interface.

2.4 All interconnection cables including the RF feeder cable shall be provided and installed by the Contractor in accordance with RS/C6014/02.

2.5 The system block diagram of the Trainborne Radio Set is shown in Figure 1. The Contractor shall liaise with the Named Supplier to define the detailed interconnections between various equipment.

2.6 Performance Requirements of the Trainborne Radio Set and Train System Interfaces

2.6.1 Mobile Unit

(a) The Mobile Units to be provided by the Named Supplier shall be TETRA compliant equipment and shall comply with the requirements stated in below table.

Item	Description	Requirement
1	Frequency Band (TMO)	Receive (Rx) 851 – 866 MHz Transmit (Tx) 806 – 821 MHz
2	Frequency Band (DMO)	806 to 821 MHz and 851 to 866 MHz
3	Duplex Spacing	45 MHz
4	RF Channel Bandwidth	25 kHz
5	Operation/Switching Bandwidth	At least 19 MHz
6	Transmitted Power	3 W, Power Class 3 as defined in the latest revision of ETSI EN 300 392-2.
7	Transmitted Power Control	4 or 5 steps of 5 dB
8	Receiver Sensitivity	-112 dBm static at 4% BER -103 dBm dynamic at 4% BER
9	Receiver Class	A according to EN300 392-2
10	Control Head LCD Display	- Provide illumination for operation in dark environment
11	Display and Input Languages	English and Traditional Chinese
12	Audio output power	3 W (5% THD maximum)
13	User Control	- Talk-group Selector, - Volume Control, - PTT Key, - Power On/Off Key, - Soft Keys, Menu Key and up-down-left-right Navigation Keys - *-#-0-to-9 Alphanumeric keypad, - Emergency Key with red/orange colour, - User Definable Short-cut Keys - Keypad tone can be enabled or disabled by the Employer's engineering users.

Item	Description	Requirement
14	Talk-groups	- Trunked Mode Operation (TMO): support a maximum of 1300 groups and 200 folders - Direct Mode Operation (DMO): support a maximum of 180 groups
15	Dynamic Group Number Assignment (DGNA)	- Support a maximum of 24 DGNA groups - Accept DGNA assignment with attachment
16	Scanning	- Support a maximum of 10 scan lists with 10 groups per list - Support background scanning - Scan group attachment signalling - Provide a scan on/off status
17	Address Book	- Support at least 255 persons (name entries). - Support at least 10 digits (0 – 9, * and #) per entry.
18	Short Data Service (SDS)	- Allow SDS messages to be sent/received to/from an individual / a talk-group - Support up to 140 bytes per SDS message. - Store up to 100 SDS messages and, when enabled, allow re-cycling overwriting upon memory full
19	Status Message	- Allow Status messages to be sent/received to/from an individual / a talk-group - Support 100 status lists
20	Data Interface	External Interface for RS232 Data via Short Data Service and Packet Data
21	Half Duplex / Full Duplex	Support both half duplex and full duplex operation
22	Security features	- Support Air Interface Encryption of TEA1, TEA2 and TEA3. TEA1 shall be used in the Delivered System if Option 2 is exercised. - Support keying with Security Class 1 (Clear), Class 2 (SCK) and Class 3 (DCK and CCK) - Support Authentication initiated by infrastructure and made mutual by terminal

Item	Description	Requirement
23	Security – End-to-end Encryption	The Mobile Units shall allow equipage of end-to-end encryption (between dispatcher and terminal, and between terminals) by adding a SIM card and/or software/firmware upgrade in a workshop in Hong Kong.
24	Other Features	- Ambient Listening - Emergency Hot Mic. - DTMF Over-dial - Late Entry - Talking Party Identification - Busy User Pre-emption (Pre-emption Priority Call) - Keypad lock - Supporting JAVA or WAP
25	Hand Over	- undeclared cell reselection - unannounced cell reselection - announced type 3 cell reselection
26	Real Time Clock	The real time clock shall be available for the user to set to show or hide from the hand-portable radio display. The clock time shall be synchronized to the Employer's system clock.
27	Dimensions (H x W x D)	Transceiver Unit not larger than 60 x 190 x 170 mm (H x W x D) Control Head not larger than 80 x 190 x 130 mm (H x W x D)
28	Weight	The weight of a Control Head together with a Transceiver unit shall not be more than 1800 g.
29	Operating Temperature	-10 to +55°C continuous
30	Humidity	5 to 95% RH, non-condensing, ETS 300 019-1-7 class 7.3E.
31	Enclosure	IEC 60529 IP55
32	Durability	- Polycarbonate and hard-coated display window. - Protected against drop, high shock and vibration according to MIL-Standard 810 D/E/F

(b) On switching on, the registration and Air interface encryption using TEA1 of a Mobile Unit with the active Call and Switching Centre shall be completed within 5 seconds if radio coverage of the MTR Radio System is available and the Mobile Unit shall be ready to make and receive calls.

(c) The Mobile Unit de-registration time, starting from an operator switching off the Mobile Unit to the moment the system finished updating all relevant databases, shall not be more than 3 seconds.

(d) The Trainborne Radio Set shall be able to store at least 100 most recent messages. When the Trainborne Radio Set runs out of memory, the earliest message received shall be discarded once a new message arrives.

(e) During the event of changing of status of the “Cab Occupied”, the changing of status of the signal to the completion of updating of information by the Central Equipment of the MTR Radio System shall be completed within 5 seconds.

(f) The radio control head of the Mobile Unit shall have backlights for the screen and keys for working in situations where ambient lighting is not sufficient.

(g) The screen of the radio control head of each Mobile Unit shall be able to display at least 2 lines of text, with 14 English/7 Traditional Chinese characters per line. Message scrolling function (both up and down) shall be provided for the users to read the whole message in case the message cannot be fitted on one screen.

(h) The loudspeaker shall produce an adjustable sound pressure level of 75-95 dBA when measured at a height of 1.65 meters above the floor level of the train cab while the handset shall enable audible communications under a background noise of 90 dBA.

2.6.2 Trainborne Antenna

(a) The trainborne antennae should be installed on the roof of train. All opening and the gap between the trainborne antenna and the car body shall be sealed properly using sealants approved by the Engineer to prevent leakage of water into train compartment.

(b) The trainborne antennae shall support the following frequency range:

Uplink (Mobile Unit Tx) : 806MHz – 821MHz
Downlink (Mobile Unit Rx) : 851MHz – 866MHz

The VSWR of the trainborne antennae shall be less than 1.5 and with a gain of 0 dBi within the frequency bands above.

(c) The trainborne antennae of the Delivered System shall comply with all the environmental requirements in below table and maintain its performance under such conditions. Moreover, the trainborne antennae shall be designed for operation under prolonged exposure to direct sunlight and with an operating life of not less than 15 years.

Environmental factor	**Range/Requirement**
Temperature	0 to 50°C without air circulation
Humidity (Relative)	5 to 99%
shock and vibration	RIA 20 (Category 1 for equipment mounted on a vehicle body)
Immunity to Environmental	shall not be degraded by sunlight, dust, dirt, grease, heavy rainfall, water droplets, vapour disposition and the above operating conditions.
Wind speed	Up to 117km/h and gust speed of up to 216km/h blowing in the opposite direction of train movement.

(d) The trainborne antenna shall be able to withstand corrosive environment, including the use of commercial acidic wash plant for train exterior cleaning.

(e) The trainborne antenna shall be properly grounded and protected against lightning and high tension lines. Attention shall be drawn to the 1500V DC high voltage traction current supplied by the overhead line system of the Employer. The material of the radome of the antennae shall not breakdown under these operating conditions.

2.7 Design Constraints

2.7.1 Power Supply Requirement for the Trainborne Radio Equipment

A power supply shall be provided to supply the trainborne radio equipment with the following output:

Output voltage: 110 v d.c.
Output current rating: 5.0 A continuous

2.7.2 Accommodation of the Trainborne Radio Equipment

The Contractor shall liaise with the Named Supplier to define the mechanical requirements (location and dimensions) to accommodate the

Trainborne Radio Equipment. Typical mechanical envelops and locations of the Trainborne Radio Equipment are summarised as follows:

Equipment to be purchased from the Named Supplier	Typical mechanical envelops H x W x D in mm	Typical location	Reference Drawing No.
Mobile unit comprising of radio transceiver, train control interface unit and dc-dc converter mounted in an equipment enclosure	Height : 100mm Width : 400mm Depth : 300mm (a further 30 mm allowed to the front to provide access for cable connections)	inside the cab back cubicle	TBA
Control Head	Height : 80mm Width : 190mm Depth : 130mm (including mounting bracket and screws)	on the driving console (refer to PS 8)	TBA
Loudspeaker	Ceiling speaker: 100mm diameter x 37mm (L) And Speaker near console: Height : 80mm Width : 140mm Depth : 50mm	One speaker mount on the ceiling and one mount on the driving console near the handset (refer to PS 8)	TBA
Handset	Height : 82mm Width : 218mm Depth : 62mm	on the driving console (refer to PS 8)	TBA
Antenna	Length : 300mm Width : 300mm Height : 80mm	mounted on the roof of the train	TBA

2.8 Interface with Trainborne PA Equipment

2.8.1 Each set of Trainborne Radio Set shall interface with the Trainborne PA System of the respective train cab to support the making of CPA calls from designated OCC operators.

2.8.2 The Trainborne Radio Set shall provide an interface of

- 0 +/- 10dBm 600Ω 2-wire audio
- 24V dry contact

to the Trainborne PA System. During ordinary radio calls, the audio of the Trainborne Radio Set shall not be routed to the Trainborne PA System. For CPA calls, the Trainborne Radio Set shall pull the dry contact to 24V to indicate the incoming of a CPA call and the audio shall be sent to the Trainborne Radio Set through the 2-wire audio. The dry contact shall be sent prior to the audio to ensure no truncation of the incoming audio messages. The audio output level to trainborne PA equipment shall be adjustable through 10-turns trimmer in the Train Control Interface box.

2.8.3 On establishment of a CPA call, the audio output of the Trainborne Radio Set shall automatically be routed to the Trainborne PA System as well as to the loudspeaker but not to handsets of the Mobile Unit.

2.9 Interface with future Passenger Call equipment

2.9.1 The Contractor shall provide an interface on each Trainborne Radio Set for interfacing with the future passenger call equipment as shown in Figure 1 and detailed below.

2.9.2 The passenger call interface shall provide the following connections:

- a 2-wire audio input;
- an RS422 port (one of the 3 RS422 ports described in PS Clause 18.2.23); and
- a PTT input for relay contact connection.

2.9.3 The audio input in PS Appendix I_Annex 4_Clause 2.9.2 shall have the following characteristics:

- 2-wire input connection with 600 ohm input impendence;
- an input sensitivity of -10dbm, adjustable for +/-10dB;

and this audio input shall work with the audio output for the Trainborne PA interface (described in PS Appendix I Annex 4 Clause 2.8) to form a 4-wire

audio interface, such that the return audio will go through the Trainborne PA system to the passenger.

2.9.4 The Contractor shall propose a protocol to enable normal call requests and emergency call requests to the Traffic Controllers of the associated line of the train to be made via the above RS422 port. The protocol shall handle the complete call process to enable the call to be answered and cleared by the associated Traffic Controller. Both half-duplex calls and full-duplex calls shall be supported by this protocol.

2.9.5 Upon a passenger call request is answered by a Traffic Controller, the call shall also be connected to the loudspeaker of the Trainborne Radio Set in the front train cab for monitoring.

2.10 Confirmation of Design Information

2.10.1 Any change in the design constraints (including power supply, accommodation and interconnection cables wiring arrangement) as stipulated in clause 2.7 above shall be submitted for Approval in accordance with the Configuration Control Program (refer to Appendix P) before the end of SEMP Stage 3.

2.10.2 The Contractor shall ensure that the Trainborne Radio shall be programmed in an identical manner of other Trainborne Radio Equipment currently in use by the Employer.

3 In-Cab CCTV

3.1 The Named Supplier of the In-Cab CCTV shall be in accordance with Appendix Q. The Contractor shall purchase from the Named Supplier all the In-Cab CCTV equipment, except the trainborne video display unit, as stipulated in clause 3.2 below.

3.2 Each driving cab shall be fitted with the following In-Cab CCTV equipment:

(a) Wireless video receiver integrated with video demodulator and picture auto on/off control;
(b) Two flat antennas;
(c) Connections of video output (which shall interface with the trainborne video display unit and TMS);
(d) Isolation transformer box; and
(e) All interconnection cables in accordance with RS/C6014/06.

3.3 The system block diagram of the In-Cab CCTV is shown in Drg. No. C6014-14E/TSEG/667/008 which indicates the interconnection between the various units of the trainborne In-Cab CCTV system.

3.4 Performance Requirements of the In-Cab CCTV and Train System Interfaces

3.4.1 General

The design of the train system shall ensure that the main objectives of the In-Cab CCTV summarised as below can be achieved:

(a) To show clearly the alighting, boarding and waiting passengers at the platform and the passenger loading and unloading conditions when the train enters the signal coverage area as detailed in PS 18.3.4(b).

(b) Fallback control for bypassing the picture auto on/off control to display the received pictures in case of malfunction of the picture auto on/off equipment via TMS on-screen commands.

3.4.2 Detailed Functions

(a) The pictures of the platform shall be displayed on the integrated trainborne video display (split screen for straight platform and quadrant screen for curved platform) automatically when the train enters the signal coverage area.

(b) Fallback control for bypassing the picture auto on/off control shall be provided by TMS on-screen commands such that the display of pictures can be manually controlled by the train operator.

3.5 Design Constraints

3.5.1 Power Supply Requirement for the In-Cab CCTV Equipment

The maximum power consumption of all trainborne In-Cab CCTV equipment will be less than 150 W and the total current less than 0.6 A. The power supply for the In-Cab CCTV shall be taken from the DC output of the Auxiliary Converter system (refer to PS 17.4). The power supply to the In-Cab CCTV shall be available when either one of the Auxiliary Converter is running.

3.5.2 Accommodation of the Trainborne In-Cab CCTV Equipment

The Contractor shall liaise with the Named Supplier to accommodate the In-Cab CCTV equipment. Typical dimensions and location of the InCab CCTV equipment are summarised as follows:

Equipment to be purchased from the Named Supplier	Typical dimensions H x W x D in mm	Typical location	Reference Drawing No.
Wireless video receiver with video demodulator	112 x 333 x 97	inside driving cab ceiling and facing the normal running direction	C6014-14E/TSEG/667/008 (refer to clause 3.5.3 below)
Not used	Not used	Not used	Not used
Equipment to be purchased from the Named Supplier	Typical dimensions H x W x D in mm	Typical location	Reference Drawing No.
Power supply unit	130 x 220 x 65	equipment cubicle within a space envelope of 350 x 350 x 150 mm (H x W x D)	NA
Not used	Not used	Not used	Not used

3.5.3 Control Interfaces with TMS

TMS shall be able to send the following control commands to the In-cab CCTV equipment and display the corresponding control status for Mode and Channel on the TMS screen (refer to PS 10.3.3). The In-Cab CCTV equipment will respond to the commands and perform the operations respectively as below:

Control Group	Operation Selection	Operation Method	Remarks

Mode	Auto / Manual	Press once	Toggle the operation mode between Auto / Manual
Channel	Ch 1 / Ch 2	Press once	Toggle the channel selection between Channel 1 and 2 by a single strobe activation

3.5.4 Status Interfaces with TMS

TMS shall be able to receive the following reply from the In-cab CCTV equipment and display the status respectively.

Indication Group	Operation Selected	On-screen Indication
Microwave Reception (Rx)	Fail	Red
	Healthy	Grey

3.5.5 Physical Interfaces from the In-cab CCTV equipment

Connector	To	Description	Data Carried
Video Output	Trainborne video display	BNC connector type 22 BNC75-0-1	1Vp-p composite video, PAL, 625 lines, 50Hz, 75Ω impedance
Control Data I/O	TMS	10 way chassis mounted Amphenol Pattern 105 bayonet plug type 62GB 12E 12-10 P (760)	4 RS422 Digital Levels: • Output: Display On / Off • Output: Mode Selection Auto / Manual • Input: Rx status Healthy / Fail • Output: Channel Selection Ch1 / Ch2

3.6 Confirmation of Design Information

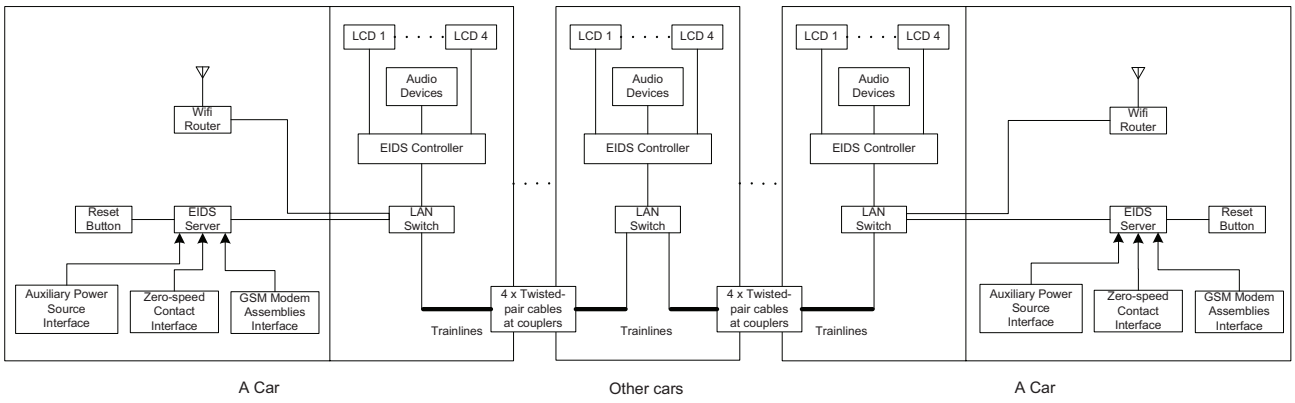
Any change in the design constraints (including power supply, accommodation and interconnection cables wiring arrangement) as stipulated in clause 3.5 above shall be submitted for Approval in accordance with the Configuration Control Program (refer to Appendix P) before the end of SEMP Stage 3.

4 Electronic Information Display System

4.1 The Employer will free-issue the EIDS equipment, including Bulk Data Transmission Facilities (the WiFi Access Point and WiFi Router), EIDS Server, LAN Switch, EIDS Controller and Audio equipment, reset button, except the GSM Modem Assemblies Interface and EID panels, to the Contractor for installation.

4.2 The Contractor shall provide and install the EID panels for the information display.

4.3 All interconnection cables between cars shall be supplied and installed by the Contractor in accordance with RS/C6014/06. System Schematic Diagram as follows:



4.4 Performance Requirements of the EIDS Equipment and Train System Interfaces

4.4.1 General

The design of the train system shall ensure that the main objectives of the EIDS equipment summarised as below can be achieved:

(a) The Bulk Data Transmission Facilities will provide a secure communication link to allow EIDS server to receive scheduling list, advertising messages and other information on certain strategic locations in the Urban Lines.

(b) The GSM Modem Assemblies Interface shall allow EIDS Server to receive a dry contact signal via the public GSM network in the Urban Lines for blanking the screen or display pre-loaded images/video files on the EID panels in the event of broadcasting emergency messages.

(c) The EIDS controller will control the EID panels and audio equipment to display and broadcast messages and advertisements in accordance with

the scheduling list, message priority and audio levels that are compensated from the ambient conditions.

(d) The Zero-speed Contact Interface shall allow EIDS Server to obtain a voltage free relay contact for indicating whether the speed of the train is zero or not and achieve audio output level adjustment with respect to whether the train is moving or stationary.

(e) The Auxiliary Power Source Interface shall allow EIDS Server to monitor its power of the train for achieving the required delay shutdown function.

4.4.2 Use of Attachment App-I-Annex-4

The Contractor shall refer to Attachment App-I-Annex-4 “Detailed Interface Design Specification for Communications”. The Contractor shall ensure the trains are fully adapted to the EIDS equipment.

Attachment App-I-Annex-4 shall be read in conjunction with other Clauses in the PS Appendix I Annex 4. To the extent that any provision of Attachment App-I-Annex-4 is inconsistent with any provision of other Clauses in PS Appendix I Annex 4, the provisions of the other Clauses in PS Appendix I Annex 4 shall prevail.

4.5 Design Constraints

4.5.1 Bulk Data Transmission Facilities

(a) Power Supply and Electrical Requirement

(i) The power of WiFi Router shall be supplied by DC110V and the power consumption will be less than 200W; and

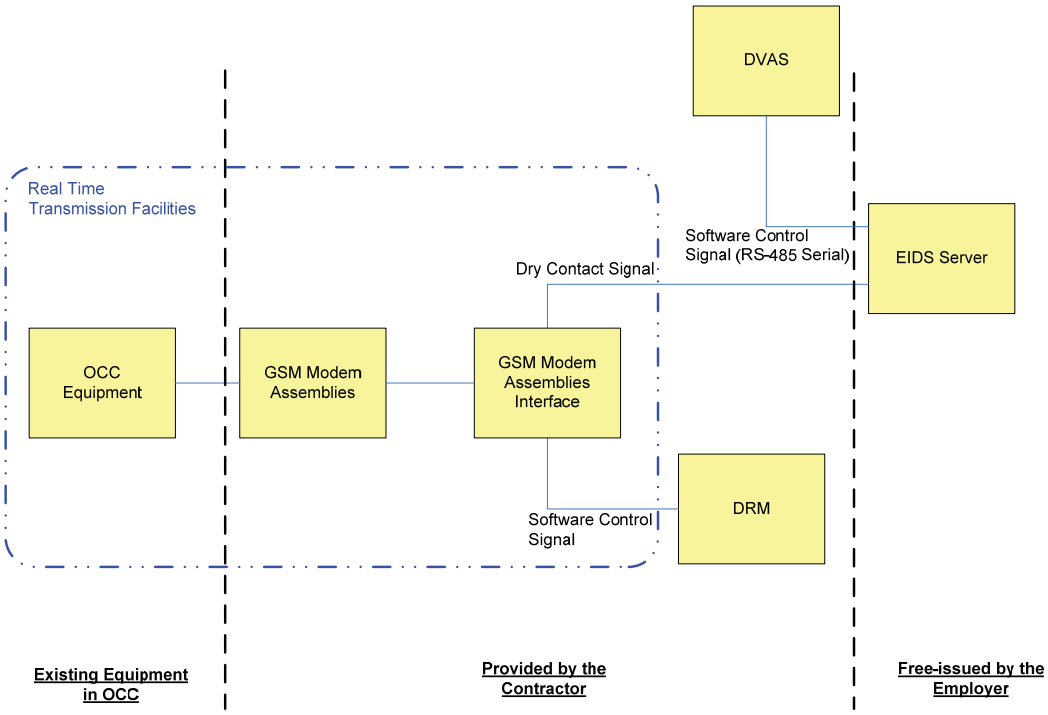
(ii) The power of WiFi Access Point will be supplied by the WiFi Router via a feeder cable.

(b) Accommodation Requirement

The Contractor shall install the Bulk Data Transmission Facilities according to the mechanical requirements (location and dimensions), installation requirements (the maximum allowable separation between the antenna and the WiFi Router) as stipulated in the Attachment App-I-Annex-4.

4.5.2 Real Time Transmission Facilities

The interface between the GSM Modem Assemblies Interface and EIDS Server shall be a dry contact signal and satisfy the interface requirement which shall be submitted for Approval during the detailed design. The interface demarcation diagram is shown as follows:



(a) Power Supply and Electrical Requirement

(i) The power of the real time data receivers (GSM Modem Assemblies) shall fulfil the requirement as stipulated in Appendix I Annex 9 Clause 2.2.2.

(ii) Not used.

(b) Accommodation Requirement

(i) The size, exact location, mounting method and arrangement of the real time data receiver, with all associated antenna, necessary cases and enclosures shall fulfil the requirement as stipulated in Appendix I Annex 9 Clause 2.2.2.

(ii) The total weight of the trainborne real time data receiver shall fulfil the requirement as stipulated in Appendix I Annex 9 Clause 2.2.2.

(iii) The Contractor shall liaise with the Employer to define the mechanical requirements (location and dimensions) and installation requirements to accommodate the GSM Modem Assemblies Interface.

4.5.3 Zero-speed Contact

The interface between the Zero-speed Contact and the EIDS Server shall be a voltage free relay contact and satisfy the interface requirement and submit for Approval during the detailed design.

(a) Accommodation Requirement

(i) The Contractor shall liaise with the Employer to define the mechanical requirements (location and dimensions) and installation requirements to accommodate the Zero-speed Contact Interface.

4.5.4 Auxiliary Power Source

The interface between the Auxiliary Power Source and the EIDS Server shall be a voltage supplied by the Auxiliary Power Source and satisfy the interface requirement and submit for Approval during the detailed design.

(a) Power Supply and Electrical Requirement

(i) The power supplied by the Auxiliary Power Source shall be in the form of 110V DC.

(b) Accommodation Requirement

(i) The Contractor shall liaise with the Employer to define the mechanical requirements (location and dimensions) and installation requirements to accommodate the Auxiliary Power Source Interface.

4.5.5 EIDS Server and LAN Switch

(a) Power Supply and Electrical Requirement

The power of the EIDS Server and LAN Switch shall be supplied from DC 110V and the maximum power consumptions will be less than 600 W.

(b) Accommodation Requirement

The EIDS Server and LAN Switch shall be installed in saloon electric equipment cabinet of each A car respectively. The Contractor shall install the EIDS Server and LAN Switch according to the mechanical requirements (location and dimensions) and installation requirements as stipulated in the Attachment App-I-Annex-4.

4.5.6 EIDS Controller

(a) Power Supply and Electrical Requirement

The power of the EIDS Controller and audio equipment shall be supplied from DC 110V and the maximum power consumption will be less than 200 W.

(b) Accommodation Requirement

The EIDS Controller and audio equipment shall be installed in saloon electric equipment cabinet of in each car respectively. The Contractor shall install the EIDS Controller and audio equipment according to the mechanical requirements (location and dimensions) and installation requirements as stipulated in the Attachment App-I-Annex-4.

4.5.7 Inter-car connections

(a) Electrical Requirement

The performance of connection cables shall meet the data rate of Cat.5e standard.

(b) Accommodation Requirement

The Contractor shall provide the connection interfaces with the LAN cables at the electrical connection boxes of the couplers.

4.5.8 Reset button

(a) Accommodation Requirement

The reset button shall be installed in cab of each A car respectively. The Contractor shall install the reset button according to the layout Zone C2 as stipulated in the Drg No. C6014-14E/TSEG/110/004.

4.6 Confirmation of Design Information

Any change in the design constraints (including power supply, accommodation and interface arrangement) as stipulated in clause 4.5 above shall be submitted for Approval in accordance with the Configuration Control Program (refer to Appendix P) before the end of SEMP Stage 3.

5 Door Chime System (DCS)

5.1 The DCS equipment per cab which will be free issued by the Employer are as follow:

(i) Train-borne Unit (TU)
(ii) DCS antenna
(iii) DCS antenna cable with connectors (for connection between TU and DCS antenna)
(iv) DCS external loudspeaker
(v) DCS external loudspeaker cable with connectors (for connection between TU and DCS external loudspeaker)

5.2 The DCS consists mainly of a Train-borne Unit (TU) for the coordinated and simultaneous operation onboard a train and on the platform where the train stops at.

5.3 The TU shall be installed inside each driving cab and it shall interface with train-borne Vehicle Control Circuit (VCC) and the train PA system for automatic broadcast of audible alerts on board the train and send commands to the platform via Radio Frequency (RF) link for triggering of broadcast of the same audible alerts at the platform through the station PA system. The RF link working in the Industrial, Science, and Medical (ISM) band at 2.4GHz, IEEE802.15.4, maximum transmission power at 2W is used for the communication between the TU and the platform.

5.4 Performance Requirements of the Door Chime System and Train System Interfaces

5.4.1 General

The design of the train system shall ensure that the main objectives of the Door Chime System summarized as below can be achieved:

(a) The DCS shall synchronize the platform announcement system to broadcast the unified chime/audible announcement on platform to alert passengers when train doors, platform screen doors (PSD) and automatic platform gates (APG) are opening, about to close, and closing.

(b) When a train stops at a platform and its doors begin to open, a "Door Opening" chime shall be broadcast through the Train Public Address (PA) System. When the train is about to leave and before the train doors begin to close, a “door-about-to-close” PA message (DPA) shall be announced. And when the train doors begin to close, a “Door Closing” chime shall be played until the moment the doors close completely.

(c) The broadcast of the chimes and the DPA shall also take place on the platform simultaneously with that on the train. This shall be achieved by relaying the broadcast commands from the train via wireless link to the platform where the commands will be sent through hardwire to the station PA system to initiate the appropriate broadcast.

(d) The DCS shall be programmed to broadcast the chime/audible announcement, and to ensure that they are broadcast at the right times under the various scenarios of door open/close activities.

5.5 Design Constraints

5.5.1 Power Supply Requirement for the Door Chime System Equipment

(a) The Contractor shall provide power supply at 24Vd.c. ±10% (min. 300mA) to DCS equipment in driving cab. The circuit protection device, i.e. Miniature Circuit Breaker shall be provided for the DCS equipment.

(b) The power supply for DCS equipment shall always be available when the train is switched on and D1 supply is energized.

5.5.2 Installation Requirement

(a) The TU shall be located in driving cab. DCS antenna and DCS external loudspeaker shall be installed on auxiliary console where appropriate. The design details and any alternative locations shall be proposed subject to Engineer’s Approval.

(b) The dimension of TU will not be larger than 150(W) x 200(H) x 100(D) mm. The dimension of DCS external loudspeaker and DCS antenna are provided in Clause 5.5.5

(c) The distance between a DCS antenna (in a driving cab) and a platform RF receiver (at platform headwall/tailwall) to establish the communication is less than 10 meters. A metal free zone for installation of DCS antenna shall be provided in light of this coverage requirement.

5.5.3 Interface with train-borne Vehicle Control Circuit (VCC)

5.5.3.1 The Contractor shall provide the following VCC interface to TU:

(a) A-side Door (open/close) Command;
(b) B-side Door (open/close) Command;
(c) Door Public Announcement (DPA) Command;
(d) Cab Occupied Status (for indication of leading cab) for enabling/disabling of the TU;
(e) Emergency Brake Status.

5.5.3.2 The electrical characteristic and signal interpretation of individual command are tabulated as follows:

<table>
<tr><th rowspan="2">Signal Name</th><th colspan="3">Electrical Characteristic</th><th rowspan="2">Interpretation of Signal</th></tr>
<tr><th>VCC</th><th colspan="2">TU</th></tr>
<tr><td>A-side Door Command</td><td rowspan="5">Dry Contact

Contact Capacity: 350Vdc 8A max.

Min. Voltage: 12Vdc

Wetting Current: 10mA</td><td rowspan="5">Input</td><td rowspan="5">Voltage Sink (Input) 24Vdc</td><td>Contact Open -> Door Closed
Contact Closed -> Door Open</td></tr>
<tr><td>B-side Door Command</td><td>Contact Open -> Door Close
Contact Closed -> Door Open</td></tr>
<tr><td>DPA Command</td><td>Contact Open -> Released
Contact Closed -> Pressed</td></tr>
<tr><td>Cab Occupied Status</td><td>Contact Open -> Not Occupied
Contact Closed -> Occupied</td></tr>
<tr><td>Emergency Brake Status</td><td>Contact Open -> Emergency Brake Applied
Contact Closed -> Emergency Brake Released</td></tr>
</table>

Table App-I-Annex-4-1

5.5.3.3 The system timing diagrams are provided in Clause 5.5.7

5.5.4 Interface with Train PA System

5.5.4.1 The outputs of PA microphone audio and Press-To-Talk (PTT) circuit shall be connected to TU. The following signals will therefore be received by TU and then relayed to train PA system when any PA microphone is engaged for live manual PA:

(a) Audio output signal from the PA microphones;
(b) PTT (contact) signals from the PA microphones.

5.5.4.2 The TU will emulate as a microphone (when triggered by the VCC) and send the following signals to the train PA system for “automatic” broadcast:

(a) Audio signal to PA microphone input;
(b) PTT (contact) signal to PA microphone PTT input;
(c) DPA signal (24Vdc discrete signal) to DPA input.

5.5.4.3 The audio output signal of the TU will be interrupted immediately and discontinued if the PA microphone's PTT is pressed. This is to ensure that live manual PA (through the PA microphone) will have the highest priority at any time.

5.5.4.4 The microphone of train PA system will remain operational regardless of whether the TU is powered on or off.

5.5.4.5 When the TU is in the idle state, i.e. with no signals received from the VCC, all audio and PTT signals from the PA microphone will be relayed (or "repeated") to the train PA system allowing live manual PA operation be made in a normal way.

5.5.4.6 The electrical characteristic and interpretation of the signals are detailed as follows:

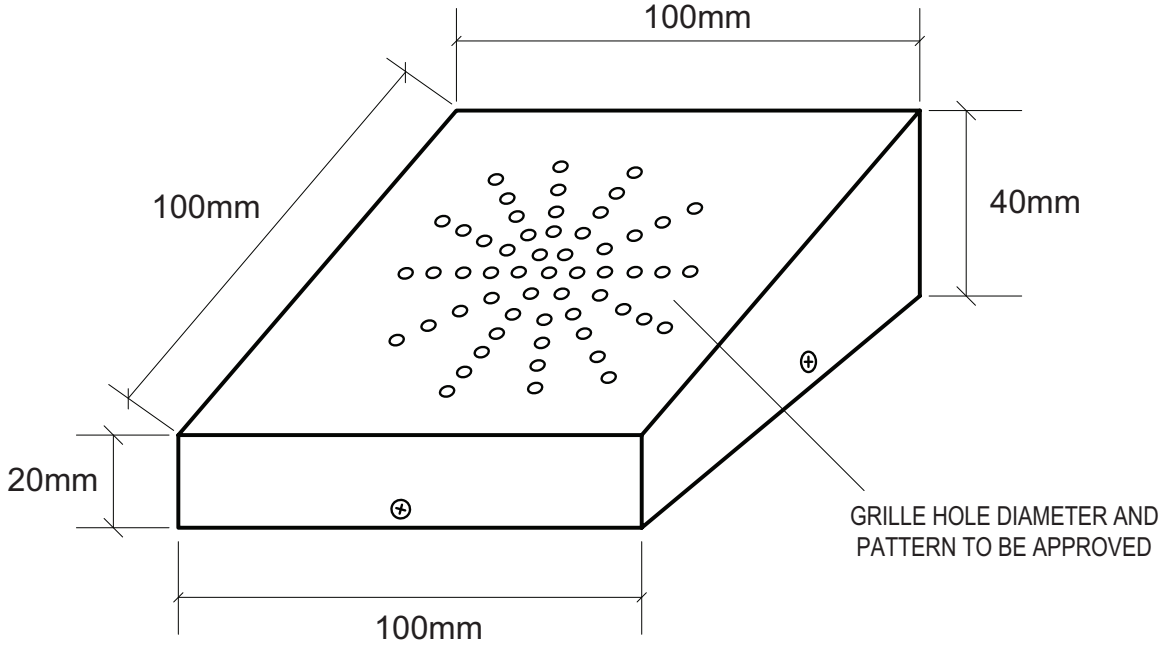
Signal Name	Electrical Characteristic			Interpretation of Signal
	Train PA System	TU		
Audio output from PA microphone	AC Voltage	Input	Load	Audio signal at approximate 1V from PA microphone output
PTT (contact) from PA microphone	Dry Contact or 24Vdc Voltage	Input	Voltage Sink (Input) 24Vdc, ≦20mA (This input point shall be software configurable to read 24Vdc discrete signal from the Train PA instead of dry contact)	Contact open -> PTT released Contact closed -> PTT pressed or 0Vdc -> PTT released 24Vdc -> PTT pressed
PTT (contact) from PA microphone	Dry Contact	Input	Voltage Sink (Input) 24Vdc, ≦20mA	Contact open -> PTT released Contact closed -> PTT pressed
Audio output from digital announcer of TU	Load	Output	AC Voltage	Audio signal at approximate 1V to train PA system

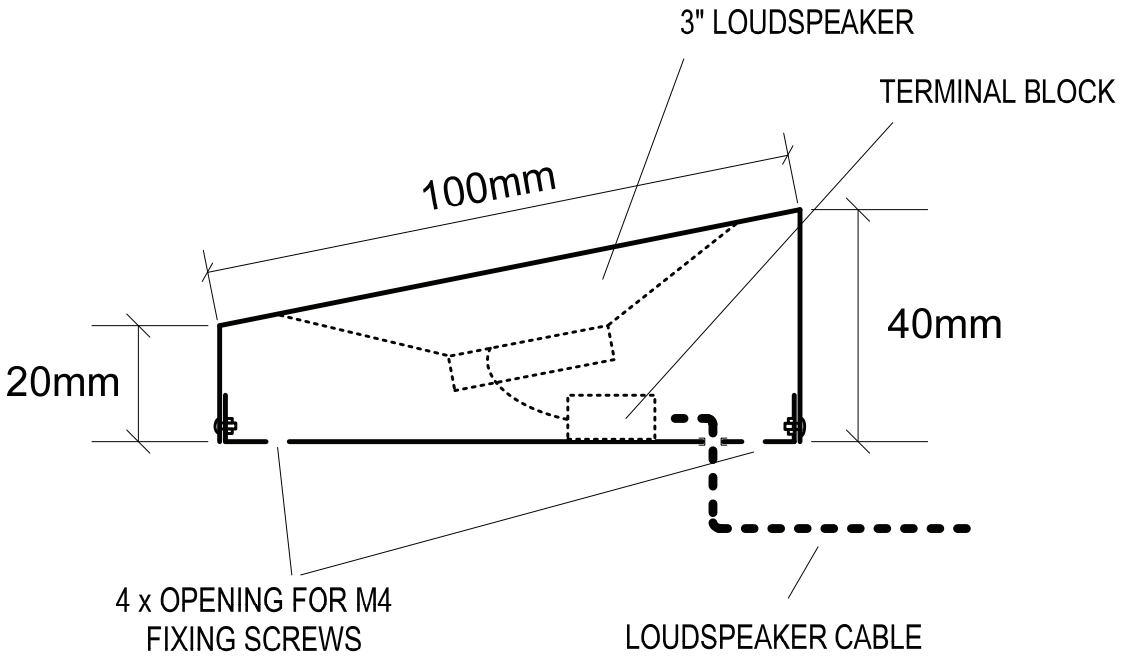
Signal Name	Electrical Characteristic			Interpretation of Signal
	Train PA System	TU		
PTT (contact) from TU	DC Voltage or Load	Output	Dry Contact (This output point shall be software configurable to send 24Vdc voltage to the Train PA instead of dry contact)	Contact open -> PTT released Contact closed -> PTT pressed or 0Vdc -> PTT released 24Vdc -> PTT pressed
DPA signal from TU	DC Voltage	Output	24Vdc discrete signal	0Vdc -> all DPA pushbuttons released 24Vdc -> any DPA pushbutton pressed

Table App-I-Annex-4-2

5.5.5 Dimensions of Door Chime System Equipment

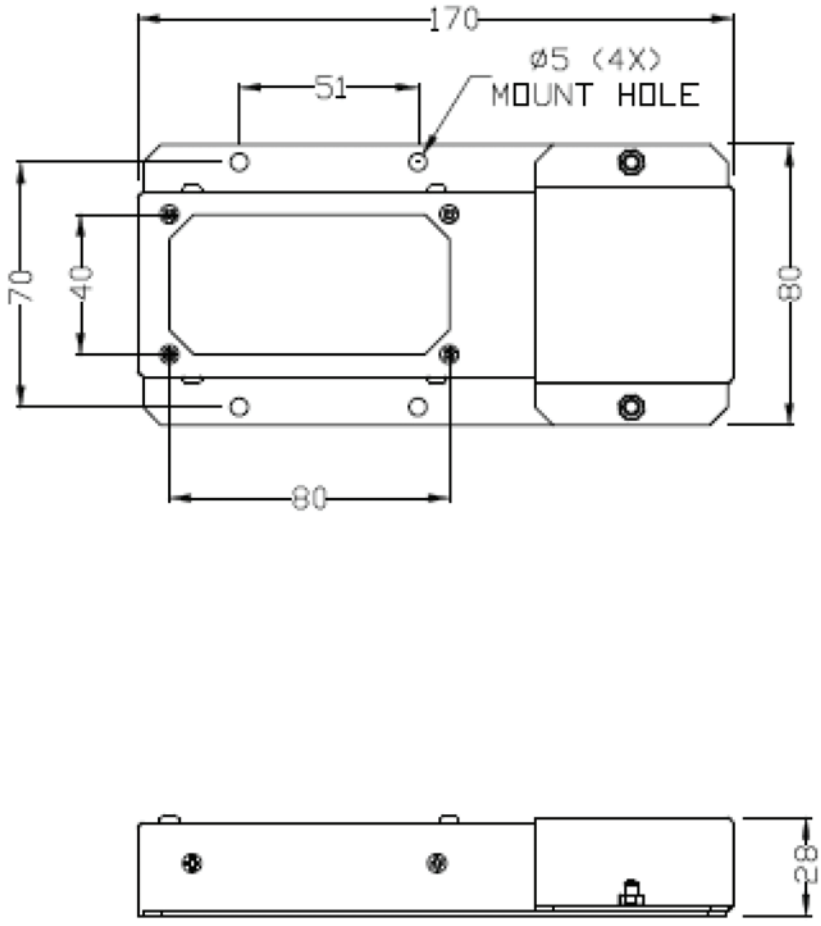
DCS External Loudspeaker



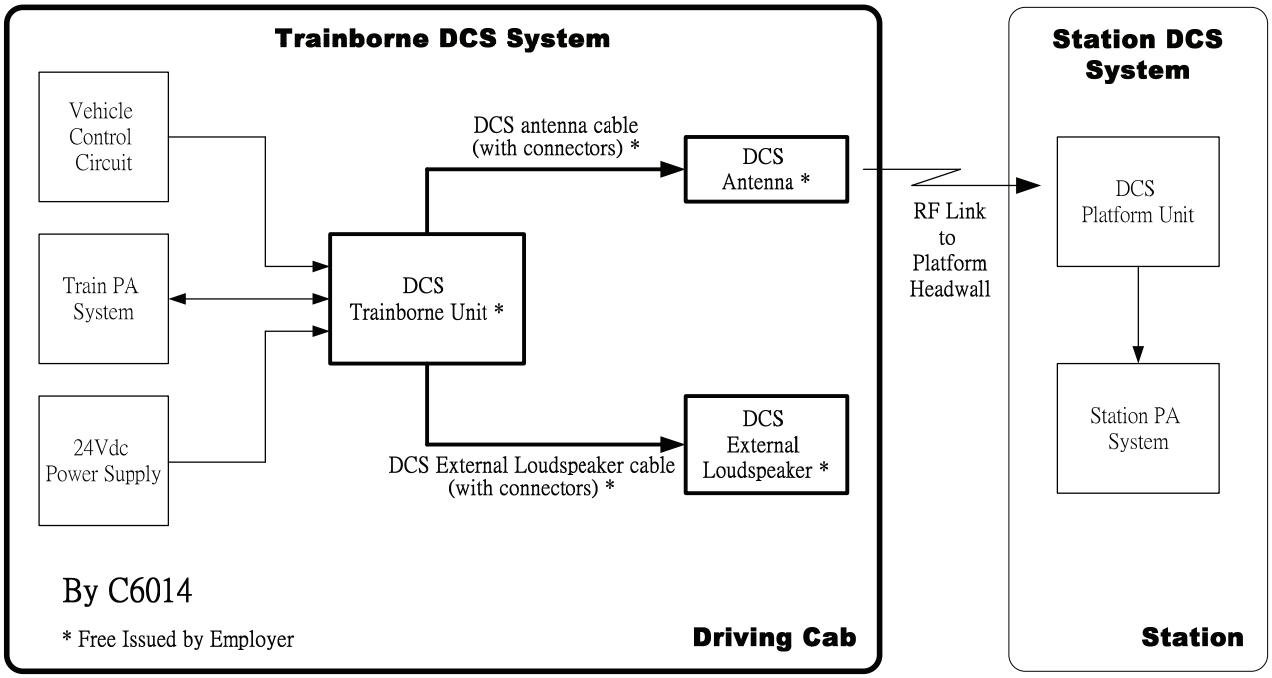


CROSS-SECTIONAL VIEW

Dimension of DCS Antenna

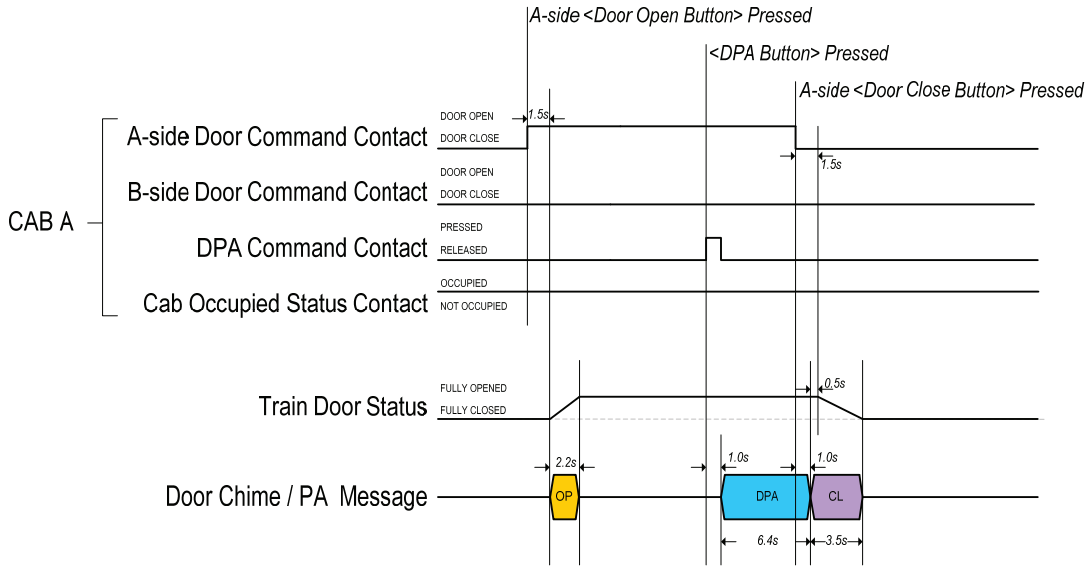


5.5.6 Interface Demarcation Diagram

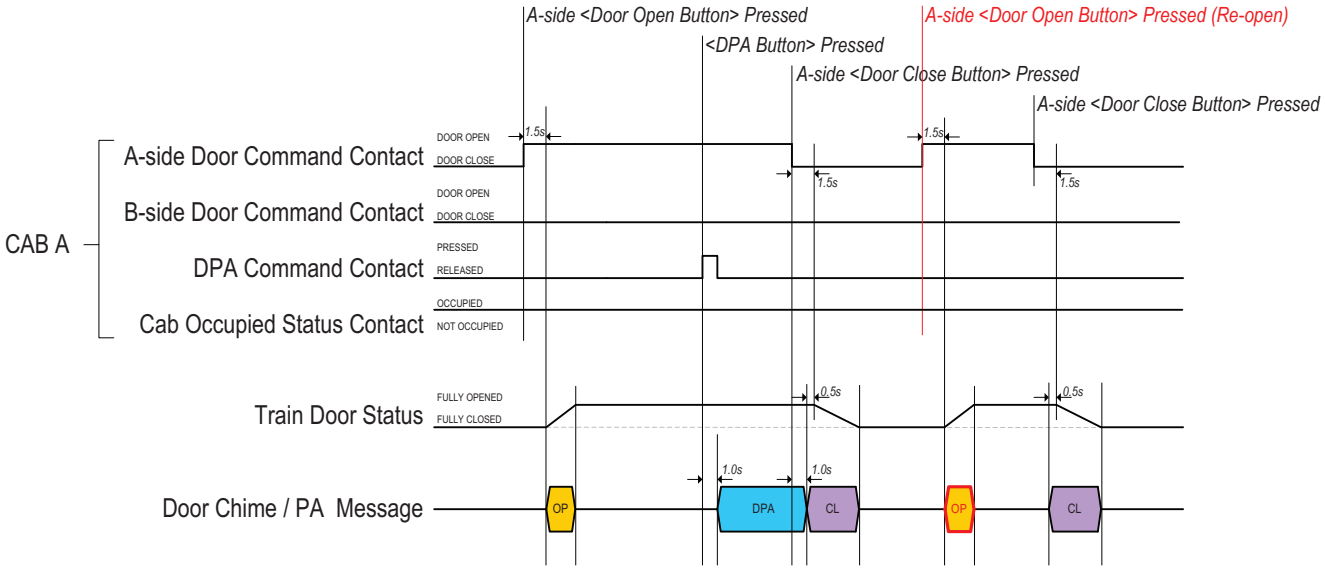


5.5.7 System Timing Diagram

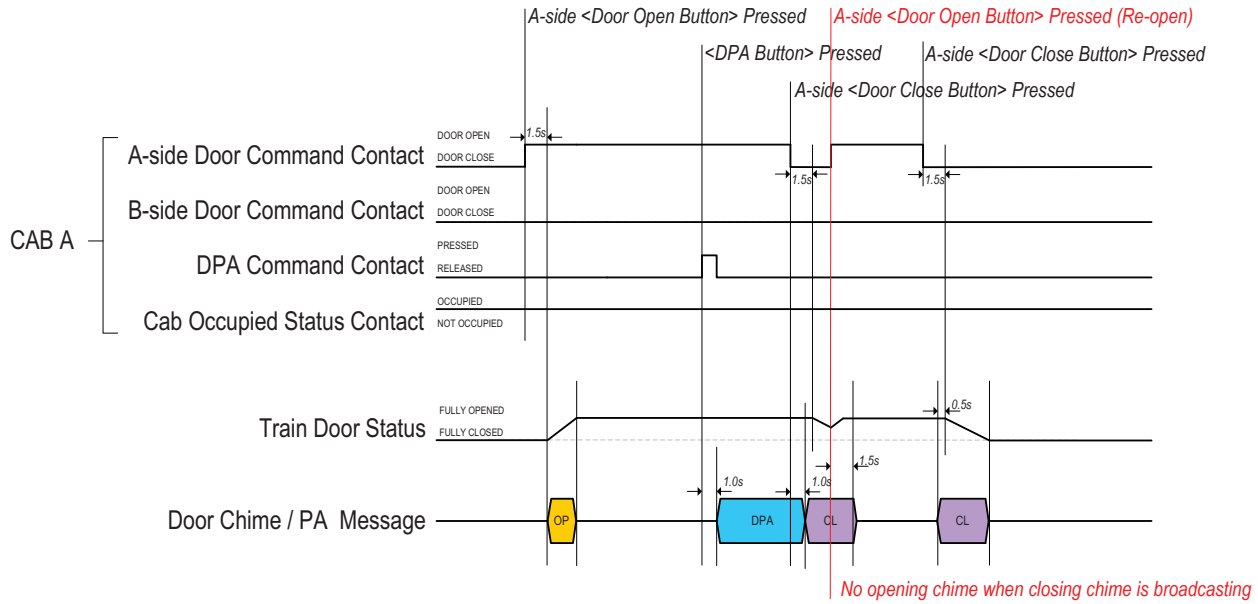
Scenario 1 - Normal Door Open and Close



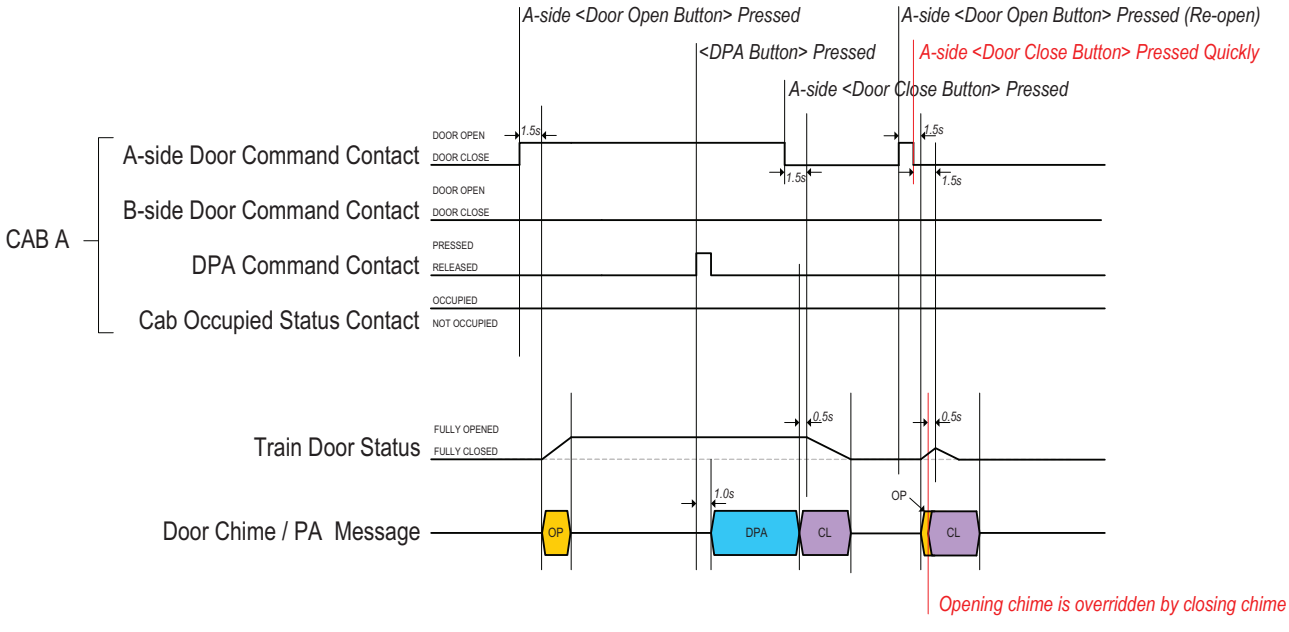
Scenario 2 - Door Re-Open



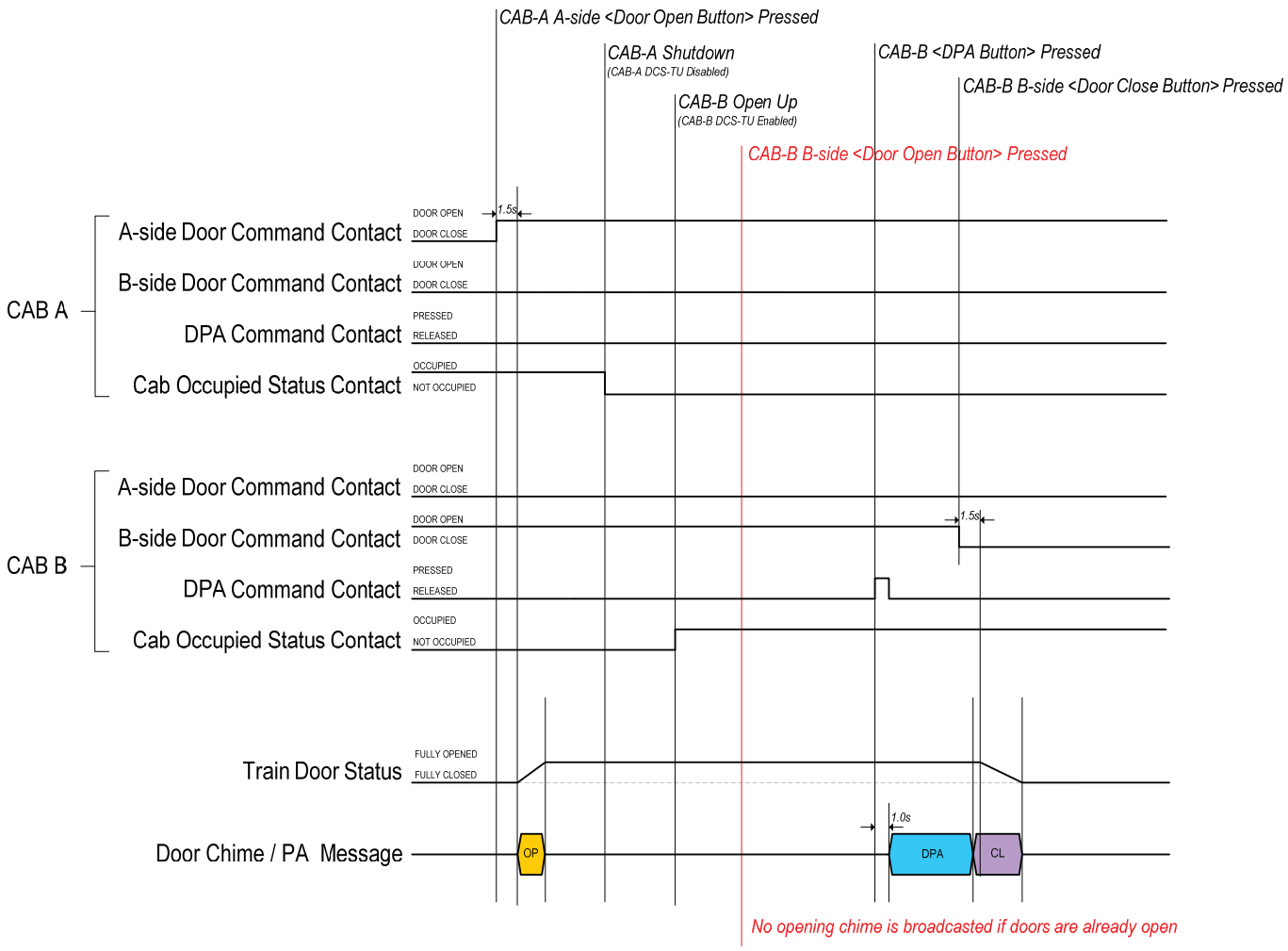
Scenario 3 - Door Re-Open (During Door Closing)



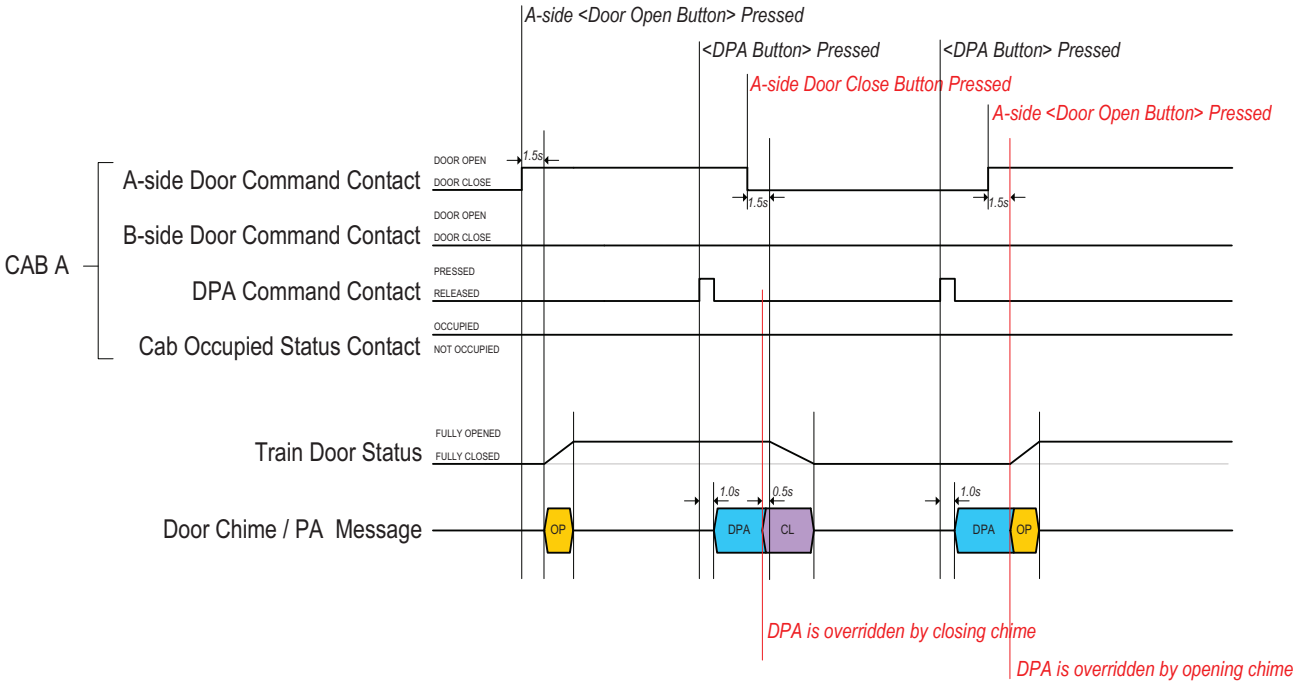
Scenario 4 - Door Close (During Door Opening)



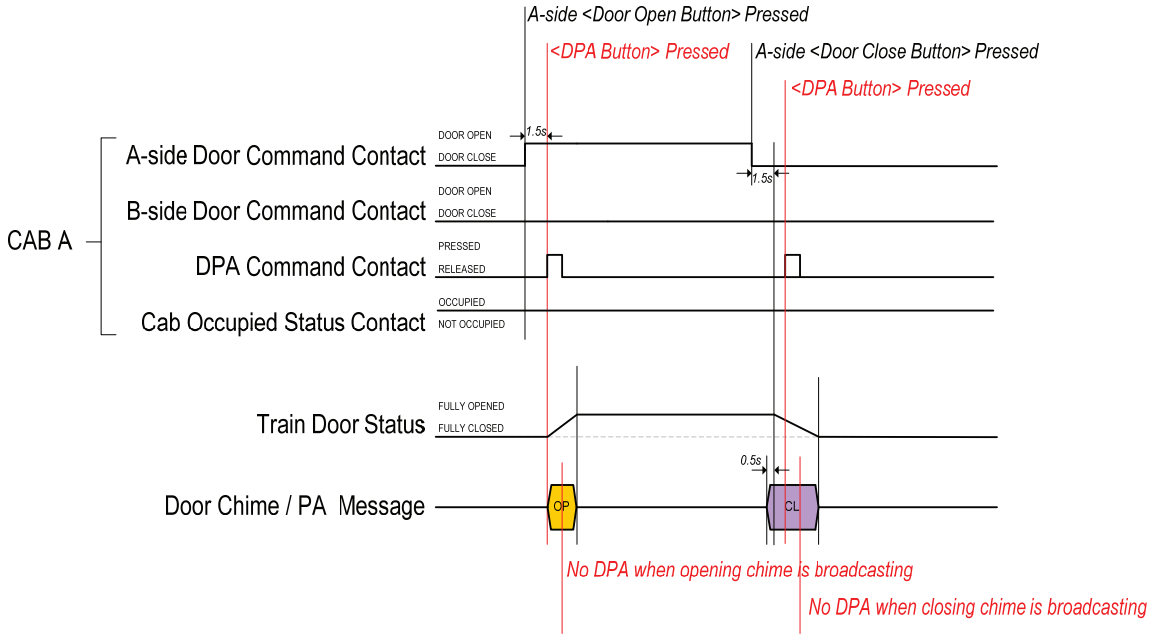
Scenario 5 - Change End Operation



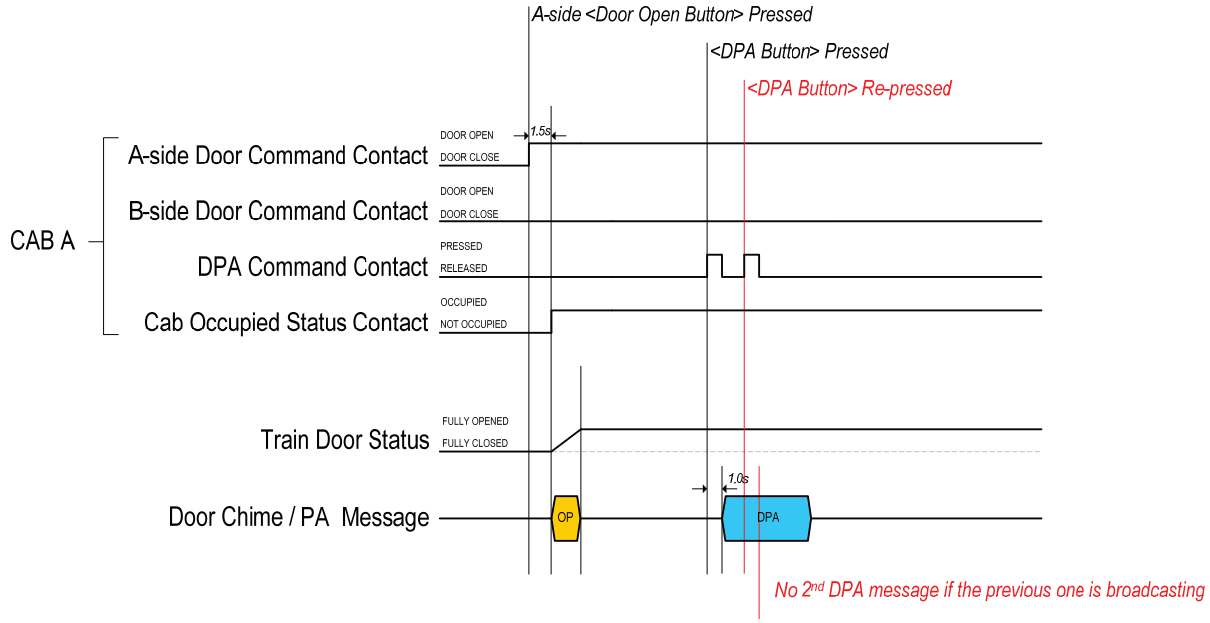
Scenario 6 - Door Open/Close (During DPA broadcasting)



Scenario 7 - Door Open/Close (During DPA broadcasting)



Scenario 8 - DPA Button pressed for the 2nd time (During previous DPA broadcasting)



5.6 Confirmation of Design Information

Any change in the design constraints (including power supply, accommodation and interconnection cables wiring arrangement) as stipulated in clause 5.5 above shall be submitted for Approval in accordance with the Configuration Control Program (refer to Appendix P) before the end of SEMP Stage 3.

6 Trainborne Video Display

6.1 The Contractor shall provide an integrated trainborne video display for the images of the In-Cab CCTV system and the In-Saloon CCTV system.

6.2 Control Interfaces with TMS

TMS shall be able to send the following control commands to the trainborne video display. The trainborne video display will respond to the commands and perform the operations respectively as below:

Control Group	Operation Selection	Operation Method	Remarks

Mode	Auto / Manual	Press once	Toggle the operation mode between Auto / Manual
Display	ON / OFF	Press once	Toggle the display between ON / OFF by a single strobe activation
ALC	Active / Inactive	Press once	Toggle the automatic light control between Active / Inactive by a single strobe activation
Brightness	+ / -	Press once or continuous	Increment or decrement the brightness level step by step or continuously at 5 steps/sec
Contrast	+ / -	Press once or continuous	Increment or decrement the contrast level step by step or continuously at 5 steps/sec
Colour Saturation	+ / -	Press once or continuous	Increment or decrement the colour saturation level step by step or continuously at 5 steps/sec

6.3 Video Input Interfaces to the Trainborne Video Display

Interfaces	**From**	**Description**	**Data Carried**
Video Input	In-Cab CCTV	BNC connector type 22 BNC-75-0-1	1Vp-p composite video, PAL, 625 lines, 50Hz, 75Ω impedance
	In-Saloon CCTV	RGB connector or VGA connector	1Vp-p composite video, PAL, 625 lines, 50Hz, 75Ω impedance or VGA/SVGA/XGA multi scan mode

7 In-Saloon CCTV

TMS shall be able to send the following control commands to the In-Saloon CCTV :

(a) Mode selection - to choose between single, split and quad screen modes for displaying the camera images from the saloons (refer to PS 18.7.9(f)(vi));

(b) Source selection - to select the camera or groups of camera to be viewed (refer to PS 18.7.9(f)(vii));

(c) "cab-occupied" control command via a serial link to active the trainborne video display. The In-Saloon CCTV System shall automatically start to display the real time images on the screen on receiving such "caboccupied" control; and

(d) TMS shall report fault on receiving fault information of video storage failure from In-Saloon CCTV (refer to PS 18.7.10(h)).

8 RFID Tags

8.1 The Named Supplier of RFID tags shall be in accordance with Appendix Q. The Contractor shall purchase from the Named Supplier RFID tags as stipulated in clause 8.2 below.

8.2 Each driving cab shall be fitted with the following equipment:

(a) Four (4) RFID tags
(b) Four (4) mounting brackets for RFID tags

8.3 Performance Requirements of the RFID Tags and Train System Interfaces

8.3.1 General

The design of the train system shall ensure that the main objectives of the RFID tags summarized as below can be achieved:

RFID tags information at each train's driving cab could be successfully read by RFID readers as a means to track specific operating scenarios of trains including entering or leaving depots and crossing the railway lines.

8.4 Design Constraints

8.4.1 RFID Tags

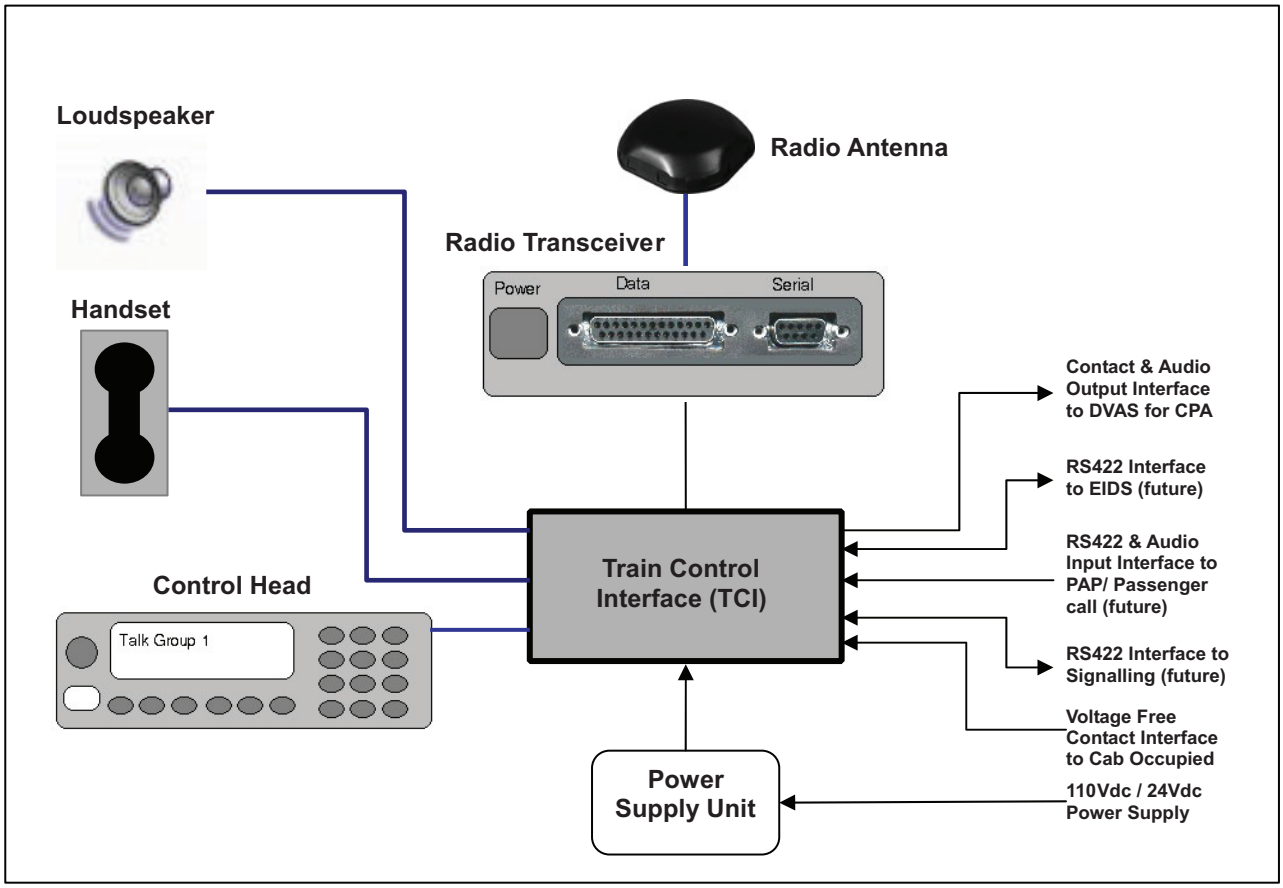
(a) Power Supply and Electrical Requirement

The RFID tags shall not rely on any power supply source or battery,including internal battery, to support their operation.

(b) Accommodation Requirement

The size of a RFID tag is approximately 13.4 cm (L) x 6 cm (H) x 1 cm (D). The mounting bracket shall be provided to mount the RFID tags at the level 600 mm above the rail in each corners of the driving cab.

Figure 1 System Block Diagram of Trainborne Radio Set



9 RFID Axle Box Temperature Detection System

9.1 The Named Supplier of trainborne RFID Axle Box Temperature Detection System is specified in Appendix Q.

9.2 The RFID tags shall be properly enclosed and installed on every bogie. Each RFID tag shall connect with a temperature sensor which shall be installed on an axle box.

9.3 The information transmitted by each RFID tag shall include but not limited to the following:

(a) Preset high temperature indication
(b) High temperature sensor fault
(c) Tag healthy signal
(d) Unique RFID serial number
(e) Time and date of the transmission

9.4 The RFID tags shall operate in 2.4GHz ISM frequency for communication with trackside receivers.

9.5 The RFID tags shall transmit tag and temperature data in a fixed time interval automatically. No acknowledgement is required from trackside receiver unit.

9.6 The data received by the receiver will be transmitted via the Corporate Data network (CDN) to their respective Depot Monitoring Servers and Monitoring Servers in MMC. The respective lines and depots are shown as follow:

(a) Kwun Tong Line – Kowloon Bay Depot
(b) Tseung Kwan O Line – Tseung Kwan O Depot
(c) Tsuen Wan Line – Tsuen Wan Depot
(d) Island Line – Chai Wan Depot

9.7 Performance Requirements of the Trainborne RFID Axle Box Temperature Detection System Interfaces

9.7.1 The operation of the trainborne RFID Axle Box Temperature Detection System shall not interfere with the normal operation of the EMU and Signalling System. The operation of the trainborne RFID Axle Box Temperature Detection System shall not cause interference to other RFID and electronic equipment currently in use on the railway systems.

9.7.2 The trainborne RFID Axle Box Temperature Detection System shall be able to uniquely recognise and detect the current temperature and highest temperature in past two hours from each axle box.

9.7.3 The RFID tags and temperature sensors shall be able to real-time monitor the axle box temperature and transmitted the data to track-side receiver at pre-defined location. Interval for data transmission of not more than 30 seconds for each cycle.

9.7.4 The measured temperature of the trainborne RFID Axle Box Temperature Detection System shall be within ±2°C from the true temperature from the axle box mounting bolt. The range of temperature measurement shall be from 0°C up to 200°C.

9.7.5 The RFID tag must display a negative temperature or fault notification when the temperature sensor disconnected from the RFID tag body.

9.7.6 The axle box temperature sensing RFID system shall cater for future expansion of the Employer fleet size.

9.8 Design Constraints

9.8.1 Power Supply and Electrical Requirements

The RFID tags shall be powered by internal battery to support its operation. External power source is not required.

9.8.2 Reliability Requirement

The axle box temperature sensing RFID tag shall achieve a reliability figure of 99.98% of all radio transmitted.

9.8.3 Maintainability Requirements

(a) The RFID tag shall achieve a minimum service life of 4 years. One battery replacement is allowed during its service life and no major replacement shall be required during the 4 years period.

(b) The RFID tags shall be designed and installed to maximise its availability, to minimise the amount of maintenance required and to ensure that maintenance can be safely easily and quickly carried out.

(c) The Contractor shall provide easy access for components which require regular inspection, adjustment and replacement.

(d) All equipment, including the mechanical mountings and cabling of the RFID tag, shall be designed to facilitate prompt removal and replacement.

(e) The Contractor shall provide all the special equipment necessary for the installation and removal of modules from the trainborne RFID Axle Box Temperature Detection System.

9.8.4 System Life Time

(a) The RFID tag shall be designed that it can achieve a minimum service life of 4 years. One battery replacement is allowed during its service life and no major replacement shall be required during the 4 years period.

(b) The Contractor shall declare the expected life and the maintenance requirement of the equipment to achieve the design life time.

9.9 Functional Requirement

9.9.1 The RFID tags and temperature sensors shall be able to real-time monitor the axle box temperature and transmitted the data to track-side receiver at pre-defined location.

9.9.2 The axle box temperature sensing RFID system shall be able to update and forward the last detected temperature and continuous detected maximum temperature in the past 2 hours at the last detected point from individual tag with its unique information, from temperature sensing area with date and time to monitoring system for processing.

9.9.3 The axle box temperature sensing RFID system shall be able to evaluate the temperature detected from the axle box mounting point (target zone) on the axle box and translate the information into 'Normal' and different temperature alarm levels. The axle box temperature sensing RFID system shall provide at least the following preset temperature alarms in accordance to BS EN 15437-1:

(a) Critical temperature alarm;
(b) Warning temperature alarm; and
(c) Attention temperature alarm.

9.9.4 The Contractor shall provide preset temperature alarm levels customised for the Employer's EMU and running conditions in HKSAR. The temperature reading shall be made available on the monitoring station. The threshold or range of each level shall be made editable with preferential access.

9.10 Design Requirement

9.10.1 RFID Tag and Temperature Sensor

9.10.1.1 The temperature sensor and RFID tag-on-PCB and related accessories for EMU installation shall include.

(a) RFID tag-on-PCB;
(b) IP66 rated box housing to install RFID tag-on-PCB according to BS EN 60529: 1992;
(c) Battery to power the RFID tag-on-PCB and must be last longer than 3 years;
(d) Temperature probe extended from the RFID tag-on-PCB and the cable extension, the cable must have sufficient length to connect from the housing mounting position onto the axle box cover;
(e) The cable between RFID tag-on PCB and temperature probe must be protected and approved by the Engineer. All other current

operation and maintenance operation on Rolling Stock shall not cause damage to temperature sensor cable;

(f) Fixing assembly for housing mounting position, which are provided in the form of completed assembly of RFID tags and mounting bracket;

(g) The RFID brackets are preferably being mounted by bolt and nut.

9.10.1.2 The RFID tag and temperature sensor shall comply with:

(a) Battery life with at least 3 years for continuous operation;

(b) OFTA approved general public communication frequency;

(c) Interval for data transmission of not more than 10 seconds for each cycle

(d) Temperature variation not more than ±2 °C;

(e) Temperature memory on highest temperature detected in the past 2 hours at last data transmission cycle;

(f) Disconnection on temperature sensor from RFID tag-on PCB must display a fault temperature lower than zero degree Celsius.

9.10.1.3 The Contractor shall comply with international Rolling Stock standard which cover EMC, Vibration & Shock and Water & Dust Ingress for all equipment installed.

9.10.1.4 The RFID tag must be self-powered and must not be connected to power source from the train.

9.10.1.5 Following design standard must be observed for PCB and temperature sensors with associated mounting bracket:

(a) The RFID tags to be installed onto the EMU shall comply with the shock and vibration test requirements per BS EN 61373:2010. The test category shall depend on the position on EMU where the tags are installed. The Contractor shall submit a test plan to the Engineer for Approval prior to carrying out the shock and vibration test. All non-metallic materials to be installed on the EMU shall also compile with BS6853:1999 or EN 45545-2:2013 and shall be submitted to the Engineer for Approval;

(b) The temperature sensor shall comply with shock and vibration test requirement per BS EN 61373 category 3 for axle mounted equipment;

(c) The RFID equipment shall comply with emission and immunity requirement of BS EN 50121-3-2 and BS EN 50121-4;

(d) The temperature senor and RFID tag shall be weather proof to IP66 or above per BS EN 60529: 1992;

(e) Bolts, nuts and studs shall be of Grade 8.8 or above to BS EN ISO 898-1;

(f) Plastic materials shall be flame retardant, acid-based cleaner resistant and UV resistant to appropriate standards including RoHS;

(g) The tag and mounting assembly must subject to static stress / fatigue analysis / random vibration simulation under the maximum bending moment. The mounting bracket shall demonstrate life of more than 2.5 times of prescribed service life, 20 years;

(h) For avoidance of the doubt, the standard of the extreme load cases depending on its mounting position as follows without permanent deformation:

(i) Carbody mounted equipment – The equipment shall be designed to survive the load cases stipulated in PS 6.4.4;
(ii) Bogie mounted equipment – The equipment shall be designed to survive the load cases stipulated in PS12.9.3; or
(iii) Axle mounted equipment – The equipment shall be designed to survive the load cases stipulated in Clause D.2.3 in Annex D of EN 13749:2011.

9.10.2 RFID Axle Box Temperature Monitoring System automatic association

9.10.2.1 The Contractor shall propose a fully automatic system to associate both RFID tag at individual axle box on New Trains.

9.10.2.2 The Contractor shall confirm the method of association for the Engineer's Approval.

9.10.2.3 The Contractor shall note to keep the human intervention on automatic association to minimum. For avoidance of the doubt, the MMI shall be automatic recognise association after RFID tag has been changed on individual axle box.

9.10.2.4 Mobile RFID Reader and association mechanism shall be provided as part of automatic association. The association result

shall be uploaded onto MMI software via any means of transfer protocol. Double check mechanism shall be provided on both MMI software and Mobile RFID reader.

9.10.2.5 The Contractor shall provide permanent labelling on both New trains and RFID tag with associated printing tool to allow Employer to reproduce label. The Contractor shall supply the supplier and model of label for the Engineer's Approval.

9.10.3 The Contractor shall provide necessary amendment on the software or install new MMI software used in the URL RFID Axle Box Temperature Monitoring System to ensure the information of New Trains can also be monitored in URL depots and MMC.

9.10.4 Environment Considerations

9.10.4.1 The outdoor ambient air temperature and relative humidity in HKSAR ranges from 0 °C to 40 °C and 0 % to 100 % non-condensing, respectively.

9.10.4.2 The RFID Temperature Monitoring System shall have built in mechanism to compensate the ambient temperature for true Axle Box Temperature display.

9.11 Material and Workmanship Requirement

9.11.1 Unless otherwise specified, the material and workmanship of the RFID Axle Box Temperature Monitoring System shall comply with the requirement specified in RS/C6014/02.

9.11.2 The Contractor shall carry out the insulation resistance test and dielectric withstanding voltage test on all wiring with the following sequence:

(a) Conduct 1st insulation resistance test at 1,000 VDC to the wiring with respect to earth. The result insulation resistance of each cable shall be no less than 100 MΩ;
(b) Conduct dielectric withstanding voltage test with voltage at 2,500 VAC for 1 minute. The leakage current shall be no more than 100 mA; and
(c) Conduct 2nd insulation resistance test at 1,000 VDC to the wiring with respect to earth. The result insulation resistance of each cable shall be no less than 100 MΩ.

9.11.3 All conduits and fittings shall be of hot dip galvanized steel to BS 4568 -1, BS EN 61386 -1 and BS EN 61386 -21 with Class 4 protection. Flexible

conduit shall be flame-retardant, flexible, of heavy duty nylon types made of polyamide PA66, of UL94 Class V-0 and halogen free.

9.11.4 Labelling

9.11.4.1 All electrical components such as controllers, motors, fuses, relays, contactors, timers, solenoids, limit switches, cables and sensors shall be labelled according to their identity in the respective schematic diagrams for easy maintenance.

9.11.4.2 Cable marker shall be provided at both sides of each cable. The identification numbers of the cable markers shall be the same as shown in the electrical circuit diagrams.

9.12 Testing and Commissioning

9.12.1 The RFID Axle Box Temperature Detection System shall be tested and commissioned in accordance with PS Appendix C.

9.12.2 Calibration and Test certificates applicable to the equipment shall be submitted to the Engineer for Approval before the acceptance of the axle box temperature sensing RFID System.

Attachment App-I-Annex-4
Detailed Interface Specification for Communications

Detailed Interface Design Specification for Communications

Contents

1 Introduction 4
1.1 Abbreviations and Acronyms 4
2 Scope of Supply 5
2.1 EIDS Interfacing Contractor Provision 6
2.2 C6014-14E Provision 6
2.2.1 Relevant Communication Equipment 6
2.2.2 Cable and connector interface arrangement 7
3 Mechanical Interface 7
3.1 EIDS Equipment 7
3.1.1 EIDS Sever 7
3.1.1.1 EIDS Sever Mounting Position 7
3.1.1.2 EIDS Server Mounting Details 7
3.1.2 EIDS Controller 7
3.1.2.1 EIDS Controller Mounting Position 7
3.1.2.2 EIDS Controller Mounting Dimension 8
3.1.3 WiFi Router & Antenna 8
3.1.3.1 WiFi Router equipment 8
3.1.3.2 Antenna Mounting Requirement 8
3.1.3.3 Antenna Mounting Details 8
3.1.4 EIDS Loudspeaker 9
3.1.5 EID DVI Booster 9
3.1.6 Audio amplifier 9
3.2 Interfaced Train Systems 9
3.2.1 EIDS Panel 9
3.3 Cable Connections 10
3.3.1 EIDS Server to DVAU Cables 10
3.3.2 EIDS Controller to EID Panel Cables 10
3.4 Cable containment 10
4 Electrical Interface 10
4.1 Interface Between EIDS Sever and DVAU 11
4.2 Interface Between EIDS Controller and EID panel 11
4.3 Zero-speed Dry Contact 12
4.4 Earthing 12
5 Functional Interface 12
5.1 Interface Between EIDS Sever and DVAU 12
5.2 Interface Between EIDS Controller and EID panel 13
6 EMC 14

7 Testing 14
Appendix 15

1 Introduction

This document describes the detailed interface between the trainborne communications equipment and the train system, i.e. the interface for Electronic Information Display System (EIDS) which is free-supplied by MTR and the train system.

- MTR shall free-issue the EIDS equipment, including Bulk Data Transmission Facilities (the WiFi Access Point and WIFi Router), EIDS Server, LAN Switch, EIDS Controller and Audio equipment;
- The Contractor shall provide the real time data receivers (GSM Modem Assemblies Interface), EID panels and all interconnection cables (including 4x twisted pair cable) between cars;

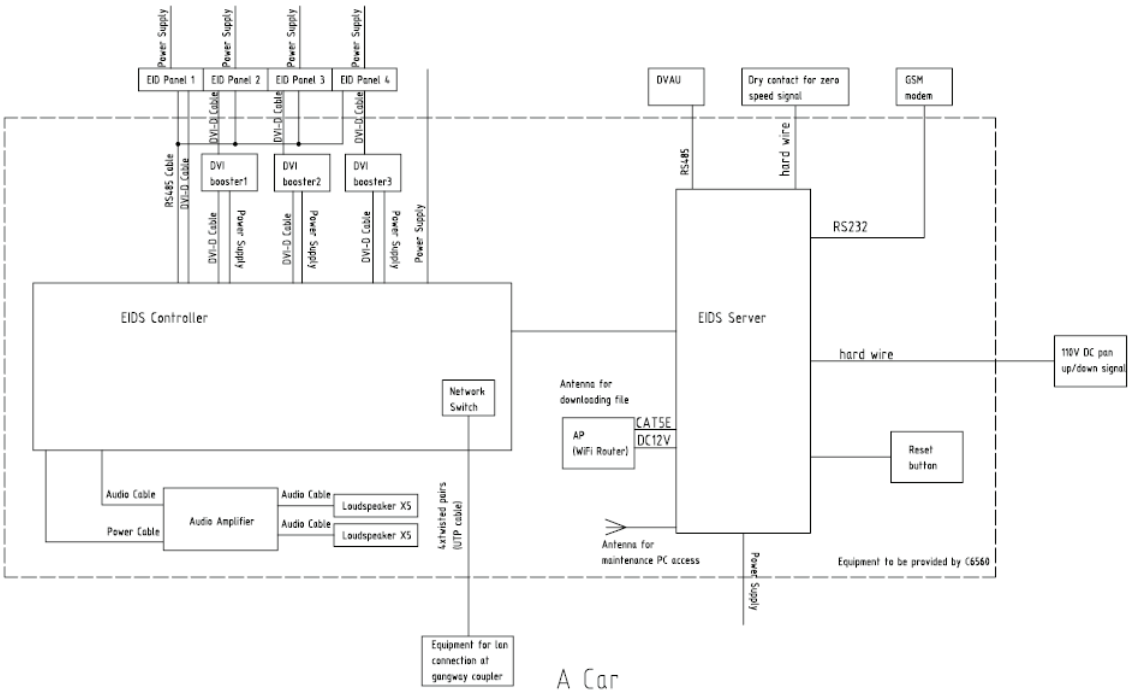
The purpose of this document is to ensure complete compatibility between EIDS and train system.

1.1 Abbreviations and Acronyms

DDS	Detailed Design Specification
DID	Detail Interface Document (including the Interface Design Specification)
DVAS	Digital Voice Announcement System
DVAU	Digital Voice Announcement Unit
EIDS	Electronic Information Display System
EMC	Electromagnetic Compatibility
IMP	Interface Management Plan
IR	Interface Register
GS	General Specification
MoM	Minutes of Meeting
MTR	Mass Transit Railway
PA	Public Address
PDS	Preliminary Design Specification
PS	Particular Specification
RAM	Reliability Availability and Maintainability
SEMP	System Engineering Management Plan
TMS	Train Management System
TRDR	Trainborne Real-time Data Receivers

2 Scope of Supply

The EIDS equipment (except EID panels and inter-car connections) free-supplied by MTR will be required to operate together with communication equipments and system (supplied from the Contractor under MTR contract C6014-14E). The detailed interfaces are shown in the following figure.



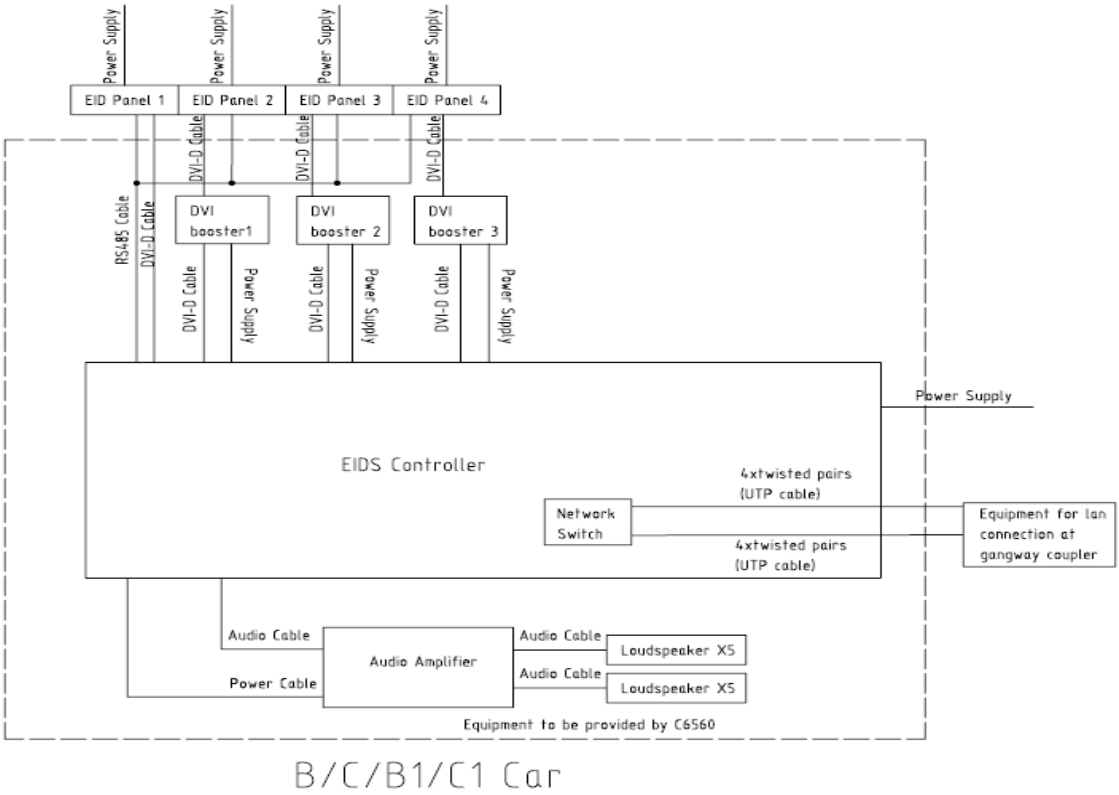


Figure 3-1: Signal Interface between EIDS Interfacing Contractor and C6014-14E

2.1 EIDS Interfacing Contractor Provision

1. EIDS Server
2. EIDS Controller
3. WiFi Router
4. LCD Loudspeaker
5. LAN switch for EIDS
6. EID DVI booster
7. Antenna for maintenance PC access
8. Antenna for download file
9. EIDS reset button
10. Audio Amplifier

2.2 C6014-14E Provision

2.2.1 Relevant Communication Equipment

1. DVAU
2. EID Panel

3. GSM Modem Assemblies
4. Dry contact for zero speed signal in the cab cubicle
5. 110V DC power supply and 110VDC Pan Up / Down signal
6. The equipment for jumper cable of Cat5e for connecting the LAN cables at the gangway couplers

2.2.2 Cable and connector interface arrangement

The cable and connector interface arrangement refers to Appendix 4 Annex 4.6.

3 Mechanical Interface

3.1 EIDS Equipment

The dimensions and mounting arrangements of EIDS Equipment are described as follows.

The minimum bending radius of DVI cable is 150mm, the minimum bending radius of UTG cable is 100mm and minimum bending radius of SMA cable is 50mm. The design is according to this requirement.

3.1.1 EIDS Sever

3.1.1.1 EIDS Sever Mounting Position

There are two EIDS severs in one 8-car train, and the EIDS servers are installed in saloon electric equipment cabinet of A car respectively. The power of EIDS server is supplied by DC110V. EIDS Server is located in end 2 B side of A car. The detailed layout is given in annex 3.1. The connection which is in the front of the equipment and the cable will be connected to the connector. The cables are bundled along the fixed pole to terminal board.

3.1.1.2 EIDS Server Mounting Details

The EIDS server including mounting dimension is 340x435x480.5mm. The details of the EIDS server mounting drawing including connectors is shown in annex 4.1.

3.1.2 EIDS Controller

3.1.2.1 EIDS Controller Mounting Position

There is an EIDS controller in each car, and the EIDS controller is installed in saloon electric equipment cabinet. The power of EIDS controller is supplied by DC110V. The detailed layout of EIDS controller

including audio amplifier is given in annex 3.1. The dimension which is marked on the drawings is in annex 4.2.

The connection which is in the front of the equipment and the cable will be connected to the connector. The cables are bundled along the fixed pole to terminal board.

The detail distance information between cubicle frame and EIDS Controller (or audio amplifier) is shown in annex 3.2.

3.1.2.2 EIDS Controller Mounting Dimension

The EIDS controller including mounting dimension is 340x240x480mm. The details of the EIDS controller mounting drawing including connector is shown in annex 4.2.

3.1.3 WiFi Router & Antenna

3.1.3.1 WiFi Router equipment

There are two different types of antenna, one is only an antenna which is installed in A car saloon cabinet, and another is the antenna which is installed in driving cab.

3.1.3.2 Antenna Mounting Requirement

The position of the antenna on the cab roof is critical for efficient operation, and there must be clear of any metal obstructions which may shadow the antenna. The space restriction is shown is Appendix 4 Annex 4.3. In the current design, the space restriction is that in the front of antenna, there must not be 50mm width metal panel.

3.1.3.3 Antenna Mounting Details

The space restriction for antenna for downloading file is 240mmx260mmx137mm. Detailed equipment layout of the antenna shall refer to Annex 4.4.

The maintenance antenna is connected to EIDS Server CN5 port directly for communication.

The detailed layout of the antenna for downloading file is shown in the annex 3.14.

3.1.4 EIDS Loudspeaker

There are 10 loudspeakers for EIDS in each car and they are arranged in the saloon ceiling. And the arrangement of loudspeaker is shown in annex 3.15. The audio cable schedule including cable length is shown in annex 3.12.

The EIDS loudspeaker provided by EIDS Interfacing Contractor shall be referred to Annex 4.5.

3.1.5 EID DVI Booster

There are 3 EID DVI boosters in each car, only the nearest EID panel need not EID DVI booster to magnify signal. EID DVI booster is mounted on the carbody structure. The detailed mounting drawing is shown in annex 3.13. The minimum cable bending radius is 150mm, so the cable should be straight for 150mm-300mm at the connector side to meet the 150mm bending radius requirement. The sketch is shown in annex 3.18.

3.1.6 Audio amplifier

There is an audio amplifier in each car, and the audio amplifier is connected to EIDS controller and EID loudspeakers.

The mounting position details are shown in annex 3.2.

3.2 Interfaced Train Systems

3.2.1 EIDS Panel

The EIDS is designed for 8-car train with the following configuration:

Equipment name	Quantity								Remark
	A	C	B	B1	C1	B	C	A	
EID panels	3	3	3	3	3	3	3	3	240V AC Input
	1	1	1	1	1	1	1	1	110V DC Input

32 EID Panels (4 panels per car) for electronic information display, and the EIDS system architecture for 8-car train as shown in Annex 3.3.

The layout of EID panel is shown in annex 3.5.

3.3 Cable Connections

3.3.1 EIDS Server to DVAU Cables

EIDS Interfacing Contractor will provide all the RS 485 cables and connector except the connector at the DVAU equipment side (supplied by C6014).
Detailed information of cable and connector is described in annex 4.6.

3.3.2 EIDS Controller to EID Panel Cables

(1) DVI cables

EIDS Interfacing Contractor will supply the DVI-D cables (including connector at both sides of the cable).The length of the DVI cable shall not be longer than 10m for transmitting signal within acceptable signal level, so three EID panels need booster. The booster mounting drawing is shown in annex 4.7, and the booster layout is shown in annex 3.9. The length of DVI cable is shown in annex 3.10.

EIDS Interfacing Contractor will supply connector of EIDS controller side and C6014 will provide connector of EID panel side.

(2) RS 485 cables

EIDS Interfacing Contractor will provide connector at RS 485 cable of EIDS Controller side and RS 485 connector of EIDS controller side.

C6014 will supply the RS 485 cables (including RS 485 connector of EID panel side and RS 485 cable of panel side).

3.4 Cable containment

For the cables used for EIDS system, RS485 cables and DVI cables will be through the RS 485 duct. The audio cable is through audio duct. And power supply cables and 110VDC control / signal cables will be through the DC duct. The detailed cable containment drawing is shown in annex 3.16.

4 Electrical Interface

EIDS server and EIDS controller will be powered from 110V DC power source. The control schematic diagram is described in annex 4.8, and the pin assignment is shown in annex 3.11. And the electrical interface relation is shown in the following figure.

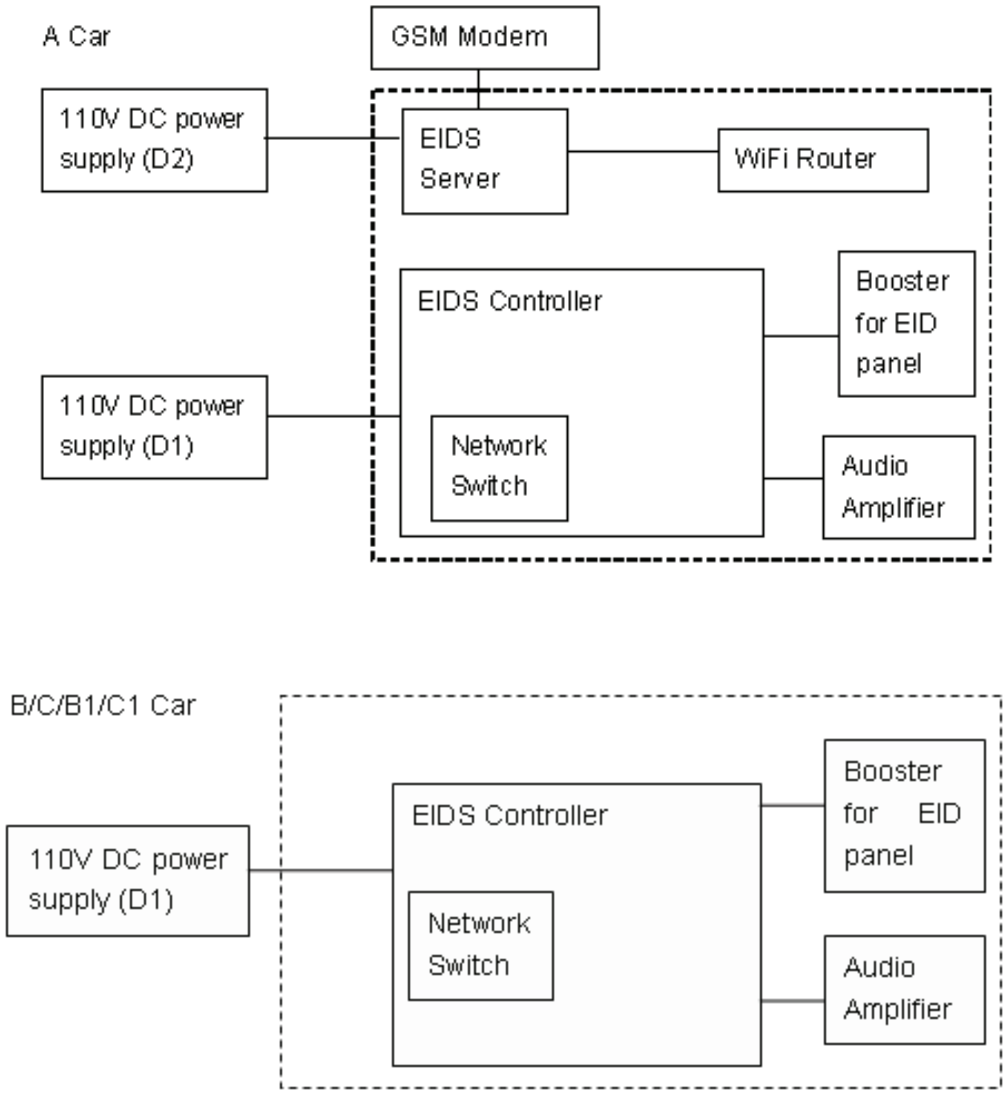


Figure 5-1 Power supply arrangement between EIDS Interfacing Contractor and C6014-14E

4.1 Interface Between EIDS Sever and DVAU

The schematic of the interface between the EIDS Server and DVAU is provided in annex 3.11.

4.2 Interface Between EIDS Controller and EID panel

The booster is for the signal transmission from EIDS controller to EID panel, the power for the booster is DC 5V. And the power is from EIDS controller.

There are 4 EID panels per car. Three units are operating at 240V AC power input, while the other one is operating at 110V DC power input. In

current design, the EID panel which is mounted in Side A and near to the End 1 is supplied by 110V DC, and the rest are supplied by 240V AC.

When there is a loss of AC power on the train, only the panel supplied by DC shall be in service. Normal messages shall not be displayed and only those priority messages shall be displayed in order to save the emergency DC power from the battery.

4.3 Zero-speed Dry Contact

A voltage free relay contact will be provided to EIDS Server for indicating whether the speed of the train is zero or not. The EIDS Server shall monitor this relay contact to achieve the required audio output level adjustment with respect to whether the train is moving or stationary.
The nominal rating used by the EIDS Server to detect the zero speed signals is 100mA at 5VDC.

4.4 Earthing

On the each cabinet, there is an earthing connection bolt, the electronic equipment will be used the cable to connect to it to ensure earthing requirement. For A car, the EID Controller and EID Server will be connected together to earth, and for other cars, the controller will be directly earthed. The washer inner diameter is 4mm or 5mm will be used to earth bonding, and the outer diameter is 12mm or 15mm. So EIDS equipment relevant position paint should be removed.
For the earthing of EID panel, there are equipment earthing point and carbody earthing point, and a cable is used to connect two points to ensure well earthing.

5 Functional Interface

5.1 Interface Between EIDS Sever and DVAU

EIDS Server interfaces with the DVAS and PA to obtain information of door status, next station, pre-recorded DVAS and PA message codes.

Two EIDS Servers are for information updates, controls of network equipment, GSM modem interface and DVAS/PA interface.

According to discussion with C6014 and EIDS Interfacing Contractor, communication mode is confirmed. There are three cases for communication.

Case 1: Both DVAS Sever and EIDS Server are active in the same end. Active DVAS sends all information to the active EIDS Server, and the active EIDS Server performs all necessary actions.

Case 2: The DVAS Server is active in one end while the EIDS Server is active in the other end. And the standby EIDS Server is in service.
At first, the active DVAS Server sends all information to the standby EIDS Server. Then the standby EIDS Server sends all information to the active EIDS Server. At last, the active EIDS Server performs all necessary actions.

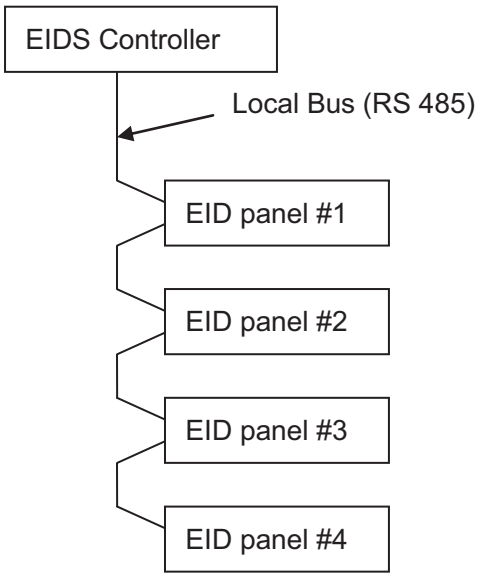
Case 3: The DVAS Server is active in one end while the EIDS Server is active in the other end. In addition, the EIDS Server in the standby mode is out of service.

The active DVAS polls the standby EIDS Server, and active DVAS fails to communicate with the standby EIDS Server. Then the active DVAS sends all information to the standby DVAS (with a delay of no more than 10s). The standby DVAS sends all information to the active EIDS Server and the active EIDS Server performs all necessary actions. The detailed information is shown in annex 4.9.

EIDS Server will transmit some information to DVAU, and DVAU will send the information to TMS for monitor. The detailed interface information which is between DVAU and EIDS Sever is shown in annex 3.20.

5.2 Interface Between EIDS Controller and EID panel

There are 4 EID panels in one car and these EID panels are connected by the multi-drop method. The overall configuration is shown as follows:



There is only one “COMM” port at the EID Panel for the RS485 cables. Connection details shall refer to the latest and approved Detailed Design Specification for EIDS There is only on “COMM” port for RS485 cable, but there is a connector for one “COMM” port. Using the connecter, the RS485 cable will be connected to next EID Panel.

The detailed interface between EIDS controller and EID panel is shown in annex 3.19.

EIDS Panel will transmit error information (no signal input) to EIDS Controller, and when controller can not monitor EID Panel during a period of time, it will determine connection overtime with EID Panel automatically.

6 EMC

To ensure that there is no electro-magnetic interference to the communication equipments supplied by C6014 and communication equipments and systems supplied by MTR, the EMC analysis and testing will be carried out in accordance with PS RS/C6014/04.

7 Testing

The interface test shall be jointly conducted by C6014 and EIDS Interfacing Contractor, and interface test specification will be developed. C6014 and EIDS Interfacing Contractor shall support the testing by

attending the tests and to provide technical advice with regard to the design and operation of the equipment as and when necessary.

Both contractors will ensure that their respective equipment is fully tested.

Detailed test procedure will be provided from the Contractor in the future.

Appendix

Appendix 1 Not used.

Appendix 2 Not used.

Appendix 3 Interface Information and Drawings provided by C6014-14E

annex 3.1 EIDS Server and EIDS Controller layout

annex 3.2 Distance for partition door&EIDS controller front panel

annex 3.3 EIDS Panel architecture for 8-car Train

annex 3.4 Not used.

annex 3.5 Layout of EID panel

annex 3.6 Not used.

annex 3.7 Not used.

annex 3.8 Not used.

annex 3.9 Booster Layout

annex 3.10 length of DVI cable

annex 3.11 Schematic of EIDS system

annex 3.12 Audio cable schedule including cable length

annex 3.13 EID DVI Booster mounting drawing

annex 3.14 Detailed layout of antenna in cab

annex 3.15 EIDS Loudspeaker installation

annex 3.16 Cable containment drawing.

annex 3.17 Not used.

annex 3.18 DVI cable layout sketch

annex 3.19 Interface Control Document Between EIDS Panel & Controller ver F

annex 3.20 Interface Control Document Between DVAS&EIDS Rev G

annex 3.21 Not used.

Appendix 4 Interface Information and Drawings provided by EIDS Interfacing Contractor

Annex 4.1 Details of the EIDS server mounting drawing (including connector)

Annex 4.2 Details of the EIDS controller mounting drawing (including connector)

Annex 4.3 Non-metal space restriction for WiFi Router in cab

Annex 4.4 Agreed mounting drawing of the antenna on the driving cab

Annex 4.5 EIDS Interfacing Contractor speaker drawing

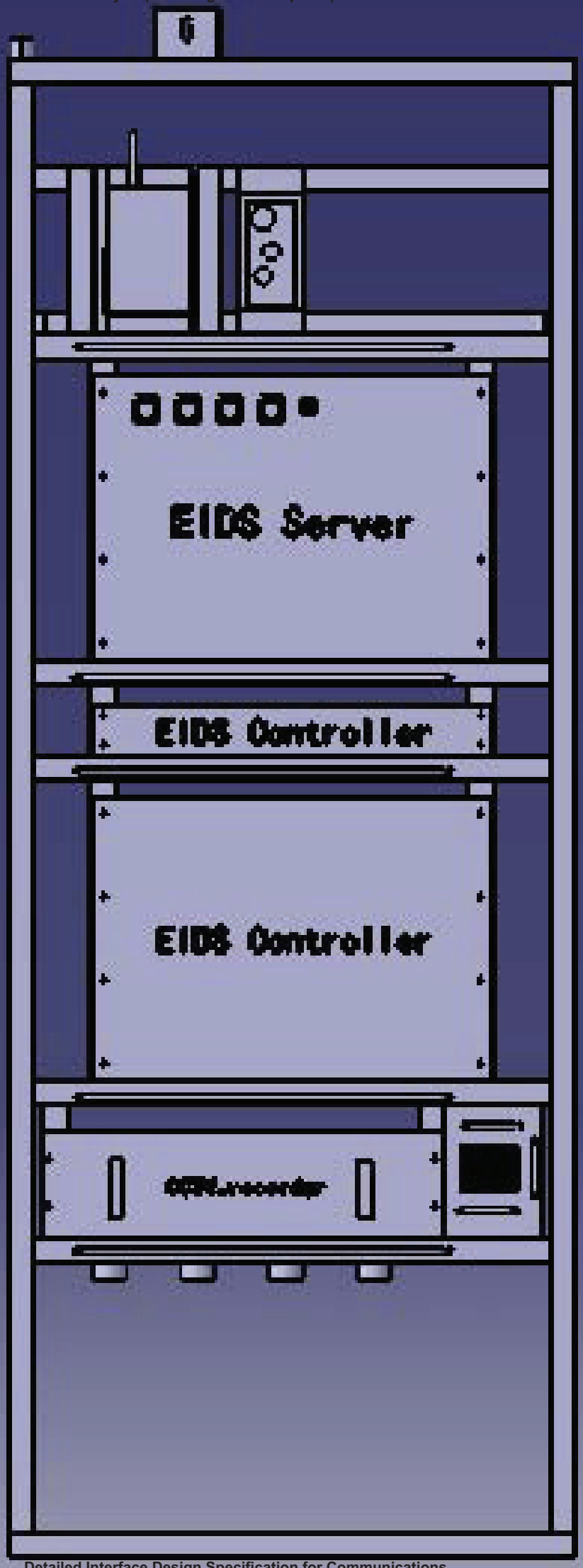
Annex 4.6 Detailed cable and connector information

Annex 4.7 Booster mounting drawing

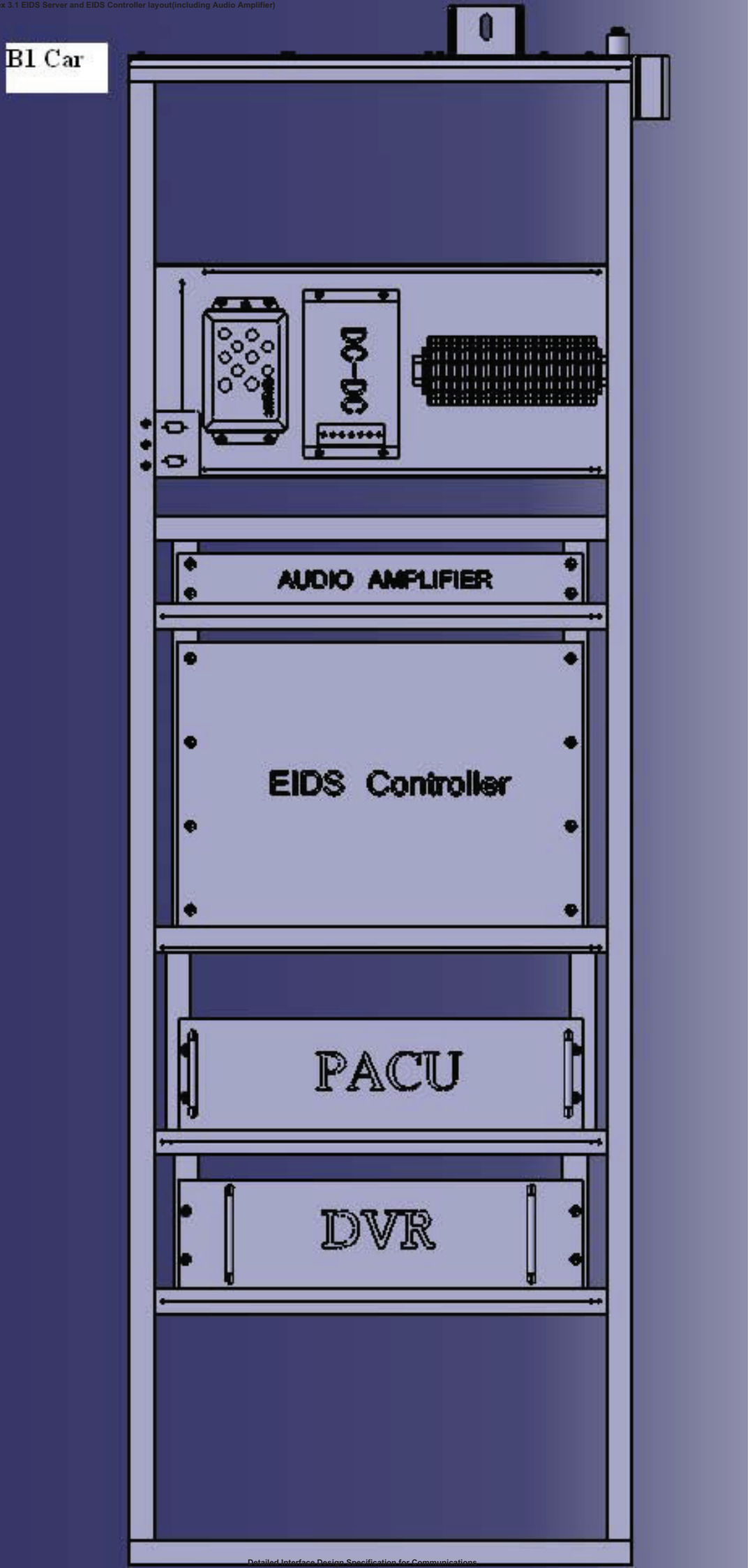
Annex 4.8 Control schematic diagram

Annex 4.9 Communication mode between DVAU and EIDS Server

A Car



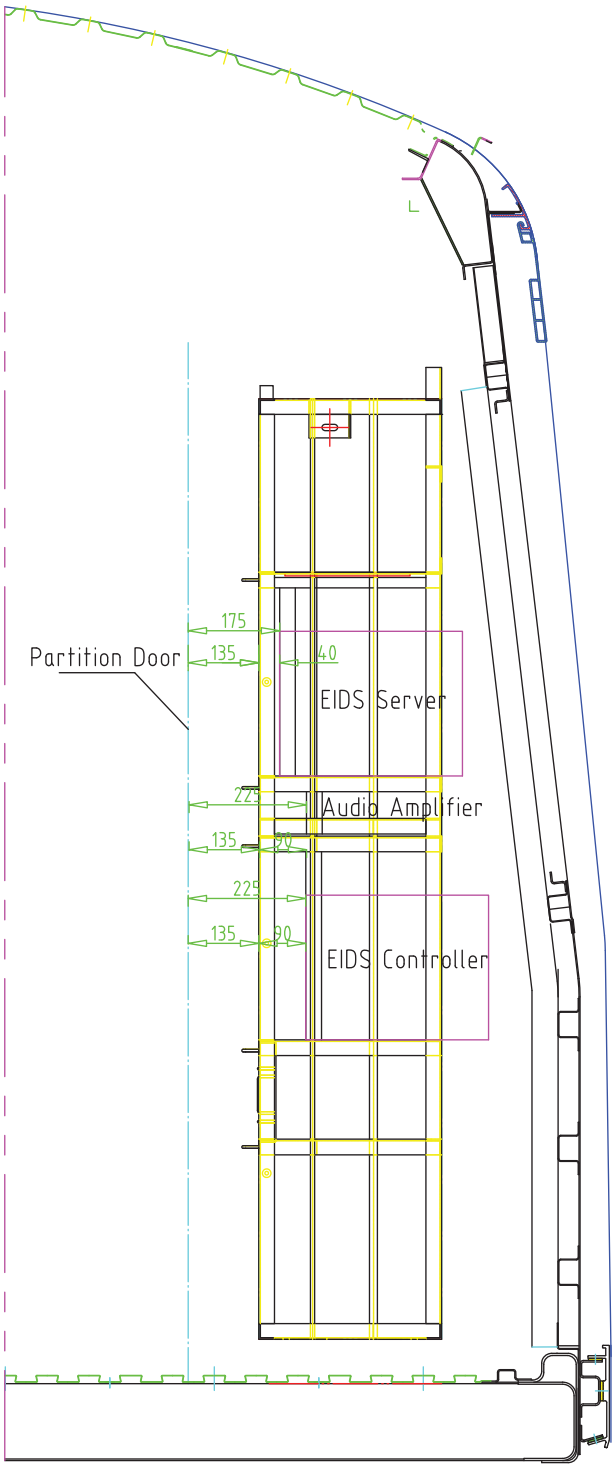
B Car
0
DC-DC
AUDIO AMPLIFIER
EIDS Controller
PACU


B1 Car
AUDIO AMPLIFIER
EIDS Controller
PACU
DVR

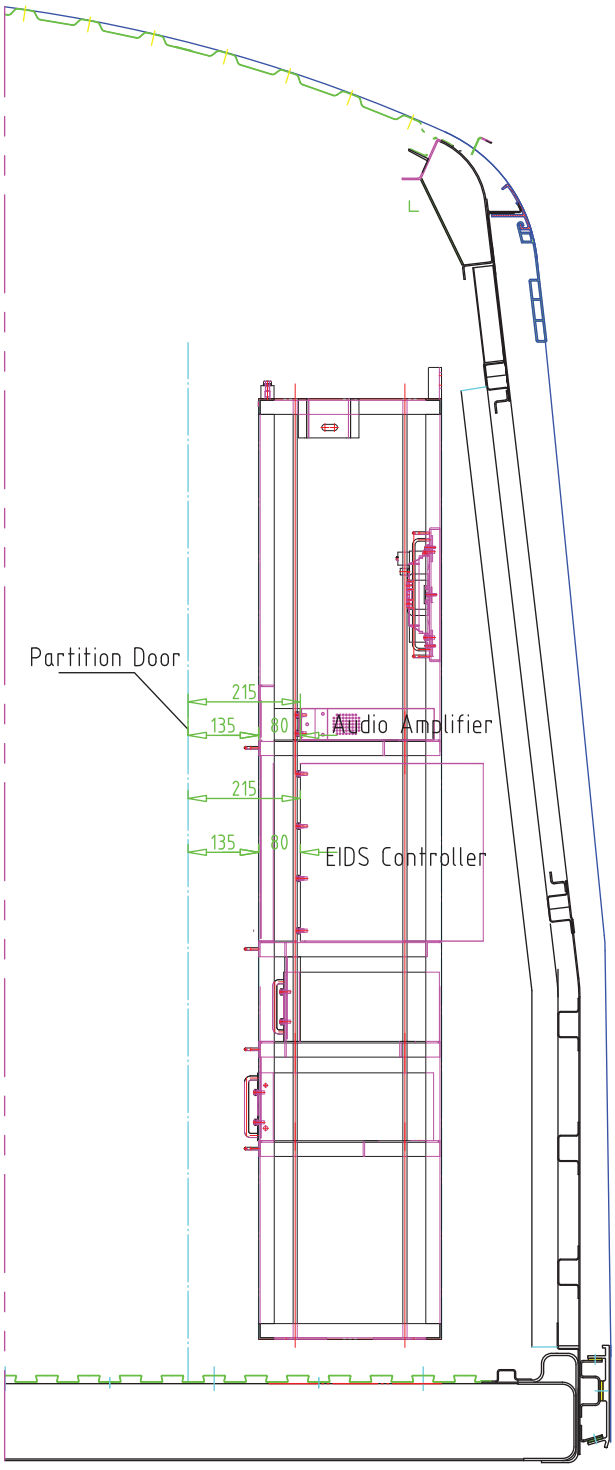
C Car
AUDIO AMPLIFIER
EIDS Controller
PACU

C1 Car

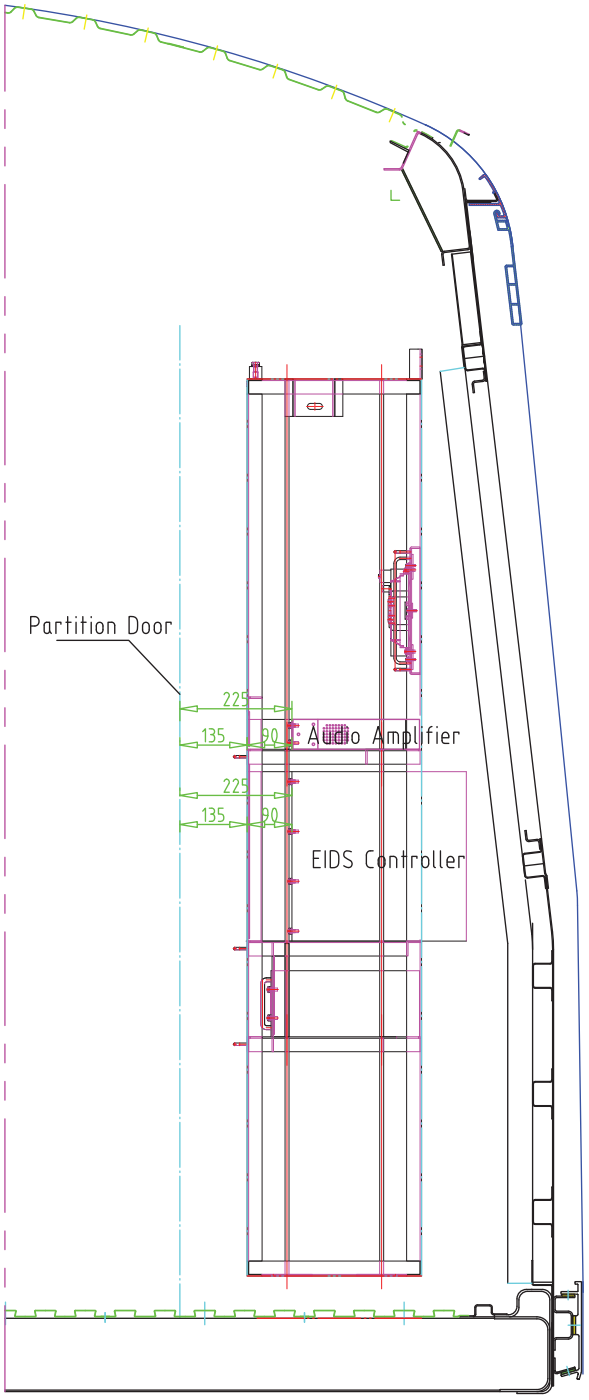
A CAR


Partition Door
175
135
40
EIDS Server
225
Audio Amplifier
135
80
225
135
80
EIDS Controller

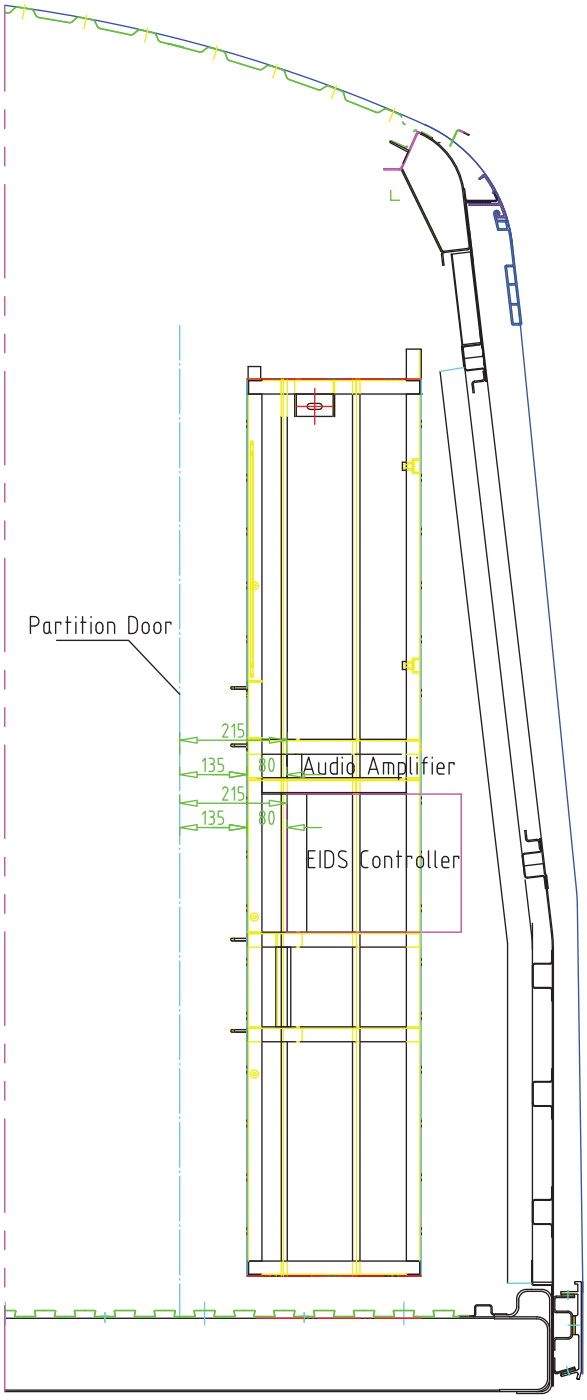
B1 CAR

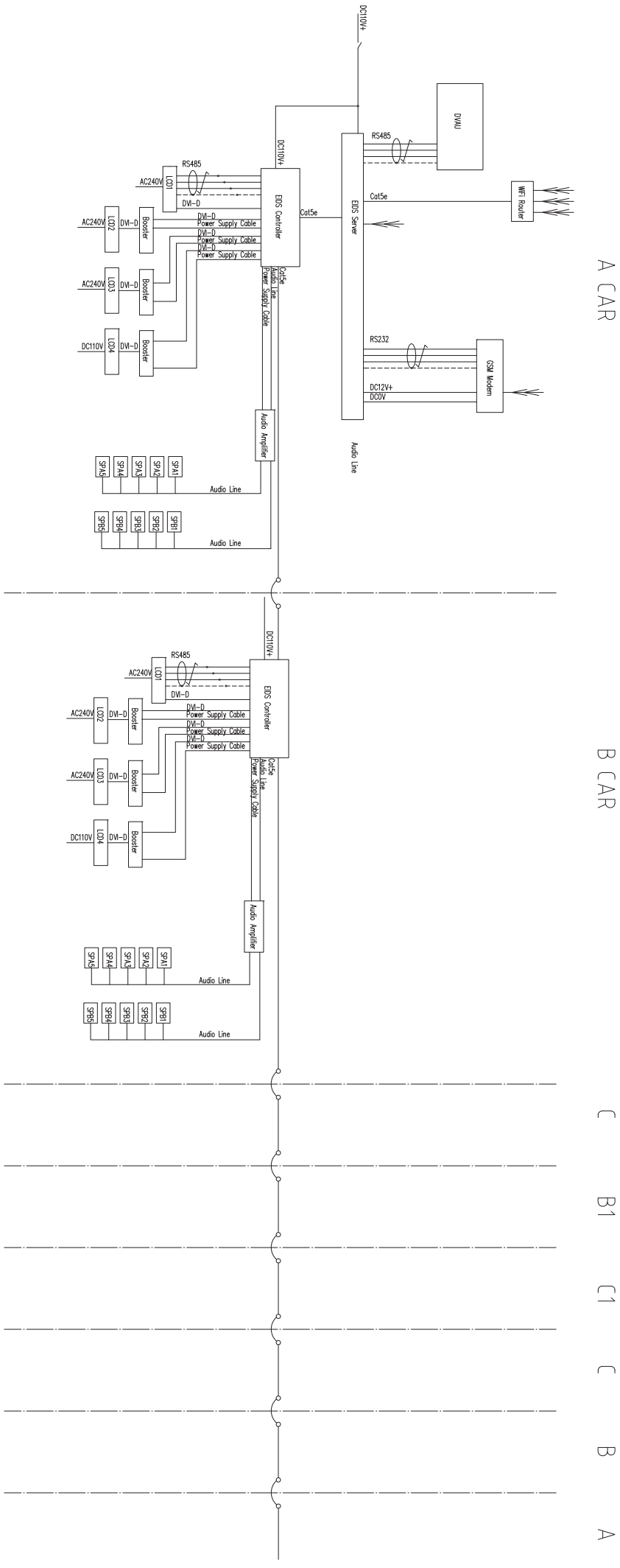

Partition Door
215
135
80
Audio Amplifier
215
135
80
EIDS Controller

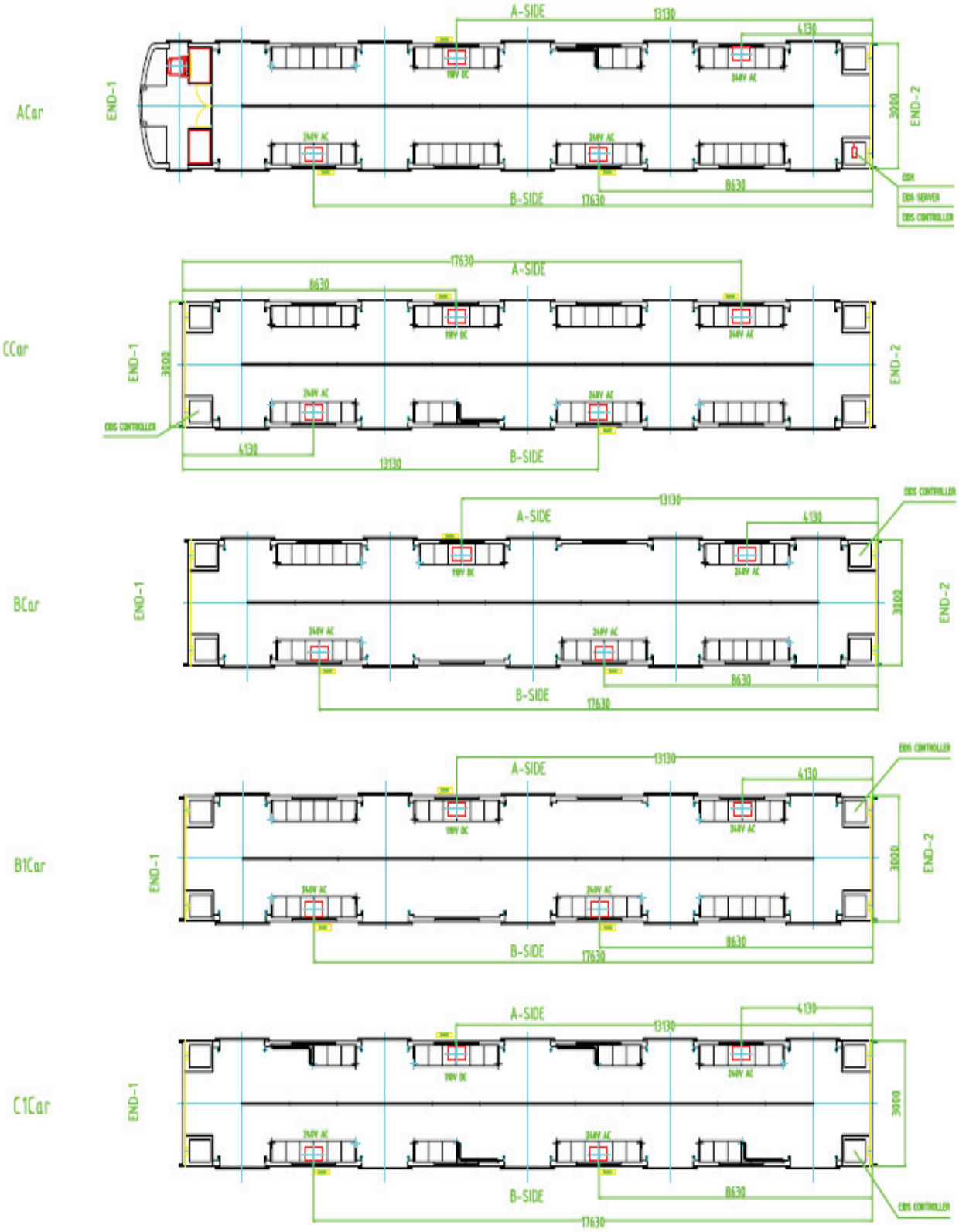
B/C CAR

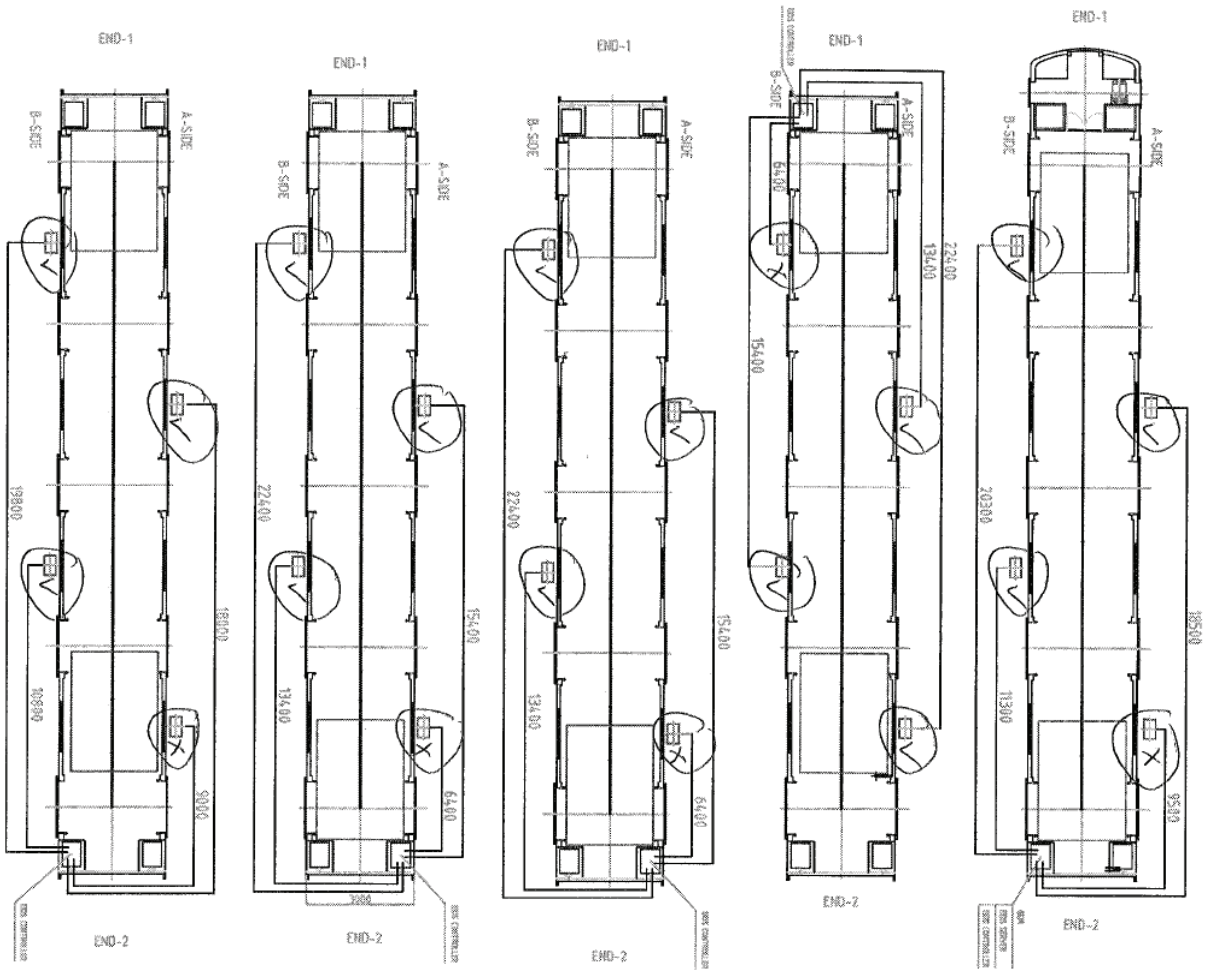

Partition Door
225
135
90
Audio Amplifier
225
135
90
EIDS Controller

C1 CAR


Partition Door
215
135
80
Audio Amplifier
215
135
80
EIDS Controller


DC110V+
DVAU
RS485
EIDS Server
Cat5e
WiFi Router
RS232
GSM Modem
DC12V+
DC0V
Audio Line
A CAR
B CAR
C
B1
C1
C
B
A
EIDS Controller
LCD1
LCD2
LCD3
LCD4
AC240V
DC110V
DVI-D
Booster
Power Supply Cable
Audio Amplifier
SPA1
SPA2
SPA3
SPA4
SPA5
SPB1
SPB2
SPB3
SPB4
SPB5


ACar
A-SIDE
13130
4130
END-1
END-2
3000
B-SIDE
17630
8630
EDS SERVER
EDS CONTROLLER
CCar
EDS CONTROLLER
BCar
B1Car
C1Car

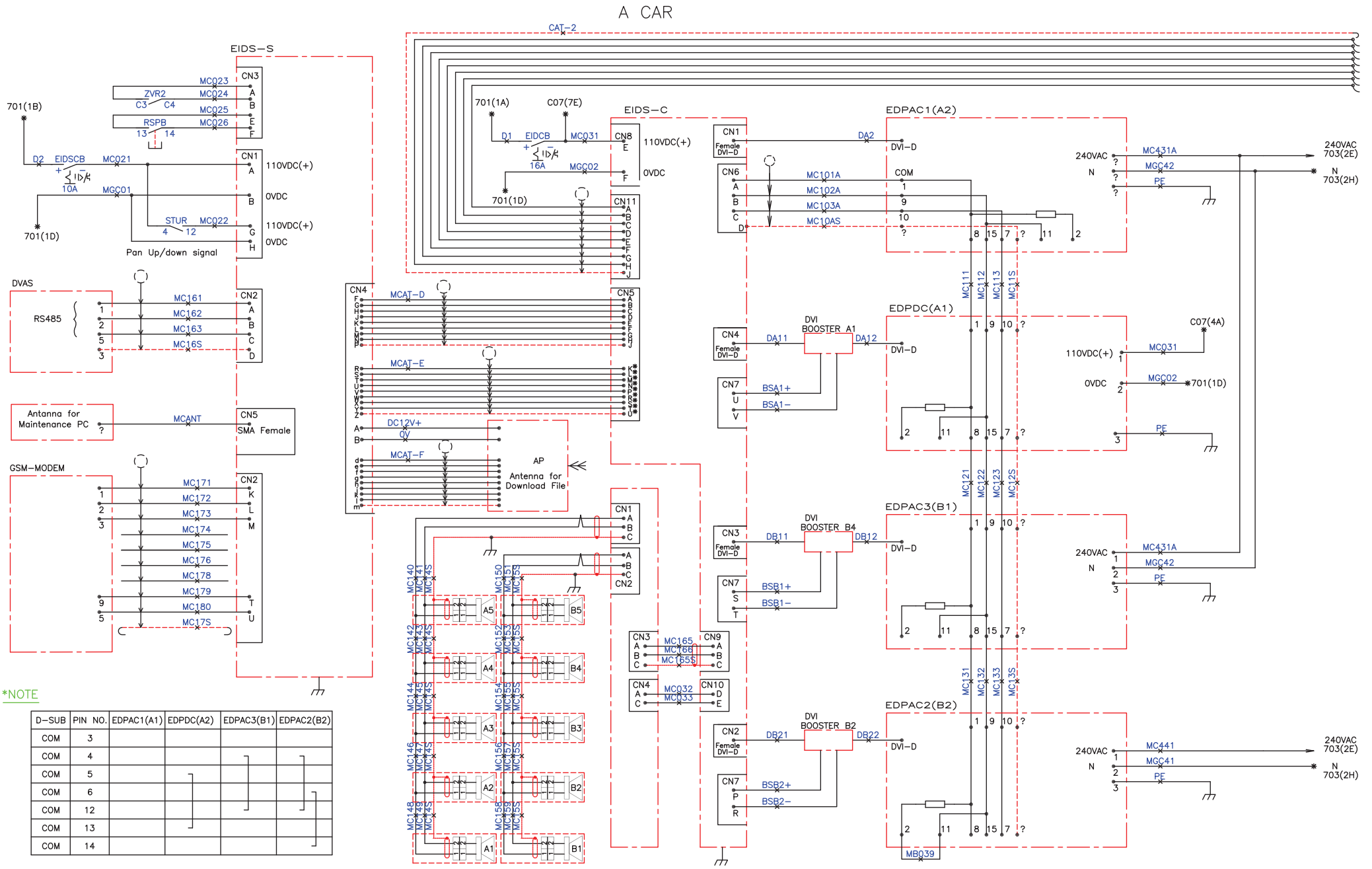


Legend：The “Tick” is the EID panel need EID booster

The “Cross” is the EID panel need not EID booster

DVI Cable(预制)

					From		To		
Car Type	Cable type	Cable No	Core No (C6554)	Core No (C6560)	location	Plug/Socket	location	Plug/Socket	Length(mm)
Odd A car	DVI-D	M314917	DA11	80101	EIDS Controller	DVI-D(M)	booster A1	DVI-D(M)	19000
Odd A car	DVI-D	M304919	DA12	?	booster A1	DVI-D(M)	EIDS Panel A1	DVI-D(M)	1500
Odd A car	DVI-D	M314916	DA2	80102	EIDS Controller	DVI-D(M)	EIDS Panel A2	DVI-D(M)	11000
Odd A car	DVI-D	M314914	DB11	80103	EIDS Controller	DVI-D(M)	booster B1	DVI-D(M)	20500
Odd A car	DVI-D	M304919	DB12	?	booster B1	DVI-D(M)	EIDS Panel B1	DVI-D(M)	1500
Odd A car	DVI-D	M314915	DB21	80104	EIDS Controller	DVI-D(M)	booster B2	DVI-D(M)	11500
Odd A car	DVI-D	M304919	DB22	?	booster B2	DVI-D(M)	EIDS Panel B2	DVI-D(M)	1500
Odd C car	DVI-D	T314915	DA11	80101	EIDS Controller	DVI-D(M)	booster A1	DVI-D(M)	11500
Odd C car	DVI-D	T304919	DA12	?	booster A1	DVI-D(M)	EIDS Panel A1	DVI-D(M)	1500
Odd C car	DVI-D	T314914	DA21	80102	EIDS Controller	DVI-D(M)	booster A2	DVI-D(M)	20500
Odd C car	DVI-D	T304919	DA12	?	booster A2	DVI-D(M)	EIDS Panel A2	DVI-D(M)	1500
Odd C car	DVI-D	T314916	DB1	80103	EIDS Controller	DVI-D(M)	EIDS Panel B1	DVI-D(M)	11000
Odd C car	DVI-D	T314917	DB21	80104	EIDS Controller	DVI-D(M)	booster B1	DVI-D(M)	19000
Odd C car	DVI-D	T304919	DB22	?	booster B1	DVI-D(M)	EIDS Panel B2	DVI-D(M)	1500
Odd B car	DVI-D	R314913	DA11	80101	EIDS Controller	DVI-D(M)	booster A1	DVI-D(M)	16000
Odd B car	DVI-D	R304919	DA12	?	booster A1	DVI-D(M)	EIDS Panel A1	DVI-D(M)	1500
Odd B car	DVI-D	R314912	DA2	80102	EIDS Controller	DVI-D(M)	EIDS Panel A2	DVI-D(M)	8000
Odd B car	DVI-D	R314910	DB31	80103	EIDS Controller	DVI-D(M)	booster B1	DVI-D(M)	23500
Odd B car	DVI-D	R304919	DB32	?	booster B1	DVI-D(M)	EIDS Panel B1	DVI-D(M)	1500
Odd B car	DVI-D	R314911	DB21	80104	EIDS Controller	DVI-D(M)	booster B2	DVI-D(M)	14500
Odd B car	DVI-D	R304919	DB22	?	booster B2	DVI-D(M)	EIDS Panel B2	DVI-D(M)	1500
B1 car	DVI-D	H314913	DA11	80101	EIDS Controller	DVI-D(M)	booster A1	DVI-D(M)	16000
B1 car	DVI-D	H304919	DA12	?	booster A1	DVI-D(M)	EIDS Panel A1	DVI-D(M)	1500
B1 car	DVI-D	H314912	DA2	80102	EIDS Controller	DVI-D(M)	EIDS Panel A2	DVI-D(M)	8000
B1 car	DVI-D	H314910	DB31	80103	EIDS Controller	DVI-D(M)	booster B1	DVI-D(M)	23500
B1 car	DVI-D	H304919	DB32	?	booster B1	DVI-D(M)	EIDS Panel B1	DVI-D(M)	1500
B1 car	DVI-D	H314911	DB21	80104	EIDS Controller	DVI-D(M)	booster B2	DVI-D(M)	14500
B1 car	DVI-D	H304919	DB22	?	booster B2	DVI-D(M)	EIDS Panel B2	DVI-D(M)	1500
C1 car	DVI-D	K314917	DA11	80101	EIDS Controller	DVI-D(M)	booster A1	DVI-D(M)	19000
C1 car	DVI-D	K304919	DA12	?	booster A1	DVI-D(M)	EIDS Panel A1	DVI-D(M)	1500
C1 car	DVI-D	K314916	DA2	80102	EIDS Controller	DVI-D(M)	EIDS Panel A2	DVI-D(M)	11000
C1 car	DVI-D	K314914	DB31	80103	EIDS Controller	DVI-D(M)	booster B1	DVI-D(M)	20500
C1 car	DVI-D	K304919	DB32	?	booster B1	DVI-D(M)	EIDS Panel B1	DVI-D(M)	1500
C1 car	DVI-D	K314915	DB21	80104	EIDS Controller	DVI-D(M)	booster B2	DVI-D(M)	11500
C1 car	DVI-D	K304919	DB22	?	booster B2	DVI-D(M)	EIDS Panel B2	DVI-D(M)	1500
Even B car	DVI-D	R314913	DA11	80101	EIDS Controller	DVI-D(M)	booster A1	DVI-D(M)	16000
Even B car	DVI-D	R304919	DA12	?	booster A1	DVI-D(M)	EIDS Panel A1	DVI-D(M)	1500
Even B car	DVI-D	R314912	DA2	80102	EIDS Controller	DVI-D(M)	EIDS Panel A2	DVI-D(M)	8000
Even B car	DVI-D	R314910	DB31	80103	EIDS Controller	DVI-D(M)	booster B1	DVI-D(M)	23500
Even B car	DVI-D	R304919	DB32	?	booster B1	DVI-D(M)	EIDS Panel B1	DVI-D(M)	1500
Even B car	DVI-D	R314911	DB21	80104	EIDS Controller	DVI-D(M)	booster B2	DVI-D(M)	14500
Even B car	DVI-D	R304919	DB22	?	booster B2	DVI-D(M)	EIDS Panel B2	DVI-D(M)	1500
Even C car	DVI-D	T314915	DA11	80101	EIDS Controller	DVI-D(M)	booster A1	DVI-D(M)	11500
Even C car	DVI-D	T304919	DA12	?	booster A1	DVI-D(M)	EIDS Panel A1	DVI-D(M)	1500
Even C car	DVI-D	T314914	DA21	80102	EIDS Controller	DVI-D(M)	booster A2	DVI-D(M)	20500
Even C car	DVI-D	T304919	DA12	?	booster A2	DVI-D(M)	EIDS Panel A2	DVI-D(M)	1500
Even C car	DVI-D	T314916	DB1	80103	EIDS Controller	DVI-D(M)	EIDS Panel B1	DVI-D(M)	11000
Even C car	DVI-D	T314917	DB21	80104	EIDS Controller	DVI-D(M)	booster B1	DVI-D(M)	19000
Even C car	DVI-D	T304919	DB22	?	booster B1	DVI-D(M)	EIDS Panel B2	DVI-D(M)	1500
Even A car	DVI-D	M314917	DA11	80101	EIDS Controller	DVI-D(M)	booster A1	DVI-D(M)	19000
Even A car	DVI-D	M304919	DA12	?	booster A1	DVI-D(M)	EIDS Panel A1	DVI-D(M)	1500
Even A car	DVI-D	M314916	DA2	80102	EIDS Controller	DVI-D(M)	EIDS Panel A2	DVI-D(M)	11000
Even A car	DVI-D	M314914	DB11	80103	EIDS Controller	DVI-D(M)	booster B1	DVI-D(M)	20500
Even A car	DVI-D	M304919	DB12	?	booster B1	DVI-D(M)	EIDS Panel B1	DVI-D(M)	1500
Even A car	DVI-D	M314915	DB21	80104	EIDS Controller	DVI-D(M)	booster B2	DVI-D(M)	11500
Even A car	DVI-D	M304919	DB22	?	booster B2	DVI-D(M)	EIDS Panel B2	DVI-D(M)	1500



*NOTE

D-SUB	PIN NO.	EDPAC1(A1)	EDPDC(A2)	EDPAC3(B1)	EDPAC2(B2)
COM	3				
COM	4				
COM	5				
COM	6				
COM	12				
COM	13				
COM	14				

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

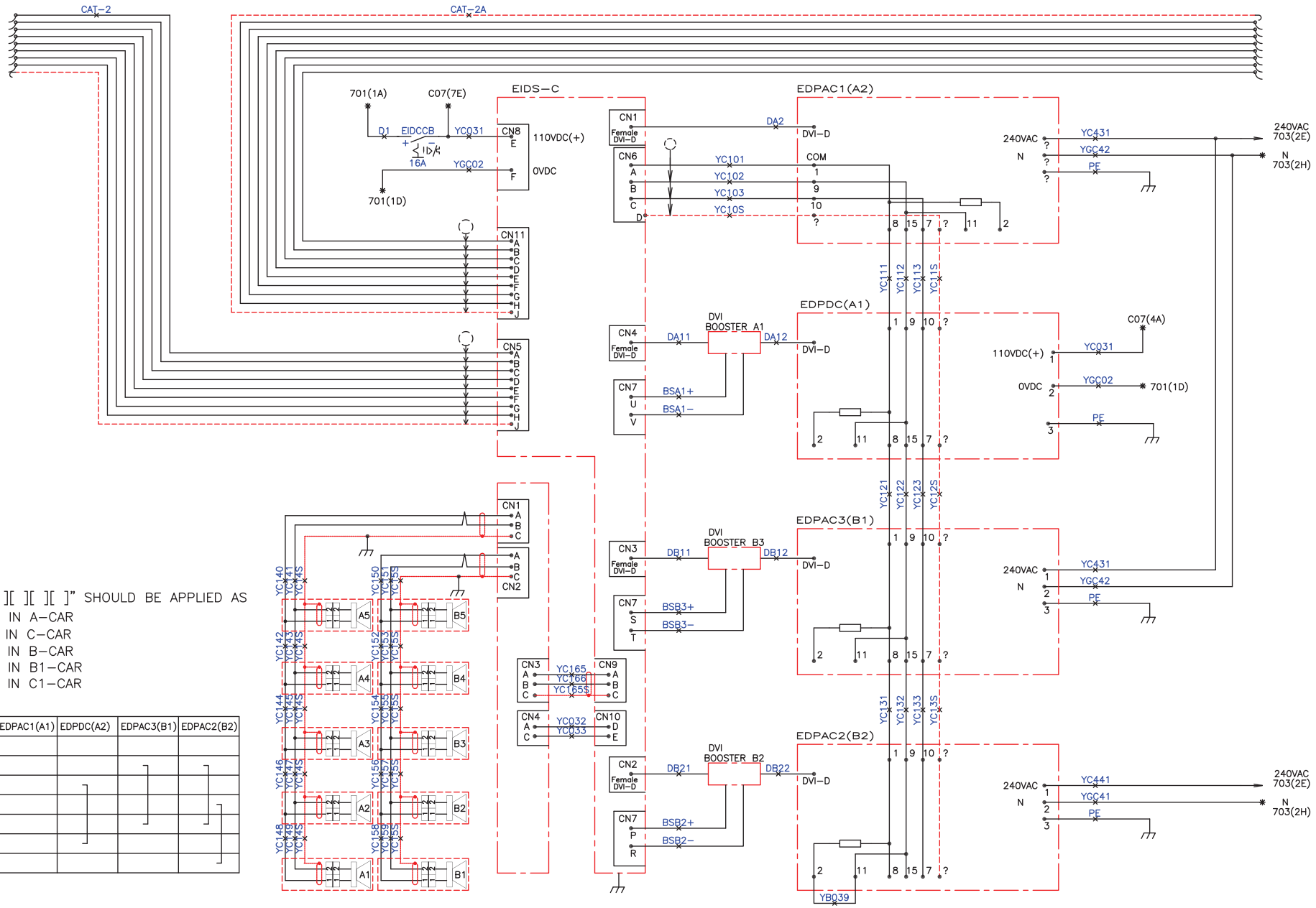
REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

TITLE: EIDS A CAR

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1		

DRAWING NO. | VERSION

B/B1/C1 CAR



*NOTE

1. WIRE NO. "Y[ ][ ][ ][ ]" SHOULD BE APPLIED AS
   "M[ ][ ][ ][ ]" IN A-CAR
   "T[ ][ ][ ][ ]" IN C-CAR
   "R[ ][ ][ ][ ]" IN B-CAR
   "H[ ][ ][ ][ ]" IN B1-CAR
   "K[ ][ ][ ][ ]" IN C1-CAR

D-SUB	PIN NO.	EDPAC1(A1)	EDPDC(A2)	EDPAC3(B1)	EDPAC2(B2)
COM	3				
COM	4				
COM	5				
COM	6				
COM	12				
COM	13				
COM	14				

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

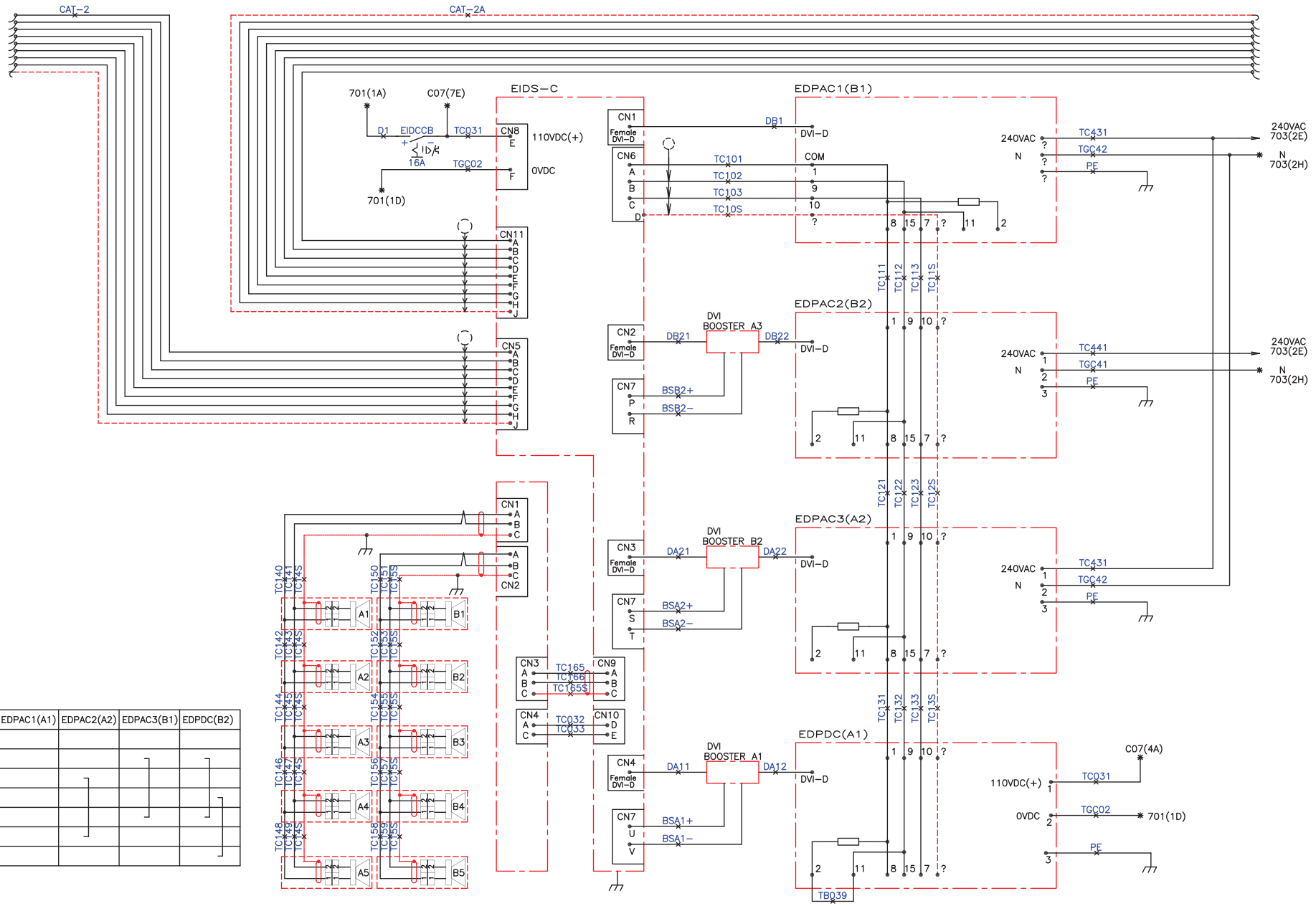
REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

TITLE: EIDS B,B1,C1 CAR

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1		

DRAWING NO. | VERSION

C CAR



*NOTE

D-SUB	PIN NO.	EDPAC1(A1)	EDPAC2(A2)	EDPAC3(B1)	EDPDC(B2)
COM	3				
COM	4				
COM	5				
COM	6				
COM	12				
COM	13				
COM	14				

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

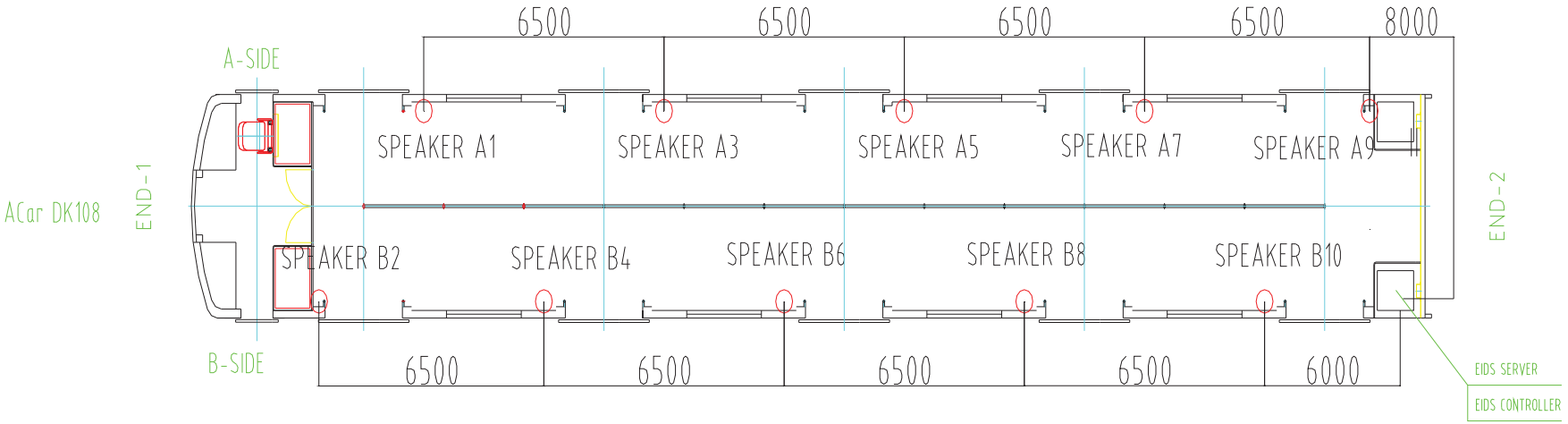
REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

TITLE: EIDS C CAR

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1		

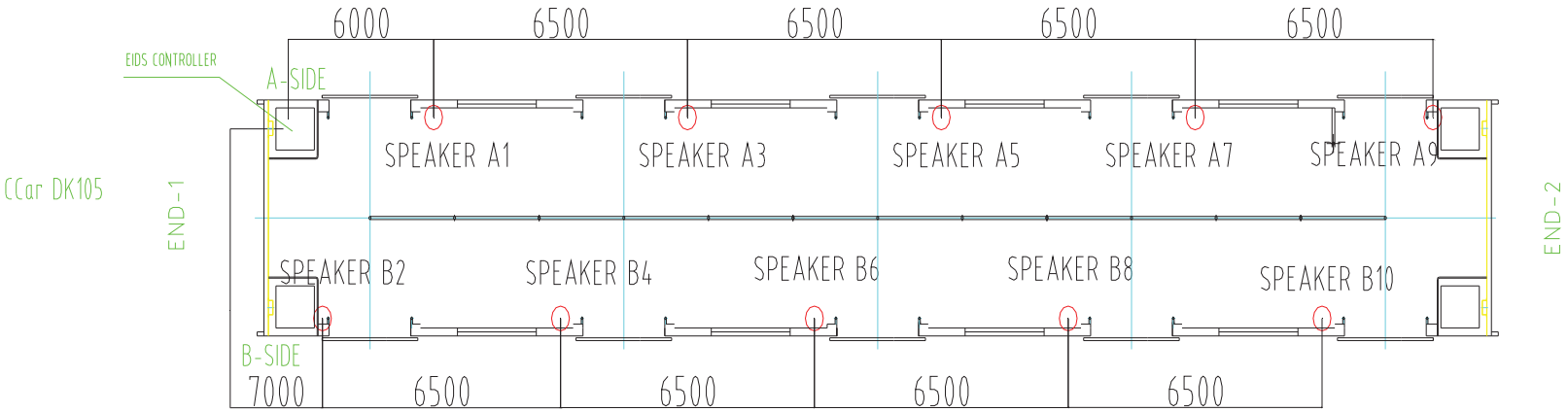
A CAR

Cable type	Cable No	From		To		Length(mm)
		location	Plug/Socket	location	Plug/Socket	
2 core twisted pair Screen cable (Audio cable)		Audio amplifier CN1	*UTG-6/14/12P (M)*	Louder speaker A9 S1	*Terminal block in Loudspeaker*	8000
2 core twisted pair Screen cable (Audio cable)		Louder speaker A9 S1	*Terminal block in Loudspeaker*	Louder speaker A7 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A7 S1	*Terminal block in Loudspeaker*	Louder speaker A5 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A5 S1	*Terminal block in Loudspeaker*	Louder speaker A3 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A3 S1	*Terminal block in Loudspeaker*	Louder speaker A1 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Audio amplifier CN2	*UTG-6/14/12P (M)*	Louder speaker B10 S1	*Terminal block in Loudspeaker*	6000
2 core twisted pair Screen cable (Audio cable)		Louder speaker B10 S1	*Terminal block in Loudspeaker*	Louder speaker B8 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B8 S1	*Terminal block in Loudspeaker*	Louder speaker B6 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B6 S1	*Terminal block in Loudspeaker*	Louder speaker B4 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B4 S1	*Terminal block in Loudspeaker*	Louder speaker B2 S1	*Terminal block in Loudspeaker*	6500


6500
6500
6500
6500
8000
A-SIDE
SPEAKER A1
SPEAKER A3
SPEAKER A5
SPEAKER A7
SPEAKER A9
ACar DK108
END-1
END-2
SPEAKER B2
SPEAKER B4
SPEAKER B6
SPEAKER B8
SPEAKER B10
B-SIDE
6500
6500
6500
6500
6000
EIDS SERVER
EIDS CONTROLLER

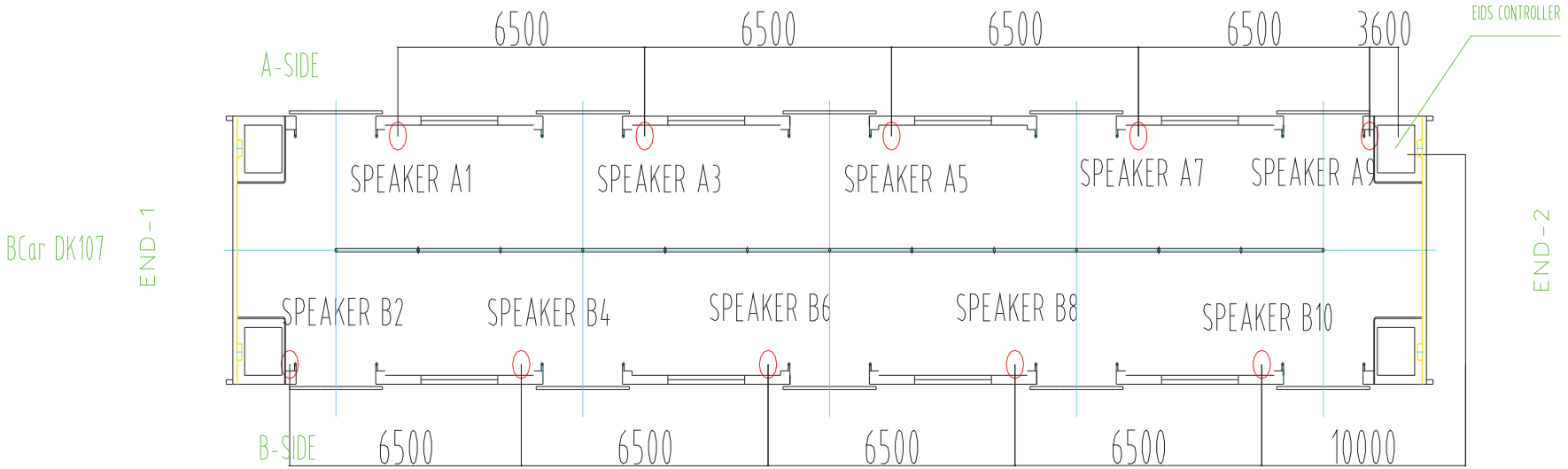
C CAR

Cable type	Cable No	From		To		Length(mm)
		location	Plug/Socket	location	Plug/Socket	
2 core twisted pair Screen cable (Audio cable)		Audio amplifier CN1	*UTG-6/12/BP (M)*	Louder speaker A1 S1	*Terminal block in Loudspeaker*	6000
2 core twisted pair Screen cable (Audio cable)		Louder speaker A1 S1	*Terminal block in Loudspeaker*	Louder speaker A3 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A3 S1	*Terminal block in Loudspeaker*	Louder speaker A5 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A5 S1	*Terminal block in Loudspeaker*	Louder speaker A7 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A7 S1	*Terminal block in Loudspeaker*	Louder speaker A9 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Audio amplifier CN2	*UTG-6/12/BP (M)*	Louder speaker B2 S1	*Terminal block in Loudspeaker*	7000
2 core twisted pair Screen cable (Audio cable)		Louder speaker B2 S1	*Terminal block in Loudspeaker*	Louder speaker B4 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B4 S1	*Terminal block in Loudspeaker*	Louder speaker B6 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B6 S1	*Terminal block in Loudspeaker*	Louder speaker B8 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B8 S1	*Terminal block in Loudspeaker*	Louder speaker B10 S1	*Terminal block in Loudspeaker*	6500


6000
6500
6500
6500
6500
EIDS CONTROLLER
A-SIDE
SPEAKER A1
SPEAKER A3
SPEAKER A5
SPEAKER A7
SPEAKER A9
CCar DK105
END-1
END-2
SPEAKER B2
SPEAKER B4
SPEAKER B6
SPEAKER B8
SPEAKER B10
B-SIDE
7000
6500
6500
6500
6500

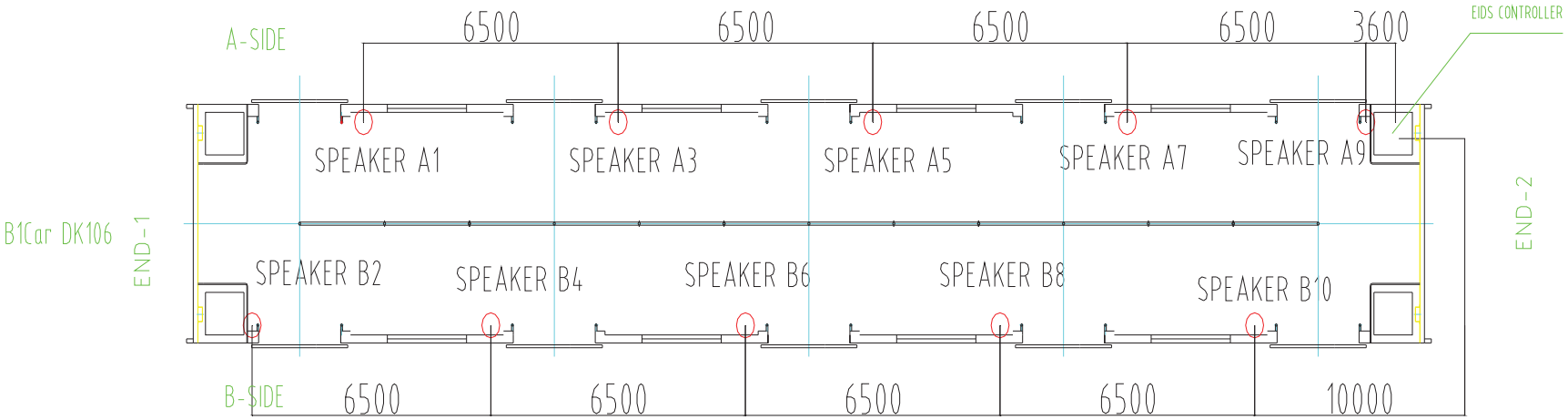
B CAR

Cable type	Cable No	From		To		Length(mm)
		location	Plug/Socket	location	Plug/Socket	
2 core twisted pair Screen cable (Audio cable)		Audio amplifier CN1	*UTG-6/12/8P (M)*	Louder speaker A9 S1	*Terminal block in Loudspeaker*	3600
2 core twisted pair Screen cable (Audio cable)		Louder speaker A9 S1	*Terminal block in Loudspeaker*	Louder speaker A7 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A7 S1	*Terminal block in Loudspeaker*	Louder speaker A5 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A5 S1	*Terminal block in Loudspeaker*	Louder speaker A3 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A3 S1	*Terminal block in Loudspeaker*	Louder speaker A1 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Audio amplifier CN2	*UTG-6/12/8P (M)*	Louder speaker B10 S1	*Terminal block in Loudspeaker*	10000
2 core twisted pair Screen cable (Audio cable)		Louder speaker B10 S1	*Terminal block in Loudspeaker*	Louder speaker B8 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B8 S1	*Terminal block in Loudspeaker*	Louder speaker B6 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B6 S1	*Terminal block in Loudspeaker*	Louder speaker B4 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B4 S1	*Terminal block in Loudspeaker*	Louder speaker B2 S1	*Terminal block in Loudspeaker*	6500


6500
6500
6500
6500
3600
EIDS CONTROLLER
A-SIDE
SPEAKER A1
SPEAKER A3
SPEAKER A5
SPEAKER A7
SPEAKER A9
BCar DK107
END-1
END-2
SPEAKER B2
SPEAKER B4
SPEAKER B6
SPEAKER B8
SPEAKER B10
B-SIDE
6500
6500
6500
6500
10000

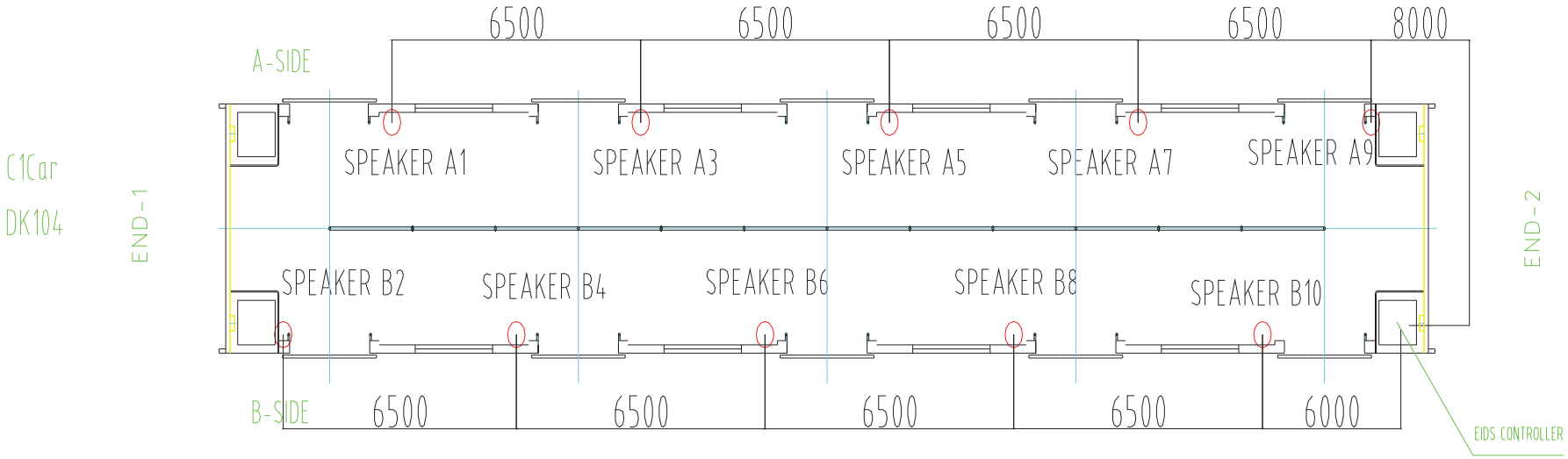
B1 CAR

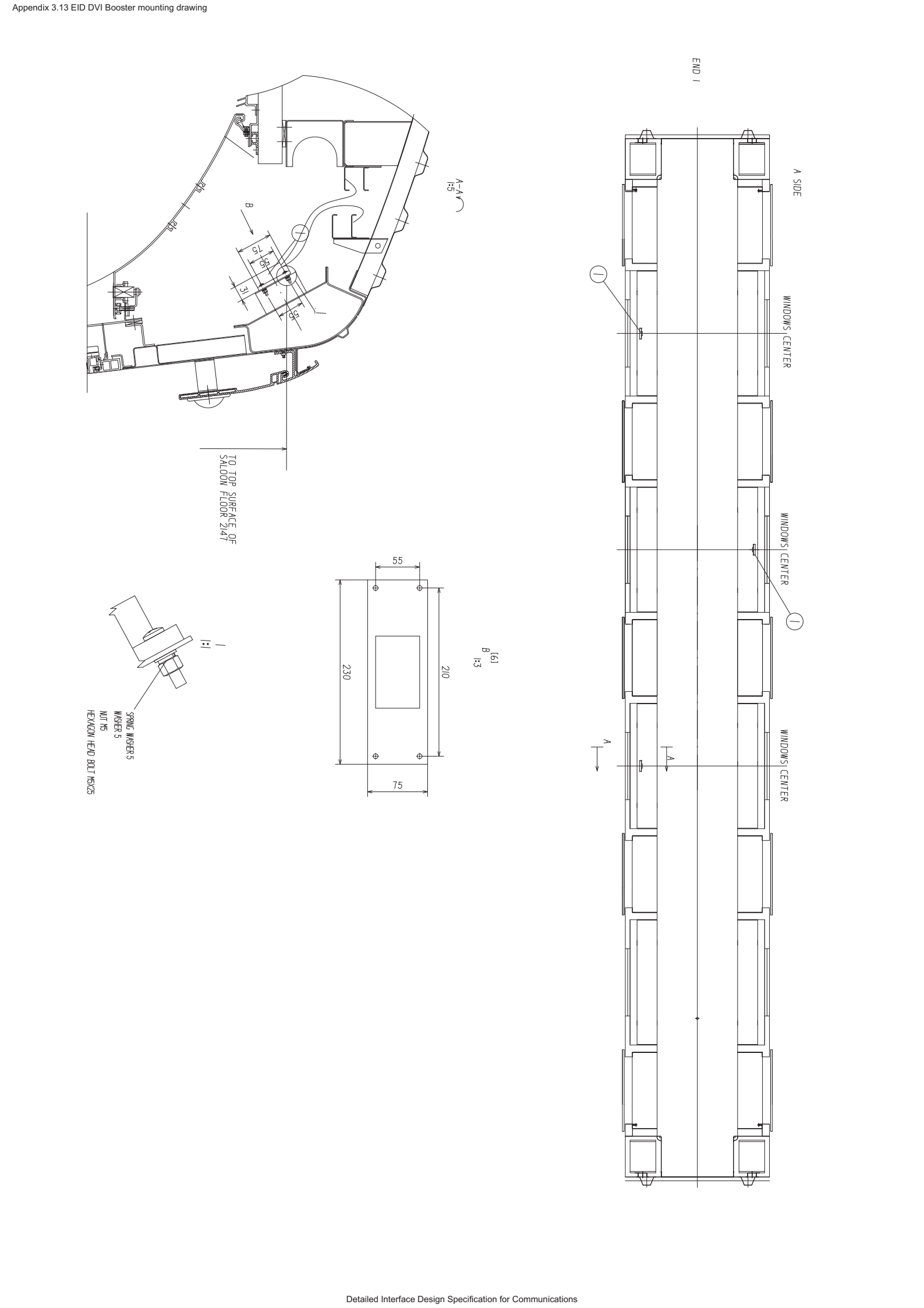
Cable type	Cable No	From		To		Length(mm)
		location	Plug/Socket	location	Plug/Socket	
2 core twisted pair Screen cable (Audio cable)		Audio amplifier CN1	*UTG-6/12/RP (M)*	Louder speaker A9 S1	*Terminal block in Loudspeaker*	3600
2 core twisted pair Screen cable (Audio cable)		Louder speaker A9 S1	*Terminal block in Loudspeaker*	Louder speaker A7 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A7 S1	*Terminal block in Loudspeaker*	Louder speaker A5 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A5 S1	*Terminal block in Loudspeaker*	Louder speaker A3 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A3 S1	*Terminal block in Loudspeaker*	Louder speaker A1 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Audio amplifier CN2	*UTG-6/12/RP (M)*	Louder speaker B10 S1	*Terminal block in Loudspeaker*	10000
2 core twisted pair Screen cable (Audio cable)		Louder speaker B10 S1	*Terminal block in Loudspeaker*	Louder speaker B8 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B8 S1	*Terminal block in Loudspeaker*	Louder speaker B6 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B6 S1	*Terminal block in Loudspeaker*	Louder speaker B4 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B4 S1	*Terminal block in Loudspeaker*	Louder speaker B2 S1	*Terminal block in Loudspeaker*	6500

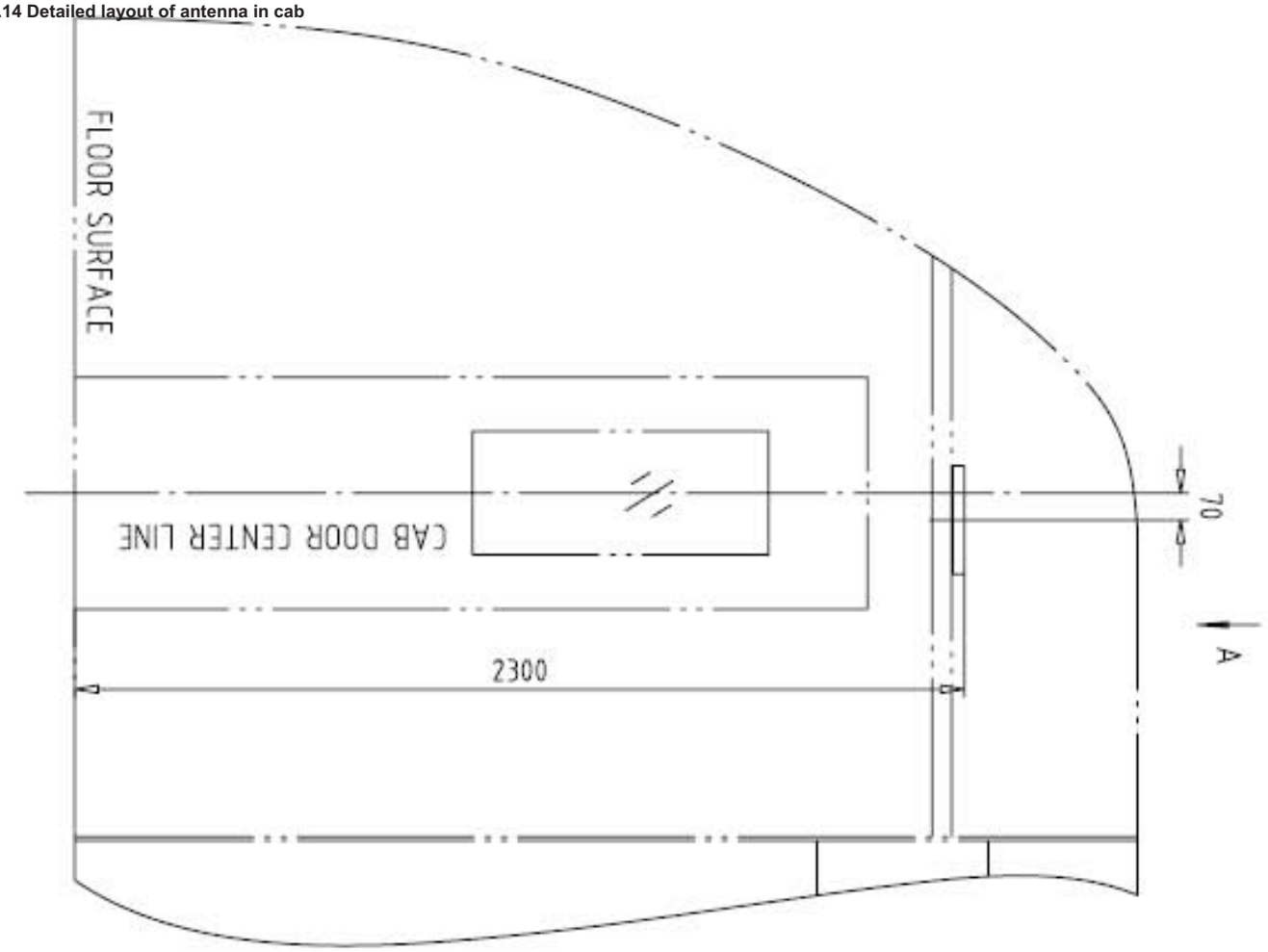

A-SIDE
6500
6500
6500
6500
3600
EIDS CONTROLLER
SPEAKER A1
SPEAKER A3
SPEAKER A5
SPEAKER A7
SPEAKER A9
B1Car DK106
END-1
END-2
SPEAKER B2
SPEAKER B4
SPEAKER B6
SPEAKER B8
SPEAKER B10
B-SIDE
6500
6500
6500
6500
10000

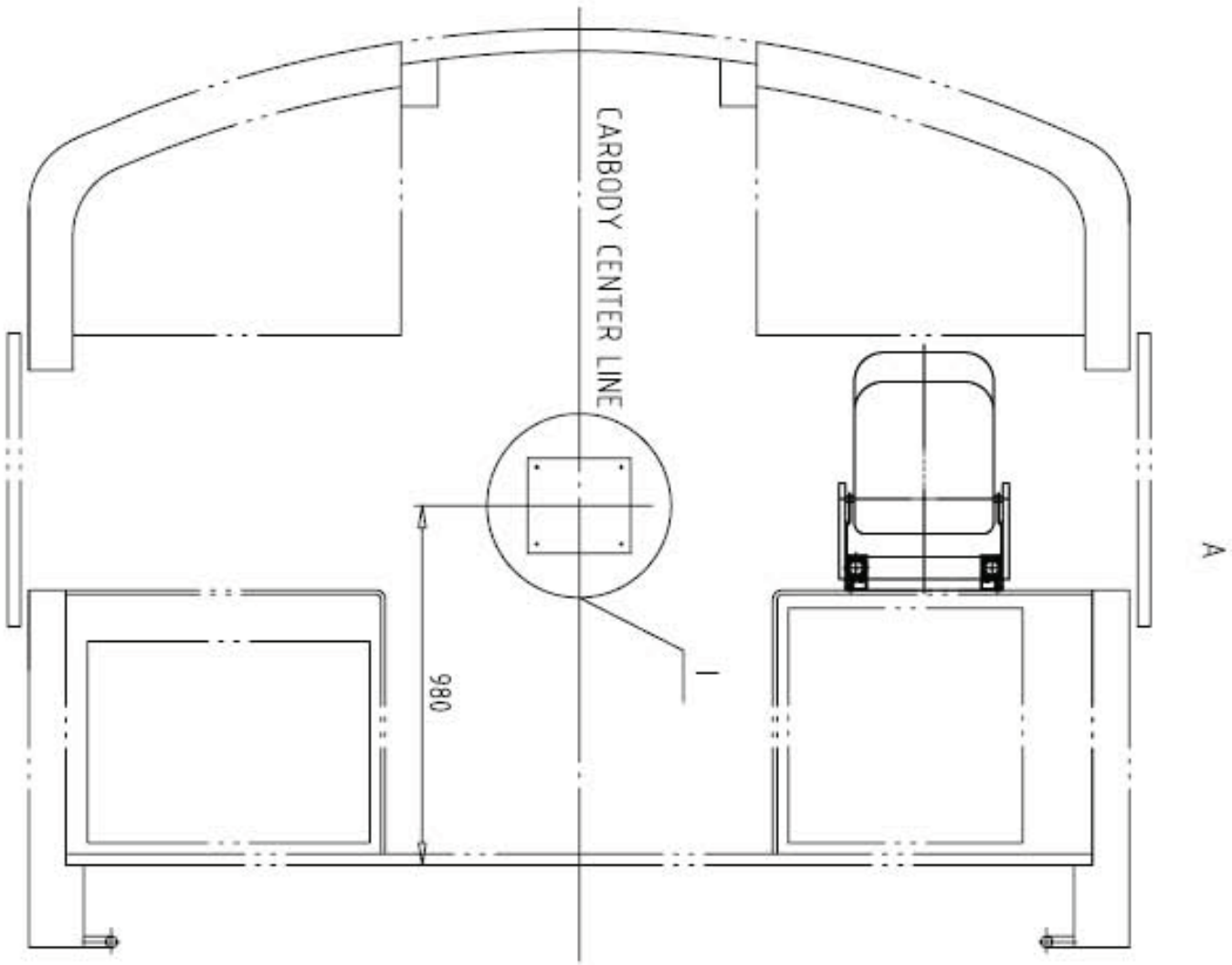
C1 CAR

Cable type	Cable No	From		To		Length(mm)
		location	Plug/Socket	location	Plug/Socket	
2 core twisted pair Screen cable (Audio cable)		Audio amplifier CN1	*UTG-6/12/RP (M)*	Louder speaker A9 S1	*Terminal block in Loudspeaker*	8000
2 core twisted pair Screen cable (Audio cable)		Louder speaker A9 S1	*Terminal block in Loudspeaker*	Louder speaker A7 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A7 S1	*Terminal block in Loudspeaker*	Louder speaker A5 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A5 S1	*Terminal block in Loudspeaker*	Louder speaker A3 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A3 S1	*Terminal block in Loudspeaker*	Louder speaker A1 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Audio amplifier CN2	*UTG-6/12/RP (M)*	Louder speaker B10 S1	*Terminal block in Loudspeaker*	6000
2 core twisted pair Screen cable (Audio cable)		Louder speaker B10 S1	*Terminal block in Loudspeaker*	Louder speaker B8 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B8 S1	*Terminal block in Loudspeaker*	Louder speaker B6 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B6 S1	*Terminal block in Loudspeaker*	Louder speaker B4 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B4 S1	*Terminal block in Loudspeaker*	Louder speaker B2 S1	*Terminal block in Loudspeaker*	6500

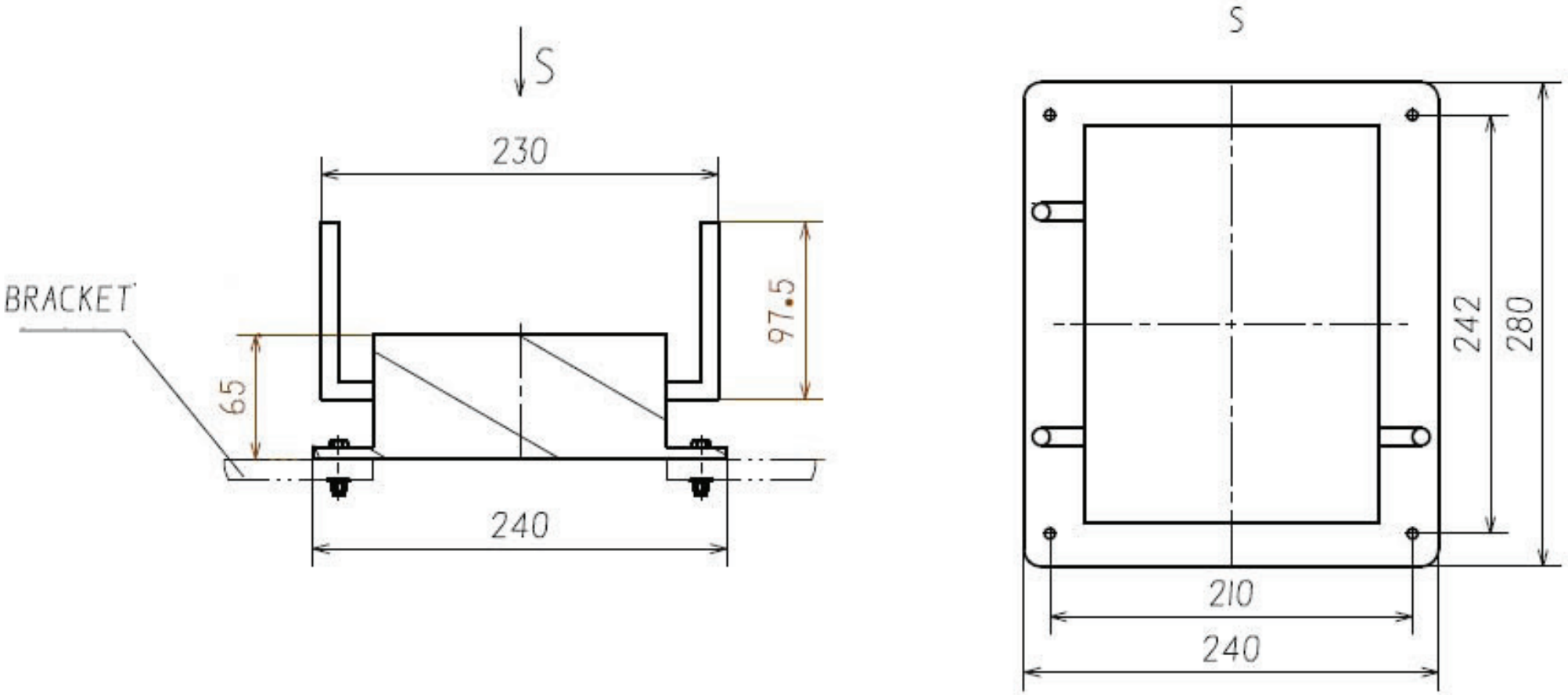

6500
6500
6500
6500
8000
A-SIDE
C1Car
DK104
END-1
END-2
SPEAKER A1
SPEAKER A3
SPEAKER A5
SPEAKER A7
SPEAKER A9
SPEAKER B2
SPEAKER B4
SPEAKER B6
SPEAKER B8
SPEAKER B10
B-SIDE
6500
6500
6500
6500
6000
EIDS CONTROLLER

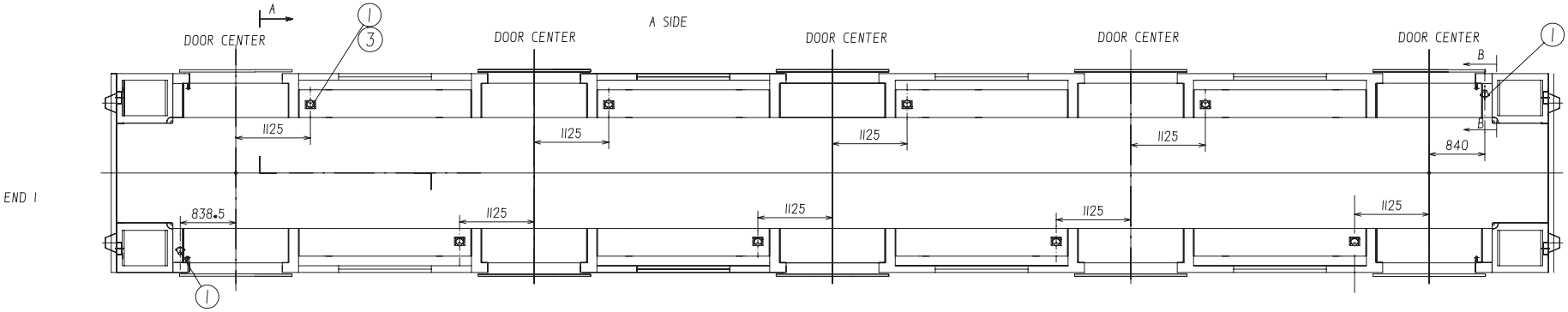

END I
A SIDE
WINDOWS CENTER
WINDOWS CENTER
WINDOWS CENTER
A
A
A–A
1:5
B
15
55
31
53
TO TOP SURFACE OF
SALOON FLOOR 247
55
230
210
75
B
[6]
1:3
I
1:1
SPRING WASHER 5
WASHER 5
NUT M5
HEXAGON HEAD BOLT M5X25

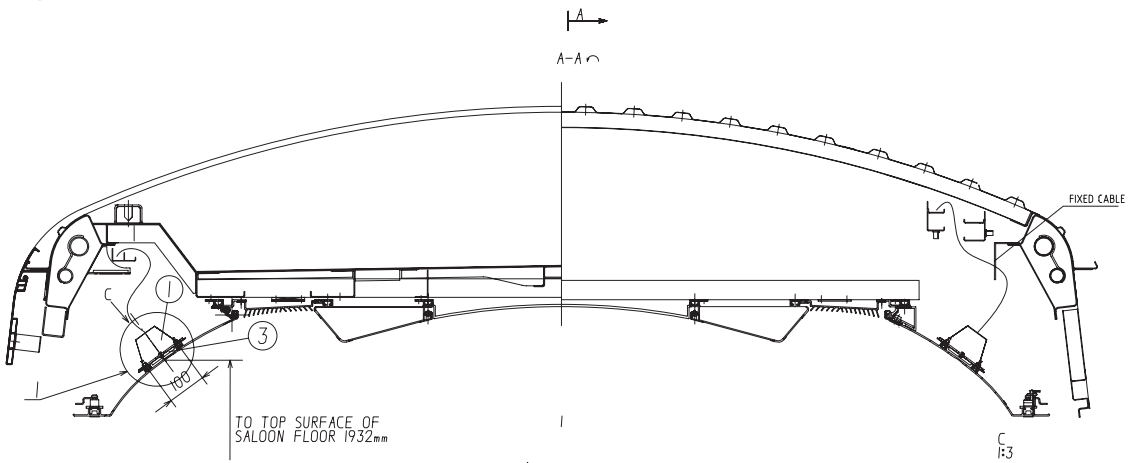

FLOOR SURFACE
CAB DOOR CENTER LINE
70
A
2300

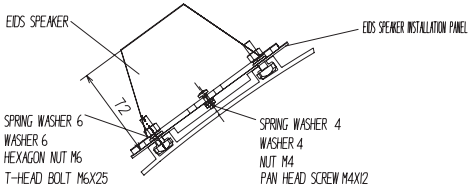

CARBODY CENTER LINE
980
A

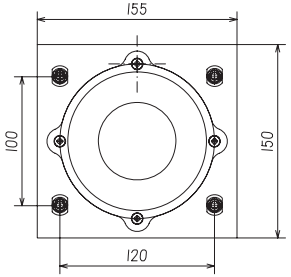
annex 3.14 Detailed layout of antenna in cab

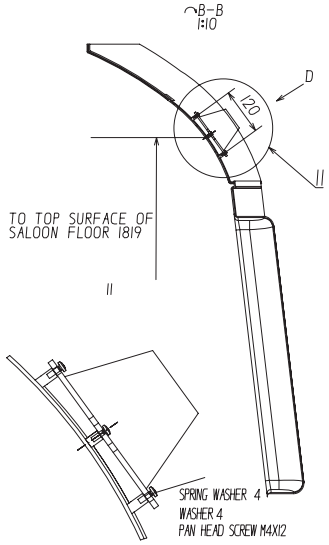


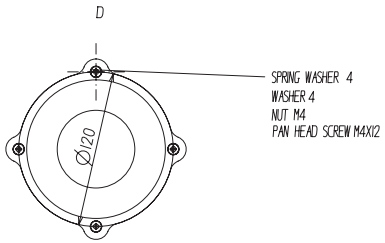

A
DOOR CENTER
DOOR CENTER
A SIDE
DOOR CENTER
DOOR CENTER
DOOR CENTER
B
B
END 1
1125
1125
1125
1125
840
838.5
1125
1125
1125
1125

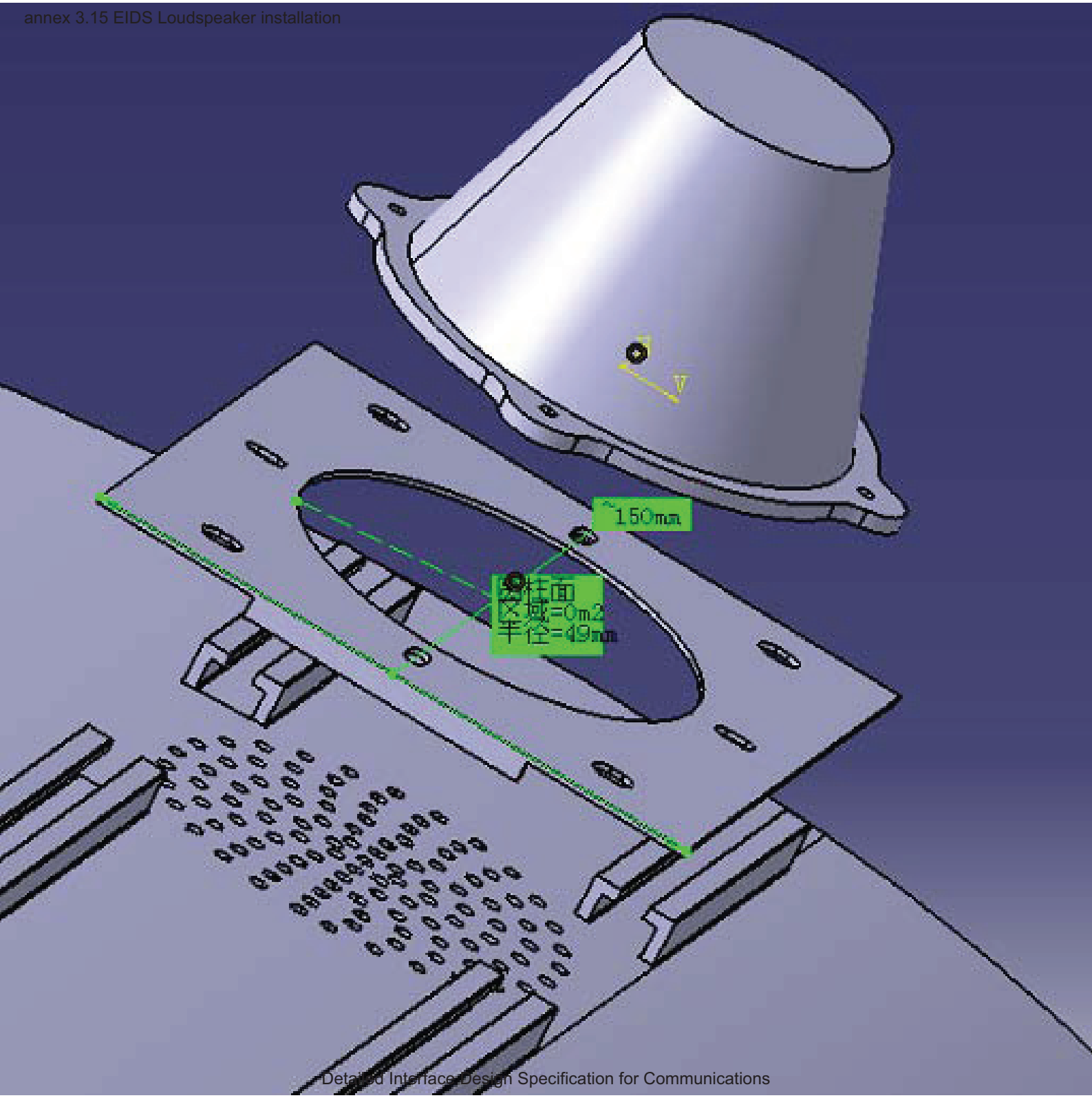

A
A-A
FIXED CABLE
C
100
TO TOP SURFACE OF
SALOON FLOOR 1932mm
C
1:3

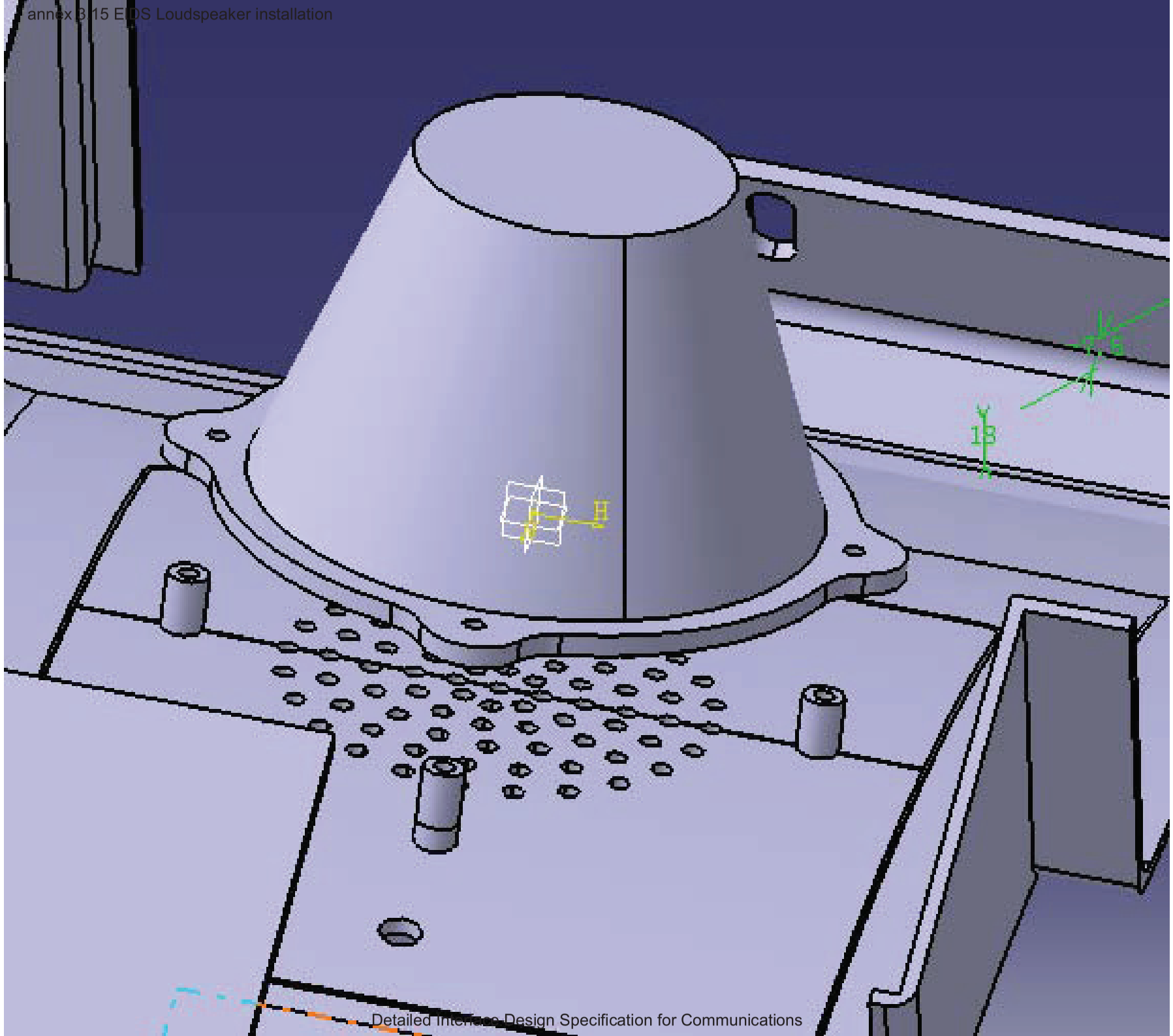

EIDS SPEAKER
EIDS SPEAKER INSTALLATION PANEL
72
SPRING WASHER 6
WASHER 6
HEXAGON NUT M6
T-HEAD BOLT M6X25
SPRING WASHER 4
WASHER 4
NUT M4
PAN HEAD SCREW M4X12

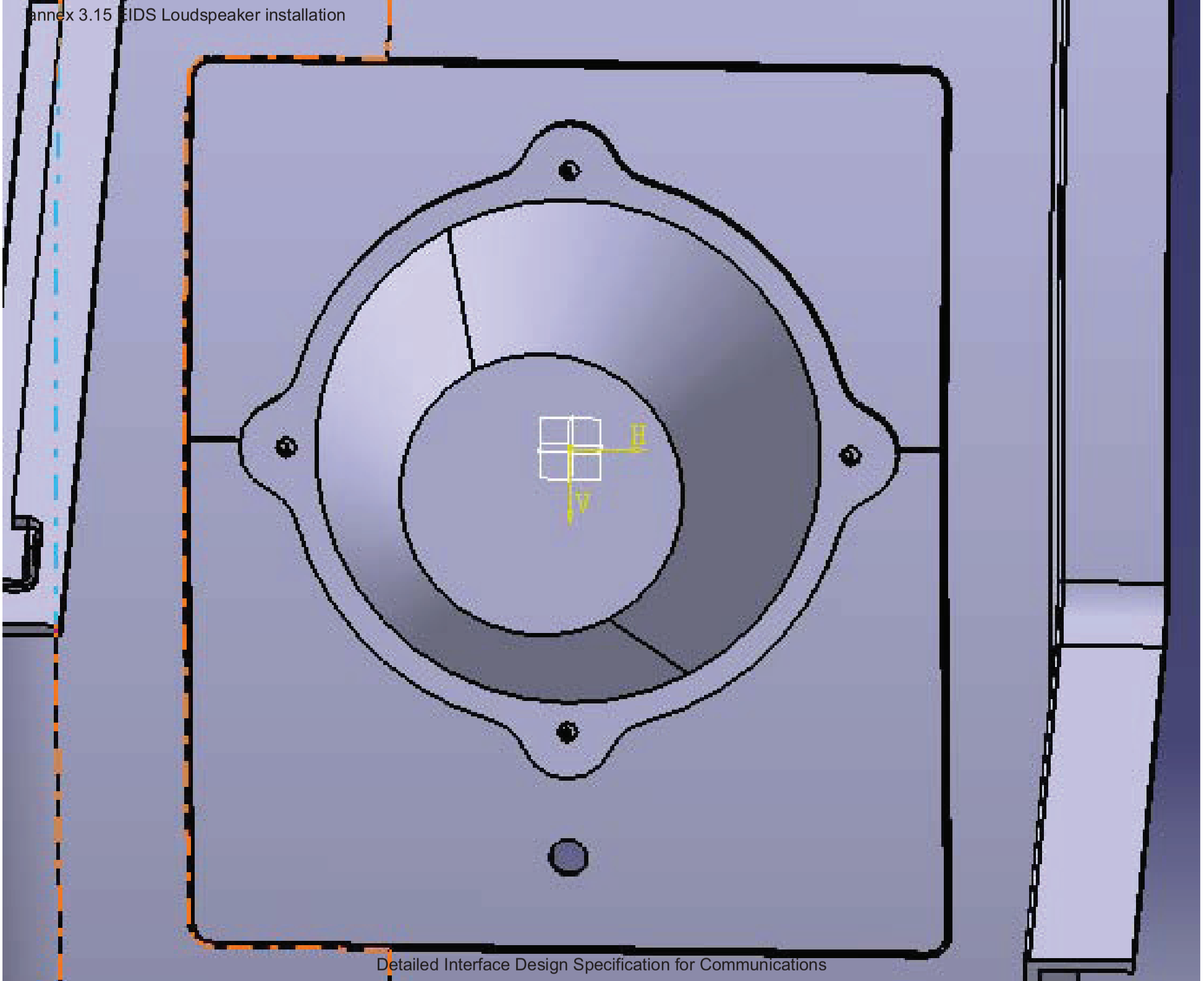

155
100
150
120

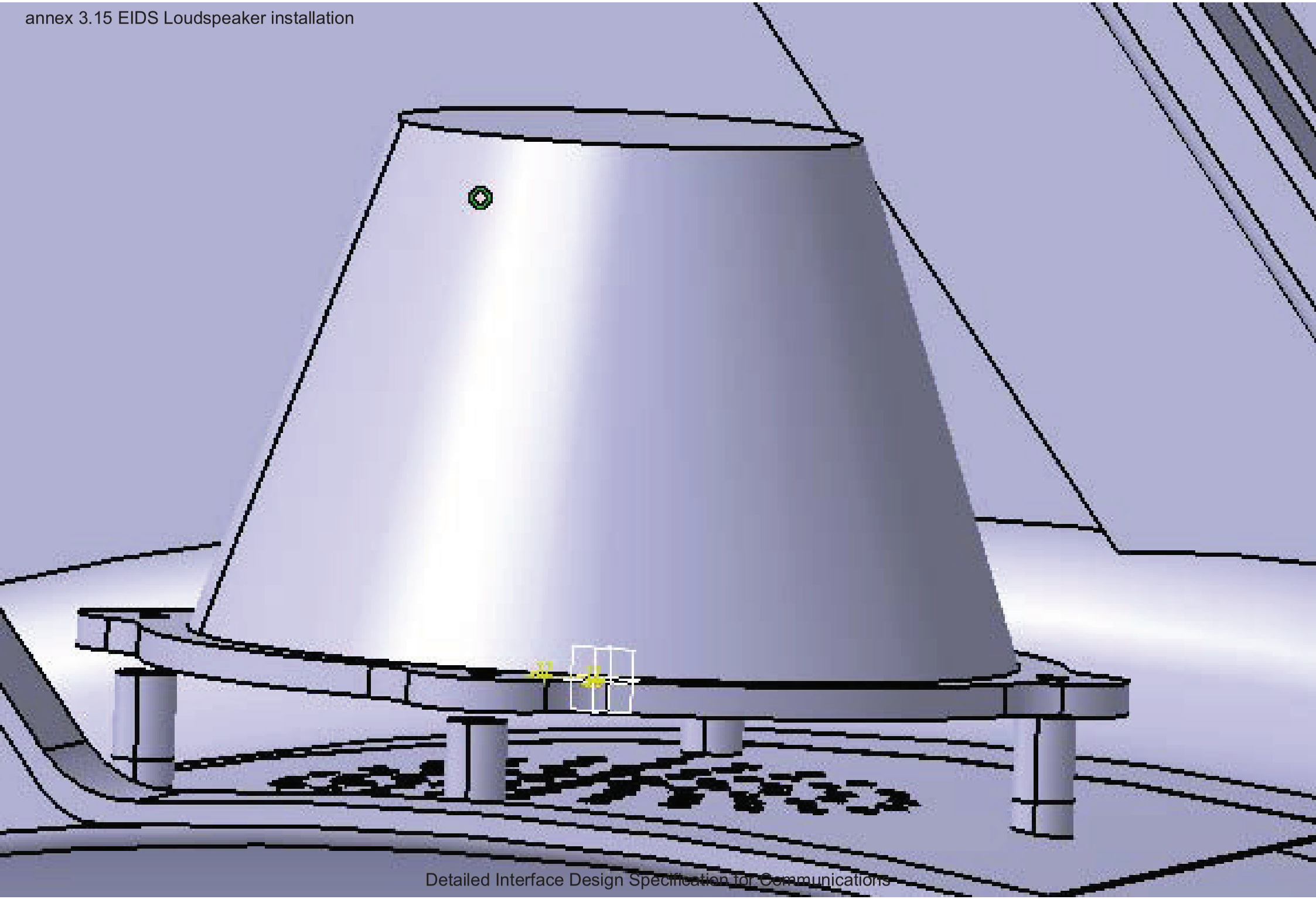

B-B
1:10
D
120
II
TO TOP SURFACE OF
SALOON FLOOR 1819
II
SPRING WASHER 4
WASHER 4
PAN HEAD SCREW M4X12

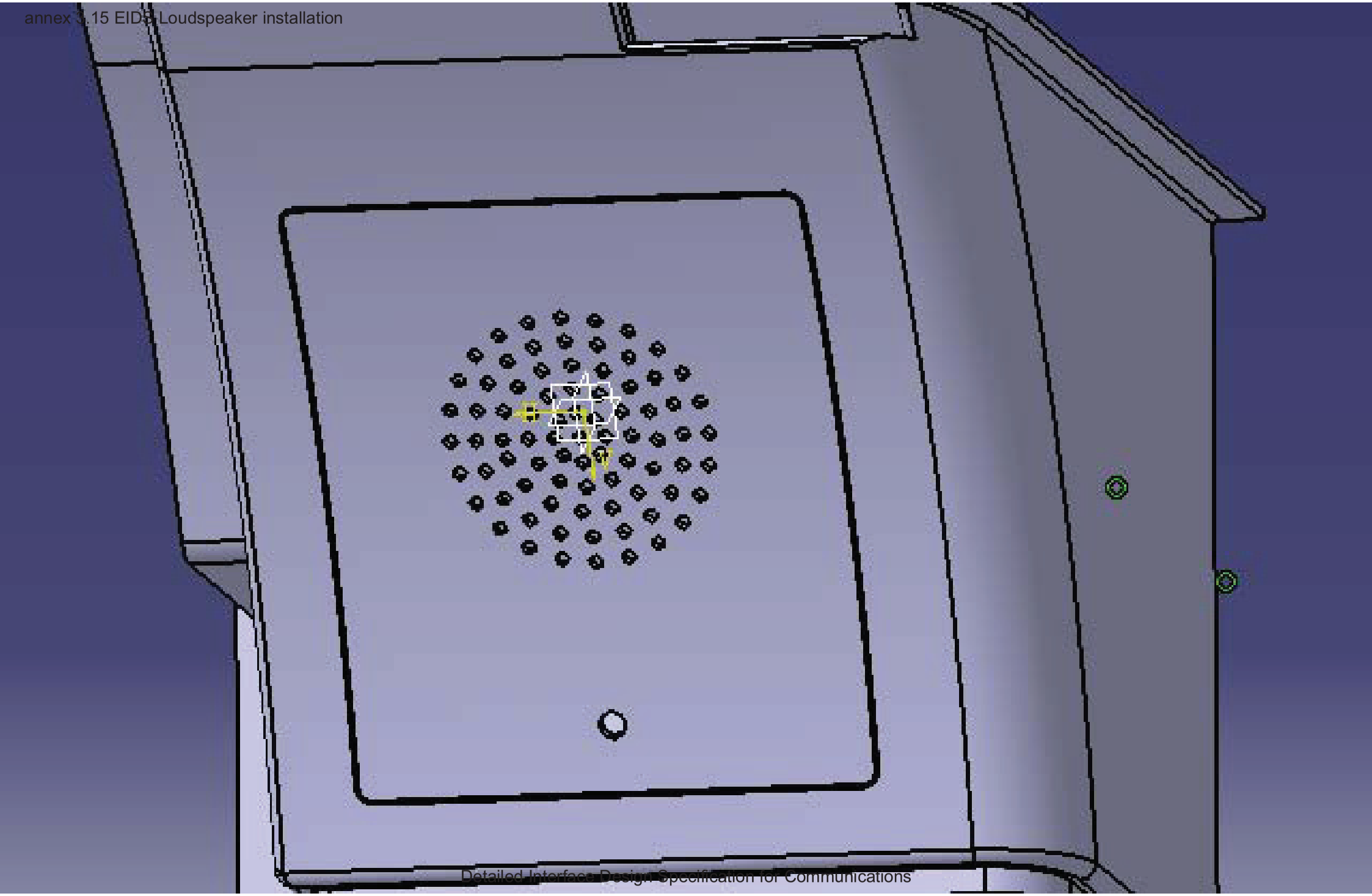

D
SPRING WASHER 4
WASHER 4
NUT M4
PAN HEAD SCREW M4X12
Ø120

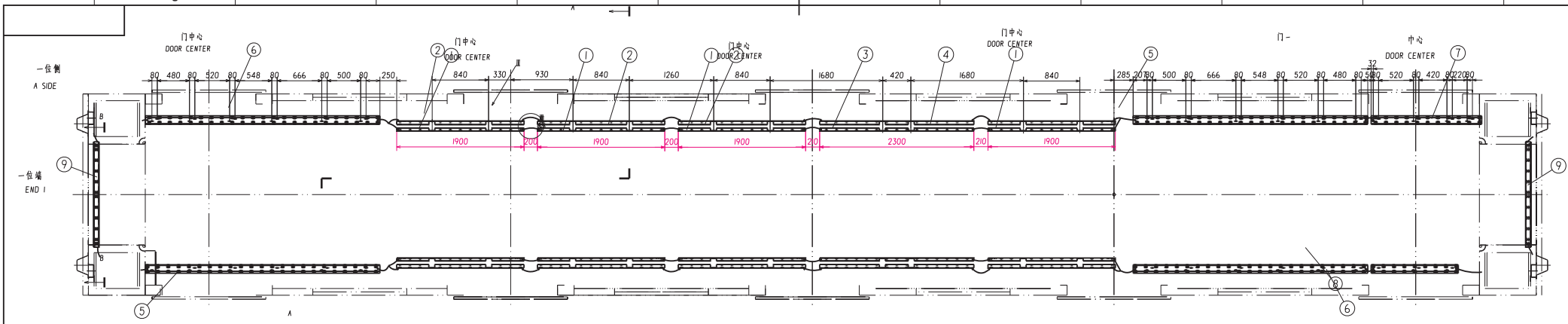

~150mm
面
域=0m2
半径=49mm

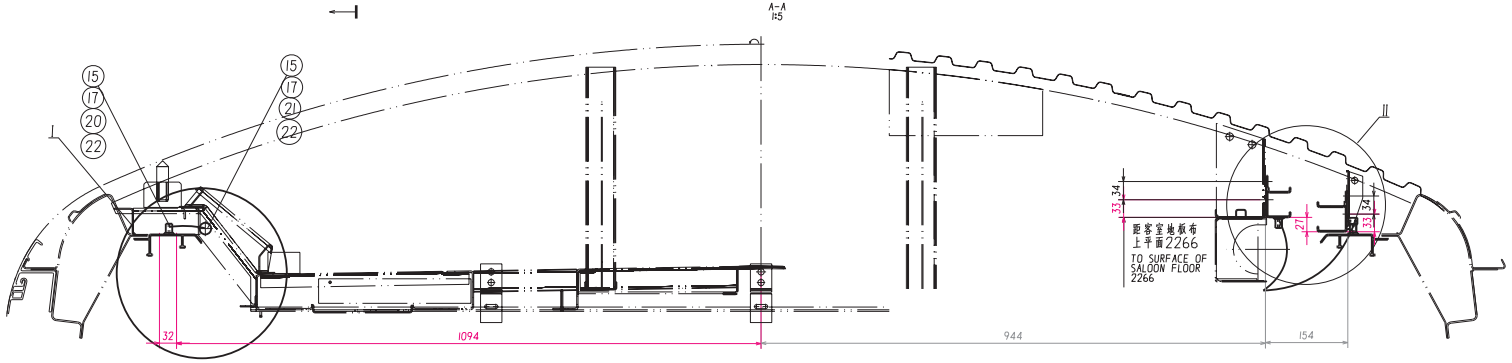

H
G
B

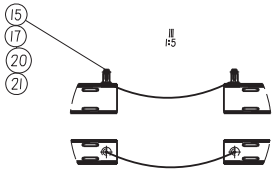

H
V

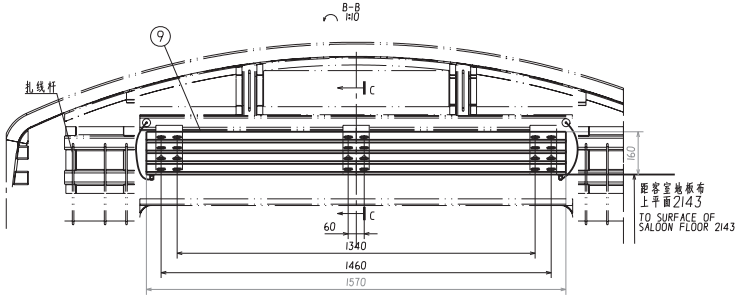


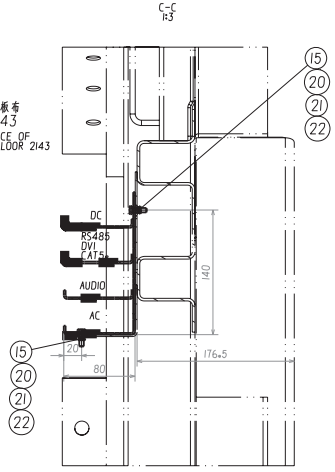


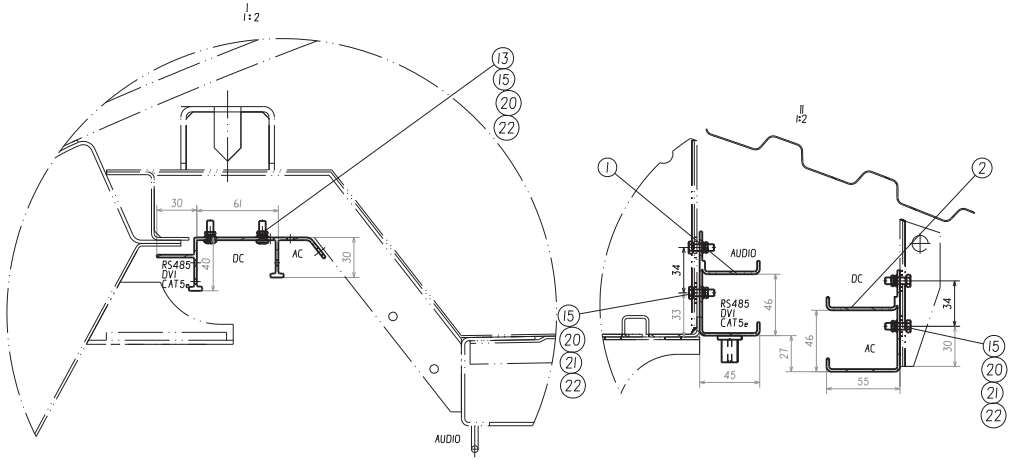












ACCORDING TO CABLE DIAGRAM.

-TRY

技术要求

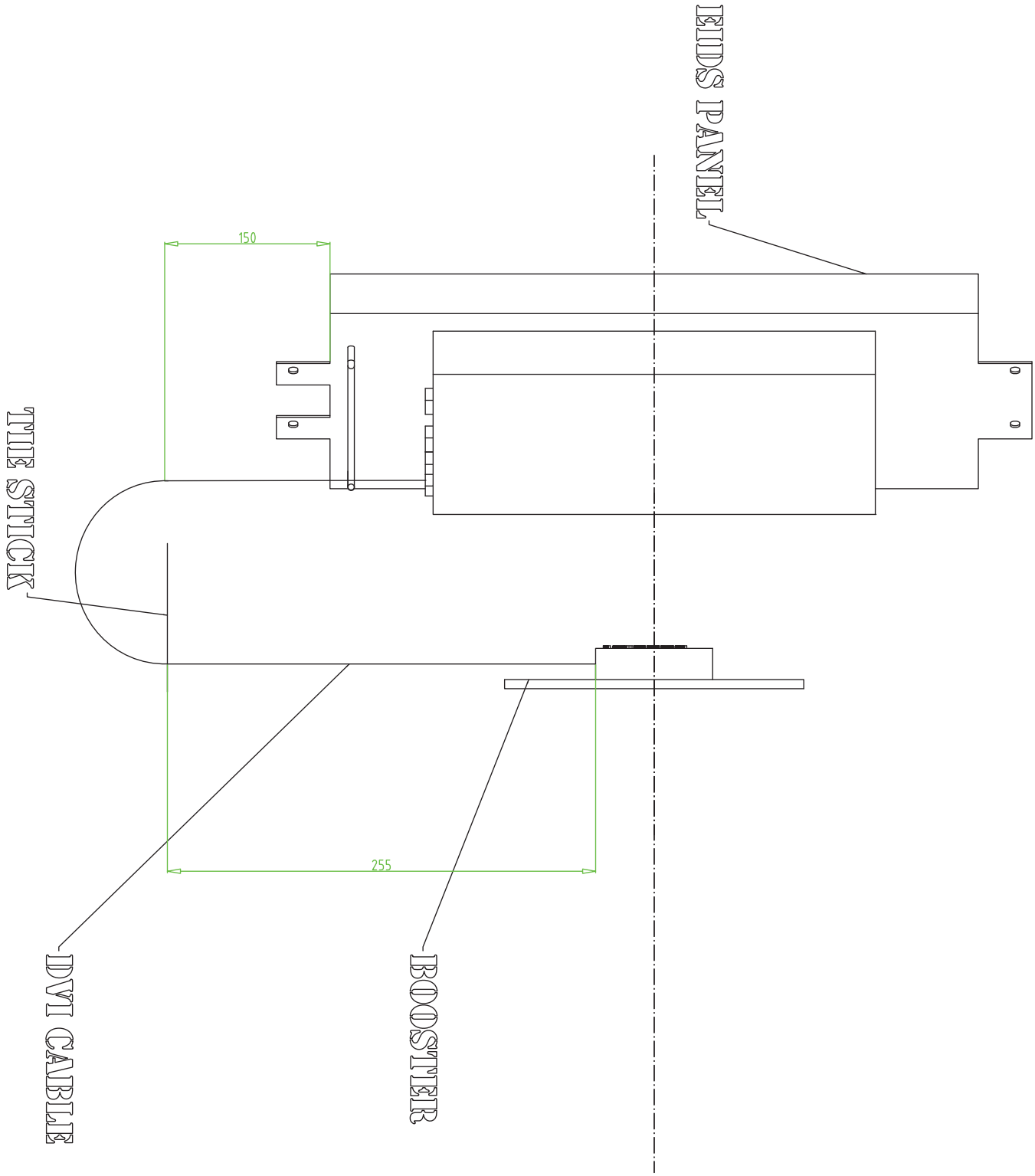
1 线槽安装沿着车体中心线一、二位侧镜像对称。

NOTES

1 CABLE DUCT WILL BE ARRANGED TO SYMME

总数	
服	
玻	
具	
试	
镀	
木	
械	
冲	
体一	
体二	
装一	
装二	
锻	
精	
钢	
铆	
协	
供	
单位 数量	
旧底图总号	
底图总号	
签字	
日期	

	版本	
		A1


EIDS PANEL
150
TILESTICK
255
DVI CABLE
BOOSTER

INTERFACE CONTROL DOCUMENT BETWEEN EIDS PANEL & EIDS CONTROLLER

Contents

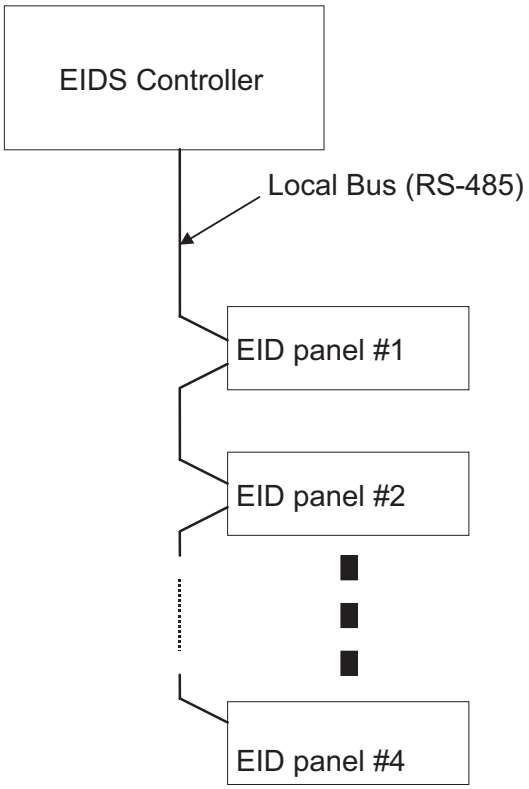
1 Introduction 3
1.1 Abbreviations 3
2 Interface Configuration 5
2.1 Interface Configuration between EIDS Panel and EIDS Controller 5
3 Interface Specifications 6
3.1 Transmission Specifications 6
3.2 Package Format 6
3.3 Calculation of CRC 8
4 Communication Procedure 9

1 Introduction

This document details the interface specification between the Electronics Information Display System (EIDS) and the Electronics Information Display (EID) panel.

The EIDS consists of the EIDS Server, the EIDS Controller and the EID panel. There are 4 EID panels in one car and these EID panels are connected by the multi-drop method. Hardware arrangement and physical connection applied to document for RS 485 Transmission.

The overall configuration is shown as follows:



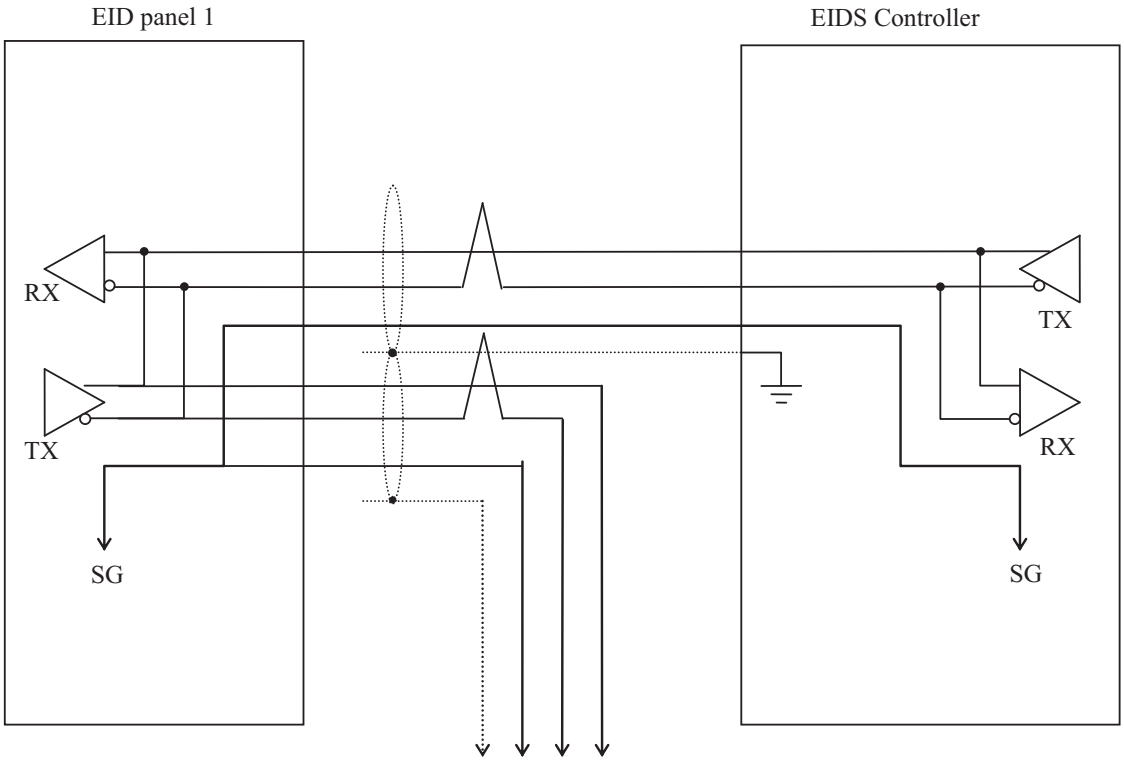
1.1 Abbreviations

ATC	Automatic Train Controller
CAB	Cabin
CPU	Central Processing Unit
DVAU	Digital Voice Announcement Unit

EDD	Electronic Destination Display
EID	Electronic Information Display
EMU	Electric Motion Unit
ETND	Electronic Train Number Display
FSM	Flashing System Map
GND	Ground
HMI	Human Machine Interface
I/O	Input/Output
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MTR	Mass Transit Railway
MTBF	Mean Time Between Failures
NA	Not Applicable
PCB	Printed Circuit Board
PCBA	Printed Circuit Board Assembled
PIS	Passenger Information System
PS	Particular Specification
PWR	Power
RX	Receive
RXD	Receive Data
SPK	Speaker
SRAM	Static Random Access Memory
SW	Switch
TBD	To Be Determined
TMS	Train Monitoring System
TX	Transmit
TXD	Transmit Data
V	Voltage
W	Watt

2 Interface Configuration

2.1 Interface Configuration between EIDS Panel and EIDS Controller



3 Interface Specifications

3.1 Transmission Specifications

The following local bus specification is applied to the interface.

(1) Wire: Shielded twisted cable
1 data pair and 1 data ground line
(2) Network topology: Multi-drop bus
(3) Transmission method: Asynchronous
(4) Protocol: Polling/selecting
(5) Baud rate: 9600 bps
(6) Transmission signal RS-485 (half-duplex)
Matching resistor = 120 ohm
(Matching resistor is installed in EIDS Controller and the terminal equipment.)
(7) Character format: Start bit: 1
Data bit: 8
Parity bit: none
Stop bit: 1
(8) Polling: Polling at every 1 second

3.2 Package Format

(1)Command Package (from EIDS Controller)

LENGTH 1 byte	TYPE 1 byte	CMD 1 Byte	Arrow 1 Byte	Reserve 1 Byte	Reserve 1 Byte	CRC 1 byte

The following is the example for the data package.

No.	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	
Example	0x07	0x51	0x32	0x00	0x00	0x00	0x76	
Define	Length	Address	StateCommand	Arrow	reserve	reserve	Check Sum	

Byte0：Length of package=0x07.
Byte1：Address of EID Panel.

（0x51，Panel A1；0x52，Panel A2；0x53，Panel B1；0x54，Panel B2）

Byte2：=0x32H, request the current state of EID Panel.
0x3fH, request the EID Panel to display emergency arrow.

Byte3：=0x00H, clear arrow or default.
0x01H, request the EID Panel to display the right oriental arrow.
0x02H, request the EID Panel to display the left oriental arrow.

Byte6：Checksum, please see Chapter 3.3 for the details.

(2) Reply Package (from EID panel)

Length 1 byte	STX 1byte	FIX 0x45	FIX 0x50	Status 1 byte	Reserved 0x00	Address 1 byte	Reserved 0x00	CRC 1 byte

The following is the example for the data package.

No	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Example	0x09	0x0D	0x45	0x50	0x57	0x00	0x51	0x00	AD
Define	Length	StartCode	E	P	Current state	0	Address	0	CheckSum

Byte0：Length of package=0x09.
Byte1：Define start code 0x0D.
Byte2：Always=0x45.
Byte3：Always=0x50.
Byte4：Current state of EID Panel.
（0x4E，Normal；0x57，No Signal）
Byte5：Always=0x00.
Byte6：Address of this EID Panel.
Byte7：Always=0x00.
Byte8：CheckSum, please see Chapter 3.3 for the details.

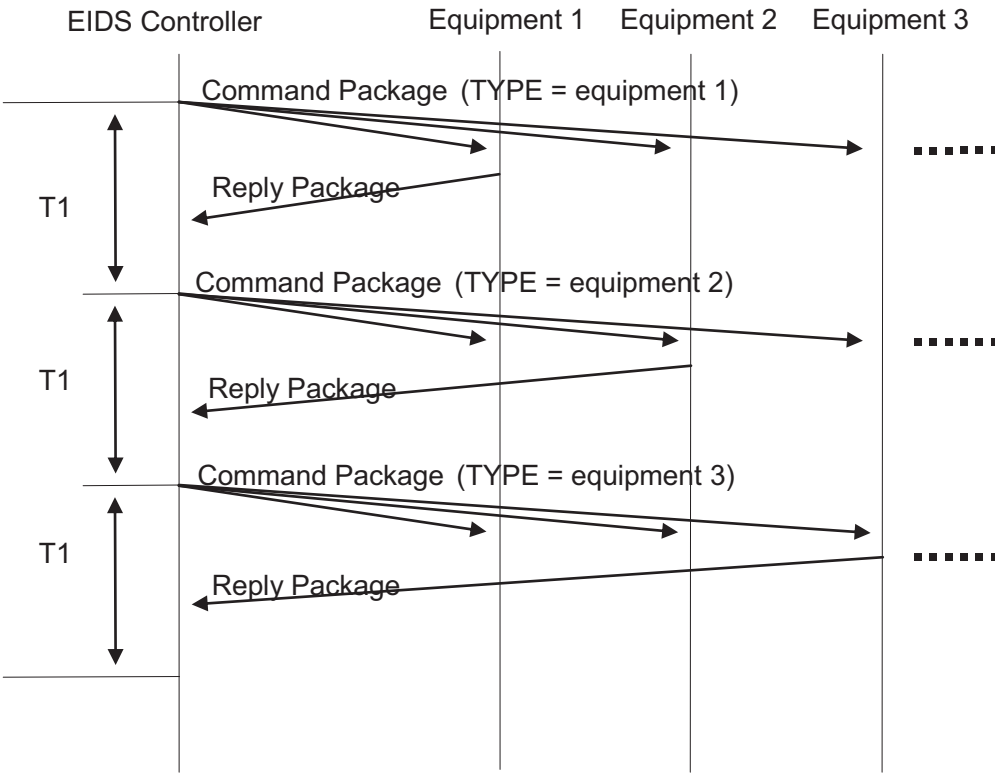
3.3 Calculation of CRC

A package is calculated from Byte 0 to Byte n (n =5, or 7).

```
Unsigned char CheckSum(unsigned char *pt,unsigned char len)
{
  Unsigned char i;
  Unsigned char z;
  Z=0;
  For(i=0;i<len;i++)
  {
    Z+=*pt;
    Pt++;
  }
z=~z+1;
  Return(z);
}
```

4 Communication Procedure

T1: for EIDS Panel is 1s.



INTERFACE CONTROL DOCUMENT BETWEEN DVAS & EIDS

Contents

Contents 2
1. Introduction 3
   1.1 Abbreviations 3
   1.2 Reference Documents 3
2. Functions 4
3. Transmission Data 4
   3.1 From DVAU to EIDS Server 4
   3.2 From EIDS Server to DVAU 4
4. Interface Specifications 5
   4.1 Transmission Specifications: 5
   4.2 Pin Configuration 5
   4.3 Packet Format 5
   4.4 Transmission Format 6
5. Transmission Data Format 6
   5.1 Data from DVAU 6
   5.2 Data from EIDS Server 13

1. Introduction

This document designates the required interface specifications between the Digital Voice Announcement and Public Address System (DVAS & PA) and Electronic Information Display System (EIDS).

The EIDS consists of the EIDS Server, the EIDS Controller and the EID panel. There are 4 EID panels and 1 EIDS controller in each saloon and 1 EIDS Server in each driver cab.

1.1 Abbreviations

DVAS	Digital Voice Announcement System
DVAU	Digital Voice Announcement Unit
EID	Electronic Information Display
EIDS	Electronic Information Display System
LSB	Least Significant bit
MSB	Most Significant bit
LDR	Load Data Request
SDR	Send Data Request

2. Functions

EIDS shall interface with the DVAS and PA to obtain information and status. The EIDS Server will respond to the DVAU and send the corresponding data.

3. Transmission Data

3.1 From DVAU to EIDS Server

1. Route code from DVAU.
2. Station code from DVAU.
3. Door Status from DVAU.
4. Detainment Signal
5. Request Self test

3.2 From EIDS Server to DVAU

1. EIDS Server response Active/Inactive status to DVAU.
2. EIDS Server response EID Panel, EIDS Server and EIDS Controller status to DVAU.
3. EIDS Server response Testing Validating status to DVAU.

4. Interface Specifications

4.1 Transmission Specifications:

The following local bus specification is applied to the interface.

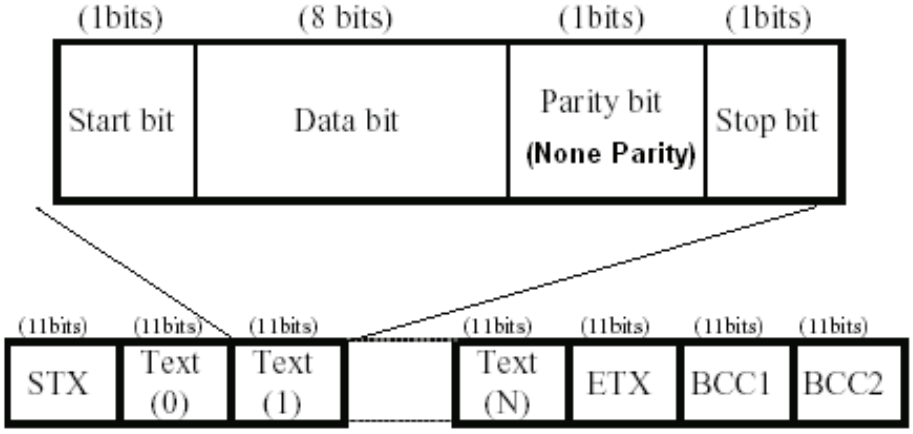
(1)	Wire:	Shielded twisted cable 1 data pair and 1 data ground line
(2)	Network topology:	point to point bus
(3)	Transmission method:	Asynchronous
(4)	Protocol:	Polling/selecting
(5)	Baud rate:	9600 bps
(6)	Transmission signal:	RS-485 (half-duplex) Matching resistor = 120 ohm (Matching resistor is installed in EIDS and DVAU.)
(7)	Character format:	Start bit: 1 Data bit: 8 Parity bit: None Stop bit: 1
(8)	Polling:	Polling at every 500ms

4.2 Pin Configuration

Pin	Signal	Cable Type
1	RS-485 Data (-)	1 x Twisted Triad
2	RS-485 Data (+)	
5	GND	

4.3 Packet Format

The proposed Command Package (from EIDS Server) is as follows:

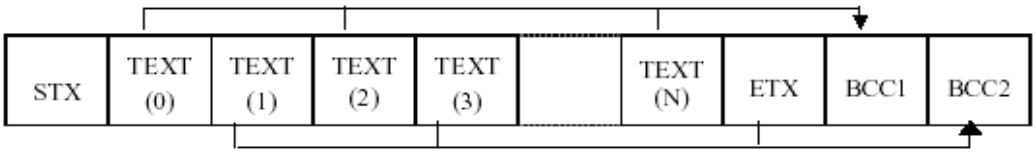


The bits are sent from the LSB to the MSB
STX: Start of Text [STX=02H]
TEXT: Contents of TEXT
ETX: END of TEXT (Message) [ETX=03H]
BCC: Block Checker Count

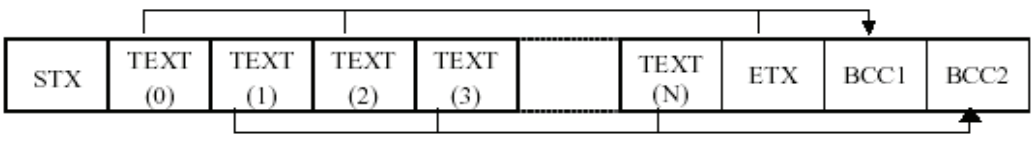
4.4 Transmission Format

To generate check sum:
The BCC is generated using XOR method.

N = (even number)



N = (odd number)



5. Transmission Data Format

5.1 Data from DVAU

Contents of Status Data Request (SDR)

TEXT No.	Bit No. 7	6	5	4	3	2	1	0	Contents	Note
0	Text code : 20H									
1	Self test								Binary	Test execution request
2	Line Number				Station Number					Refer to Note 8
3	Route Code								BCD code	Refer to Note 2
4	Station Code								BCD code	Refer to Note 1
5	Cab Occup -ied	PA Mode						Ann Status	Binary	Refer to Note 7
6	Event									Refer to Note 4
7	Spare									
8	Message Index									Refer to Note 6
9	Car No. (X00)				Car No. (0X0)				BCD Code	
10	Car No. (00X)				Detrainment Signal				BCD Code	Refer to Note 3
11	Car No. (X00)				Car No. (0X0)				BCD Code	
12	Car No. (00X)				Detrainment Signal				BCD Code	Refer to Note 3
	Spare									

[Note 1] Station Code (subject to changes with respect to TMS protocol)

CODE	STATION
00H	not valid
01 – 04H	not used
05 – 06H	spare
07H	KET
08H	HKU
09H	SYP
10H	SHW
11H	CEN
12H	ADM
13H	WAC
14H	CAB
15H	TIH
16H	FOH
17H	NOP
18H	QUB
19H	TAK
20H	SWH
21H	SKW
22H	HFC
23H	CHW
24 - 29H	spare
30H	TSW
31H	TWH
32H	KWH
33H	KWF
34H	LAK
35H	MEF
36H	LCK
37H	CSW
38H	SSP
39H	PRE
40H	MOK

CODE	STATION
41H	YMT
42H	JOR
43H	TST
44-45H	not used
46-49H	spare
50-51H	not used
52H	LAT
53H	KWT
54H	NTK
55H	KOB
56H	CHH
57H	DIH
58H	WTS
59H	LOF
60H	KOT
61H	SKM
62-64H	not used
65H	HMT
66H	WHA
67-69H	spare
70-79H	spare
80H	spare
81H	TKS
82H	POA
83H	HAH
84H	TKO
85H	TIK
86H	YAT
87-89H	spare
90-95H	not used
96-99H	spare

[Note 2] Route Code (subject to changes with respect to TMS protocol)

CODE	ROUTE
00H	not valid
01-0FH	spare
10H	ISL-up
11H	ISL-down
12H	KTL-up
13H	KTL-down
14H	TWL-up
15H	TWL-down
16-2FH	spare
30H	TKL1-up
31H	TKL1-down
32H	TKL2-up
33H	TKL2-down
34-4FH	Spare
50H	TWL-KTL-up
51H	KTL-TWL-down
52H	ISL-TWL up
53H	TWL-ISL-down
54H	KTL- TKL1-up
55H	TKL1-KTL-down
56H	KTL- TKL2-up
57H	TKL2-KTL-down
58H	ISL- TKL1-up
59H	TKL1-ISL-down
5AH	ISL- TKL2-up
5BH	TKL2-ISL-down
5C-6FH	Spare
70-FFH	Spare

CODE	ROUTE

[Note 3]
0- normal
1- detrainment

[Note 4]
01H- door opening message
02H- door closing message
03H- special message
04H- emergency message
05H- next station message (ATC code)
06H- Non ATC operational message

[Note 6]
The details of the message index will be provided by the Engineer after the award of the Contract.

[Note 7]

Bit No.							
7	6	5	4	3	2	1	0
Cab Occupied Status	PA Mode	–	–	–	–	–	Announcement Status

Cab Occupied Status:

‘0’-Not-Occupied
‘1’-Occupied

PA Mode:

‘0’- Automatic Mode
‘1’- Manual mode (ATC disabled)

Announcement Status:

‘0’- No announcement

'1'- On-going announcement

[Note 8]
Line Number/Station Number.

Bit No.							
7	6	5	4	3	2	1	0
Line Number			Station number				

The bit format for line/station number shall follow the Interface between TMS and DVAS & PA as shown below:

Line number:

Island line - up track : 1
Island line - down track : 2
Kwun Tong Line - up track : 3
Kwun Tong Line - down track : 4
Tsuen Wan Line - up track : 5
Tsuen Wan Line - down track : 6
Tseung Kwan O Line - up track : 7
Tseung Kwan O Line - down track: 0

	MTR Rolling Stock Project	

No.	Station number	Line - Track							
		ISL Up	ISL down	KTL up	KTL Down	TWL Up	TWL Down	TKL Up	TKL down
1	01	CEN	HFC	MOK	LAT	ADM	TWH	NOP	TKS
2	02	ADM	SKW	PRE	KWT	ADM_PLT	KWH	QUB	POA
3	03	ADM_PLT	SWH	SKM	NTK	TST	KWF	YAT	HAH
4	04	WAC	TAK	KOT	KOB	JOR	LAK	TIK	HAH_PLT
5	05	CAB	QUB	LOF	CHH	YMT	MEF	TKO	TKO
6	06	TIH	NOP	WTS	DIH	MOK	LCK	HAH	TIK
7	07	FOH	FOH	DIH	WTS	PRE	CSW	HAH_PLT	YAT
8	08	NOP	TIH	CHH	LOF	SSP	SSP	POA	QUB
9	09	QUB	CAB	KOB	KOT	CSW	PRE	POA_PLT	NOP
10	0A	TAK	WAC	NTK	SKM	LCK	MOK	TKS	NOP_PLT
11	0B	SWH	ADM	KWT	PRE	MEF	YMT	TKS_PLT	NOP_SDG
12	0C	SKW	ADM_PLT	LAT	MOK	LAK	JOR	BHT_SDG	BHT_SDG
13	0D	HFC	CEN	QUB	YMT	KWF	TST	YAT_PLT	TKO rev
14	0E	CHW	SHW	QUB_PLT	YMT_PLT	KWH	ADM	TKO rev	TIK rev
15	0F	CHW_PLT	SHW_PLT	YMT	QUB	TWH	ADM_PLT	TIK rev	POA_SDG
16	10	SHW	CHW	KOT rev	PRE rev	TSW	CEN	NOP rev	DEP_DN
17	11	ADM rev	WAC rev	CHH rev	-	TSW_PLT	CEN_PLT	NOP_SDG	TKS rev
18	12	CAB rev	HFC rev	KWT rev	CHH rev	CEN	TSW	DEP_UP	TIK_PLT
19	13	TAK rev	QUB rev	LAT rev	CHH cen	JOR rev	KWH rev	DEP_SN	
20	14	CHW rev		CHH cen	YMT rev	LAK rev	MEF rev	TKO_PLT tks	
21	15			TTT	TTT	MEF rev	TST rev	TKO_PLT hah	
22	16			SKM rev	NOP		CEN rev	TKS rev	
23	17			NOP	NOP_rev		TSW rev	TKO tks	
24	18			NOP_PLT	TIK		LAK rev	DVAS	
25	19			YAT	YAT				
26	1A			TIK	YAT_PLT				
27	1B			TIK_SDG	NOP_SDG				
28	1C			NOP_SDG					
29	1D			TIK_PLT					
30	1E								
31	1F								

5.2 Data from EIDS Server

DVAU shall poll from EIDS Server repeatedly for 3 times before declaring that the link between EIDS Server and DVAU is down to TMS.

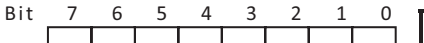
Contents of Status Data (SD)

TEXT NO.	bit No. 7	6	5	4	3	2	1	0	Contents	note
0	Text code : 22H									
1	LCD Fault Status EID 1 (110 v)								Binary	Refer to Note 8
2	LCD Fault Status EID 2 (240 v)								Binary	Refer to Note 8
3	LCD Fault Status EID 3 (240 v)								Binary	Refer to Note 8
4	LCD Fault Status EID 4 (240 v)								Binary	Refer to Note 8
5	Fault Status EID Controller								Binary	Refer to Note 8
6	Fault Status EIDS Server								Binary	Refer to Note 8
7	Message Code Error		Station Code Error			Route Code Error			Binary	Refer to Note 9
8	EIDS Status									Refer to Note 10
9	Spare									

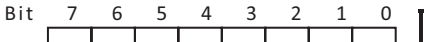
[Note 8] Illustrates the indication of the Status of the EIDS Server, EID Controller and EIDS Panel.

Bit	7	6	5	4	3	2	1	0
	Cab A	Cab C	Cab B	Cab B1	Cab C1	Cab B	Cab C	Cab A

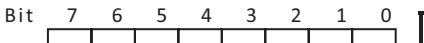
signal name	description
EID Panel 1 (110V)	“1”: error ; “0”: Working
EID Panel 1 (110V)	“1”: error ; “0”: Working
EID Panel 1 (110V)	“1”: error ; “0”: Working
EID Panel 1 (110V)	“1”: error ; “0”: Working
EID Panel 1 (110V)	“1”: error ; “0”: Working
EID Panel 1 (110V)	“1”: error ; “0”: Working
EID Panel 1 (110V)	“1”: error ; “0”: Working
EID Panel 1 (110V)	“1”: error ; “0”: Working



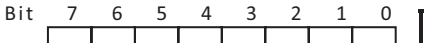
signal name	description
EID Panel 2 (240 V)	“1”: error ; “0”: Working
EID Panel 2 (240 V)	“1”: error ; “0”: Working
EID Panel 2 (240 V)	“1”: error ; “0”: Working
EID Panel 2 (240 V)	“1”: error ; “0”: Working
EID Panel 2 (240 V)	“1”: error ; “0”: Working
EID Panel 2 (240 V)	“1”: error ; “0”: Working
EID Panel 2 (240 V)	“1”: error ; “0”: Working
EID Panel 2 (240 V)	“1”: error ; “0”: Working



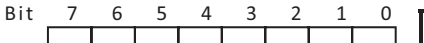
signal name	description
EID Panel 3 (240 V)	“1”: error ; “0”: Working
EID Panel 3 (240 V)	“1”: error ; “0”: Working
EID Panel 3 (240 V)	“1”: error ; “0”: Working
EID Panel 3 (240 V)	“1”: error ; “0”: Working
EID Panel 3 (240 V)	“1”: error ; “0”: Working
EID Panel 3 (240 V)	“1”: error ; “0”: Working
EID Panel 3 (240 V)	“1”: error ; “0”: Working
EID Panel 3 (240 V)	“1”: error ; “0”: Working



signal name	description
EID Panel 4 (240 V)	“1”: error ; “0”: Working
EID Panel 4 (240 V)	“1”: error ; “0”: Working
EID Panel 4 (240 V)	“1”: error ; “0”: Working
EID Panel 4 (240 V)	“1”: error ; “0”: Working
EID Panel 4 (240 V)	“1”: error ; “0”: Working
EID Panel 4 (240 V)	“1”: error ; “0”: Working
EID Panel 4 (240 V)	“1”: error ; “0”: Working
EID Panel 4 (240 V)	“1”: error ; “0”: Working



signal name	description
EID Controller	“1”: error ; “0”: Working
EID Controller	“1”: error ; “0”: Working
EID Controller	“1”: error ; “0”: Working
EID Controller	“1”: error ; “0”: Working
EID Controller	“1”: error ; “0”: Working
EID Controller	“1”: error ; “0”: Working
EID Controller	“1”: error ; “0”: Working
EID Controller	“1”: error ; “0”: Working



signal name	description
EIDS Server	“1”: error ; “0”: Working
EIDS Server	“1”: error ; “0”: Working

[Note 9]*

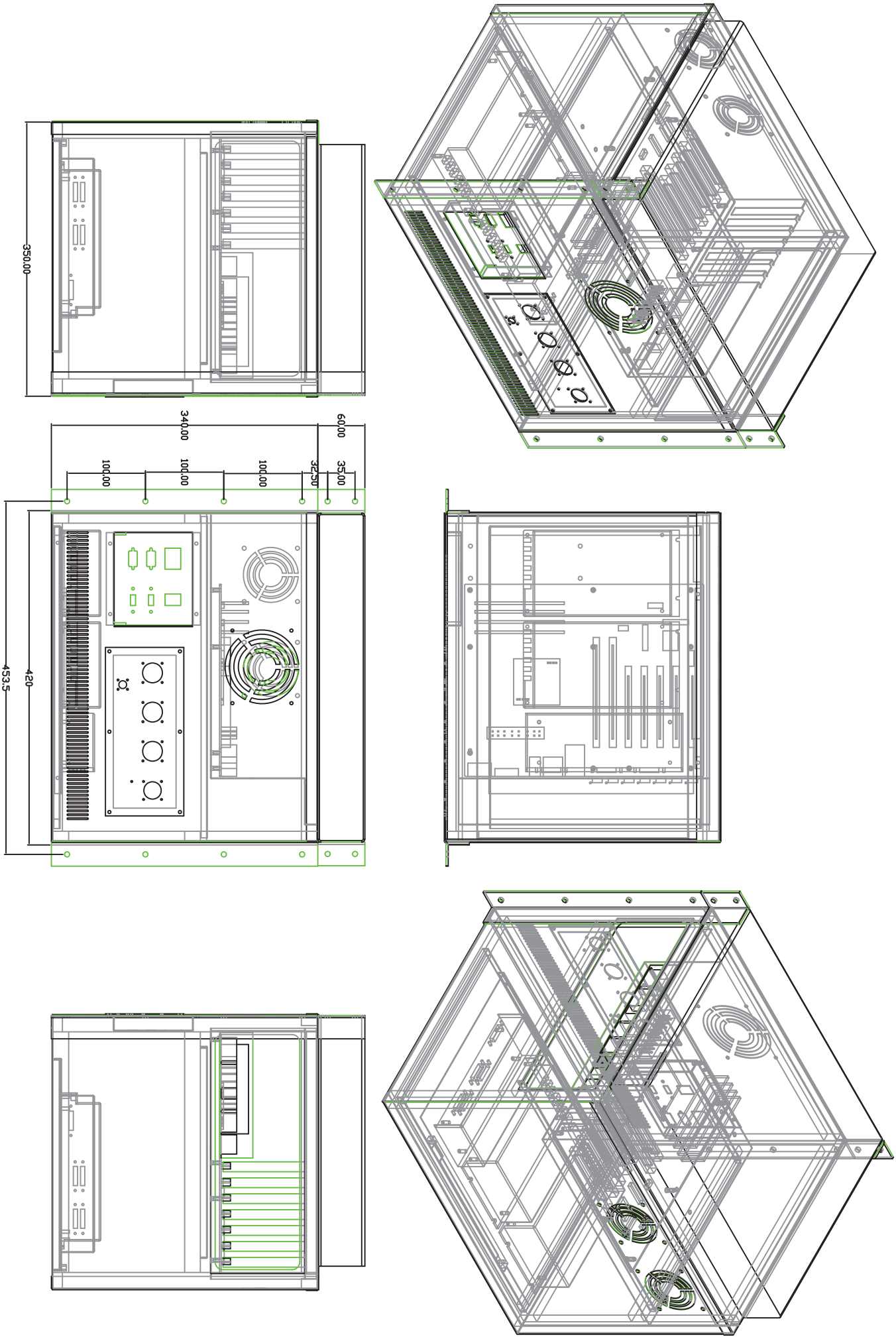
Bit 7	6	5	4	3	2	1	0
Spare	Spare	Spare	Spare	Spare	Message Code Error	Station Code Error	Route Code Error

0 – Normal
1 – Error

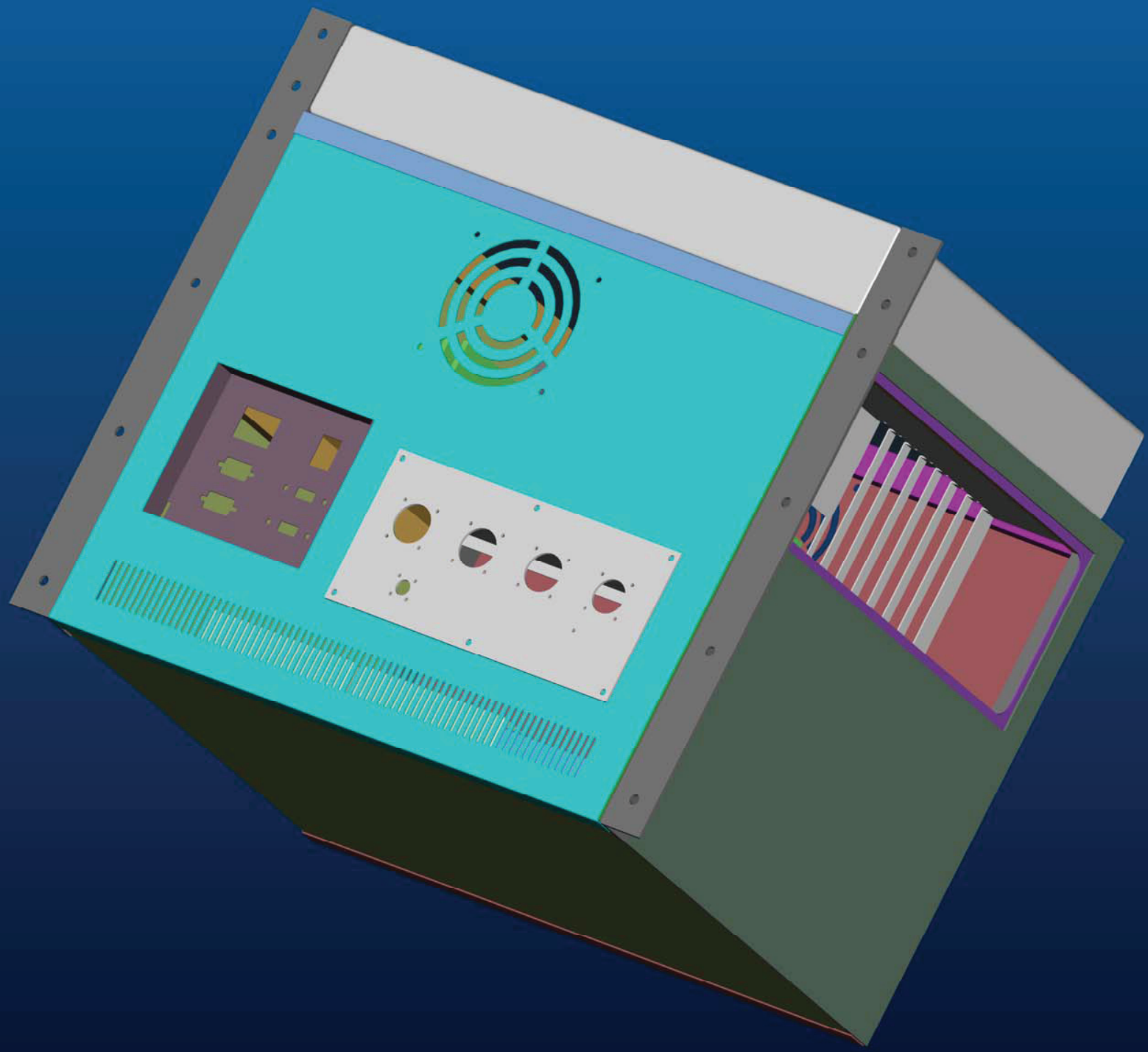
*Subject to TMS confirmation

[Note 10]

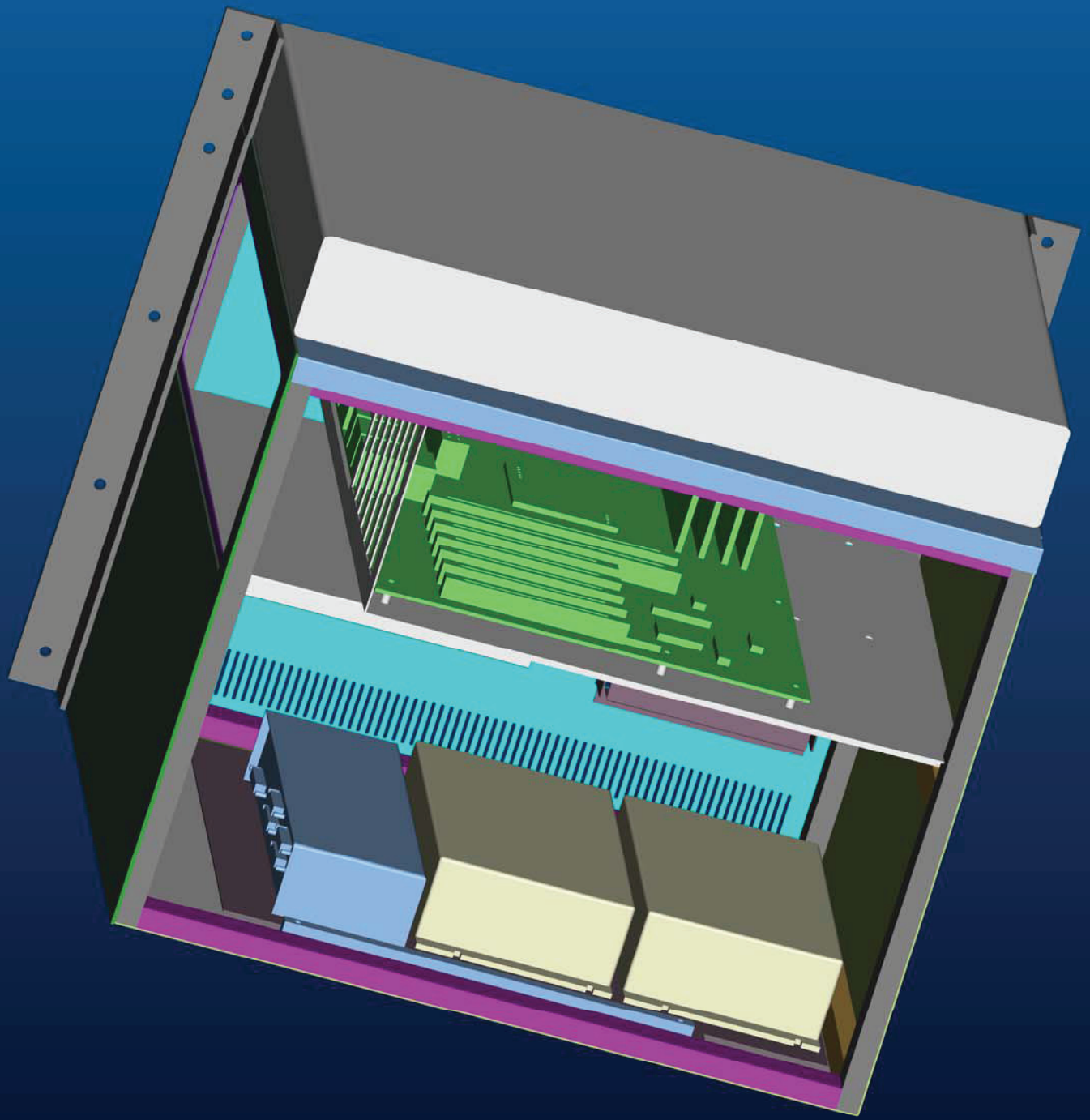
1- Active
2- Stand by

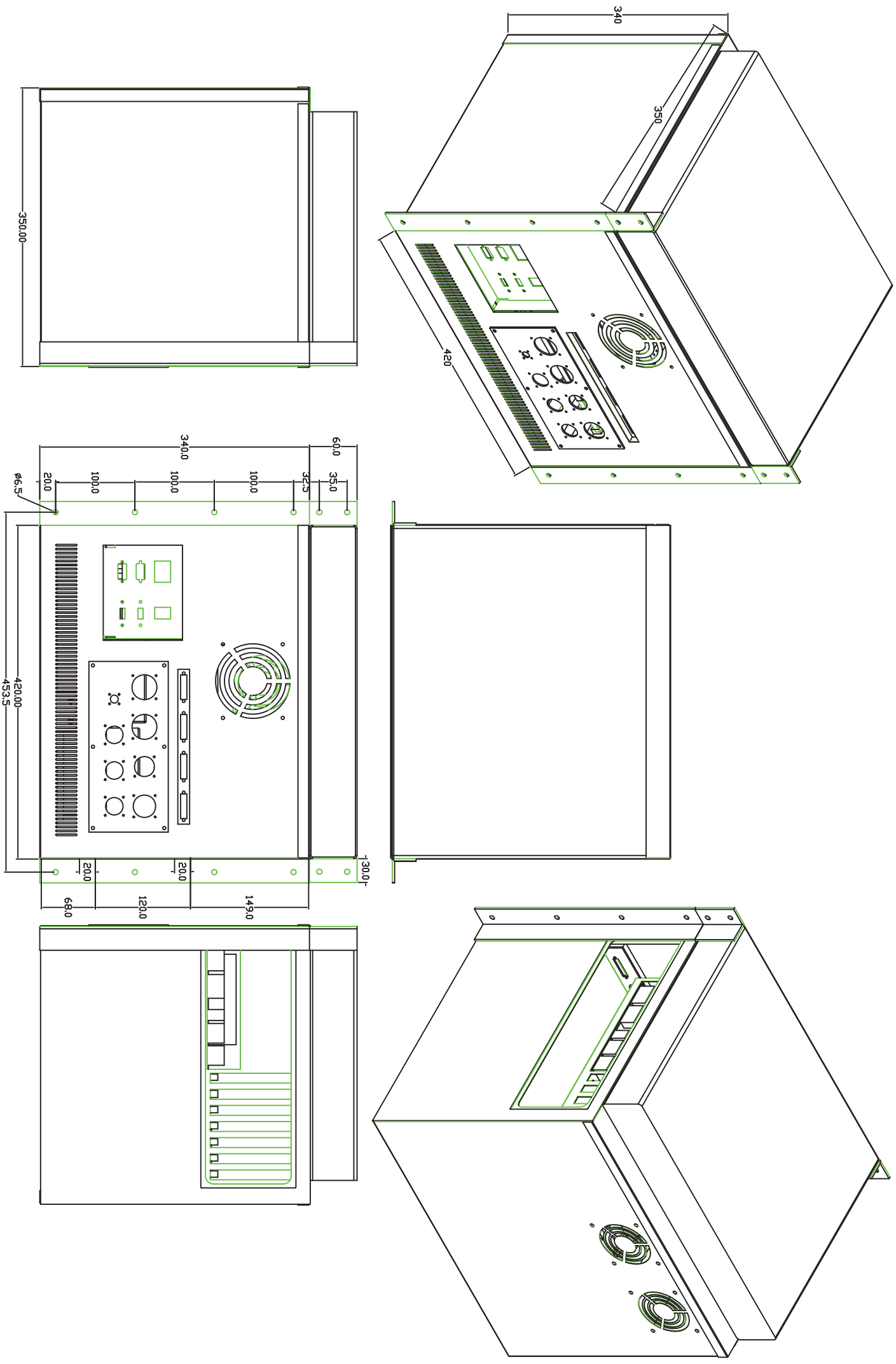

350.00
340.00
60.00
100.00
100.00
100.00
32.50
35.00
453.5
420

annex 4.1 Details of the EIDS server mounting drawing(including connector)

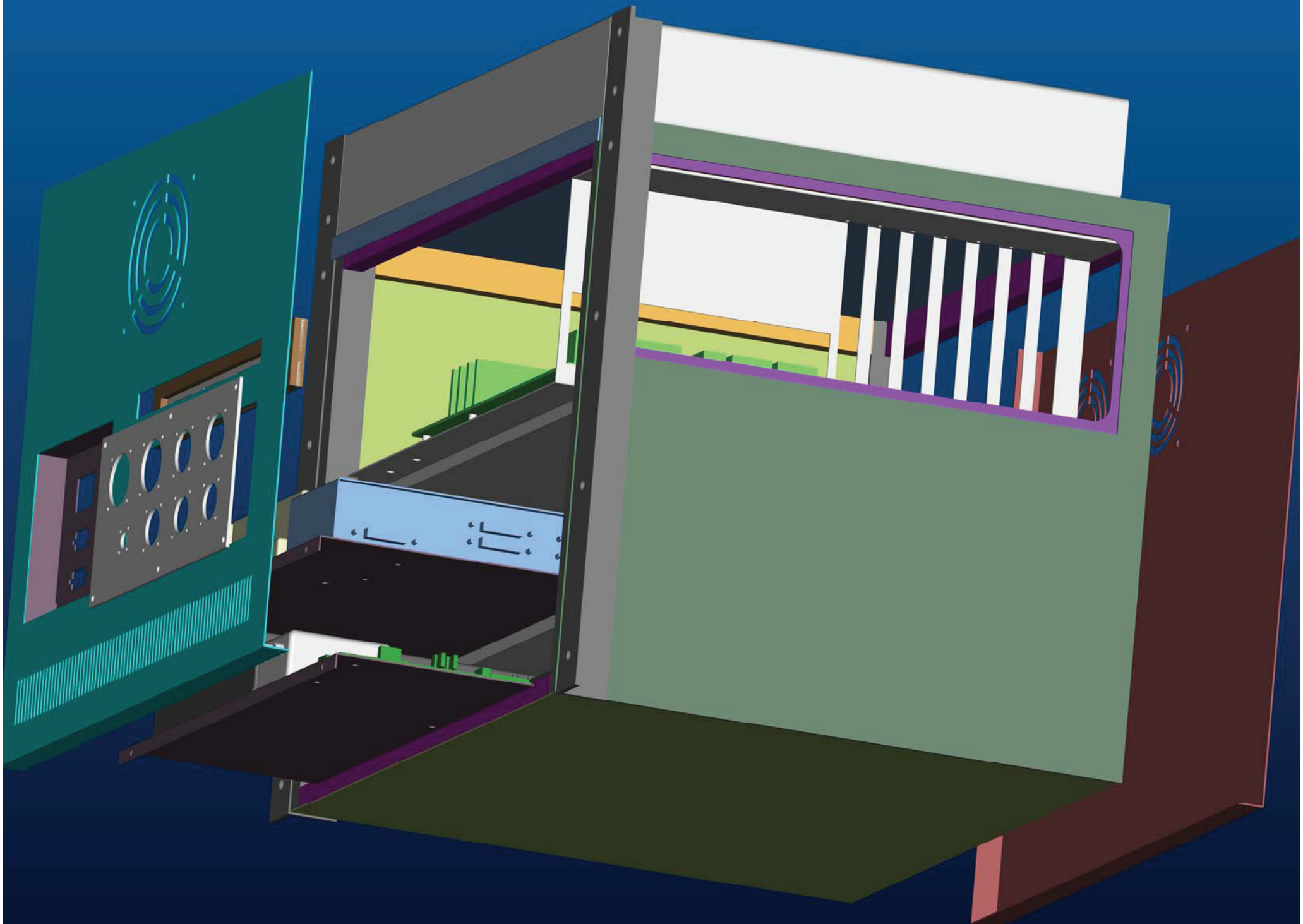


annex 4.1 Details of the EIDS server mounting drawing(including connector)

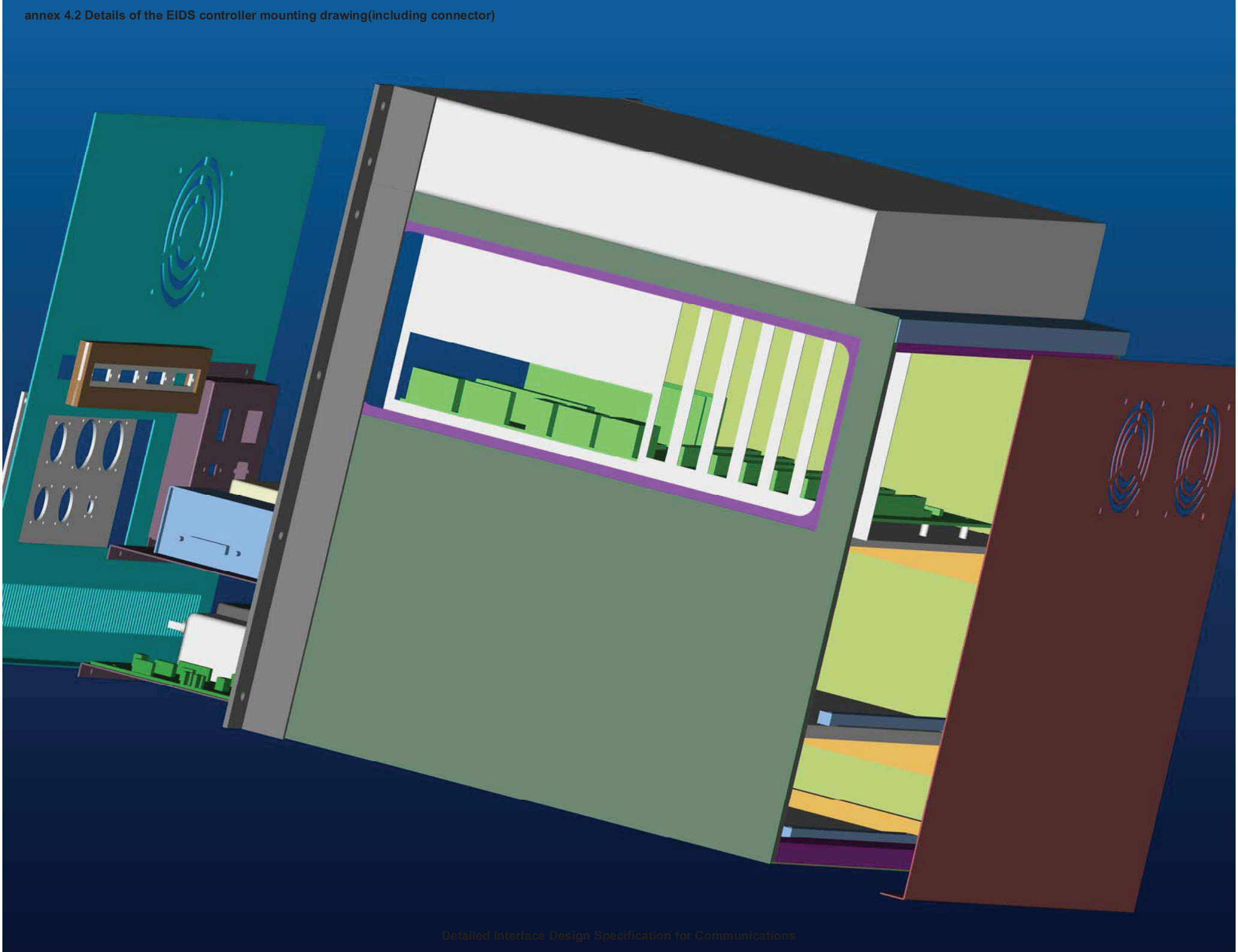



340
350
350.00
420
340.0
60.0
ø6.5
20.0
100.0
100.0
100.0
32.5
35.0
420.00
453.5
20.0
20.0
30.0
68.0
120.0
143.0

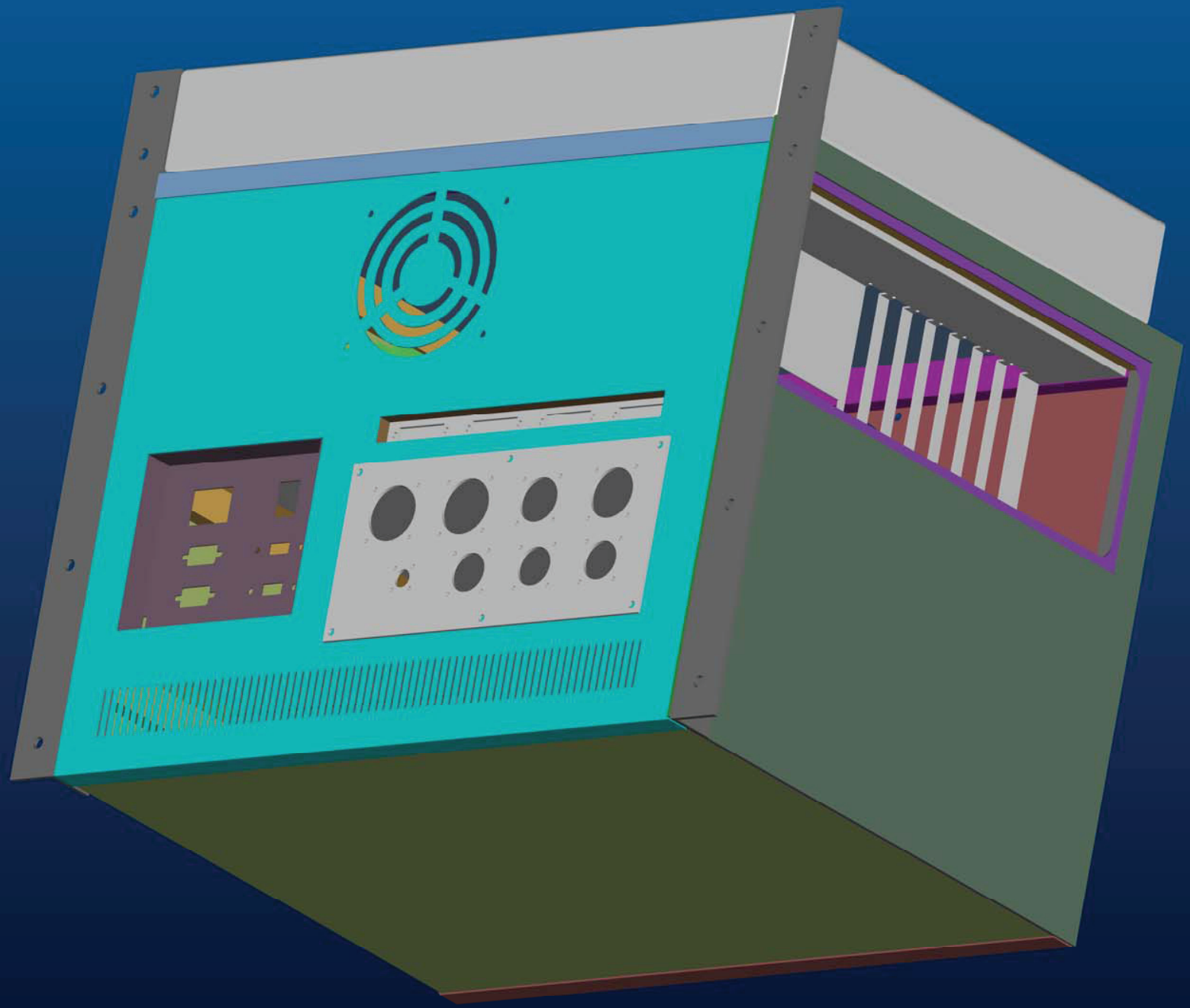
annex 4.2 Details of the EIDS controller mounting drawing(including connector)



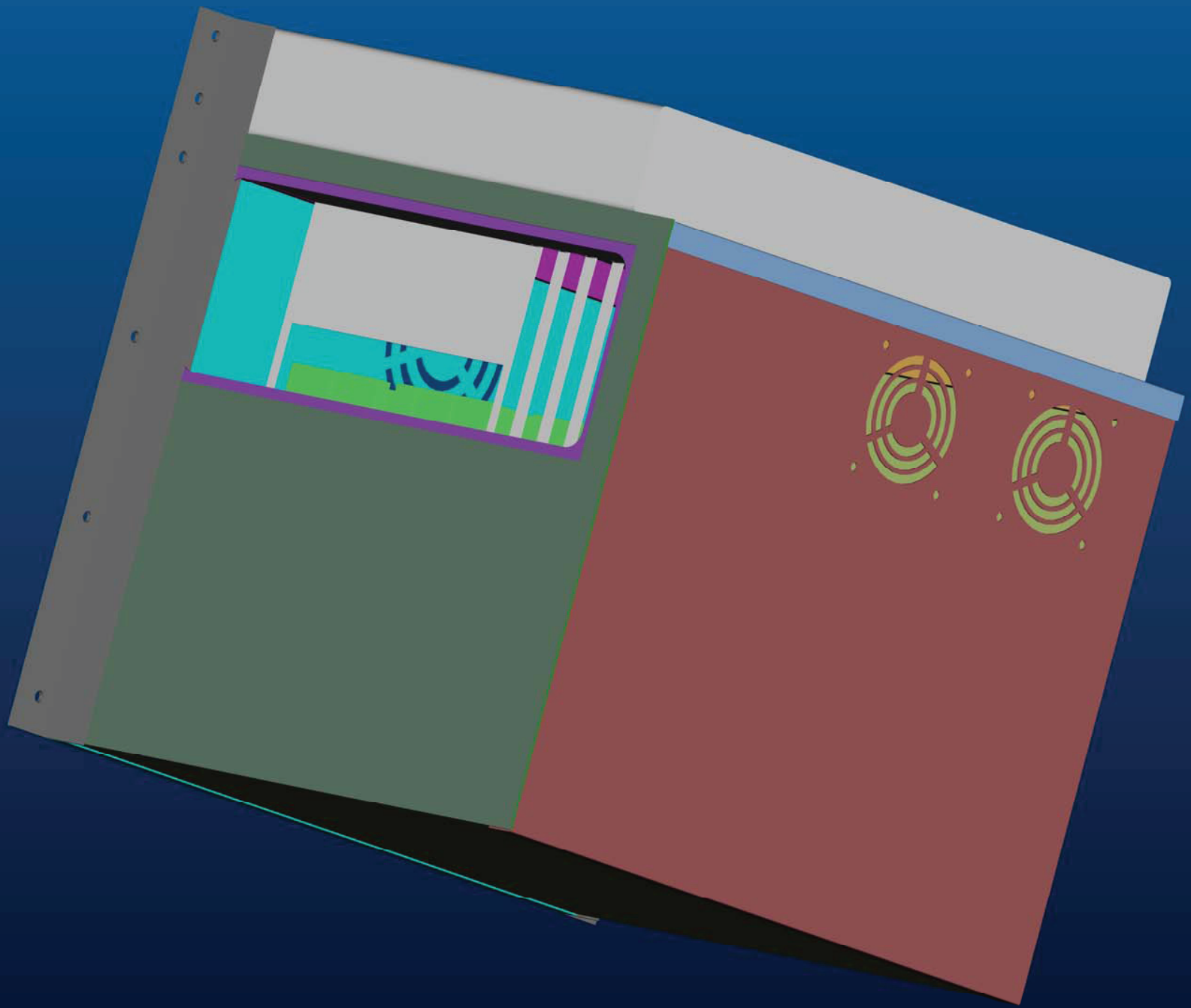
annex 4.2 Details of the EIDS controller mounting drawing(including connector)

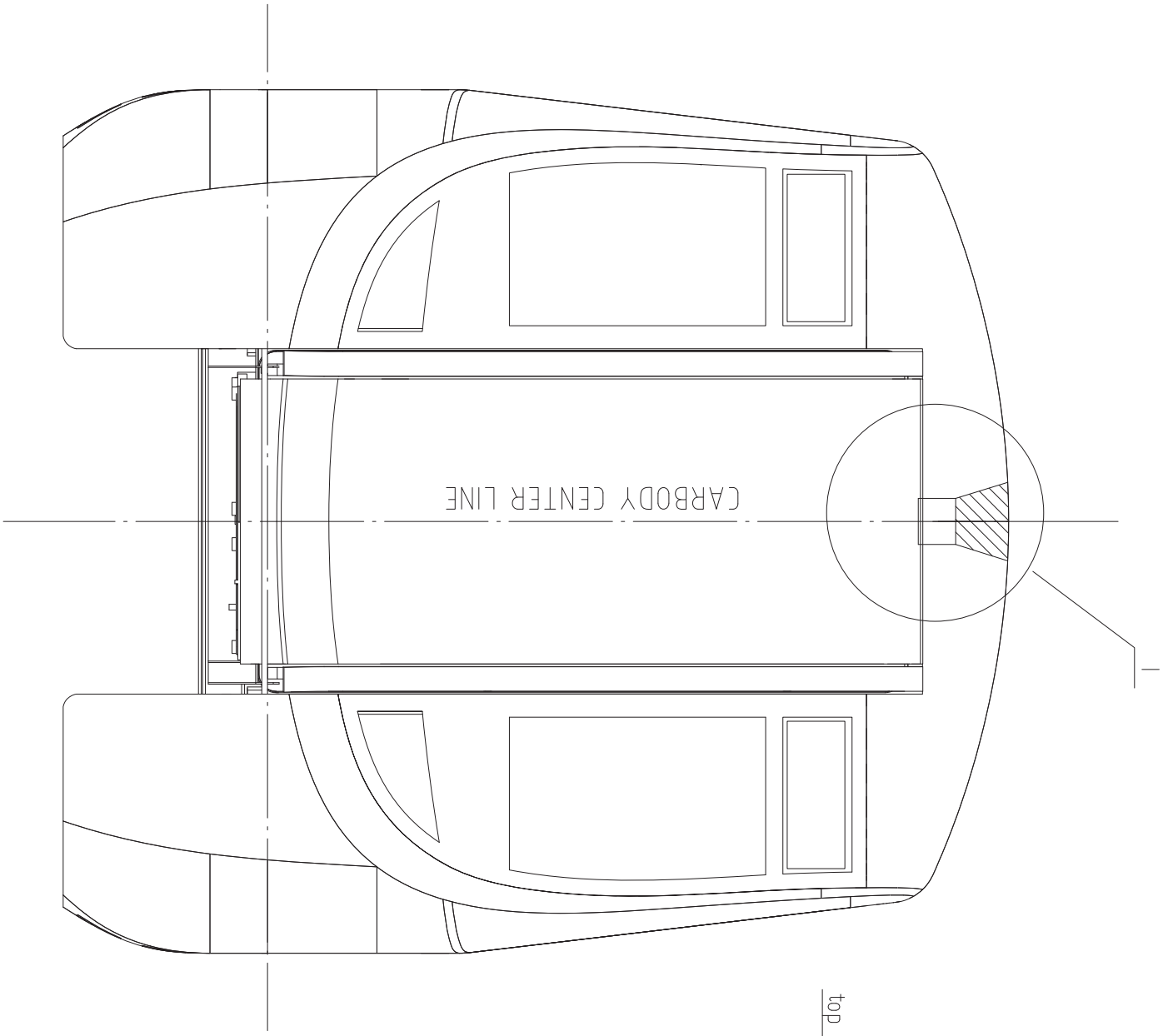


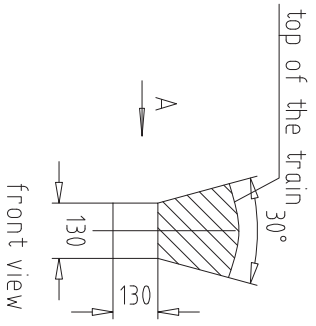
annex 4.2 Details of the EIDS controller mounting drawing(including connector)

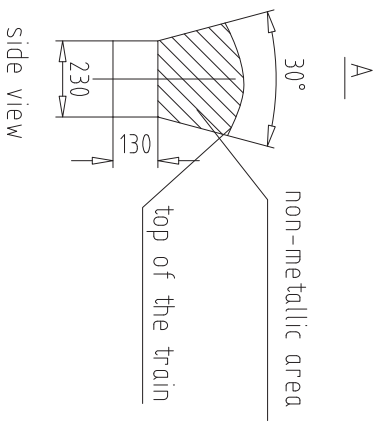


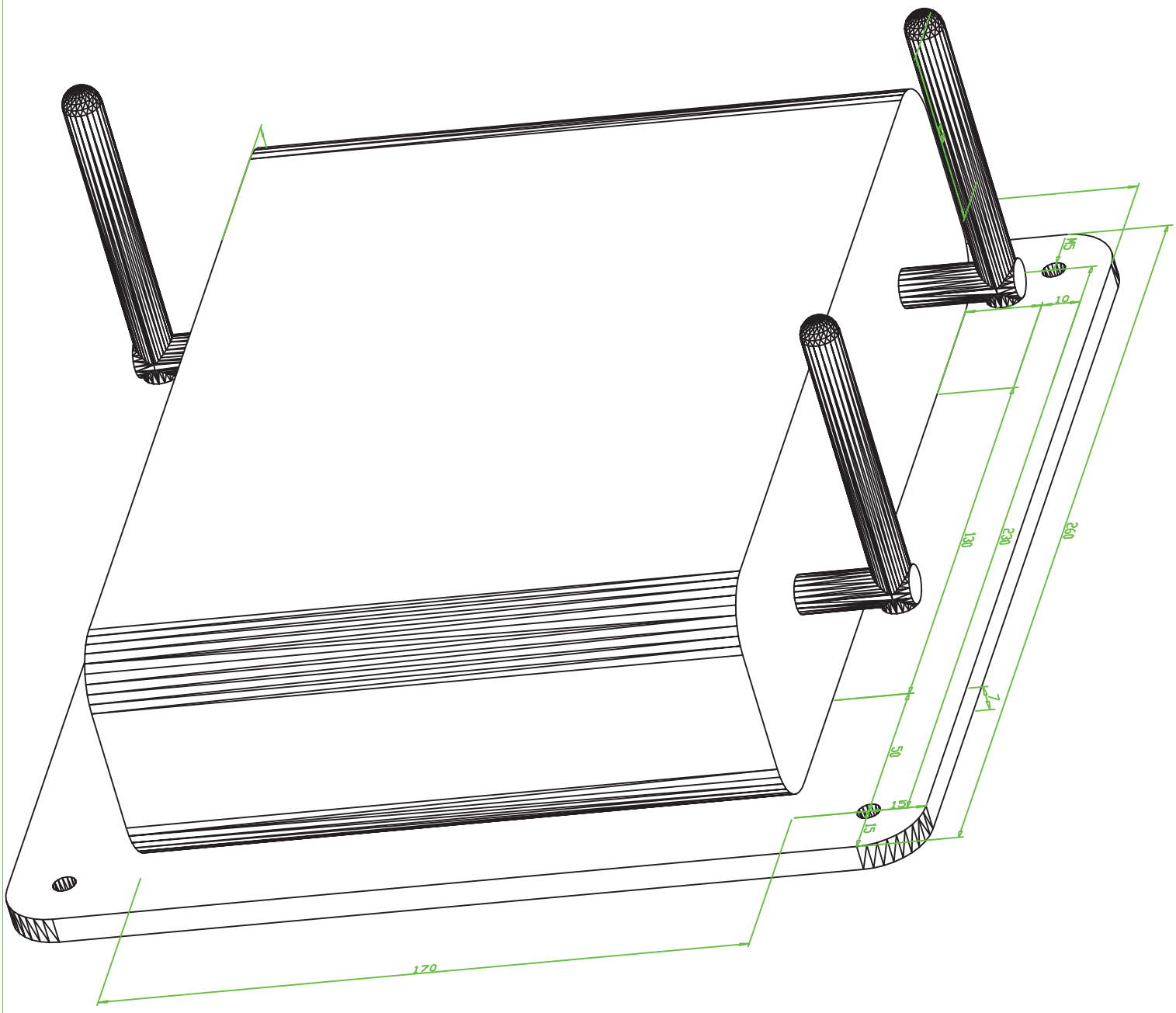
annex 4.2 Details of the EIDS controller mounting drawing(including connector)



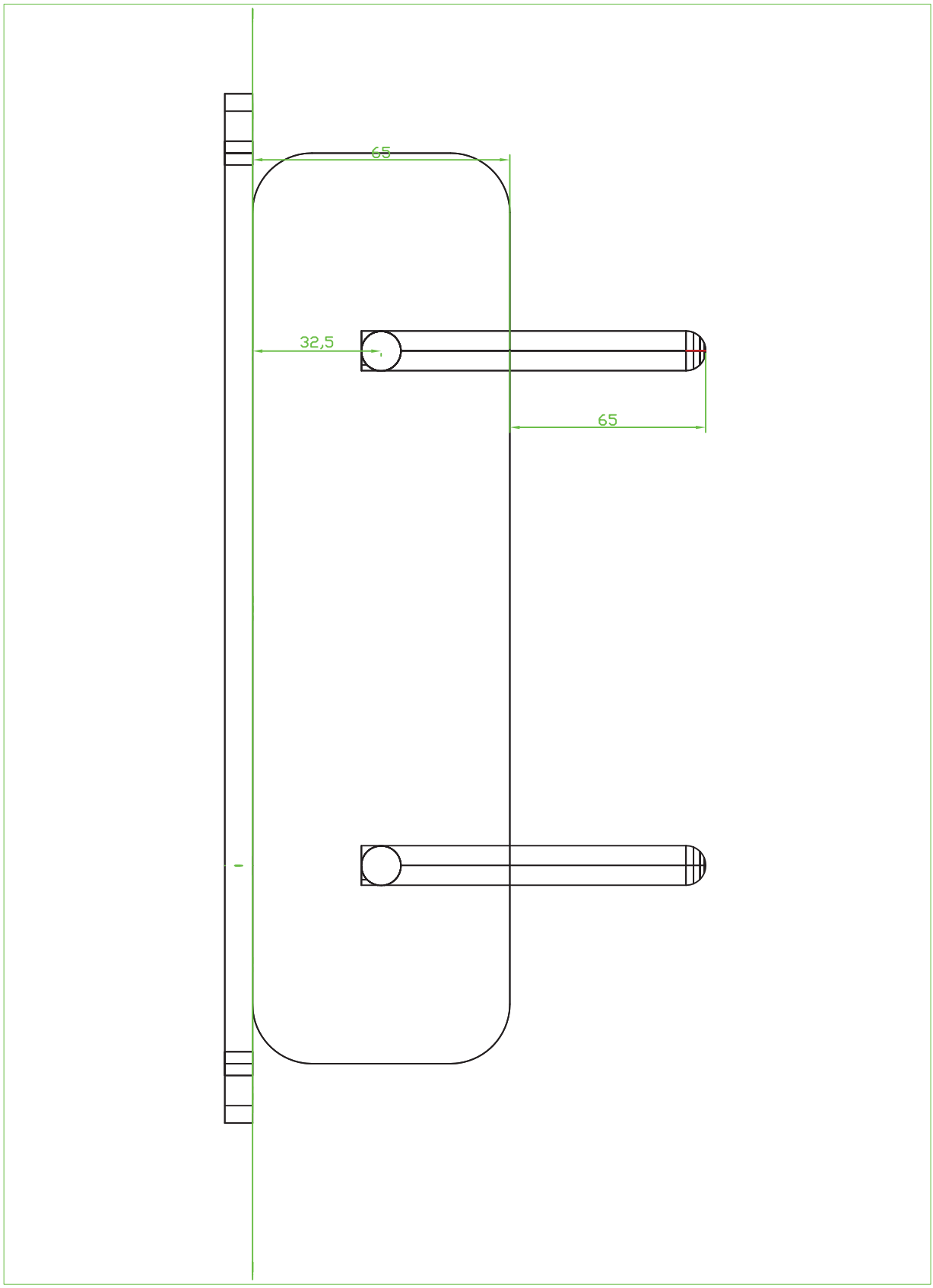

CARBODY CENTER LINE
I


top of the train
A
front view
130
130
30°
I

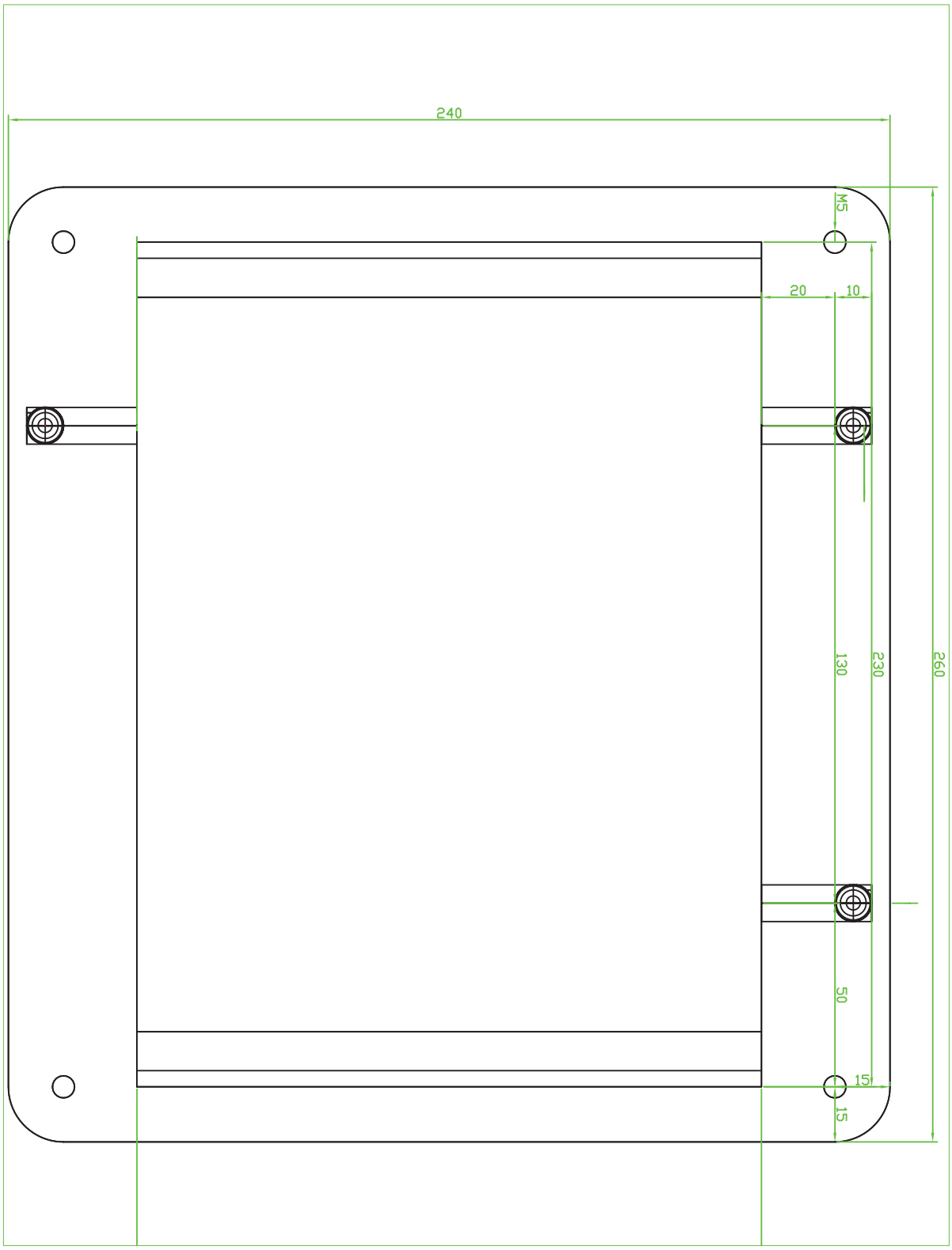

side view
230
130
30°
A
top of the train
non-metallic area

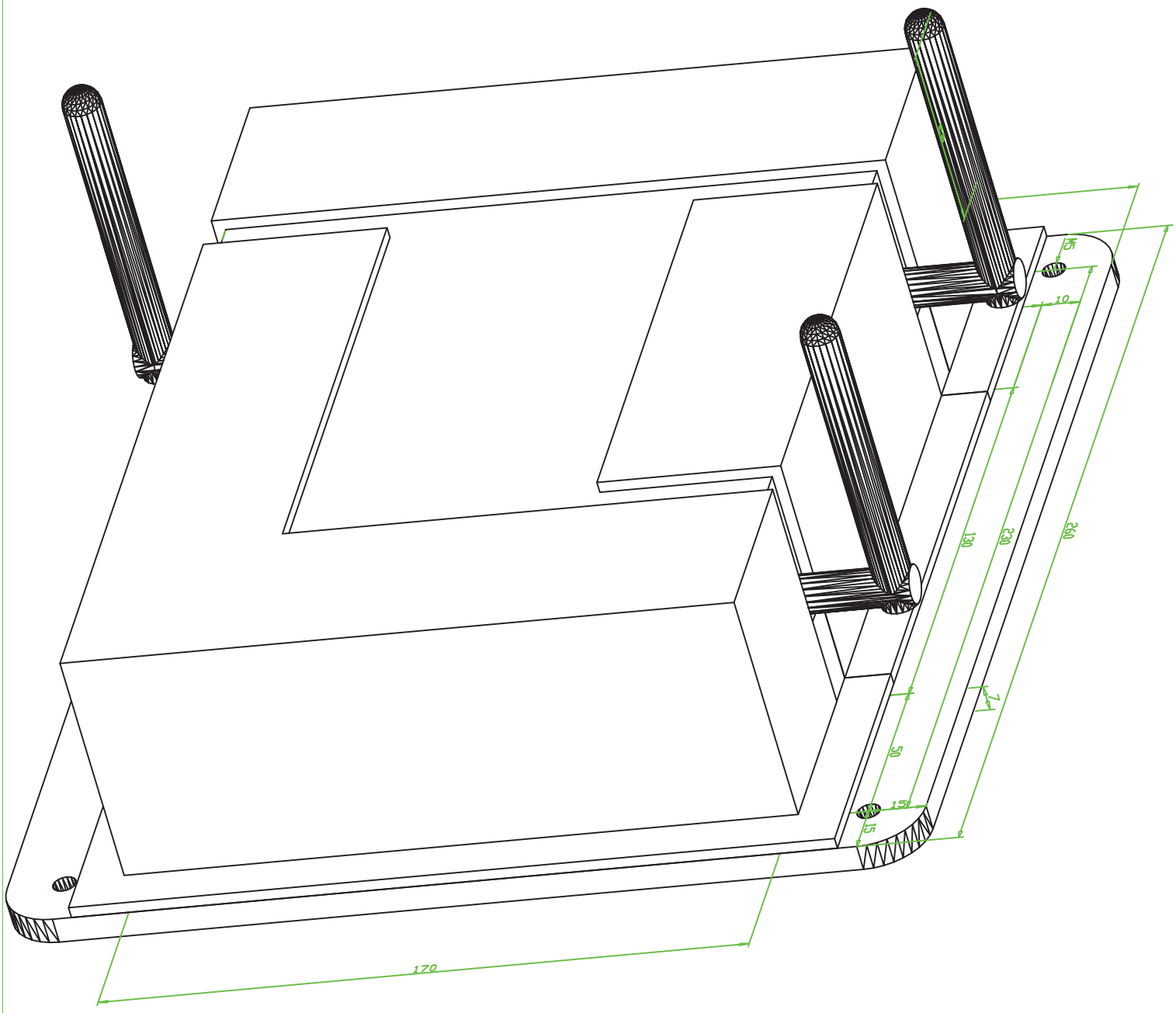

35
10
130
230
260
50
15
15
170

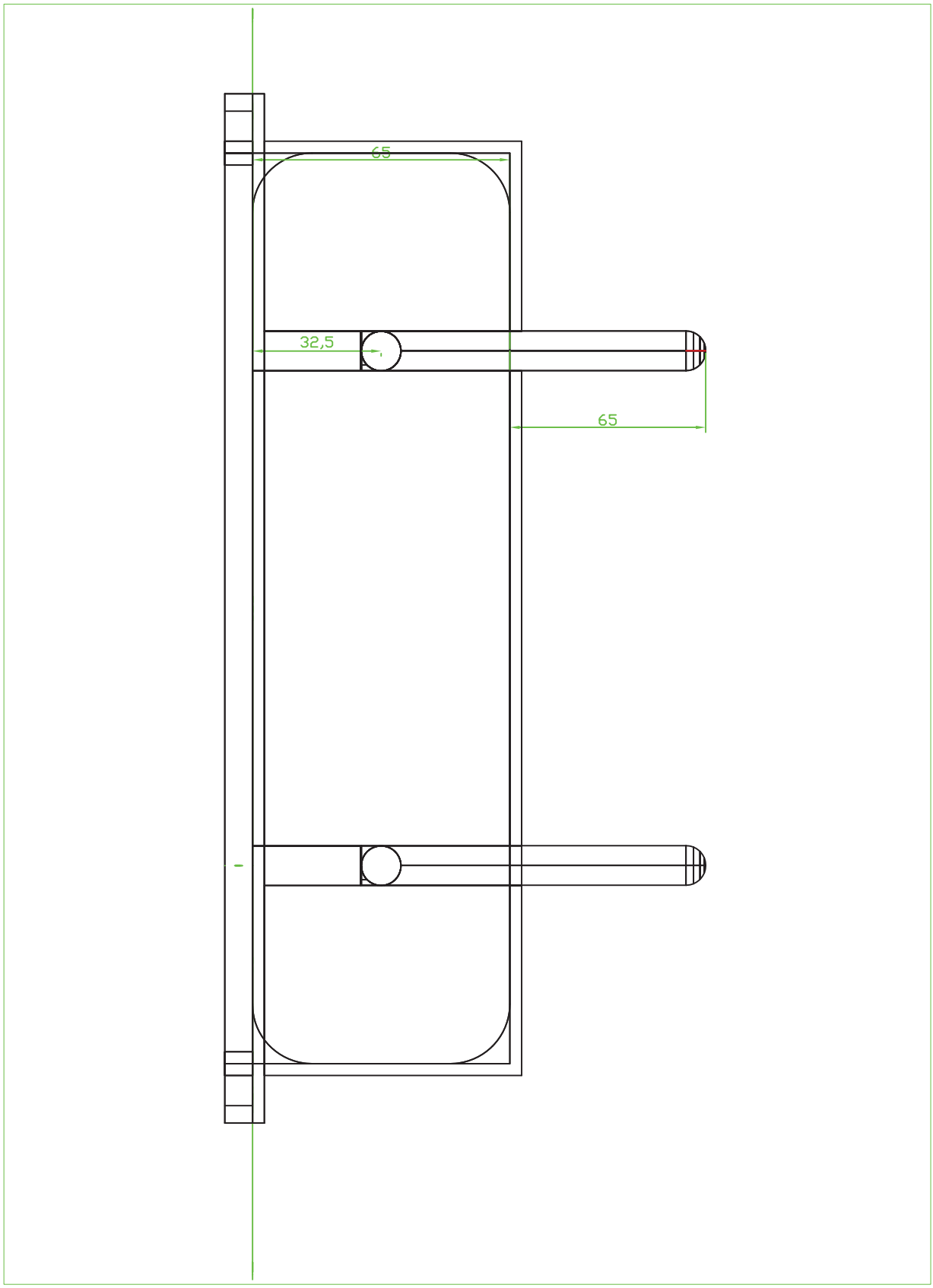
annex 4.4 Agreed mounting drawing of the antenna on the driving cab



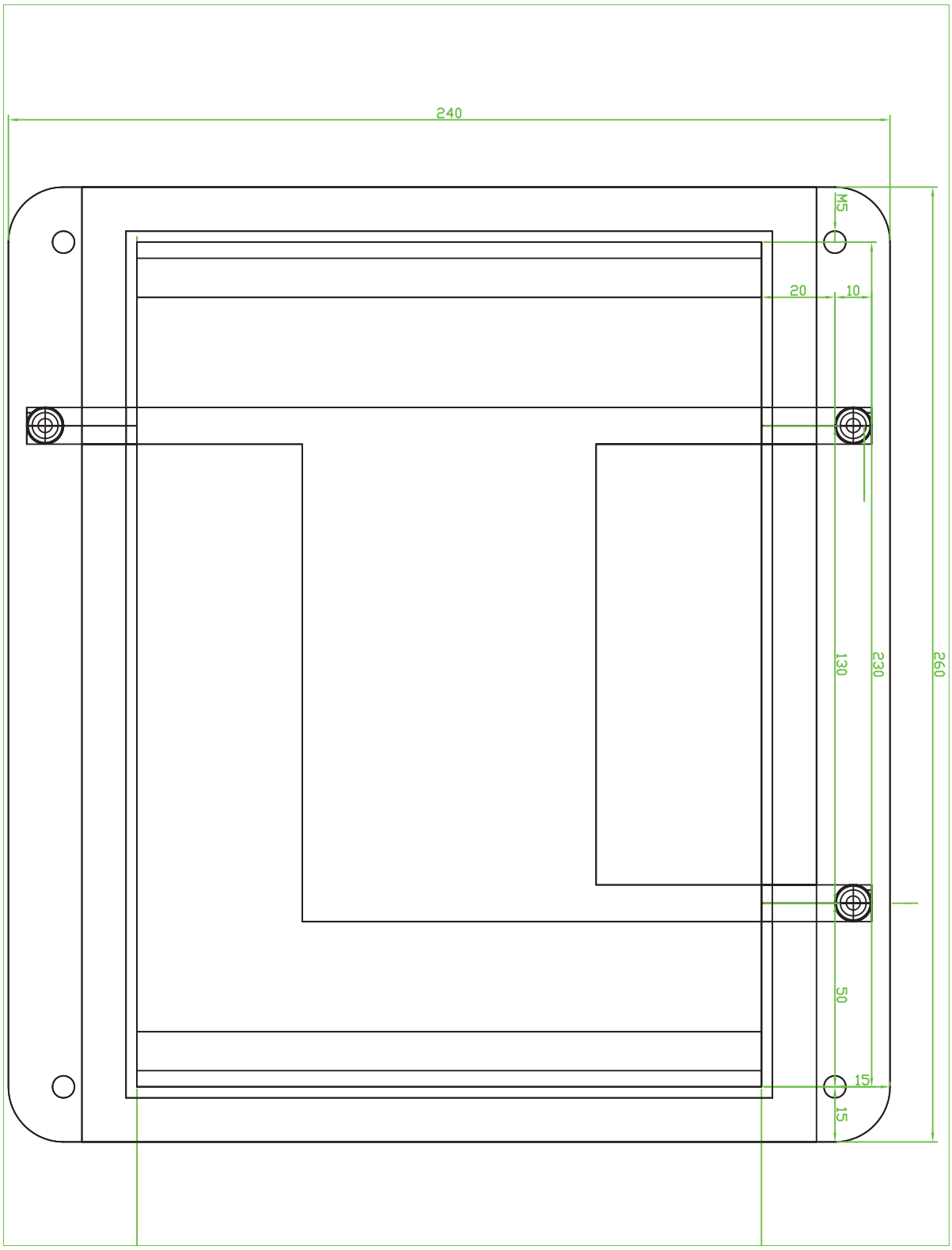
annex 4.4 Agreed mounting drawing of the antenna on the driving cab




35
10
130
230
260
7
50
15
15
170


65
32,5
65

annex 4.4 Agreed mounting drawing of the antenna on the driving cab



TOA

CEILING MOUNT SPEAKER PC-1869

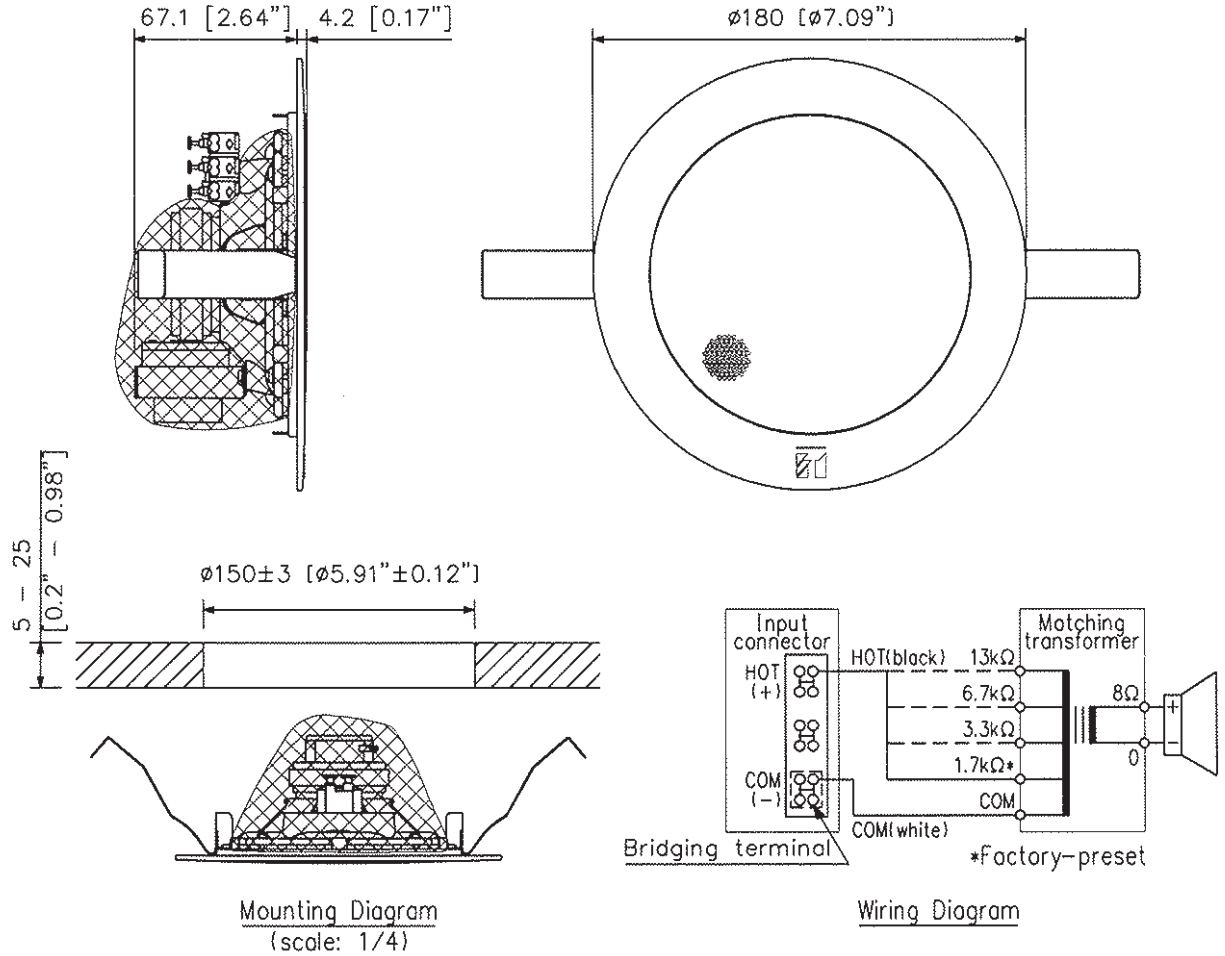
■DESCRIPTION

Integrated with a speaker unit and panel, the PC-1869 Ceiling Mount Speaker is of all metallic construction and ideal for use in a voice alarm system. It feature spring clamp mechanism for easy speaker mounting to the ceiling. The input impedance can be easily changed by changing the tap position of the transformer. The push-in type input terminal block makes cable connections easy and allows bridge wiring.

■SPECIFICATIONS

Rated Input	6 W (100 V line), 3 W (70 V line)
Rated Impedance	100 V line: 1.7 kΩ (6 W), 3.3 kΩ (3 W), 6.7 kΩ (1.5 W), 13 kΩ (0.8 W) 70 V line: 1.7 kΩ (3 W), 3.3 kΩ (1.5 W), 6.7 kΩ (0.8 W), 13 kΩ (0.4 W)
Sensitivity	90 dB (1 W, 1 m) (500 – 5,000 Hz, pink noise)
Frequency Response	55 – 18,000 Hz (peak –20 dB)
Speaker Component	12 cm (5") cone-type
Dimensions for Fixing Hole	Mounting hole: ø150±3 mm (ø5.91"±0.12") Ceiling thickness: 5 – 25 mm (0.2" – 0.98")
Speaker Mounting Method	Spring clamp
Applicable Cable	600 V vinyl-insulated cable (IV wire or HIV wire) Solid copper wire: ø0.8 – ø1.6 mm (equivalent to AWG 20 – 14) 7-core twisted copper wire: 0.75 – 1.25 mm² (equivalent to AWG 18 – 16)
Connection	Push-in connector (bridging terminal-2 branch type)
Finish	Baffle: Steel plate, off-white (RAL 9010 or equivalent color), paint Grille: Surface-treated steel plate net, off-white (RAL 9010 or equivalent color), paint
Dimensions	ø180 × 72 (D) mm (ø7.09" × 2.83")
Weight	620 g (1.37 lb)
Accessory	Paper pattern ···1

■APPEARANCE



Mounting Diagram (scale: 1/4)

Wiring Diagram

UNIT: mm SCALE: 1/3

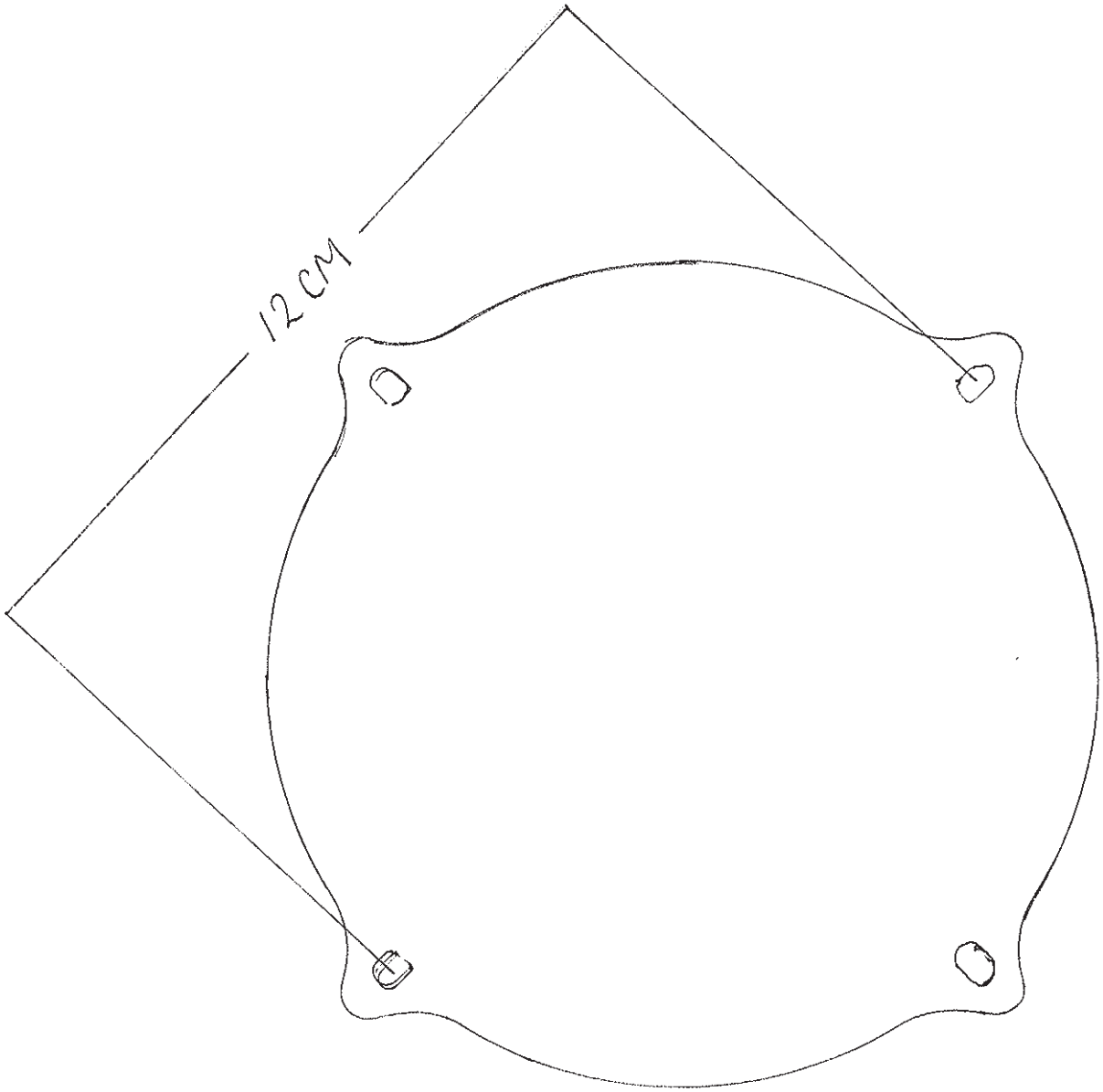
07D

TOA Corporation

DWG No: GPC02PA1

ELEPHANT HOLDINGS LIMITED

Exact Dimensions of PC-1869 Speaker Unit for your Information



C6014 and EIDS Interfacing Contractor Interface Agreement Table

System Provided by	DVAS input								110V DC Power Input			Reset button in driving cab			Zero Speed Dry Contact		
	C6014								C6014			EIDS Interfacing Contractor			C6014		
	DVAS interface in EIDS Server								Power Interface in EIDS Server			Reset Button Interface in EIDS Server			Zero Speed Interface in EIDS Server		
	EIDS Interfacing Contractor								EIDS Interfacing Contractor			EIDS Interfacing Contractor			EIDS Interfacing Contractor		
Cable ID	A								C			D			E		
Cable type	3 core twisted pair Screen cable								1 core cable x2 (One pair of power cable)			2 core Screen cable			2 core Screen cable		
Cable supplied by	EIDS Interfacing Contractor								EIDS Interfacing Contractor			EIDS Interfacing Contractor			EIDS Interfacing Contractor		
Cable specification	Provided by EIDS Interfacing Contractor								Provided by EIDS Interfacing Contractor			Provided by EIDS Interfacing Contractor			Provided by EIDS Interfacing Contractor		
Connector ID	*A1*	*A1'*	*CN2'*	*CN2*					*Circuit breaker*	*CN1'*	*CN1*	*Reset button*	*CN3'*	*CN3*	*Z*	*CN3'*	*CN3*
Connector type	*DB-9 (M)*	*DB-9 (F)*	*UTG-6/16/19P (M)*	*UTG0/16/19S (F)*					*Circuit breaker*	*UTG-6/14/12S (F)*	*UTG0/14/12P (M)*	*Reset button*	*UTG-6/16/19S (F)*	*UTG0/16/19P (M)*	*Provided by C6014*	*UTG-6/16/19S (F)*	*UTG0/16/19P (M)*
Connect or supplied by	C6014	EIDS Interfacing Contractor							C6014	EIDS Interfacing Contractor		EIDS Interfacing Contractor			C6014	EIDS Interfacing Contractor	

Connection for system provided by	**110V DC Pan/down Input**		
	C6014		
	110VDC Pan up/down interface in EIDS Server		
	EIDS Interfacing Contractor		
Cable ID	H		
Cable type	1 core cable x2 (One pair of power cable)		
Cable supplied by	EIDS Interfacing Contractor		
Cable specification	Provided by EIDS Interfacing Contractor		
Connector ID	*110V DC*	*CN1'*	*CN1*
Connector/Relay type	*Provided by C6014*	*UTG-6/14/12S (F)*	*UTG0/14/12P (M)*
Connect or supplied by	C6014	EIDS Interfacing Contractor	

EIDS Controller (EIDS Interfacing Contractor) and LCD Monitor (C6014) Interface Agreement Table

Connection for system provided by	**EIDS Controller LCD Display Interface**				**EIDS Controller LCD Display Interface**				**EIDS Controller LCD Power Interface**				**DVI Booster (D1, D2 & D3)**				**EIDS Controller LCD Signal Interface**			
	EIDS Interfacing Contractor				EIDS Interfacing Contractor				EIDS Interfacing Contractor				EIDS Interfacing Contractor				EIDS Interfacing Contractor			
	LCD Monitor 1				**DVI Booster (D1, D2 and D3)**				**DVI Booster (D1, D2 and D3)**				**LCD Monitor 2, 3 & 4**				**LCD Monitor 1, 2, 3 &4**			
	C6**014**				EIDS Interfacing Contractor				EIDS Interfacing Contractor				C6**014**				C6014			
Cable ID	I				I				K				I				J			
Cable type	DVI Cable				DVI Cable				1 core cable x6 (Three pairs of power cable)				DVI Cable				RS 485 Cable			
Cable supplied by	EIDS Interfacing Contractor				EIDS Interfacing Contractor				EIDS Interfacing Contractor				EIDS Interfacing Contractor				C6014			
Cable specification	Provided by EIDS Interfacing Contractor				Provided by EIDS Interfacing Contractor				Provided by EIDS Interfacing Contractor				Provided by C6014				Provided by C6014			
Connector ID	*CN1*	*CN1'*	*L1'*	*L1*	*CN2/ CN3/ CN4*	*CN2'/ CN3'/ CN4'*	*D1'/D2'/ D3'*	*D1/D2/ D3*	*CN7*	*CN7'*	*P1'/P2'/ P3'*	*P1/P2/ P3*	*O1/O2/ O3*	*O1'/O2' /O3'*	*L2'/L3'/ L4'*	*L2/L3/L 4*	*CN6*	*CN6'*	*R1'/R2' /R3'/R4 ,*	*R1/R2/ R3/R4*
Connector/Relay type	*DVI-D (F)*	*DVI-D (M)*	*DVI-D (M)*	*DVI-D (F)*	*DVI-D (F)*	*DVI-D (M)*	*DVI-D (M)*	*DVI-D (F)*	*UTG0/16/ 19S (F)*	*UTG-6/16/19P (M)*	**DC Power Jack (F)*	**DC Power Jack (M)*	*DVI-D (F)*	*DVI-D (M)*	*DVI-D (M)*	*DVI-D (F)*	*UTG0/ 18/23S (F)*	*UTG-6/18/23P (M)*	*Provided by C6014*	*Provided by C6014*
Connect or supplied by	EIDS Interfacing Contractor			C6014	EIDS Interfacing Contractor				EIDS Interfacing Contractor				EIDS Interfacing Contractor			C6014	EIDS Interfacing Contractor		C6014	

*Note: The DC power jack connector will be delivered with the cable to C6014 for installation.

EIDS Controller (EIDS Interfacing Contractor) and 110V DC Power (C6014) Interface Agreement Table

Connection for system provided by	**110V DC Power Input from D1**		
	C6014		
	Power Interface in EIDS Controller		
	EIDS Interfacing Contractor		
Cable ID	M		
Cable type	1 core cable x2 (One pair of power cable)		
Cable supplied by	EIDS Interfacing Contractor		
Cable specification	Provided by EIDS Interfacing Contractor		
Connector ID	*Circuit breaker*	*CN8'*	*CN8*
Connector type	*Circuit breaker*	*UTG-6/14/12S (F)*	*UTG0/14/12P (M)*
Connect or supplied by	C6014	EIDS Interfacing Contractor	

EIDS Interfacing Contractor Internal Cat5e Cables Interface Agreement Table For A-car:

Connection for system provided by	**EIDS Server UTP Interface**				**Wireless Router(AP) UTP Interface**				**EIDS Controller UTP Interface**				**Wireless Interface for b/g Maintenance PC download**	
	EIDS Server (EIDS Interfacing Contractor)				EIDS Interfacing Contractor				EIDS Server (EIDS Interfacing Contractor)				EIDS Server (EIDS Interfacing Contractor)	
	EIDS Controller UTP Interface				**EIDS Server UTP Interface**				**Next Car EIDS Controller UTP Interface (*by Gangway Copular LAN Interface) Note: Car to Car Lan connection to be provided by C6014**				**External Antenna**	
	EIDS Controller (EIDS Interfacing Contractor)				EIDS Server (EIDS Interfacing Contractor)				EIDS Controller (EIDS Interfacing Contractor)				EIDS Server (EIDS Interfacing Contractor)	
Cable ID	G				G				G				P	
Cable type	8 core twister pair screen cable (Cat5e cable)				8 core twister pair screen cable (Cat5e cable)				8 core twister pair screen cable (Cat5e cable)				Antenna Cable	
Cable supplied by	EIDS Interfacing Contractor				EIDS Interfacing Contractor				EIDS Interfacing Contractor				EIDS Interfacing Contractor	
Cable specification	Provided by EIDS Interfacing Contractor				Provided by EIDS Interfacing Contractor				Provided by EIDS Interfacing Contractor				Antenna Cable	
Connector ID	*CN4*	*CN4'*	*CN5'*	*CN5*	*P*	*P'*	*CN4'*	*CN4*	*CN11*	*CN11'*	*Provided by C6014*	*Provided by C6014*	*CN5'*	*CN5*
Connector/Relay type	*UTG0/22/35S (F)*	*UTG-6/22/35P (M)*	*UTG-6/20/28P (M)*	*UTG0/20/28S (F)*	*RJ-45 (F)*	*RJ-45 (M)*	*UTG-6/22/35P (M)*	*UTG0/22/35S (F)*	*UTG0/20/28P (M)*	*UTG-6/20/28S (F)*	*Provided by C6014*	*Provided by C6014*	*SMA (M)*	*SMA (F)*
Connect or supplied by	EIDS Server		EIDS Controller		Wireless AP		EIDS Server		C6560 (First Car EIDS Controller)		*C6014*		EIDS Interfacing Contractor (Antenna)	EIDS Server

For B/C Car

<table>
<tr><td rowspan="3">Connection for system provided by</td><td colspan="4">Previous Car EIDS Controller UTP
(from Gangway Copular LAN Interface)</td><td colspan="4">EIDS Controller UTP Interface</td></tr>
<tr><td colspan="4">*Gangway Coupler LAN Interface (C6014)
* Note: Car to Car Lan connection to be provided by C6014</td><td colspan="4">EIDS Controller (EIDS Interfacing Contractor)</td></tr>
<tr><td colspan="4">EIDS Controller UTP Interface</td><td colspan="4">Next Car EIDS Controller UTP Interface (*by Gangway Copular LAN Interface)
* Note: Car to Car Lan connection to be provided by C6014</td></tr>
<tr><td>Cable ID</td><td colspan="4">G</td><td colspan="4">G</td></tr>
<tr><td>Cable type</td><td colspan="4">8 core twister pair screen cable (Cat5e cable)</td><td colspan="4">8 core twister pair screen cable (Cat5e cable)</td></tr>
<tr><td>Cable supplied by</td><td colspan="4">EIDS Interfacing Contractor</td><td colspan="4">EIDS Interfacing Contractor</td></tr>
<tr><td>Cable specification</td><td colspan="4">Provided by EIDS Interfacing Contractor</td><td colspan="4">Provided by EIDS Interfacing Contractor</td></tr>
<tr><td>Connector ID</td><td>Provided by C6014</td><td>Provided by C6014</td><td>CN5’</td><td>CN5</td><td>CN11</td><td>CN11’</td><td>Provided by C6014</td><td>Provided by C6014</td></tr>
<tr><td>Connector/Relay type</td><td>Provided by C6014</td><td>Provided by C6014</td><td>UTG-6/20/28P (M)</td><td>UTG0/20/28S (F)</td><td>UTG0/20/28P (M)</td><td>UTG-6/20/28S (F)</td><td>Provided by C6014</td><td>Provided by C6014</td></tr>
<tr><td>Connect or supplied by</td><td colspan="2">C6014</td><td colspan="2">EIDS Controller</td><td colspan="2">EIDS Controller</td><td colspan="2">C6014</td></tr>
</table>

EIDS Controller (EIDS Interfacing Contractor) and Audio Amplifier (EIDS Interfacing Contractor) Interface Agreement Table

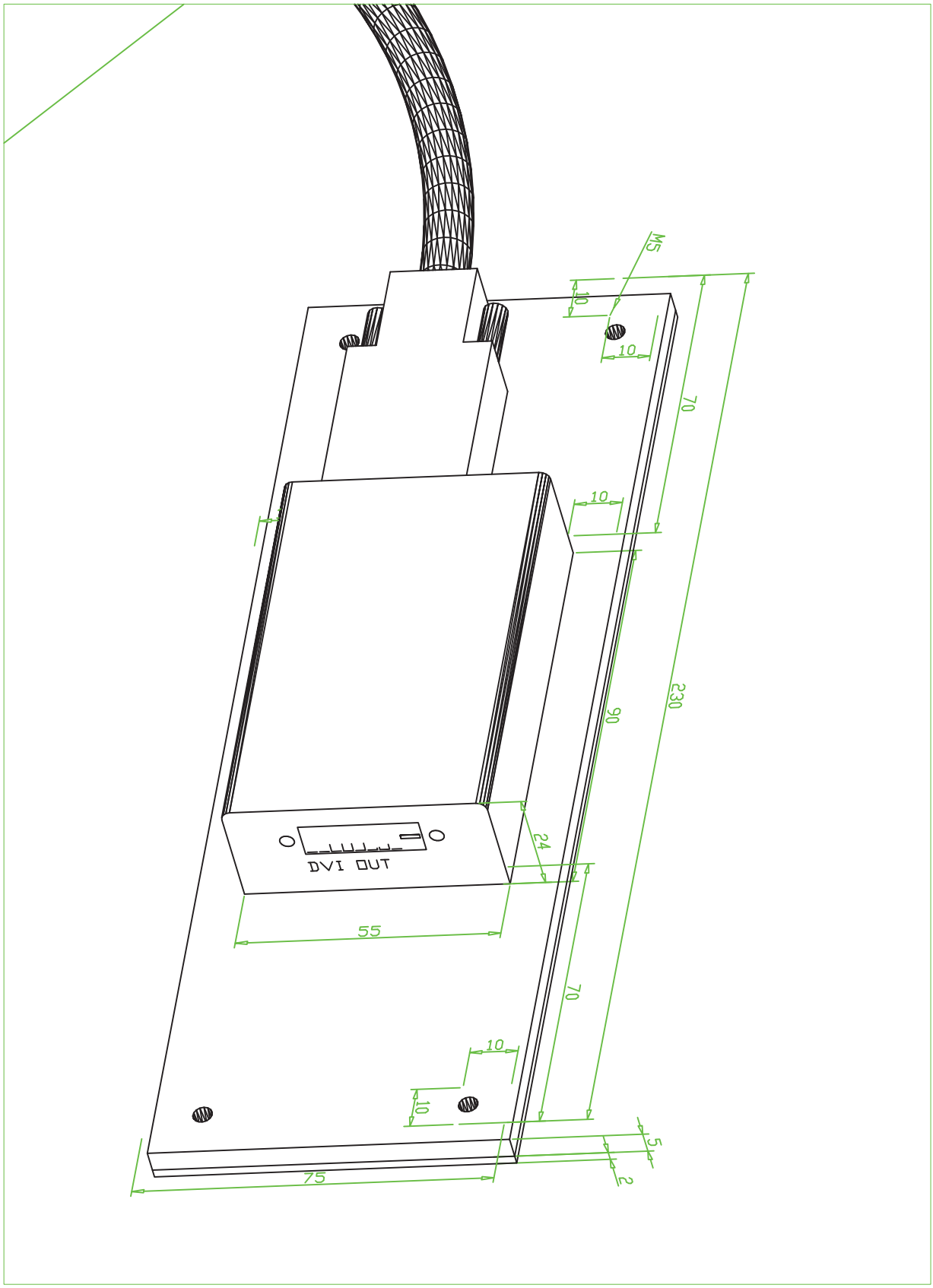
Connection for system provided by	**EIDS Controller Audio Amplifier Interface**				**EIDS Controller Loudspeaker Interface**			
	EIDS Interfacing Contractor				EIDS Interfacing Contractor			
	Audio Amplifier				**Audio Amplifier**			
	EIDS Interfacing Contractor				EIDS Interfacing Contractor			
Cable ID	M				L			
Cable type	1 core cable x2 (One pair of power cable)				2 core twisted pair Screen cable (Audio cable)			
Cable supplied by	EIDS Interfacing Contractor				EIDS Interfacing Contractor			
Cable specification	Provided by EIDS Interfacing Contractor				Provided by EIDS Interfacing Contractor			
Connector ID	*CN10*	*CN10'*	*CN4'*	*CN4*	*CN9*	*CN9'*	*CN3'*	*CN3*
Connector/terminal type	*UTG0/14/12S (F)*	*UTG-6/14/12P (M)*	*UTG6/12/8S (F)*	*UTG0/12/8P (M)*	*UTG0/14/12S (F)*	*UTG-6/14/12P (M)*	*UTG6/12/8P (M)*	*UTG0/12/8S (F)*
Connect or supplied by	EIDS Interfacing Contractor(EIDS Controller)		EIDS Interfacing Contractor (Audio Amplifier)		EIDS Interfacing Contractor(EIDS Controller)		EIDS Interfacing Contractor(Audio Amplifier)	

Driving Cab Wireless Access Point and EIDS Server 12V DC Power Interface Table

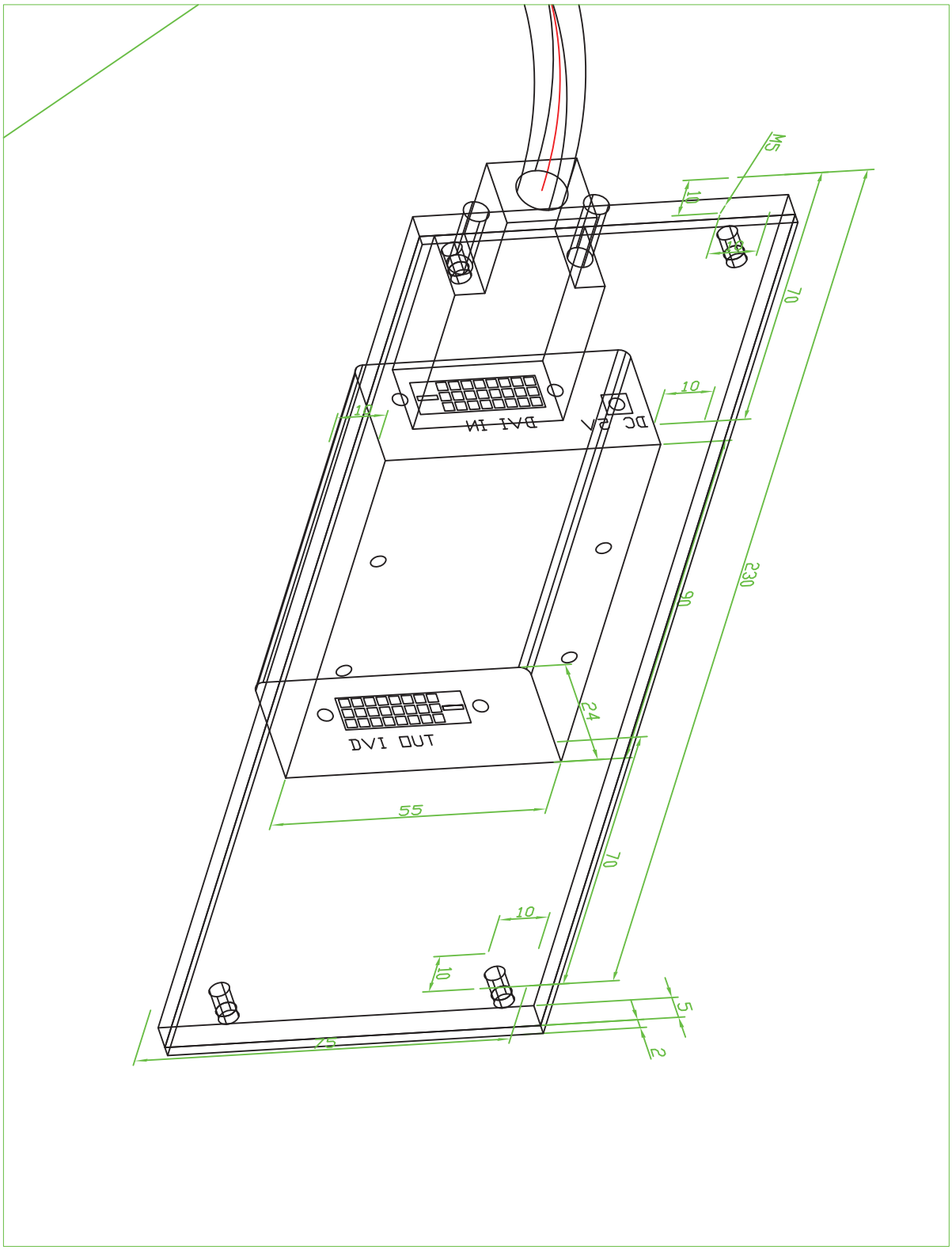
Connection for system provided by	**12V DC Power Output from EIDS Server**			
	EIDS Interfacing Contractor			
	Power Interface in Access Point			
	EIDS Interfacing Contractor			
Cable ID	F			
Cable type	One pair of power cable			
Cable supplied by	EIDS Interfacing Contractor			
Cable specification	Provided by EIDS Interfacing Contractor			
Connector ID	*CN4'*	*CN4*	*S'*	*S*
Connector type	*UTG-6/22/35P (M)*	*UTG0/22/35S (F)*	*Power Jack (F)*	*Power Jack (M)*
Connect or supplied by	EIDS Server		Wireless AP	

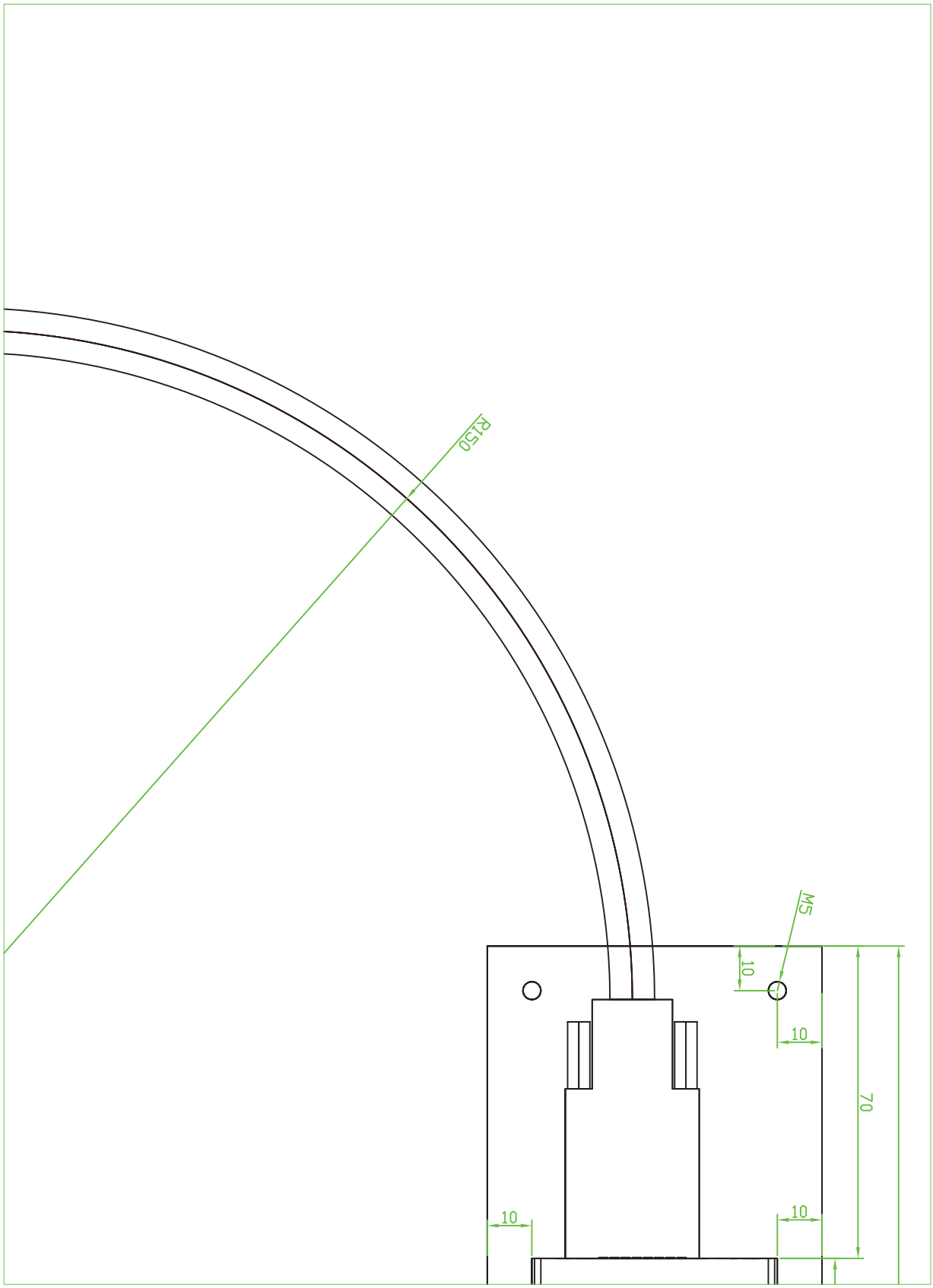
Audio Amplifier (EIDS Interfacing Contractor) and Loud Speaker (EIDS Interfacing Contractor) Interface Agreement Table

Connection for system provided by	**Audio Amplifier Loudspeaker Interface**			**Audio Amplifier Loudspeaker Interface**		
	EIDS Interfacing Contractor			EIDS Interfacing Contractor		
	Left Loudspeaker (x5)			**Right Loudspeaker (x5)**		
	EIDS Interfacing Contractor			EIDS Interfacing Contractor		
Cable ID	L			L		
Cable type	2 core twisted pair Screen cable (Audio cable)			2 core twisted pair Screen cable (Audio cable)		
Cable supplied by	EIDS Interfacing Contractor			EIDS Interfacing Contractor		
Cable specification	Provided by EIDS Interfacing Contractor			Provided by EIDS Interfacing Contractor		
Connector ID	*CN1*	*CN1'*	*S1*	*CN2*	*CN2'*	*S1*
Connector/terminal type	*UTG0/12/8S (F)*	*UTG-6/12/8P (M)*	*Terminal block in Loudspeaker*	*UTG0/12/8S (F)*	*UTG-6/12/8P (M)*	*Terminal block in Loudspeaker*
Connect or supplied by	EIDS Interfacing Contractor (Audio Amplifier)		EIDS Interfacing Contractor (loudspeaker)	EIDS Interfacing Contractor (Audio Amplifier)		EIDS Interfacing Contractor (Loudspeaker)

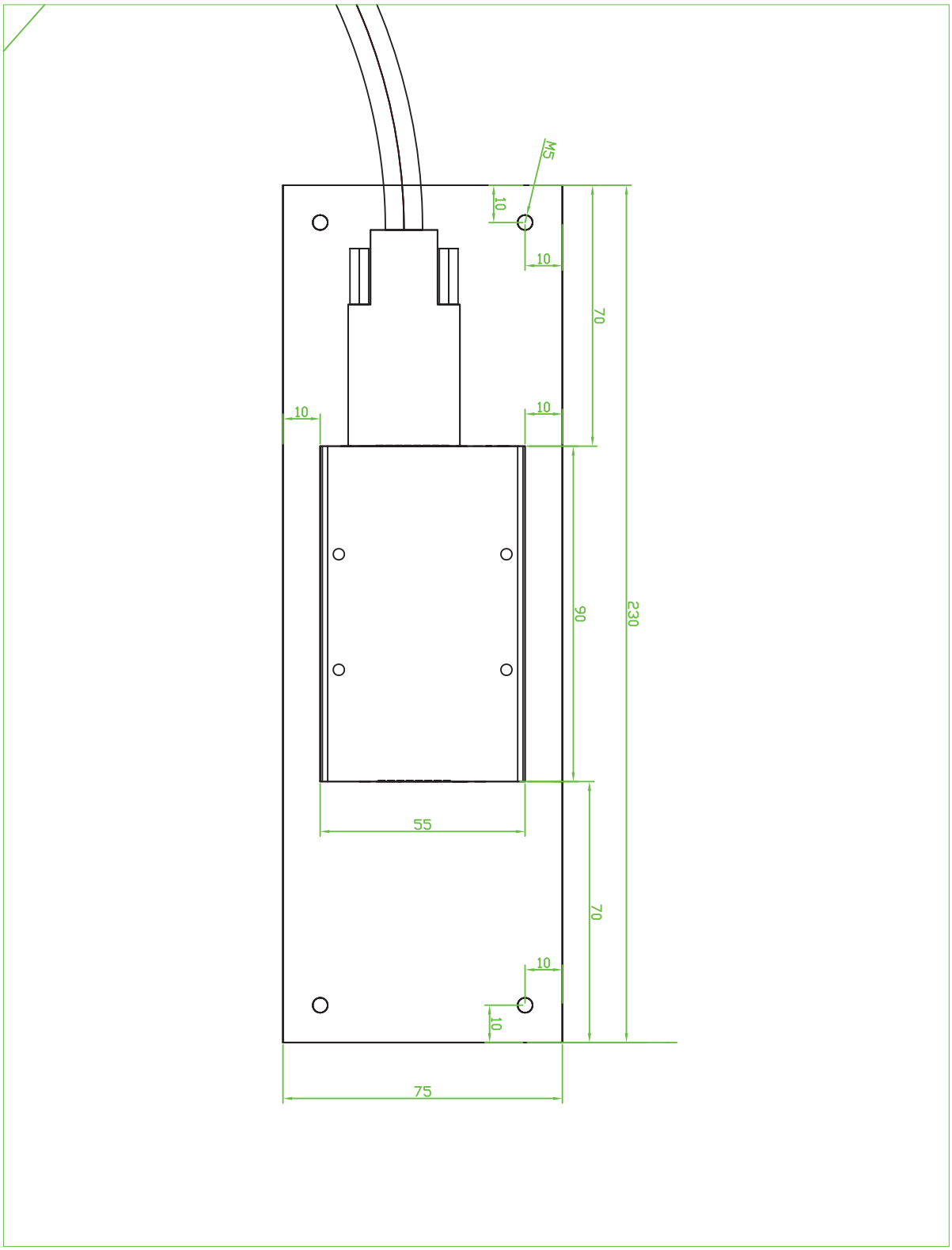

M5
10
10
70
10
230
90
24
DVI OUT
55
70
10
10
5
2
75

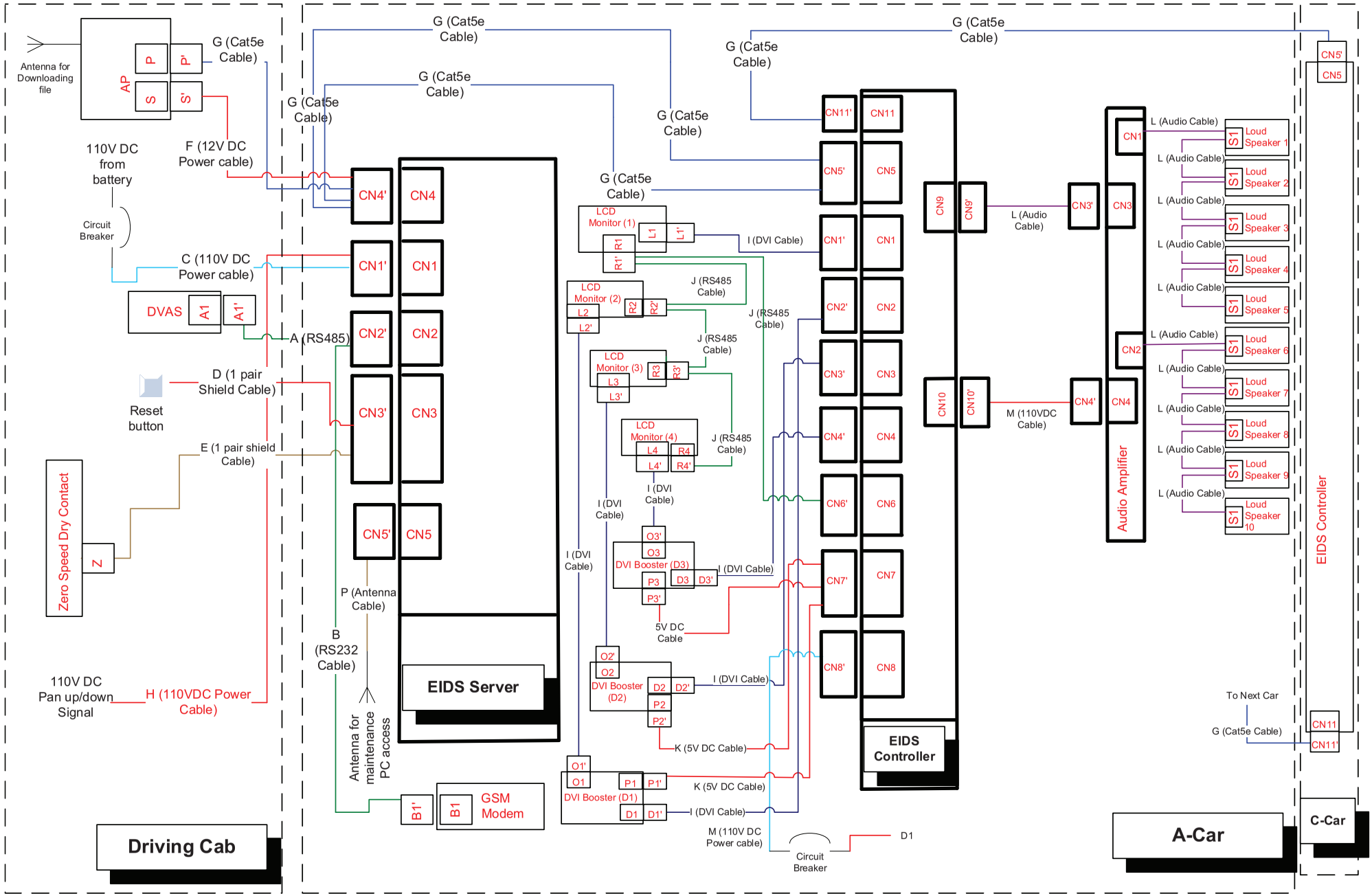
annex 4.7 Booster mounting drawing



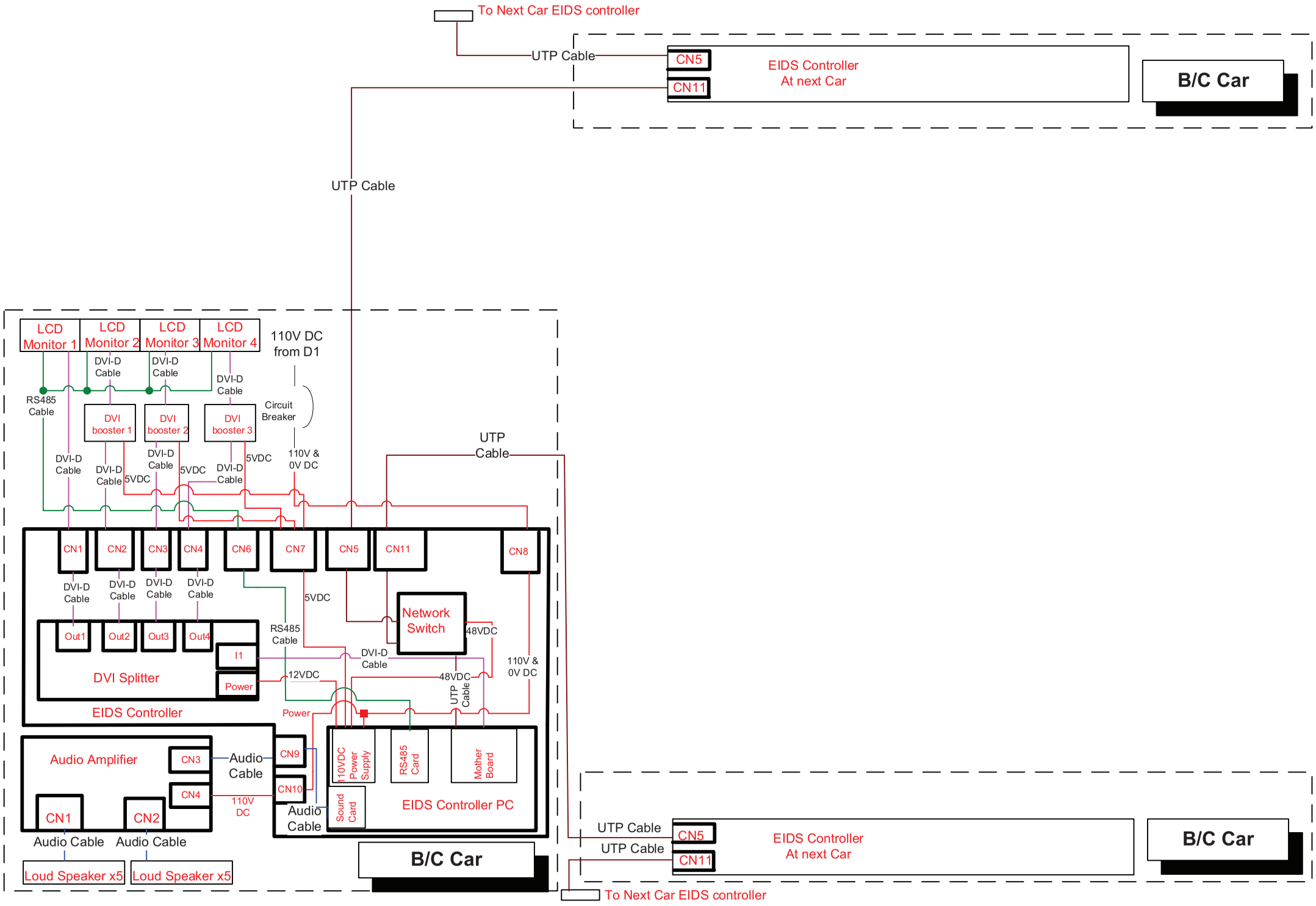

R150
M5
10
10
70
10
10

annex 4.7 Booster mounting drawing




Antenna for Downloading file
AP
P
P'
S
S'
G (Cat5e Cable)
F (12V DC Power cable)
110V DC from battery
Circuit Breaker
C (110V DC Power cable)
DVAS
A1
A1'
A (RS485)
D (1 pair Shield Cable)
Reset button
E (1 pair shield Cable)
Zero Speed Dry Contact
Z
110V DC Pan up/down Signal
H (110VDC Power Cable)
P (Antenna Cable)
B (RS232 Cable)
Antenna for maintenance PC access
B1'
B1
GSM Modem
CN4'
CN4
CN1'
CN1
CN2'
CN2
CN3'
CN3
CN5'
CN5
EIDS Server
Driving Cab
LCD Monitor (1)
LCD Monitor (2)
LCD Monitor (3)
LCD Monitor (4)
I (DVI Cable)
J (RS485 Cable)
DVI Booster (D3)
DVI Booster (D2)
DVI Booster (D1)
5V DC Cable
K (5V DC Cable)
M (110V DC Power cable)
Circuit Breaker
D1
CN11'
CN11
CN6'
CN6
CN7'
CN7
CN8'
CN8
EIDS Controller
CN9'
CN9
CN10'
CN10
L (Audio Cable)
M (110VDC Cable)
Audio Amplifier
Loud Speaker 1
Loud Speaker 2
Loud Speaker 3
Loud Speaker 4
Loud Speaker 5
Loud Speaker 6
Loud Speaker 7
Loud Speaker 8
Loud Speaker 9
Loud Speaker 10
EIDS Controller
To Next Car
G (Cat5e Cable)
A-Car
C-Car

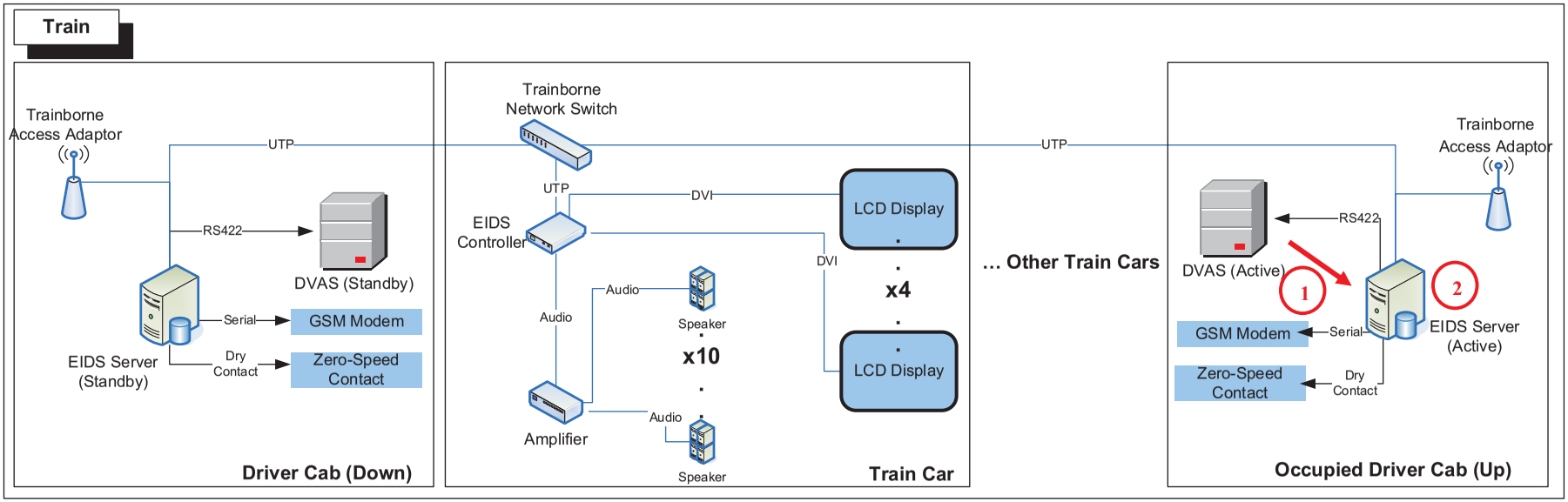
annex 4.8 Control schematic diagram



EIDS and DVAS Communication Methodology

Case 1

Description: Both DVAS Server and EIDS Server are active in the same end.



For all actions, please refer to the labels in the figure above in red.

Action:

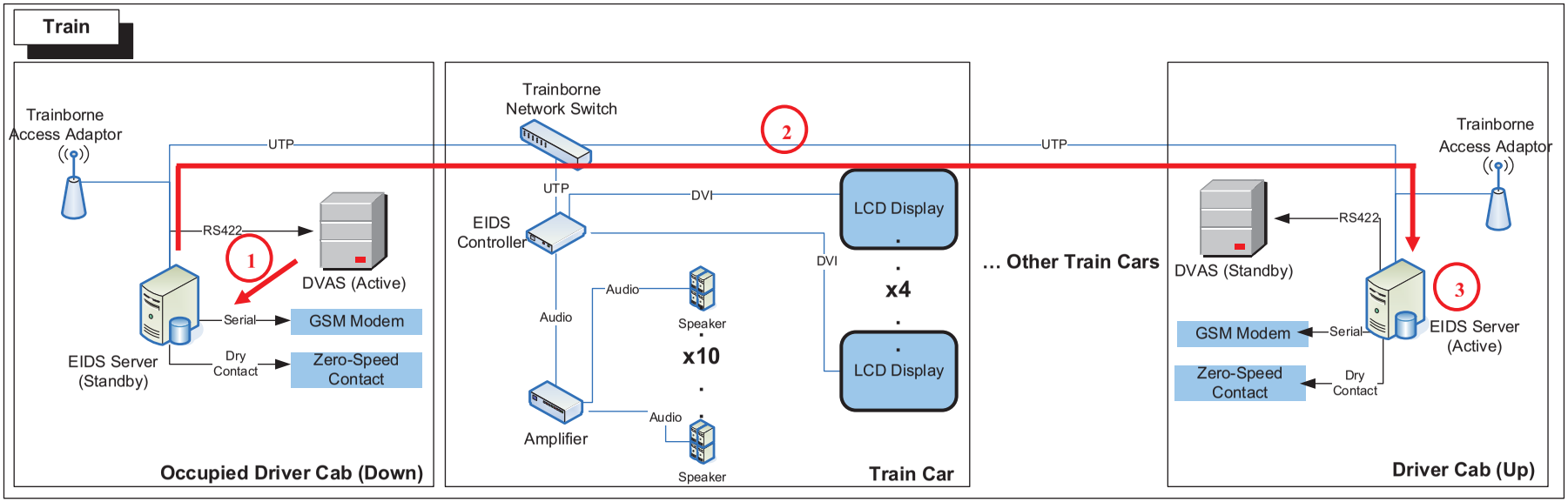
1. **DVAS (Active) sends all information to the EIDS Server (Active).**
2. **EIDS Server (Active) performs all necessary actions.**

Fault Messages:

1. **The DVAS (Active) shall be able to receive all fault messages from the EIDS Server (Active).**
2. **The DVAS (Active) shall pass all fault messages received from EIDS Server (Active) to TMS.**
3. **The EIDS fault messages from EIDS Server (Active) to the DVAS (Active) shall include both fault messages from EIDS Server (Active) and EIDS Server (Standby).**

Case 2

Description: The DVAS Server is active in one end while the EIDS Server is active in the other end.



For all actions, please refer to the labels in the figure above in red.

Action:

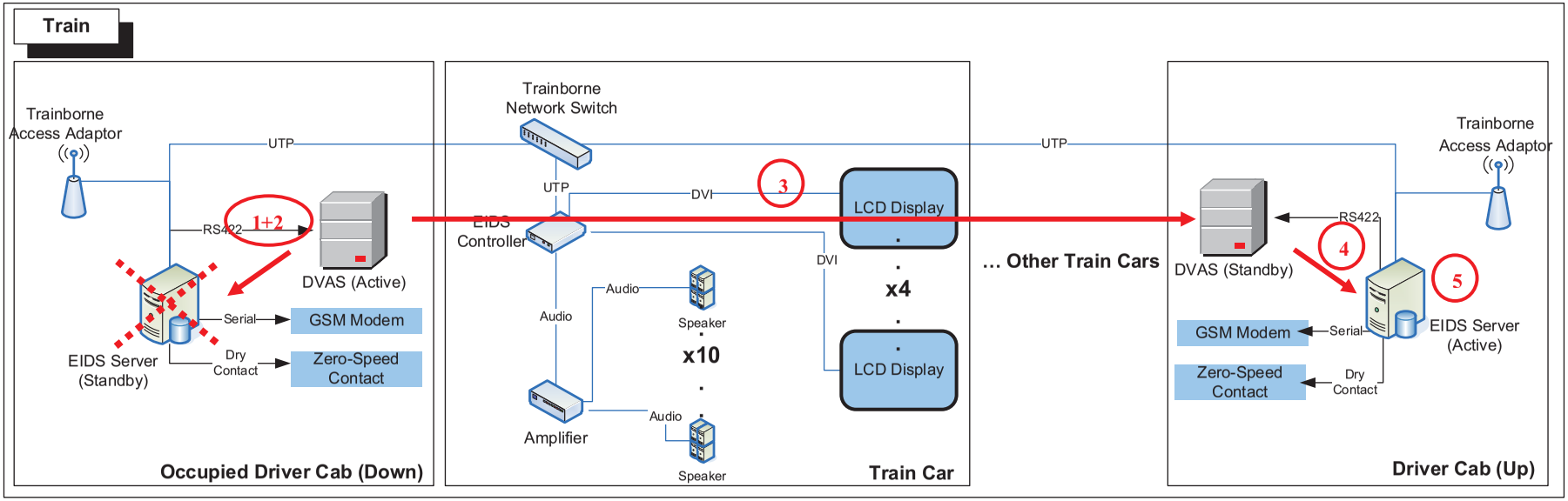
1. **DVAS (Active) sends all information to the EIDS Server (Standby).**
2. **EIDS Server (Standby) sends all information to the EIDS Server (Active).**
3. **EIDS Server (Active) performs all necessary actions.**

Fault Messages:

1. **The DVAS (Active) shall be able to receive all fault messages from the EIDS Server (Standby).**
2. **The DVAS (Active) shall pass all fault messages received from EIDS Server (Standby) to TMS.**
3. **The EIDS fault messages from EIDS Server (Standby) to the DVAS (Active) shall include both fault messages from EIDS Server (Active) and EIDS Server (Standby).**

Case 3

Description: The DVAS Server is active in one end while the EIDS Server is active in the other end. In addition, the EIDS Server in the Standby mode is out of service.



For all actions, please refer to the labels in the figure above in red.

Action:

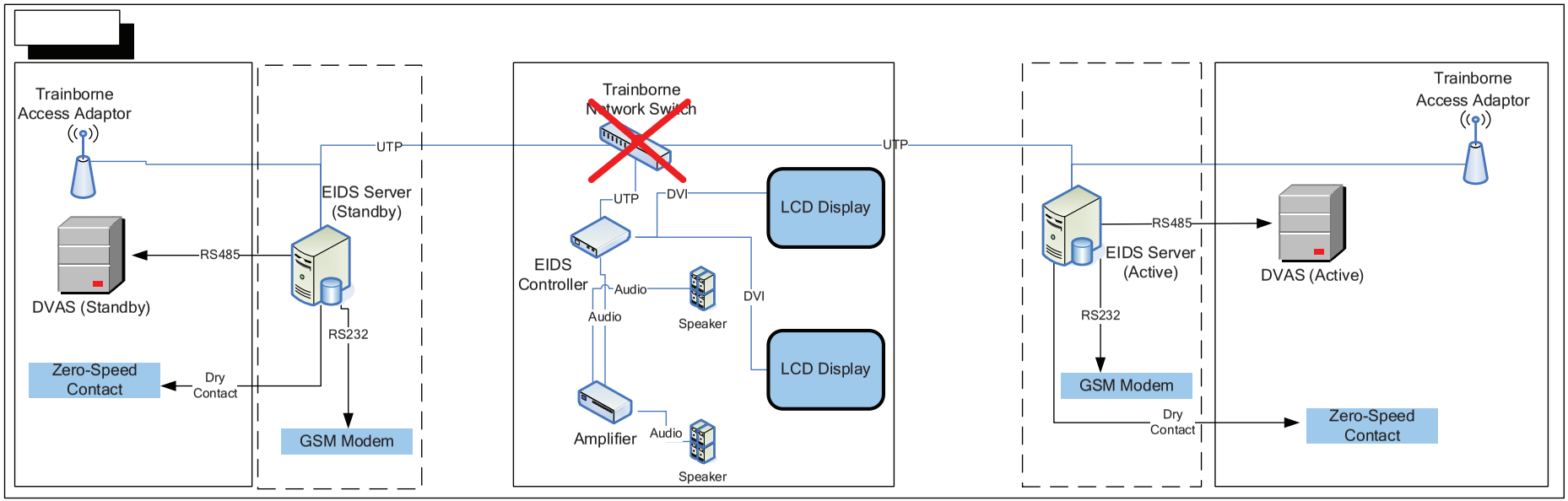
1. **DVAS (Active) polls the EIDS Server (Standby).**
2. **DVAS (Active) fails to communicate with the EIDS Server (Standby).**
3. **DVAS (Active) sends all information to the DVAS (Standby). **Note: With a delay of no more than 10s.***
4. **DVAS (Standby) sends all information to the EIDS Server (Active).**
5. **EIDS Server (Active) performs all necessary actions.**

Fault Messages:

1. **The DVAS (Active) shall be able to inform TMS that the EIDS Server at the DVAS (Active) end is out of service.**

Case4

1. One of the network switches in train car suddenly fails to operate and the Standby EIDS Server will not receive the pre-defined protocol (Heart Beat) from the active EIDS Server. The EIDS Controller starting from the car with failed network switch will not receive the streaming data from active EIDS Server and blank screen will be displayed.

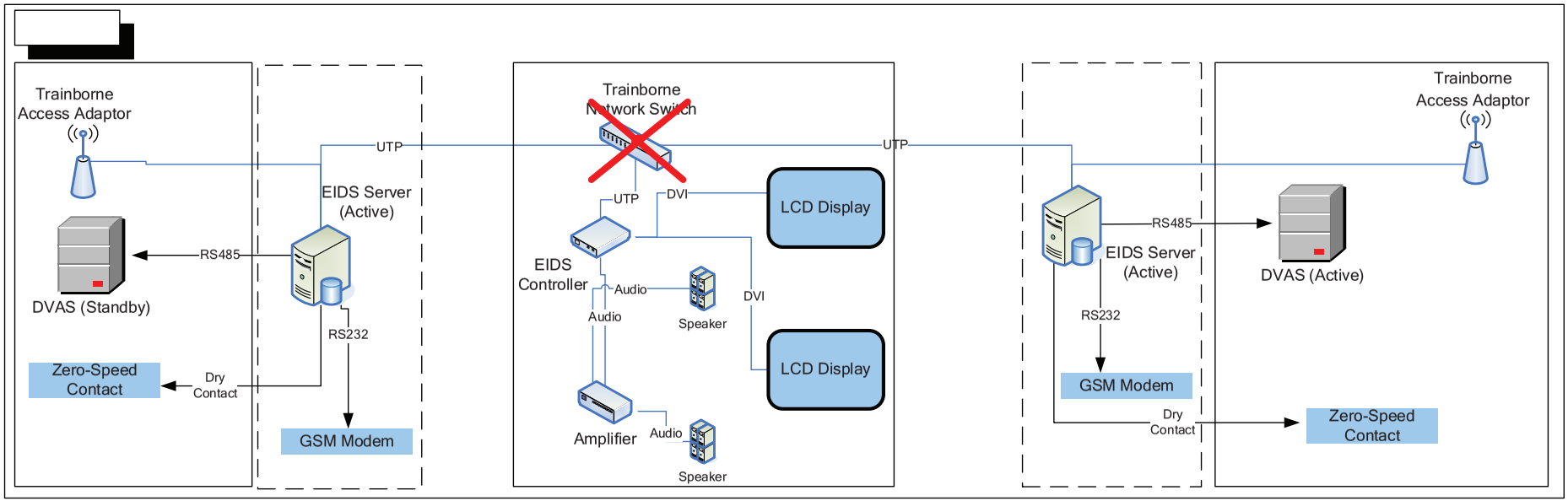


Train

2. After losing the heart beat for 30 seconds, the Standby EIDS Server will switch to Active server and send protocol to EIDS Controller next to the car with failed network switch to set the streaming data input from it. At this moment, the LCD display starting from the down-end car to the car with failed network switch may show different content files with that starting from the up-end car to the car with failed network switch.

Note:

1. No operational messages will be shown on the EIDS Panels on cars with the EIDS Controller connected to the EIDS Server attached to the Standby DVAS. This is due to no trigger will be sent out by the Standby DVAS.
2. The EIDS Server attached to the Standby DVAS shall instruct all EIDS Controller under its control to mute all audio output to ensure all Operational messages could be audible to passengers.



Train

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 5 PLATFORM SCREEN DOOR INTERFACES

1 Introduction

2 Operation Performance of the PSD and Requirements of the Train System Interfaces

3 Control Interface of PSD and Train System

4 Dimensional Interface of PSD and Train System

5 Confirmation of Design Information

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 5 PLATFORM SCREEN DOOR INTERFACES

1 Introduction

1.1 This Annex defines the interface requirements for the Platform Screen Door (PSD) and the train system.

1.2 It is a requirement that the train system in particular the passenger bodyside doors shall be designed and constructed to operate in an integrated manner with the PSD to ensure safe operation.

1.3 The Contractor shall provide:

1.3.1 Control Interface

On opening / closing of the passenger bodyside doors (refer to PS 9.8), a corresponding non-latched signal shall be sent to the trainborne ATC for transmission to PSD for synchronised operation. The transmission time of the non-latched signal measured from the time the door open / close pushbutton (refer to PS 8.8, 8.10 & 8.11) contact is operated until the signal is received by the trainborne ATC shall be 0.1 sec maximum.

1.3.2 Physical Interface

The design and construction of the passenger bodyside doors door pitch shall be in accordance with PS 16.1.1(e).

2 Operation Performance of the PSD and Requirements of the Train System Interfaces

The passenger bodyside doors shall be opened and closed in conjunction with the opening and closing of PSD. Requirements for the passenger bodyside doors are stipulated in PS 16. The following are the operational performance of the PSD:

2.1 Door Opening and Closing Time (duration of door movement)

The maximum opening time of PSD will be 3 sec and the maximum closing time will be 3.5 sec to match with the opening and closing of passenger bodyside doors.

2.2 Obstruction Detection (physical obstruction of door movement)

An obstruction detection facility will be provided for PSD. PSD will employ an obstacle detection mechanism to stop door closing force, which will be restored

after an adjustable period (0 - 10 sec). If the PSD cannot be confirmed closed after 3 obstacle detections, a door close not proven alarm will be raised at the PSD Local Control Panel. However, the passenger bodyside doors can still be able to be opened and closed independent of the PSD status. The re-opening and re-closing of passenger bodyside doors will also command re-opening / re-closing of all PSD and all PSD obstruction delay timers and the obstruction cycle counters will be reset.

2.3 Door Close Detection

A door close detection facility will be provided for the PSD. The PSD door control unit for each pair of PSD will be able to positively detect its door leaves position. If the door leaves have reached their home position and no confirmation signal of "door fully closed" is received, then the door pair will be automatically re-opened for a certain distance and re-closed immediately. The re-opening distance and the maximum number of re-openings will be adjustable by maintenance staff.

2.4 Door Synchronisation

The opening and closing of PSD will be in synchronisation with the passenger bodyside doors opening and closing (refer to clause 3 below).

2.5 PSD Local Control Panel

A PSD Local Control Panel will be fitted in each Headwall Unit / Tailwall Unit (located at station platform) which provides indication and control for the PSD system. The PSD Local Control Panel will consist of the following control and indication functions:

2.5.1 Each PSD Local Control Panel will provide the following control functions:

(a) The Signalling System will send a LOCAL CONTROL ENABLE (non-latched signal) to PSD system if the platform track circuit is occupied or failed.

(b) DOORS OPEN is a non-latched illuminated push button which will enable the DOOR OPEN command signal to be sent to all PSDs if enabled by receipt of LOCAL CONTROL ENABLE signal, indicated by illumination of the push button.

(c) DOORS CLOSE is a non-latched illuminated push button which will enable the DOOR CLOSE command signal to be sent to all PSDs if enabled by receipt of LOCAL CONTROL ENABLE signal, indicated by illumination of the push button.

(d) PSD/EED INTERLOCK OVERRIDE switch is a two position spring return keyswitch which will enable the PSD/EED INTERLOCK OVERRIDE signal to be sent to the Signalling system.

(e) LOCAL CONTROL ENABLE switch is a two position spring return keyswitch which will operate together with Doors Open / Doors Close illuminated pushbutton when PSD Local Control Panel is function enabled.

2.5.2 Each PSD Local Control Panel will provide the following indications:

(a) DOORS OPEN push button will be illuminated when the LOCAL CONTROL ENABLE command signal is received and will be extinguished when the LOCAL CONTROL ENABLE command signal is not received.

(b) DOORS CLOSE push button will be illuminated when the LOCAL CONTROL ENABLE command signal is received and will be extinguished when the LOCAL CONTROL ENABLE command signal is not received.

(c) PSD/EED CLOSED is an indicator lamp which will be illuminated when the PSD/EED CLOSED signal is confirmed and will be extinguished when the PSD/EED CLOSED signal is not confirmed.

3 Control Interface of PSD and Train System

3.1 Door Opening

The train door control circuit shall interface with the trainborne ATC system such that it is enabled for correct side door opening by the ATC unit when the following conditions are met (refer to Appendix I Annex 3) :

3.1.1 train is stationary (i.e. train speed measured by the ATC is below 1 km/h);

3.1.2 train service brakes applied; and

3.1.3 train is within ± 500 mm of the service stopping point.

The detailed passenger bodyside door controls are specified in PS 9.8.

On operation of the door open push button when the above conditions are confirmed by the trainborne ATC, a non-latched signal shall be sent to the trainborne ATC for transmission to PSD for PSD opening. This non-latched signal shall be transmitted to the PSD via an air interface (refer to clause 3.3). A

conceptual arrangement demonstrating the door opening scenario is depicted in Drg. No. C6014-14E/TSEG/077/002.

3.2 Door Closing

On operation of the door close push button, a non-latched signal shall be sent to the trainborne ATC for transmission to PSD for PSD closing. This non-latched signal shall be transmitted to the PSD via an air interface (refer to clause 3.3). When all PSD are proved closed, the ATC system will provide non-zero target speed and the train can be started by the train operator. A conceptual arrangement demonstrating the door closing scenario is depicted in Drg. No. C6014-14E/TSEG/077/003.

3.3 Air Interface

The non-latched signal for PSD opening and closing shall be transmitted via an air interface which will be provided by the return channel of the ATC system.

The Contractor shall design the train door control circuits to provide the input signals to the trainborne ATC.

The transmission time of the non-latched signal measured from the time the door open / close pushbutton contact is operated until the signal is received by the trainborne ATC (refer to clause 2.3.1(i) of Appendix I Annex 3) shall be in accordance with clause 1.3.1.

4 Dimensional Interface of PSD and Train System

4.1 The PSD setting out from centre line of track and kinematic envelope is depicted in Drg. No. C6014-14E/TSEG/077/001.

5 Confirmation of Design Information

5.1 The Contractor shall ensure that all the requirements as stipulated in this Annex are achieved.

5.2 Any change to the above requirements shall be submitted for Approval before the end of SEMP Stage 3.

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 6 DEPOT INTERFACES

1 Introduction

2 Running Maintenance Area

3 Lifting / Heavy Maintenance Area

4 Cleaning

5 Underfloor Wheel Lathe

6 Miscellaneous Interfaces

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 6 DEPOT INTERFACES

1 Introduction

The trains will be stabled and maintained at any of the Employer's existing depots and workshops. This Annex defines the standards for interfaces between the trains and the Employer's train maintenance facilities. The design of the trains shall aim to make the best use of existing equipment provided for the Urban Lines Trains, both to ensure compatibility and to minimize the number of different maintenance facilities for similar functions across the Employer's fleet.

2 Running Maintenance Area

2.1 General

2.1.1 The following activities will be carried out at the Running Maintenance Area of a depot:

(a) Preventive maintenance service checks (refer to PS 26.3.2)
(b) Corrective maintenance (refer to PS 26.4)
(c) In-situ cleaning of air conditioning units using high pressure hot water. In some depots, cleaning of roof mounted air conditioning units will be carried out at a Heavy Cleaning Track (refer to Clause 4.4 below) provide with roof level access platforms.
(d) Replacement of equipment that do not require car lifting or overhead cranes
(e) Re-commissioning of trains after car overhauls

2.1.2 The Running Maintenance Area will consist of raised tracks on a depressed floor each of 8-car long. A typical cross-section is shown in Drg. No. C6014-14E/TSEG/990/001.

2.1.3 The following service supply points will be provided at regular intervals along each running maintenance track:

(a) 240V 13A single phase and 415V 60A 3 phase AC, 50Hz electrical power supply
(b) compressed air at 7.5 bar

2.1.4 Routine in-situ charging of the batteries on the trains will be carried out at the Running Maintenance Area using a mobile battery charger.

2.2 Access to Trainborne Equipment

2.2.1 Access to the underframe of the trains will be provided by raised tracks in the Running Maintenance Area.

2.2.2 Access to the interior of the trains and to the outside of the car body will be provided by mobile platforms fitted with ladders or stairs.

2.2.3 An overhead traction supply wire will be positioned over each running maintenance track. Access to roof mounted equipment will be provided by a fixed high level platform running along the full length of a train on one side. Access gates to the platforms will be interlocked with the isolation of the overhead line.

2.3 Drainage for Air Conditioning Units

2.3.1 Drainage points for condensate from trainborne air conditioning units shall be positioned at the corners of the cars at a distance of 1250mm to 1450mm from the centre of the track, in order that the condensate will be collected at special channels on the floor.

2.3.2 During the in-situ cleaning of air conditioning units, the drainage points will be connected to a hose so that the effluent from the cleaning process can be directed to a suitable location for treatment and disposal. The design of the drainage points shall enable such connections to be made.

3 Lifting / Heavy Maintenance Area

3.1 General

3.1.1 The following activities will be carried out at the Lifting / Heavy Maintenance Area of a depot:

(a) Car overhauls
(b) Replacements of equipment that require car lifting or overhead cranes

3.1.2 The Lifting / Heavy Maintenance Area will consist of tracks laid on a flat floor area and will be provided with abovefloor or underfloor car lifting equipment. The cross-section of a typical Lifting / Heavy Maintenance Area is given in Drg. No. C6014-14E/TSEG/990/002.

3.1.3 The following service supply points will be provided at regular intervals along a heavy maintenance track:

(a) 240V 13A single phase and 415V 60A 3 phase AC, 50Hz electrical power supply

(b) compressed air at 7.5 bar

3.1.4 No overhead traction supply wire will be provided at the Heavy Maintenance Area.

3.1.5 An overhead travelling crane will be provided above the lifting / heavy maintenance tracks for the replacement of roof mounted equipment. The Contractor shall provide the special lifting attachments or load spreaders if required for handling roof mounted equipment, as part of the special tools specified in PS 24.

3.2 Access to Equipment

3.2.1 Access to the underframe and underframe mounted equipment will be provided by car lifting equipment. Cars undergoing car overhauls will be supported on accommodation bogies or car lifting equipment.

3.2.2 Disconnection of bogies and bar couplers will be carried out at pitted tracks or underfloor car lifting berths. The cross-section of a typical pitted track is shown in Drg. No. C6014-14E/TSEG/990/002.

3.2.3 Access to the interior of a car and to the outside of the car body will be provided by mobile platforms fitted with ladders or stairs.

3.2.4 Access to roof mounted equipment will be provided by fixed or mobile high level platforms.

3.2.5 An overhead travelling crane will be provided for handling heavy equipment in the Lifting / Heavy Maintenance Area.

3.3 Car Lifting

3.3.1 Jacking points shall be provided on the cars so that they can be lifted to allow access to and replacement of bogies and heavy underframe mounted equipment. The cars shall allow lifting either individually as single cars, or as a complete Train Unit coupled together without dismantling the bar couplers.

3.3.2 The design of the cars shall allow both abovefloor and underfloor car lifting equipment to be used. Details of lifting claws and working range of existing abovefloor car lifting equipment are given in Drg. No. C6014-14E/TSEG/990/004. A conceptual sketch of under-floor car lifting equipment is shown in Drg. No. C6014-14E/TSEG/990/005.

3.3.3 In order that the same car lifting equipment for the Urban Lines Trains can be used, the layout of jacking points on a car shall conform to the arrangement shown in Drg. No. C6014-14E/TSEG/990/003.

3.4 Accommodation Bogies

3.4.1 Cars undergoing car overhauls will be placed on accommodation bogies to provide an ergonomic height for working on equipment mounted on the underframe. The accommodation bogies also allow the cars to be moved around. The design of the cars shall allow existing accommodation bogies to be used for such purposes. Details of existing accommodation bogies are shown in Drg. No. C6014-14E/TSEG/990/006.

3.4.2 The Contractor shall propose for Approval any necessary modifications to existing accommodation bogies so that they can accommodate the cars supplied. Such modifications shall not affect the existing functions of the accommodation bogies. In the event that special work is required each time to convert the accommodation bogies between Urban Lines cars and cars supplied, the conversion for each bogie shall be completed within 15 minutes with not more than 0.5 man-hour.

3.4.3 Relative horizontal movements between the car body and accommodation bogies shall be constrained by mechanical stops to allow braking of the cars during shunting.

3.4.4 The design of the underframe of the trains shall allow accommodation bogies to be installed or removed from the cars using the car lifting equipment described in Clause 3.3 above.

3.5 Handling of Underframe Mounted Equipment

The design of the trains shall facilitate handling of underframe mounted equipment as follows:

(a) Mobile scissors platforms and fork lift trucks will be used for removing and refitting underframe mounted equipment.

(b) Bogies will be removed from the cars by raising carbodies on car lifting equipment described in Clause 3.3 above. When underfloor lifting equipment is used, the bogies will be rolled out under the cars along the length of the track.

(c) Bogie turntables of 3.5 m diameter will be provided for transferring bogies between adjacent tracks.

3.6 Towing

3.6.1 Cars standing on the heavy maintenance tracks will be pulled or pushed by a tractor fitted with road wheels. The tractor will be positioned at the ends or sides of the car to be moved. Towing points shall be provided at the 4 corners of each car to accommodate a tow bar for such shunting movements. Typical arrangement of towing points on Urban Lines Trains is shown in Drg. No. C6014-14E/TSEG/990/007 for reference.

3.6.2 Towing points shall also be provided on each car or each bogie to allow towing by a winch at the underfloor wheel lathe for positioning the wheels over the cutting tools.

3.6.3 Each towing point shall be designed to withstand the force required to move and stop a 8-car train on a level track at 200 m curve radius.

4 Cleaning

The design of the trains shall aim to adopt the same external cleaning processes for Urban Lines Trains without additional external cleaning operations.

4.1 Automatic External Water/Detergent Washing

4.1.1 A drive-through automated water / detergent wash plant fitted with sprays and rotating brushes will be available for external cleaning as the trains enter the depot from service.

4.1.2 The train will be driven through the plant at 5 km/h on its own power. A mixture of water and detergent will be sprayed on the carbody, followed by brushing and a final rinse with fresh water.

4.1.3 The exterior of the complete carbody between cantrails and solebar, including the end faces, will be washed.

4.1.4 The following chemicals are used for the water / detergent washing of Urban Lines Trains with aluminium bodies:

Rochester Midland Cleanaire 1200, diluted to 1:40 and Henkel P3-T-768, diluted to 1:40

4.2 Automatic External Acid Washing

4.2.1 Where the external finish of the trains requires acid washing, a drivethrough automated acid wash planted fitted with sprays and rotating brushes will be available for acid wash.

4.2.2 The train will be driven through the plant at 5 km/h on its own power. A mixture of water and acid will be sprayed onto the body and left to stand for a length of time. The mixture is then removed by water and brushes, followed by a final rinse with fresh water. The process may be repeated a few times to achieve the required standard of cleanliness.

4.2.3 The exterior of the complete carbody between cantrails and solebar will be washed.

4.2.4 The following chemicals are used for the acid washing of Urban Lines Trains with aluminium bodies:

Rochester Midland AC 500, diluted to 1:7 and
Henkel P3-allpass 271, diluted to 1:7

4.3 Cleaning of Windows

4.3.1 To prevent the accumulation of water stains, the outside surface of Urban Lines Train windows are cleaned at regular intervals using handheld power brushes and the proprietary chemical AJAX 4942 disinfectant creme cleanser.

4.3.2 The Contractor may submit alternative cleaning methods, or suitable treatment that obviate such cleaning for Approval.

4.4 Heavy Internal Cleaning

Heavy internal cleaning will be carried out with the train berthed at a heavy cleaning track. Access to the trains will be provided by platforms at floor level along the full length of the train. Power supply points and water taps will be provided at regular intervals along each platform. The trains shall be designed to utilize such facilities for internal cleaning.

5 Underfloor Wheel Lathe

5.1 The wheels of the trains will be reprofiled by an underfloor wheel lathe. The design of the bogie, wheelset and axle box shall be compatible with the Employer's underfloor wheel lathe hold down device as shown in Drg. No. C6014-14E/TSEG/990/008, so that wheels can be re-profiled without dismantling any trainborne equipment.

5.2 As an alternative, the Contractor may provide a suitable device, as part of the special tools in accordance with PS 24, which can be installed on the Employer's underfloor wheel lathes to provide the hold down function. Such device shall satisfy the following requirements:

(a) Installation or removal time: not more than 15 minutes
(b) Number of staff required: not more than 2 persons
(c) No crane or lifting equipment shall be required for handling the device

The design of the device shall be submitted for Approval.

6 Miscellaneous Interfaces

6.1 Target Holder

A target is a disc which is placed at the ends of a car or train to warn against movement of the car or train. An example of a target is shown in Drg. No. C6014-14E/TSEG/990/010. A target holder shall be provided at each end of a car according to the details shown in Drg. No. C6014-14E/TSEG/990/011.

6.2 Pneumatic Connector

6.2.1 Quick release pneumatic connectors shall be provided at strategic points in the pneumatic system to facilitate maintenance activities such as pressure measurements and charging of the system.

6.2.2 As a minimum, quick release pneumatic connectors shall be provided for the following purposes:

(a) All air pressure measurements during preventive maintenance work (refer to PS 26.3)
(b) For charging of the main air system from a shore supply
(c) Measurement of brake cylinder pressure
(d) Measurement of air suspension pressure

6.2.3 Quick release pneumatic connectors shall be compatible with the 'Schrader' plug connector shown in Drg. No. C6014-14E/TSEG/990/012.

6.3 Shore Auxiliary Supply

When the overhead line is isolated, a mobile external power supply will be provided to allow function tests to be carried out on equipment, such as air conditioning units, which are powered by the trainborne auxiliary supply system. An adequately rated 3 phase AC socket inlet shall be provided at each auxiliary converter according to PS 17.3.3 to accept a mating connector from the external power supply unit.

6.4 Recovery from Derailment and Locked Axle

6.4.1 The design of the trains shall aim to utilize the existing recovery equipment with minimum requirement for additional hardware:

(a) In the event of a derailment, the derailed car shall be restored to the running rails using a set of specialist re-railing equipment which consists of hydraulic jacks, re-railing bridge and roller carriages. The working principles of existing rerailing equipment are shown in Drg. No. C6014-14E/TSEG/990/013.

(b) In the event of a locked axle, a pair of wheel skates shall be fitted to the affected axle by jacking under the bogie frame or axle boxes. The design of existing wheel skates is shown in Drg. No. C6014-14E/TSEG/990/014.

6.4.2 The Contractor shall provide additional equipment, or modifications to existing equipment, for recovery of the trains from derailments and locked axles, as part of the special tools specified in PS 24.

6.4.3 All jacking points, including those that will be used for applying the wheel skates described in Clause 6.4.1(b) above, shall be painted with the alternate yellow and black stripes pattern shown in Drg. No. C6014-14E/TSEG/990/015.

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 7 ELECTRIC VEHICLE INTERFACES

1 Introduction

2 General Description of the Existing Electric Vehicles

3 Compatibility Requirements

4 Electric Vehicles Power Circuit Component Information

Table App-I-Annex-7-1 Stock Allocation of the Electric Vehicles
Table App-I-Annex-7-2 CM/CT-Stock Cars Power Circuit Component Information
Table App-I-Annex-7-3 G-Stock Cars Power Circuit Component Information
Table App-I-Annex-7-4 H-Stock Cars Power Circuit Component Information
Table App-I-Annex-7-5 I-Stock Cars Power Circuit Component Information
Table App-I-Annex-7-6 K Train Cars Power Circuit Component Information
Table App-I-Annex-7-7 CM/CT/I-Stock Cars Auxiliary Static Inverter Circuit Component Information
Table App-I-Annex-7-8 G-Stock Cars Auxiliary Inverter Circuit Component Information
Table App-I-Annex-7-9 H-Stock Cars Auxiliary Converter Circuit Component Information
Table App-I-Annex-7-10 K Train Cars Auxiliary Static Inverter Circuit Component Information
Table App-I-Annex-7-11 CM -Stock Cars Auxiliary Circuit Component Information
Table App-I-Annex-7-12 CT-Stock Cars Auxiliary Circuit Component Information
Table App-I-Annex-7-13 I-Stock Cars Auxiliary Circuit Component Information
Table App-I-Annex-7-14 G-Stock Cars Auxiliary Circuit Component Information
Table App-I-Annex-7-15 H-Stock Cars Auxiliary Circuit Component Information
Table App-I-Annex-7-16 Mark I/II BE Loco Power Circuit Component Information
Table App-I-Annex-7-17 Mark I/II BE Loco Auxiliary Circuit Component Information
Table App-I-Annex-7-18 Mark III BE Loco Power Circuit Component Information
Table App-I-Annex-7-19 Mark III BE Loco Auxiliary Circuit Component Information
Table App-I-Annex-7-20 C Train Cars Power Circuit Component Information
Table App-I-Annex-7-21 C Train Cars Auxiliary Static Inverter Component Information

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 7 ELECTRIC VEHICLE INTERFACE

1 Introduction

1.1 This Annex of Appendix I contains details of the existing electric vehicles, including the electrical multiple units (EMU) and battery electric locomotives (BE loco) which will be operated together with the trains on Urban Lines.

1.2 It is a requirement that the trains shall be interchangeable with the Urban Lines Trains on a train to train basis.

1.3 In order to ensure the compatibility between the existing electric vehicles and the new trains, the following system requirements and design constraints are specified according to the experience gained from the operation of the Urban Lines.

1.4 The Contractor shall provide appropriate interface specification, design study, delivery schedule, installation, testing and setting to work in order to demonstrate to the satisfaction of the Engineer that the trains are compatible with the existing electric vehicles.

2 General Description of the Existing Electric Vehicles

2.1 The EMUs are used for passenger service. EMUs equipped with DC traction propulsion are consisted of 'CM' and 'CT' stock chopper converted cars which are using self-ventilated Gate-Turn-Off (GTO) chopper, G stock chopper cars which are using forced air cooling GTO chopper, H stock chopper cars which are using self-ventilated GTO chopper and I stock chopper cars which are using forced air cooling Reverse-Conduct-Thyristor (RCT) chopper. For K Trains and C Trains, the EMUs are equipped with IGBT traction inverter for the AC traction propulsion.

2.2 The BE locos are used for hauling a consist of wagon as engineering trains. At least two BE locos are used i.e. one at each end to form a train consist and maximum of four BE locos will be used depending on the hauling loads. The BE locos are consisted of the mark I and II types BE locos which are using the forced air cooling RCT chopper and mark III type BE locos which are using forced air cooling GTO chopper. The BE locos are only equipped with the traction propulsion equipment and a 750VDC motor driven motor-alternator set.

2.3 A stock allocation summary of the above electric vehicles is shown on Table AppI-Annex-7-1.

2.4 The traction equipment of all electric vehicles are using the overhead line supply of 1,500VDC as the traction positive supply and the running rail as the traction negative returns.

2.5 For passenger service,:

2.5.1 The M Trains of CM, CT, G, H and I stock cars are comprised of: 6 power cars and 2 trailer cars i.e. the train configuration is (A - C_T - D - B - C - D - C_T - A); or

2.5.2 8 power cars i.e. the train configuration is (A - C_T - B - C - B - C - C_T - A).

where:

A Power car which is equipped with the driving cab, DC traction propulsion equipment and 1,500VDC driven auxiliary equipment and pneumatic equipment.

B Power car which is equipped with the DC traction propulsion equipment and 1,500VDC driven auxiliary equipment and pneumatic equipment.

C_T Power car which is equipped with the pantograph, DC traction propulsion equipment and 1,500VDC driven auxiliary equipment.

C Power car which is equipped with the pantograph, DC traction propulsion equipment and 1,500VDC driven auxiliary equipment.

D Trailer car which has no traction equipment.

- Couplers

2.5.3 The EMUs of K Train and C Train cars are comprised of 6 power cars and 2 trailer cars
i.e. the train configuration of K Train is (A - C - B - B - C - B - C - A)
the train configuration of C Train is (A - C - B - B1 - C1 - B - C - A)

where:

A Trailer car which is equipped with the driving cab.

B/B1 Power car which is equipped with the AC traction propulsion equipment and 415VAC driven auxiliary equipment and pneumatic equipment.

C/C1 Power car which is equipped with the pantograph, AC traction propulsion equipment and 1,500VDC driven auxiliary equipment.

- Couplers

2.6 The tare weight of the individual car type is:

Stock Type	Car Type	Weight(Tonne)
CM/CT/G/ H/I	A	41
	B	40
	C, C_T	41
	D	30
K Train	A	37
	B	41
	C	41
C Train	A	38.7
	B	40.9
	C	42
	B1	42
	C1	42

2.7 Power Circuits of the EMUs

2.7.1 For 'CM' stock and 'CT' stock chopper converted EMUs:

(a) The traction propulsion equipment are depicted in Drg. No. OD4/305/00241/0004 entitled "CT Stock Chopper Conversion Power Circuit Diagram for EMU Cars" and Drg. No. OD4/305/00141/0001 entitled "CM Stock Chopper Conversion Power Circuit Diagram For EMU Cars".

(b) The 1,500VDC driven auxiliary equipment and pneumatic equipment are depicted in Drg. No. OD4/305/00262/0001 entitled "CT Stock Chopper Conversion Auxiliary Circuit Diagram A-CT-D Cars" and Drg. No. OD4/305/00162/0001 entitled "CM Stock Chopper Conversion Auxiliary Circuit Diagram A-CT-D Cars".

2.7.2 For G stock chopper EMUs:

(a) The traction propulsion equipment are depicted in Drg. No. OD4/303/00042/0027 entitled "Power Circuit Diagram for EMU Cars".

(b) The 1,500VDC driven auxiliary equipment are depicted in Drg. No. OD4/303/00042/0108 entitled "Circuit Diagram of Static Auxiliary Inverter".

(c) The 1,500VDC driven pneumatic equipment are depicted in Drg. No. OD4/303/00063/0011 entitled "Auxiliary Circuit Diagram EMU Cars AC-T".

2.7.3 For H stock chopper EMUs:

(a) The traction propulsion equipment are depicted in Drg. No. OD4/306/00041/0001 entitled "Power Circuit Diagram for EMU Cars Additional Rolling Stock".

(b) The 1,500VDC driven auxiliary equipment are depicted in Drg. No. OD4/306/00063/0003 entitled "Circuit Diagram Of Static Auxiliary Converter".

(c) The 1,500VDC driven pneumatic equipment are depicted in Drg. No. OD4/306/00063/0004 entitled "H Stock Auxiliary Circuit Diagram EMU Cars A-CT-D Additional Rolling Stock".

2.7.4 For I stock chopper EMUs:

(a) The traction propulsion equipment are depicted in Drg. No. OD4/302/00003/0011 entitled "Schematic Diagram Of Power Circuit".

(b) The 1,500VDC driven auxiliary equipment and pneumatic equipment are depicted in Drg. No. OD4/302/00303/0002 entitled "Auxiliary Circuit Diagram A, C & D Cars Melco Chopper Unit".

2.7.5 The 'CM' and 'CT' stock chopper converted cars and G stock and H stock chopper cars uses the GTO technology and the I-stock chopper cars uses RCT technology. The K Train and C Train cars use IGBT traction inverter for the AC traction propulsion.

2.7.6 For the GTO choppers, the power circuit is effectively divided into three component sections namely a common supply, line filter and rheostatic brake section which serves two identical motor circuits. Power is supplied via the single filter circuit to two choppers, each chopper controlling a string of four motors connected in series configuration. The motor voltage and current are controlled by switching the main GTO device at an operating frequency of 260Hz. This chopper is then interlaced with the other motor circuit chopper to give a fundamental ripple frequency of 520Hz in the line.

Apart from the motoring function, the power circuit also provides electric braking, mainly in the form of regenerative brakes converting the EMU's kinetic energy into electrical energy which is returned to the overhead line supply conductor. There is also a limited facility for rheostatic braking, in which case the energy is dissipated in a resistor, to maintain electric braking through short line gaps, transient non-receptive conditions and during transition to air braking when longer term nonreceptive conditions are encountered.

2.7.7 For the RCT choppers, the eight motors are controlled by the chopper control unit which is composed of mutually coupled two-phase chopper with phase-shifting between each chopping part. Constant frequency control (i.e. 520Hz with 260Hz per unit chopper operated interlacedly with the other) will be applied for powering and braking. The brake series resistor is used to improve the regenerative brake performance in high speed region and a short-time rated auxiliary chopper and rheostatic brake resistor are provided for the reversible blending control of regenerative/rheostatic brake.

2.7.8 All EMUs are provided with auxiliary converters or static inverters. In addition, all EMUs are provided with a 1,500VDC or 415VAC motor driven air compressor.

2.7.9 For the auxiliary converter, it is made up of GTO thyristors together with associated freewheel diodes, snubber circuits and series inductors. The principal stages of power conversion process are:

(a) power supply input;
(b) input filter;
(c) step-down chopper;
(d) dc link filter;
(e) three phase inverter and transformer; and (f) inverter output filter.

Various protective circuits are employed to safeguard the system as well as to prevent the generation of harmonics which cause interference to external systems.

2.7.10 For the auxiliary static inverter, it is made up of IGBT transistors together with associated snubber circuits. The principal stages of power conversion process are:

(a) power supply input;
(b) input filter;
(c) three phase inverter and transformer; and

(d) inverter output filter.

Various protective circuits are employed to safeguard the system as well as to prevent the generation of harmonics which cause interference to external systems.

2.8 Power Circuits of the BE Locos

2.8.1 For Mark I,II BE locos:

(a) The traction propulsion equipment are depicted in Drg. No. OD4/312/00005/0001 entitled "BE Loco (MK I,II) Power Circuit Diagram Battery Electric Locomotive".

(b) The 750VDC driven auxiliary equipment are depicted in Drg. No. OD4/312/00005/0002 entitled "Dual Mode Locomotive (Mark I,II) Auxiliary Circuit Diagram".

2.8.2 For Mark III BE locos:

(a) The traction propulsion equipment are depicted in Drg. Nos. OD4/313/00005/0026 entitled "BE Loco (MK III) Power Circuit Diagram", OD4/313/00005/0027 entitled "BE Loco (MK III) Power Circuit Diagram", and OD4/313/00005/0028 entitled "BE Loco (MK III) Power Circuit Diagram".

(b) The 750VDC driven auxiliary equipment are depicted in Drg. No. OD4/313/00005/0049 entitled "BE Loco (Mark III) Auxiliary Circuit Diagram".

2.8.3 The flow of power from the 1,500VDC overhead line supply is fed to the two series wound dc motors and regulated by two dc to dc convertors i.e. choppers. The first stage of power conversion is to step the overhead line supply down to 750VDC nominal. Connected across the voltage source is a 350 cell, 365Ah lead acid battery and the second chopper. The battery is a power source for the locomotive when there is no 1,500VDC overhead line supply available. The motor chopper, using the 750VDC intermediate link as its supply, regulates the power supply to the traction motors. A motor-alternator set is connected across the 750VDC link to generate 3 phase, 440VAC 60Hz power for the locomotives and train auxiliaries. No re-generative braking function is provided by the BE locos.

2.8.4 The BE loco's power conversion equipment has four modes of operation:

(a) Battery charging mode

In this mode the line chopper charges the traction battery without power being supplied to the motors. The line switches are closed and the motor contactor open. The line chopper regulates the charging current, or the input voltage to the battery terminals.

(b) Operation with overhead line supply

In this mode the line chopper runs constantly as long as the line voltage is within limits, to maintain the correct battery charging conditions and to supply the motor alternator set. When the traction control electronics receives a power demand, the motor contactor closes, the reverser is set in the correct direction and the motor chopper controls the level of current in the two series connected motors.

(c) Operation off the traction battery

If no overhead supply is present, the line switches are opened and the line chopper disabled. If the auxiliaries circuit are set, the motor alternator set runs continuously off the traction battery and when a power demand is presented to the traction control system, the motor chopper supplies power from the traction battery to the traction motors.

(d) Operation without the traction battery

This is not a normal operational mode. However, if the traction battery has been isolated due to earth leakage or a short circuit fault, it is possible to still use the line chopper to provide a voltage source for the motor chopper for emergency operation purpose.

3 Compatibility Requirements

3.1 Electrical Compatibility

3.1.1 In order to ensure the compatibility with the 50Hz track circuit before it is obsolete by minimising the currents due to substation 50Hz ripple voltage, the following provisions have been made on the EMUs:

(a) For the propulsion choppers:

(i) Input impedance in the range 47 to 52 Hz of all traction equipment are designed to be inductive and not less than 1.2 Ω under all operating conditions. In addition, the principal resonant frequency of the input filter is not greater than 40 Hz.

(ii) An EMI monitors, namely, the 50Hz line ripple detector is provided on all EMUs, such that, for any 50Hz component which is greater than $2.5A_{rms}$ ± 5% for 250ms. The detector bandwidth is 44 Hz to 60 Hz and the time to detect the current and isolate the traction equipment will not exceed 250 ms.

(b) For the auxiliary converters:

(i) Input impedance in the range 47 to 52 Hz of all traction equipment are designed to be inductive and not less than 10 Ω under all operating conditions. In addition, the principal resonant frequency of the input filter is not greater than 40 Hz.

(ii) The filter initial charging current is limited by a series resistor. The settling time of the filter is less than 250 ms i.e. the line current of the filter of one converter falls to less than 0.25 A r.m.s. within 250 ms of closing the converter line contactor at a line voltage of 1800 VDC.

(iii) An EMI monitor, namely, the 50Hz line ripple detector is provided on all EMUs, such that, for any 50Hz component which is greater than $0.4A_{rms}$ ± 5% for 250ms. The detector bandwidth is 44 Hz to 60 Hz.

(c) For the auxiliary static inverters:

(i) Input impedance in the range 47 to 52 Hz of all traction equipment are designed to be inductive and not less than 10 Ω under all operating conditions. In addition, the principal resonant frequency of the input filter is not greater than 40 Hz.

(ii) The filter initial charging current is limited by a series resistor. The settling time of the filter is less than 250 ms i.e. the line current of the filter of one inverter falls to less than 0.25 A r.m.s. within 250 ms of closing the inverter line contactor at a line voltage of 1800 VDC.

3.1.2 Similar to Clause 3.1.1 above, the following provisions have been made for the input chopper of the BE locos for 50Hz track circuit compatibility:

(a) Input impedance in the range 47 to 52 Hz of the chopper equipment is designed to be inductive and not less than 1.2 Ω under all operating conditions. In addition, the principal resonant frequency of the input filter is not greater than 40 Hz.

(b) An EMI monitor, namely, the 50Hz line ripple detector is provided on all BE locos, such that, for any 50Hz component which is greater than $3.25A_{rms}$ ± 5% for 250ms. The detector bandwidth is 44 Hz to 60 Hz and the time to detect the current and isolate the traction equipment will not exceed 250 ms.

3.1.3 The operating frequency of the chopper equipment of all electric vehicles is 520 Hz with an allowable tolerance of ± 1 Hz.

3.1.4 A chopper frequency detector is fitted on the chopper equipment such that deviation from the operating frequency will cause the traction or auxiliary equipment to be mechanically latched out.

3.1.5 The detector settings are ± 4 Hz at the operating frequency of 520 Hz. The time to detect the drift and isolate the chopper equipment will not exceed 0.25 second.

3.1.6 For the ATP carrier frequencies of 1365 Hz and 1953 Hz, the magnitude of input current at these carrier frequencies will not exceed 200 mA_{rms}. Also, the magnitude of voltage induced in a 10 metre loop of cable clipped to the rails will not exceed 50 mV_{rms} in the 1320-1410 Hz band or 80 mV in the 1900-2000 Hz band.

3.1.7 For commutation purpose of the dc traction motors of the EMUs, the maximum motor current is 600 A and the current ripple is < 20%.

3.1.8 The design of the train system shall ensure that no adverse effect to the normal operation of the above safety provisions of the electric vehicles will be caused by the operations of the train.

3.2 Electric Braking Compatibility with the EMUs

3.2.1 The receptivity of the overhead line is determined by the presence of other motoring electric vehicles on the system able to absorb the regenerated energy. If there is insufficient capacity to absorb the regenerated energy then the line voltage will tend to rise to an unacceptable level, for example the line becomes non-receptive.

3.2.2 When a regenerating EMU encounters a non-receptive line and the system voltage rises through the range 1,670VDC to 1,770VDC then the electric brake demand is automatically reduced from maximum to minimum, and replacement air braking is blended in to maintain the overall brake effort. This will either continue until an equilibrium is achieved i.e. with a line having limited receptivity, or until minimum electric brake demand is achieved should the line be totally nonreceptive.

If the electric brake cannot be reduced quickly enough to keep the voltage below 1,770VDC, then, as the voltage rises above 1,770VDC so the thyristor of the rheostatic chopper is turned "on" to divert the regenerated energy into the brake resistor where it is dissipated as heat until the electric braking has reduced such that either equilibrium is achieved in the purely regenerative mode or the electric brake demand has ramped down to zero and the air brake has taken over i.e. the line is non-receptive. The range of operation of the rheostatic brake is between 1,770VDC with the thyristor of the rheostatic chopper at minimum "on" time, to 1,830VDC with the thyristor of the rheostatic chopper fully "on".

3.2.3 In the event of a regenerative EMU encountering a sudden complete loss of receptivity, for example traversing a line section insulator, the voltage on the unit will rise rapidly such that the thyristor of the rheostatic chopper will immediately turn on to divert the regenerated energy into the braking resistor. Additionally, the electric brake demand will commence ramping down to minimum and the air brake will commence blending in. On restoration of receptivity the voltage will revert to the line voltage and the thyristor of the rheostatic chopper would ramp "off" rapidly. Electric brake demand will ramp up to its previous level and the air brake will fade off. For a brief transient such as passing a section insulator the electric brake will be maintained through the line loss interval by the rheostatic brake.

3.2.4 The electric braking performance of the trains shall ensure its compatibility with the electric brakes of the Urban Lines Trains.

3.2.5 The electric braking performance of the trains shall also maximise the utilisation of regenerative braking energy under the co-working of the trains and the Urban Line Trains in a running mainline.

3.3 Recovery Compatibility with the EMUs

3.3.1 During the emergency operations (refer to PS 9.11), the train shall meet the two recovery requirements, namely, push out and the "train to train" emergency evacuation.

3.3.2 Pushing out of an immobile Urban Lines Train

(a) When the train is pushing out of an immobile Urban Lines Train, the trains shall be able to couple mechanically and then the following operation will be carried out at the immobile Urban Lines Train:

(i) apply all parking brakes by venting all main pneumatic air; and
(ii) release all friction brakes by operating the brake isolation cocks.

(b) The train shall be able to push the immobile Urban Lines Train under the conditions specified in PS 4.4.3 taking into account of the car weights specified in Clause 2.6 above.

(c) In order to avoid any potential electrical fault caused by the different applications of contact pins of the electrical box. Due consideration shall be given to the trainlines allocation on the electrical box such that there is no equipment damages or abnormal behaviours, in the Urban Lines Train or the train, if the cab end electrical boxes of the train and the Urban Lines Train are mated. Urban Lines Train cab end electrical box contact pin arrangements are shown on Drg. No. C6014-14E/TSEG/157/001" Urban Lines Trains Cab End Coupler Electrical Box Pin Arrangement".

(d) It shall be noted that frequent braking and re-motoring may be required during the push-out operation, the train shall be able to push the immobile Urban Lines Train from any point of the running mainline to the nearest depot at speed of less than 10 km/h without any adverse effect to the train equipment.

3.3.3 Being pushed out by an Urban Lines Train

(a) When the train became immobile and is pushed out by an Urban Lines Train, the train shall be able to be coupled mechanically and pneumatically by the Urban Lines Train. The service and emergency brake of the immobile train shall be controlled by and synchronised with the assisting Urban Lines Train.

(i) The service and emergency brake of the immobile train shall release when the emergency brake in the assisting Urban Lines Train is released. Emergency brake of the immobile train shall be applied in case of the two trains are separated, when any Emergency Stop pushbutton in the immobile train leading cab is operated, or when the emergency brake in the assisting Urban Lines Train is applied.

(ii) A 110V DC voltage will be provided from the assisting Urban Lines Train via the cab end coupler electrical head for control of the brake. The voltage is available by operation of the Emergency Switch in the leading cab of the Urban Lines Train to Emergency position after the cab end electrical boxes of the two trains are mated.

(b) It shall be noted that frequent braking and re-motoring may be required during the push-out operation, the train shall be able to be pushed by an

Urban Lines Train from any point of the running mainline to the nearest depot at a speed of less than 10 km/h without any adverse effect to the train equipment.

3.3.4 When the "train to train" emergency evacuation is performed between the train and an Urban Line Train, after these two trains are coupled, the emergency doors of the two trains shall be operated according to PS 9.11.2(c) and the detrainment plate (refer to PS 8.7.8) will be used to place over the couplers between the two trains to work as a walkway for the above "train to train" detrainment.

3.4 Shunting Compatibility with the EMUs and Locomotives

When the train is undergoing high level maintenance and train movement is required with no motive power available, a locomotive will be used to couple with the train or Train Unit for shunting purpose. Therefore, it is a requirement that the autocoupler of the train shall be compatible with the existing Urban Lines BSI coupler (refer to PS 14.1.5) used on both EMUs and locomotives.

3.5 Electro-Magnetic Compatibility (EMC) with EMUs and BE Locos

3.5.1 For the purpose of this Contract, the Contractor shall assume that there shall be no electro-magnetic interference (EMI) limit (except the limits associated with the monitoring circuits of the 50Hz line ripple detector and chopper frequency detector specified in Clause 3.1 above) applied to the Urban Lines Trains and BE locos. Similarly, no EMI immunity protection shall be required by the electric vehicles when they are operated together with the train.

3.5.2 If necessary, the Contractor shall measure the EMC performance of the electric vehicles, at his own expense, to satisfy himself with the interface design requirements. At the discretion of the Engineer, the electric vehicles can be arranged for the above purpose.

3.5.3 The design of the train system shall ensure that:

(a) The train system shall be immune against any EMI generated from the electric vehicles; and

(b) The train system shall not generate excessive EMI affecting the normal operation of the electric vehicles particularly there shall be no nuisance operation of those EMI monitors of the electric vehicles, for example, the 50Hz line ripple detector and chopper frequency detector.

3.6 Compatibility Tests

3.6.1 The Contractor shall demonstrate to the satisfaction of the Engineer by appropriate tests including on-site tests that all compatibility requirements for the electric vehicles are met.

3.6.2 By the end of SEMP stage 3, the Contractor shall perform an analysis of the 1,500VDC power circuits of the train and all electric vehicles, using well accepted modelling techniques, which shall demonstrate that the train system will not introduce any circuit resonances, or similar undesirable effects, which would cause incompatibility with the electric vehicles. The analysis shall include all operating conditions specified in this PS.

3.6.3 The analysis, together with details of the modelling system and the mathematical model of the train system shall be submitted for Approval.

3.6.4 During SEMP stage 4, the model shall be updated as design information (refer to Appendix N Clause 7) becomes available until final verification can be confirmed during compatibility tests of the vehicles at SEMP stage 5.

4 Electric Vehicles Power Circuit Component Information

The electric vehicles power circuit component information are depicted in Tables App-I-Annex-7-2 to App-I-Annex-7-21.

Table App-I-Annex-7-1 Stock Allocation of the Electric Vehicles

Contract	Car Number	Stock Type	A Car	B Car	C Car	D Car	Sub-total
E1 (CM-Stock)	AC101 - AC170	M	70		70		140
E1A (CM Stock)	BC401 - BC435	M		35	35		70
351 (CT Stock)	AC171 - AC207 BC436 - BC473 (less BC459)	T T	37	 37	37 37		74 74
351A (CT Stock)	AC208 - AC232 BC474 - BC479	T T	25	 6	25 6		50 12
451 (CT Stock) 451 (Trailer) 451 (Special "A" car) 451 (B to D Conversion)	AC233 - AC243 D601 - D702 A244 - A247 BC480 to D703, C244 BC481 to D704, C245 BC482 to D705, C246 BC483 to D706, C247	T Q T T T T T	11 4		11	 102 1 1 1 1	22 102 4 2 2 2 2
451A (Melco Chopper)	AC248 - AC256	I	9		9		18
451B (Melco Chopper)	BC459 (RCT prototype Chopper)	I		1	1		2
451C (Trailer)	D707 - D752	Q				46	46
451D/E (GEC Chopper) (Trailer)	AC257 - AC269 BC480 - BC485 D753 - D763	G G Q	13	 6	13 6	 11	26 12 11
901 (H Stock) (Trailer)	AC270 - AC286 BC486 - BC495 D764 - D785	H H Q	17	 10	17 10	 22	34 20 22
1661 (Trailer)	D786 - D788	Q				3	3
651 (K Train)	ACB301 – ACB326 BC801 – BC813	K	26	39	39		104
C6554 (C Trains)	ACB351 – ACB394 BC851 – BC872	C	44	66	66		176
		Total	256	200	386	188	1030

Contract	Car Number	Stock Type	Sub-total
333	L51 - L55	Mark I	5
936	L56 - L61	Mark II	6
971	L62 - L82	Mark III	21
		Total	32

Table App-I-Annex-7-2 CM/CT-Stock Cars Power Circuit Component Information

Dwg. OD4/305/00141/0001 and OD4/305/00241/0004 - Power Circuit Diagram For EMU Cars	
Equipment	**Specification**
AZ1,2	0.909ohm
BZ	0.34ohm
CCZ	6ohm
FCZ1,2	0.234ohm
FDZ1,2	0.2ohm
FK	1755uF
FL	5.5mH, 0.0074ohm
KDZ	9kohm
LL11,12	16uH, 0.0035ohm
LL2	6.5uH, 0.002ohm
RFK	0.22uF
SDZ1,2	100kohm
TFK	1755uF
TFL	6.9mH, 0.014ohm
TFZ	15ohm
TSN11,12 - Ci	2uF
TSN11,12 - Cs	20uF
TSN11,12 - K2-K4	68nF
TSN11,12 - RR	0.159ohm
TSN11,12 - Z2-Z5	10ohm
TSN2 - K1	6uF
TSN2 - Z1	5ohm
DSN3,21,22 - K1	1uF
DSN3,21,22 - Z1	5ohm
Traction motor - armature	0.016ohm
Traction motor - series field	0.0274ohm
Traction motor - compole field	0.0104ohm

Table App-I-Annex-7-3 G-Stock Cars Power Circuit Component Information

Dwg. OD4/303/00042/0027 - Power Circuit Diagram For E.M.U. Cars	
Equipment	**Specification**
AZ1,2	0.909ohm
BZ	0.34ohm
CCZ	24ohm
FCZ1,2	0.234ohm
FDZ1,2	0.2ohm
FK	1755uF
FL	5.5mH
KDZ	3900ohm
LL2,11,12	15.4uH
RFK	0.22uF
SDZ1,2	100kohm
TFK	1755uF
TFL	6.9mH, 0.014ohm
TFZ	15ohm
TSN11,12 - GK	2.2uF
TSN11,12 - GZ1,2	2.2ohm
TSN11,12 - K1	6uF
TSN11,12 - Z1-Z6	30ohm
TSN2 - GK	1uF
TSN2 - GZ1,2	10ohm
TSN2 - K1	6uF
TSN2 - Z1-Z3	15ohm
DSN11,12 - K1	1uF
DSN11,12 - Z1,2	10ohm
Traction motor - armature	0.016ohm
Traction motor - series field	0.0274ohm
Traction motor - compole field	0.0104ohm

Table App-I-Annex-7-4 H-Stock Cars Power Circuit Component Information

Dwg. OD4/306/00041/0001 - Power Circuit Diagram For EMU Cars	
Equipment	**Specification**
AZ1,2	0.909ohm
BZ	0.34ohm
CCZ	6ohm
FCZ1,2	0.234ohm
FDZ1,2	0.2ohm
FK	1755uF
FL	5.5mH, 0.0074ohm
KDZ	9kohm
LL11,12	16uH, 0.0035ohm
LL2	6.5uH, 0.002ohm
RFK	0.22uF
SDZ1,2	100kohm
TFK	1755uF
TFL	6.9mH, 0.014ohm
TFZ	15ohm
TSN11,12 - Ci	2uF
TSN11,12 - Cs	20uF
TSN11,12 - K2-K4	68nF
TSN11,12 - RR	0.159ohm
TSN11,12 - Z2-Z5	10ohm
TSN2 - K1	6uF
TSN2 - Z1	5ohm
DSN3,21,22 - K1	1uF
DSN3,21,22 - Z1	5ohm
Traction motor - armature	0.016ohm
Traction motor - series field	0.0274ohm
Traction motor - compole field	0.0104ohm

Table App-I-Annex-7-5 I-Stock Cars Power Circuit Component Information

Dwg. OD4/302/00003/0011 - Schematic Diagram Of Power Circuit	
Equipment	**Specification**
AFC	534uF
AFL	22uH
AFR	100ohm
BSR	0.227ohm
CDR1	0.378ohm
CDR2	0.95ohm
CHR (E5-E6)	3.325ohm
CHR (E6-E7)	3.325ohm
CHR (E7-E7D)	16.4ohm
CMC1,2	24uF
CMC3	28uF
CMCR1,2	50ohm
FC	534uF
FL	5.5mH
IS1,2	2-7mH
MSL1,2	11mH
NVR	1330ohm
NVRR	3600ohm
OVCR	2060ohm
OVCRR1	18kohm
OVCRR2	18kohm
WFR1 (E10-E15)	0.0844ohm
WFR1 (E15-E15A)	0.0535ohm
WFR2 (E13-E17)	0.0909ohm
WFR2 (E17-E17A)	0.0589ohm
Traction motor - armature coil	0.0196ohm
Traction motor - main coil	0.01233ohm
Traction motor - commutating coil	0.0310ohm

Table App-I-Annex-7-6 K Train Cars Power Circuit Component Information

Dwg. OD4/361/00742/0034 - Power Circuit Diagram For EMU Cars	
Equipment	**Specification**
CHRe	7.2ohm (3.6ohm × 2S)
DCHRe	250ohm (500ohm x 2P)
FL	10mH
OVR	2.5ohm
BR	1.776ohm
FCR	33kohm
FC	6600uF (3300uF x 2)
C11A &C11B	22uF
IM	0.148ohm (phase resistance at 150 °C)

Table App-I-Annex-7-7 CM/CT/I-Stock Cars Auxiliary Static Inverter Component Information

Dwgs. C6014-14E/TSEG/637/001 & 002 – Schematic Diagram of SIV Power Circuit	
Equipment	**Specification**
L1	9mH
R3, R4, R9	27ohm
C1, C2	3800uF
R5, R6	20k ohm
R7, R8	680 ohm
C3~C8	0.1uF

Table App-I-Annex-7-8 G-Stock Cars Auxiliary Inverter Circuit Component Information

Dwg. OD4/303/00042/0108 - Circuit Diagram Of Static Auxiliary Inverter	
Equipment	**Specification**
AICZ1,2	11ohm
DSN1 - K	0.25uF
FK	1755uF
FKDZ1,2	27kohm
FL	46mH, 0.035ohm
IT	Primary : 0.1026ohm, Secondary : 0.035ohm
KDZ1,2	3.9ohm
LFK	2000uF
LFL	7mH
LKDZ	470kohm
LL	16uH
RFIK	0.22uF
TFK	1755uF
TFL	10.1mH
TSN1 - K1	1uF
TSNA,B - K	1uF
TSNA,B - Z1,2	2.5ohm
TSN1 - Z1-Z8	10ohm
DSN1 - Z1-Z4	5ohm

Table App-I-Annex-7-9 H-Stock Cars Auxiliary Converter Circuit Component Information

Dwg. OD4/306/00063/0003 - Circuit Diagram Of Static Auxiliary Converter	
Equipment	**Specification**
AICZ1,2	22ohm
CSK1	1.5uF
CSK2	5uF
CSZ	0.195ohm
FK	1000uF
FKDZ1,2	27kohm
FL	46mH
IL1-3	4uH
ISK1-6	2uF
ISZ1-3	4.7ohm
IT	Primary : 0.1026ohm, Secondary : 0.035ohm
KDZ1,2	6ohm
LFK	2000uF
LFL	7mH
LKDZ	47kohm
LL	10uH
RFIK	0.22uF
TFK	1000uF
TFL	10.1mH
DSN1,2 - K	0.033uF
DSN1,2 - Z1,2	10ohm
DSN3 - K	0.033uF
DSN3 - Z	4.7ohm

Table App-I-Annex-7-10 K Train Cars Auxiliary Static Inverter Component Information

Dwg. OD4/361/00741/9731 - Auxiliary Circuit Diagram A-C-B Cars	
Equipment	**Specification**
FL	12mH (at 110A)
RC	250ohm (50 ohm x 5S)
RD	17.5kohm (35kohm x 2P)
FC1, FC2	3000uF
ACC	430uF × 3 phase

Table App-I-Annex-7-11 CM -Stock Cars Auxiliary Circuit Component Information

Dwg. OD4/305/00162/0001 - Auxiliary Circuit Diagram A-CT-D Cars	
Equipment	**Specification**
Air compressor - motor armature	3.52ohm
Air compressor - motor compole	1.28ohm
Air compressor - motor main field	5.97ohm
CPZ	2.33ohm

Table App-I-Annex-7-12 CT -Stock Cars Auxiliary Circuit Component Information

Dwg. OD4/305/00262/0001 - Auxiliary Circuit Diagram A-CT-D Cars	
Equipment	**Specification**
Air compressor - motor armature	3.52ohm
Air compressor - motor compole	1.28ohm
Air compressor - motor main field	5.97ohm
CPZ	2.33ohm

Table App-I-Annex-7-13 G -Stock Cars Auxiliary Circuit Component Information

Dwg. OD4/303/00063/0011 - Auxiliary Circuit Diagram EMU 'A'-'CT'-'D'	
Equipment	**Specification**
Air compressor - motor armature	6.87ohm
Air compressor - motor main field	5.42ohm
Air compressor - motor compole	3.01ohm
CPZ	2.33ohm

Table App-I-Annex-7-14 H-Stock Cars Auxiliary Circuit Component Information

Dwg. OD4/306/00063/0004 - Auxiliary Circuit Diagram EMU 'A'-'CT'-'D'	
Equipment	**Specification**
Air compressor - motor armature	6.87ohm
Air compressor - motor main field	5.42ohm
Air compressor - motor compole	3.01ohm
CPZ	2.33ohm

Table App-I-Annex-7-15 I-Stock Cars Auxiliary Circuit Component Information

Dwg. OD4/302/00303/0002 - Auxiliary Circuit Diagram A-CT-D Cars	
Equipment	**Specification**
Air compressor - motor armature	3.52ohm
Air compressor - motor compole	1.28ohm
Air compressor - motor main field	5.97ohm
CPZ	2.33ohm

Table App-I-Annex-7-16 Mark I/II BE Loco Power Circuit Component Information

Dwg. OD4/312/00005/0001 - Power Circuit Diagram	
Equipment	**Specification**
FLZ	3.47ohm
L10	8mH
C4	1uF
C5	3.3mF
R13	0.485ohm
L14	13.5mH
C3	46uF
R7-12	450ohm
L11	325uH
L7	50uH
L8	15uH
L9	15uH
L6	5.5mH
L5	17.5mH
CCZ	1.52ohm
BCZ	1ohm
C2	2.4mF
L4	10uH
FDZ	0.0259ohm
R1-6	266ohm
L3	10uH
L2	210uH
L1	1.891mH
C1	70uF
Traction motor - armature	0.0135ohm
Traction motor - interpole	0.0074ohm
Traction motor - main pole winding	0.00912ohm

Table App-I-Annex-7-17 Mark I/II BE Loco Auxiliary Circuit Component Information

Dwg. OD4/312/00005/0002 - Auxiliary Circuit Diagram	
Equipment	**Specification**
MAZ1	8ohm
MAZ2	0.25ohm
MAZ3-4	83ohm
MAZ5-6	83ohm
Motor alternator - motor armature	0.369ohm
Motor alternator - motor interpoles	0.225ohm
Motor alternator - motor shunt field	162ohm
Motor alternator - motor shunt field ballast resistor	200 - 330ohm

Table App-I-Annex-7-18 Mark III BE Loco Power Circuit Component Information

Dwg. OD4/313/00005/0026,0027,0028 - Power Circuit Diagram	
Equipment	**Specification**
NVRZ	200kohm
NVR	48.5kohm
LSCZ	3.47ohm
LFL	8mH
LFCP	3mF
TFCP	750uF
TFDZ	0.485ohm
TFL	13.5mH
LCL	7-8uH
LERCP	20uF
LSCP	0.5uF
MFL	5.5mH
BCZ	1ohm
BCL	15-20mH
MSCP	4uF
MSCZ	1.52ohm
MFCP	2400uF
FDZ	0.0259ohm
MCL	3-3.5uH
MERCP	20uF
LCDZ1-3	10kohm
LSDZ1-4	1Mohm
LSDZ5	60ohm
LDSCP1-4	0.5uF
LSZ1-6	12ohm
LFDSZ1-3	15ohm
MCDZ1-2	10kohm
MFDSZ1-3	15ohm
MDSCP1-4	0.5uF
MSDZ1-3	1Mohm
MSZ1-6	12ohmTraction motor - armature0.0135ohm
Traction motor - field	0.0912ohm

Table App-I-Annex-7-18 Mark III BE Loco Power Circuit Component Information

Dwg. OD4/313/00005/0026,0027,0028 - Power Circuit Diagram	
Equipment	**Specification**
Traction motor - interpole	0.074ohm

Table App-I-Annex-7-19 Mark III BE Loco Auxiliary Circuit Component Information

Dwg. OD4/313/00005/0049 - Auxiliary Circuit Diagram	
Equipment	**Specification**
MAZ1	8ohm
MAZ2	0.25ohm
MAZ3-4	91.5ohm
MAZ5-6	83ohm
Motor alternator - motor armature	0.369ohm
Motor alternator - motor interpoles	0.205ohm
Motor alternator - motor shunt field	162ohm
Motor alternator - motor shunt field ballast resistor	200 - 330ohm

Table App-I-Annex-7-20 C-Train Cars Power Circuit Component Information

Dwg. C6014-14E/TSEG/637/003 - Power Circuit Diagram For EMU Cars	
Equipment	**Specification**
CHRe	7.5ohm (3.75ohm × 2S)
DCHRe	250ohm (500ohm x 2P)
FL	19mH
BR	1.63ohm (At 20 °C)
FCR	33kohm
FC	6600uF (2200uF x 3)
C11A &C11B	22uF
IM	0.148ohm (phase resistance at 150°C)

Table App-I-Annex-7-21 C-Train Cars Auxiliary Static Inverter Component Information

Dwg. C6014-14E/TSEG/637/004 – Circuit Diagram of Auxiliary Static Inverter	
Equipment	**Specification**
FL	12mH
RC	50 ohm x 5
RD	75ohm x 2
FC1, FC2	6000uF, 1050V x 2s
ACC	430uF × 3

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 8 NOT USED

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 9 DYNAMIC ROUTE MAP INTERFACES

1 Introduction

2 Dynamic Route Map

Attachment App-I-Annex-9 Operation and Maintenance Manual of the Real Time Transmission Facilities

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 9 DYNAMIC ROUTE MAP INTERFACES

1 Introduction

1.1 This document defines the interface requirements for the Dynamic Route Map (DRM) and the train system/equipment including TMS, DVAS & PA, GSM Modem Assemblies and Doors.

1.2 The Contractor shall install all the DRM equipment as stipulated in PS 10.4.2. All the required connectors, interfacing plugs and sockets, earthing connections and all associated mounting materials shall be provided by the Contractor.

1.3 The Contractor shall provide accommodation including mountings, equipment cabinets and cable access for the installation of all the DRM equipment as stipulated in PS 10.4.2.

1.4 The Contractor shall provide the appropriate power supply, including the power supply interface and the protection device to all the DRM equipment as stipulated in RS/C6014/02.

1.5 The Contractor shall provide all required EMI protective measures, such as special EMC cubicle, to protect the DRM equipment in order to fulfil the EMC requirements as stipulated in RS/C6014/04.

1.6 The Contractor shall incorporate appropriate interfaces, power supply, delivery schedule, installation, testing and setting to work. The Contractor shall ensure that the equipment can be easily operated, removed and replaced.

1.7 The Contractor shall be responsible for the test and commissioning of all DRM equipment and interfaces.

1.8 EMC Consideration and Constraints

1.8.1 The Contractor shall ensure that all train equipment is designed and constructed in accordance with RS/C6014/04 or equivalent, to ensure proper functioning of all the DRM equipment.

1.8.2 The Contractor shall ensure the EMC is achieved between all the DRM equipment and train systems. The Contractor shall ensure each DRM equipment shall be fully functional without suffering interference from any other equipment.

1.8.3 The Contractor shall, through this interface, develop a Compatibility Specification which shall identify the possible interference sources and define the levels of susceptibility and emissivity for all the trainborne DRM

equipment that will guarantee compatibility in SEMP Stage 2. A Compatibility Study shall be developed in SEMP Stage 3 to document the steps taken to ensure that the defined level of susceptibility and emissivity is achieved for all DRM equipment and train systems.

1.8.4 Train systems and equipment shall be EMC tested in SEMP Stage 4 in accordance with RS/C6014/04 to demonstrate compliance with the PS. An appropriate technical construction file shall be developed in accordance with the EC EMC Directives and be certified by an appropriate Competent Body for the compliance of the EMC Directives.

2 Dynamic Route Map

2.1 The system block diagram of the DRM is shown in Figure 1. The Contractor shall define the detailed interconnection between different equipment.

2.2 Performance Requirements of the DRM and Train System Interfaces

2.2.1 General

The design of the train system shall ensure that the main objectives of the DRM summarised as below can be achieved:

(a) To obtain information of door status, next station, pre-recorded DVAS & PA message codes to display next station name, pre-recorded DVAS & PA text message in parallel with the audible announcement from DVAS & PA.

(b) To relay the received real time message via the public GSM network in the Urban Lines from the GSM Modem Assemblies to the DRM. The current displaying message on DRM displays shall be interrupted and display the received real time message in accordance to the message priorities.

(c) To obtain the route information, cab status and provide equipment status reporting and equipment control.

(d) To obtain the information of door's side open/close status to display the corresponding message on DRM displays.

2.3 Design Constraints

2.3.1 Interface with DVAS & PA

The DRM shall provide an interface means in obtaining data from DVAS & PA without affecting its integrity and function subject to the Approval of the Employer as shown in Figure 1 and in the following table:

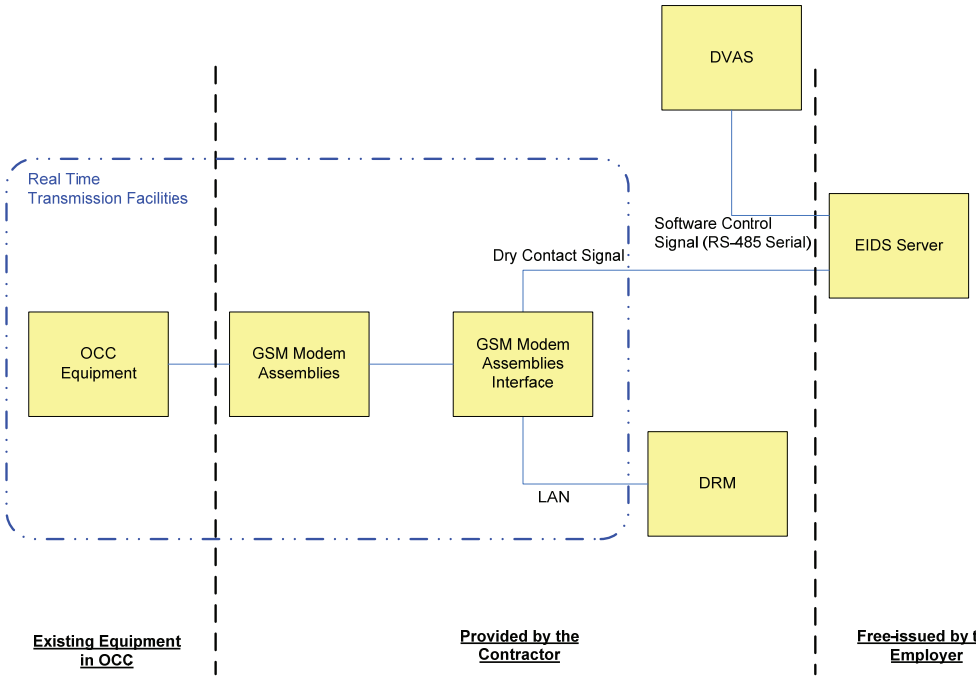
Interfaces	From	Description
Serial	DRM / DVAS & PA	Provide necessary wired communications between DRM and DVAS & PA.
	DVAS & PA	Develop the interface protocol to provide message codes to DRM for message broadcasting.

2.3.2 Interface with GSM Modem Assemblies

The DRM shall provide an interface means in obtaining data from GSM Modem Assemblies without affecting its integrity and function subject to the Approval of the Employer as shown in Figure 1 and in the following table:

Interfaces	From	Description
LAN	DRM / GSM Modem Assemblies	Provide necessary wired communications between DRM and GSM Modem Assemblies.
	GSM Modem Assemblies	Develop the interface protocol to capture live messages and train pre-recorded messages triggered from OCC to DRM for message broadcasting.

The Contractor shall purchase Wavecom Fastrack Modem M1306B or compatible equipment which shall be submitted for approval for the GSM Modem Assemblies for real time data transmission. The interface demarcation diagram is shown as follows:



(a) Power Supply and Electrical Requirement

(i) The power of the real time data receivers (GSM Modem Assemblies) shall be supplied from the DRM server and the maximum current shall be 500 mA.

(ii) The Contractor shall define and provide the power supply and electrical interface for the real time data receivers.

(b) Accommodation Requirement

The Contractor shall define the mechanical requirements (location and dimensions) to accommodate the trainborne transceivers.

(i) The size of the real time data receiver, with all necessary cases and enclosures, will not exceed 250 mm (L) x 100 mm (H) x 160 mm (W). The antennae shall not be reachable by the passengers and shall match with the saloon finish. The Contractor shall define the exact location, mounting

method and arrangement of the real time data receiver and the associated antenna.

(ii) The total weight of the trainborne real time data receiver will not be greater than 1 kg.

The Contractor shall refer to the existing Operation and Maintenance Manual of the Real Time Transmission Facilities according to Attachment App-I-Annex-9 to develop protocol of the interface between DRM and GSM Modem Assemblies.

2.3.3 Interface with TMS

The DRM shall provide an interface means in obtaining data from TMS without affecting its integrity and function subject to the Approval of the Employer as shown in Figure 1 and in the following table:

Interfaces	From	Description
Serial	DRM / TMS	Provide necessary wired communications between DRM and TMS.
	TMS	Develop the interface protocol to provide route data to DRM for route information broadcasting.
	DRM	Develop the interface protocol to provide DRM equipment status reporting to TMS and shown in graphic on TMS MMI.
	TMS	Develop the interface protocol to provide DRM equipment control functions and shown in graphic on TMS MMI.

2.3.4 Interface with Doors

The DRM shall provide an interface means in obtaining data from Doors without affecting its integrity and function subject to the Approval of the Employer as shown in Figure 1 and in the following table:

Interfaces	From	Description
Shielded Cable / Dry contacts	DRM / Doors	Provide necessary wired connections between DRM and Doors.
	Doors	Develop the door open / close status signal of A side or B side doors to DRM for displaying the related information.

2.3.5 The servers shall be of redundant designs in order to receive data/commands from different interfaces.

2.4 Confirmation of Design Information

Any change in the design constraints (including power supply, accommodation and interconnection cables wiring arrangement) as stipulated in Clause 2.2 above shall be submitted for Approval in accordance with the Configuration Control Program (refer to Appendix P) before the end of SEMP Stage 3.

Figure 1 System Block Diagram of DRM

Attachment App-I-Annex-9
Operation and Maintenance Manual of the Real Time Transmission Facilities

***The Operation and Maintenance Manual shall be read in conjunction with several interface documents which will be given after the award of the contract.**

Operation & Maintenance Manual

For

MTRCL Contract C6512-05E

Replacement of Paging System for Broadcasting Emergency EIDS Messages

Amendment History

Revision Number	Description of Change (s)	Date of Revision
V.3.9	The following sections are amended 1.1, 1.2, 1.2.3, 3.2, 3.3.3, 3.3.5, 3.4, 4.2.3, 5.3	2007-01-17
V.4.0	The following sections are amended 2.1.1, 3.3.3, 3.3.4, 4.3	2007-01-26

Table of Contents

1 GENERATION INFORMATION 5

1.1 SCOPE 5
1.2 SYSTEM DESCRIPTION 6
1.2.1 CMS Server Description 8
1.2.2 TRDR 9
1.2.3 KVM Switch 13

2 CONFIGURATION 14

2.1 GENERAL 14
2.1.1 Configuration Details 14

3 OPERATION 21

3.1 GENERAL 21
3.2 KVM SWITCH 22
3.3 CMS OPERATION 23
3.3.1 Check background processes 23
3.3.2 Check foreground processes 25
3.3.3 Alarm Monitor 28
3.3.4 Administration 33
3.3.5 Message dissemination to AEL Trains (Option 2) 57
3.3.6 Housekeeping 61
3.4 TRDR OPERATION 62

4 TROUBLESHOOTING 67

4.1 SYSTEM DIAGNOSTICS 67
4.1.1 For CMS 67
4.1.2 For TRDR 70
4.2 SYSTEM TROUBLESHOOTING 70
4.2.1 For CMS Server 70
4.2.2 For TRDR 71
4.3 CMS SIMULATOR 71
4.3.1 Procedure of installing the CMS simulator 71
4.3.2 Simulator for testing TRDR 76

5 REPLACEMENT PROCEDURE 79

5.1 FOR CMS 79
5.2 FOR TRDR 88
5.3 REINSTALLATION OF CMS SERVER 88

6 APPENDIX 115

6.1 SPECIFICATION FOR CMS PC 115
6.2 ATTACHED DOCUMENTS 116

1 Generation Information

1.1 Scope

This manual provides the information necessary to operate and maintain the Central Message Server (CMS) and Trainborne Real-time Data Receiver (TRDR) for the MTR project “Replacement of Paging System for Broadcasting Emergency EIDS Messages”

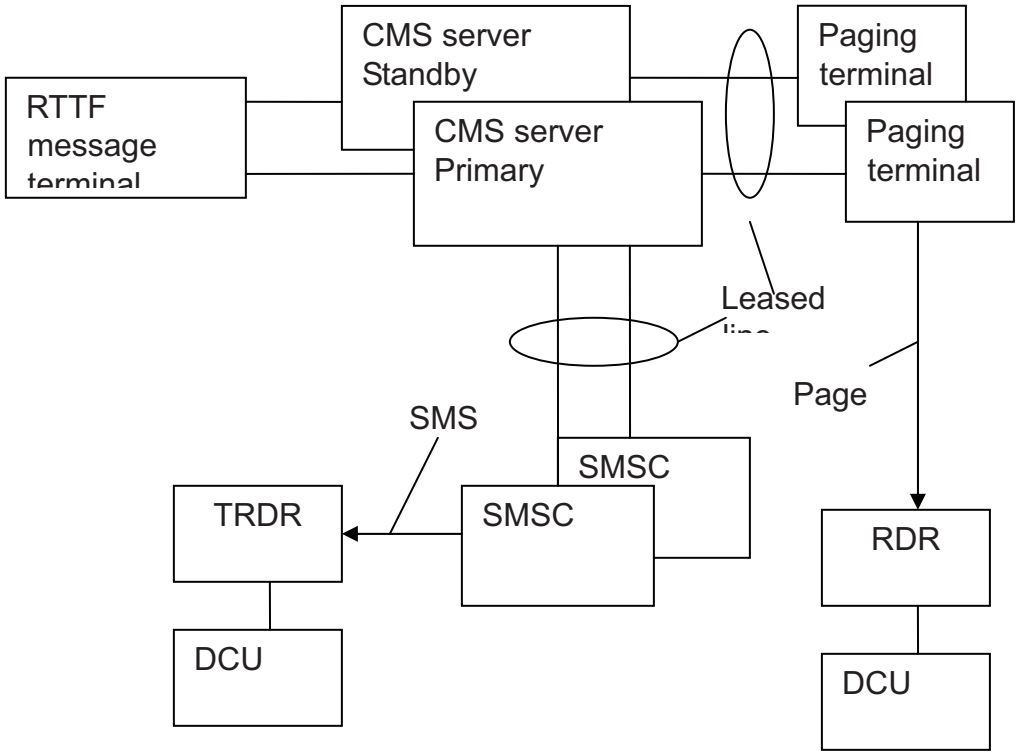
The CMS is to capture the messages from the existing Real-Time Transmission Facility (RTTF) terminal (or VCN Express Communicator), convert the messages to SMS format and send the SMS to the mobile operator.

The CMS also provides the necessary administration function for the operation and maintenance purpose.

The TRDR is a SMS receiver to replace the existing paging receiver on trains.

Option 2 includes a new interface RTTF terminal (or VCN Express Communicator) to compose and send messages for Airport Express Line trains (AEL) and the provision of TRDRs to 11 AEL trains or 22 driving cab in the AEL fleet.

1.2 System Description



The CMS server is connected between the existing RTTF terminal and the paging terminal. It accepts the RTTF message from the RTTF terminal using TAP 1.8 protocol through a serial line. The RTTF message received will be processed by the CMS server.

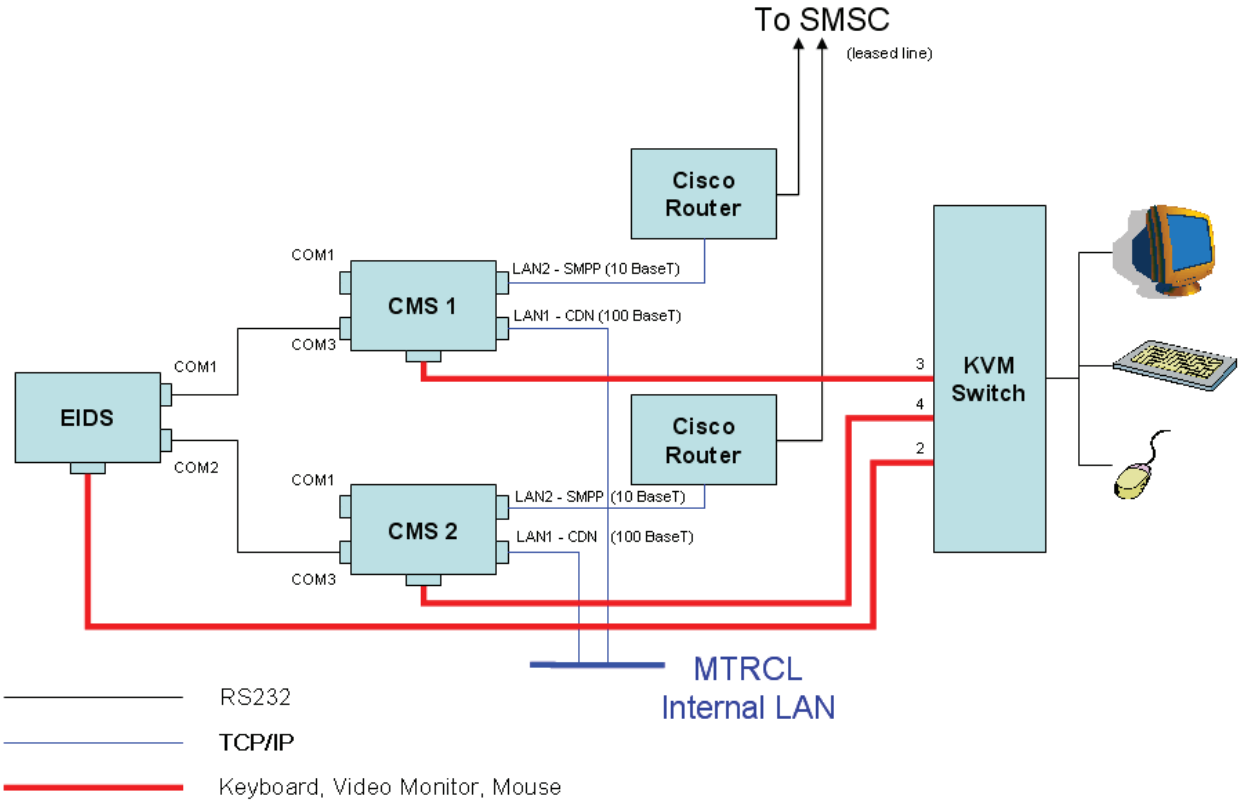
The CMS server will deliver the RTTF message to either the Paging terminal or SMSC, or both.

When the RTTF message is delivered to the paging terminal, the paging terminal will send the message to the train through their paging network. The connection between the CMS server and paging terminal is a lease line running RS232 data link protocol.

When the RTTF message is delivered to the SMSC, the SMSC will deliver the message to the train through SMS of the GSM network. The connection between CMS server and SMSC is through a lease line running on a TCPIP network. The message protocol between CMS server and the SMSC is SMPP 3.4.

The TRDR is connected to DCU, it receives the SMS message sending from CMS server and send the message to DCU for displaying.

New Systemic Diagram in OCC



CMS LAN1 – CDN (100 BaseT)
CMS LAN2 – SMPP (10 BaseT)
KVM Port2 – EIDS Terminal
KVM Port3 – CMS 1
KVM Port4 – CMS 2

1.2.1 CMS Server Description

The CMS server is installed with multiple process/service. These processes include:
- Smpp Submit Service (CMS_SmppSubmitService.exe)
- Smpp Delivery Service (CMS_SmppDeliveryService.exe)
- House Keeping Service (CMS_HouseKeepingService.exe)
- Tap Client Application (TapClientServiceForm.exe)
- Tap Server Application (TapServerServiceForm.exe)
- Alarm Monitor (AlarmMonitor.exe)
- Administration (Administration.exe)

The server is running on Windows 2003 server. It receives the RTTF message from VCN terminal through the TAP connection. The message received will deliver to the ACAR/LINE according to the RTTF message content. It can either be delivered through PSP or PMSP, or both, according to the system configuration.

If the message is being sent through the PMSP, it will be keep track to determine if it can be received by the designated train (ACAR). The delivery status can be check from the Alarm Monitor module. In addition to the delivery status, the Alarm monitor can be used to keep track of the current system connectivity, include the PSP connectivity and PMSP connectivity.

The system is configured with the Administration module which can be used to define the system setting, ACAR and the corresponding MSN (Mobile station number) mapping, User administration, House keeping etc.

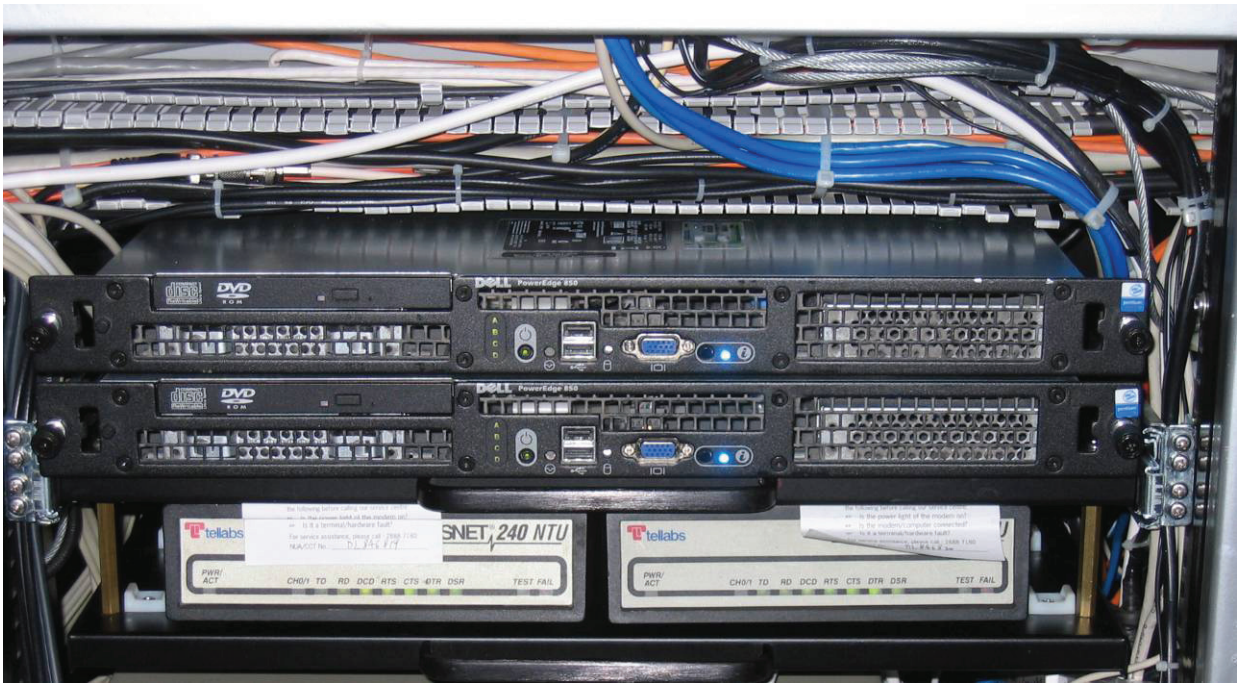
The Smpp Submit Service is used to send SMS, through the PMSP, while the Smpp Delivery Service is used to receive the SMS's delivery status.

The TAP client is used to send page through the PSP, while the TAP server is used to receive RTTF message from the VCN terminal.

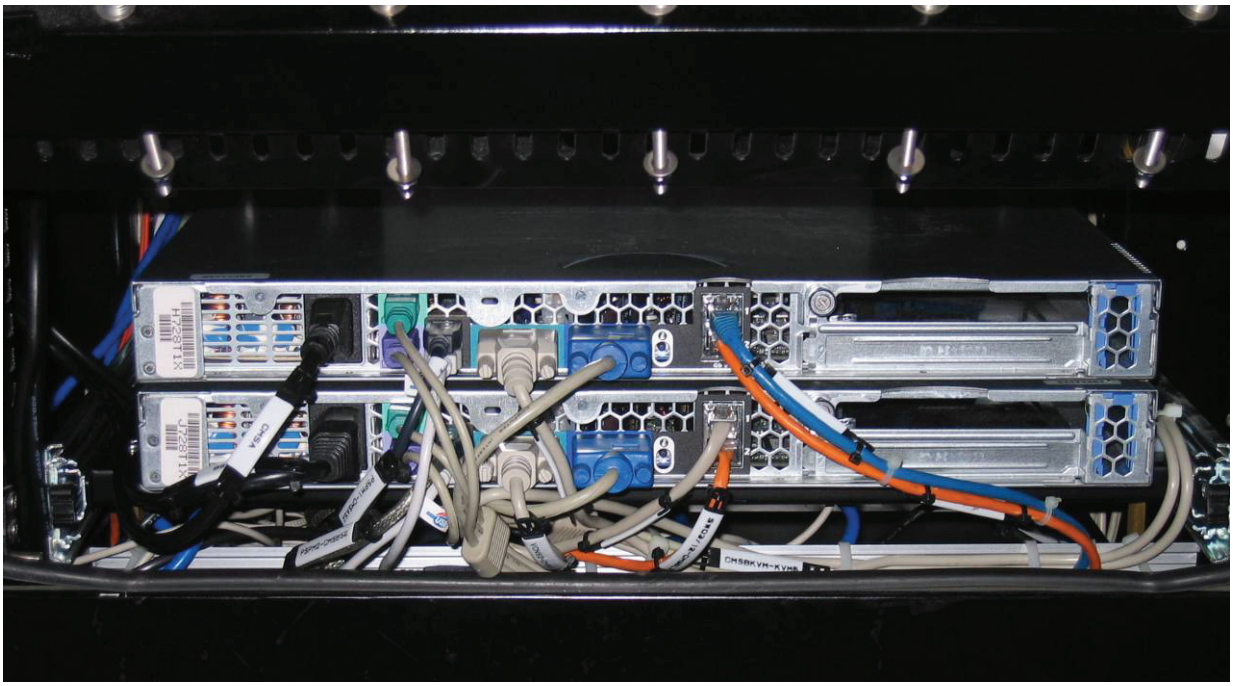
The Housekeeping Service is used to maintenance the system. It provides function such as database backup, purging etc.

Two CMS servers are running at the same time to provide hot standby. If one CMS server failure, the other can still be used to send SMS/page to the PMSP/PSP respectively.

- Front view of CMS in OCC



- Rear view of CMS in OCC



1.2.2 TRDR

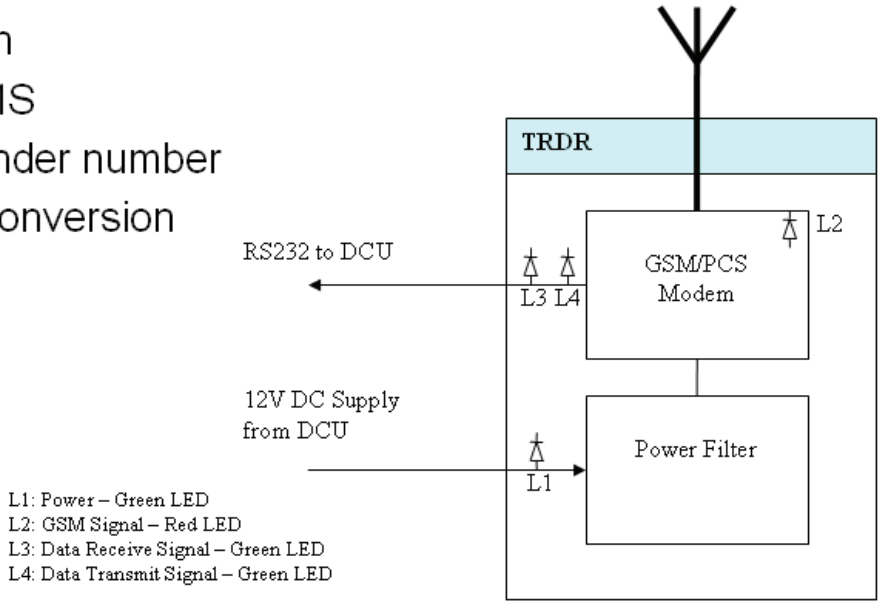
The TRDR consists of GSM modem, industrial communication controller and 12V power supply circuit. When the GSM modem receives the SMS sending from CMS server, it will trigger the controller to validate the originator of the SMS message, the

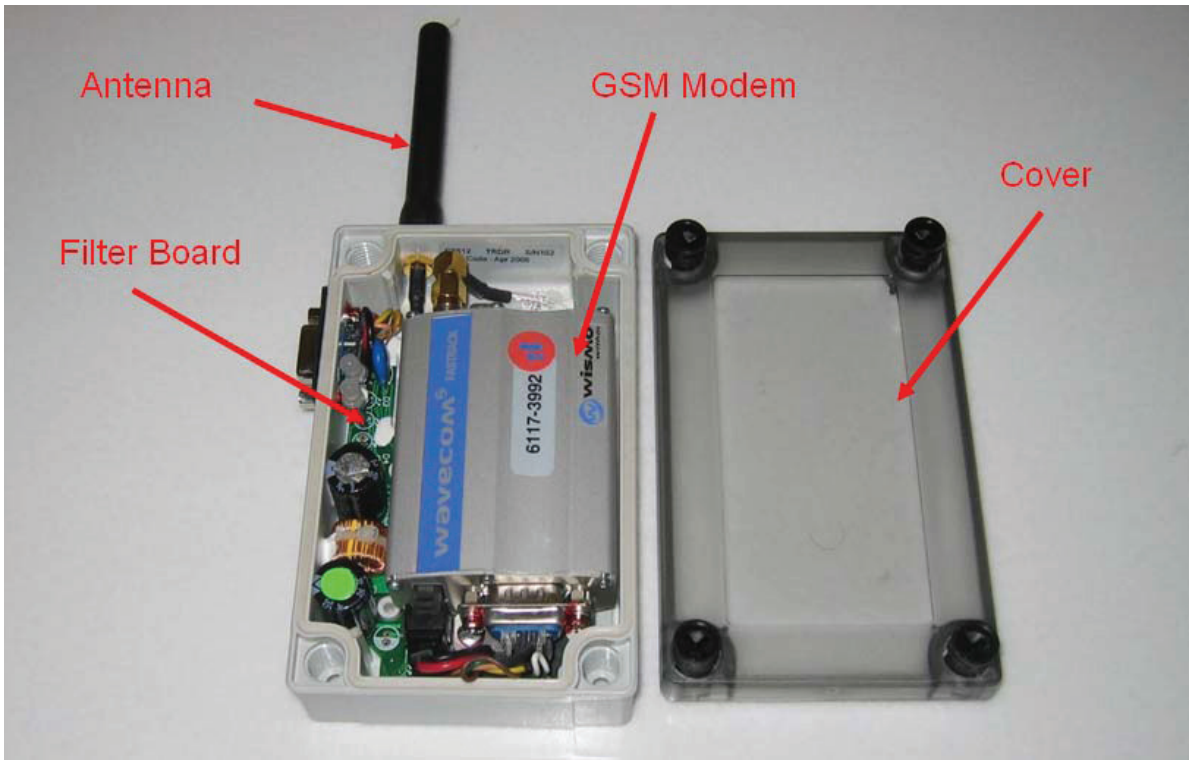
controller will convert the message to the necessary format and send it to DCU for displaying.

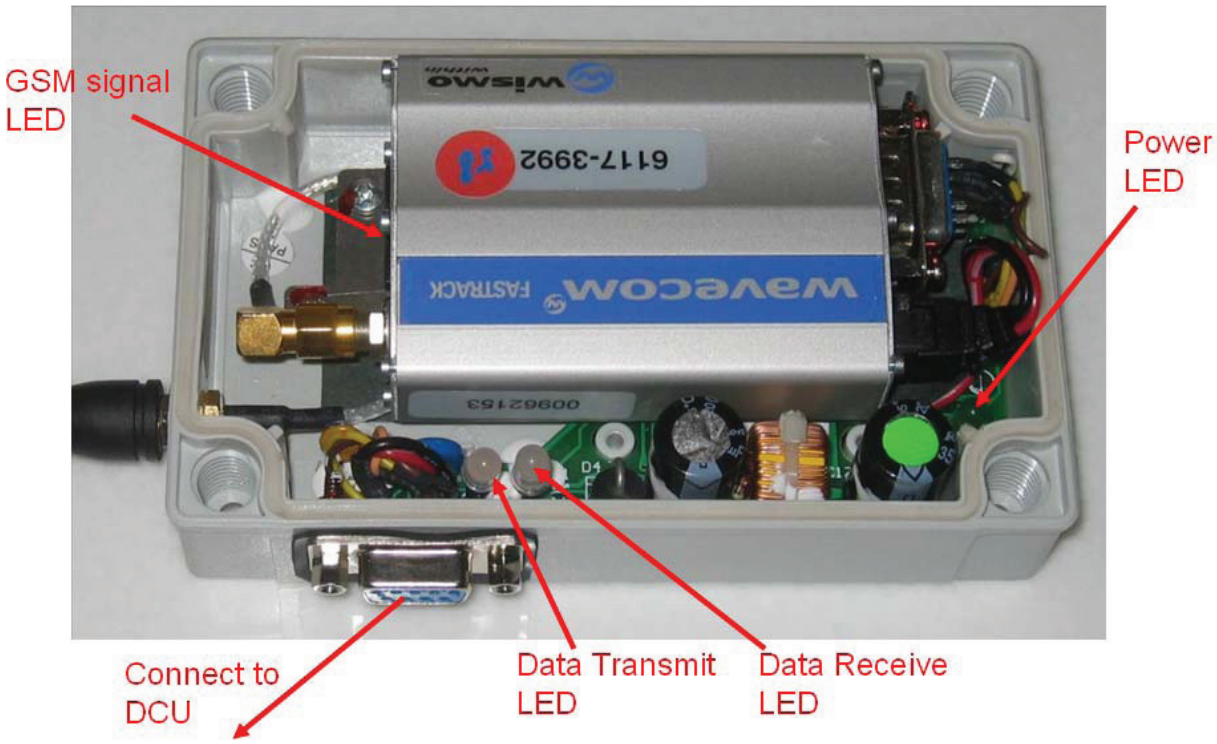
Train-bourn Real-time Data Receiver (TRDR)

TRDR Function

- Receive SMS
- Validate sender number
- Character conversion






GSM signal LED
Power LED
Connect to DCU
Data Transmit LED
Data Receive LED

SIM Card
6117-3992
wavecom
wismo

Four LED's status in TRDR during normal operation

L1: Power – Green LED, it should be ON when power on.

L2: GSM Signal – Red LED, it should be blinking in the GSM signal coverage area.

L3: Data Receive Signal – Green LED, it should be ON when connecting DCU.

L4: Data Transmit Signal – Green LED, it should be ON when connecting DCU.

1.2.3 KVM Switch

KVM (Key, Video Monitor, Mouse) Switch

- Enables a single keyboard, video monitor and mouse to control more than one computer one at a time.

- Front View

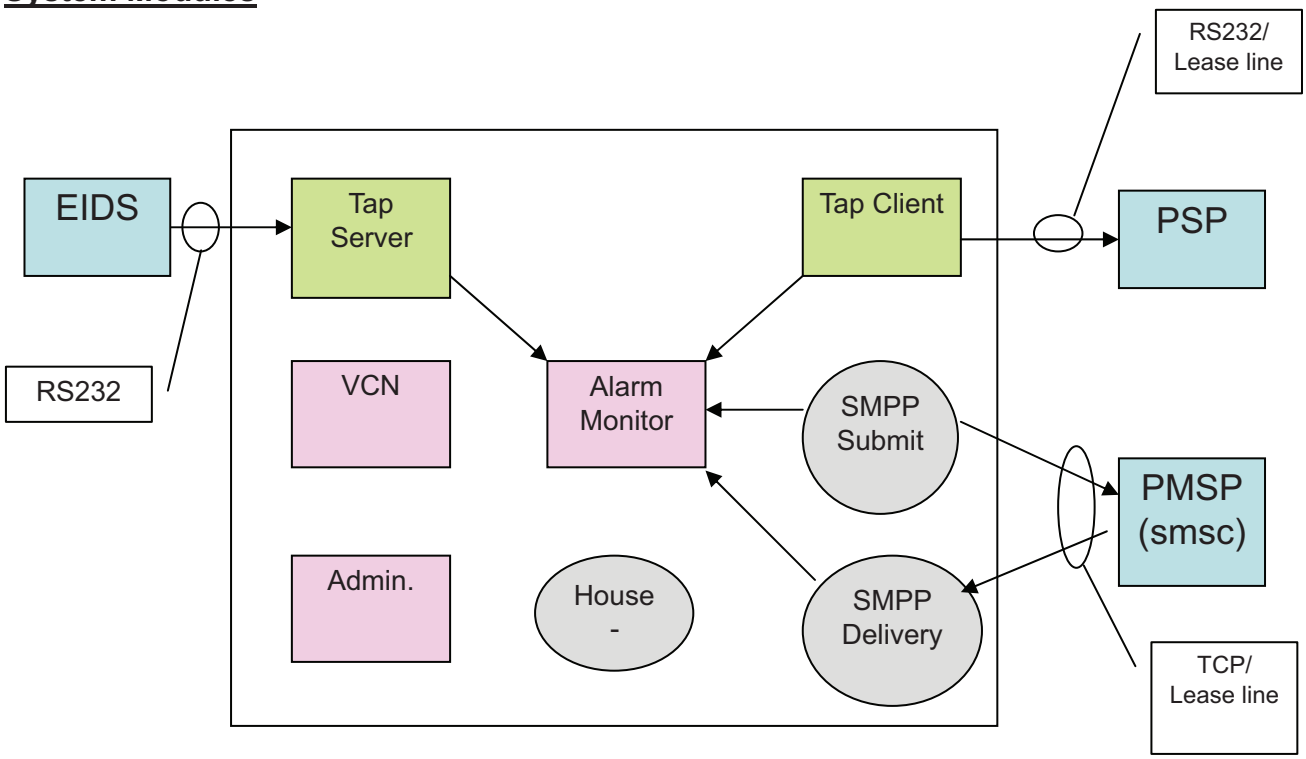
- Rear View

2 Configuration

2.1 General

This section explains all settings and adjustments that configure the CMS Server and TRDR.

System Modules



2.1.1 Configuration Details

CMS configuration

- 2 serial ports are required to connect to PSP and VCN terminal.
- The system is equipped with 2 network cards. One network card is used to connect to PMSP through the dedicated lease line. Another network card is used to connect to the secondary CMS server for database synchronization.

In the installed directory, there is a configure file which should be modified to content the requirement of the hardware or drivers settings. The configuration file is applied by the following module:

1. SMPP Submit Service configuration
2. SMPP Delivery Service configuration
3. TAP Client configuration
4. TAP Server configuration
5. House Keeping Service configuration
6. VCN Express Communicator configuration
7. Administration configuration
8. Alarm Monitor configuration

For example, the configure file will be named as “ApplicationAssembly.exe.config” the extension of the file is “.config”. For the SMPP Submit service module, the installed directory is: d:\Program Files\CMS_SmppSubmitService\, and the configure file is CMS_SmppSubmitService.exe.config.

Open the configure file using text editor, the configure file is a standard XML configure file, locate the tag: “<appSettings></appSettings>”, there are several items:

General configuration

- The configuration file of each of the module is name as ‘[module name].exe.config’ under each module’s program folder.
- The configuration file is in XML format, which contains parameter and value pair
- This part of configuration applicable to all system module

• SystemID : current system’ s ID • connectionString : database configuration parameter, (don’t change) • DBPassword : Encrypted database password. (don’t change) • SystemID2 : another online system’s ID (secondary system) • SecondaryDB : database connection parameter of the secondary system (don’t change) • SecDBPassword : Encrypted password of the secondary system • Others : Table mapping. Don’t change	<add key="SystemID" value="002" /> <add key="connectionString" value="Database=cmsdb;Data Source=127.0.0.1; User Id=root;Password=[[encPass]]" /> <add key="DBPassword" value="8Mg2nrl/jyBwkmIoaMqWOw==" /> <add key="SystemId2" value="001" /> <add key="SecondaryDB" value="Database=cmsdb;Data Source=138.9.5.61; User Id=root;Password=[[encPass]]" /> <add key="SecDBPassword" value="8Mg2nrl/jyBwkmIoaMqWOw==" /> <add key="TblAlarmMsg" value="tblalarmmsg" /> <add key="TblACar" value="tblacar" /> <add key="TblRttfMsg" value="tblrttfmsg" /> <add key="TblSmppMsg" value="tblsmppmsg" /> <add key="TblSystem" value="tblsystem" /> <add key="TblGsmMessage" value="tblgsmmsg" />

	<add key="TblTapMessage" value="tbltapmsg" /> <add key="TblTrainId" value="tbltrainid" />

Tap Client

- Functions – Send message to the PSP **(obsolete function)**
- Program folder – D:\MTR Program Files\TapClientForm
- Log file folder – D:\MTR Program Files\TapClientForm\logs
- Configuration
  D:\MTR Program Files\TapClientForm\TapClientServiceForm.exe.config

- TapSendingPort : COM port used for sending message to PSP - TapSendingBaudrate : baud rate of the COM port - Others : system configuration. No need to change by administrator	<add key="TapClientHealthCheckPeriod" value="30"/> <add key="TapClientIP" value="127.0.0.1"/> <add key="TapClientPort" value="8992" /> <add key="TapStopClientIP" value="127.0.0.1"/> <add key="TapStopClientPort" value="8997" /> <add key="TapStartClientIP" value="127.0.0.1"/> <add key="TapStartClientPort" value="8998" /> <add key="TapSendingPort" value="3" /> <add key="TapSendingBaudrate" value="19200" />

Tap Server

- Functions – Receive message from EIDS , deliver the message to PSP and PMSP according to the system configuration
- Program folder – D:\MTR Program Files\TapServerForm
- Log file folder – D:\MTR Program Files\TapServerServiceForm\logs
- Configuration
  D:\MTR Program Files\TapServerForm\TapServerServiceForm.exe.config

- TapServerSendingPort : COM port used for receiving message from EIDS - TapSendingBaudrate : baud rate of the COM port - Others : system configuration. No need to change	<add key="TapServerIP" value="127.0.0.1"/> <add key="TapServerPort" value="8995" /> <add key="TapServerSendingPort" value="1" /> <add key="TapServerSendingBaudrate" value="19200" />

Smpp Submit Service

- Functions – Send message to the PMSP
- Program folder – D:\MTR Program Files\Smpp Service
- Log file folder – D:\MTR Program Files\Smpp Service\logs
- Configuration
  D:\MTR Program Files\Smpp Service\CMS_SmppSubmitService.exe.config

- 'src_msn' : mobile station number of the SMPP service. - 'SMPPServerIP' : IP address of the SMSC connected to. - SMPPServerPort : port number of the SMSC to which SMPP connect to - SMPPServerSystemID : SMPP system ID, provided by PMSP - SMPPSystemType : System Type, provided by PMSP - SMPPWindowSize : control the windows-size when sending SMS. (Don't change) - SMPPSubmitDelay : Time delay before sending next SMS. - SubmitServierSmsExpiryTimer : Time in minutes after which, the SMS will assume expiry when the SMSC is unable to delivery the SMS. The value is expressed in ([expiry] – 480), where [expiry] is the expiry time - SubmitServerIsCharacterConversion : Perform character conversion. (Don't change) - SubmitServerIP : IP address of the server listen to external event (Don't change) - SubmitServerPort : port of the server listen to external event (Don't change)	<add key="src_msn" value="85296657479" /> <add key="SMPPServerIP" value="202.140.96.169" /> <add key="SMPPServerPort" value="10500" /> <add key="SMPPServerSysId" value="HK" /> <add key="SMPPServerPassword" value="thkcomm1" /> <add key="SMPPSystemType" value="Comm" /> <add key="SMPPWindowSize" value="256" /> <add key="SMPPSubmitDelay" value="210" /> <add key="SubmitServerSmsExpiryTimer" value="-475" /> <add key="SubmitServerIsCharacterConversion" value="1" /> <add key="SubmitServerIP" value="0.0.0.0"/> <add key="SubmitServerPort" value="8990" />

Smpp Delivery Service

- Functions – Receive SMS delivery status from SMSC of the PMSP
- Program folder – D:\MTR Program Files\CMS_SmppDeliveryService
- Log file folder – D:\MTR Program Files\ CMS_SmppDeliveryService \logs
- Configuration
  D:\MTR Program Files\CMS_SmppDeliveryService\ CMS_SmppDeliveryService.exe.config

- 'src_msn' : mobile station number of the SMPP service. - 'SMPPServerIP' : IP address of the SMSC connected to. - SMPPServerPort : port number of the SMSC to which SMPP connect to - SMPPServerSystemID : SMPP system ID, provided by PMSP - SMPPSystemType : System Type, provided by PMSP - SMPPWindowSize : control the windows-size when sending SMS. (Don' t change) - SMPPSubmitDelay : Time delay before sending next SMS. - SubmitServierSmsExpiryTimer : Time in minutes after which, the SMS will assume expiry when the SMSC is unable to delivery the SMS. The value is expressed in ([expiry] – 480), where [expiry] is the expiry time - SubmitServerIsCharacterConversion : Perform character conversion. (Don' t change) - DeliverServerIP : IP address of the server listen to external event (Don' t change) - DeliverServerPort : port of the server listen to external event (Don' t' change)	<add key="src_msn" value="85296657479" /> <add key="SMPPServerIP" value="202.140.96.158" /> <add key="SMPPServerPort" value="9500" /> <add key="SMPPServerSysId" value="HK" /> <add key="SMPPServerPassword" value="hkcomm" /> <add key="SMPPSystemType" value="Comm" /> <add key="SubmitServerIsCharacterConversion" value="1" /> <add key="DeliverServerIP" value="127.0.0.1"/> <add key="DeliverServerPort" value="8991" />

Alarm Monitor

- Functions – Monitoring the status of system
- Program folder – D:\MTR Program Files\Alarm Monitor
- Log file folder – D:\MTR Program Files\ Alarm Monitor\logs
- Configuration
  D:\MTR Program Files\Alarm Monitor\AlarmMonitor.exe.config

- TapStopClientIP : IP address of the TapClient which listen to stop event - TapStopClientPort : port of the TapClient where listen to stop event - TapStartClientIP : IP address of the TapClient which listen to start event - TapStartClientPort : port of the TapClient listen to start event - MonitorIP : Alarm monitor IP address used for listening event - MonitorPort : Alarm monitor 's port used for listening event	<add key="TapStopClientIP" value="127.0.0.1"/> <add key="TapStopClientPort" value="8997" /> <add key="TapStartClientIP" value="127.0.0.1"/> <add key="TapStartClientPort" value="8998" /> <add key="MonitorIP" value="127.0.0.1"/> <add key="MonitorPort" value="8996" />

HouseKeeping Service

- Functions – database synchronization, backup, purging, message log generation.
- Program folder – D:\MTR Program Files\HouseKeeping Service
- Log file folder – D:\MTR Program Files\HouseKeeping Service\logs
- Configuration
  D:\MTR Program Files\HouseKeeping Service\CMS_HouseKeepingService.exe.config

- DBAddress : Database server address - DBUser : Database server login user - DBName : Database name - MessageLogDirectory : folder where daily SMPP text log will be stored - BackupDirectory : folder where daily backup will be saved. - PurgeStartTime : Start of the purging - PurgeEndTime : End of purging - SyncTimeIntervalMS : time interval in milliseconds where database synchrozation run - BackupTimeIntervalMS: time interval in milliseconds where backup will be run - PurgeTimeIntervalMS: time interval in milliseconds where purging will be executed	<add key="DBPassword" value="8Mg2nrl/jyBwkmIoaMqWOw==" /> <add key="DBAddress" value="localhost" /> <add key="DBUser" value="root" /> <add key="DBName" value="cmsdb" /> <add key="MessageLogDirectory" value="D:\\CMS_Log" /> <add key="BackupDirectory" value="E:\\" /> <add key="PurgeStartTime" value="2005-1-1 00:00:00" /> <add key="PurgeEndTime" value="2100-1-1 00:00:00" /> <add key="SyncTimeIntervalMS" value="60000" /> <add key="BackupTimeIntervalMS" value="3600000" /> <add key="PurgeTimeIntervalMS" value="86400000" />

- **Functions – maintain system configuration and table maintenance**
- Program folder – D:\MTR Program Files\Administration
- Log file folder – D:\MTR Program Files\Administration
- Configuration
  D:\MTR Program Files\Administration\Administration.exe.config

- AdminMsnPrefix : mobile station number's country code as prefix - AdminMsnLength : mobile station number's length - OperationLogFolder : folder where message log will be create and generated	<add key="AdminMsnPrefix" value="852" /> <add key="AdminMsnLength" value="11" /> <add key="OperationLogFolder" value="d:\\cms_log" />

TRDR configuration

There is only one serial port in TRDR to connect DCU
Baud: 2400
Databit: 8
Stopbit: 1
Parity: No
FlowControl: No

3 Operation

3.1 General

This section contains information and instructions required for proper operation of CMS Server and TRDR.

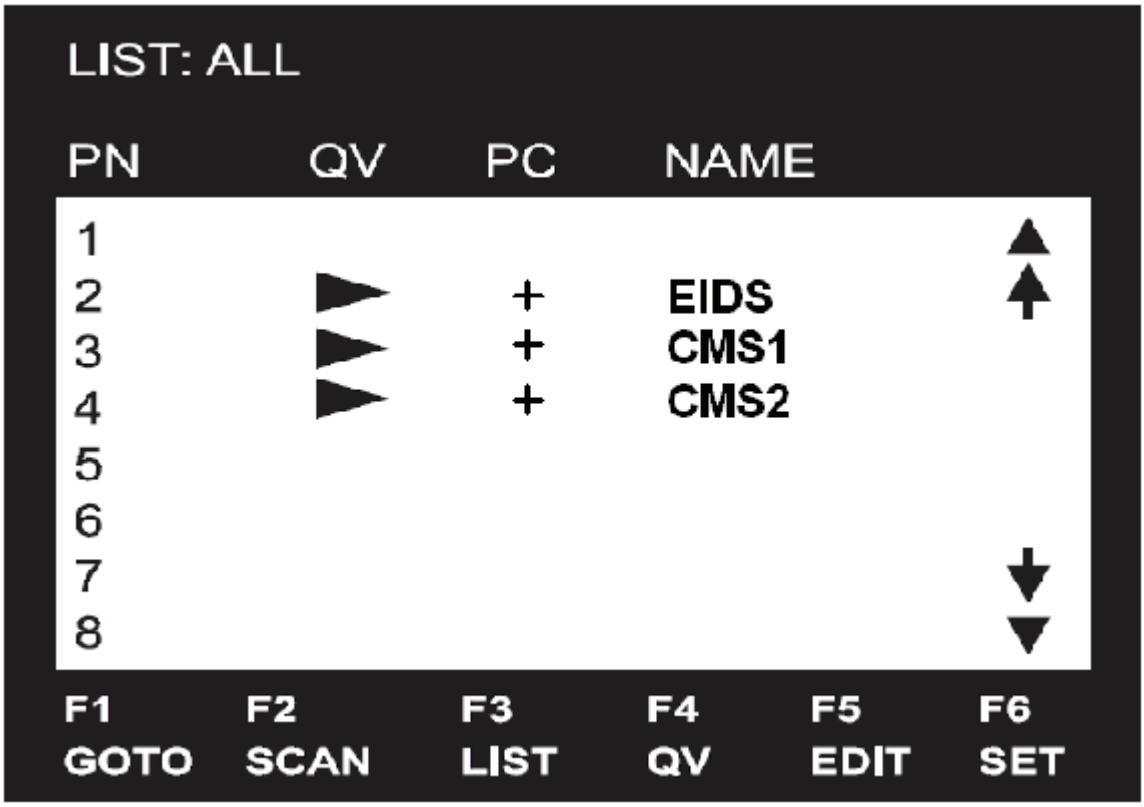
There are 3 window services or background processes running in CMS
- CMS_SmppSubmitService.exe
- CMS_SmppDeliveryService.exe
- CMS_HouseKeepingService.exe

2 foreground processes
- TapClientServiceForm.exe
- TapServerServiceForm.exe

3 applications programs
- AlarmMonitor.exe
- Administration.exe
- VCNExpressComm.exe

3.2 KVM Switch

Press Ctrl-Ctrl to go to OSD (On Screen Display) menu.



KVM Port 2 – EIDS Terminal
KVM Port 3 – CMS 1
KVM Port 4 – CMS 2

Control Keys
ESC – discard and go back
Arrow keys – move up and down
Enter – highlight server then enter

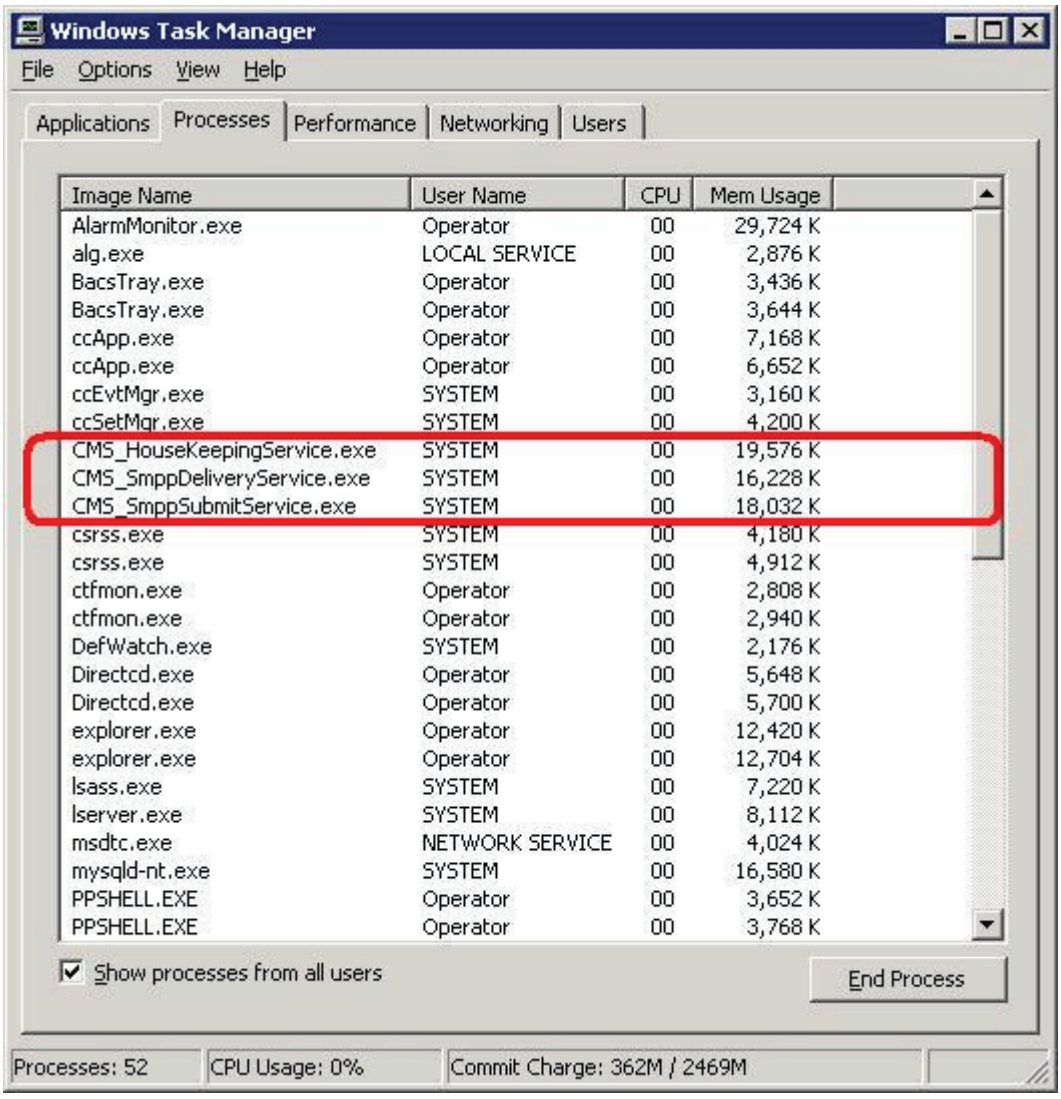
3.3 CMS operation

3.3.1 Check background processes

Procedure

- Press Ctrl + Shift + Esc keys to call Windows Task Manager
- Check the existence of the 3 background processes
  1. CMS_SmppSubmitService.exe
  2. CMS_SmppDeliveryService.exe
  3. CMS_HouseKeepingService.exe

Screenshot



The installation procedures of these three modules are similar, take house keeping service for example:

In the installation directory of House keeping Service, assumed that is "D:\MTR_Project\House Keeping Service\" in the command prompt,
Type "**InstallUtil -i CMS_HouseKeepingService.exe**", and then press enter, the house keeping service will be installed. Note that there should NOT install an instance of the same service twice, or else installation will be failed.

To uninstall the service, the same as the command prompt, and go to the installation directory. Type "**InstallUtil –u CMS_HouseKeepingService.exe**" instead. Please note that if uninstalling the service, the service status should be turned to stop.

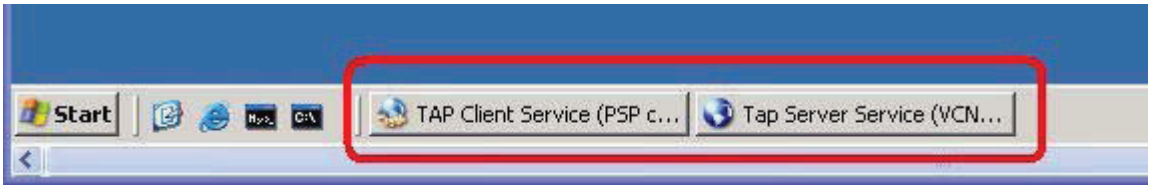
The same procedures can be applied to the modules of SMPP Submit Service and SMPP Delivery Service.

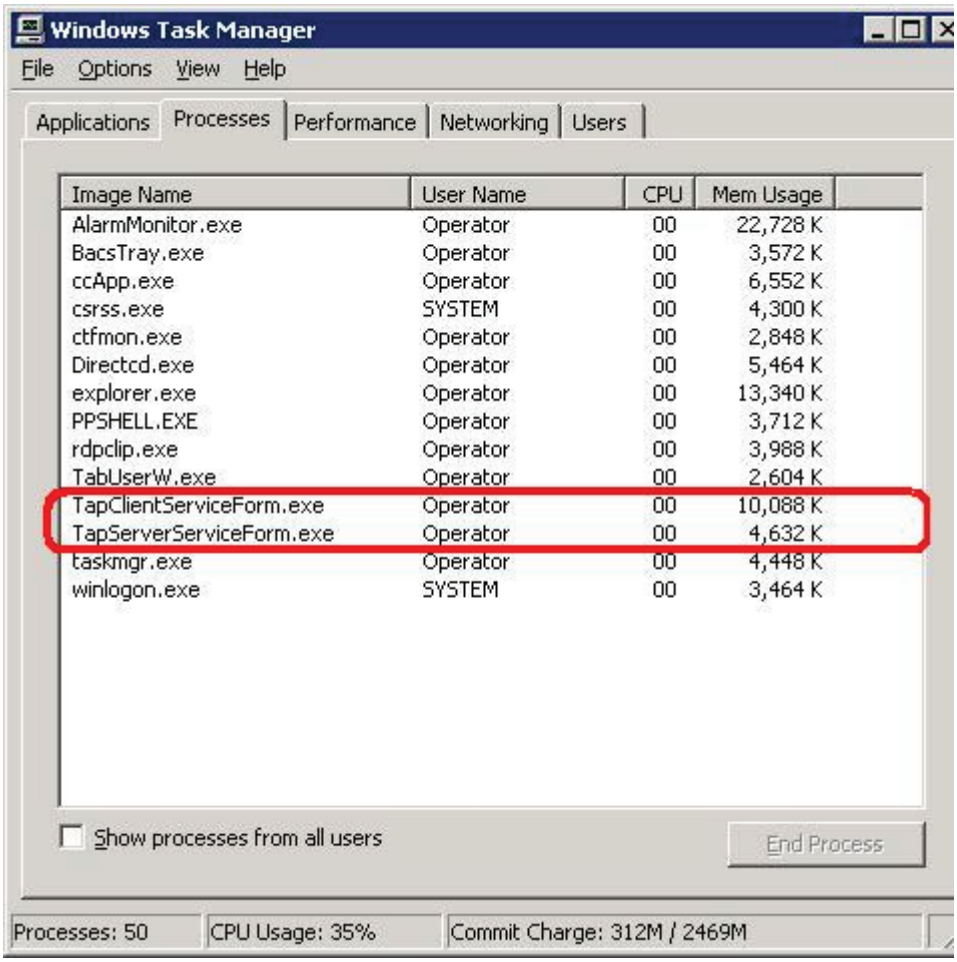
3.3.2 Check foreground processes

Procedure

- Check the Windows Task Bar or press Ctrl+Shift+Esc keys to call Windows Task Manager
- Check the existence of 2 foreground processes
  1. TapServerServiceForm.exe
  2. TapClientServiceForm.exe

- Screenshot



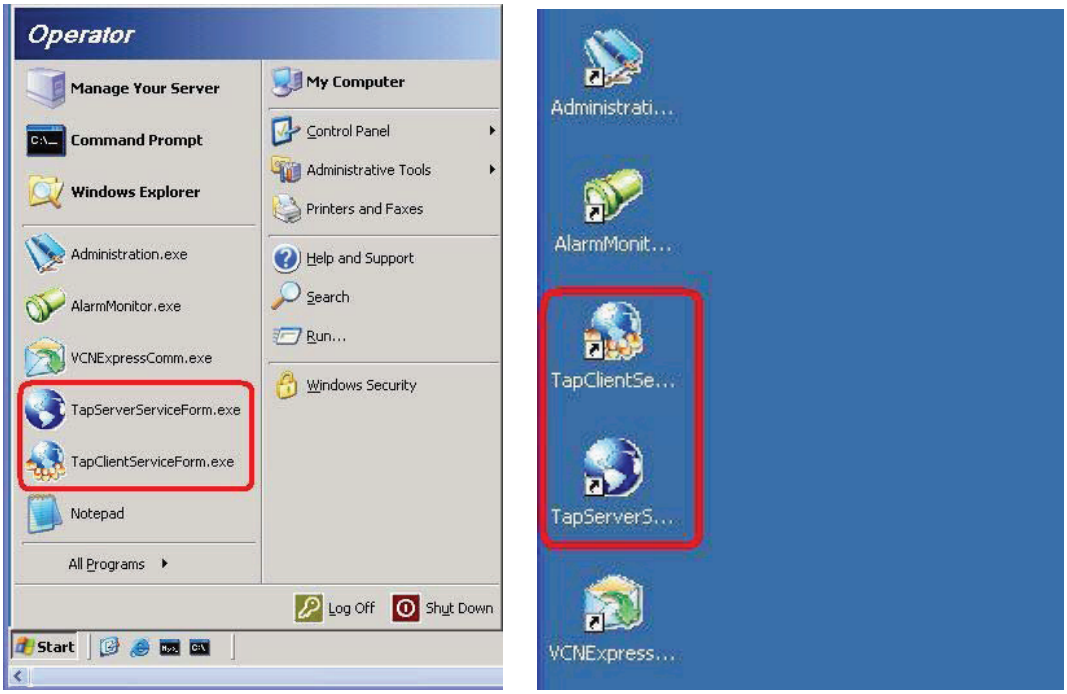


Startup these 2 processes if they are not running in the system.

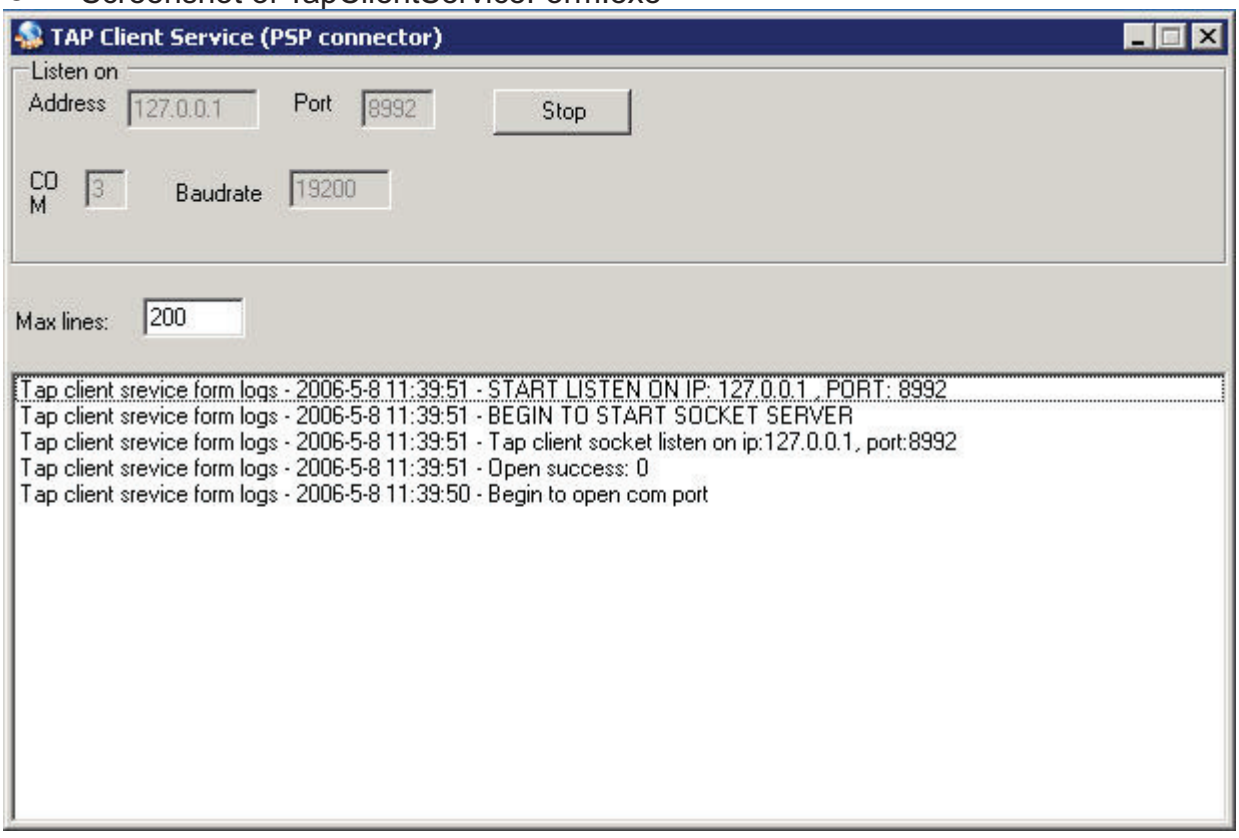
- Click [Start] -> [TapServerServiceForm.exe]
- Click [Start] -> [TapClientServiceForm.exe]

Or

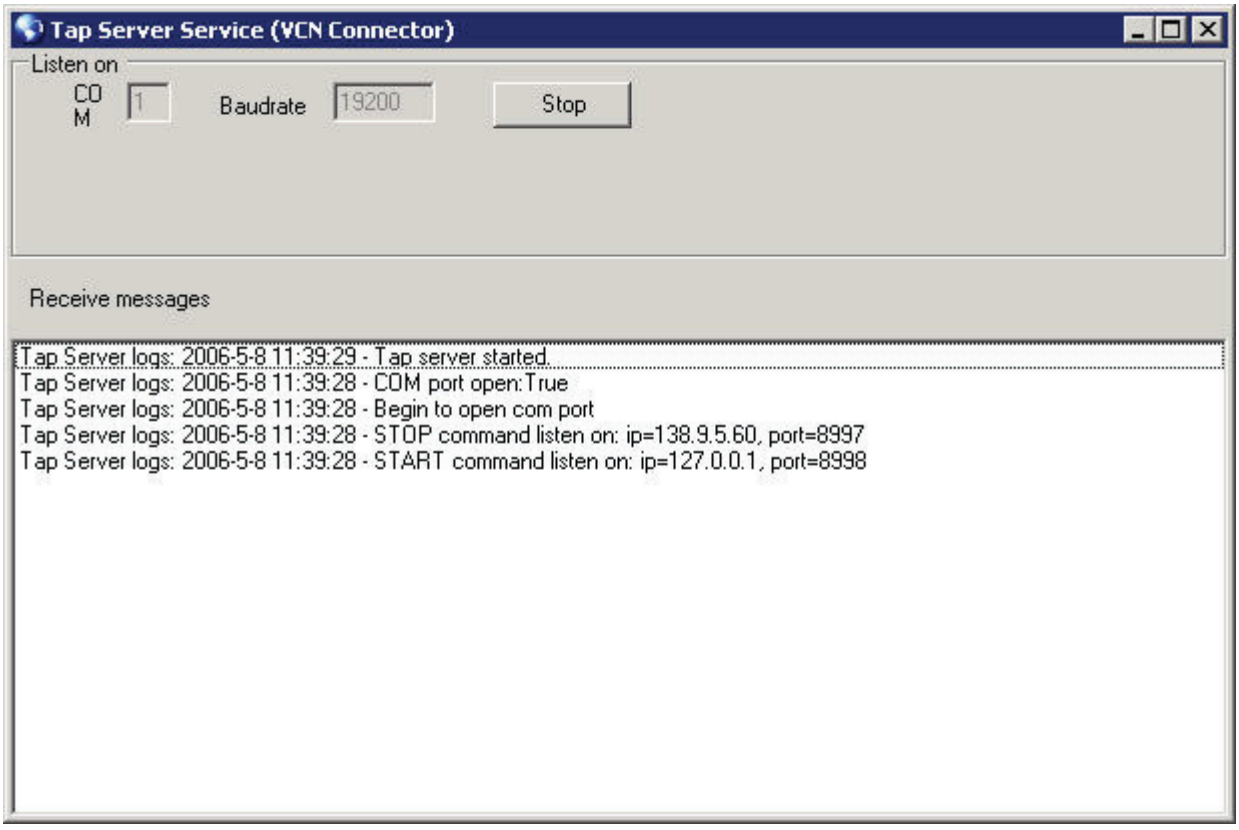
- Double click on icons of TapServerServiceForm.exe and TapClientServiceForm.exe on the Windows desktop.



- Screenshot of TapClientServiceForm.exe



- Screenshot of TapServerServiceForm.exe



3.3.3 Alarm Monitor

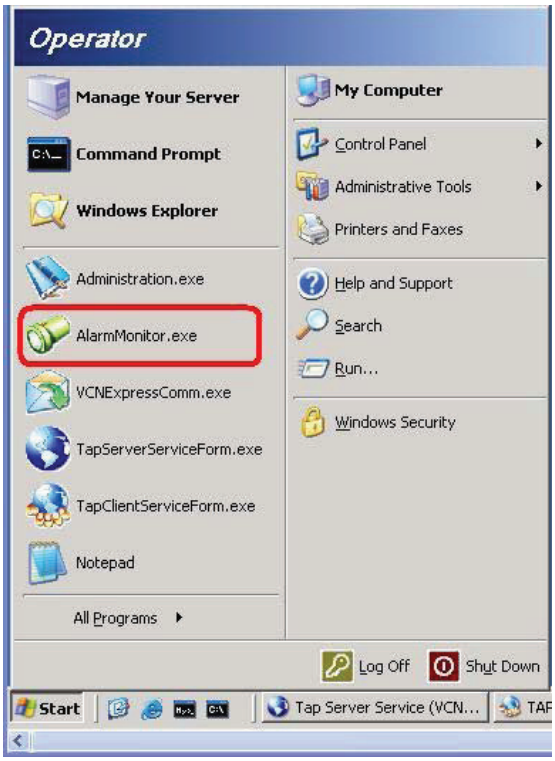
The Alarm Monitor is used for monitoring the status of SMPP connection (mobile operator's SMSC) and TAP connection (RTTF terminal); display the Alarm Message History and the SMPP message delivery status.

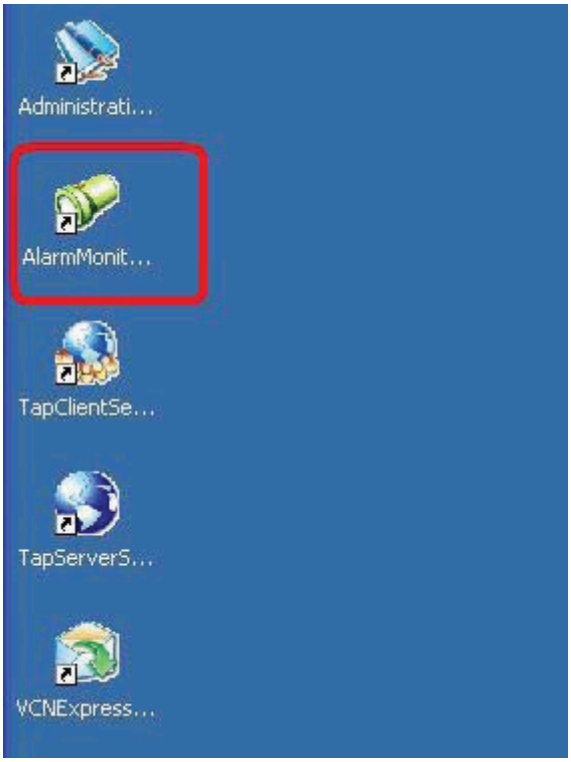
To startup this application

- Click [Start] -> [AlarmMonitor.exe]

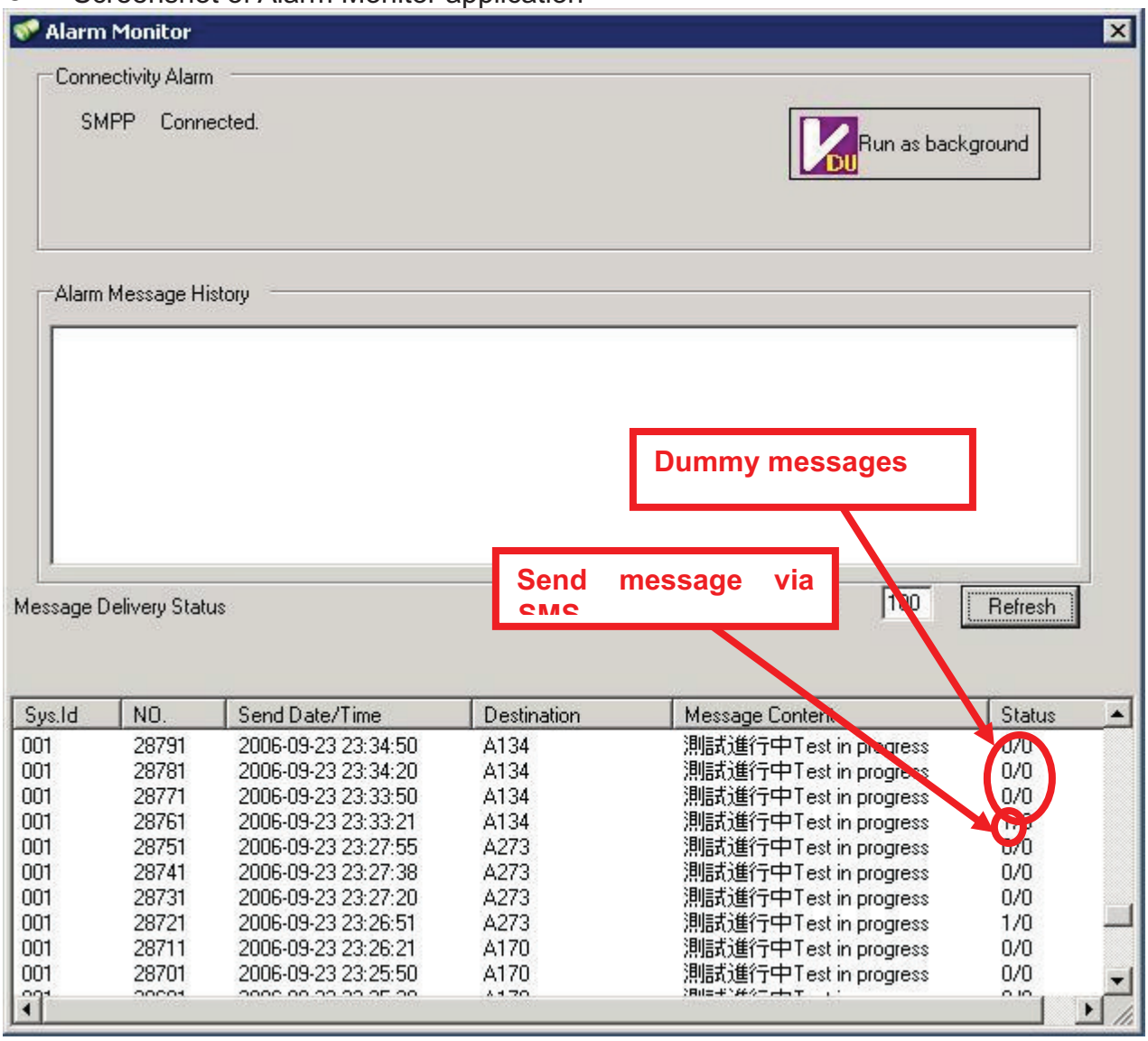
Or

- Double click on the icon of AlarmMonitor.exe on the Windows desktop.


Operator
Manage Your Server
Command Prompt
Windows Explorer
Administration.exe
AlarmMonitor.exe
VCNExpressComm.exe
TapServerServiceForm.exe
TapClientServiceForm.exe
Notepad
All Programs
My Computer
Control Panel
Administrative Tools
Printers and Faxes
Help and Support
Search
Run...
Windows Security
Log Off
Shut Down
Start
Tap Server Service (VCN...


Administrati...
AlarmMonit...
TapClientSe...
TapServerS...
VCNExpress...

- Screenshot of Alarm Monitor application



Connectivity Alarm

- To display the SMPP and TAP connections status.
- The connection status will not show if the corresponding output control is disabled by Administration.exe.

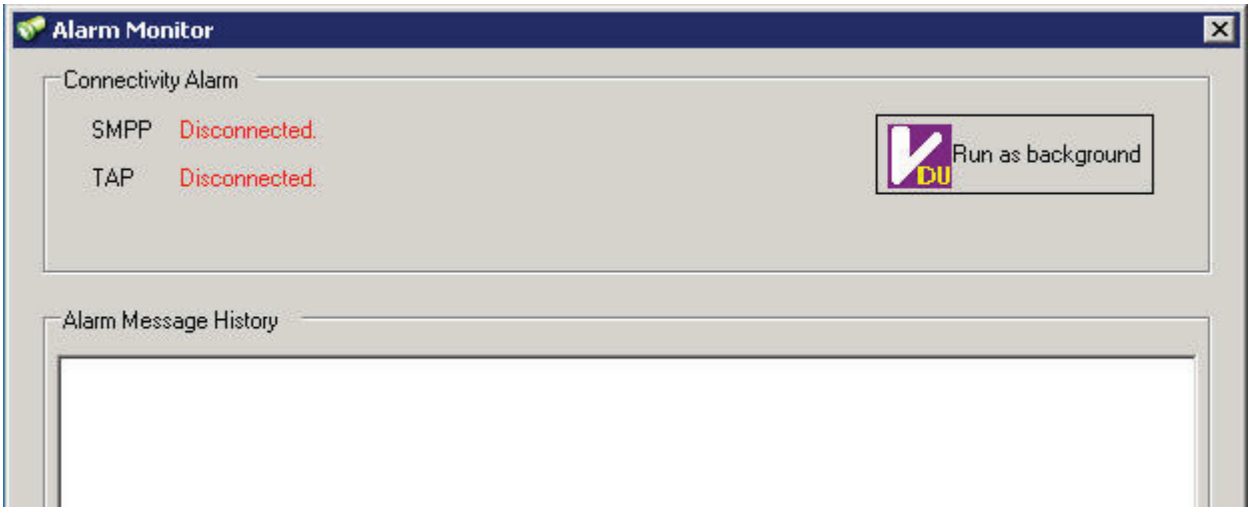
Alarm Message History

- To display run-time messages

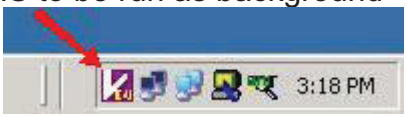
Message Delivery Status

- To display message delivery information
- Status format: <send via SMS / send via Page> (where 0=Not send, 1=Send)

- The following screenshot shows the example of the SMPP and TAP connection fails.



- Click on the button

to bring CMS to be run as background process, an icon will show in the Windows Task Bar 

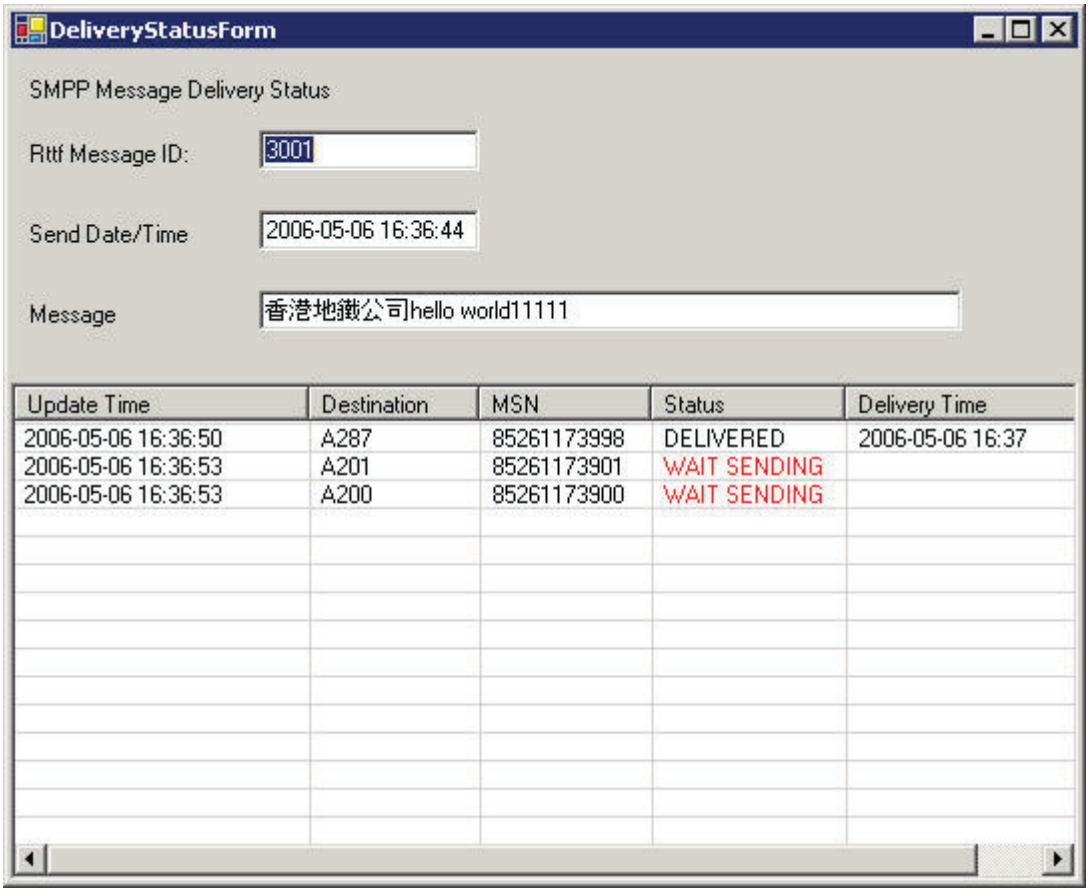
- The no. of latest record of Message Delivery Status can be changed by entering value and pressing refresh button.

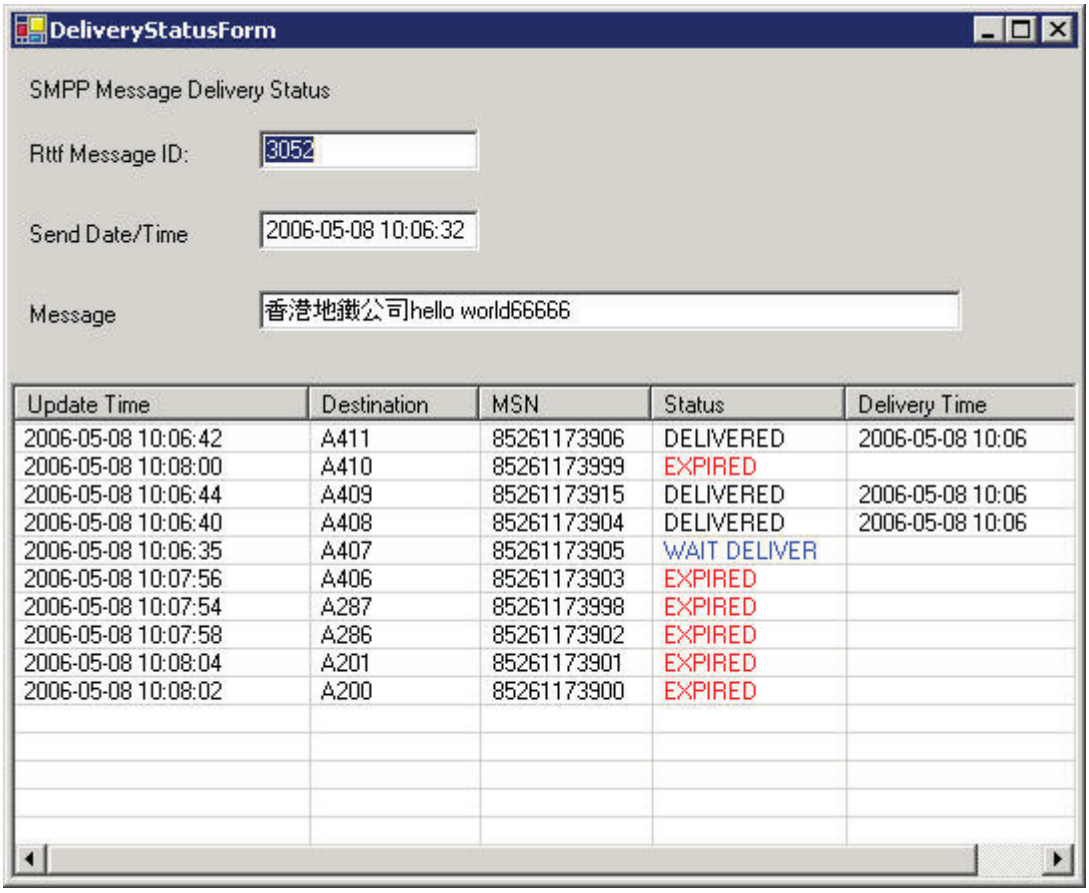
- Using a mouse to highlight and double click on any lines in the Message Delivery Status Window, the following pop-up windows will be shown.

Attention

The message delivery time provided by the Mobile operator is in Date-Hour-Minute format without second.

Since the Mobile operator update the CMS with the message delivery time in predefined periods, it is possible that the message update time may appear to be later than the delivery time.


DeliveryStatusForm
SMPP Message Delivery Status
Rttf Message ID:
3001
Send Date/Time
2006-05-06 16:36:44
Message
香港地鐵公司hello world11111
Update Time
Destination
MSN
Status
Delivery Time
2006-05-06 16:36:50
A287
85261173998
DELIVERED
2006-05-06 16:37
2006-05-06 16:36:53
A201
85261173901
WAIT SENDING
2006-05-06 16:36:53
A200
85261173900
WAIT SENDING



There are 5 delivery statuses in the system

1. WAIT SENDING - the message is ready to send and waits for the SMPP connection with SMSC.
2. WAIT DELIVER - the message is already sent to SMSC and waits for the status reply from SMSC.
3. DELIVERED - delivers the message to the SMS receiver (TRDR) successfully.
4. EXPIRED - the message cannot be delivered within 5 minutes.
5. SEND ERROR - the message is rejected by SMSC.

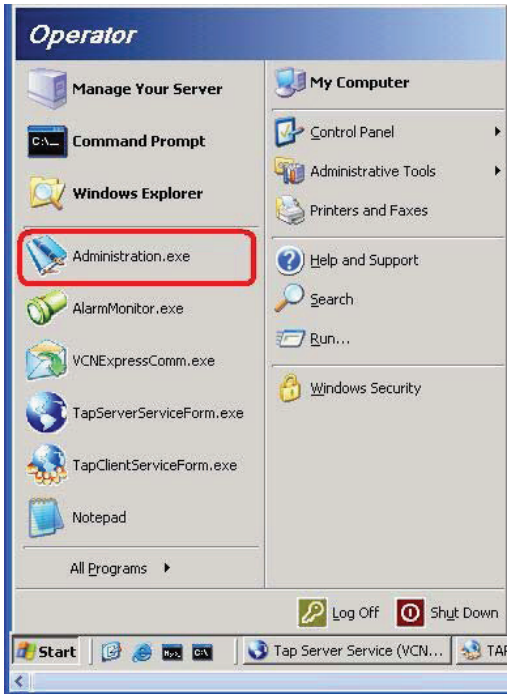
3.3.4 Administration

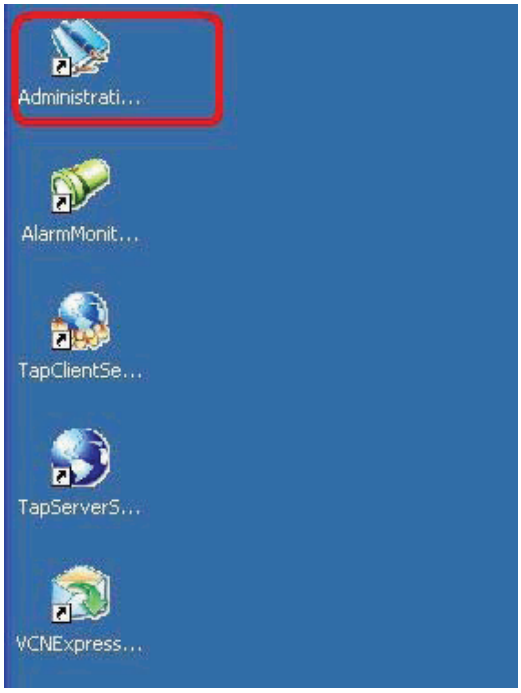
The procedure for operating the Administration.exe is shown below

- To start up the Administration.exe, click [start] -> [Administration.exe]

Or

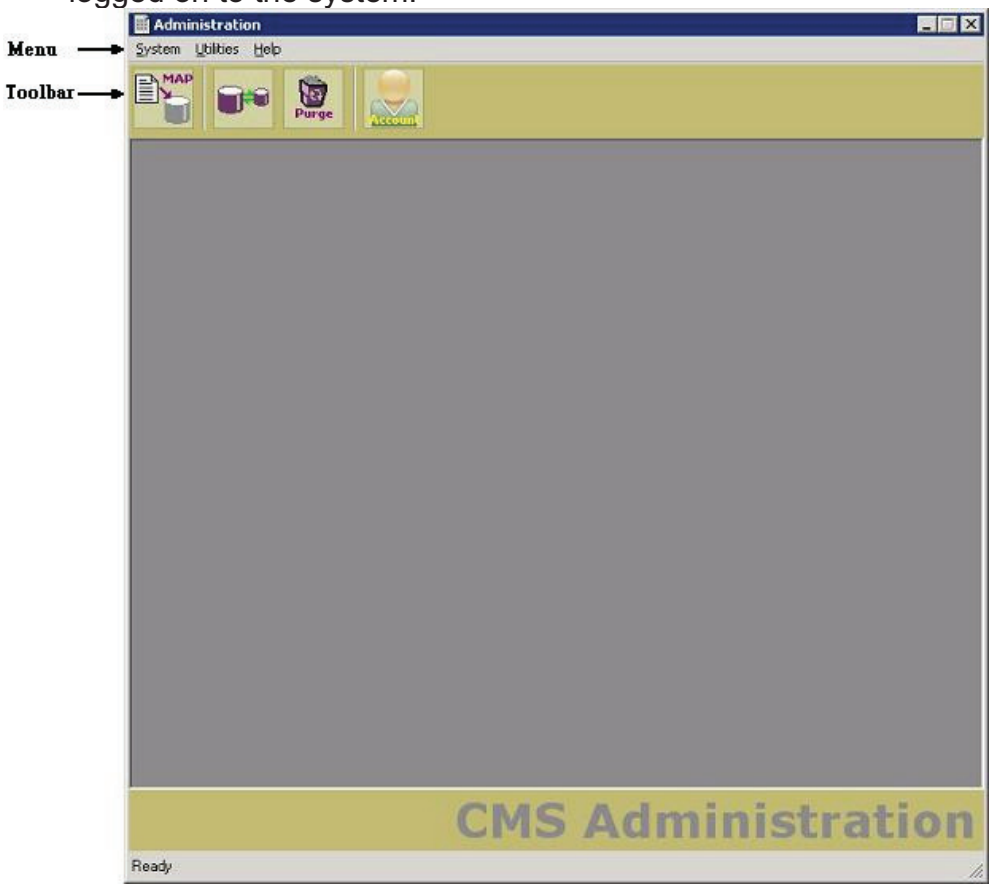
- Double the icon of Administration.exe on the Windows desktop.


Operator
Manage Your Server
Command Prompt
Windows Explorer
Administration.exe
AlarmMonitor.exe
VCNExpressComm.exe
TapServerServiceForm.exe
TapClientServiceForm.exe
Notepad
All Programs
My Computer
Control Panel
Administrative Tools
Printers and Faxes
Help and Support
Search
Run...
Windows Security
Log Off
Shut Down
Start
Tap Server Service (VCN...

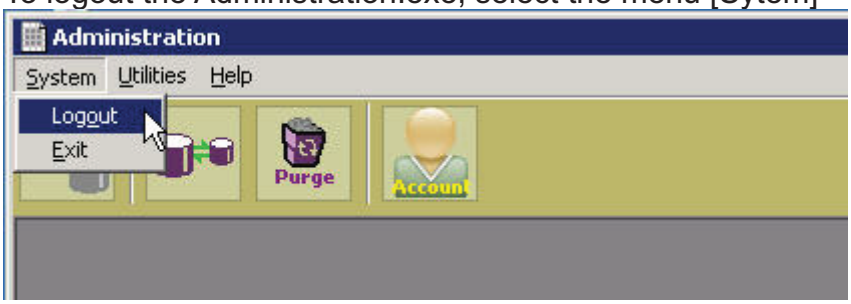

Administrati...
AlarmMonit...
TapClientSe...
TapServerS...
VCNExpress...

- Log-in prompt is shown anytime when the Administration.exe start-up.

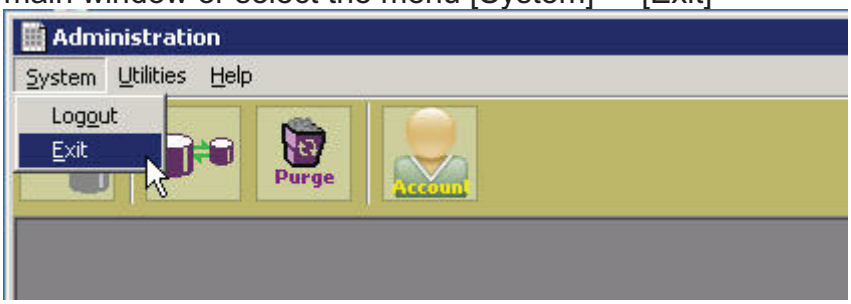
- The main window of Administration.exe is shown when the user has successfully logged on to the system.



- To logout the Administration.exe, select the menu [Sytem] -> [Logout]

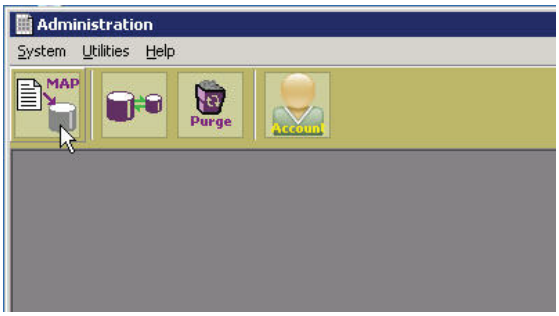


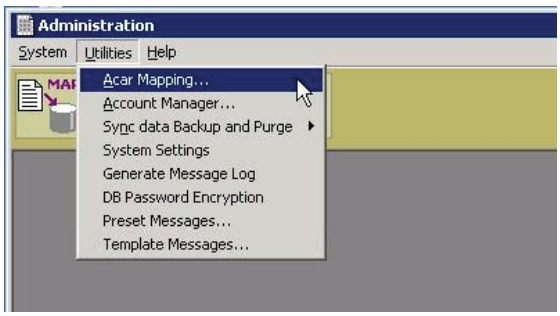
- To exit the Administration.exe, click the button at the upper right corner in the main window or select the menu [System] -> [Exit]



The exit prompt box is shown, select Yes to exit program or select No to abort.

- To start the Acar Mapping, click the first button in toolbar or select the menu [Utilities] -> [Acar Mapping…]





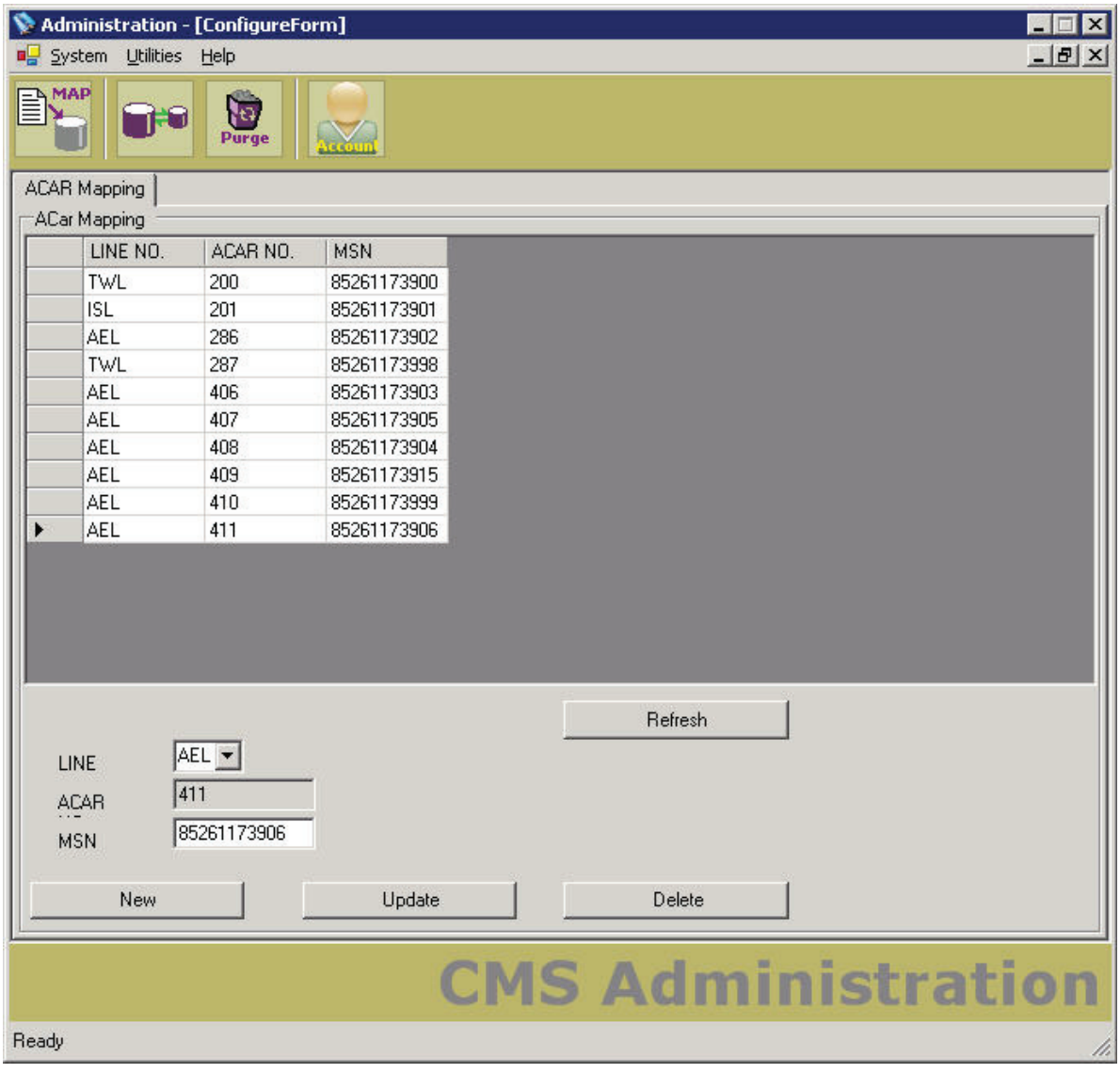
- This function is used for user to maintain in the mapping table of the Mobile Station No. (MSN) and the train no. (ACar No.) with line no. (Kwun Tong Line, Tsuen Wan Line, Island Line, Tseung Kwan O Line, Tung Chung Line and Airport Express)

Procedure

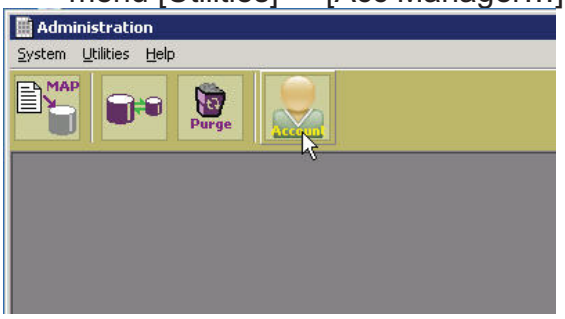
- Add new entry
  1. Click the New button
  2. Select train line no.
  3. Input A-Car no.
  4. Input MSN
  5. Click Update button

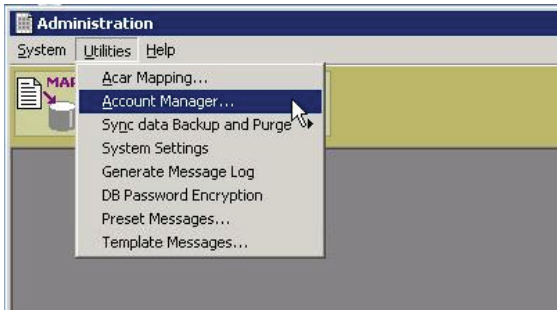
- Update entry
  1. Highlight and double click on the entry that you want to update
  2. Amend the details
  3. Click Update button

- Delete entry
  1. Highlight and double click on the entry that you want to delete
  2. Click Delete button



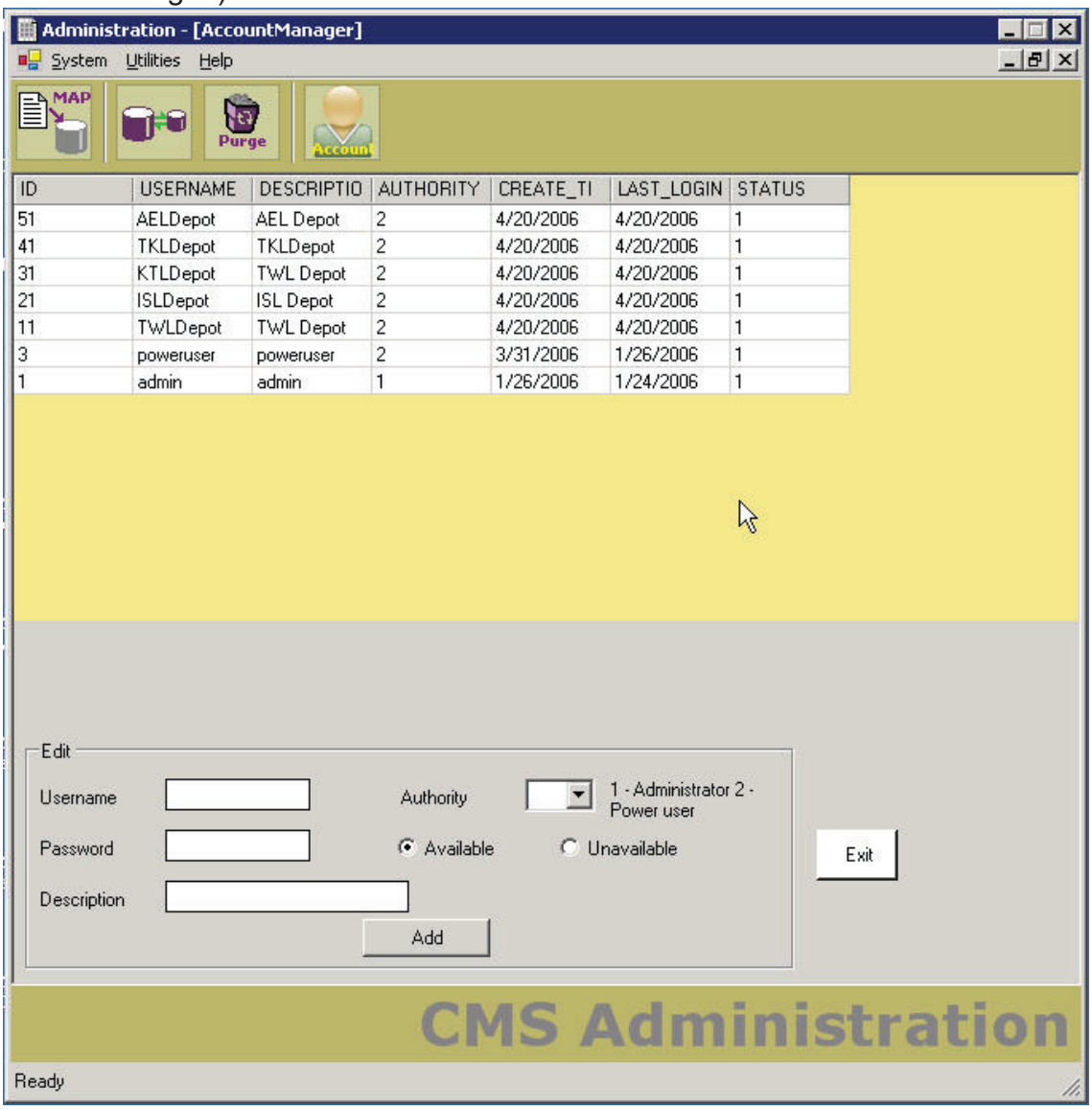
- To start user account manager, click the fourth button in toolbar or select the menu [Utilities] -> [Acc Manager…]



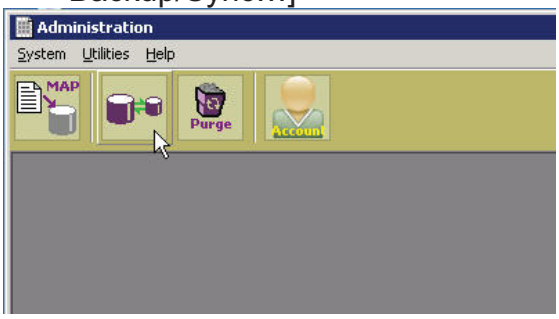


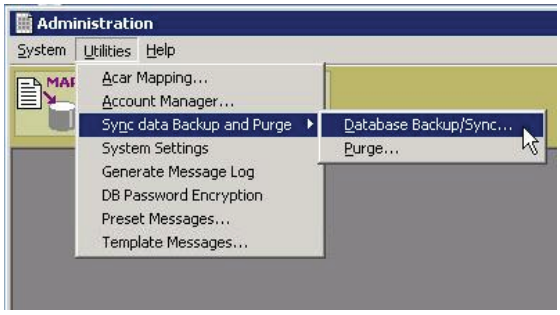
- The following window is shown for administrator to add new account or edit user account such as change password, description, authority and account status (available/unavailable)

  Authority = Administrator (access all functions)
  = Power User (Acar Mapping, Generate Message log and Preset Messages)



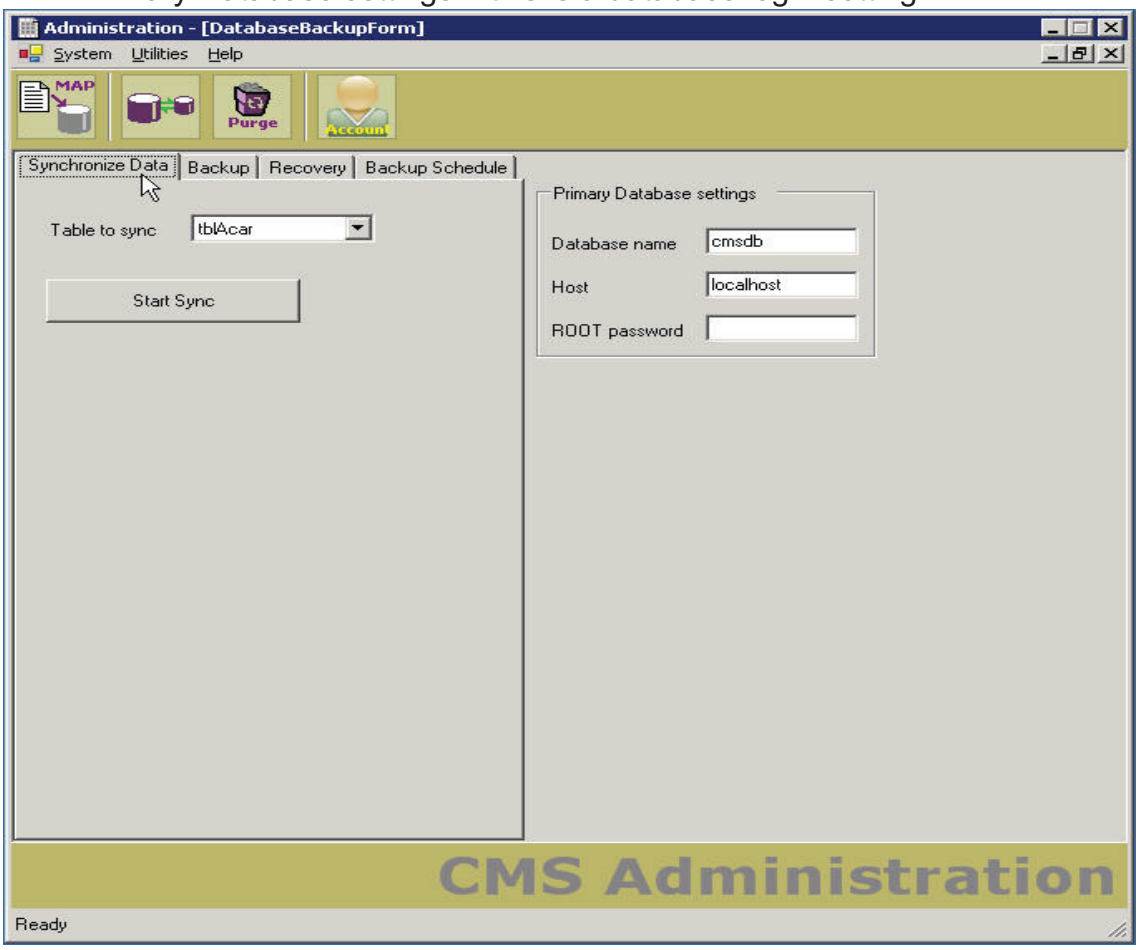
- To start database synchronize or backup, click the second button in the toolbar or select the menu [Utilities] -> [Sync data Backup and Purge] -> [Database Backup/Sync…]



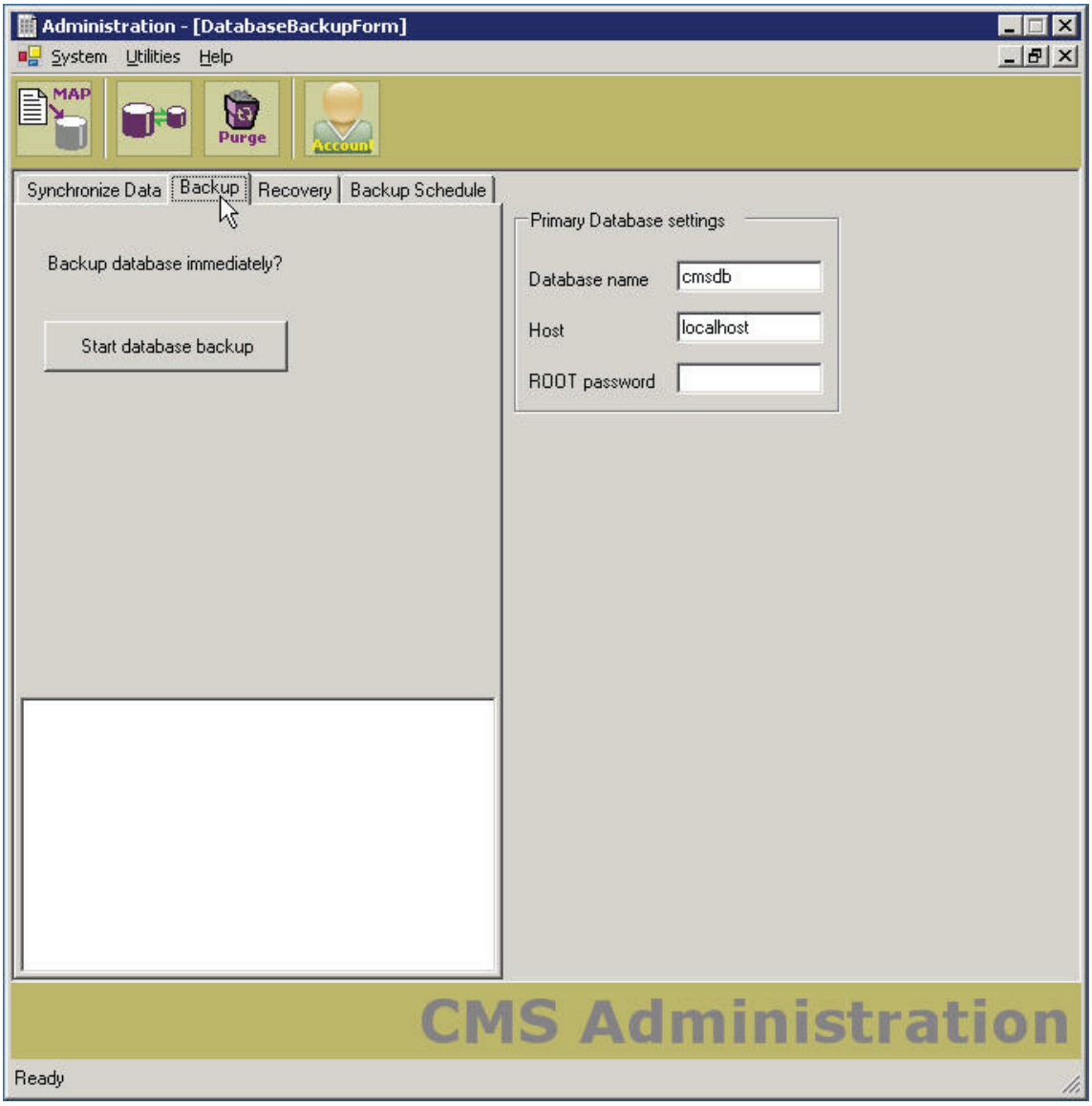


- Database synchronize data, two tables can be selected and synchronized immediately.
  1. tblAcar
  2. tbltrainid
  3. tblAdmin
  4. tblcanmsg

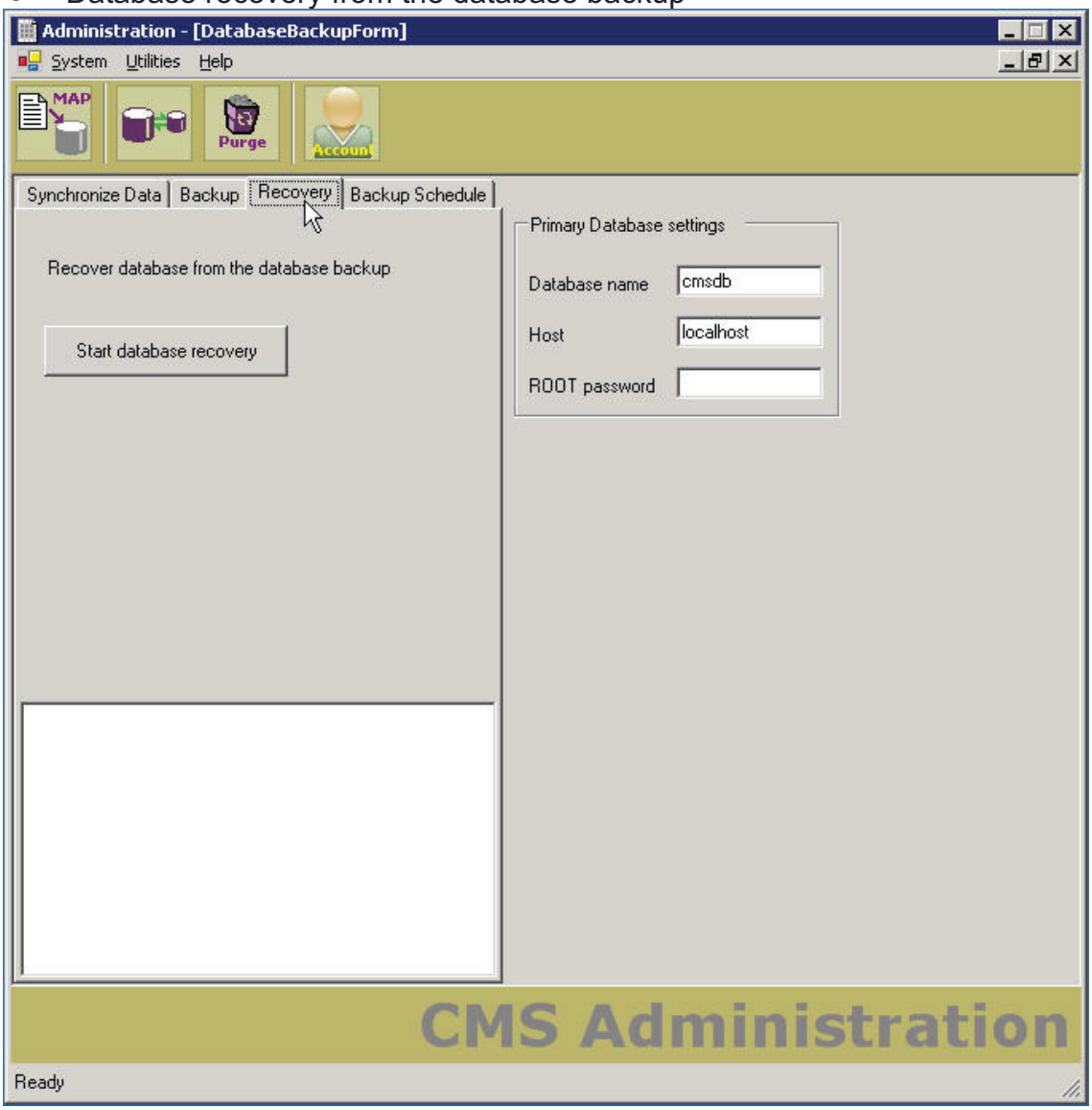
  Primary Database settings – this is a database login setting.



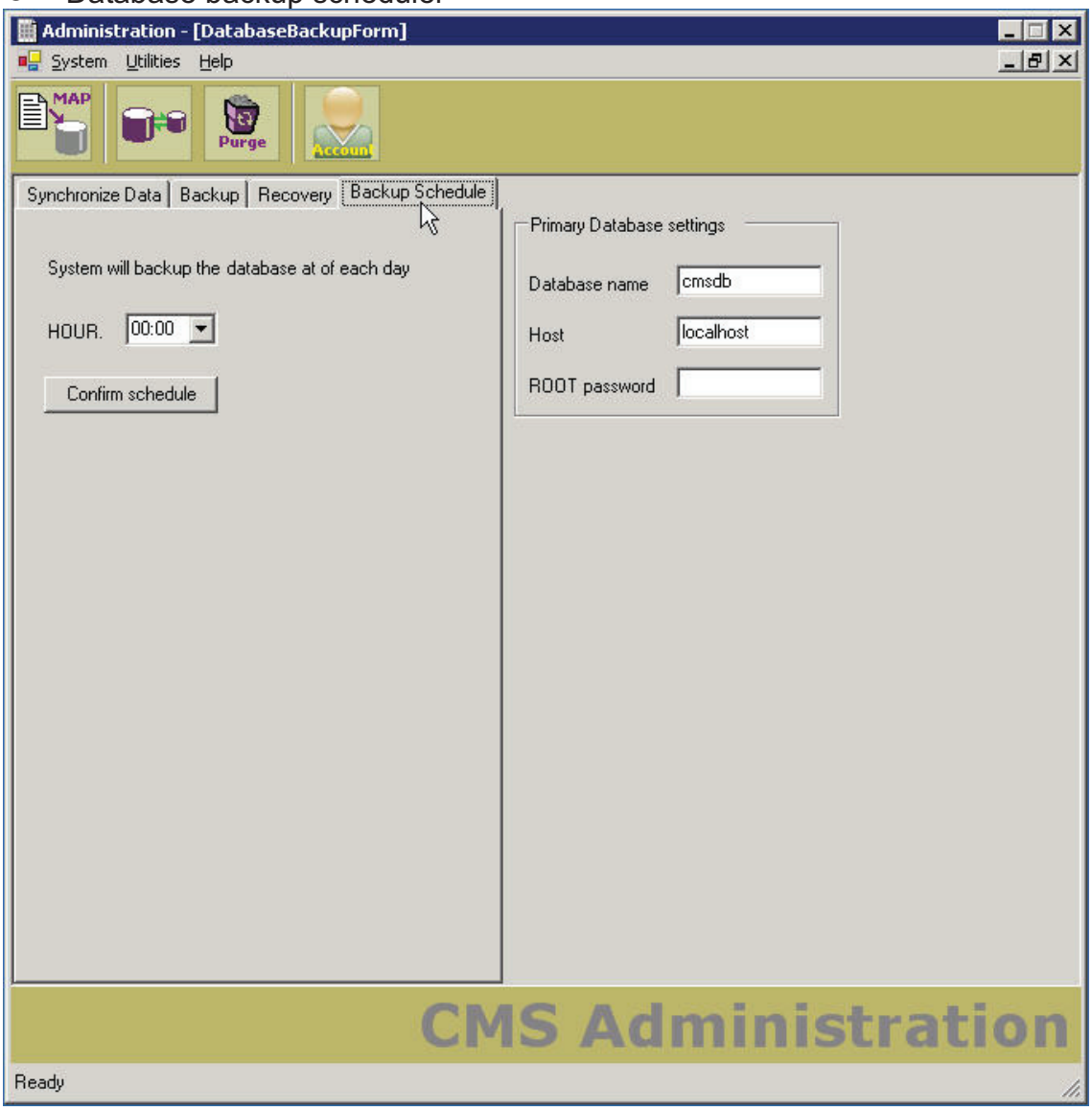
- Backup database immediately


Administration - [DatabaseBackupForm]
System
Utilities
Help
MAP
Purge
Account
Synchronize Data
Backup
Recovery
Backup Schedule
Backup database immediately?
Start database backup
Primary Database settings
Database name
cmsdb
Host
localhost
ROOT password
CMS Administration
Ready

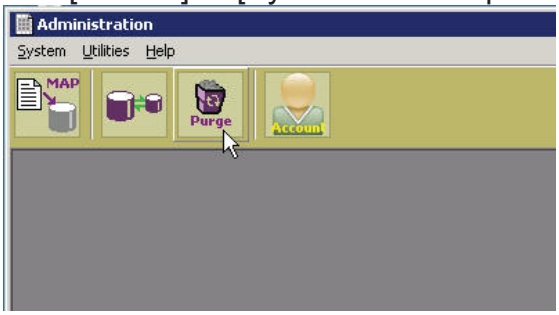
- Database recovery from the database backup

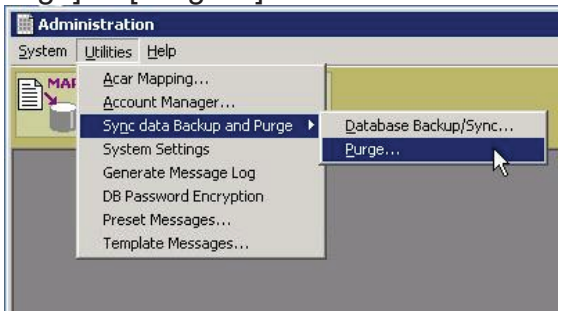


- Database backup scheduler

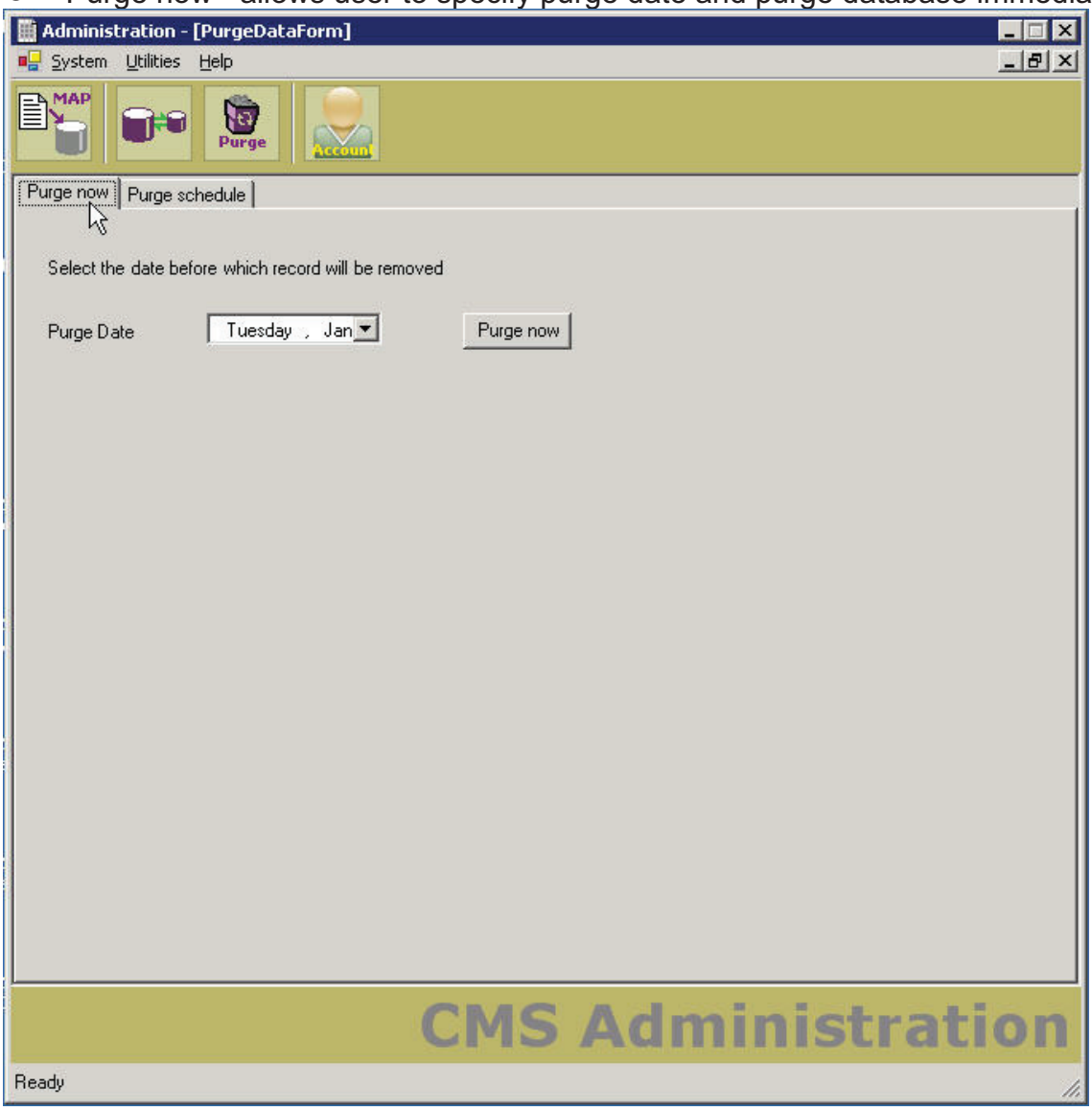


- To start database purge, click the third button in the toolbar or select the menu [Utilities] -> [Sync data Backup and Purge] -> [Purge…]

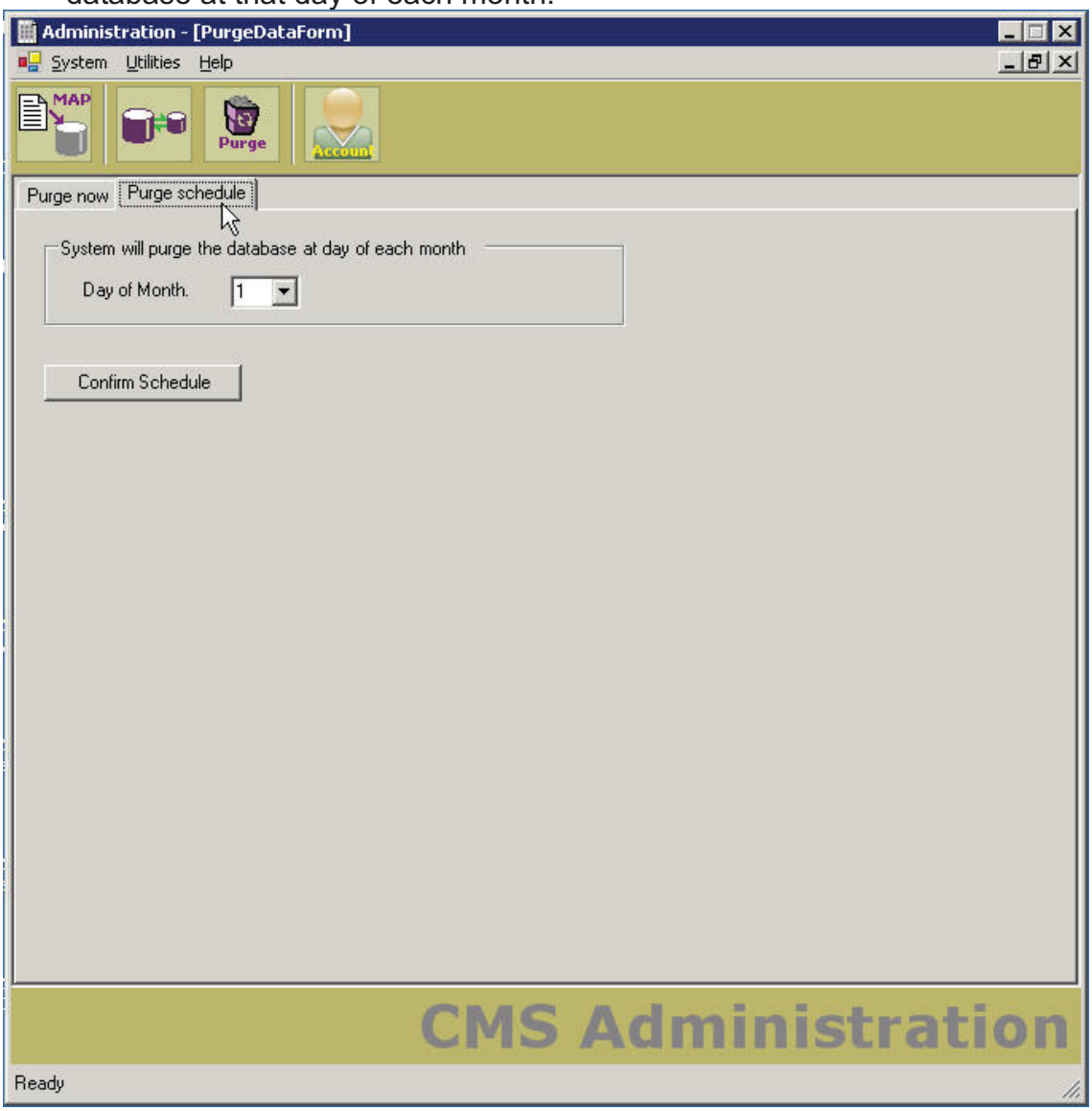




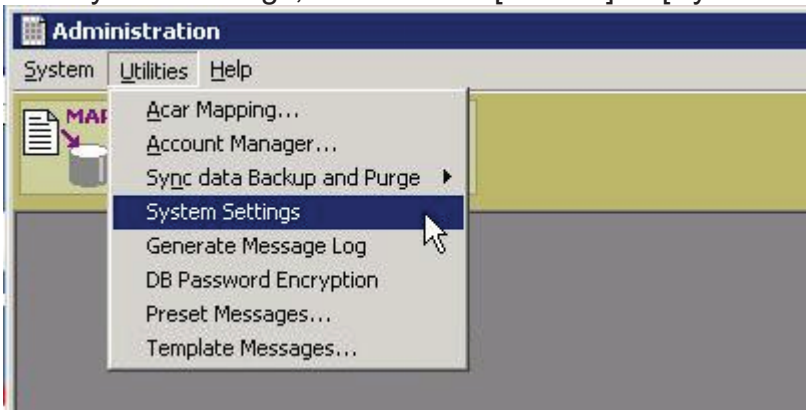
- Purge now - allows user to specify purge date and purge database immediately.



- Purge schedule – allow user to specify the day of month, system will purge the database at that day of each month.

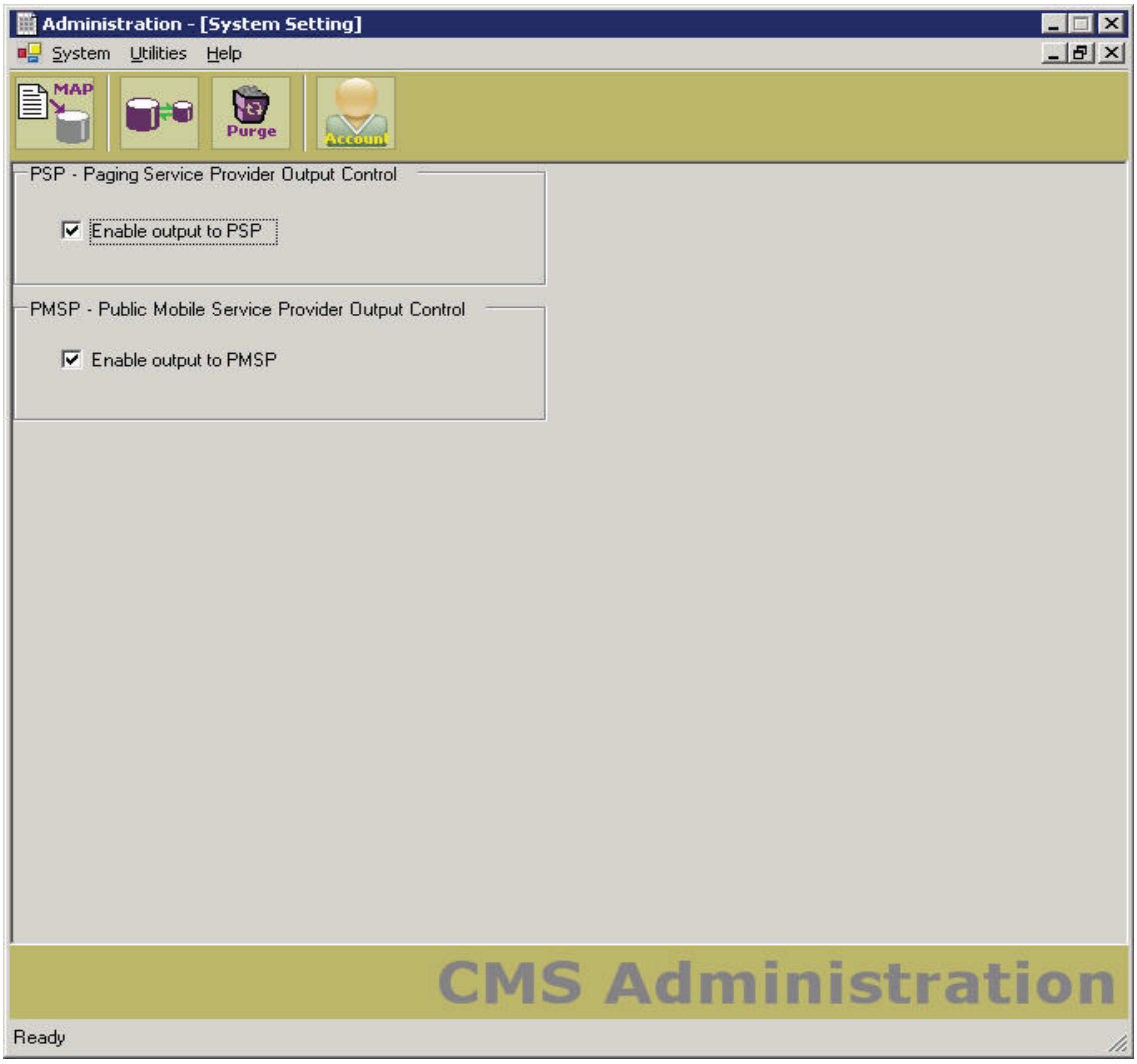


- System settings, select menu [Utilities] -> [System Settings]

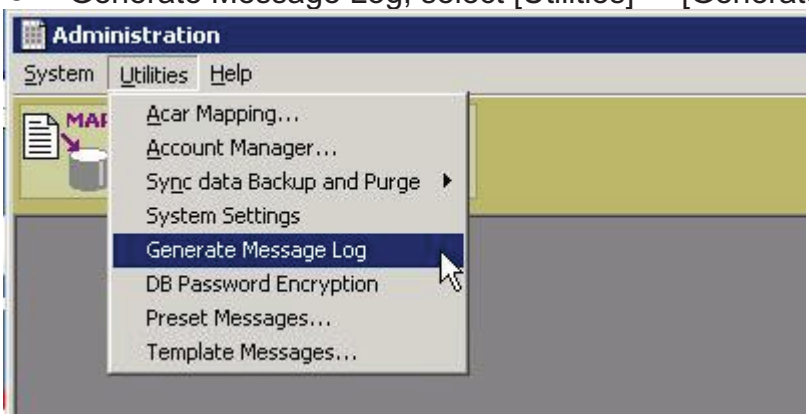


- Allows user to enable or disable Paging Service Provider Output Control (PSP) and Public Mobile Provider Output Control (PMSP).

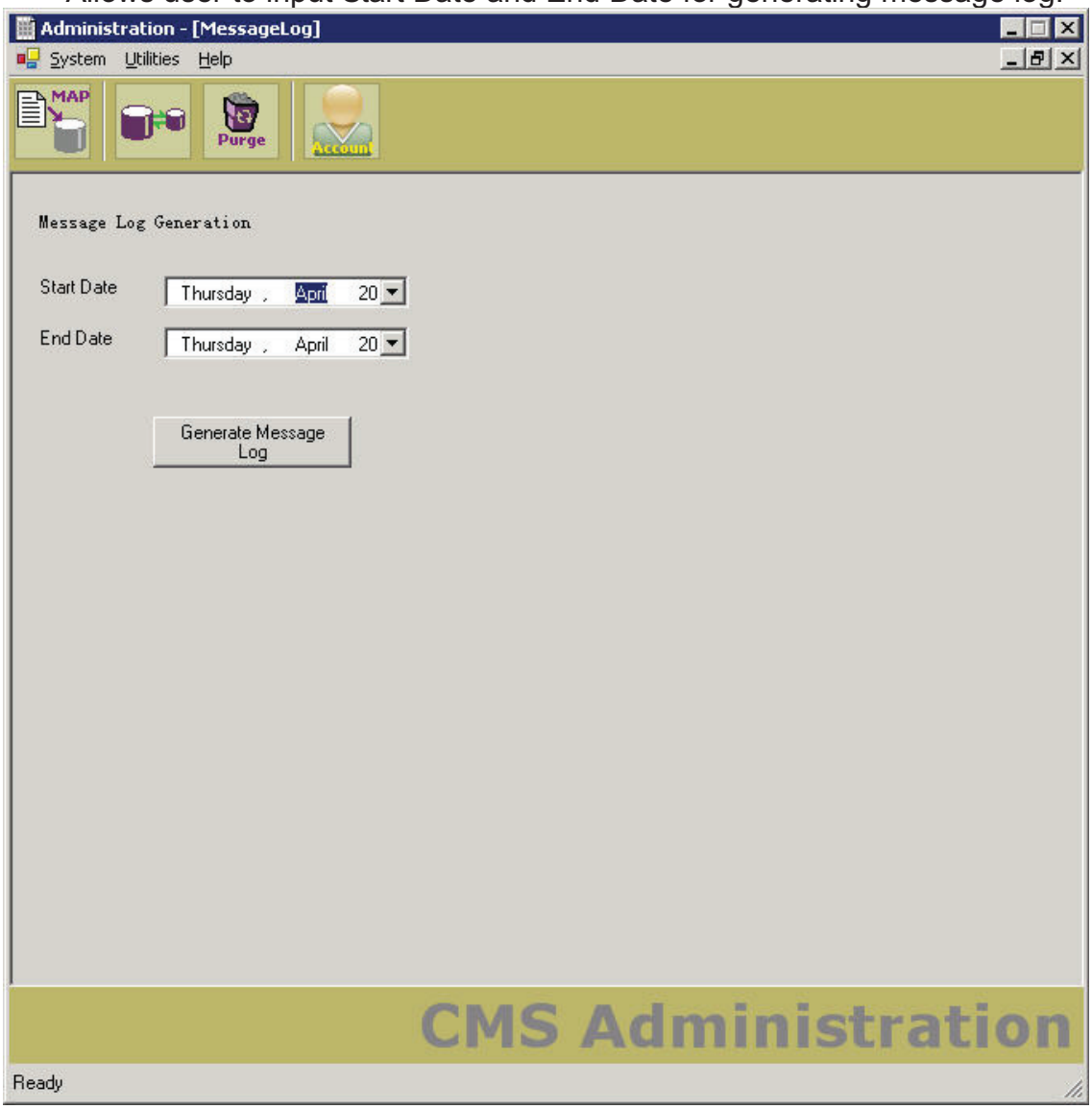
Enable output	Enable output to PMSP	Function description
On	Off	Initial setup, all trains are using RDR(pager) as EIDS message receiver.
On	On	During migration, some trains are using RDR and others are using TRDR as EIDS message receiver.
Off	On	Final setup, all trains are using TRDR as EIDS message receiver.



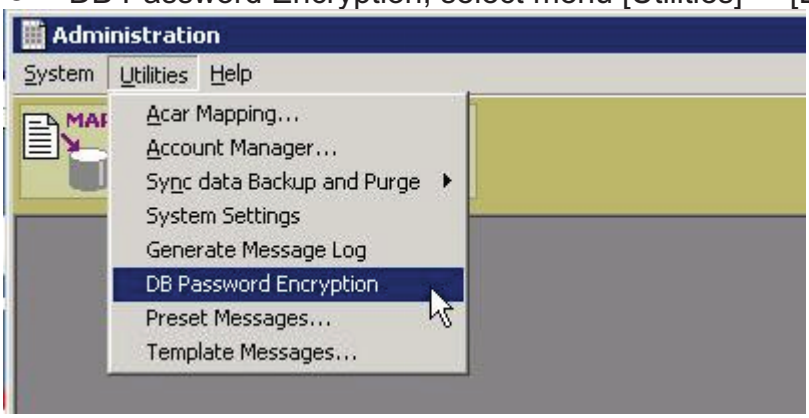
- Generate Message Log, select [Utilities] -> [Generate Message Log]



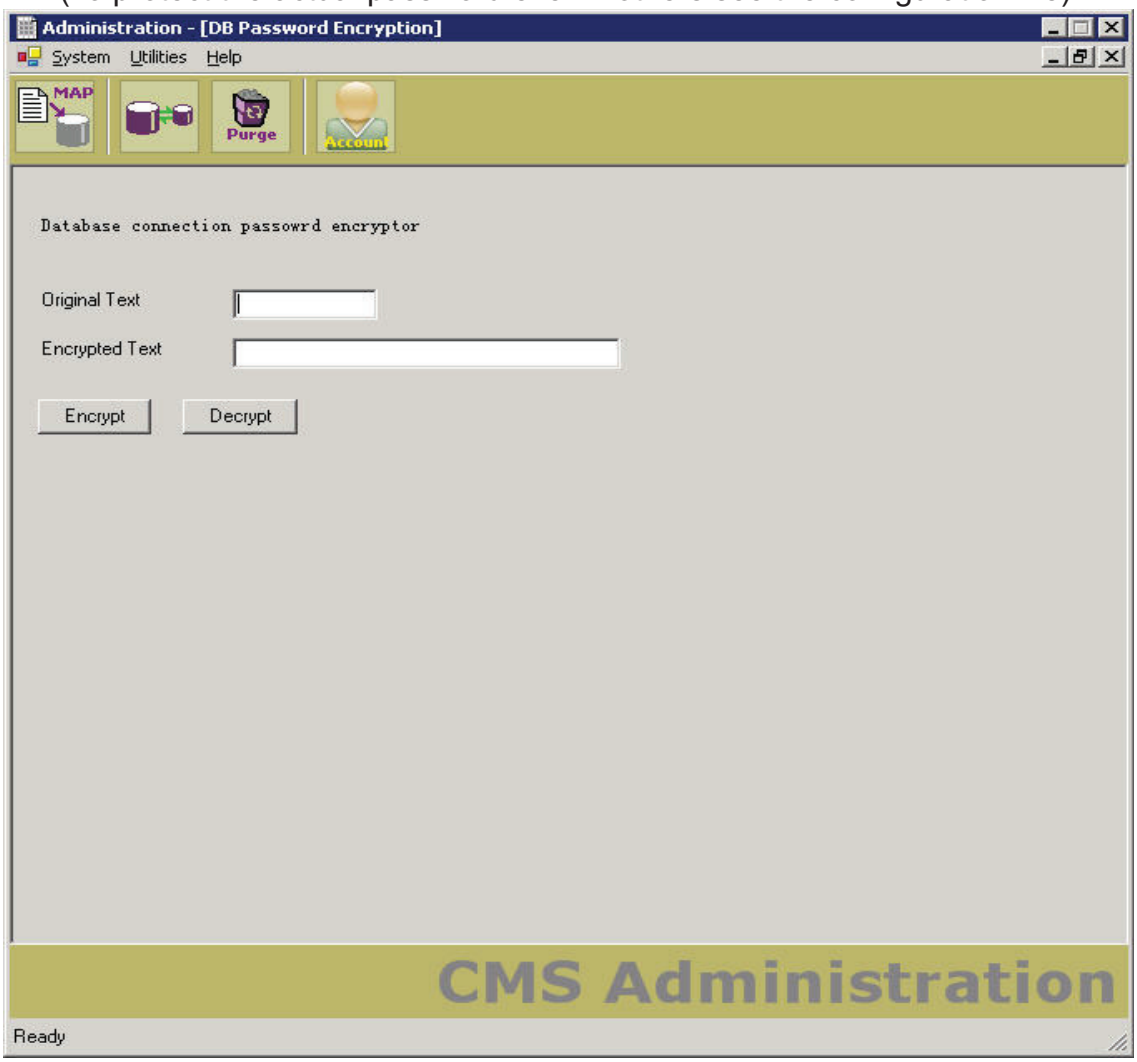
- Allows user to input Start Date and End Date for generating message log.



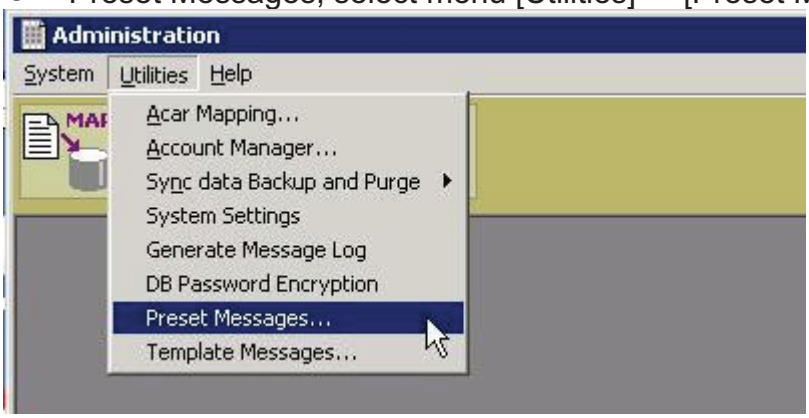
- DB Password Encryption, select menu [Utilities] -> [DB Password Encryption]



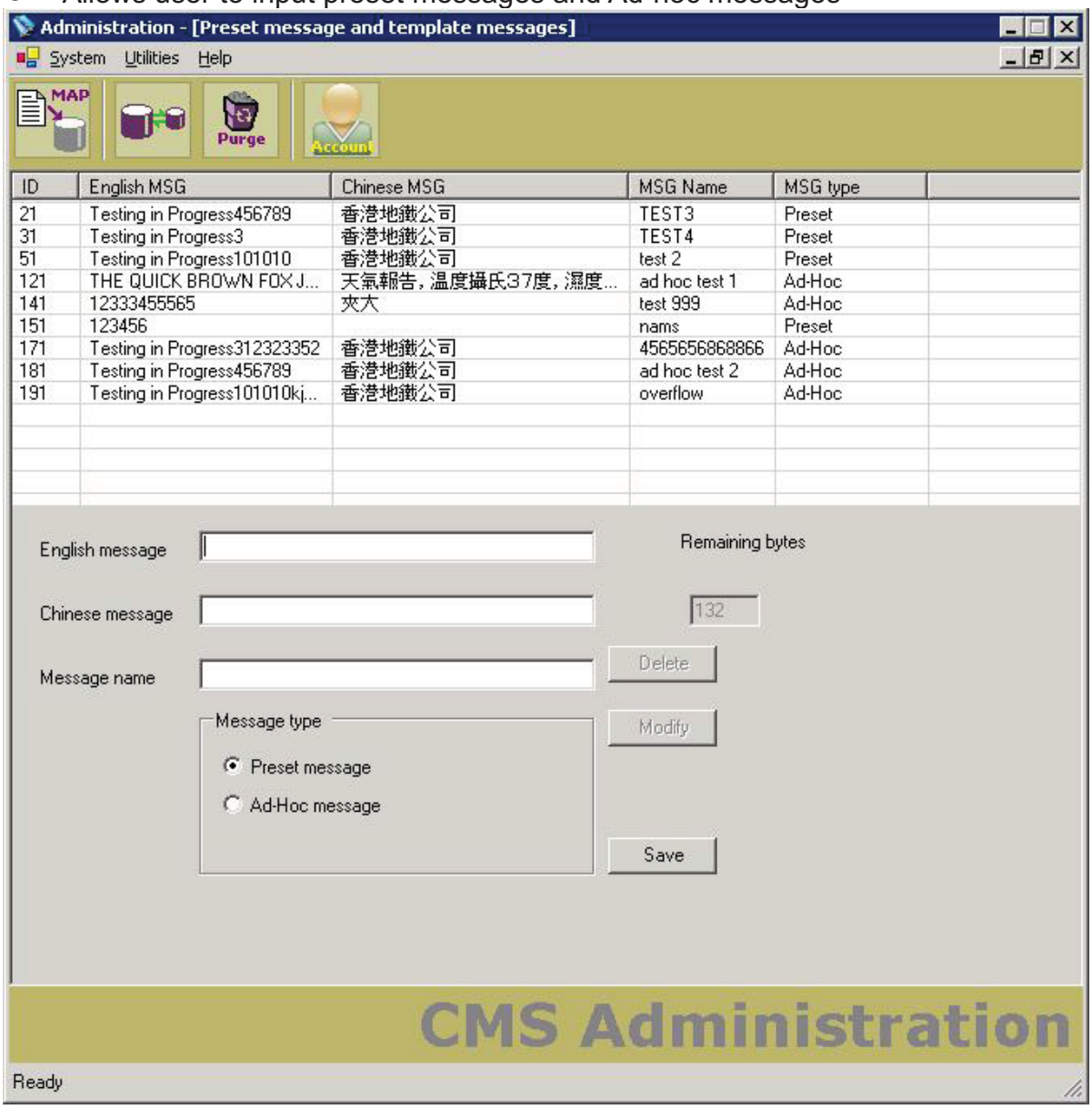
- Allows user to encrypt or decrypt a text for the database connection password. (To protect the actual password even if others see the configuration file)



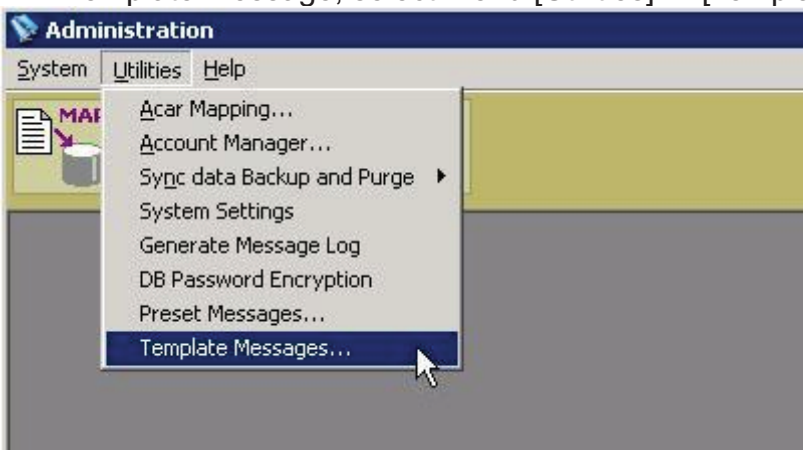
- Preset Messages, select menu [Utilities] -> [Preset Messages…]



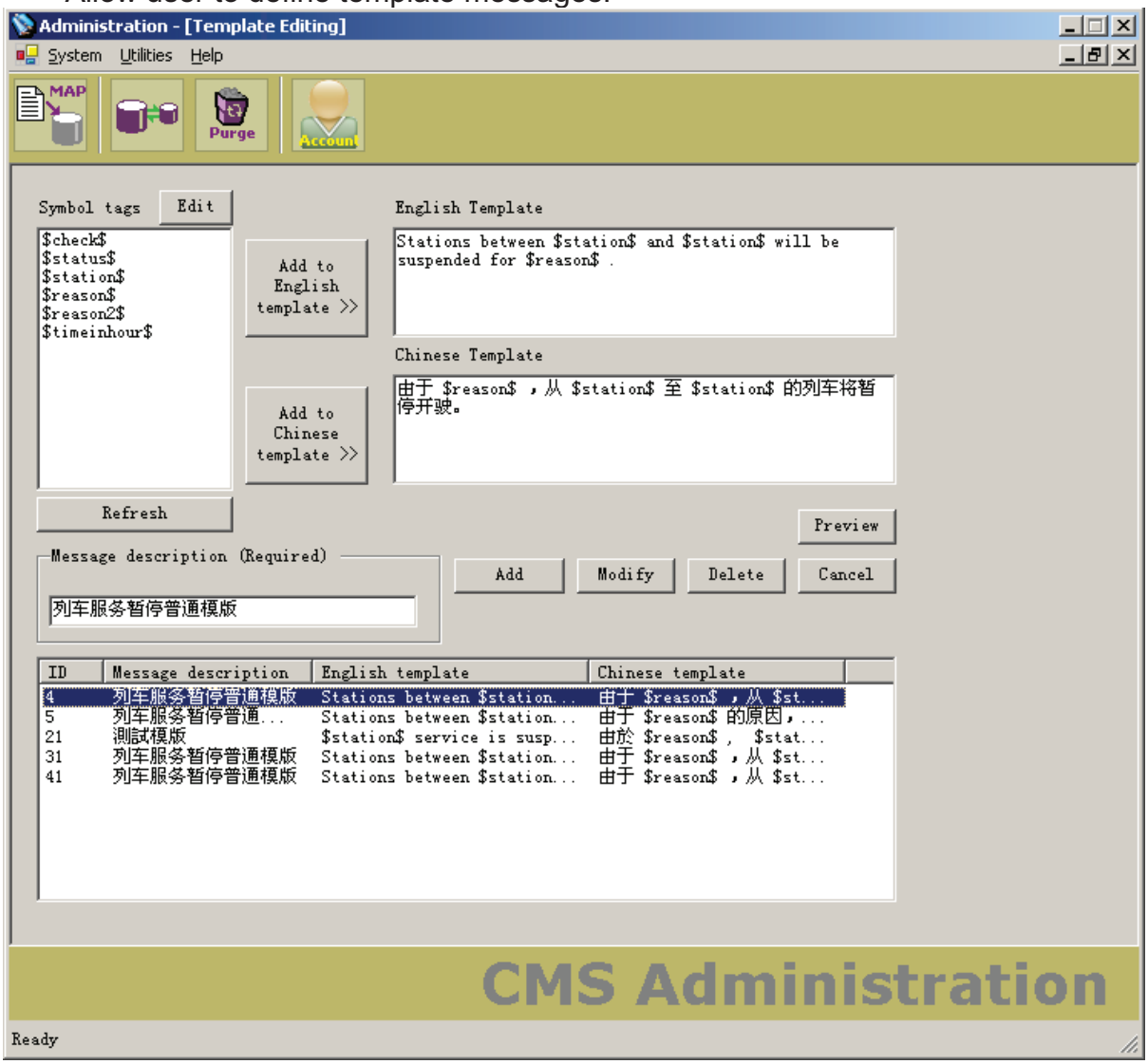
- Allows user to input preset messages and Ad-hoc messages



- Template Message, select menu [Utilities] -> [Template Messages…]

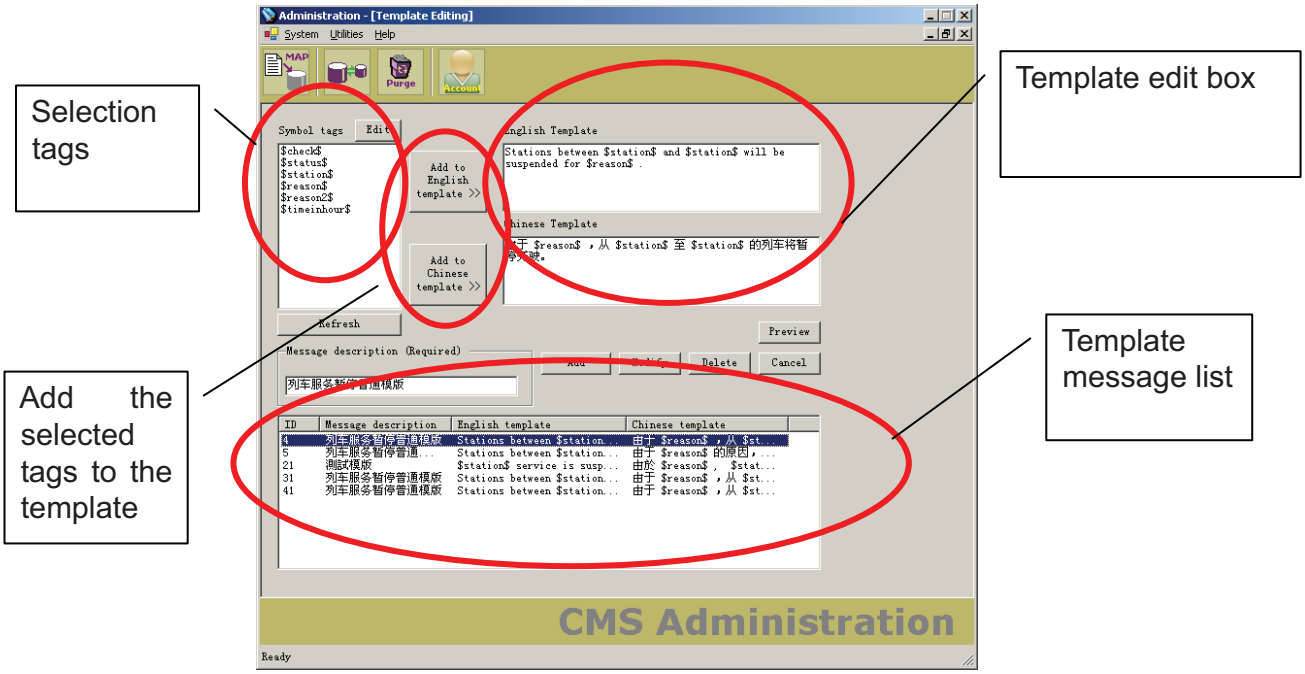


- Allow user to define template messages.

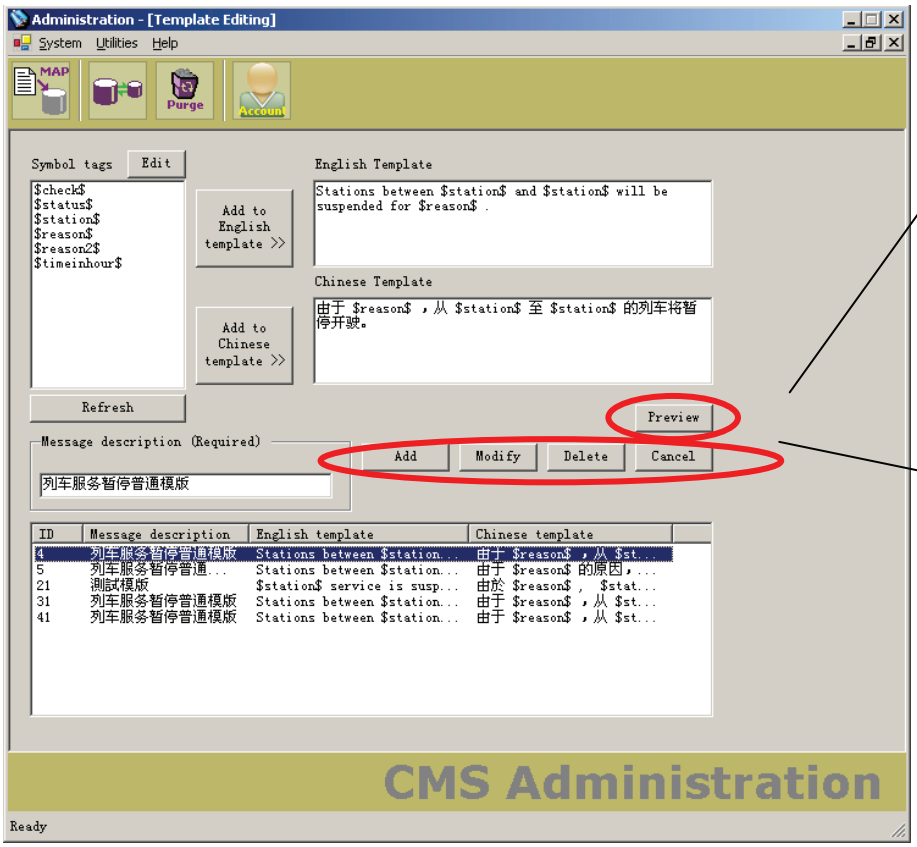


- Template Message

1. At the bottom of the screen, it's the template message list.
2. At the upper RHS, it's the template message edit box.
3. At the upper LHS, it's selection tags used by the template message



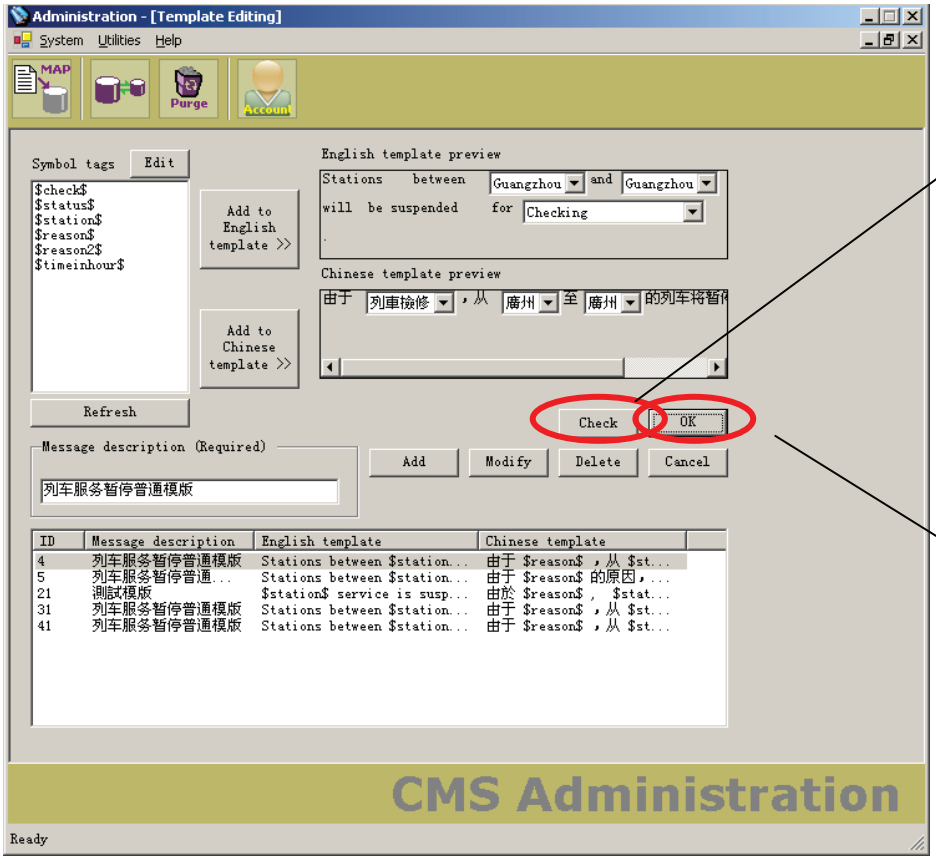
- Save / Modify / Delete template message



Previewing the template

Add, modify, delete buttons.

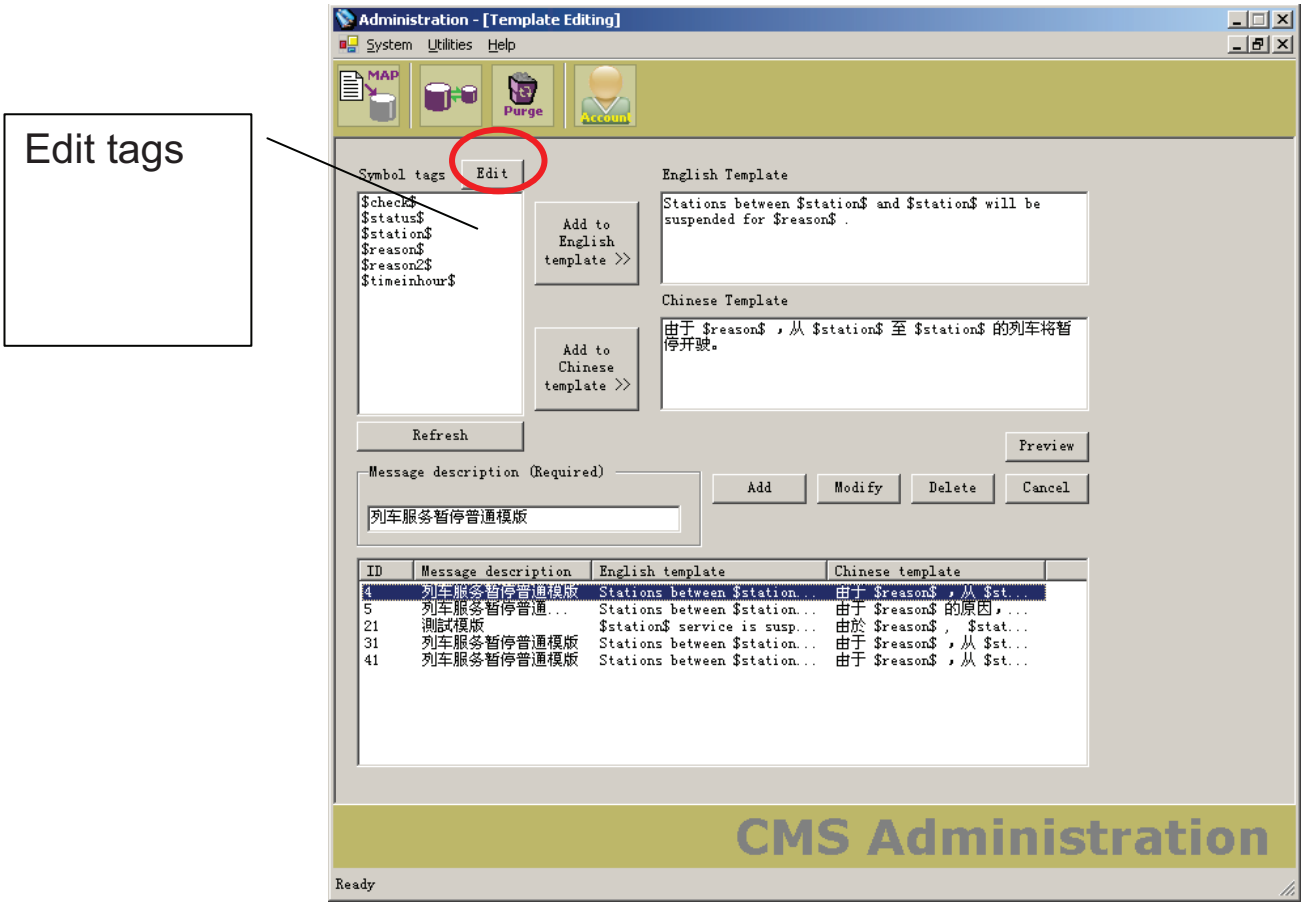
- Once the preview button click, the effect show on the operator screen will be simulated.
- You may check the message length without exceed limit by using the check button



Previewing the template

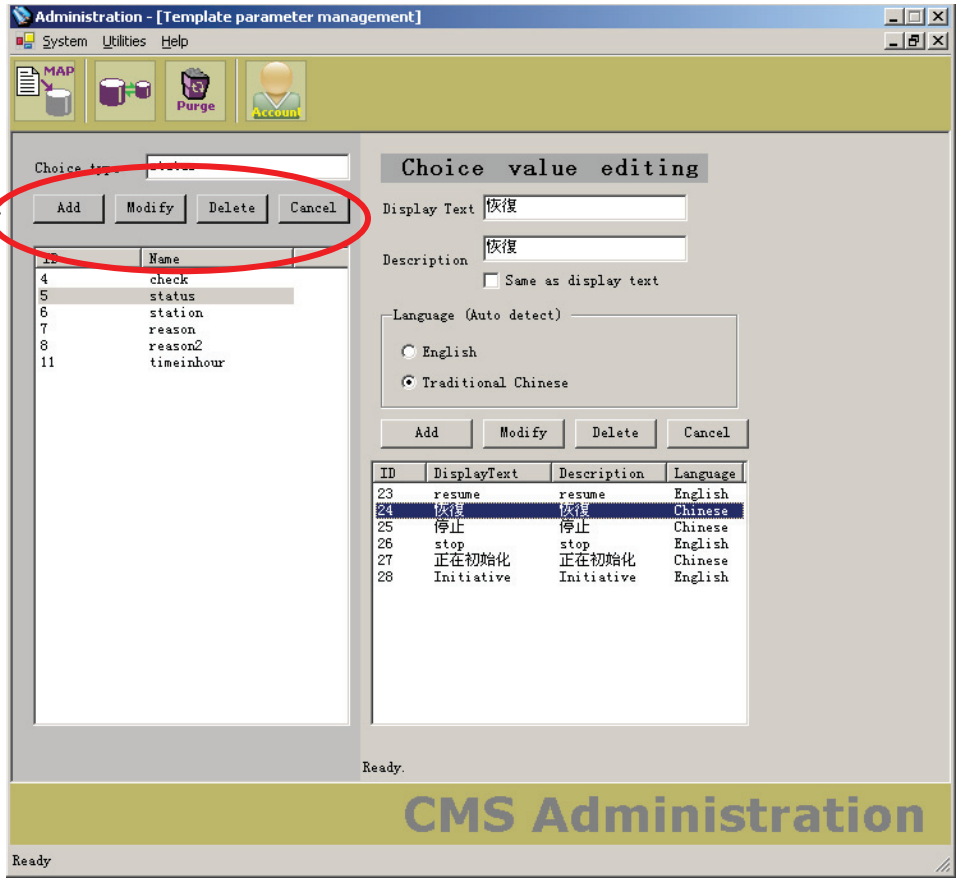
Click ‘OK’ when end of preview

- You may edit the 'tag' content by clicking the 'Edit button'



- You may add new 'tag' by input the 'Choice type' and click 'Add' button
- You may also modify/delete the selected 'tag' by click 'Modify' /' Delete' button

Add/ Modify/ Delete/ Cancel Button



3.3.5 Message dissemination to AEL Trains (Option 2)

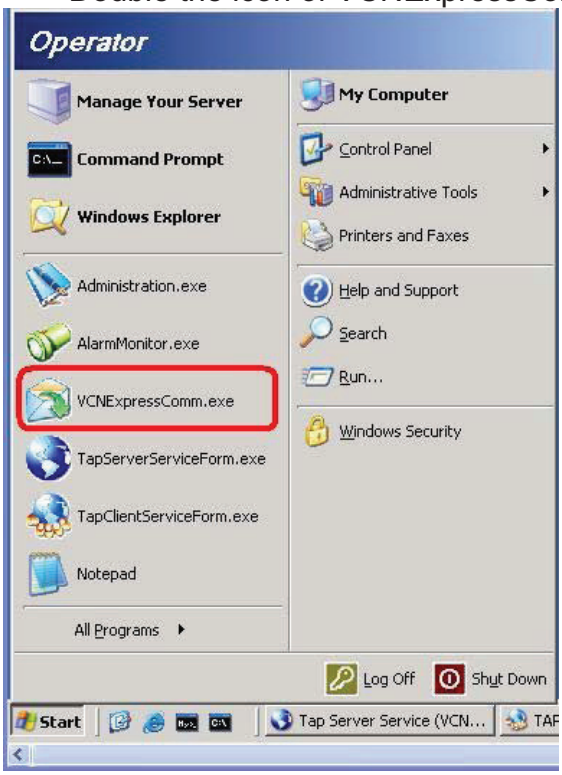
A new interface RTTF (or VCN Express Communicator) is used for the dissemination of specialized central messages from the Operations Control Centre (OCC) to Airport Express Line (AEL) trains.

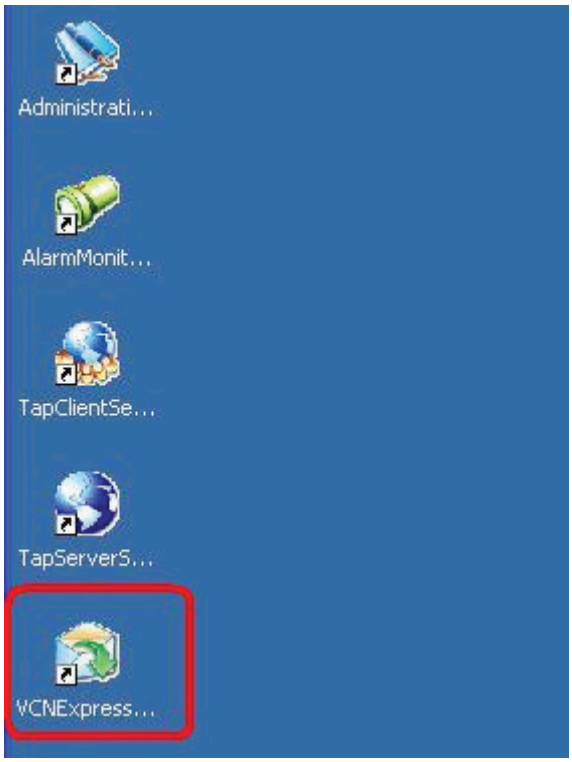
Attention
VCN Express Communicator has no interface with the SICP so user can either send to only one AEL train or to all AEL trains at a time. User shall also be responsible for checking manually if the train selected is actually in service.

- To start up the VCNExpressComm.exe, click [start] -> [VCNExpressComm.exe]

Or

- Double the icon of VCNExpressComm.exe on the Windows desktop.



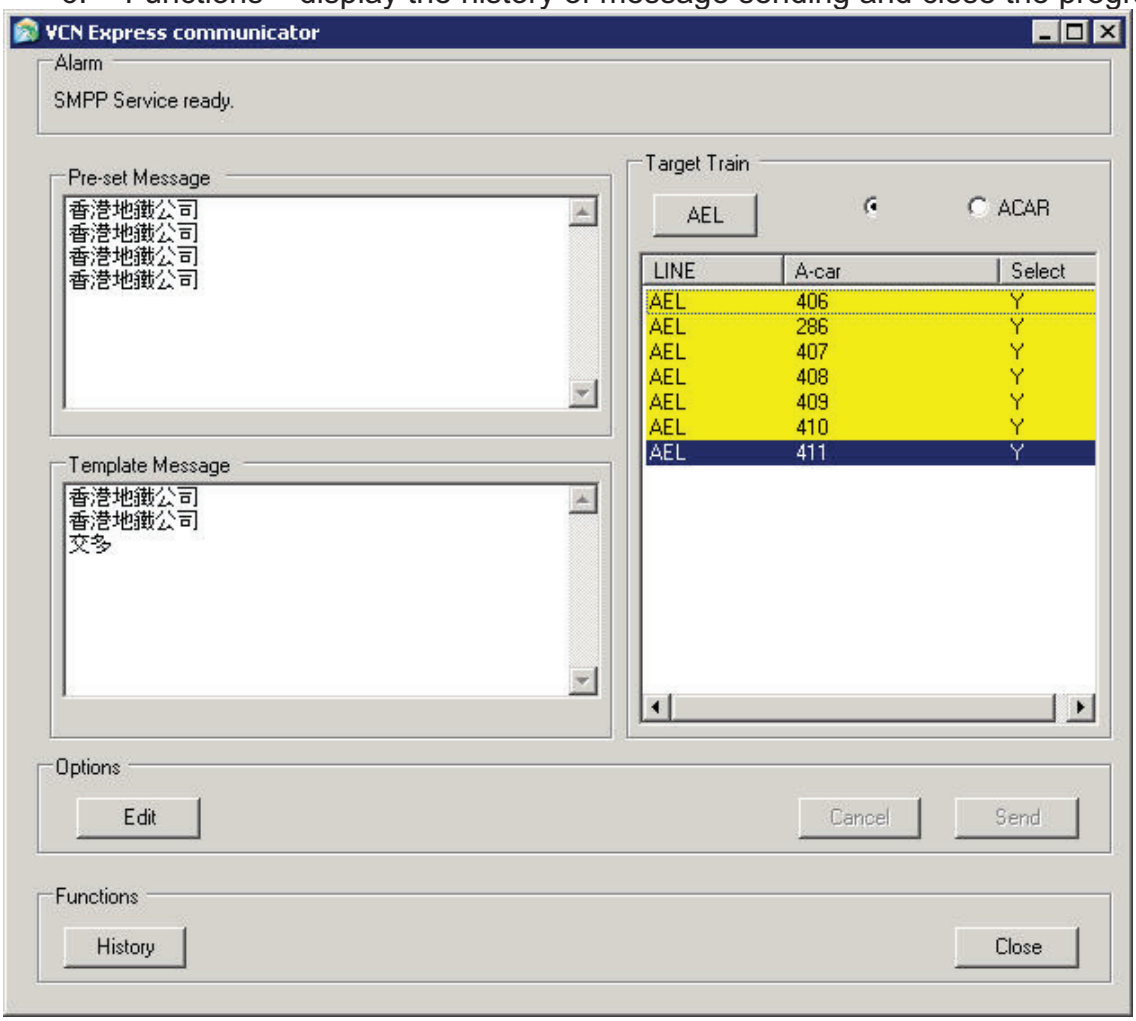


- Login prompt

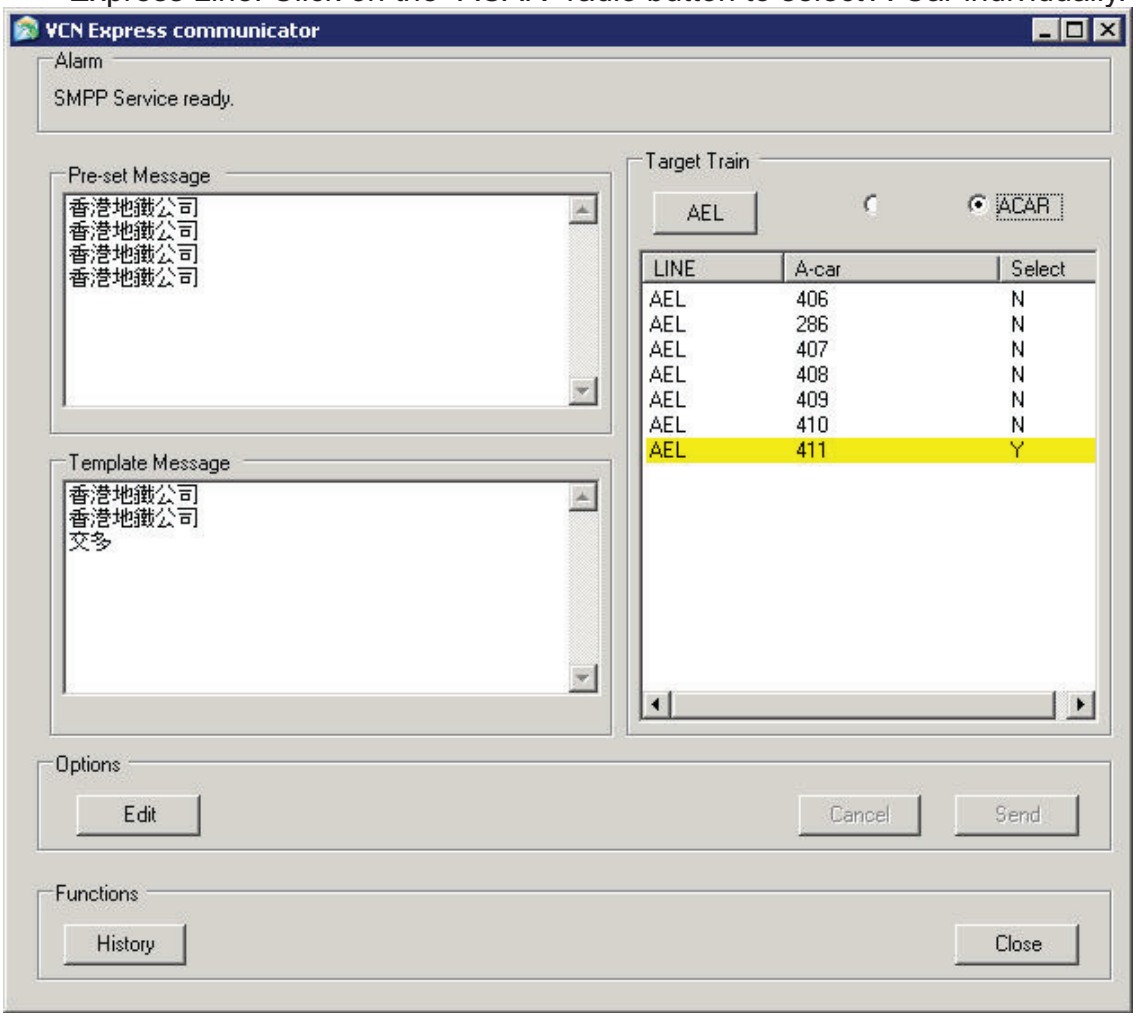
- Main screen

Functions provided in the main screen

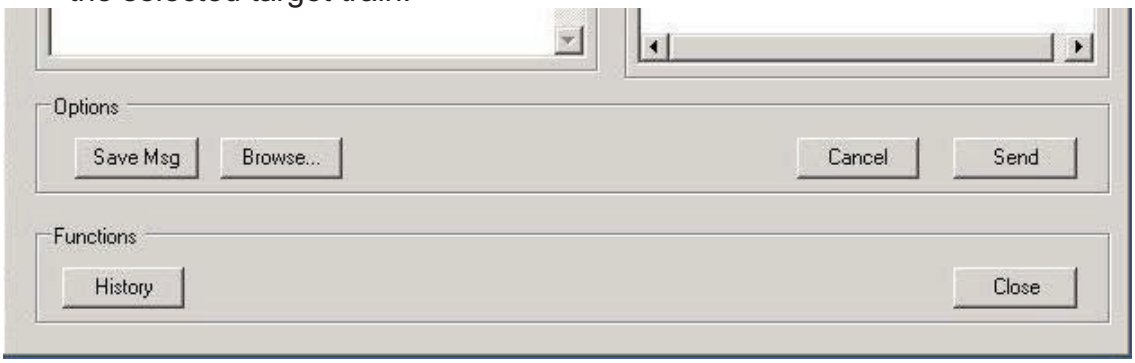
1. Alarm – display the status of SMPP connection.
2. Pre-set Message – display the pre-set messages for selection.
3. Template Message – display the template message for selection.
4. Target Train – select the train line or A-Car individually.
5. Options – allows user to edit and send the message.
6. Functions – display the history of message sending and close the program.



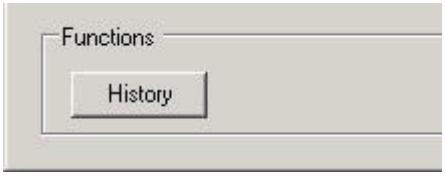
- Click on the “AEL” button or their radio button to select all trains in Airport Express Line. Click on the “ACAR” radio button to select A-Car individually.



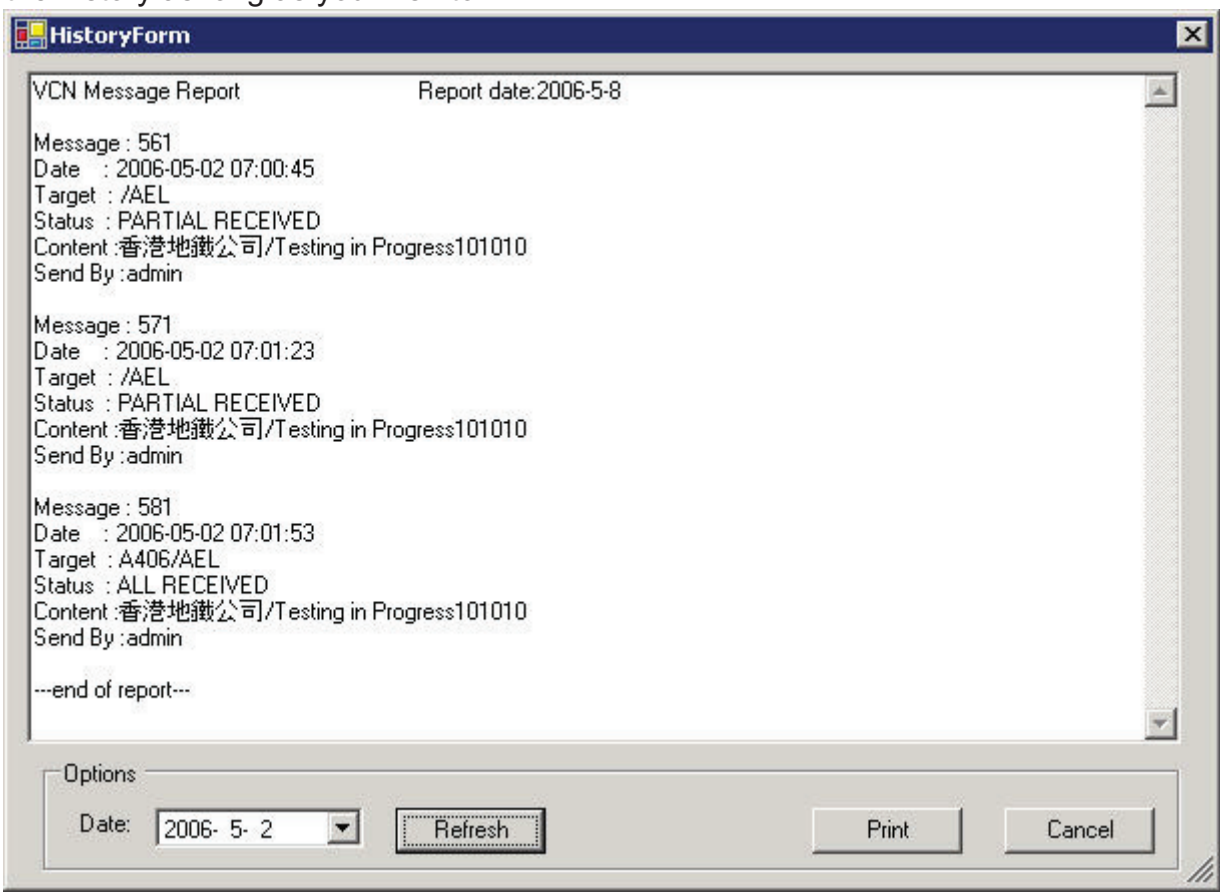
- When the Pre-set or Template message and target train are selected, click on Edit button, the message can be modified in English and Chinese message textbox and then click Send button, the message would be sent immediately to the selected target train.



- When click the Edit button, the Edit button will switch to Saving message mode and browse message mode.
- History - click the History button of the main screen.



You can go over the message status and filter the history by date. And you may print the history as long as you wish to.



3.3.6 Housekeeping

- Automatic database backup

The CMS contains a daily schedule to backup database automatically, the database backup are kept for 3 days only.

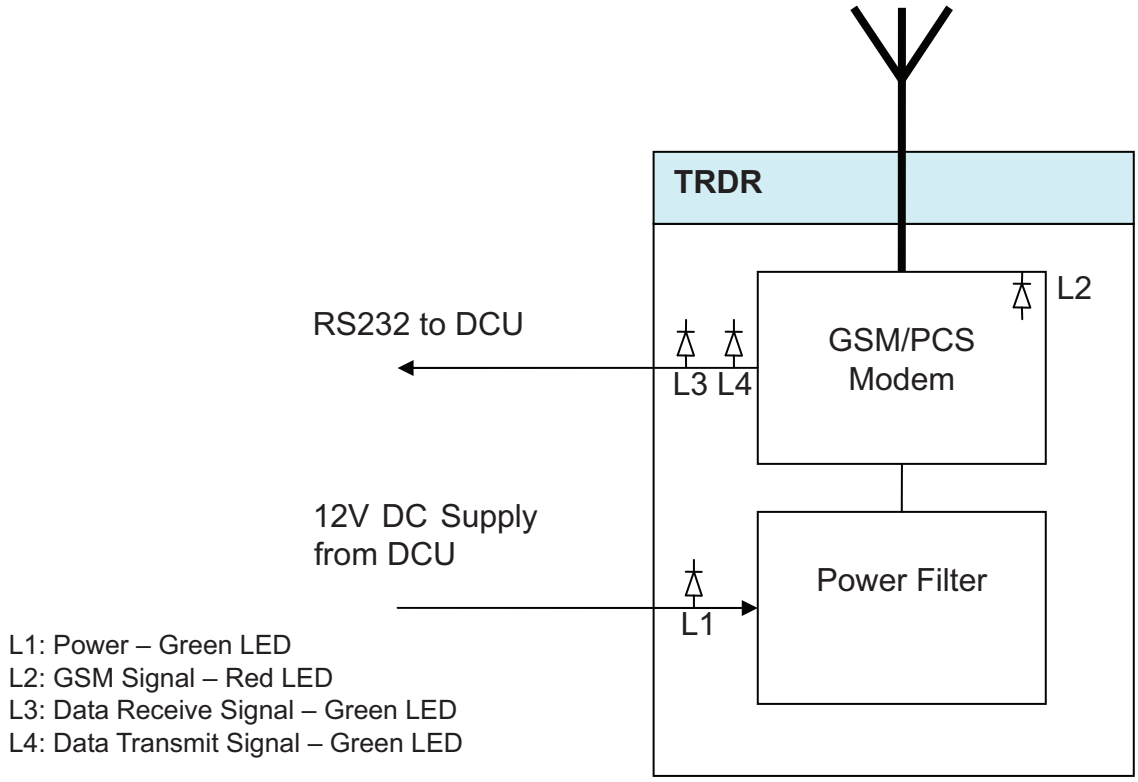
- CD-RW media

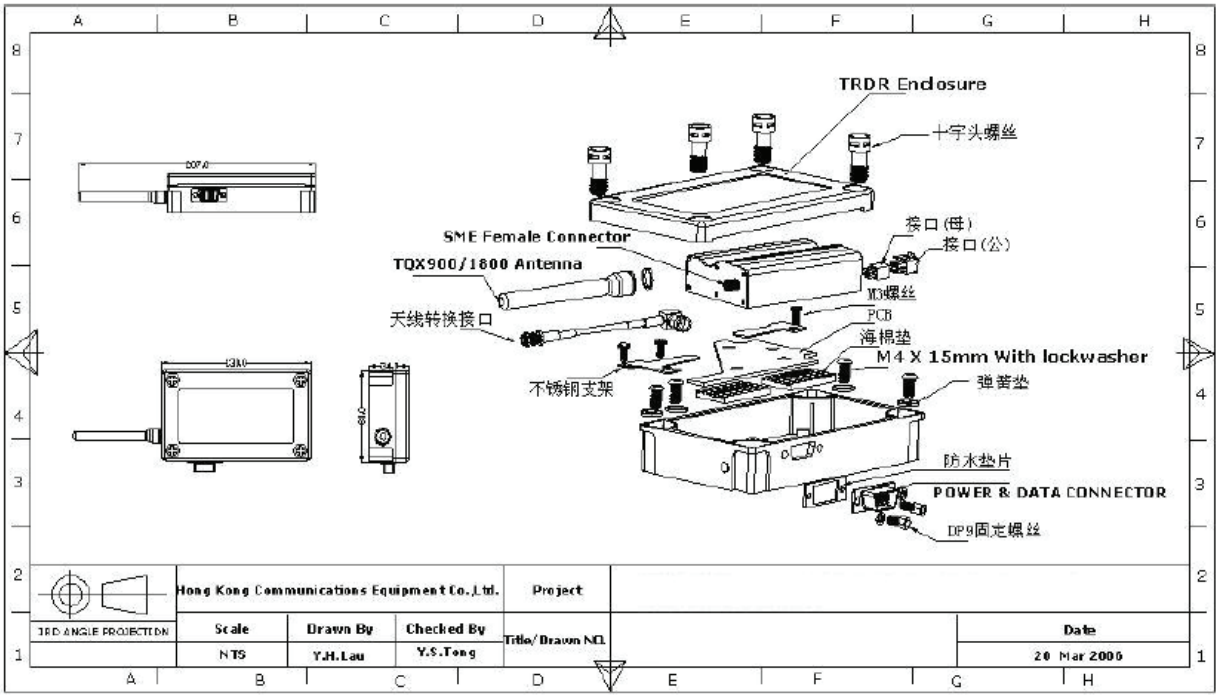
The CMS contains a CD writer, the database backup SQL files would backup to CD-RW disc and the disc should be replaced monthly with an empty disc.

- Daily SMPP log

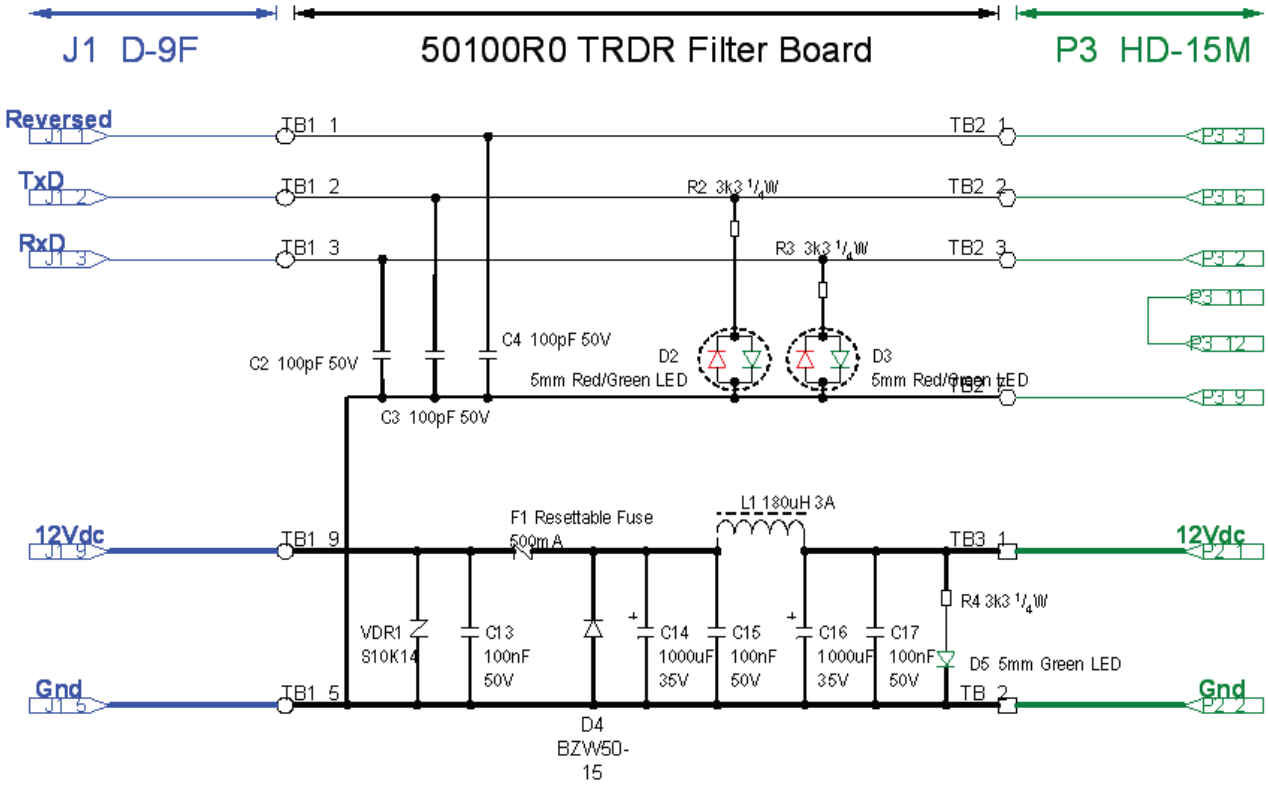
The CMS writes a daily SMPP log in D:\CMS_LOG
Filename: smpp.log.[yyyymmdd] e.g. smpp.log.20060513
The log contains the 3 timestamps which are:-
1. The time of SMS sending to SMSC
2. SMS delivery time (all second segment are zero)
3. The last updated timestamp

3.4 TRDR operation





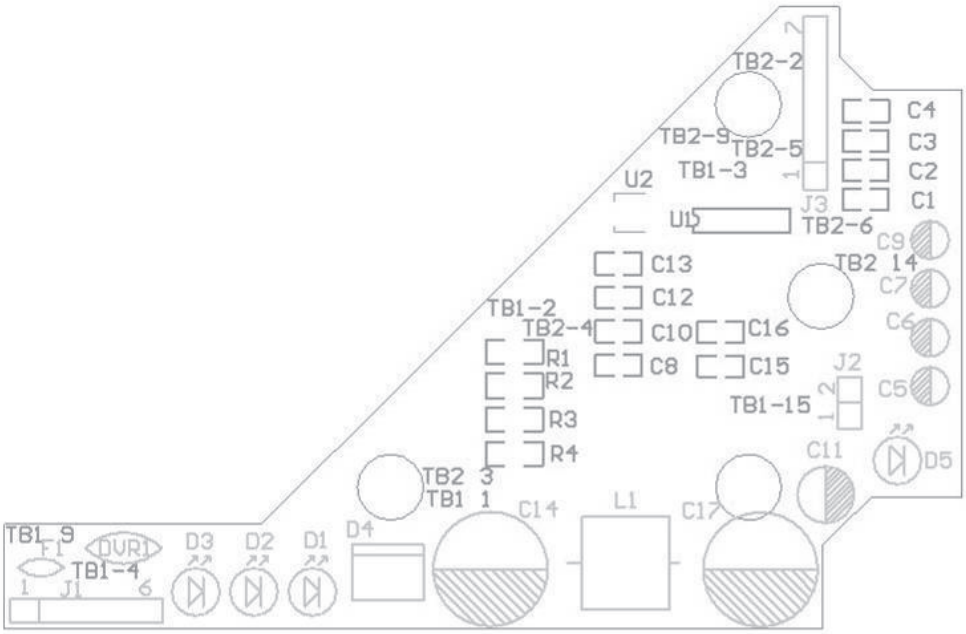
TRDR Filter Board (Wiring Diagram)

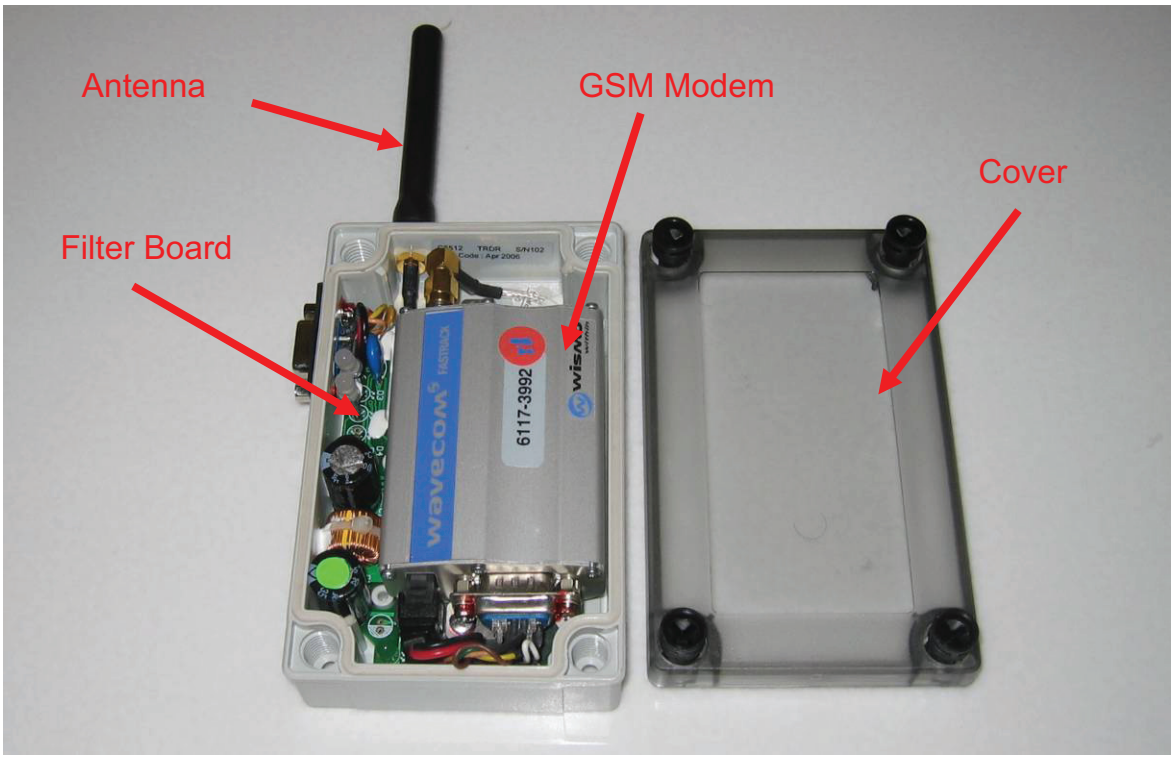


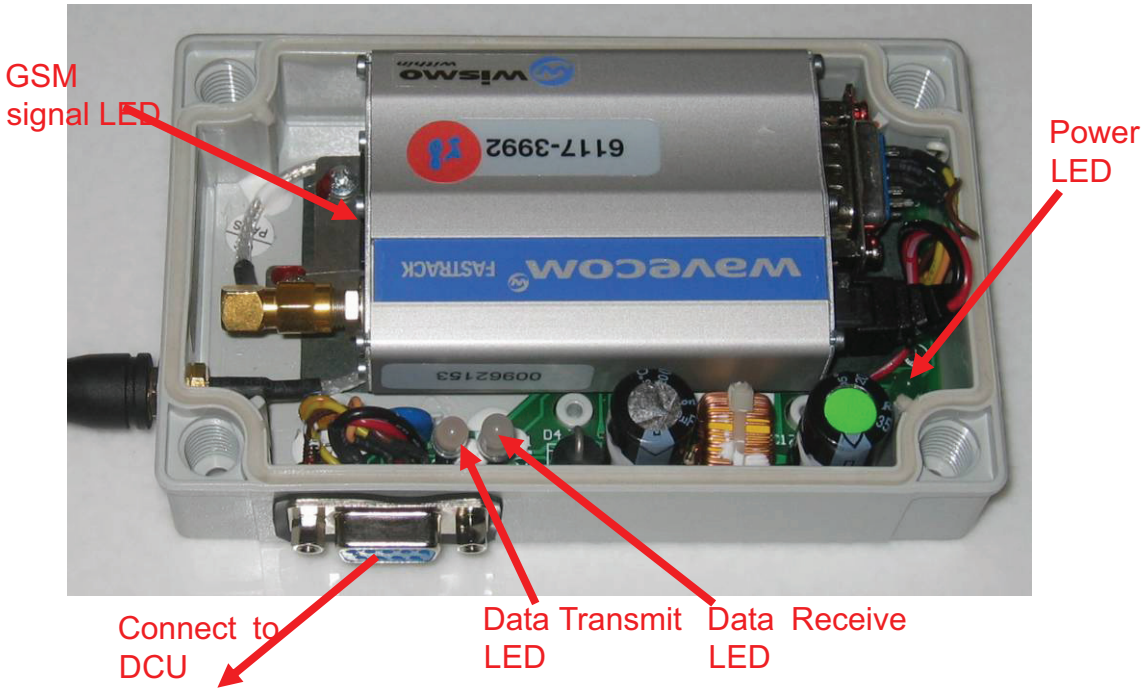
Pin assignment of TRDR

Pin 1: Reversed
Pin 2: Transmit Data
Pin 3: Receive Data
Pin 5: Ground
Pin 9: 12VDC

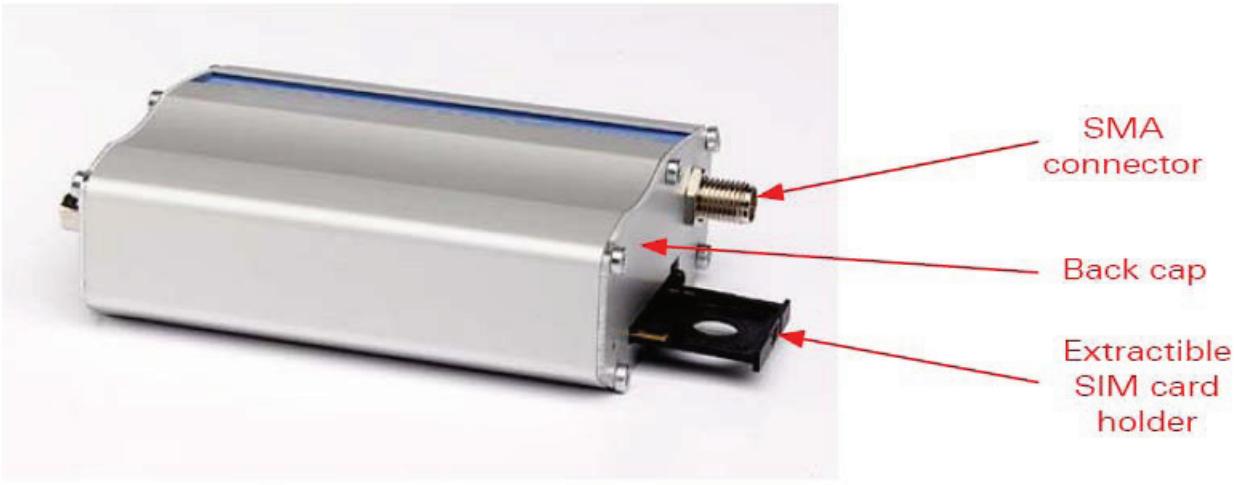
TRDR Filter Board (Component Layout)



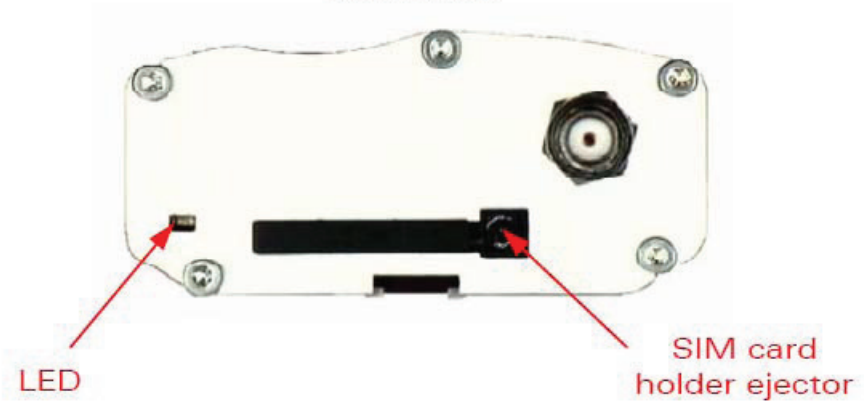



GSM
signal LED
Power
LED
Connect to
DCU
Data Transmit
LED
Data Receive
LED

SIM
Card
6117-3992
wavecom
wismo



BACK CAP



Each TRDR consists of a GSM/PCS modem (Wavecom Fastrack modem M1306B) and a 12V DC power filter with LED. The modem and the power filter will be housed in an IP 55 box of size 165 (L) x 90 (W) x 22 (D). The connection from TRDR to DCU is the RS232 connector and cable.

2. SIM card installation

The GSM modem needs a SIM card to operate, insert the SIM card into a slot on the underside of the modem module.

- LED status during normal operation

L1: Power – Green LED, it should be ON when power on.
L2: GSM Signal – Red LED, it should be blinking in the GSM coverage area.
L3: Data Receive Signal – Green LED, it should be ON when connecting DCU.
L4: Data Transmit Signal – Green LED, it should be ON when connecting DCU.

3. Update the mapping table

A user interface is provided at power user level to update the mapping table of A-car number and the mobile number of the SIM card that installed in the TRDR.

4 Troubleshooting

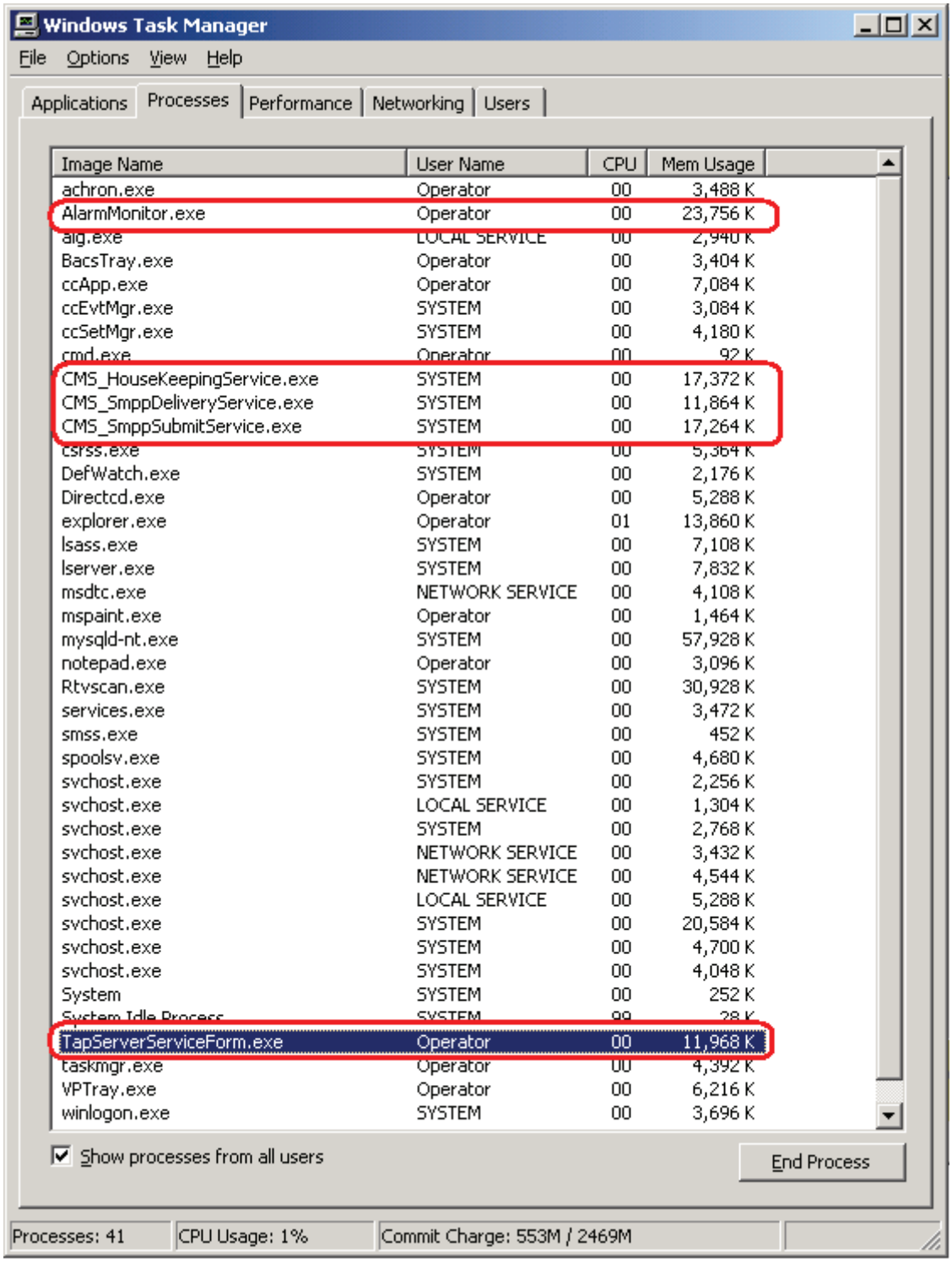
4.1 System Diagnostics

4.1.1 For CMS

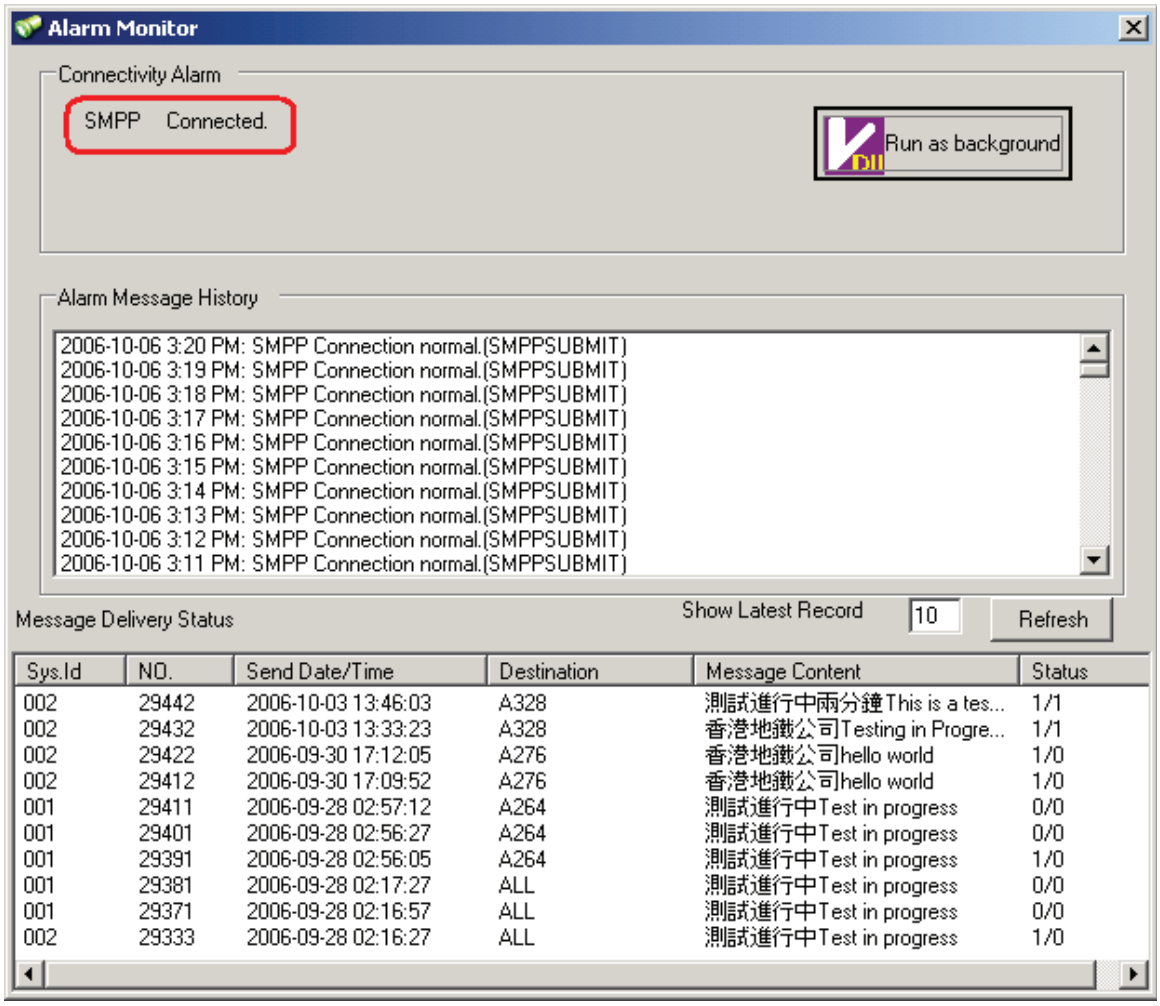
For the hardware diagnostic, please refer to Dell™ PowerEdge™ 850 Systems Installation and Troubleshooting Guide

For the CMS software diagnostic, here's testing procedure:

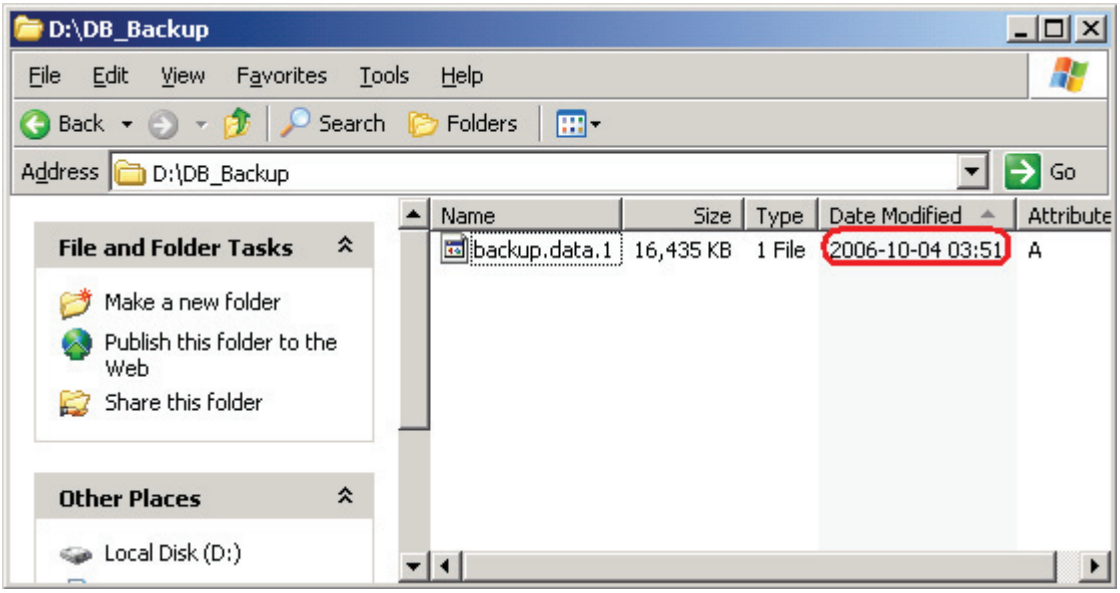
- After the server's network is properly connected, power on the server. After the server power on, check that the following program is running at the task manager:
  - AlarmMonitor.exe
  - CMS_HouseKeepingService.exe
  - CMS_SmppDeliveryService.exe
  - CMS_SmppSubmitService.exe
  - TapServerServiceForm.exe



- Testing and verification
  - Verify the Alarm Monitor program and SMPP service is working normally by check from the AlarmMonitor screen that the SMPP connection status is “Connected”



- Verify the TAP module is working normally by check from the EIDS terminal that both LINE are ready (No alarm show on the EIDS terminal)
- Verify the Administration program and Housekeeping service is working normally by start the Administration program and update the ACAR mapping. After 5 minutes, you can check from the Administration program of another live CMS server that the ACAR is updated.
- Verify the overall message sending function is working normally by shut down another live CMS server. Send a message from EIDS terminal, and check that the train can receive it correctly. (Restart the stopped CMS server after testing done)
- Verify the backup function is working normally by: on the next day, check the date of the database backup and make sure the backup function is working normally is current day.



4.1.2 For TRDR

Power up self test

1. Disconnect the RS232 connector from TRDR for 10 sec.
2. Reconnect the RS232 connector to TRDR.
3. Check the 3 Green LEDs (Power, Data send and receive), they are ON.
4. Red LED (GSM signal) is blinking.

4.2 System Troubleshooting

4.2.1 For CMS Server

1. For the server hardware diagnostic, you may refer to Dell™ PowerEdge™ 850 Systems Installation and Troubleshooting Guide

2. For the CMS software, you may check from the Alarm Monitor that:
   - If SMPP connection is normal, you may see that the SMPP status is 'connected'. Otherwise, there may be the network connection problem between SMARTONE and OCC.

4.2.2 For TRDR

1. If power fault, the Green LED (L1) is off.
2. If GSM signal fault or SIM error, the Red LED (L2) is not blinking.
3. If data receive fault, the Green LED (L3) is off.
4. If data transmit fault, the Green LED (L4) is off.

4.3 CMS Simulator

CMS Simulator is used to simulate sending RTTF message to the train. This is useful when the engineer required to test the installation of TRDR inside the train is successful. This document is the procedure of installing the Simulator.

Prerequisites

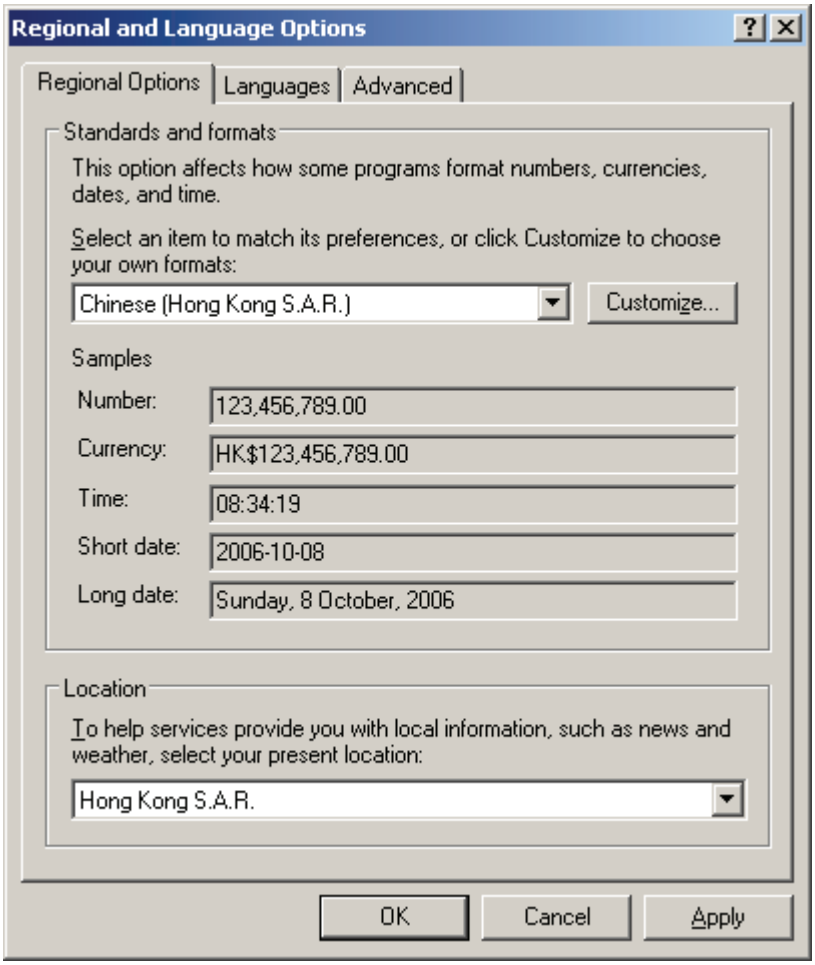
- An Intel computer installed with Window 2000 Server or Window XP professional. The latest Service Pack should be download and installed too. This server requires the Microsoft .Net framework V1.1. You have to download from Microsoft.
- The hardware requirement of the computer is:
  - CPU Intel Pentium 1.5GHz or above
  - Memory 512MB or above
  - Harddisk disk space 50GB or above
  - 1 LAN ports with 10/100 base-T Ethernet support
  - 1 serial port (configured as COM1)
- CMS simulator Installation disk is ready, which contains CMS software 'MTR Program Files', 'MySQL' database
- The engineer who will install the CMS simulator should have windows 2000 server or windows XP administration skill.
- The computer should also be installed with the proper AntiVirus software, Time synchronization software.
- Have the Simulator Installation Disk ready in the PC's CDRom. (Assume E: drive in this Procedure.)

4.3.1 Procedure of installing the CMS simulator

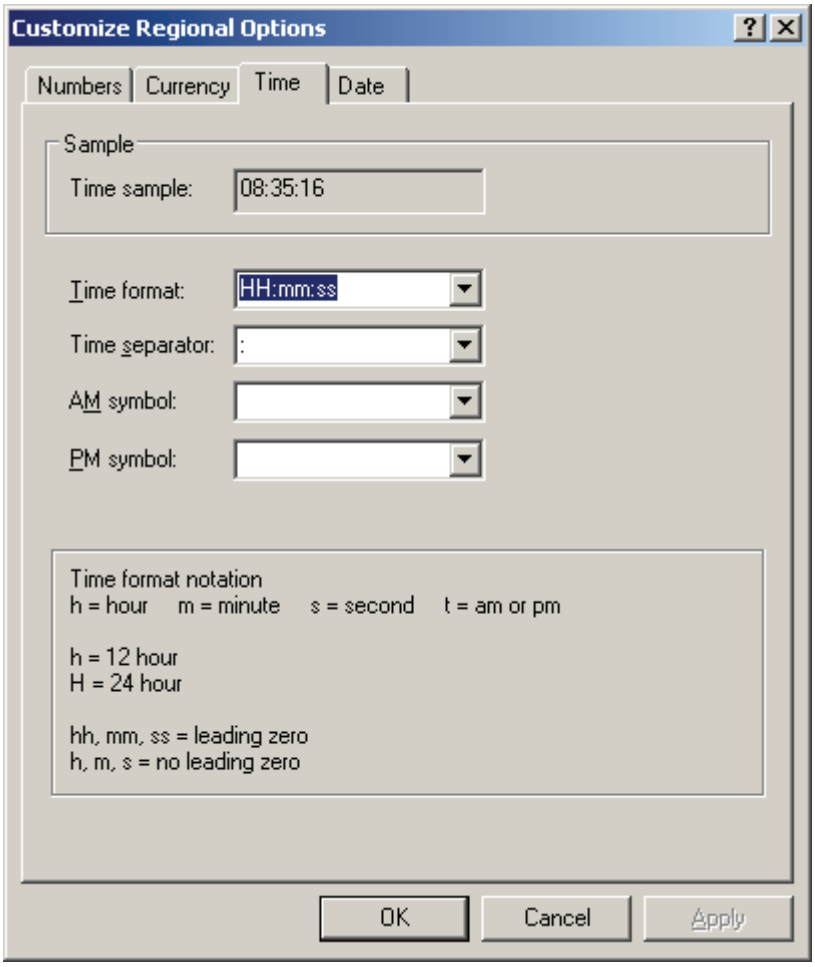
1. Power on the CMS simulator and logon as Administrator

2. Create folder
   C:\MTR Program Files

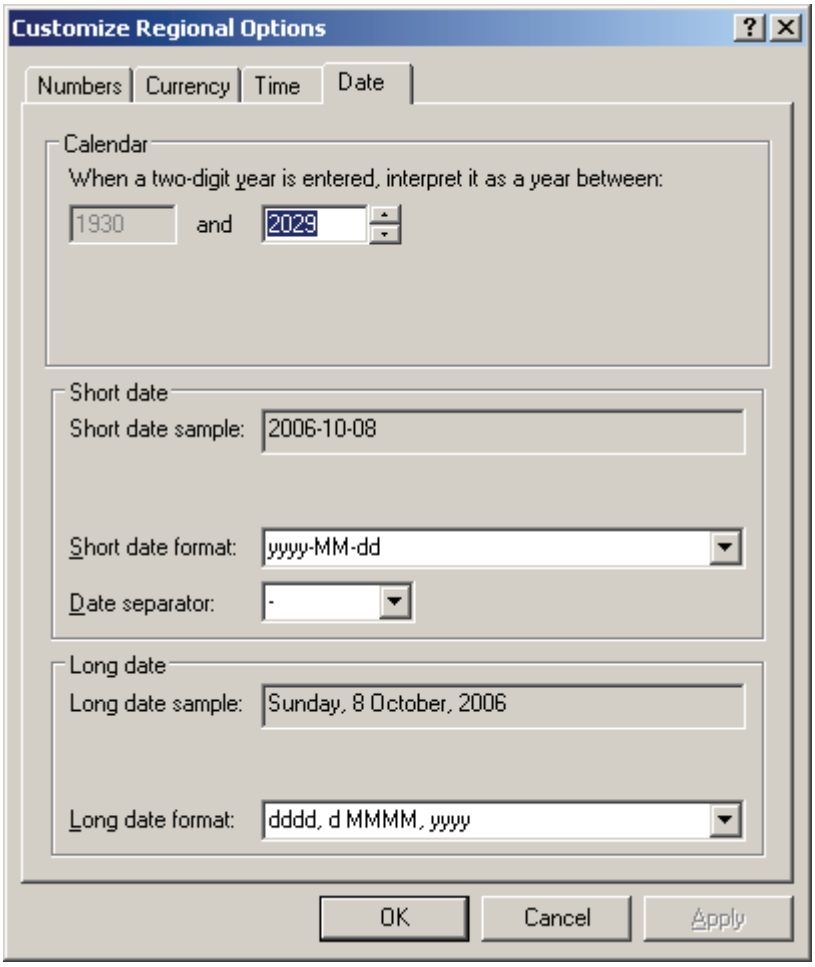
3. Change window's regional setting as followed:
   - Open control panel and select the "Regional and Language Options". At the "Regional Options" tab, click customize.



   - The "Customize Regional Options" opened, select the "Time" tab, change the time format to "HH:mm:ss".



- Then select the “Date tab, change the short date format to “yyyy-MM-dd”



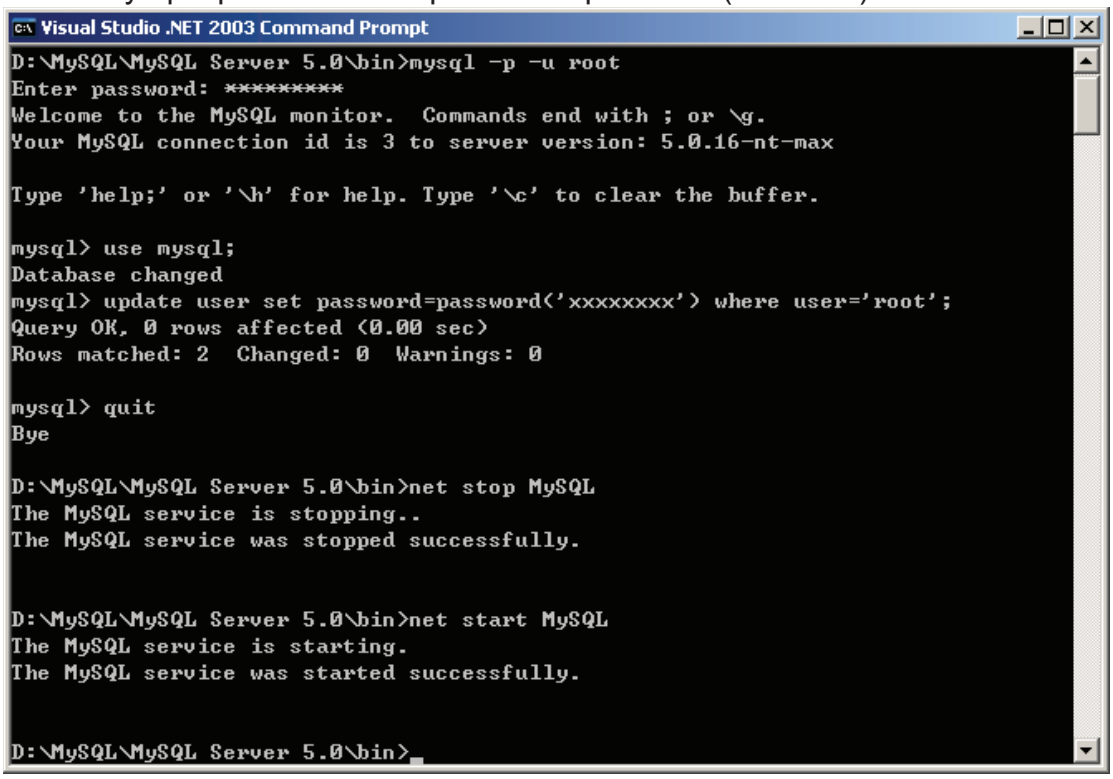
4. Install MySQL database server
   - Start the command prompt

   - Copy the MySQL database backup from the installation CD to C:
   Xcopy E:\MySQL C:\Program Files\MySQL /Y /S

   - Install MySQL as a service
   C:
   cd C:\Program Files\MySQL\MySQL Server 5.0\bin
   mysqld-max-nt.exe –install
   net start MySQL

5. This step is required if the MySQL root password has been changed after the system delivered. To change MySQL root password, you have to
   - Start the command prompt
   C:
   cd C:\Program Files\MySQL\MySQL Server 5.0\bin
   Mysql –p –u root
   Enter password:********
   mysql>*use mysql;*

mysql>update user set password=password('xxxxxxx') where user='root';



6. Install Microsoft >Net Framework 1.1
   Install .NET Framework 1.1 using the file dotnetfx.exe in the Microsoft Folder in CD.
   Install updates NDP1.1sp1-KB867460-X86.exe then NDP1.1sp1-KB886903-X86.exe in the same folder

7. Install CMS Simulator Software
   Assume that the program is to be installed in C: drive.
   - Open command prompt
   - Copy "MTR Program Files" from CDROM to C: drive

xcopy "E:\MTR Program Files" "C:MTR Program Files" /Y /S

   - Setup windows service

Cd C:\MTR Program Files\GSM Service
c:\windows\microsoft.net\framework\v1.1.4322\installutil CMS_GSMService.exe

8. You may have to create short-cut onto the desktop of windows user according to the operating requirement. Here's short-cut program:

   - Simulator
   C:\MTR Program Files\CMS Simulator\CMSSimulator.exe

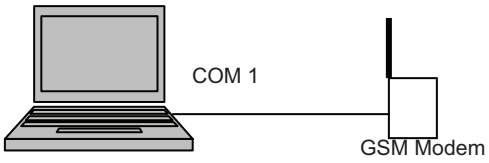
9. Connect the GSM modem to the COM1 one of the simulator computer

10. Testing and verification
    After the simulator installed, you have to test that the system is working normally by:
    - Check that "mysql-nt.exe" is running at Task Manager
    - Check that "CMS_GSMService.exe" is running at Task Manager
    - Start the simulator and check that it can send the RTTF message to the receiver through SMS.

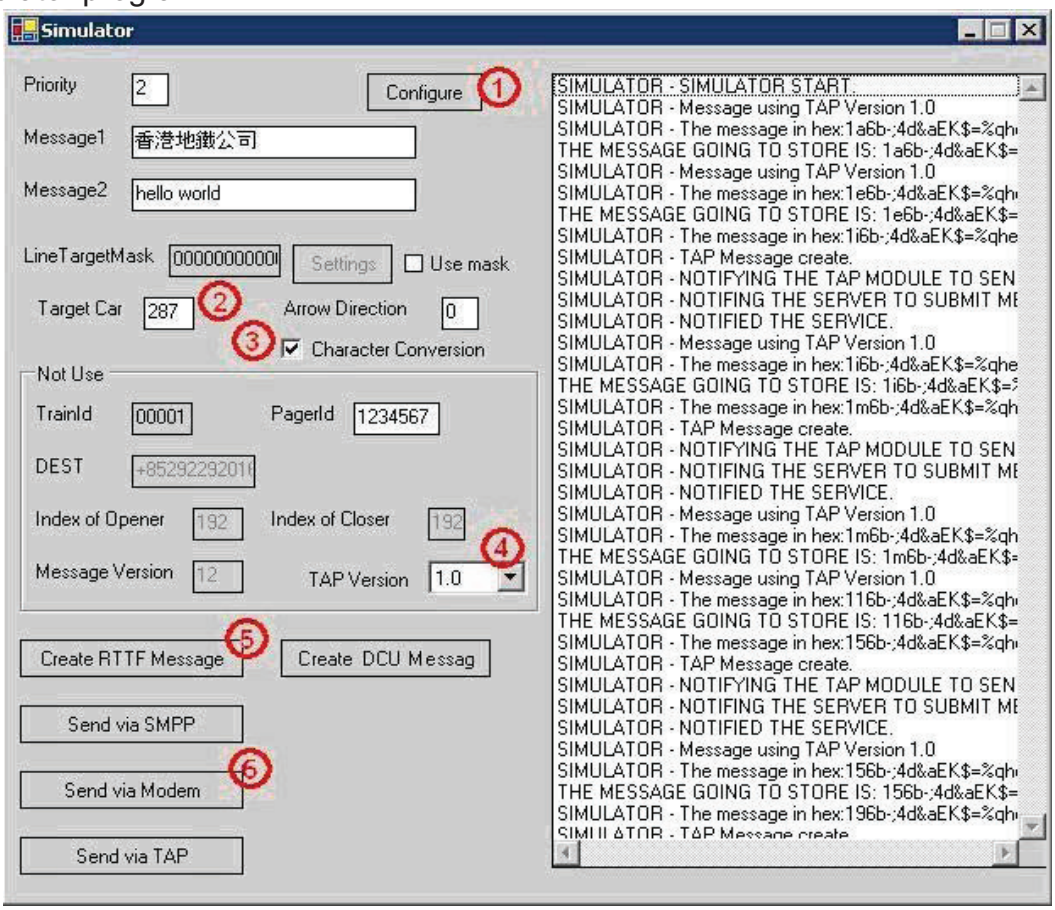
11. System installation done and ready.

4.3.2 Simulator for testing TRDR

Setup - connect the GSM modem (or TRDR) with the selected SIM card (preset mobile numbers) to COM1 of Simulator PC (Notebook Computer)

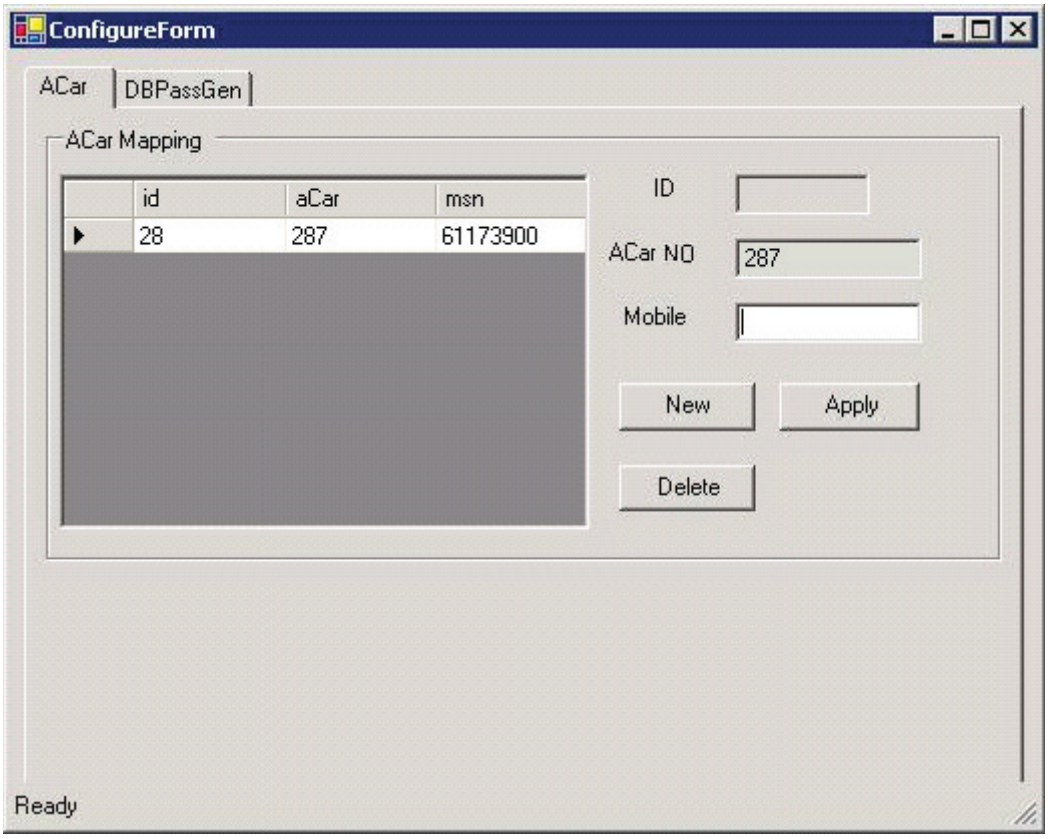


Simulator program



Operation

1. Select **Configure** to set the A-Car number and mobile number (No 852 prefix is needed) for testing, only 1 record can be entered. Close **Configure**.



2. Enter A-Car number in the **Target Car**
3. Select Character conversion and TAP version 1.0 (TAP 2.1 is for AEL TRDR).
4. Change version number by pressing **Create RTTF Message**
5. Send to GSM modem by selecting **Send via Modem.**

Notes: The message content may be changed in the box. Beware that in the Chinese character box, only double byte Chinese characters are acceptable.

5 Replacement Procedure

5.1 For CMS

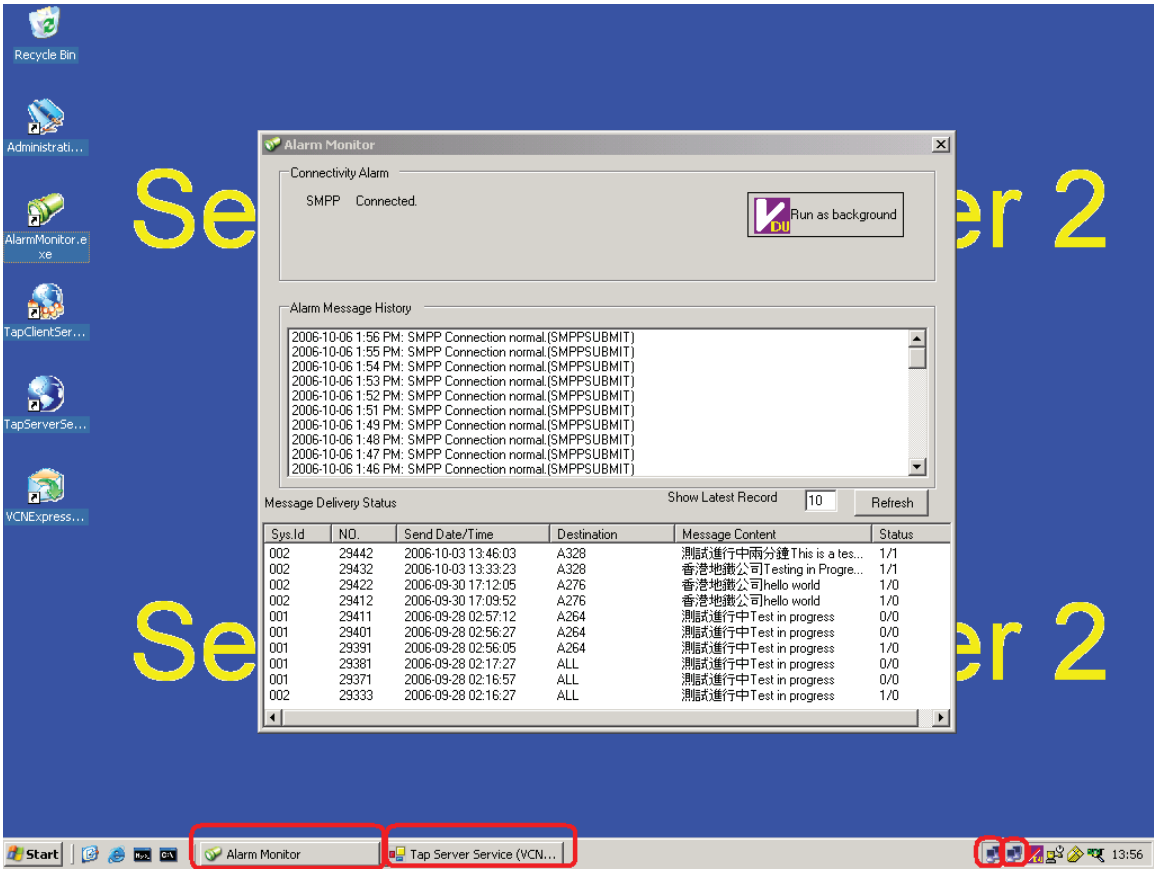
Whenever CMS1 or CMS2 server is failed, it's required to replace by the spare CMS server. This is document is telling the procedure required to replace it.

Prerequisites

- The spare CMS server is ready and installed with the Windows 2003 server, CMS software and Database.
- Latest database backup of the live CMS server. It's advised to backup the latest database from the live CMS server which is still running normally. Otherwise, you may use the latest database backup. For the backup procedure, you may refer to the administration user menu.
- The engineer who replace the CMS server should have basic windows server network administration skill.

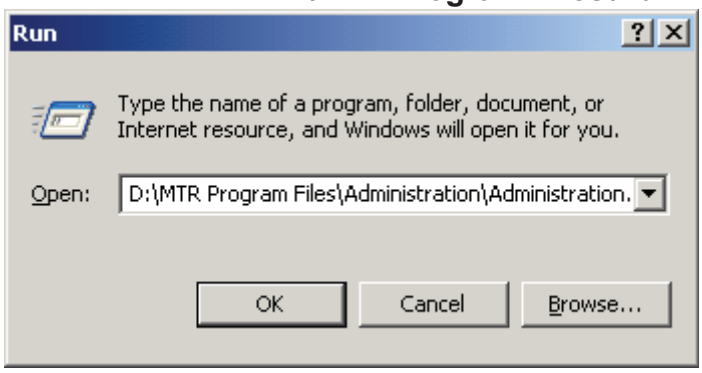
Procedure of replacing the CMS server

- Power on the spare CMS server (DO NOT connect to the live system at this moment). The server should be boot up with operating system 'Windows 2003 server'. After boot up, the server should have been logon as user 'operator' and the application 'Alarm Monitor' and 'Tap Server Form' is started on the desktop.

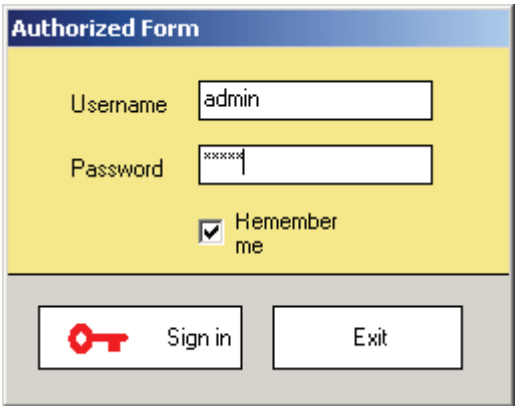


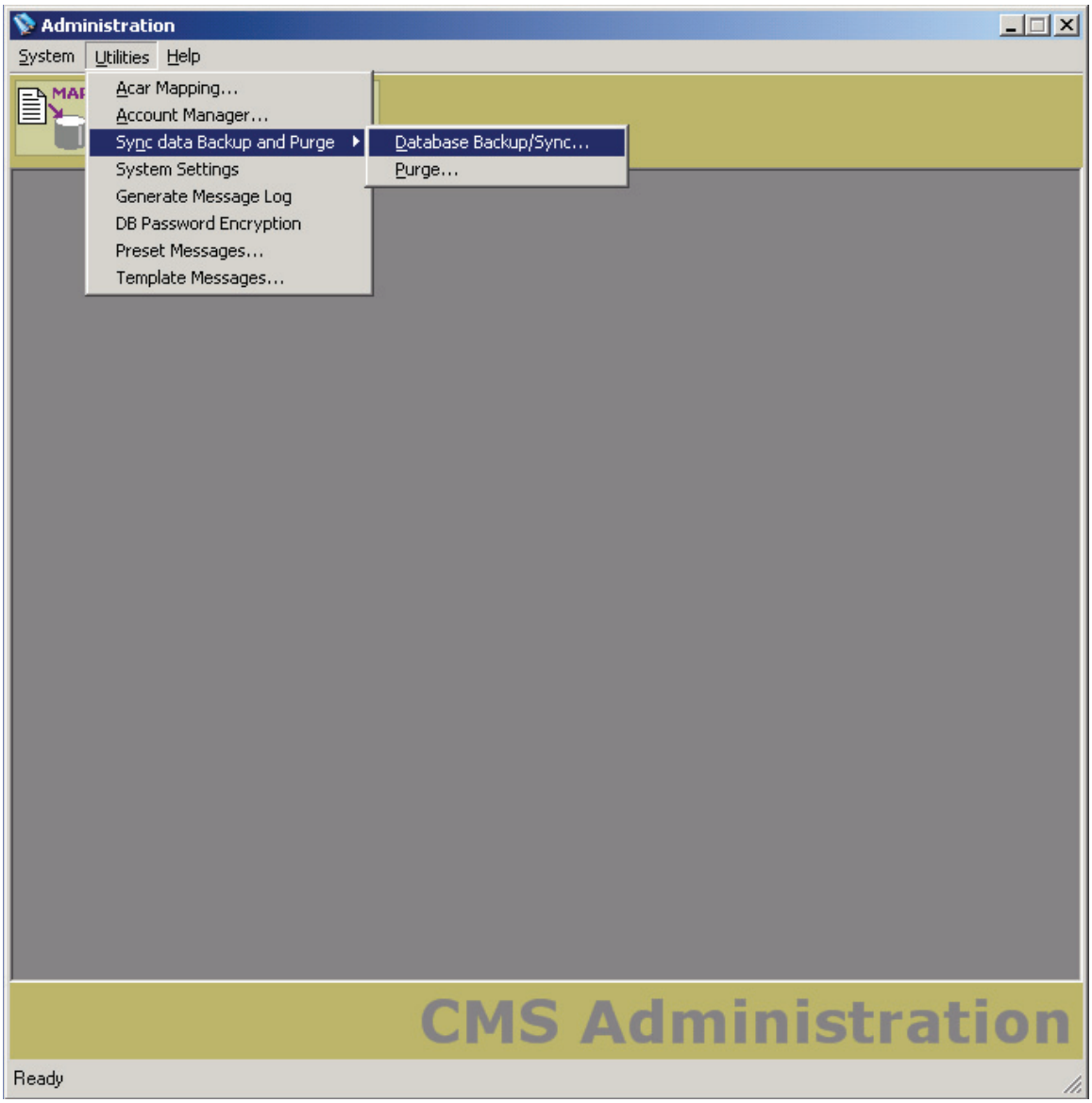
- Connect the server's LAN ports to the switch. Make sure the 2 network interface on the server is up and normal.

- Restore the latest database backup into the spare CMS server. Run the CMS administration program at
"**D:\MTR Program Files\Administration\Administration.exe**"

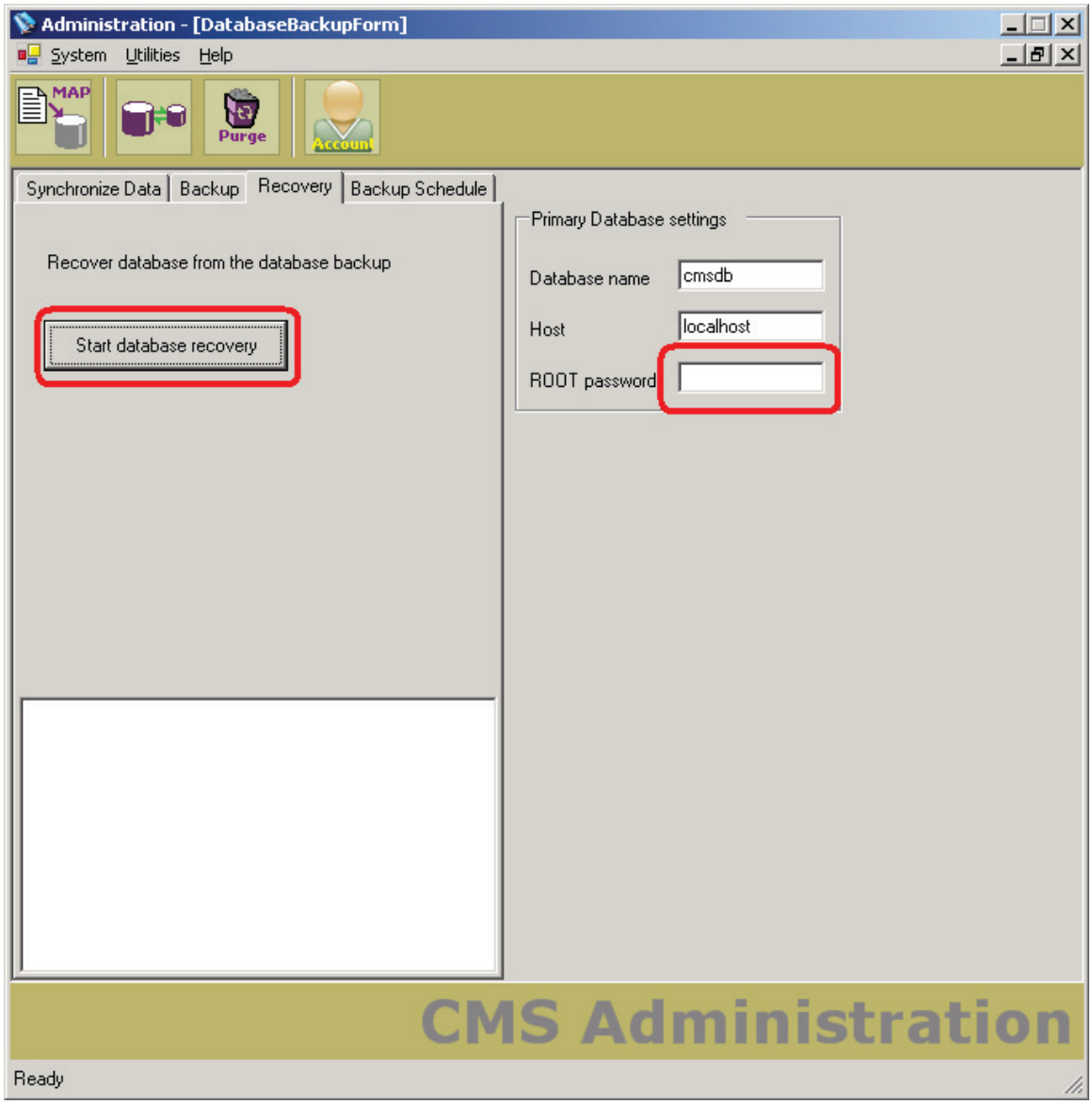


Login as administrator user. Select "Utilities->Sync data Backup and Purge->Database Backup/Sync"

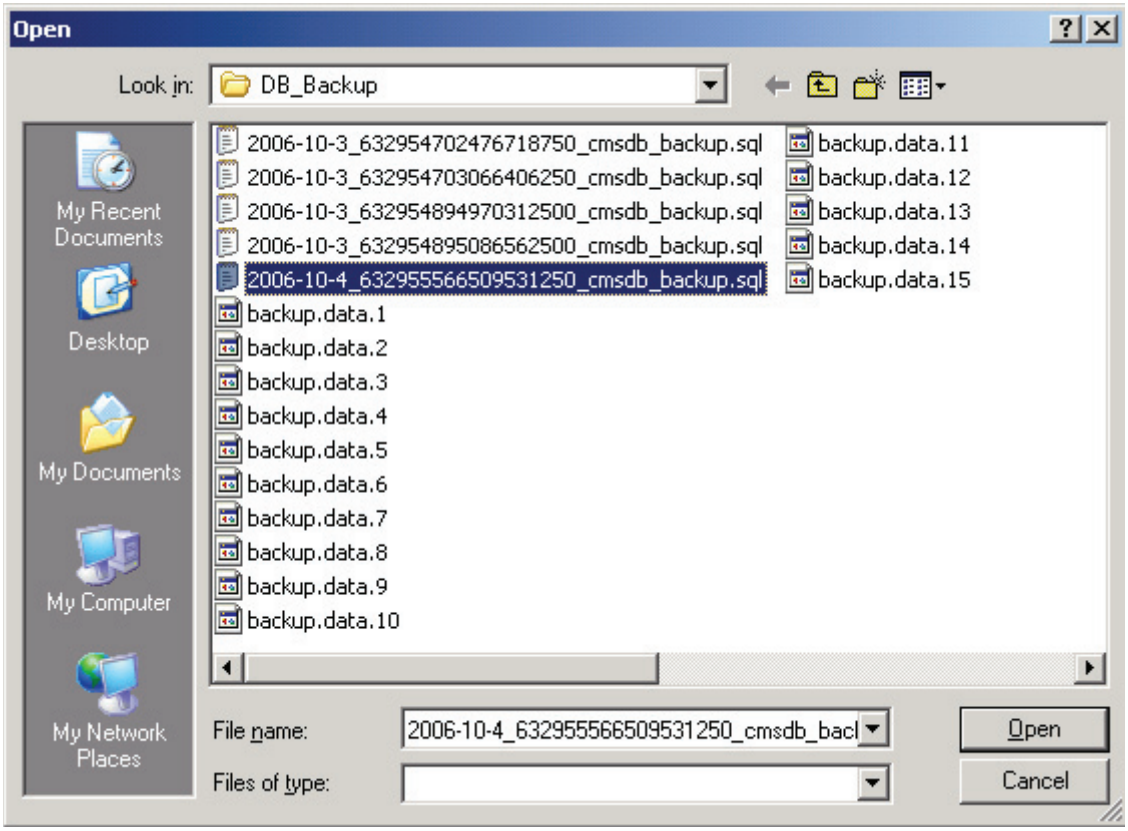




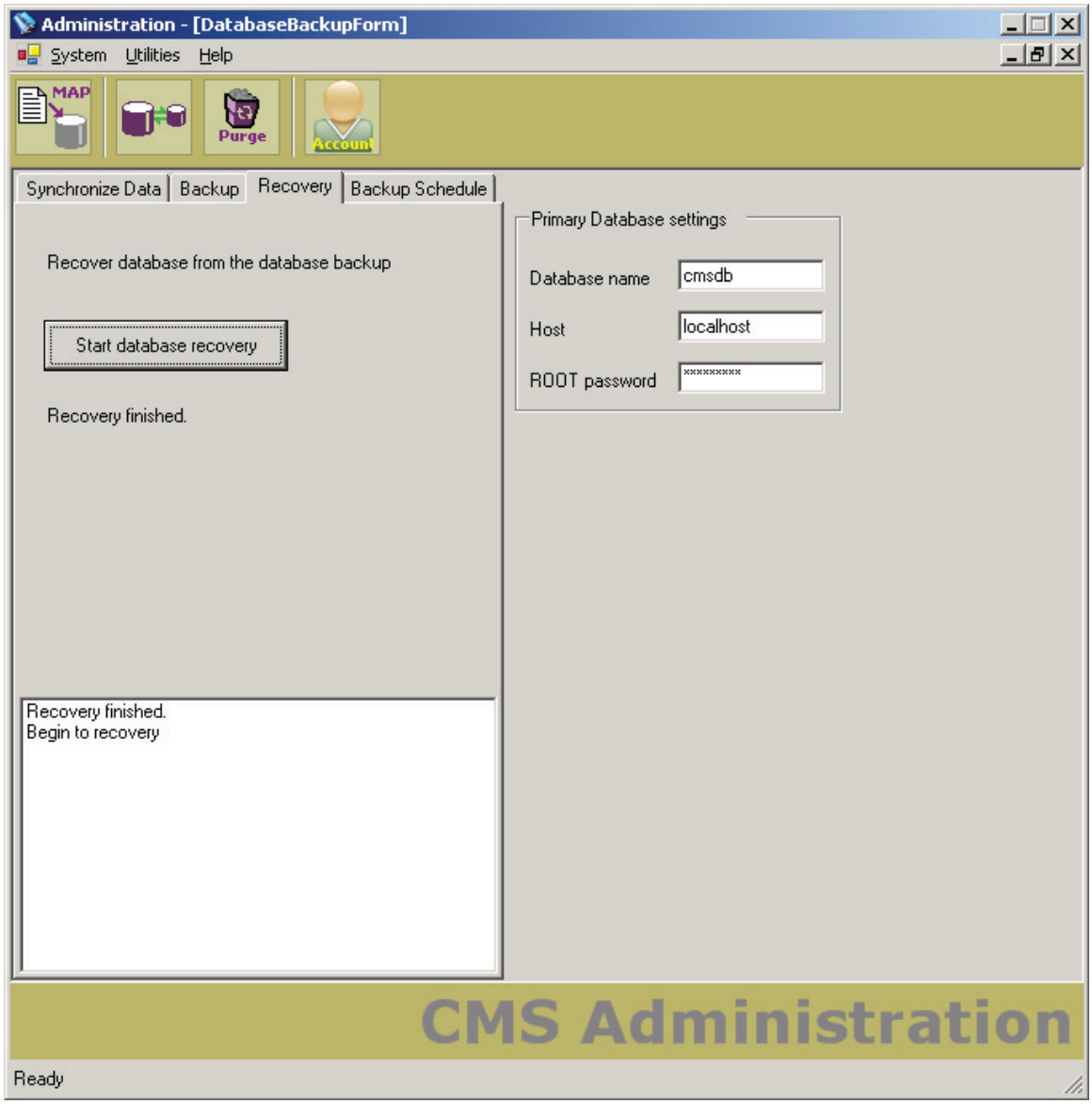
Select the tag ‘Recovery’. Input the database server’s ROOT password at the ‘Primary Database settings’. Then click ‘start database recovery’.



A pop up windows will be display and prompting you to select the database backup. Select the backup and click 'Open' to proceed.



A prompt will shown that the recovery is done. You may exit the CMS Administration program.



- Change the windows' network configuration according to the latest live configuration of CMS1 or CMS2 whatever one Is going to be replaced. For the latest configuration, you have to refer to the configuration information. The current configuration is followed (reference only):

  CMS1:

  Local Area Connection:
  - IP address: 138.9.5.60
  - Subnet mask: 255.255.252.0
  - Gateway: 138.9.5.1

  Local Area Connection 2:
  - IP address: 10.10.130.2

- Subnet mask: 255.255.255.0

Static route:
route add 202.140.96.0 mask 255.255.255.0 10.10.130.1 metric 1 –p

CMS2:

Local Area Connection:
- IP address: 138.9.5.61
- Subnet mask: 255.255.252.0
- Gateway: 138.9.5.1

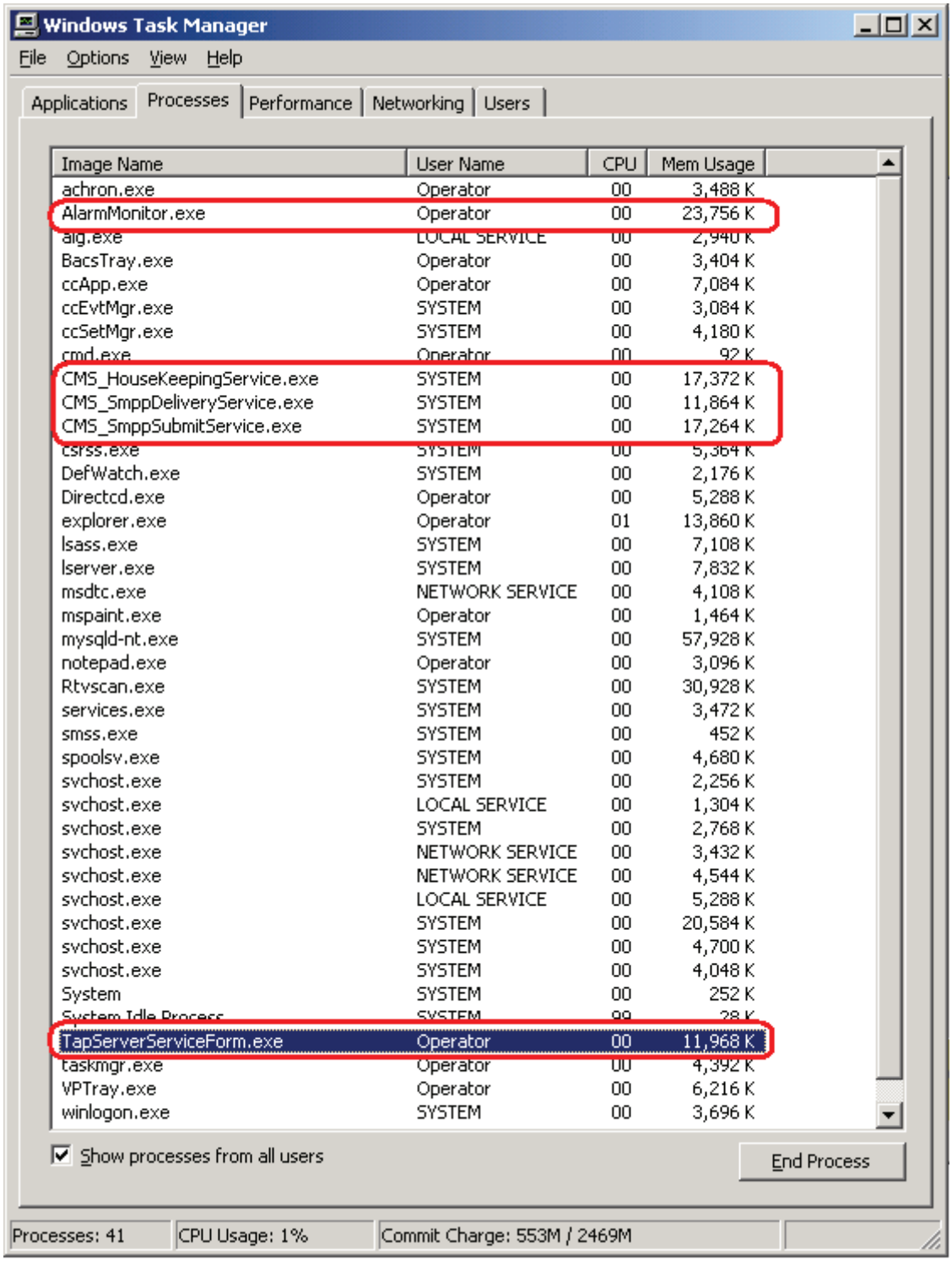
Local Area Connection 2:
- IP address: 10.10.130.66
- Subnet mask: 255.255.255.0

Static route:
route add 202.140.96.0 mask 255.255.255.0 10.10.130.65 metric 1 –p

- Replace the fail CMS server by reconnect all the serial cable and network connections. You may have to refer to the latest connection diagram. Make sure the following connector is connected:
  - 2 LAN port connected
  - serial cable connected to the EIDS terminal
  - serial cable connected to the PSP (Only if paging network is still in used)
  - CMS server's power cord

- Re-start the system

  After the server's network is properly connected. You can power on the server. After the server power on, please check that the following program is running at the task manager:
  - AlarmMonitor.exe
  - CMS_HouseKeepingService.exe
  - CMS_SmppDeliveryService.exe
  - CMS_SmppSubmitService.exe
  - TapServerServiceForm.exe

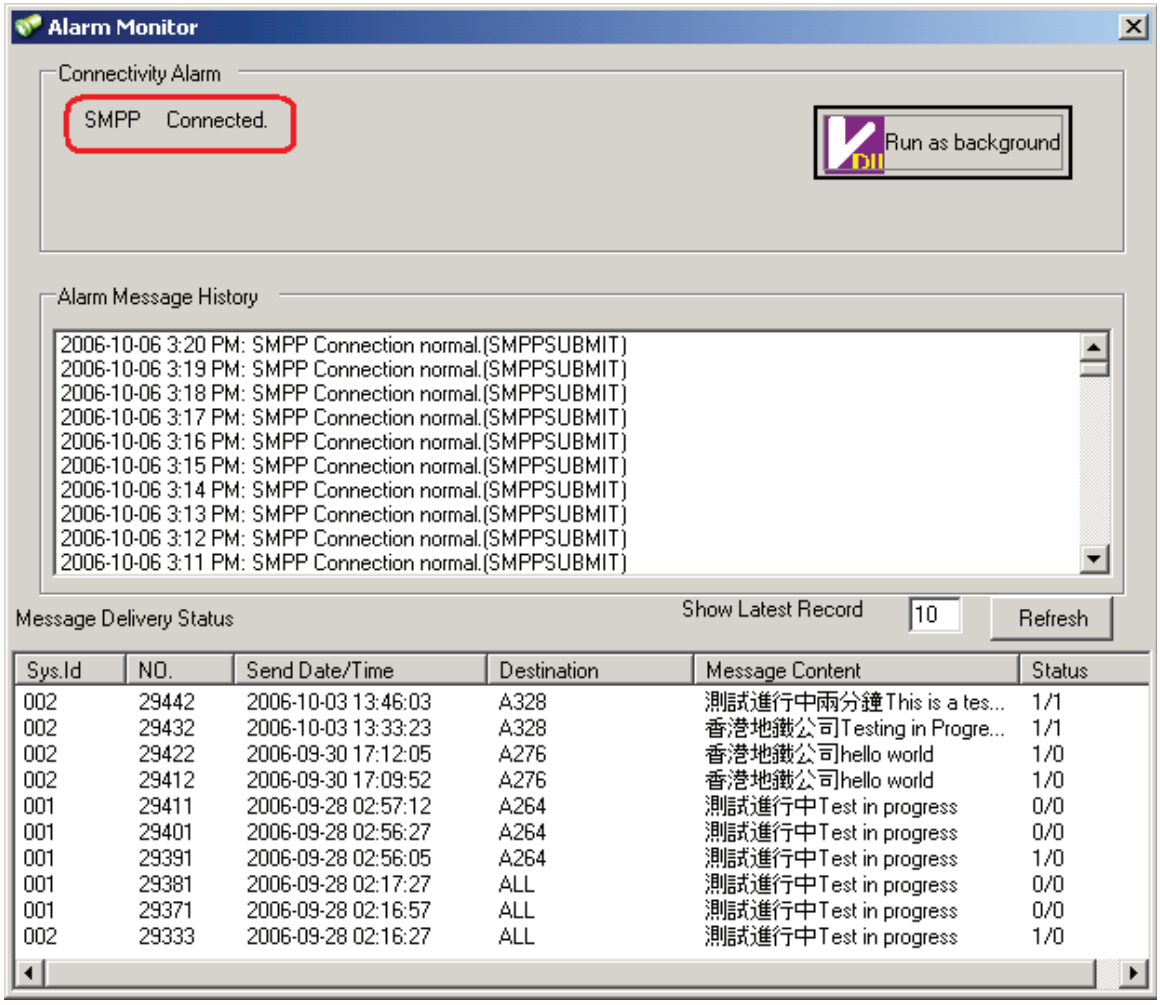


- Testing and verification

  After the system replaced, you have to test that the system is working normally by:

  Verify the Alarm Monitor program and SMPP service is working normally by:

- Check from the AlarmMonitor screen that the SMPP connection status is “Connected”



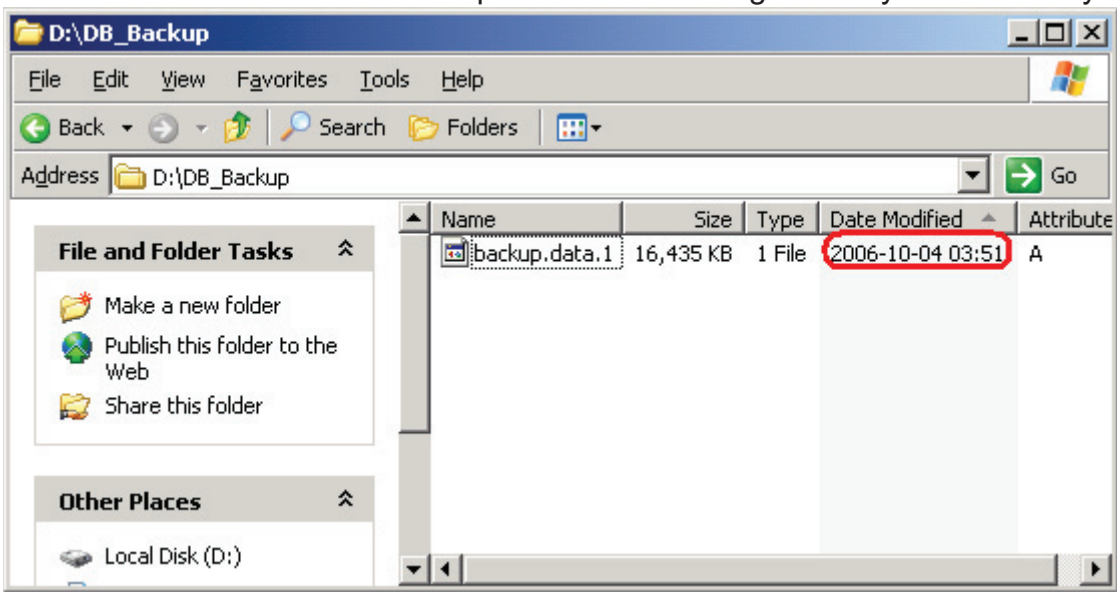
Verify the TAP module is working normally by:
- Check from the EIDS terminal that both LINE are ready (No alarm show on the EIDS terminal)

Verify the Administration program and Housekeeping service is working normally by:
- Start the Administration program and update the ACAR mapping. After 5 minutes, check from the Administration program of another live CMS server that the ACAR is updated.

Verify the overall message sending function is working normally by:
- Shut down another live CMS server. Send a message from EIDS terminal, and check that the train can receive it correctly. (Restart the stopped CMS server after testing done)

Verify the backup function is working normally by:

- On the next day, check the date of the database backup and make sure the backup function is working normally is current day.



5.2 For TRDR

There are some spare of TRDR and SIM for the faulty TRDR replacement.

Replacement Procedure for faulty SIM
1. Disconnect the RS232 connector
2. Remove the faulty SIM from TRDR
3. Insert a new SIM into TRDR
4. Reconnect the RS232 connector
5. Change the mapping of A-Car and SIM via administration terminal.

Replacement Procedure for TRDR
1. Disconnect the RS232 connector
2. Remove the faulty TRDR
3. Install the new TRDR
4. Remove the SIM from the faulty TRDR and insert it into the new TRDR.

5.3 Reinstallation of CMS Server

When the CMS server system failure due to the unrecoverable server problem, it may have to re-installation the whole system. This document is telling the procedure required to re-install the server.

Prerequisites

- An Intel server is ready. It should have been installed with the OS Windows 2003 Server and downloaded the latest Service Pack (Service Pack 1 is using now). Please note that the server should be running with Microsoft .Net framework V1.1. (By default, it's come with Windows 2003 Server)
- The hardware requirement of the server is:
  - CPU Intel Pentium 1.5GHz or above
  - Memory 1GB or above
  - ATA Harddisk disk space 100GB or above
  - 2 LAN ports with 10/100 base-T Ethernet support
  - 2 serial port (one is configured with COM1, another is configured with COM2)
- CMS server Installation disk is ready, which include CMS software 'MTR Program Files', 'MySQL' database
- Latest database backup of the live CMS server. It's advised to backup the latest database from the live CMS server which is still running normally. Otherwise, you may use the latest database backup. For the backup procedure, you may refer to the administration user menu.
- The engineer who re-install the CMS server should have windows 2003 server administration skill.
- The windows 2003 server should also be installed with the proper AntiVirus software, Time synchronization software (Network Time Protocol Client) and GoGo Pen.

Procedure of replacing the CMS server

12. Power on the spare CMS server (DO NOT connect to the live system at this moment)
    - The server should be boot up with operating system 'Windows 2003 server'.
    - Logon as Administrator

13. Create windows user account and folder
    - Create user 'operator' which is belong to the administrators group and set the password properly.
    - Create folder:
      D:\MTR Program Files
      D:\cms_log
      D:\CMS_BACKUP
    - Create other user account. You may have to create other windows user account according to the actual operation requirement.

14. Configure window 2003 server auto-logon during startup
    - You have to define the following registry key using regedit

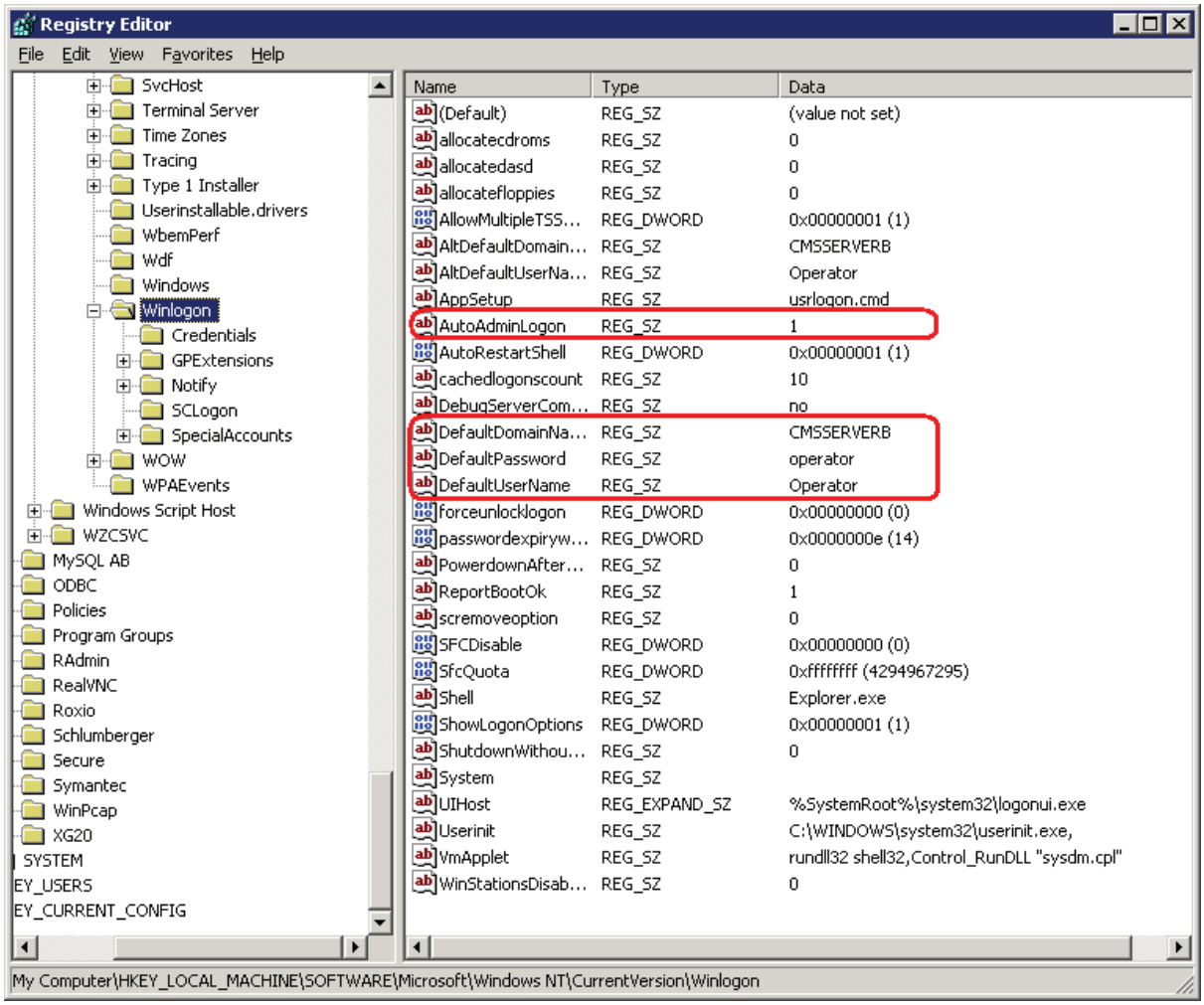
Hive:	**HKEY_LOCAL_MACHINE**
Key:	**SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon**
Name:	**AutoAdminLogon**

Type: **REG_SZ**
Value: 1 (enable auto logon)

Hive: HKEY_LOCAL_MACHINE
Key: SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon
Name: DefaultUserName
Type: REG_SZ
Value: Operator (*account to logon automatically)*

Hive: HKEY_LOCAL_MACHINE
Key: SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon
Name: DefaultPassword
Type: REG_SZ
Value: Operator (*password for DefaultUserName above)*
Caution: Password is stored in clear text. Set security permissions on Winlogon subkey to protect the account used.

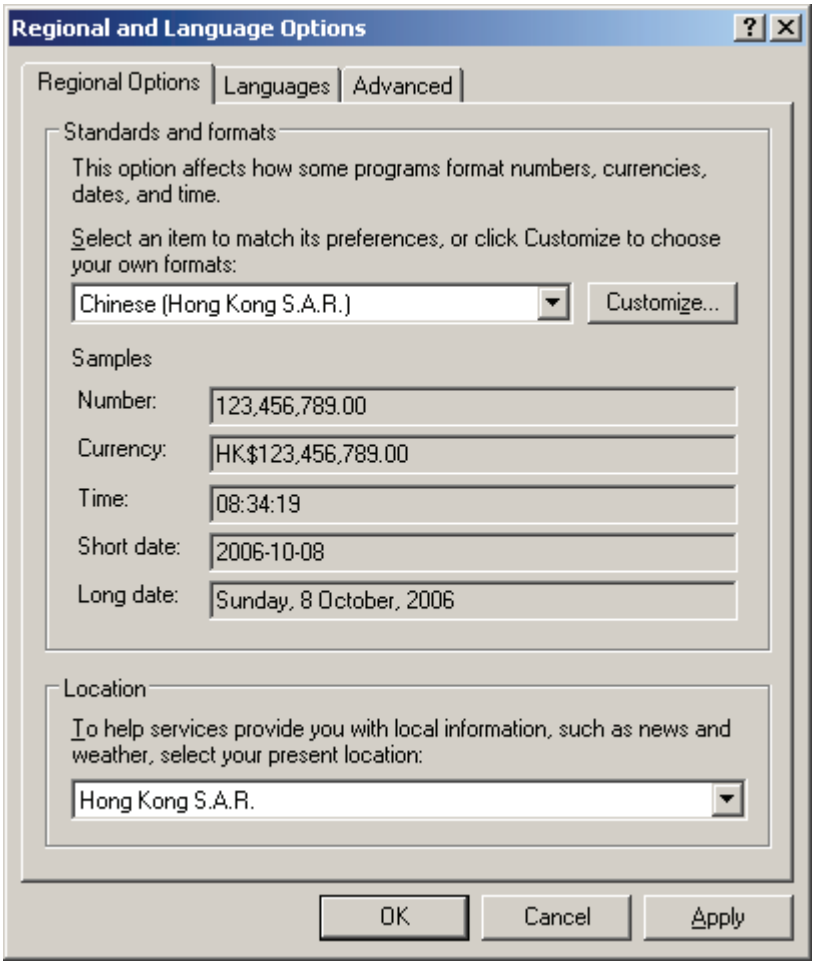
Hive: HKEY_LOCAL_MACHINE
Key: SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon
Name: DefaultDomainName
Type: REG_SZ
Value: WorkGroup (*if domain account, domain name; if local account, server name)*



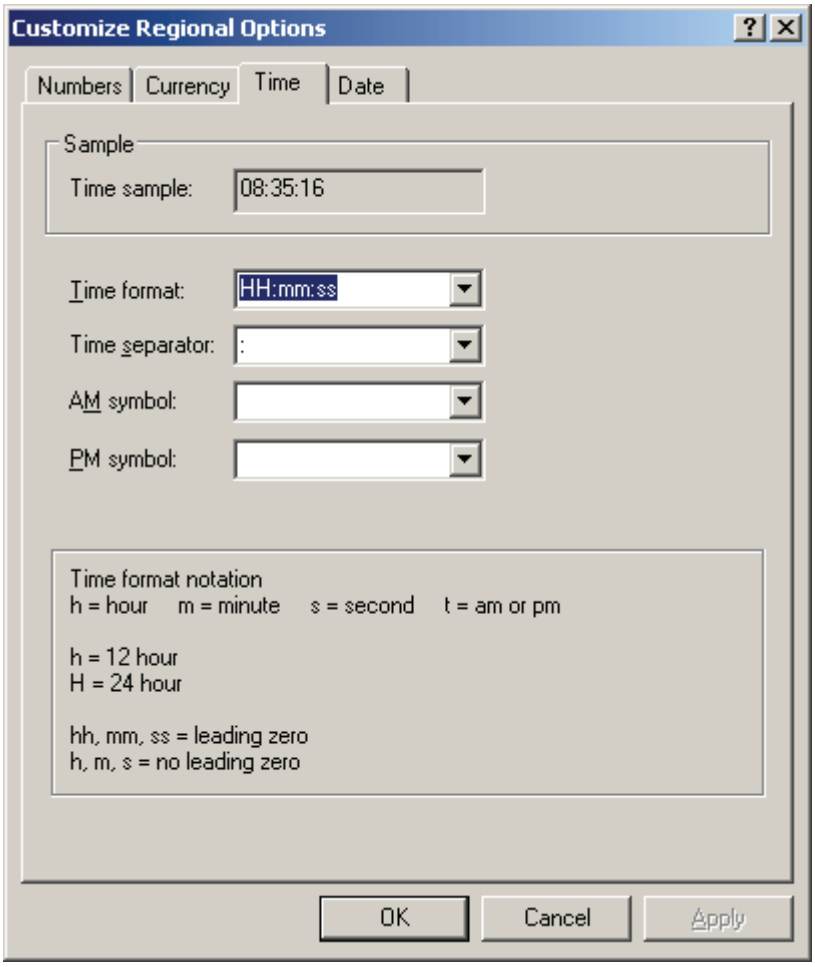
The following registry values must not exist: **LegalNoticeCaption, LegalNoticeText**.

These values force a person logging into a PC to acknowledge having read the notice. If these values exist, the legal notice dialog hangs until someone hits enter. Don't just null out the values. Delete them.

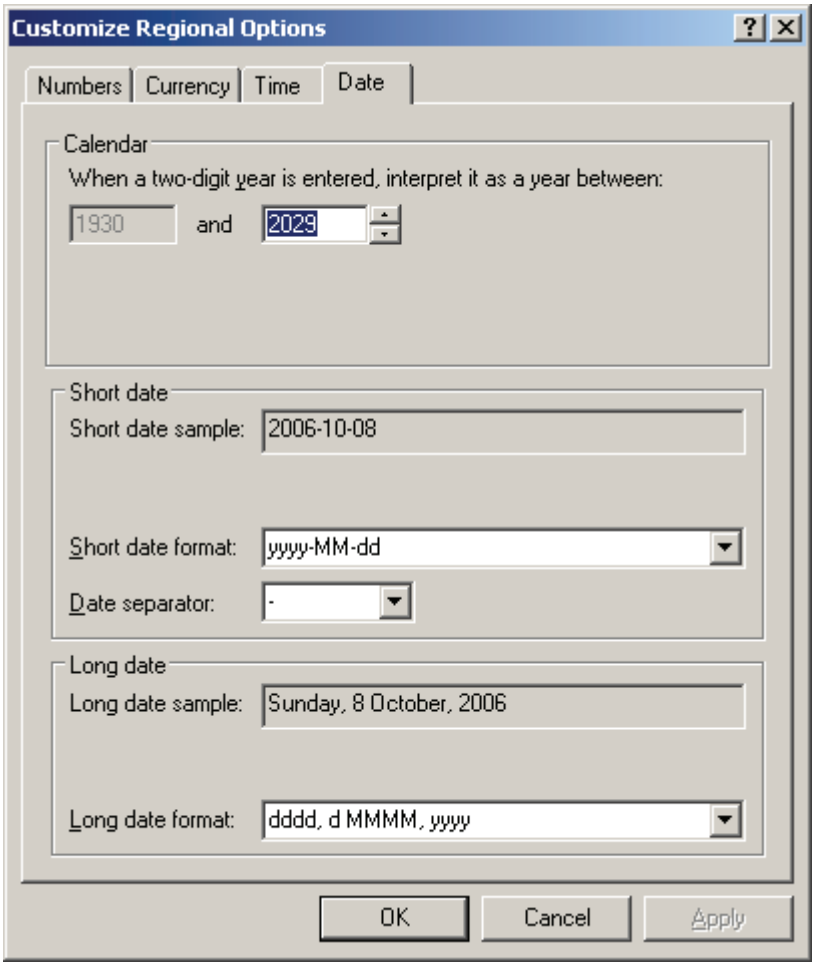
15. Change window's regional setting as followed:
    - Open control panel and select the "Regional and Language Options". At the "Regional Options" tab, click customize.



    - The "Customize Regional Options" opened, select the "Time" tab, change the time format to "HH:mm:ss".



- Then select the “Date tab, change the short date format to “yyyy-MM-dd”



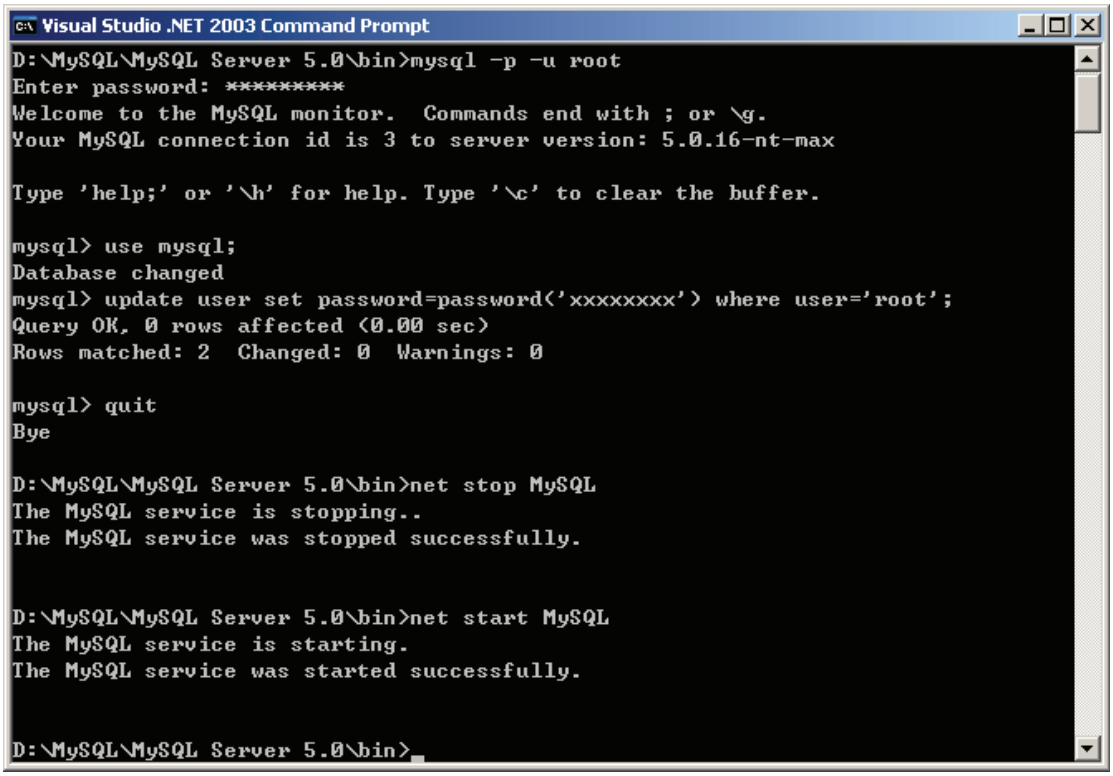
16. Install MySQL database server
    - Start the command prompt
    - Copy the MySQL database backup from the installation CD to D:

    Copy E:\MySQL D:\MySQL /Y
    - Install MySQL as a service

    D:
    cd D:\MySQL\MySQL Server 5.0\bin
    mysqld-max-nt.exe –install
    net start MySQL

17. This step is required if the MySQL root password has been changed after the system delivered. To change MySQL root password, you have to
    - Start the command prompt

    D:
    cd D:\MySQL\MySQL Server 5.0\bin
    Mysql –p –u root
    Enter password: ********
    mysql>*use mysql;*
    mysql>update user set password=password('xxxxxxx') where user='root';

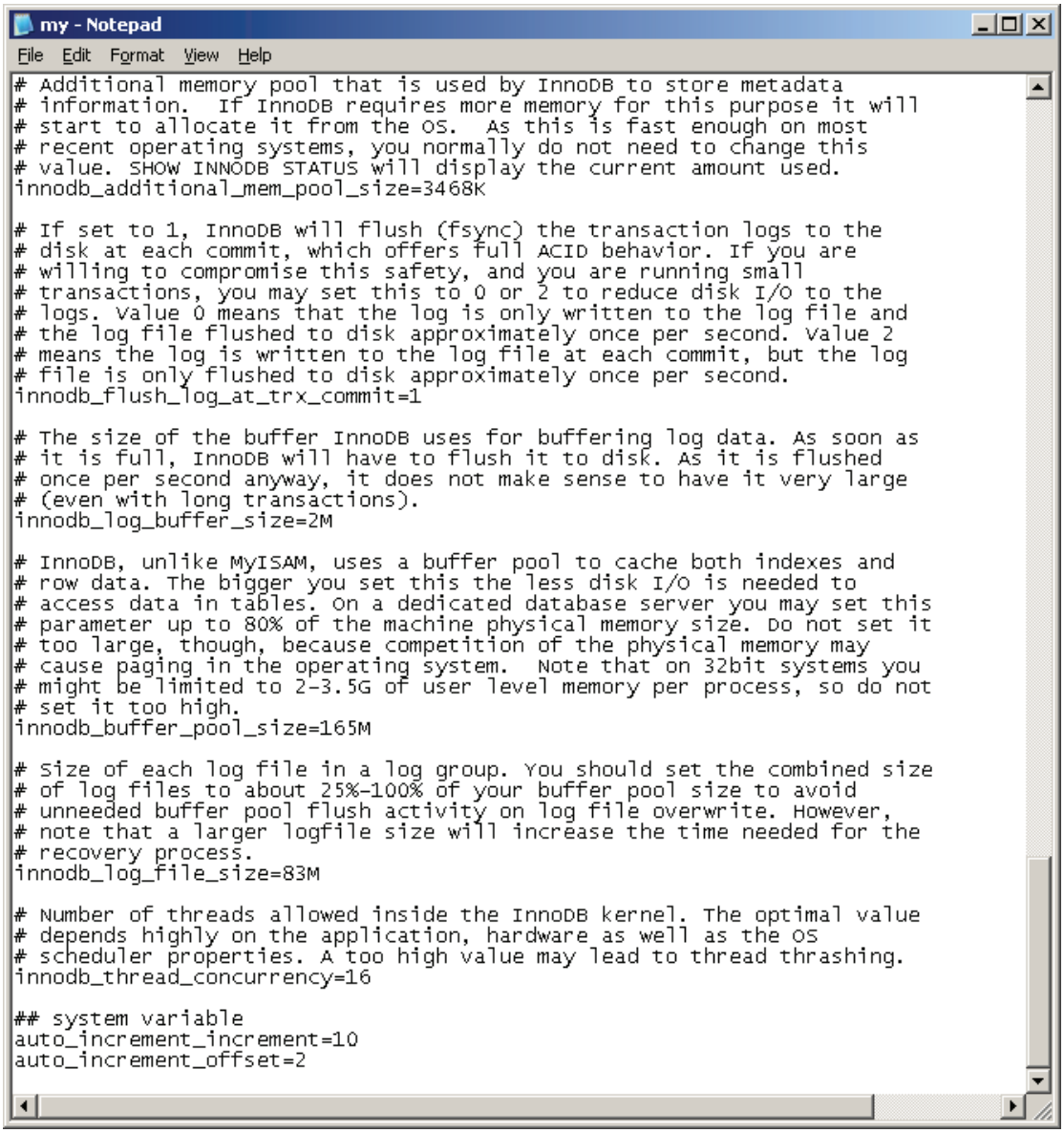


18. Change the MySQL setting in order to support data synchronization. The step is:
    - Open Notepad.exe and edit the file D:\MySQL\MySQL Server 5.0\my.ini
    - Change the following setting as according to the server. Please note that this setting must be unique amount all the CMS servers (include spare, live servers)
      auto_increment_offset=??(according to the configuration)
    - Here's the suggested configuration of the live and spare system

      <u>For primary server</u>
      auto_increment_increment=10
      auto_increment_offset=1

      <u>For secondary server</u>
      auto_increment_increment=10
      auto_increment_offset=2

      <u>For spare server</u>
      auto_increment_increment=10
      auto_increment_offset=3

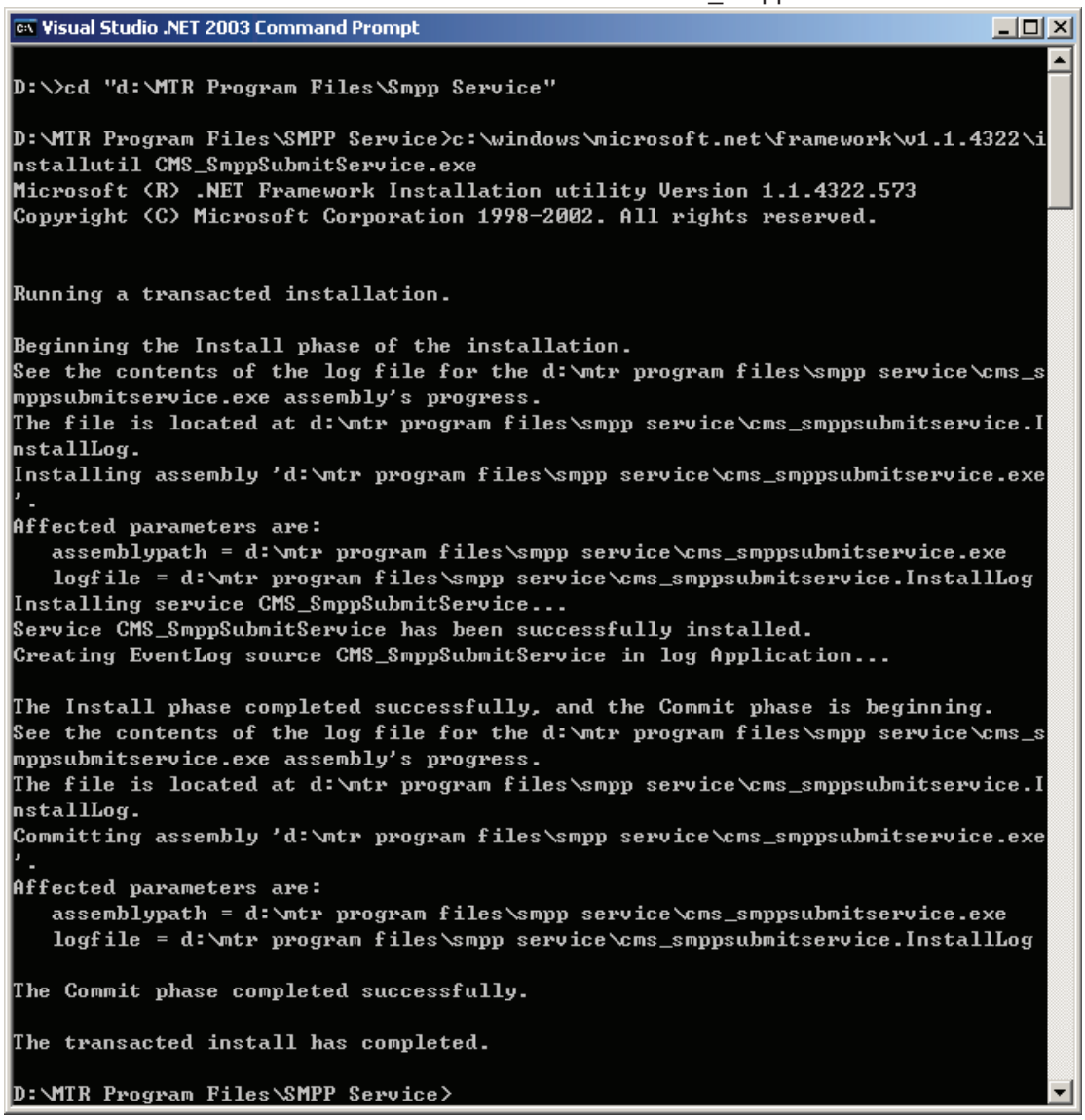

my - Notepad
File Edit Format View Help
# Additional memory pool that is used by InnoDB to store metadata
# information. If InnoDB requires more memory for this purpose it will
# start to allocate it from the OS. As this is fast enough on most
# recent operating systems, you normally do not need to change this
# value. SHOW INNODB STATUS will display the current amount used.
innodb_additional_mem_pool_size=3468K
# If set to 1, InnoDB will flush (fsync) the transaction logs to the
# disk at each commit, which offers full ACID behavior. If you are
# willing to compromise this safety, and you are running small
# transactions, you may set this to 0 or 2 to reduce disk I/O to the
# logs. Value 0 means that the log is only written to the log file and
# the log file flushed to disk approximately once per second. Value 2
# means the log is written to the log file at each commit, but the log
# file is only flushed to disk approximately once per second.
innodb_flush_log_at_trx_commit=1
# The size of the buffer InnoDB uses for buffering log data. As soon as
# it is full, InnoDB will have to flush it to disk. As it is flushed
# once per second anyway, it does not make sense to have it very large
# (even with long transactions).
innodb_log_buffer_size=2M
# InnoDB, unlike MyISAM, uses a buffer pool to cache both indexes and
# row data. The bigger you set this the less disk I/O is needed to
# access data in tables. On a dedicated database server you may set this
# parameter up to 80% of the machine physical memory size. Do not set it
# too large, though, because competition of the physical memory may
# cause paging in the operating system. Note that on 32bit systems you
# might be limited to 2-3.5G of user level memory per process, so do not
# set it too high.
innodb_buffer_pool_size=165M
# Size of each log file in a log group. You should set the combined size
# of log files to about 25%-100% of your buffer pool size to avoid
# unneeded buffer pool flush activity on log file overwrite. However,
# note that a larger logfile size will increase the time needed for the
# recovery process.
innodb_log_file_size=83M
# Number of threads allowed inside the InnoDB kernel. The optimal value
# depends highly on the application, hardware as well as the OS
# scheduler properties. A too high value may lead to thread thrashing.
innodb_thread_concurrency=16
system variable
auto_increment_increment=10
auto_increment_offset=2

19. Install CMS software
    - Open command prompt
    - Copy “MTR Program Files” from CDROM to D: drive

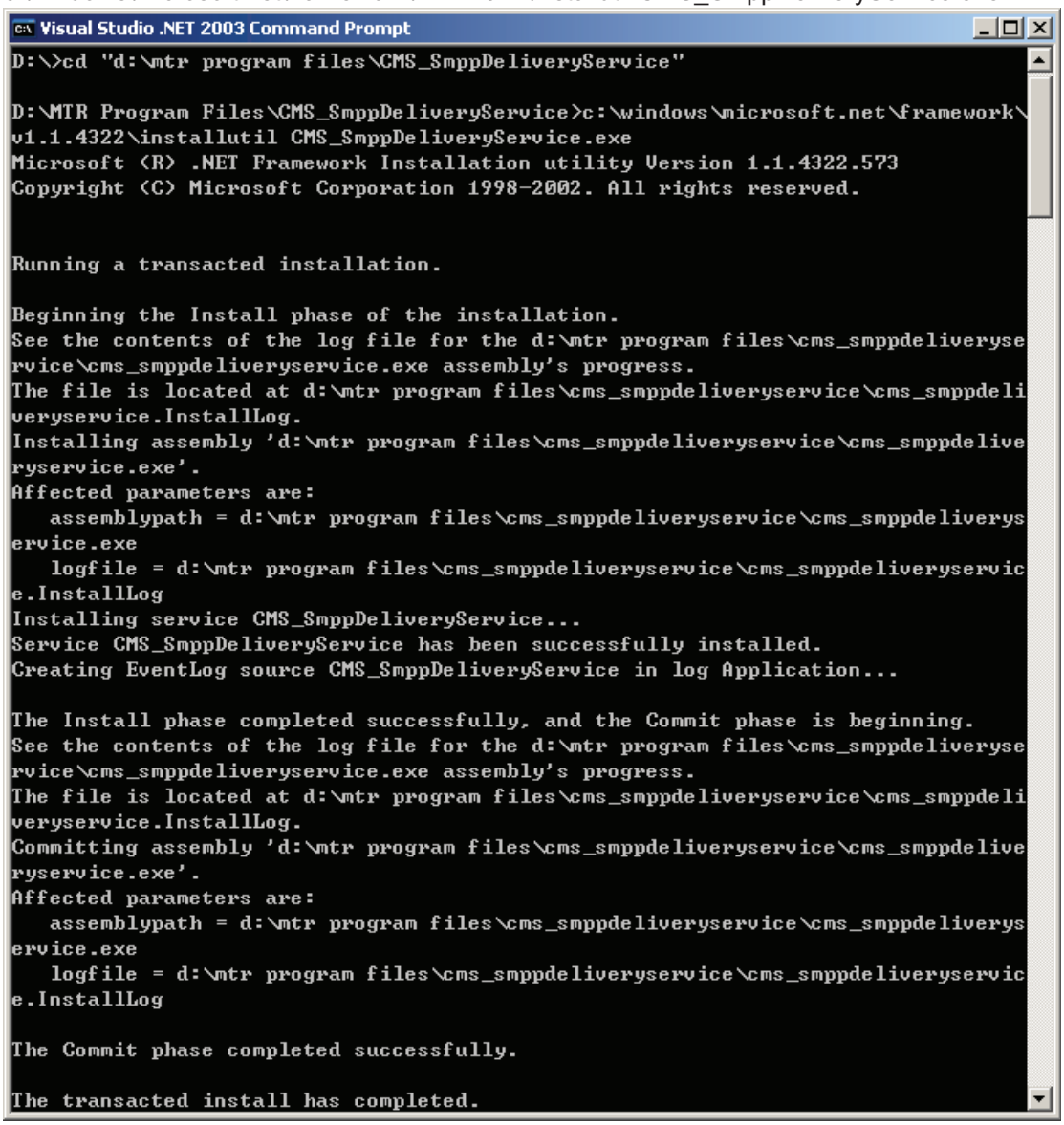
copy “E:\MTR Program Files” D:\ /Y

    - Setup windows service

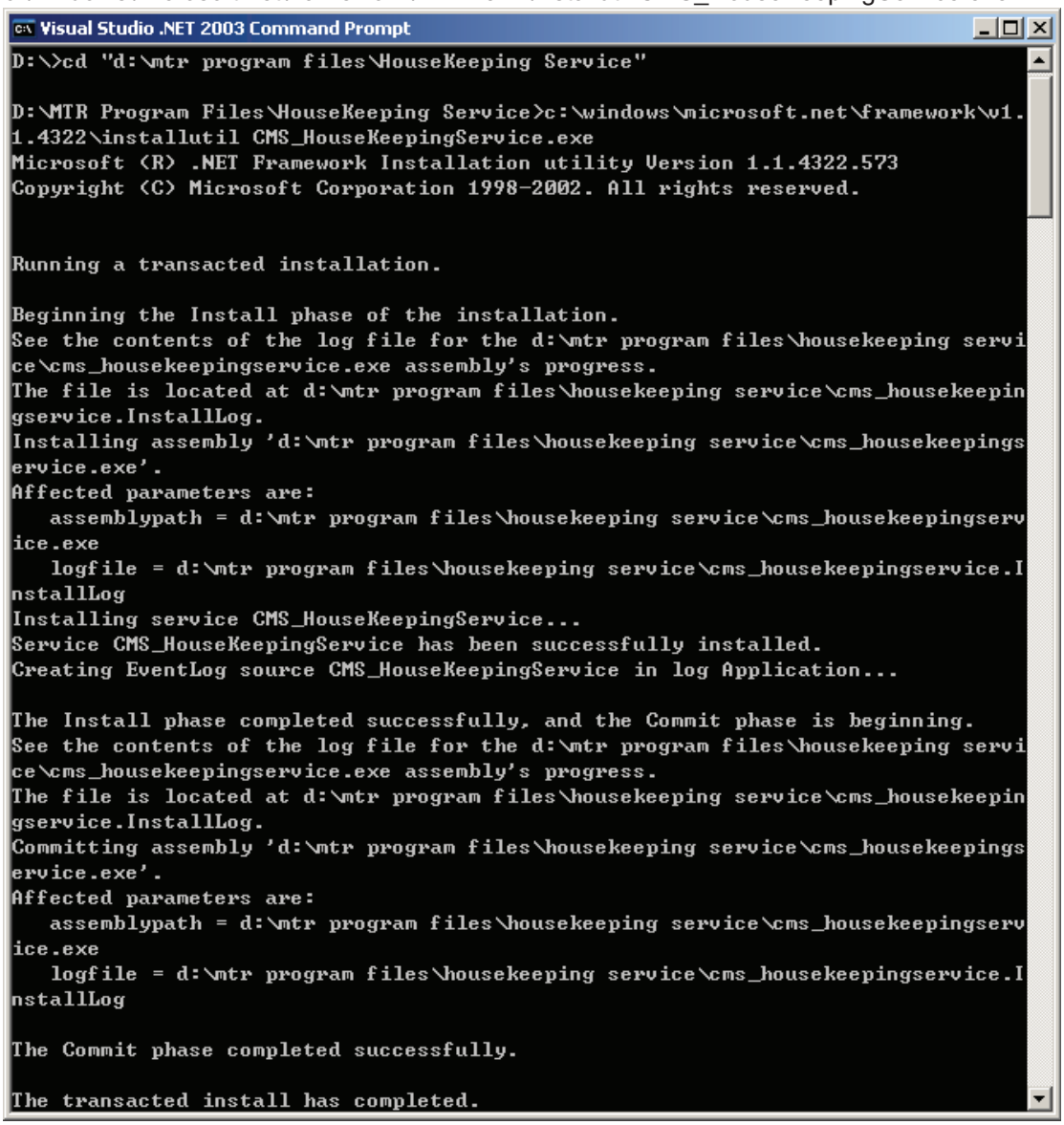
cd “d:\MTR Program Files\Smpp Service”
c:\windows\microsoft.net\framework\v1.1.4322\installutil CMS_SmppSubmitService.exe



cd “d:\mtr program files\CMS_SmppDeliverySerivce”
c:\windows\microsoft.net\framework\v1.1.4322\installutil CMS_SmppDeliveryService.exe



cd d:\mtr program files\housekeeping service
c:\windows\microsoft.net\framework\v1.1.4322\installutil CMS_HouseKeepingService.exe



20. Add the following program to windows user operator's startup, such that these program will be auto start upon system power on:
    - Tap Server Module
    D:\MTR Program Files\TapServerForm\TapServerServiceForm.exe

    - Alarm Monitor Module
    D:\MTR Program Files\Alarm Monitor\AlarmMonitor.exe

21. You may have to create short-cut onto the desktop of windows user according to the operating requirement. Here's short-cut program:

    - Tap Server Module
    D:\MTR Program Files\TapServerForm\TapServerServiceForm.exe

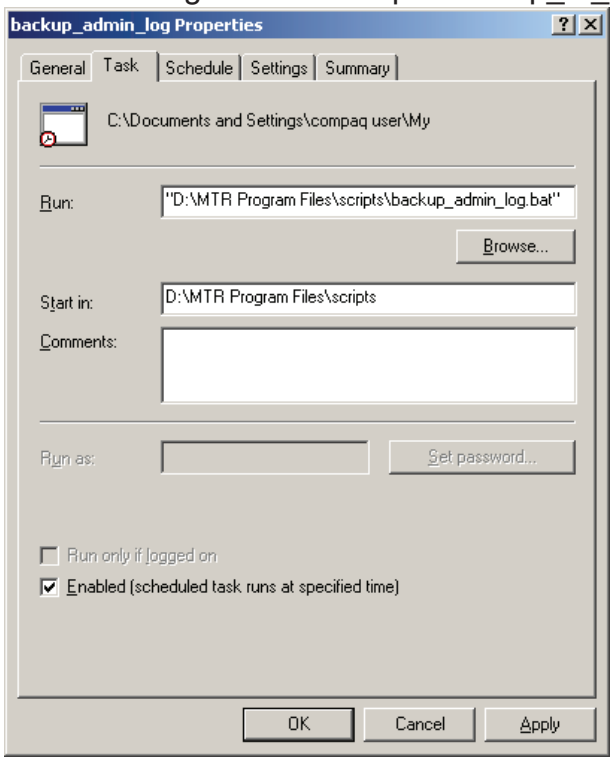
    - Alarm Monitor Module
    D:\MTR Program Files\Alarm Monitor\AlarmMonitor.exe

    - Administration Module
    D:\MTR Program Files\Administration\Administration.exe

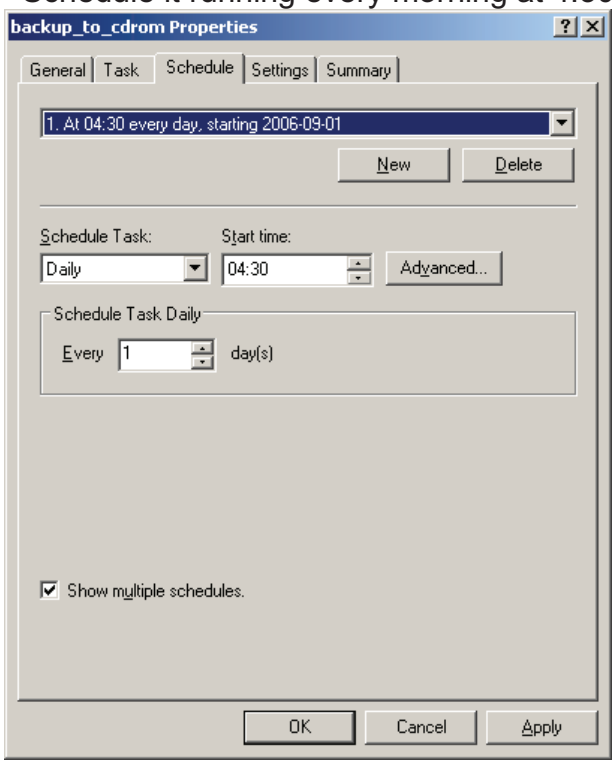
    - VCN terminal (option 2)
    D:\MTR Program Files\VCNExpressComm\VCNExpressComm.exe

    - Tap Client (when paging network is in use)
    D:\MTR Program Files\TapClientForm\TapClientServiceForm.exe

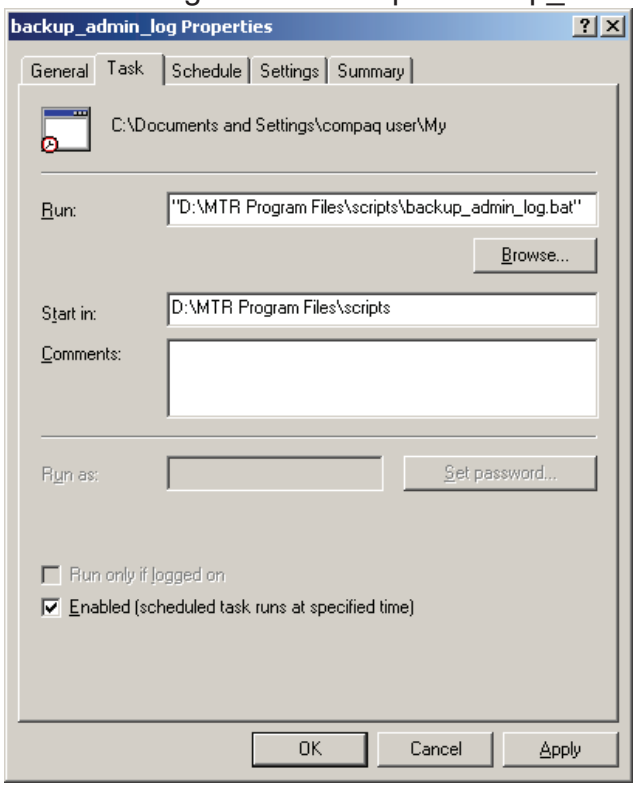
22. Create schedule using windows' Schedule and Task:
    - Backup to CDROM – copy the harddisk backup from harddisk to CDROM. It has to set task:
        i. Run the script
        "D:\MTR Program Files\scripts\backup_to_cdrom.bat"



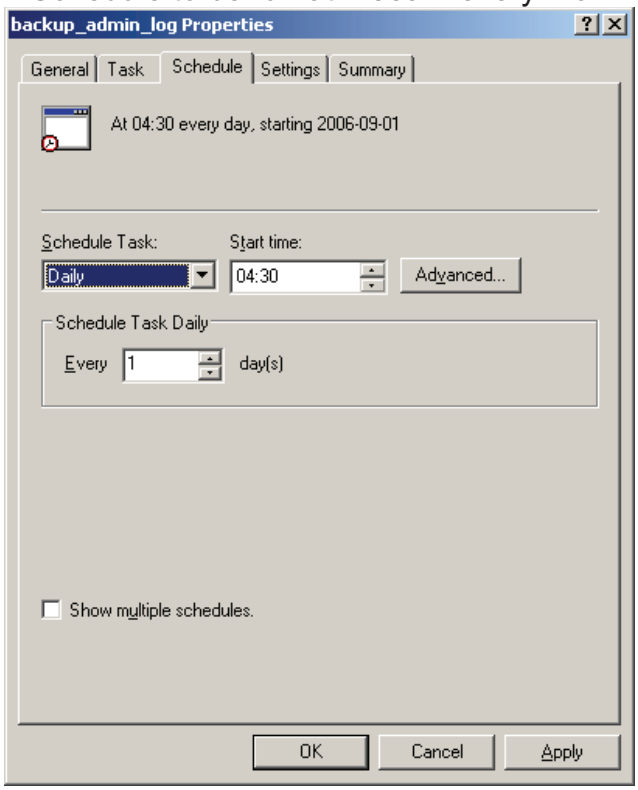
        ii. Schedule it running every morning at 4:30am



- Backup to Admin. Log – copy the administration log. It has to set task:
  i. Run the script:
  "D:\MTR Program Files\scripts\backup_admin_log.bat"

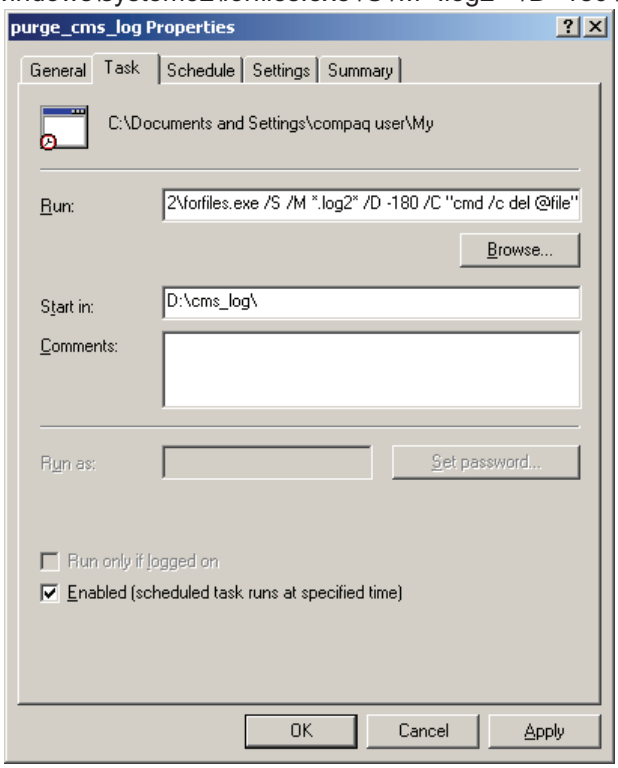


  ii. Schedule to be run at 4:30am every morning.

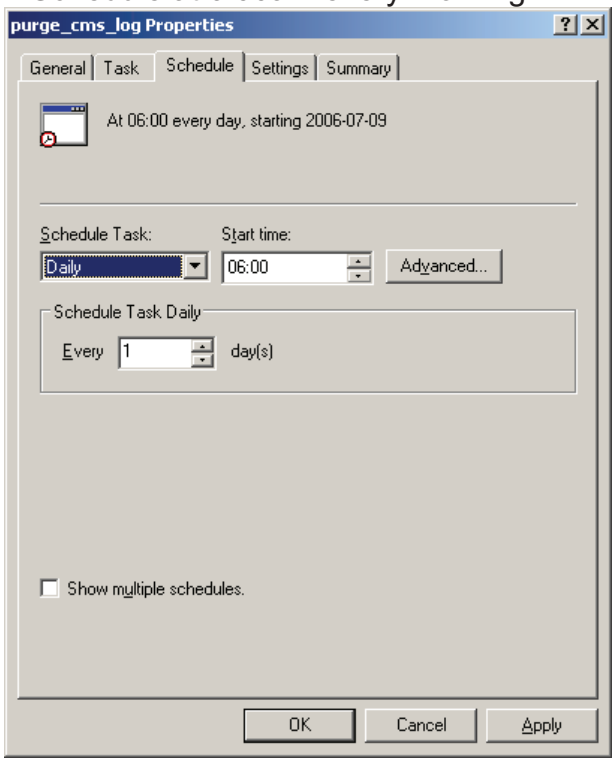


- Purge file under d:\cms_log files.
  i. Run the program:

C:\windows\system32\forfiles.exe /S /M “.log2*” /D -180 /C “cmd /c del @file”

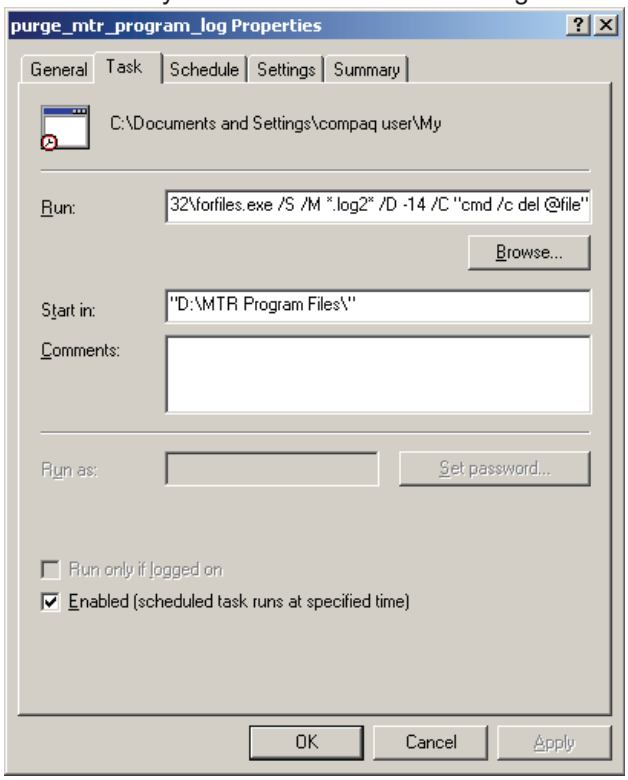


ii. Schedule at 6:00am every morning

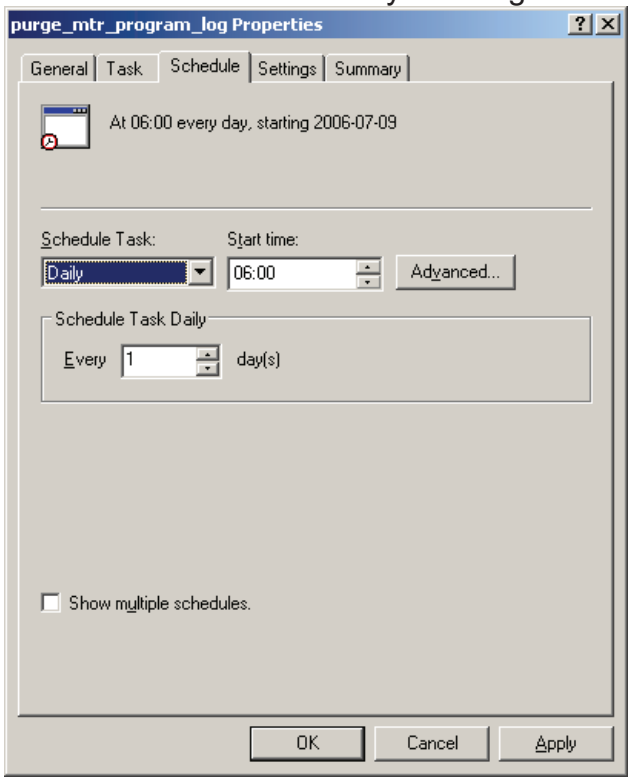


- Purge MTR program log files.
  i. Run the program:

C:\windows\system32\forfiles.exe /S /M *.log2* /D /C “cmd /c del @file”

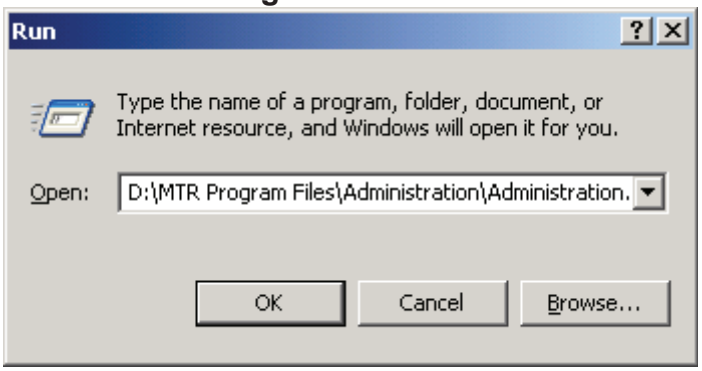


  ii. Schedule at 6:00am every morning

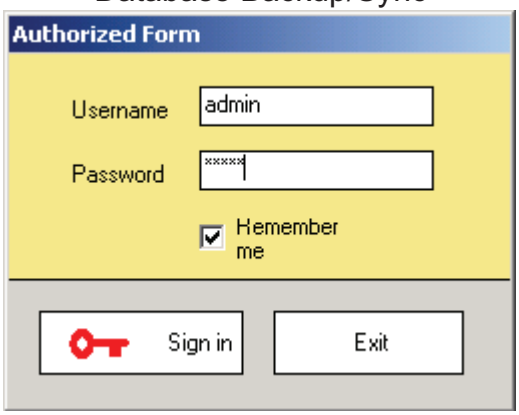


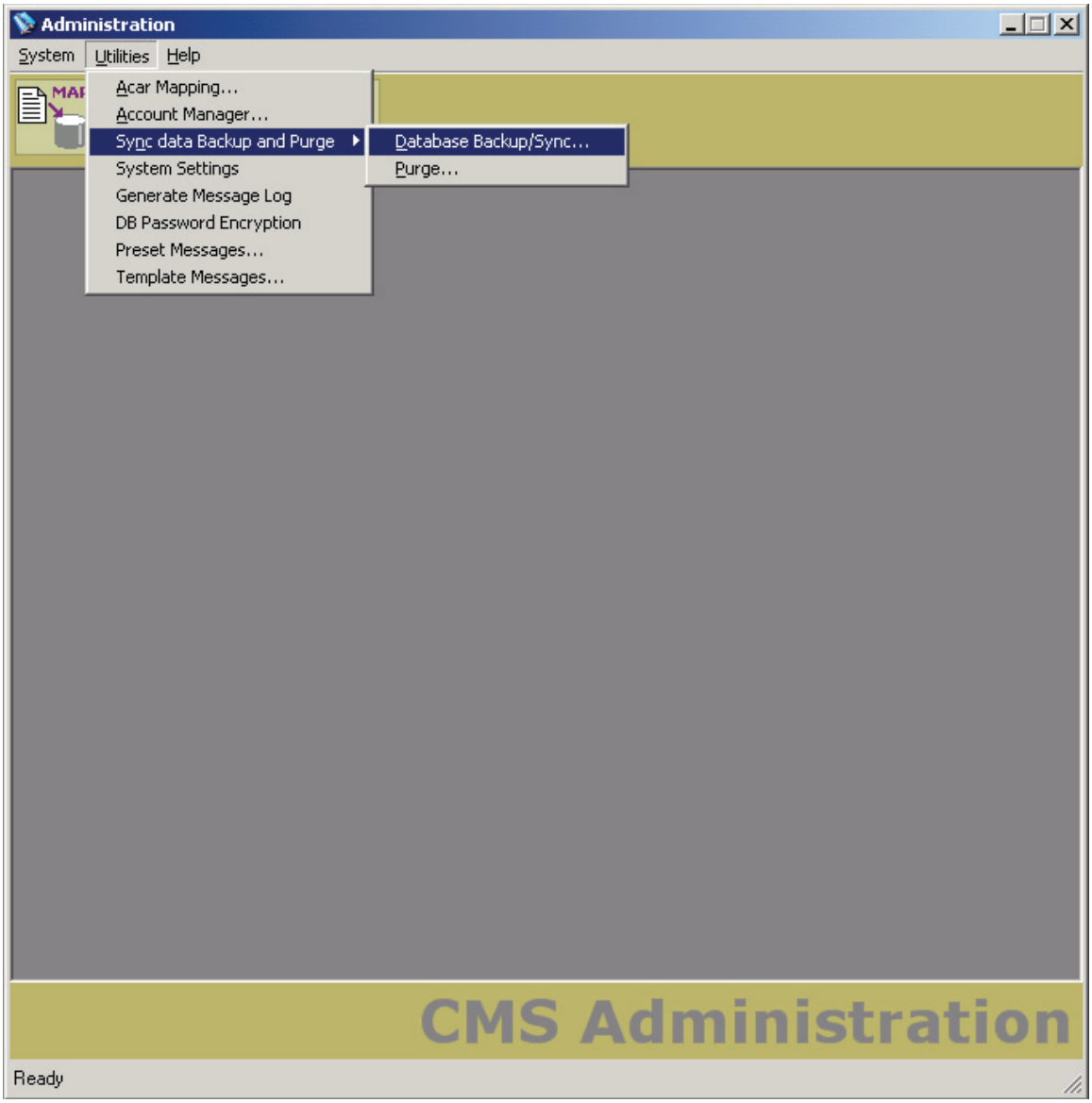
23. Restore the latest database backup into the server.

Run the CMS administration program at "**D:\MTR Program Files\Administration\Administration.exe**"

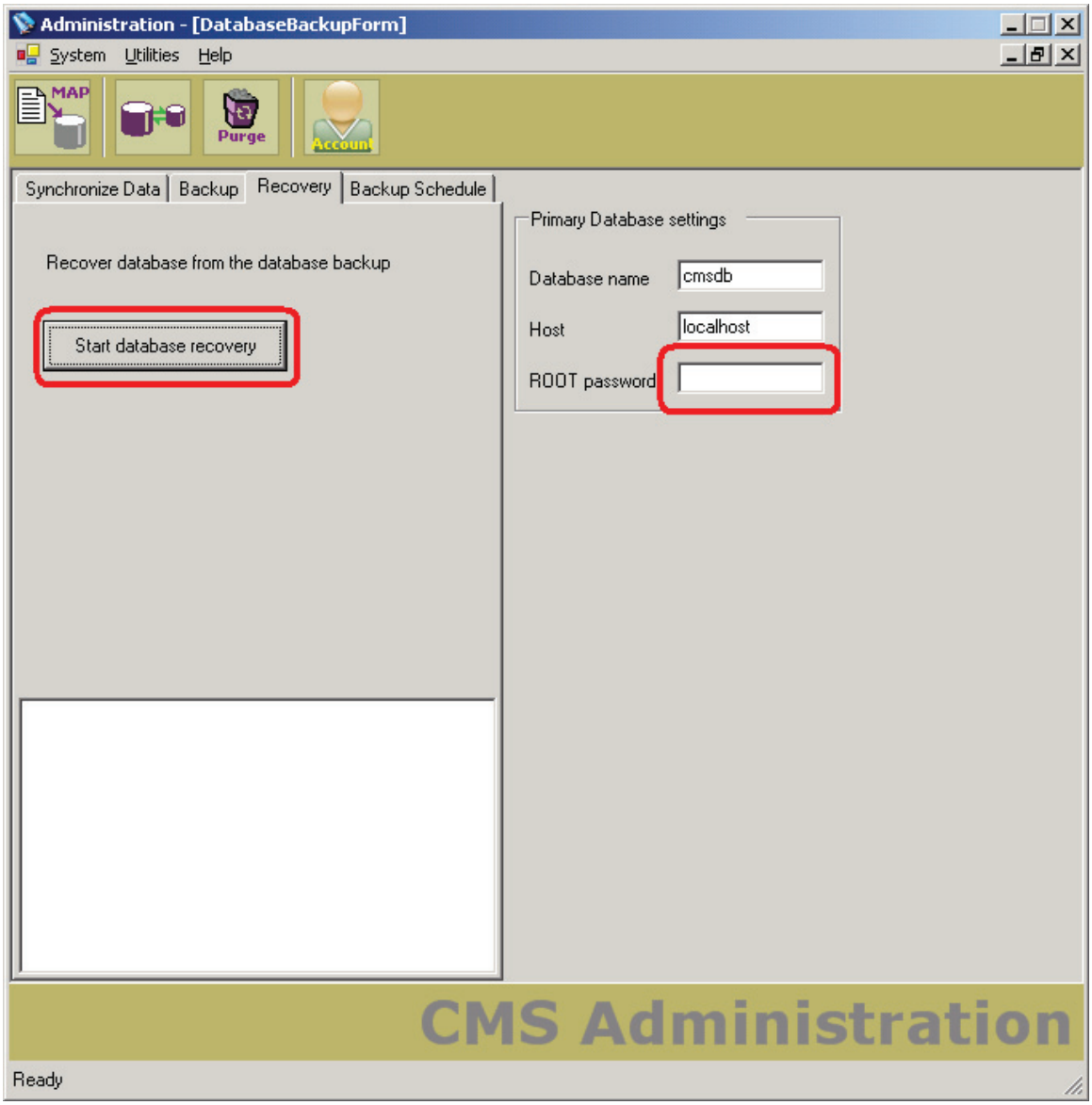


Login as administrator user. Select "Utilities->Sync data Backup and Purge->Database Backup/Sync"

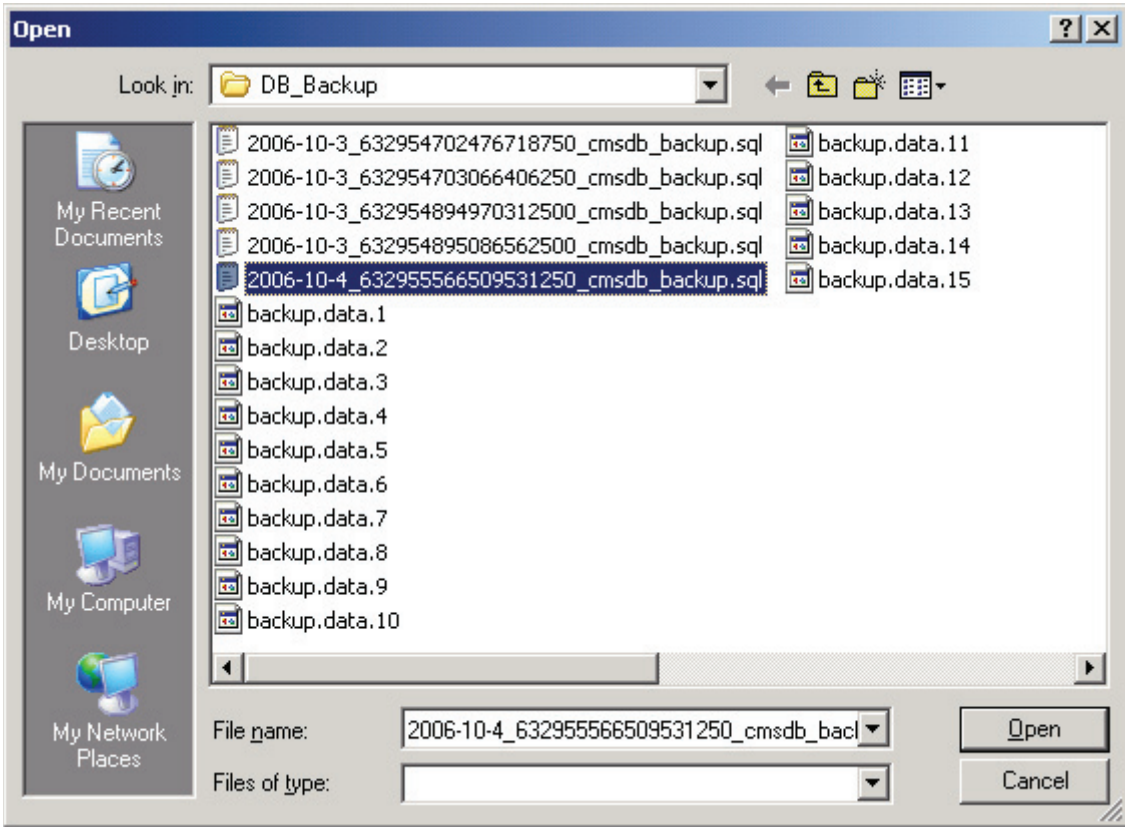




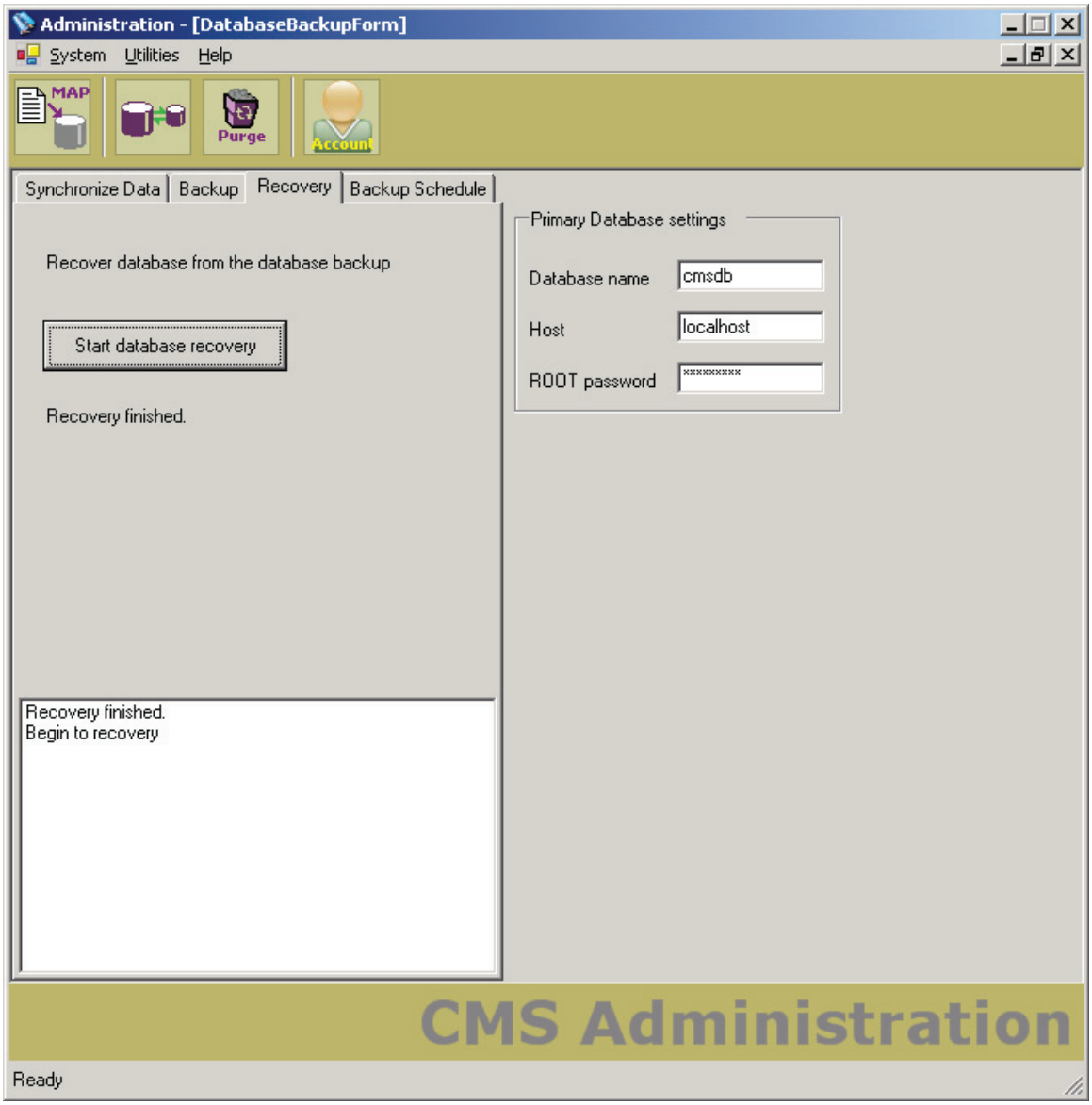
Select the tag ‘Recovery’. Input the database server’s ROOT password at the ‘Primary Database settings’. Then click ‘start database recovery’.



A pop up windows will be display and prompting you to select the database backup. Select the backup and click 'Open' to proceed.



A prompt will shown that the recovery is done. You may exit the CMS Administration program.


Administration - [DatabaseBackupForm]
System
Utilities
Help
MAP
Purge
Account
Synchronize Data
Backup
Recovery
Backup Schedule
Recover database from the database backup
Start database recovery
Recovery finished.
Recovery finished.
Begin to recovery
Primary Database settings
Database name
cmsdb
Host
localhost
ROOT password
CMS Administration
Ready

24. Change the windows' network configuration according to the latest live configuration of CMS1 or CMS2 whatever one Is going to be replaced. For the latest configuration, you have to refer to the configuration information. The current configuration is followed (reference only):

CMS1:

Local Area Connection:
- IP address: 138.9.5.60
- Subnet mask: 255.255.252.0
- Gateway: 138.9.5.1

Local Area Connection 2:
- IP address: 10.10.130.2
- Subnet mask: 255.255.255.0

Static route:
route add 202.140.96.0 mask 255.255.255.0 10.10.130.1 metric 1 –p

CMS2:

Local Area Connection:
- IP address: 138.9.5.61
- Subnet mask: 255.255.252.0
- Gateway: 138.9.5.1

Local Area Connection 2:
- IP address: 10.10.130.66
- Subnet mask: 255.255.255.0

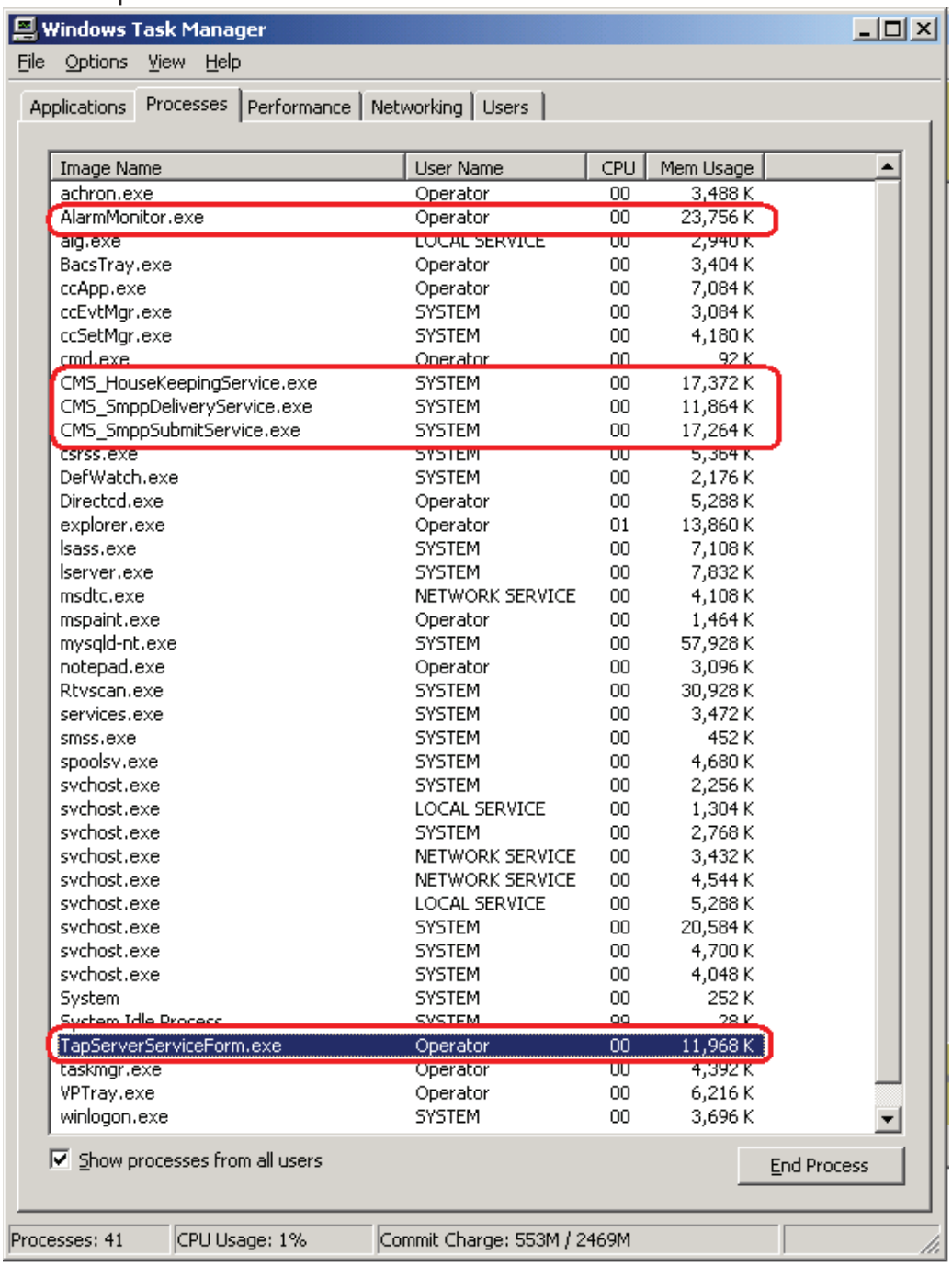
Static route:
route add 202.140.96.0 mask 255.255.255.0 10.10.130.65 metric 1 –p

25. Replace the fail CMS server by reconnect all the serial cable and network connections. You may have to refer to the latest connection diagram. Make sure the following connector is connected:
    - 2 LAN port connected
    - serial cable connected to the EIDS terminal
    - serial cable connected to the PSP (Only if paging network is still in used)
    - CMS server's power cord

26. Re-start the system

After the server's network is properly connected. You can power on the server. After the server power on, please check that the following program is running at the task manager:

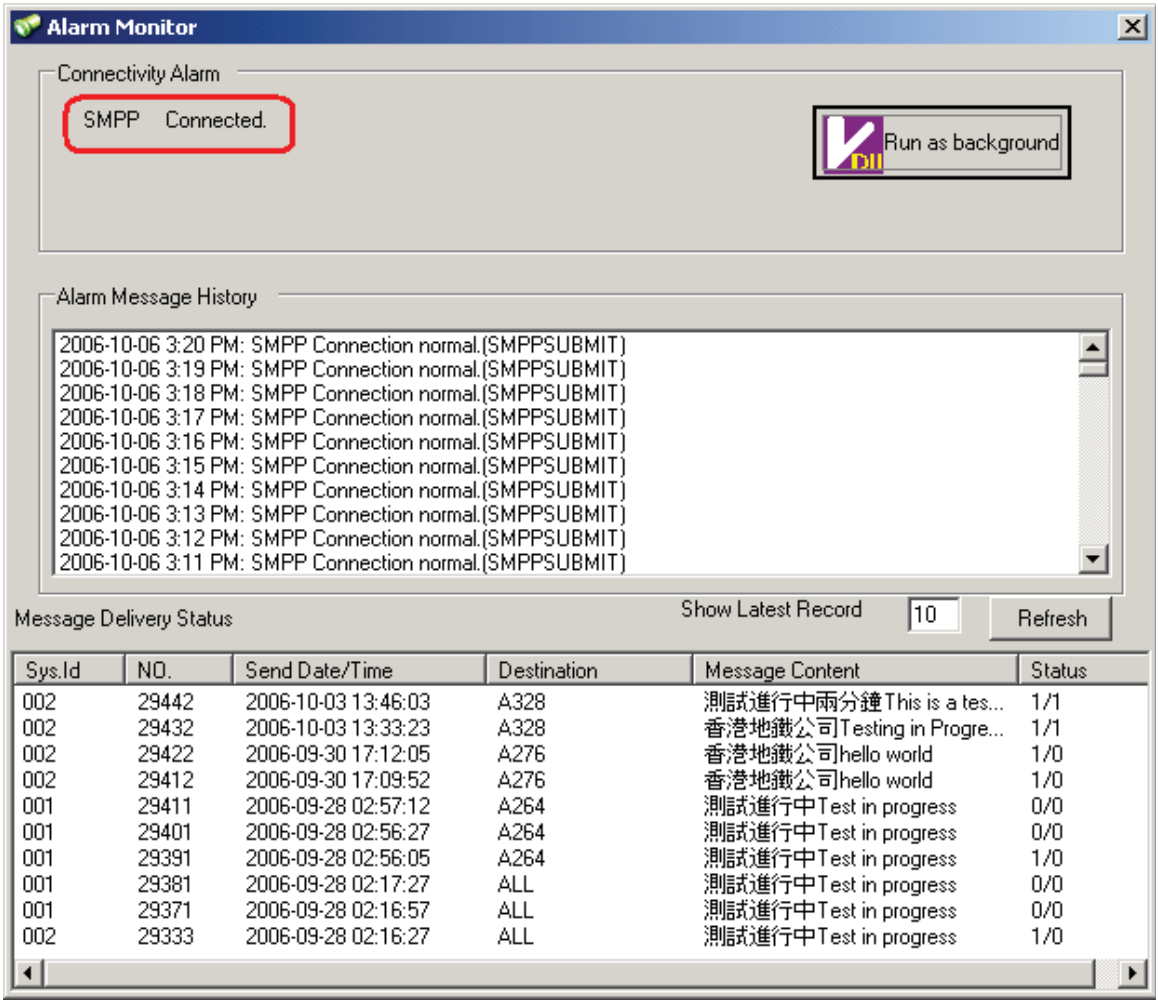
- AlarmMonitor.exe
- CMS_HouseKeepingService.exe
- CMS_SmppDeliveryService.exe
- CMS_SmppSubmitService.exe
- TapServerServiceForm.exe



27. Testing and verification

After the system replaced, you have to test that the system is working normally by:

- Verify the Alarm Monitor program and SMPP service is working normally by: Check from the AlarmMonitor screen that the SMPP connection status is “Connected”

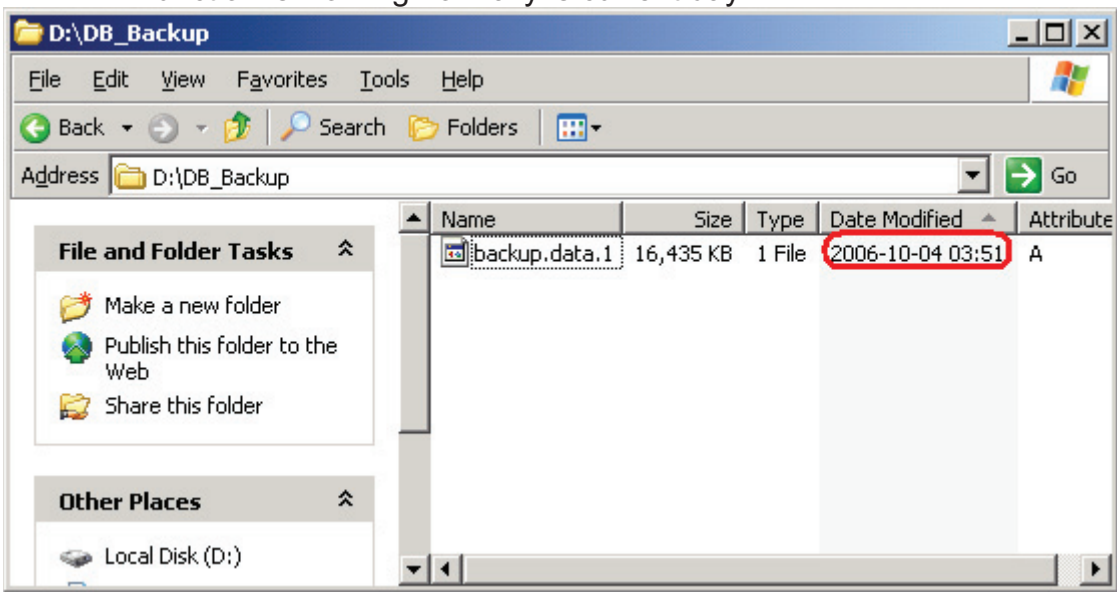


- Verify the TAP module is working normally by: Check from the EIDS terminal that both LINE are ready (No alarm show on the EIDS terminal)

- Verify the Administration program and Housekeeping service is working normally by: Start the Administration program and update the ACAR mapping. After 5 minutes, check from the Administration program of another live CMS server that the ACAR is updated.

- Verify the overall message sending function is working normally by: Shut down another live CMS server. Send a message from EIDS terminal, and check that the train can receive it correctly. (Restart the stopped CMS server after testing done)

- Verify the backup function is working normally by: on the next day, check the date of the database backup and make sure the backup function is working normally is current day.



28. System installation done and ready.

6 Appendix

6.1 Specification for CMS PC

Dell Model PowerEdge(TM) 850

with Intel(R) Pentium(R) D Proc 3.0GHz/2x1MB/L2,EM64T

-Integrated Dual Broadcom 5721J Gigabit Network Card
-Integrated XGI XG20 VGA Controller (16MB)
-Integrated SATA (2 Channels)
-Integrated USB 2.0
-Expansion Riser: 2x PCIe slots (1xPCIe x8 and 1xPCIe x4)
-1GB (2x512), DDR-2 533MHz ECC 1R Memory
-160GB (7200 RPM) SATA Hard Drive
-Microsoft(R) Windows(R) Server 2003 Standard Edition English (5 CALs)
-CD Kit for Microsoft(R) Windows(R) Server 2003 Standard Edition (English)
-Dell(TM) OpenManage(TM) Software Kit for PowerEdge(TM) 850
-CDRW/DVD Combo Drive with 24x Max Speed 8H657 -No Rack Mounting Rails
-Power Cord with IEC C13-C14 plugs for UPS/PDU connection
-User's Guide and Installation & Troubleshooting Guide for PE850 (ENG)

-Chassis

- Form Factor: 1U Rack
- Height: 1.68" (4.27 cm)
- Width: 21.50" (54.61 cm)
- Depth: 17.60" (44.70 cm)
- Weight: ~ 26.0 lbs. (11.80kg)

6.2 Attached documents

(The following documents will be provided upon request)

- Dell™ PowerEdge™ 850 Systems Installation and Troubleshooting Guide
  \Dell PowerEdge 850 Systems Documentation\it\index.htm
- Dell™ PowerEdge™ 850 Systems User's Guide
  \Dell PowerEdge 850 Systems Documentation\ug\index.htm
- Fastrack Modem M1306B User Guide
  P_Fastrack_Modem_M1306B_User_Guide.pdf
- AT Commands Interface Guide for AT x41
  AT Commands Interface Guide for revision X41c.pdf
- KVM Switch User Manual
  kvm_menu.pdf
- Cisco 805 Series Router Cabling and Setup Quick Start Guide
  805qsg.pdf
- Cisco 805 Router Hardware Installation Guide
  805hig.pdf
- Cisco 805 Router Software Configuration Guide
  805swg.pdf

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 10 CAB SIMULATOR SYSTEM COORDINATION

1 Introduction

1.1 Definitions and Scope

1.1.1 This Annex covers the coordination requirements between the Contract and the cab simulator system to be developed.

1.1.2 This Annex only applies to train consists to be supplied under this this Contract.

1.2 Contractor Responsibilities

1.2.1 The requirements specified herein are by no means exhaustive and it remains the Contractor's responsibility to develop and execute after the commencement of the Works and throughout the execution of the Works, to ensure that:

(a) All design and interfacing issues are satisfactorily coordinated and resolved.

2 Relevant Operation/Equipment Characteristics

Not used.

3 Mechanical Interface

Not used.

4 Electrical Interface

Not used.

5 Functional Interface

5.1 General

5.1.1 The Contractor shall provide all the necessary assistance to the Cab Simulator System Contractor who shall design and build the cab simulator for the train system being built under the Contract.

6 Scope of Supply

6.1 Scope

Not used.

6.2 Information to be Supplied

6.2.1 Drawings

(a) Train configuration drawing showing outline dimensions of the entire train with details of the position of current collectors and bogies along the length of the train;

(b) All driving cab assembly drawings including cab equipment mounting details and cab structure dimensions. Driving cab layout drawings with equipment items list and details of illuminated displays and panels;

(c) Copies of the train electrical schematic diagrams;

(d) Train electrical circuit diagrams and any associated microprocessor logic;

(e) Catalogue data sheets illustrating contact block information for each switch used on all instrument panels, referenced back to panel assembly drawings in the form of an illustrated parts list or equivalent;

(f) Colour copies of drawing should be provided if any colour coding is used.

6.2.2 Performance

(a) Passenger loading data for tare, half loaded and fully loaded.

(b) Full details of train characteristics including: mass, maximum speed, acceleration, deceleration, tractive effort, current. In particular graphs of:

(1) Tractive effort and motor current (or acceleration) against speed for each Traction Brake Controller position;

(2) Braking force and motor current (or deceleration) against speed for each Traction Brake Controller position, under all different modes of operations;

(3) Brake Cylinder pressures for each brake demand for each passenger loading;

(4) Details of blending between the dynamic brake and the air brake;

(5) The number of motors per motor car and their configuration (for simulating fault conditions);

(6) Compressor cut in and out pressures and charging times for the Main Reservoir;

(7) Parking brake - force to apply and release time.

(c) Regenerative braking data (for example, line receptivity);

(d) Outline description of the function of any items appearing as modules or subassemblies (sometimes referred to as 'black boxes');

(e) Detailed description of the functioning of any items appearing as module subassemblies (sometimes referred to as 'black boxes');

(f) Pneumatics and air distribution systems diagram;

(g) Details of any audible warning devices which are fitted in the cab or will be audible in the cab;

(h) Train weights;

(i) Tunnel train resistance curves;

(j) Train resistance to motion equation or graph and rotational mass data;

(k) Train Acceptance Test Schedule;

(l) Detailed description of Train Management System interface to hardware; and

(m) Functional description of the underlying system driving them.

6.2.3 Fault Simulation

Full details of 50 nos. of fault scenarios with all outcomes (visual & audio observations) and handling procedures.

6.3 Engineer's Scope

Not used

7 Installation, Inspection and Test

7.1 Installation

Not used.

7.2 Inspection and Test

Not used.

APPENDIX J

NOT USED

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APPENDIX J NOT USED

APPENDIX K

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APPENDIX L

INTERIOR STYLING SCHEDULE

August 2015

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APPENDIX L INTERIOR AND EXTERIOR STYLING SCHEDULE

APPENDIX L INTERIOR AND EXTERIOR STYLING SCHEDULE

This Appendix details the Employer's basic requirements and conceptual arrangement for the styling and finishes of the Trains. The Contractor shall base the styling proposal on this Appendix and any divergence from its directions shall be clearly identified and justified. It should be noted that the overall design responsibility shall vest on the Contractor. The Contractor shall satisfy himself that the interior design proposal does not compromise or contradict any other requirements of the Particular Specification.

Drawings referred to in this Schedule are general arrangement drawings to show key dimensions and sections to show form. They have been included for reference only and should not be used for production. The Drawings are not necessarily representative of all the details of the Employer's requirements.

The following relate to the saloon interior finishes and Drg. Nos. C6014-14E/TSEG/100/013 to C6014-14E/TSEG/100/023 inclusive shall be used as reference.

Item	Description	PS Ref.	Finish	Notes
1	Not used			
2	Seat	7.6.2	Stainless steel bead blast finish	
3	Seat Back	7.6.2	RAL 000 55 00 50% to 60% gloss level	
4	Seat Plinth	7.6.3	Stainless steel bead blast finish	
5	Saloon Ceiling Panel	7.5.6	RAL 000 90 00 50% to 60% gloss level	
6	Ceiling Coving Panel	7.5.7	RAL 000 90 00 50% to 60% gloss level	
7	Train Card Advertisement Holder	7.5.7(c)	RAL 000 90 00 50% to 60% gloss level	
8	Door Coving Panel	7.5.8	RAL 000 90 00 50% to 60% gloss level	
9	Saloon Window Panel	7.5.9	RAL 000 90 00 50% to 60% gloss level	
10	Flexible Trim	7.5.9(b)	RAL 000 55 00	
11	Draughtscreen Panel Trim	7.6.2	Stainless steel hairline finish	
12	Bodyside Coving Panel	7.5.10	RAL 000 90 00 50% to 60% gloss level	
13	Bodyside Floor Coving	7.5.11	Stainless steel bead blast finish	
14	Door Pillar Coving Panel	7.5.10	RAL 000 90 00 50% to 60% gloss level	
15	Door Pillar Floor Coving	7.5.11	Stainless steel bead blast finish	
16	Cab End Partition	7.5.13	RAL 000 90 00 50% to 60% gloss level	
17	Cab End Kickplate	7.5.13	Stainless steel bead blast finish	
18	Not used			
19	Bench Seat Back Trim	7.6.2	Stainless steel hairline finish	
20	Gangway Swing Panel	7.5.15	RAL 000 90 00 50% to 60% gloss level	
21	Gangway End Cubicle	7.5.15	RAL 000 90 00 50% to 60% gloss level	

Item	Description	PS Ref.	Finish	Notes
22	Gangway Kickplate		Stainless steel bead blast finish	
23	Doorway Ceiling LED Lighting	7.5.6	RAL 000 90 00 50% to 60% gloss level	
24	Train End Ceiling Panel	7.5.15	RAL 000 90 00 50% to 60% gloss level	
25	Gangway End Ceiling Panel	7.5.16	RAL 000 90 00 50% to 60% gloss level	
26	Not used.			
27	Passenger Bodyside Door Window	6.11.3	Tinted safety glass	
28	Double Branch Central Grabpole	7.7.1	Stainless steel satin finish with RAL 1023 section with embossed diamond pattern	
29	Not used			
30	Central Grabpole Fixing Caps	7.7.2	Lower Caps: Stainless steel satin finish	
31	Ceiling Grabrail	7.7.1	Stainless steel satin finish	
32	Seat Mounted Grabhandle	7.7.1	Stainless steel satin finish with RAL 1023 section with embossed diamond pattern	
33	Doorway Grabhandle	7.7.1	Stainless steel satin finish with RAL 1023 section with embossed diamond pattern	
34	Gangway Grabpole	7.7.1	Stainless steel satin finish with RAL 1023 section with embossed diamond pattern	
35	Gangway Grabpole Fixing Cap	7.7.5	Stainless steel satin finish	
36	Gangway Grabhandle	7.7.1	Stainless steel satin finish with RAL 1023 section with embossed diamond pattern	
37	Multi-purpose Area Horizontal Grabrail	7.7.1	Stainless steel satin finish with RAL 1023 section with embossed diamond pattern	
38	Multi-purpose Area Grabhandle	7.7.1	Stainless steel satin finish with RAL 1023 section with embossed diamond pattern	
39	Enlarged Multi-purpose Area Horizontal Grabrail	7.7.1	Stainless steel satin finish with RAL 1023 section with embossed diamond pattern	
40	Straphanger	7.7.7	Belt – ”Baby Blue” RAL 5024	
41	Draughtscreen	7.7.8	Clear, untinted safety glass	
42	Draughtscreen Panel	7.6.2	RAL 000 55 00 50% to 60% gloss level	
43	Floor covering	7.8.1	See Figure App-L-2 for doorway area and Figure App-L-3 for seat bay area for sample pattern	
44	Treadplate	7.8.5	Natural anodised aluminium	
45	Key and Lock	RS STD 15	Silver	
46	Passenger Bodyside Door Panel	7.5.12	RAL 000 90 00 50% to 60% gloss level	
47	Passenger Bodyside Door Kickplate	7.5.12	Stainless steel bead blast finish	

Item	Description	PS Ref.	Finish	Notes
48	Cab/Saloon Partition Door	7.5.14	RAL 000 90 00 50% to 60% gloss level	
49	Cab/Saloon Partition Door Kickplate	7.5.14	Stainless steel bead blast finish	
50	Passenger Alarm Emergency Handle	7.11.4	Housing RAL 000 90 00 50% to 60% gloss level	
51	Bodyside Window	6.11.3	Tinted safety glass	
52	Not Used			
53	Not Used			
54	Not Used			
55	Not Used			
56	Not Used			
57	Not Used			
58	Not Used			
59	Not Used			
60	Not Used			

The following relate to the carbody exterior finishes and Drg. Nos. C6014-14E/TSEG/060/001 to C6014-14E/TSEG/060/005 inclusive shall be used as reference.

Item	Description	PS Ref.	Finish	Notes
61	Cab Front (Centre)	6.2 & 6.13	Pantone Process Black C 70% to 80% gloss level	
62	Cab Front (Side)	6.2 & 6.13	Silver to match with 3M sticker Controltac 180-120 70% to 80% gloss level	
63	Cab Front (Red Band)	6.2 & 6.13	Pantone 201 C 70% to 80% gloss level	
64	Body Side (Black)	6.2 & 6.13	3M sticker Controltac 180-12	
65	Body Side (Grey Metallic)	6.2 & 6.13	3M sticker Controltac 180-221	
66	Body Side (Satin Aluminium)	6.2 & 6.13	3M sticker Controltac 180-120	
67	Body Side (Red)	6.2 & 6.13	3M sticker Controltac 180-2249	
68	Rain Gutter	6.2 & 6.13	Pantone 201 C 70% to 80% gloss level	

Figure App-L-1 Not used

Figure App-L-2 Floor Covering Sample Pattern for Doorway Area

Figure App-L-3 Floor Covering Sample Pattern for Seat Bay Area

APPENDIX M

LIFE CYCLE COST

August 2015

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APPENDIX M LIFE CYCLE COST

1 General

2 Energy Consumption Target

3 Maintenance Cost Target

4 Validation of Energy Consumption

5 Validation of Maintenance Cost

APPENDIX M LIFE CYCLE COST

1 General

1.1 The energy consumption target shall be computed as depicted in this Appendix and forms part of the incentive and contribution scheme. The maintenance cost evaluation forms part of evaluation of maintenance cost of life cycle cost.

2 Energy Consumption Target

2.1 The data of the following items shall be used by the Employer for the calculation of the Energy Consumption Target incorporated in the Letter of Clarification utilizing the simulation software Power Plan version 5.4.7 (supplied by Funkwerk Information Technologies York Ltd) :

(a) Tare weight

(b) Number of trailer and motor car

(c) Weight of motor car and trailer car

(d) Front area of leading car and other car

(e) Tractive effort curve at the various loaded conditions

(f) Regenerative braking curve at the various loaded conditions

(g) Overall electrical-to-mechanical efficiency and power factor at various running speed for motoring and regenerative braking at motor shaft

2.2 The parameters used for calculation of the Energy Consumption Target are as follows:

(a) The train resistance formula used shall be

$$\text{leading car } R = 0.65 + 13.15/W + 0.014V + 0.00453AV^2/nW$$
$$\text{other cars } R = 0.65 + 13.15/W + 0.014V + 0.000641AV^2/nW$$

where R = train resistance (kg/ton) W = axle weight (ton/axle)
V = train speed (km/h) n = number of axles per car
A = front area of train (m^2)

(b) Line voltage shall be taken as 1,500V DC.

(c) Wheel diameter shall be the half worn value.

(d) Jerk limit shall be taken as $0.8m/s^3$.

(e) Passenger loading is 2,584 passengers for peak hour services and

1,292 passengers for non-peak hour services

(f) The weight of each passenger shall be 60kg.

(g) Trip time requirement shall not exceed the following requirements:

(i) The total Round Trip Time without Coasting, from Train arrival at CHW to arrival at KET Turnaround through ISL Down and then from KET Turnaround back to CHW through ISL Up, shall not be more than 60 minutes with the Minimum Dwell Times as specified in the tables Table App M – 1 and Table App M – 2 below.

(ii) The total Round Trip Time under 4% Coasting, from Train arrival at CHW to arrival at KET Turnaround through ISL Down and then from KET Turnaround back to CHW through ISL Up, shall not be more than 66 minutes with the Normal Dwell Times as specified in the tables Table App M – 1 and Table App M – 2 below.

Table App M – 1

Up direction		
Station	**Minimum Dwell Time (Second)**	**Normal Dwell Time (Second)**
KET	32	32
HKU	32	32
SYP	32	32
SHW	32	32
CEN	29	29
ADM	40	43
WAC	28	28
CAB	27	27
TIH	17	17
FOH	19	21
NOP	19	26
QUB	29	38
TAK	19	34
SWH	18	27
SKW	18	30
HFC	16	26
CHW	30	47

Table App M – 2

Down direction		
Station	**Minimum Dwell Time (Second)**	**Normal Dwell Time (Second)**
CHW	30	47
HFC	16	19
SKW	24	27
SWH	16	31
TAK	25	35
QUB	29	37
NOP	23	51
FOH	23	33
TIH	22	37
CAB	36	48
WAC	37	49
ADM	35	46
CEN	36	42
SHW	32	32
SYP	32	32
HKU	32	32
KET	47	47

(h) The total annual number of round trips for 78 trains for peak hour services and non-peak hour services are 98,748* and 155,922* respectively.

(i) Rotating mass to the tare weight, 10% for motor car and 5% for trailer car.

(j) The Overhead line voltage for Powering, Braking and Overhead line receptivity will be calculated by simulation software Power Plan based on the service headway for both peak and non-peak service hours.
The service headway for peak and non-peak hour service are 112 second and 245 second respectively.

(k) Maximum line voltage for regeneration in Power Plan is set to 1770V.*

(l) Braking effort in Power Plan is set to reduced linearly from 100% to 0% from line voltage 1670V to 1770V.*

2.3 The simulation results shall include the total energy consumption of a train of which the alignments, gradients and speed limits are detailed in the Drawings for the following round trip conditions. The simulation is based on the all-out condition running in ISL between CHW and KET, with the train motors operating at full power to the maximum designed speed, and running at the maximum designed speed at all times as far as it can be achieved, under the following loading conditions.

(a) 2,584 passengers for peak hours services

(b) 1,292 passengers for non-peak hours services

2.4 Using the round trip energy figures from the simulation described in clause 2.3 of this Appendix, the Energy Consumption Target will be computed as follow:

(a) The annual energy consumption for peak hour services shall be obtained by multiplying the round trip energy calculated according to clause 2.3 of this Appendix with the annual number of round trips for peak hours services given in clause 2.2(h) of this Appendix.

(b) The annual energy consumption for non-peak hour services shall be obtained by multiplying the round trip energy calculated according to Clause 2.3 of this Appendix with the annual number of round trips for non-peak hours services given in clause 2.2(h) of this Appendix.

(c) The total annual energy consumption will be obtained by adding the 2 energy consumption figures from (a) and (b) above.

(d) The total energy consumption over the 20 years life will be computed by multiplying the figure from (c) by 20. This is the Energy Consumption Target.

3 Maintenance Cost Target

3.1 The data of the following items shall be used for evaluation of Maintenance Cost Target incorporated in the Letter of Clarification are as follows:

3.1.1 Preventive Maintenance (PM) Labour Costs

(a) Check type

(b) Mileage between checks (in terms of thousand km)

(c) Standard man-hours of each service check type

3.1.2 Preventive Maintenance (PM) Material Costs (Top 6 high spending items proposed

(a) Material item

(b) Unit price (in terms of HKD)

(c) Average replacement interval (in terms of thousand km)

(d) Total number per train

(e) % of top 6 high spending items in Total PM material cost

3.1.3 Overhaul (OH) Labour Cost

(a) Check type

(b) Mileage between check overhaul interval for each type of overhaul

(c) Standard man-hour required for completing each service check type

(d) Total number per train

3.1.4 Overhaul Material Cost (Top 12 high spending items proposed)

(a) Material item

(b) Unit price (in terms of HKD)

(c) Average replacement interval (in terms of thousand km)

(d) Total number per train

(e) % of the top 12 high spending item in total overhaul material cost

3.2 The parameters used for the calculation of the Maintenance Cost Target are as follows:

(a) Labour rate of HK$150 per hour

(b) The annual mileage of the fleet is 62,534 car-kkm

(c) The maintenance costs for PM and OH are averaged out for the entire operation of 20 years.

(d) Annual maintenance expenses are paid at the end of the year, which labour costs and spare costs do not escalate.

(e) Total number of train is 78 and number of cars per train is 8.

3.3 Each individual task of a given maintenance operation, including PM and OH, shall be measured by a list of tasks to be undertaken at different time intervals and the manning levels required and quantity, type and cost of spare items required. After the maintenance operation, the train involved shall be restored to service condition.

3.4 Preventive Maintenance (PM) shall include all required service checks on a complete train; inspections of critical equipment or assembly requiring frequent inspection and maintenance and the justifications; and inspections of equipment that are subject to condition based maintenance. PM costs per thousand car km shall be determined based on the total labour and material costs as per the following formulas:

$$\text{Labour costs per car kkm} = \sum \frac{\text{PM Man-hours of each check type} \times \text{Staff hourly rate}}{\text{Running mileage between checks} \times \text{No. of cars per train}}$$

$$\text{Material costs per car kkm} = \sum \frac{\text{Unit price} \times \text{Total no. per train}}{\text{Average replacement interval} \times \text{No. of cars per train}}$$

3.5 The Overhaul Costs per thousand car km shall be determined based on the total labour and material costs as per the following formulas:

$$\text{Labour costs per car kkm} = \sum \frac{\text{Overhaul man-hours of each check type} \times \text{Staff hourly rate}}{\text{Running mileage between checks} \times \text{No. of cars per train}}$$

$$\text{Material costs per car kkm} = \sum \frac{\text{Unit price} \times \text{Total no. per train}}{\text{Average replacement interval} \times \text{No. of cars per train}}$$

4 Validation of Energy Consumption

4.1 The Energy Consumption Target incorporated in the Letter of Clarification shall be subject to the following validations for the application of the Energy Consumption Incentive and Contribution Scheme.

4.2 Interim simulations of energy consumption shall be carried out for verification during the System Engineering Management Plan (SEMP) stages 3 and 4 (refer to PS 21.3.4) and the results of these simulations shall be submitted under the associated SEMP report (PS 21.3.5).

4.3 Given that the trip times stipulated in clause 2.2 of this Appendix are achieved, the Energy Consumption Target shall be validated against the finalized manufacturing information and methodology specified in clause 2.1 to 2.4 above during the SEMP stage 5 (refer to PS 21.3.4) by the Engineer using the same model for establishing the Energy Consumption Target above. The validated data shall be submitted under the associated SEMP report (refer to PS 21.3.5 refers).

5 Validation of Maintenance Cost

5.1 To verify that the targets stipulated in Clause 3.1 of this Appendix are achieved, the Maintenance Cost Target incorporated in the Letter of Clarification shall be validated.

5.2 Not used.

5.3 Interim evaluations of maintenance costs shall be carried out for verification during the System Engineering Management Plan (SEMP) stages 3 and 4 (refer to PS 21.3.4) and the results of these evaluations shall be submitted under the associated SEMP report (refer to PS 21.3.5).

5.4 The Maintenance Cost Target specified in the Letter of Clarification shall be verified against the finalized manufacturing information and methodology specified in clauses 3.1 to 3.5 above during the SEMP stage 5 (refer to PS 21.3.4) by conducting tests as stipulated below. The validated data shall be submitted under the associated SEMP report (refer to PS 21.3.5).

(a) Maintainability shall be demonstrated by conducting tests on representative tasks of the following PM and OH check types. Reference shall be made to MIL-STD-471 in the formulation of the maintainability tests and the tests details shall be submitted for Approval.

PM Check Type	Details
A Check*	A Check (Every 7.5 kkm +/ - 3 days) A Check is to be superseded by B1 to B4 Checks and C check.
B Check*	B Check (B1 to B4 Checks, every 15 kkm +/ - 3 days) B Check Pattern: B1 --> B2 --> B3 --> B4 --> B1 … All type of B Checks is to be superseded by C Check.
K Check*	K Check (Every one year, -24 / +72 days) K Check Pattern: K1 --> K2 --> K3 --> K4 --> K1 … K Check is to be superseded by C Check.

OH Check Type	Details
C Check*	C Check (Every 480kkm, +/- 6 months) Overhaul Pattern: C1 --> C2 --> C3 --> C4 --> C5 --> C1 …

* The maintenance interval of the above Check Types is of minimum requirement.

(b) Maintainability shall be demonstrated by conducting tests on the following PM and OH spare parts that marked with **. The test details shall be submitted for Approval.

Type of Spare	Details
PM spare parts:	1. Brake pad – motor car**
	2. Brake pad - trailer car **
	3. Pantograph carbon strip**
	4. Wheel flange dry solid lubricant**
	5. Cab air conditioning system air filter**
	6. Saloon air conditioning system air filter**

Type of Spare	Details
OH spare parts:	1. Axle box bearing**
	2. Wheel
	3. Brake disc**
	4. Air spring (Secondary suspension) **
	5. Bogie vertical damper repair kit
	6. Traction motor bearing**

Type of Spare	Details
	7. Battery
	8. Gangway bellow (Half-gangway)
	9. Saloon door nosing rubbers (Female and male rubbers)
	10. High Speed Circuit Breaker **
	11. In-saloon CCTV camera
	12. Cooling fan bearings (Auxiliary power supply system) **

(c) Replacement effort shall be demonstrated by conducting tests on the above PM and OH spare parts that marked with **.The test details shall be submitted for Approval.

APPENDIX N

DESIGN DATA

August 2015

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APPENDIX N DESIGN DATA

1 General

2 Design Documents

3 System Engineering Management System

APPENDIX N DESIGN DATA

1 General

1.1 The following lists the minimum Design Data required by the Engineer to be submitted for Approval according to GS Section 10.9 and 10.10. The Design Data listed below shall be submitted at the appropriate System Engineering Management Plan (SEMP) stage (refer to PS 21.3.4).

1.2 The SEMP reports of each stage and its associated design plans (refer to PS 21.2.3) shall be submitted prior to the SEMP presentation (refer to PS 21.3.5).

2 Design Documents

2.1 Based on the design plans (refer to PS 21.2.3) that serve as the design input to the System Engineering Management System (refer to PS 21.1), the following four level of design documents shall be produced and submitted as the design output to this System Engineering Management System:

Level 1: System Requirements Document (SRD)
Level 2: System Specification Document (SSD)
Level 3: System Design Document (SDD)
Level 4: Design Information (DI)

2.2 Level 1 - System Requirements Document (SRD)

2.2.1 The SRD is the top level design document which explains how the requirements of the PS are to be achieved. Proposal of system classifications shall also be provided in the SRD.

2.2.2 Design review of SEMP stage 1 shall be conducted when the SRD has been established.

2.3 Level 2 - System Specification Document (SSD)

2.3.1 The SSD is the second level design document which defines how the requirements of the SRD shall be fulfilled by the individual systems (such as, car body and traction system). This document shall demonstrate the Contractor's understanding of the system's functional requirements and of interface requirements between systems including the Contractor’s own systems and those of other interfacing contractors.

2.4 Level 3 - System Design Document (SDD)

2.4.1 The SDD defines how each system as defined in the SSD shall be achieved. The purpose of this SDD is to evaluate the optimization, correlation, completeness, and risks associated with the allocated technical requirements of a system. Due considerations shall be given to ensure all issues as stipulated in the design plans are fully addressed. Also a summary of the related design submission lists shall be included for each system SDD.

2.4.2 Basic manufacturing and/or procurement considerations shall also be reviewed and planning for production engineering in subsequent phases shall be addressed.

2.4.3 Design review on the SSD and SDD shall be timely conducted particularly when the manufacturing and/or procurement works have been started.

2.4.4 For those systems which involves the electronic and software based drive and/or control functions, the following additional four documents shall be provided:

(a) Software Requirements Specification (SRS)

The SRS shall define the major components of the software design, including data and internal interfaces. The overall structure of the software in terms of the processes involved shall be included.

(b) Software Detailed Design Specification (DDS)

The DDS shall define how each software module defined in an SRS is to be achieved. A DDS shall be either in a form of description and block diagram or pseudo-code. Signal/data paths to other DDS or circuit diagrams shall also be defined.

(c) Hardware Functional Block Specification (FBS)

The FBS shall define, in block diagrammatical form, the functions implemented on a printed circuit board or electronic assembly. Signal/data paths to other DDS, FBS or circuit diagrams shall also defined.

(d) Control Block Diagram (CBD)

The CBD shall show how the control software DDSs and electronic hardware FBSs interconnect to achieve the overall control function. Detailed design information shall not be shown here but provided in the individual design submissions.

2.4.5 The detailed requirements of the software shall comply with RS/C6014/05.

2.5 Level 4 - Design Information (DI)

2.5.1 The DI shall provide the detailed design information of:

(a) Detailed design proposal of system, assembly and component. Supplementary information, such as drawing, diagram, datasheet, calculations and product catalogue, shall also be provided, as appropriate;

(b) Test and inspection specification;

(c) Test and inspection result;

(d) Operation and Maintenance Manual;

(e) Training proposal;

(f) Deliverables of software according to RS/C6014/05.

3 System Engineering Management System

3.1 According to the definition of SEMP, the Design Data shall be grouped into 5 corresponding design packages, and the submission program of these 5 packages of Design Data shall be carefully organised, so that the at each stages of SEMP, sufficient design information are provided to demonstrate the required level of design development are achieved.

3.2 Based on the above 5 design packages of Design Data, the proposed level of design information to be submitted at each stage of SEMP shall be provided in the Design Data Submission Plan (refer to PS 21.3.2).

3.3 Consideration shall be given on the preparation of the Design Data Submission Plan, in order to ensure that the required submission dates of interface Design Data are met.

3.4 Criteria for the SEMP Stages

SEMP Stages	Design Documents to be Submitted	Status of completion*
SEMP 1: Stage of Concept Exploration;	Level 1: System Requirements Document (SRD)	100% Completion
SEMP 2: Design Development and Review;	Level 2: System Specification Document (SSD) Level 3: System Design Document (SDD)	> 90% Completion > 70% Completion
SEMP Stages	Design Documents to be Submitted	Status of completion*
SEMP 3: Design Verification and Validation;	Level 2: System Specification Document (SSD) Level 3: System Design Document (SDD) Level 4: Design Information (DI)	100% Completion > 90% Completion > 70% Completion
SEMP 4: Engineering and Manufacturing Development Phase;	Level 3: System Design Document (SDD) Level 4: Design Information (DI)	100% Completion > 90% Completion
SEMP 5: Inspection, Testing and Training;	Level 4: Design Information (DI)	100% Completion

*: The proportion of the total numbers of Design Data to be submitted of which at least an Approved in Principle status was received on the related submission(s).

APPENDIX O

DELIVERY OF EQUIPMENT

August 2015

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APPENDIX O DELIVERY OF EQUIPMENT

1 General

1.1 The Contractor shall be responsible for delivery of all equipment to the various sites as defined below.

1.2 The Contractor shall comply with the COC Clauses 25 and 26 on the insurance of the equipment to be supplied under the Contract.

1.3 The Contractor shall prepare, protect, deliver and store the equipment in accordance with GS Section 11.

2 Delivery of Equipment

2.1 Trains

(a) The trains shall be delivered to the site as described in PS 30 and Appendix G.

(b) The Contractor shall supply all manpower, lifting equipment, temporary bogies, and other equipment necessary to deliver the trains and assemble them into a safe condition for movement in the depots and the Urban Lines.

2.2 Special Tools and Test Equipment

All special tools and test equipment shall be delivered to Urban Line Depots (CWD, KBD, TKD and TWD). The Engineer will advise the delivery site for each item of equipment before shipment to Hong Kong commences.

2.3 Spares

All spare parts ordered under the Contract shall be delivered to the Main Stores, Kowloon Bay Depot, Hong Kong.

2.4 Documentation

All documentation and design data supplied under the Contract shall be delivered to the Engineer at the address stated for correspondence.

APPENDIX P

CONFIGURATION CONTROL PROGRAMME

August 2015

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APPENDIX P CONFIGURATION CONTROL PROGRAM

1 Introduction

2 Scope

3 Purpose

4 Intended Use

5 Engineering Change Proposal

6 Specification Change Notice

APPENDIX P CONFIGURATION CONTROL PROGRAM

1 Introduction

1.1 This Appendix delineates configuration control requirements and provides instructions for preparing and submitting proposed engineering changes (which is an alteration in the approved Configuration Identification List (refer to PS 21.3.10(c)) of a Configuration Item (refer to PS 21.3.10(a)(iv)) under development, delivered or to be delivered) and related information. Such changes require a complete analysis of the impact if the engineering change described by an Engineering Change Proposal (which is a proposed engineering change and the documentation by which the change is described, justified, and submitted for Approval) were implemented.

1.2 The data package submitted with an Engineering Change Proposal shall contain a description of all known interface effects and information concerning changes required in the approved Configuration Identification List.

1.3 The configuration control requirements as stipulated in this Appendix shall be imposed on both the contractor and subcontractors.

1.4 This Appendix covers requirements for submission of the above Engineering Change Proposal and Specification Change Notice. The Specification Change Notice is a document used to propose, transmit and record changes to a specification. In proposed form prior to Approval, the Specification Change Notice supplies proposed changes in the text of each page affected. In final approved form, the Specification Change Notice summarizes the approved changes to the text of each page affected.

2 Scope

2.1 This Appendix establishes the requirements, formats, and procedures to be utilized in the preparation of configuration control documentations. Included are requirements for:

2.1.1 maintaining configuration control of Configuration Items, both hardware and software;

2.1.2 preparing and submitting Engineering Change Proposal and Specification Change Notice.

3 Purpose

The purpose of this Appendix is to establish configuration control requirements and procedures applicable to the Contract.

4 Intended Use

This Appendix shall be used by the Contractor and the Engineer to:

4.1.1 Establish and maintain effective configuration control of the approved Configuration Identification List;

4.1.2 Propose engineering change to the approved Configuration Items, both hardware and software which are designed, developed or modified for meeting the Contract requirements;

4.1.3 Prepare Specification Change Notice; and

4.1.4 Control the form, fit and function of in-house developed items used in Configuration Items, including proprietary and non-developmental items. Non-developmental items are existing developed and available hardware or software that are capable of fulfilling the specified performance requirements, thereby minimizing or eliminating the need for costly research and development programs. A Non-Developmental Item is usually an off-the-shelf or commercial-type product, but may also include hardware or software already developed by or for the rolling stock applications.

5 Engineering Change Proposal

5.1 Application

Configuration control requirements established by this part of the Appendix apply only to the Configuration Identification List which has been Approved.

5.2 Classification

An engineering change shall be classified as Class I or Class II by the originator in accordance with the following definitions:

5.2.1 Class I Engineering Change

A proposed engineering change to a Configuration Item shall be determined to be Class I by examining whether the required performance would be impacted as a result of implementing the change.

5.2.2 Class II Engineering Change

A Class II engineering change identifies a minor change to a Configuration Item or its documentation that can be affected entirely by the Contractor within the scope of the Contract effort without changing the approved Configuration Identification List. Class II changes are also applicable during production and are normally identified and processed to correct documentation errors or to enhance Contractor productivity without detriment to the Engineer.

Both Class I and II Engineering Change Proposals shall be submitted for Approval.

5.3 Procedures

The steps for preparing and processing an engineering change consist of the following:

5.3.1 determination of a need for the change;

5.3.2 establishment by the originator of a classification of the engineering change as Class I or Class II as agreed by the Engineer;

5.3.3 preparation of an Engineering Change Proposal;

5.3.4 submission to the Engineer;

5.3.5 review;

5.3.6 Approval by the Engineer;

5.3.7 incorporation of approved Engineering Change in the Configuration Item and in the Configuration Identification List;

5.3.8 status accounting;

5.3.9 verification of change accomplishment; and

5.3.10 distribution of documentation change.

5.4 Preparation of Engineering Change Proposal

Although the Engineering Change Proposal originator can be either the Engineer or the Contractor, all formal Engineering Change Proposal shall be prepared by the Contractor.

5.5 Supporting Data

All Engineering Change Proposal shall be supported by drawings and other data if required to justify and describe the change and to determine its total impact including assessments of changes to system operational characteristics. Any testing done by the Contractor to validate concepts or new technology to be employed in the proposed engineering change should be presented if such test data is vital to the decision regarding acceptance of the change.

5.6 Submission of Engineering Change Proposal

To facilitate preparation and submission of Engineering Change Proposal, the Contractor may use automated processing techniques provided all essential and applicable data elements are addressed sequentially. Where facilities exist, electronic transfer should be considered to expedite processing. The Contractor shall not implement any class of proposed engineering change until it is Approved.

5.7 Revisions of Engineering Change Proposal

With the agreement of the Engineer, an Engineering Change Proposal shall be revised when major alterations or changes to the initial Engineering Change Proposal are necessary in order to describe the proposed change.

5.8 Amendments to Engineering Change Proposal

With the agreement of the Engineer, an amendment shall be provided to clarify, correct, add to, delete from or make other minor changes to a submitted or previously amended Engineering Change Proposal. Amendments to an Engineering Change Proposal shall explicitly state the change to the previous document.

6 Specification Change Notice

6.1 Application

A Specification Change Notice shall be prepared to propose a change to a specification that is affected by an Engineering Change Proposal and the specification is one that is maintained by the Engineering Change Proposal originator. Or when authorized, a Specification Change Notice shall be used to update a specification, unrelated to an Engineering Change Proposal or design change. Errors of a minor nature (such as typographical errors and punctuation) normally shall not be corrected, except as an incidental part of the next technically required Engineering Change Proposal and accompanying proposed Specification Change Notice.

6.2 Purpose

The Specification Change Notice is a document used to propose, transmit, and record changes to a specification. The Specification Change Notice is used as a cover sheet and may serve as a letter of transmittal. The page changes associated with that Specification Change Notice shall be attached and shall constitute an integral part of the Specification Change Notice.

6.3 Proposed Specification Change Notice

6.3.1 A proposed Specification Change Notice shall be used to propose to the specification approving activity the exact change in specification paragraphs, figures or other content that will be distributed to users if the Engineering Change Proposal is approved. The proposed modification in content submitted with the proposed Specification Change Notice may be in the form of specification change pages or as an enclosure on which the proposed changes in sentences, paragraphs, figures and tables, are described.

6.3.2 The Contractor shall not implement any change in the specification until the proposed Specification Change Notice is Approved under an Engineer's Instruction.

6.4 Approved Specification Change Notice

With the agreement of the Engineer, an approved Specification Change Notice shall be issued to all parties concerned to implement and record the required specification change. It shall also provide a summary listing of pages affected by all previously approved changes. Specification Change Notice is not cumulative insofar as transmittal of change pages from previous change is concerned, and changes distributed with previous Specification Change Notice remain in effect unless changed or cancelled by a Specification Change Notice of later issue. However, the summary of current changes is a cumulative summary as of the date of approval of the latest Specification Change Notice.

6.5 Changed pages

Updated and reissued pages shall be complete reprints of pages suitable for incorporation by removal of old pages and insertion of new pages. All portions affected by the change shall be indicated by a symbol in the right hand margin adjacent to the change and encompassing all changed portions. When changed pages are issued for specifications with pages printed on both sides of a sheet, and only the page on one side of a sheet is affected by the change, both sides of the sheet shall be reissued. The unchanged side shall be reprinted without change and shall not carry the date of the change or be included in the change summary as being affected by the change.

6.6 Supersession

When a proposed Specification Change Notice must be revised and resubmitted, the resubmitted Specification Change Notice shall retain the same basic Specification Change Notice number but must be re-identified as a revision to avoid confusion with the original submission.

APPENDIX Q

LIST OF NAMED SUPPLIERS

August 2015

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APPENDIX Q LIST OF NAMED SUPPLIERS

1 The Contractor shall note that the equipment included in this Appendix do not imply the Approval of a specific equipment. It is the responsibility of the Contractor to ensure full compliance with the requirements of the PS for all materials and working practices to be used.

2 The Contractor shall procure the following equipment from the corresponding Named Suppliers :

Item No.	Description	Supplier	Details	PS Reference
1	Train borne Radio Sets (TRS)	CLP Engineering Limited 36/F, Asia Trade Centre, 79 Lei Muk Road, Kwai Chung, New Territories, Hong Kong. Telephone : (852) 2429 0379 Fascimile : (852) 2711 5881 Email : vincechow@clp.com.hk	Contact Person : Mr. Vince Chow Project Manager MTRC Contract No. C3564.A-06E	PS 18.2 and Appendix I Annex 4
2	In-cab Closed Circuit Television (CCTV)	Ogier Electronics Ltd Sandridge Park, Porters Wood, St Albans, Herts AL3 6PH England Telephone : +44 (0)1727 845547 Fascimile : +44 (0)1727 852186 Email : jacqui.robbins@ogierelectronics.com	Contact Person : Ms. Jacqui Robbins Marketing Director MTRC Contract No. : C4062.02	PS 18.3 and Appendix I Annex 4
3	Not used	Not used		Not used

Item No.	Description	Supplier	Details	PS Reference
4	RFID Tags for Train Radio	CLP Engineering Limited 36/F, Asia Trade Centre, 79 Lei Muk Road, Kwai Chung, New Territories, Hong Kong. Telephone : (852) 2429 0379 Fascimile : (852) 2711 5881 Email : vincechow@clp.com.hk	Contact Person : Mr. Vince Chow Project Manager MTRC Contract No. C3564.A-06E	PS18.9 and Appendix I Annex 4
5	RFID Tags and System Reconfiguration for RFID Axle Box Temperature Detection System	Shenzhen Aerospace Innotech Corporation Limited Add: F9, Block D, SZAAT Building, 10th Road Kejinan,Hi-Tech Park, Nanshan District, Shenzhen City, Guangdong, China. Postcode: 518057 Telephone : 0086-755-26727072 ext 8005 Fascimile : 0086-755-2672 7070 E-mail: sales@htrfid.com		PS18.10 and Appendix I Annex 4

MTR CORPORATION LIMITED

CONTRACT C6014-14E

PROCUREMENT OF NEW TRAINS

Particular Specification

Volume 2a of 4

August 2015

MTR CORPORATION LIMITED

CONTRACT C6014-14E

PROCUREMENT OF NEW TRAINS

PARTICULAR SPECIFICATION

WORKING DOCUMENT

VOLUME 2a OF 4

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CONTRACT C6014-14E
PROCUREMENT OF NEW TRAINS
PARTICULAR SPECIFICATION
WORKING DOCUMENT

CONTENTS

[VOLUME 1 OF 4]

Section 1: Introduction

Section 2: Definitions and Abbreviations

Section 3: Scope of the Works

Section 4: System Description and Performance Requirements

Section 5: Infrastructure Constraints

Section 6: Car Body Structure and Exterior

Section 7: Interior of Car Body

Section 8: Cab Facilities and Layout

Section 9: Operation and Control

Section 10: Train Management System

Section 11: Traction and Braking Equipment

Section 12: Bogies and Suspensions

Section 13: Pneumatics and Air Distribution Systems

Section 14: Gangways and Couplers

Section 15: Air Conditioning and Ventilation

Section 16: Doors

Section 17: Auxiliary Electrical Supply

Section 18: Communications

[VOLUME 2a OF 4]

Section 19: Not Used

Section 20: Materials and Workmanship Requirements

Section 21: Design Requirements

Section 22: Testing Requirements

Section 23: Training Requirements

Section 24: Spare Parts, Special Tools and Test Equipment

Section 25: System Assurance

Section 26: Maintenance Requirements

Section 27: Quality Management

Section 28: Environmental Requirements

Section 29: Programme

Section 30: Site Arrangements

Section 31: Interface Arrangements

Section 32: Attendance

[VOLUME 2a OF 4 (Cont'd)]

APPENDICES

Appendix A: Schedules of Drawings

Appendix B: Codes and Standards

Appendix C: Schedule of Tests

Appendix D: Not Used

Appendix E: Schedule of Delivery

Appendix F: Engineer's Preliminary Programme, Project Calendar, Schedule of Critical Dates and Schedule of Key Dates

Appendix G: Site Layout and Works Areas

Appendix H: Rules and Procedures for Working Within or Adjacent to the Railway

- Annex 1 P-Licensing System - Caring and Coaching System for New Contractor Workers
- Annex 2 Contractor Fitness for Duty Management

Appendix I: Designated Contracts and Interfacing Systems

- Annex 1 P-way Interface (Track Data)
- Annex 2 Overhead Line/ Traction Power Supply System Interfaces
- Annex 3 ATC Interfaces

[VOLUME 2b OF 4]

Appendix I: Designated Contracts and Interfacing Systems

Annex 3 ATC Interfaces (Cont'd)
Annex 4 Communications Interfaces
Annex 5 Platform Screen Door Interfaces
Annex 6 Depot Interfaces
Annex 7 Electric Vehicle Interfaces
Annex 8 Not Used
Annex 9 Dynamic Route Map Interfaces
Annex 10 Cab Simulator System Coordination

Appendix J: Not Used

Appendix K: Not Used

Appendix L: Interior Styling Schedule

Appendix M: Life Cycle Cost

Appendix N: Design Data

Appendix O: Delivery of Equipment

Appendix P: Configuration Control Programme

Appendix Q: List of Named Suppliers

[VOLUME 3 OF 4]

ROLLING STOCK STANDARDS

RS/C6014/01: Data Transmission and Management

RS/C6014/02: Constructional and Workmanship Requirements

RS/C6014/03: Electrical and Design Requirements

RS/C6014/04: Electromagnetic Compatibility

RS/C6014/05: Software

RS/C6014/06: Cables

RS/C6014/07: Pneumatic Equipment

RS/C6014/08: Fire Performance

RS/C6014/09: Wheelsets

RS/C6014/10: Pantograph

RS/C6014/11: Battery

RS/C6014/12: Operation and Maintenance Manual

RS/C6014/13: Noise Performance and Measurement

RS/C6014/14: Operability Design Guidelines

RS/C6014/15: Keys and Locks

RS/C6014/16: LED Lighting Standard

[VOLUME 4 OF 4]

Drawings

SECTION 19

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19 NOT USED

SECTION 20

MATERIALS AND WORKMANSHIP REQUIREMENTS

August 2015

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20 MATERIALS AND WORKMANSHIP REQUIREMENTS

20.1 General

20.2 Materials

20.3 Materials Testing

20.4 Workmanship

20 MATERIALS AND WORKMANSHIP REQUIREMENTS

20.1 General

20.1.1 All materials and workmanship shall be in every respect in accordance with the proven up-to-date best practice.

20.1.2 Whenever the PS, Drawings or directions/instructions of the Engineer is doubt for about what is permissible and when the required quality of any work is not specified, the interpretation which requires the best quality of work shall be followed.

20.2 Materials

20.2.1 Materials used in the construction of the train shall not constitute a health hazard for passengers, staff or the public. Prohibited materials shall include but shall not be limited to the following:

(a) Asbestos
(b) Lead based pigment paints
(c) Halogens in greater concentrations than those specified in RS/C6014/08.

The use of all materials shall be submitted for Approval.

20.2.2 All materials including painting used on the vehicles shall be of a Limited Fire Hazard type to the requirements of RS/C6014/08 except fuel, transmission oil and lubricants.

20.2.3 The Contractor shall consider at all stages of SEMP, the specification of all materials with regard to their health and safety impact both in handling, use and disposal, and in this regard shall incorporate into the Safety Management Plan according to the GS Section 15.

20.2.4 The Contractor shall consider at all stages of SEMP, the specification of all materials with regard to their environmental impact both in use and upon eventual disposal, and in this regard shall incorporate into the Environmental Management Plan according to GS Section 17

20.2.5 A schedule of all materials used shall be regularly updated and submitted and shall include the following:-

(a) Composition
(b) Quantity (kg)
(c) Life Expectancy

(d) Items that would be re-cycled at mid-life refurbishment and at life expiry
(e) Means of disposal and environmental effect of this disposal
(f) Labelling with regards to composition and hazard

20.2.6 In addition to the materials used during construction the schedule (refer to PS 20.2.5) shall also list materials used in the maintenance and cleaning of the trains, their usage rates and disposal procedures.

20.3 Materials Testing

20.3.1 Fire Performance

(a) The Contractor shall supply and maintain a schedule of non-metallic materials used in the construction of the trains under the Configuration Management requirements (refer to PS 21.3.10(b)).

(b) This schedule shall give information in respect of the fire certification of the materials and groupings of materials in assemblies (copies of which shall be supplied), the national or international standard applicable to the material, its location, the amounts used and its calorific value.

(c) The schedule shall include a fire load calculation for the train. This latter feature will be used to highlight materials with particular fire hazard potential so that special attention can be paid to the fire test results, with a view to ensuring that this potential is not realised.

(d) The schedule shall be audited periodically in line with the Systems Assurance Plan (refer to PS 25).

(e) Triplicate testing, generally to ISO 5660: Part 1, shall be carried out for materials/composites which form major and/or significant surfaces within the saloons.

(f) Where composites are used, eg. seat trim, these shall be tested at the maximum convenient thickness (25mm) and shall be as closely representative of the item concerned as possible.

(g) In addition to the standard test house report, data from each test shall be supplied in an electronic form on CD-ROM/DVD-ROM which shall be compatible with Microsoft Windows XP computers or a later version, which submitted for Engineer's Approval (refer to GS Section 10).

(h) The materials/composites tested shall be representative of the surfaces listed below and shall be tested at the stated input radiation (flux). In each

test the scan time shall be 2.0 s and the test duration shall not be less than 1200 s irrespective of the sample behaviour.

(i) ISO 5660 instruments are available which also record smoke, CO and CO_2 emission. This data shall also be supplied. In addition, video recording an example of each material during testing shall be provided.

Surface	Flux kWm^{-2}
Floor	20
Wall	35
Ceiling	50
Seat Shell Back	35
Seat Shell Base	50
Seat Trim Back	35
Seat Trim Base	20

(j) This additional testing is required for information purposes and there shall be no pass/fail criteria.

20.3.2 Power Output on Flash-Over Fires

(a) The Contractor shall carry out prediction and final evaluation on the power output from flash over fire in accordance with RS/C6014/08.

(b) The maximum power output on flash-over fires shall not exceed 5 MW per car.

20.3.3 Suitability of Materials

(a) Where materials used in the construction of the vehicles are not in accordance with the specified requirement or standards samples of such materials shall, if instructed by the Engineer, be tested at an Approved Laboratory at the Contractor's expense.

(b) All materials or details represented by these samples, which are found not to be in accordance with this Specification, or are unfit for purpose will be rejected. The Contractor shall replace, at his own expense, any materials thus rejected, with a suitable alternative which shall be submitted for Approval.

(c) The Contractor shall submit with his offer a general precis of his procurement and quality assurance procedures. Not later than six months after placement of the order, full details shall be given so that the

Engineer can arrange for an appropriate level of inspection at all stages of manufacture.

20.3.4 Certification

(a) All materials used in the construction of the vehicles shall be procured with a Certificate of Conformity in line with the Contractors Quality Control procedures.

(b) The documentation shall be held by the Contractor or his subcontractor as appropriate and shall be made available to the Engineer at all reasonable times upon demand.

20.4 Workmanship

The constructional and workmanship requirements specified in RS/C6014/02 shall be complied with.

SECTION 21

DESIGN REQUIREMENTS

August 2015

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21 DESIGN REQUIREMENTS

21.1 Purpose

21.2 Policies

21.3 System Engineering Management Plan (SEMP)

21.4 System Assurance Plan

21.5 Operability Plan

21.6 Weight Management Plan

21.7 Electromagnetic Compatibility Plan

21.8 Noise Plan

21.9 Software Management Plan

21.10 Fire Engineering Plan

Figure 21-1 Overview of the Design Life Cycle

Figure 21-2 Overview of the System Engineering Management System

21 DESIGN REQUIREMENTS

21.1 Purpose

21.1.1 The policies and procedures presented in this Section establish a common frame of reference for developing the System Engineering Management System (SEMS).

21.1.2 These policies and procedures establish the basis for integrating the technical efforts of the entire design team of the Contractor to meet programme, quality and performance objectives with an optimal design solution that encompasses the system and its associated manufacturing, test and support processes.

21.1.3 The Contractor shall establish and maintain the SEMS in accordance with the policies and procedures.

21.2 Policies

21.2.1 The Contractor shall nominate a System Engineering Management (SEM) representative with overall responsibility for the SEMS. The SEMS shall be initiated by a series of design plans (refer to PS 21.2.3) which shall identify and establish the required documents detailing policy, organizations, engineering tasks, processes and the necessary documentation to be prepared.

21.2.2 The System Engineering Management shall be applied throughout the design life cycle (refer to Figure 21-1) as a comprehensive, iterative technical management process to:

(a) Translate the operational needs into configured systems through a systematic, concurrent approach to integrated design of the systems and the related manufacturing, test and support processes;

(b) Integrate the technical inputs of the entire design team and all technical disciplines (including the concurrent engineering of manufacturing, logistics and test) into a coordinated effort that meets established programme, quality and performance objectives;

(c) Ensure the compatibility of all functional and physical interfaces (internal and external) and ensure that system definition and design reflect the requirements for all system elements: hardware, software, facilities, people and data;

(d) Characterize technical risks, develop risk abatement approaches and reduce technical risk through early test and demonstration of system elements. The result of the above risk assessment shall be documented in the System Assurance Plan (refer to PS 21.4).

(e) The systems engineering process shall place equal emphasis on system capability, manufacturing processes, test processes and support processes.

21.2.3 The following design plans shall be documented and used in SEMS as System Engineering Management tools or agents to ensure achievement of the required performances:

(a) System Engineering Management Plan (refer to PS 21.3);
(b) System Assurance Plan (refer to PS 21.4);
(c) Operability Plan (refer to PS 21.5);
(d) Weight Management Plan (refer to PS 21.6);
(e) Electromagnetic Compatibility Plan (refer to PS 21.7);
(f) Noise Plan (refer to PS 21.8);
(g) Software Management Plan (refer to PS 21.9); and
(h) Fire Engineering Plan (refer to PS 21.10).

21.2.4 Total system approach shall be used on the System Engineering Management in order to optimise total system performance and minimize the cost of ownership. The total system consists the prime rolling stock equipment, the people who operate and maintain the system, the systems security procedures and practices, the operation of the system in its intended operational environment and the way the system responds to any effects unique to that environment; the compatibility, interoperability and integration of the system with other systems; the operational and support infrastructure (including Control, Communications); training and training devices; any data required by the system in order for it to operate; and the system's potential impact on the environment and environmental compliance.

21.2.5 The Configuration Management shall be used as a supporting function to the System Engineering Management throughout the design life cycle. The Configuration Management provides the means for formal control of the technical aspects of a project and anchors the operational and technical requirements in documentation that is standard for both the Engineer and Contractor (refer to PS 21.3.10).

21.2.6 The SEMS shall be an integral part of the Quality Management System (refer to PS 27) and shall also meet the requirement for Quality Assurance or Management in design in accordance with the ISO 9001 : 2000.

21.2.7 In order to ensure the above SEM requirements are met, a representative from the sub-contractor, manufacturer, supplier or vendor shall be nominated for each major system/equipment (refer to Appendix K) to lead the design management of the associated major system/equipment and to assist the SEM representative (refer to PS 21.2.1) to perform the required SEM tasks.

21.3 System Engineering Management Plan (SEMP)

21.3.1 The System Engineering Management Plan (SEMP) shall establish the plan for the System Engineering Management required to define the system performance parameters and preferred system configuration to satisfy the technical requirements as stipulated in the PS, the planning and control of technical program tasks, integration of the engineering specialities and the management of a totally integrated effort of design engineering, computer software engineering, specialty engineering, test engineering, logistics engineering, quality evaluation and production engineering to meet cost, technical performance, quality and schedule objectives for a specific project or program. Refer to Figure 21-2 for an overview of the System Engineering Management System.

21.3.2 Design Data Submission Plan (DDSP)

The SEMP shall include a Design Data Submission Plan (DDSP) which shall be submitted to the Engineer by the date stated in the PS (refer to Appendix F). The DDSP shall show in detail the timing and sequence of each design submission (refer to GS Section 10.9) in accordance with the SEMP. The DDSP shall contain but not be limited to the following information:

(a) Design Approval Request (DAR) Number
(b) Title of the DAR
(c) Contractor's reference
(d) Contractor's document reference or drawing number
(e) Relevant Clause(s) in the PS
(f) Expected submission date of each DAR
(g) Actual submission date of each DAR
(h) Status

21.3.3 The DDSP shall be reviewed in the Technical Review Meeting (refer to PS 21.3.8). If required by the Engineer, the DDSP shall be revised in order to meet the design requirements.

21.3.4 Five stages of SEMP

The Contractor shall identify five stages of the SEMP in accordance with the following definitions:

SEMP 1: Concept Exploration

SEMP 2: Design Development and Review;

SEMP 3: Design Verification and Validation;

SEMP 4: Engineering and Manufacturing Development Phase;

SEMP 5: Inspection, Testing and Training;

Detailed criteria for the SEMP stages are defined in Appendix N.

21.3.5 SEMP Presentation

(a) At the end of each stage of the SEMP, a SEMP presentation shall be conducted and a SEMP report shall be submitted which shall cover each section of the plans as specified in PS 21.2.3.

(b) Unless otherwise specified, the SEMP presentation shall be conducted at the Engineer's premises.

(c) The SEMP report shall present an integrated approach between the sections of the plan demonstrating that the Contractor is addressing the requirements of each section concurrently.

21.3.6 Each SEMP stage, ends in a milestone, to be identified in the Schedule of Critical Dates (refer to Appendix F).

21.3.7 Monthly SEMS Reports

(a) The Contractor shall prepare Monthly SEMS Reports, which shall be submitted to the Engineer by the first week of the month.

(b) The SEMS Report shall focus on the technical issues, progress of the SEMP and its associated design plans and summary of the design submission status.

21.3.8 Technical Review Meeting

(a) During the execution of the Contract, the Engineer will call technical review meetings as he deems necessary to discuss the progress of the design works in accordance with the above SEMP.

(b) The SEM representative (refer to PS 21.2.1) or his written delegate who shall be responsible for all technical matters, shall attend the technical review meetings.

(c) If required by the Engineer, the responsible sub-contractor, manufacturer, supplier or vendor as nominated for each major system/equipment (refer to PS 21.2.7) shall attend the technical review meetings. In addition, the responsible engineers or designers of the Contractor shall be presented in such meetings if it is deemed necessary by the Engineer.

(d) In general meetings will be held bi-monthly, but can take place more frequently if required.

(e) Unless otherwise specified, the technical review meeting shall be conducted at the Contractor's premises and minutes of these meetings will be issued by the Engineer.

21.3.9 Engineering Audit

(a) Periodically during the life of the Contract the Engineer will conduct compliance audits of the SEMS to ensure the design, procurement, manufacturing and testing works conform to the PS requirements. Not less than 4 weeks notice will be given by the Engineer. The Contractor shall provide suitably qualified staff to accompany the audit team.

(b) The Contractor shall be responsible for ensuring that subcontractors, vendors and suppliers of the major systems/equipment participate in the engineering audits, as appropriate.

(c) Unless otherwise specified, the engineering audits shall be conducted at the Contractor's facility or at a designated subcontractor facility. The Contractor shall provide the necessary equipment, facilities and material to perform the engineering audit effectively.

(d) The Contractor shall:

(i) Ensure that each engineering audit schedule is compatible with the availability of the necessary information and contract documents, for example, system engineering data, trade study results, producibility analysis results, risk analysis results, specifications, manuals, drawings, reports, hardware, software, or mockups.

(ii) Ensure that all subcontractors, vendors and suppliers personnel or those chosen to make presentations of design proposals shall be prepared to discuss in technical detail any of the presented material within the scope of the review.

(iii) Follow up and resolve all action items in the minutes which will be prepared and distributed by the Engineer and identify whether subcontractors, vendors and/or suppliers actions are required for its resolution.

21.3.10 Configuration Management

(a) Objectives

(i) To define material both functionally and physically by drawings, specifications and related documentation identifying the configuration to the lowest level required to assure repeatable performance.

(ii) To perform the technical and administrative functions of identifying, recording, controlling and reporting the functional and physical characteristics of material during its life cycle.

(iii) To allow the maximum degree of design and development latitude, yet to introduce at the appropriate time the degree and depth of configuration control necessary for production, interoperability and logistic support.

(iv) To ensure that the configuration of Configuration Items (refer to PS 21.3.10(b)) is known and the pertinent functional and physical interfaces between systems, equipments and software are established, controlled and recorded throughout their life cycle.

(v) To ensure that specifications, engineering drawings, software documentation and the related technical data are adequate to facilitate the Configuration Control Program (refer to PS 21.3.11).

(b) Configuration Items

(i) The Configuration Items shall be an aggregation of the approved hardware, firmware, software, or any of its discrete portions, which satisfies an end use function and is designated for configuration management.

(ii) Configuration Items may vary widely in complexity, size and type, from a system, assembly or component to a test meter.

(iii) During development and manufacture of the initial production configuration, Configuration Items are those items whose performance parameters and physical characteristics must be separately specified and controlled to provide the management insight needed to achieve the overall end use function and performance.

(c) As an integral part of the SEMP, the Contractor shall submit a pertinent issue of Configuration Identification List which is the summary of all approved Configuration Items at the end of each stage of SEMP. The Configuration Identification List shall also form part of the SEMS Report (refer to PS 21.3.7).

(d) The Contractor shall ensure that the current approved Configuration Documentation is available when needed.

21.3.11 Configuration Control Program

(a) Objective

(i) To attain maximum efficiency in the management of engineering changes by ensuring that Engineering Change Proposals are justified, processed and evaluated promptly and, when Approved, are implemented using approved procedures.

(ii) To ensure that total performance, cost effect and the effect of Engineering Change Proposals, concessions and production permits on the project are known at the time of their Approval.

(b) As part of the SEMP, the Contractor shall submit a Configuration Control Program for preparing and submitting Engineering Change Proposals and related information.

(c) The proposed engineering changes require a complete analysis of the impact of the proposed engineering change.

(d) The detailed requirements of the Configuration Control Program shall be referred to Appendix P.

21.4 System Assurance Plan

21.4.1 It is an essential requirement of the train design that at every stage of SEMP, the requirements of safety, reliability, availability and maintainability are adequately considered and any modifications resulting from these considerations be included in the design. Therefore, the Contractor shall provide a System Assurance Plan which shall detail the Contractor's intended methodology for controlling the system assurance process within his own organisation and cover his subcontractors, vendors and suppliers with an aim to meet the system assurance requirements specified in PS 25.

21.4.2 The detailed requirements of the System Assurance Plan shall be referred to PS 25.2.1.

21.5 Operability Plan

21.5.1 As an integral part of the SEMP, the Contractor shall submit an Operability Plan which shall include a study of the man-machine interface in order to ensure the user friendliness of the train system. Both quantitative and qualitative measures shall be used to determine the user friendliness.

21.5.2 The process of ensuring operability is continuous and consists of the verification of operability by operators and formal determinations of operability whenever a verification or other indication shall be called into question of the system's or component's ability to perform its specified function.

21.5.3 The detailed requirements of the operability plan shall be referred to RS/C6014/14.

21.6 Weight Management Plan

21.6.1 As an integral part of the SEMP, the Contractor shall submit a weight management plan which shall define the way in which the requirements for overall vehicle weight and weight distribution shall be achieved.

21.6.2 The weight management plan shall include, but not be limited to, the following items:

(a) Appointment of a person with the responsibility of developing the overall vehicle weights and weight distribution from the individual component weights.

(b) Allocation of maximum weights for subcontractors equipment during the purchasing phase so that the maximum weight for the equipment can form a part of the contract for that equipment.

(c) Review of weight with a view to weight saving as an integral part of the design review process.

(d) Publication of a weight report, on a monthly basis, in which the emerging weight is updated and any variations from the previous report are explained and justified.

(e) Verification of the weights of individual components during the manufacturing phase.

21.7 Electromagnetic Compatibility Plan

21.7.1 As an integral part of the SEMP, the Contractor shall submit a Electromagnetic Compatibility (EMC) Plan which shall define the overall approach and methodology in achieving the electromagnetic compatibility requirements.

21.7.2 It is essential that the Contractor and all sub-contractor(s) shall conform to the EMC requirements as defined by the EMC Plan.

21.7.3 The detailed requirements of the EMC Plan shall be referred to RS/C6014/04.

21.8 Noise Plan

21.8.1 The Contractor shall submit a detailed Noise Plan and programme to illustrate the manner in which the required exterior and interior noise levels will be achieved and the necessary interfaces between the Contractor and the noise specialist.

21.8.2 The detailed requirements of the Noise Plan shall be referred to RS/C6014/13.

21.9 Software Management Plan

21.9.1 As an integral part of the SEMP, the Contractor shall submit a Software Management Plan consisting of the Software Quality Plan, Software Development Programme, Software Verification and Validation Plan and Software Configuration Management Plan which shall define the planning, design, development, verification, validation, maintenance and configuration management of all software supplied for the Contract. The primary objective of the Software Management Plan is to ensure the quality of all software supplied which form part of the integrated systems to meet the Contract requirements.

21.9.2 It is essential that all software suppliers (the Contractor and all subcontractor(s)) shall conform to the software requirements as defined by the Software Management Plan.

21.9.3 The detailed requirements of the Software Management Plan shall be referred to RS/C6014/05. The events defined by the Software Quality Plan and Software Verification and Validation Plan shall be integrated with the stages of the SEMP.

21.10 Fire Engineering Plan

21.10.1 As an integral part of the SEMP, the Contractor shall submit a Fire Engineering Plan.

21.10.2 The detailed requirements of Fire Engineering Plan shall be referred to RS/C6014/08.

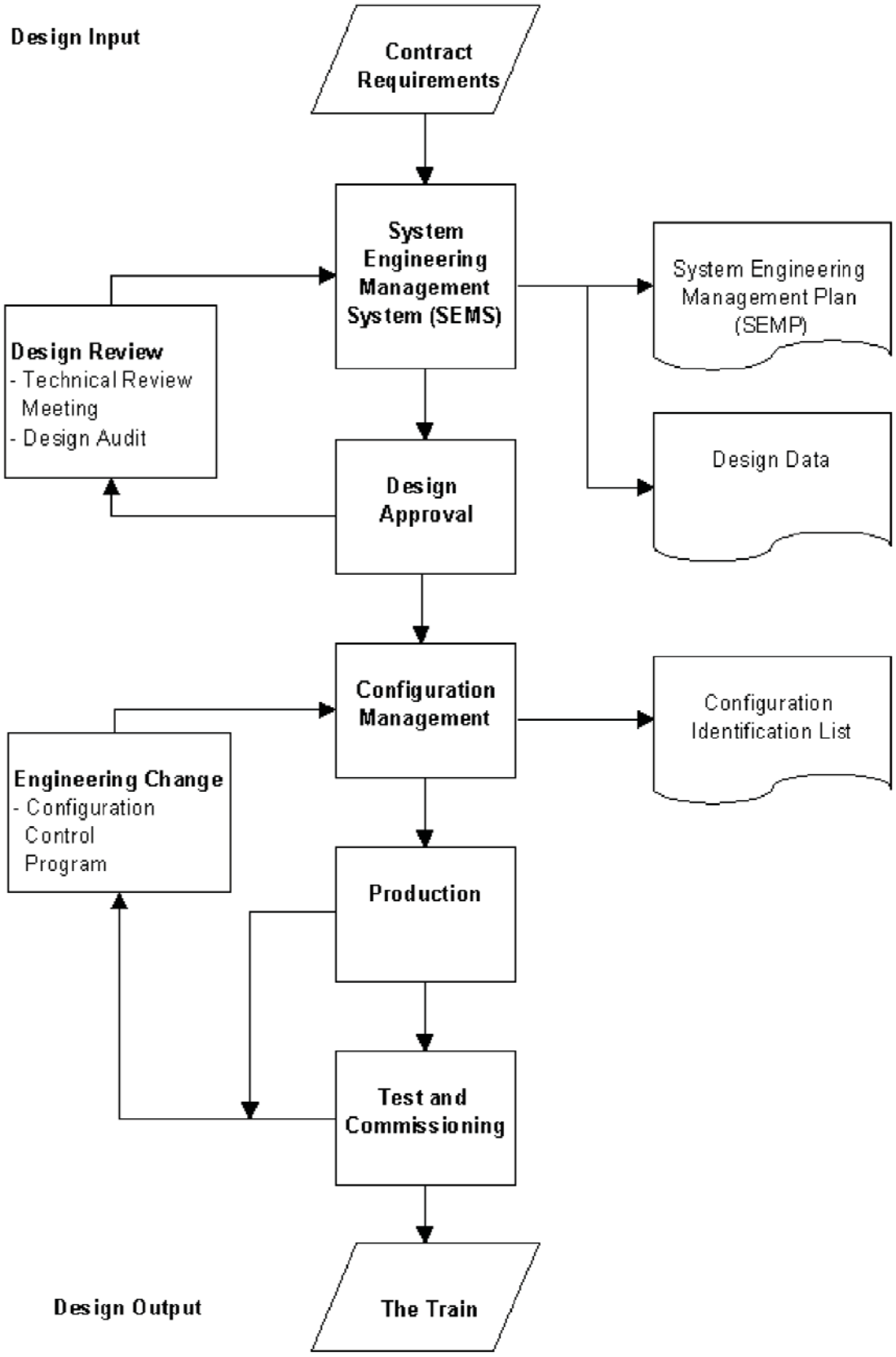

Figure 21-1 Overview of the Design Life Cycle

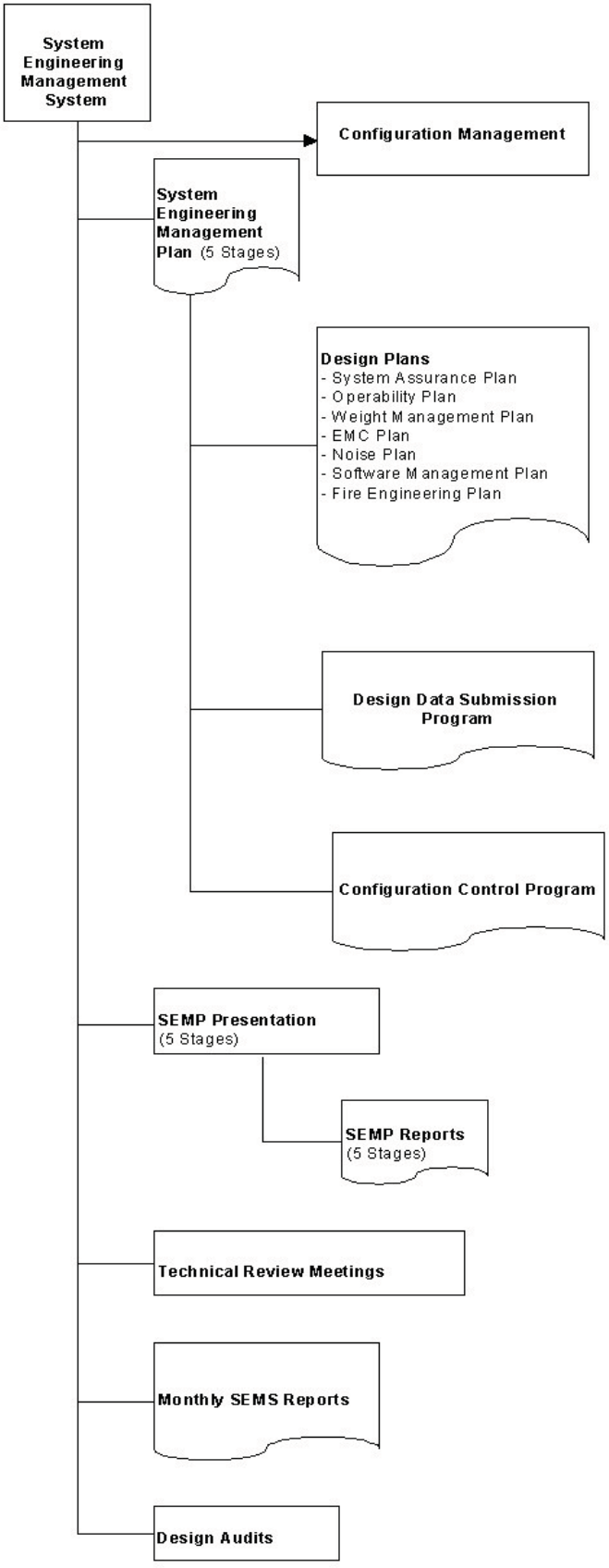

Figure 21-2 Overview of the System Engineering Management System

SECTION 22

TESTING REQUIREMENTS

August 2015

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22 TESTING REQUIREMENTS

22.1 General Requirements

22.2 Format of Specifications

22.3 Approval Process

22.4 Testing Facilities

22.5 Notification of Tests/Inspections

22.6 Nature of Tests/Inspections

22.7 Tests/inspections Process

22.8 Acceptance Procedure

22.9 Works Tests

22.10 Commissioning (Tests in Hong Kong)

22.11 Tests on Completion

22.12 Integrated Test

22.13 Certificate of Completion of Part of the Works

22.14 Not Used

22 TESTING REQUIREMENTS

22.1 General Requirements

22.1.1 The fitness for purpose of all cars, Train Units, trains, systems and items of equipment shall be demonstrated by a combination of tests/inspections including Works Tests (refer to PS 22.9), Commissioning Tests in Hong Kong (refer to PS 22.10), Tests on Completion (refer to PS 22.11) and Integrated Testing (refer to PS 22.12) during the SEMP stage 5 (refer to PS 21.3.4). These tests/inspections shall be performed at the Contractor's works or in the Employer's facilities, or other agreed venue, or as considered relevant. Detailed requirements of the above tests/inspections shall comply with the Tables App-C-1 to App-C-4 in Appendix C.

22.1.2 A Preliminary Testing Plan shall be provided and submitted for Approval by the end of SEMP stage 2. The Preliminary Testing Plan shall include the following items:

(a) Identify the testing requirements for all stages of tests specified in PS 22.1.1.

(b) Identify the Contractor's representative who will be the overall in charge of the testing and commissioning phases.

(c) Provide a preliminary testing programme which shall include staff resources. This programme shall be able to demonstrate that all tests shall be achievable taking into account of time-scales, man-power constrains with regards to the proposed testing work patterns.

(d) Identify any testing instructions and specifications that may be required.

(e) Take into account of any training needs.

(f) Define the limits of the testing, particularly the responsibilities and interfaces.

(g) Highlight the site transport and office accommodation requirements for system/equipment under test and testing staff.

(h) Ensure that occupational safety considerations are adequately addressed.

(i) Define the style and length of tests, commissioning and possessions of the Employer's track.

(j) Identify the required test and communication equipment, such as test instruments, special tools and portable radios.

22.1.3 A Testing Plan shall be provided and submitted for Approval by the end of SEMP stage 3 and the Preliminary Testing Plan specified in PS 22.1.2 shall be used as the baseline of the Testing Plan. The Testing Plan shall include the following items:

(a) Confirm all items specified in the Preliminary Testing Plan are fully covered.

(b) Give a full description of the work and the associated testing.

(c) Establish a firm testing programme, including the proposed commissioning dates.

(d) Define the limits of capabilities and responsibilities for each sections of system, sub-systems and components under test.

(e) Define the interfaces with other systems and disciplines.

(f) Specify the staff resources and competency requirements.

(g) Confirm training requirements.

(h) Identify occupational safety requirements.

(i) List all documentation to be used, including testing instructions, codes of practice and testing specification. The submission dates of these documentations shall also be specified in the testing programme for Approval.

(j) Specify the train movements, if applicable.

22.1.4 Logical and practical divisions of test/inspection items shall be included in the Testing Plan. It shall also allow sections of the system or subsystems to be tested individually and separately if necessary. Any overlap between these sections shall be clearly identified and there shall be no gaps.

22.1.5 Tests/inspections shall be planned in such a manner that all sections of the system or sub-systems shall be successfully tested and proved meeting the PS requirements before installing onto the train. In addition, once a sub-system or its component parts have been taken through a series of tests, they shall not be dismantled to facilitate subsequent tests in order to avoid negating the original tests.

22.1.6 Contingency arrangements shall be included in the Testing Plan to facilitate a planned response to foreseeable problems in order to avoid

affecting the manufacturing, assembling, testing and commissioning programmes. Procedures such as design change control (refer to Appendix P) shall be incorporated.

22.1.7 Testing Plans shall be updated and refined in response to changes in the objectives of the scheme, or to clarify the objectives of each test and its relationship with other tests.

22.1.8 A Commissioning Plan shall be developed from the above Testing Plan and submit for Approval. It shall cover all critical testing activity particularly the interfaces with other systems specified in Appendix I. Any liaison with engineers of other disciplines required from the Employer or other contracts during the test and commissioning phase shall be specified in the Plan. The Commissioning Plan shall include the following items:

(a) Define items from the testing plan in details.

(b) Define interface limits.

(c) Describe the commissioning team and allocate clearly the roles and responsibilities of each team member.

(d) List the sections of system, sub-systems or equipment to be commissioned.

(e) State the documentation control procedures to be used for the commissioning phase.

22.1.9 The tests/inspections shall be carried out to approved national or international standards or as dictated elsewhere in the Specification, and in accordance with the Approved Inspection and Testing Plan (refer to GS Clause 8.2.3).

22.1.10 All components and assemblies shall be subject to a First Article Inspection (FAI) (refer to PS 22.6) at the place of manufacture by the Engineer or his appointed representative prior to be installed onto the train.

22.1.11 Where an item of equipment has been used previously in a similar application then the Type Test (refer to PS 22.6) results may be submitted for Approval in place of conducting a type test for that item of equipment. Approval will be given only where sufficient evidence is provided to show that the equipment successfully passed all type tests required by the PS, or more arduous tests, and that the item is the same as that to be provided under the Contract.

22.1.12 For the micro-processor based systems, sub-systems or equipment shall require strict adherence to the requirements of software and change control specified in RS/C6014/05.

22.1.13 In association with the change of software version during module replacement or modification, the micro-processor based systems, subsystems and equipment shall be provided with the built-in version control and can be accessed by the diagnostic/testing facilities specified in PS 24.3.11. Proper procedure shall be provided in the above plans to state the software version change control and records shall be provided to the satisfactory of the Engineer that this control measures are being adequately performed during test and commissioning phases.

22.1.14 Where an item of equipment fails to meet the requirements of any particular test or inspection stage then it shall be the responsibility of the Contractor to take corrective action to make good any defect thus found across all items of that type on all production trains and spare parts (refer to PS 24) at his cost.

22.1.15 Between the testing and commissioning phases and handover of the trains, a maintenance regime shall be provided to ensure that all systems, sub-system and equipment remain in the design intended condition. The scope and responsibility for this shall be clearly defined in the Testing Plan (refer to PS 22.1.3) and the Commissioning Plan (refer to PS 22.1.8). Any spares, where appropriate, shall be specified and provided.

22.1.16 Any equipment or component used for the purposes of test including mock up or prototype installation shall be maintained, repaired and made good any defect found or replaced at the Contractor's cost prior to deliver to the Employer.

22.1.17 In the event that any test is failed, the Contractor shall, at his own expense, take whatever action is deemed necessary, such as, rectification, readjustment or design changes (including software modifications) on all production trains and spare parts (refer to PS 24) to the satisfaction of the Engineer, in order to meet the testing requirement.

22.1.18 A full report of all failures occurring during testing shall be submitted to the Engineer, who may require that a modification be carried out to rectify any defects thus encountered.

22.1.19 Before any proposed change is implemented, it shall be subject to a preliminary hazard and RAM assessment according to PS 25.5.1 in order to proof that no adverse effect to the safety and RAM performance will be caused by the proposed change.

22.1.20 All changes and modifications shall be subject to the normal design and Approval processes according to the Configuration Control Program (refer to Appendix P). The Engineer may, at his discretion, request the undertaking of further tests to validate the design changes undertaken at the Contractor's cost.

22.1.21 Modifications required to make equipment pass tests shall be applied to all similar equipment on all production trains and spare parts (refer to PS 24). Modification instructions, test instructions and modification programme shall be submitted for Approval according to the Configuration Control Program (refer to Appendix P). Approval will not be granted unless the Engineer is provided with sufficient information to demonstrate that the results of type tests will not be invalidated by the modification.

22.2 Format of Specifications

22.2.1 Separate specifications shall be submitted for each individual Works Tests, Commissioning Tests, Tests on Completion and Integrated Tests. The specifications shall be applied on both inspections and tests and it shall include the following items:

(a) Detailed testing procedures, the test instrumentation and circuitry to be employed, the exact parameters to be measured and the acceptance criteria to be applied to each measurement.

(b) Test records which shall serve the purpose of certification of the successful completion of a test.

(c) Check-lists to assist the recording process of tests and commissioning.

(d) Annotation to specify the following information:

(i) precise method of confirming the successful completion of a test, for example, a tick.

(ii) clear identification of who carried out the test, for example, printed name and position.

(iii) method of adding reminder notes and comments.

(iv) precise methods of confirming completed sections, for example, individual sheets, series of tests, stage-works.

(v) method of identifying errors and invoking corrective action in the event of failed tests.

(vi) maintenance of test logs showing the tests failed and the remedial action taken.

22.2.2 Should the Engineer consider that the tests/inspections proposed to be inadequate to verify fitness for purpose, the Engineer shall have the right to call for additional tests/inspections stages at no cost to the Employer.

22.2.3 Should any measurements made be subject to a tolerance then this tolerance must be stated in the testing or inspection specification.

22.3 Approval Process

22.3.1 Not less than 90 days before the commencement of any test the detailed Test or Inspection Specification shall be submitted for Approval which shall form part of the level 4 design information as defined in the Appendix N Clause 2.

22.3.2 The Contractor shall submit for Approval a Schedule of Tests according to GS Clause 10.11.4 and 24.2.2. This Schedule shall be based on the Inspection and Testing Plan (refer to GS Clause 8.2.3) and shall indicate the approximate date of the test and the venue of the test.

22.3.3 No tests shall be carried out until:

(a) the full design information has been submitted for Approval and reached an Approved in Principle status; and

(b) both the Test Specification and the Schedule of Tests have been Approved

22.3.4 At the Engineer's discretion, note that any tests carried out before Approval shall be repeated at no extra cost to the Employer and following reasonable notice.

22.4 Testing Facilities

22.4.1 The Contractor shall bear the cost of all testing facilities, including all materials, samples, test pieces, items of equipment, labour, fuel, duly certified instrumentation and measuring equipment.

22.4.2 The Contractor shall provide all facilities at his premises for conducting these tests unless a more appropriate venue is chosen. If this is the case then the Contractor shall advise the new venue for Approval and bear the costs associated with testing at the alternative site.

22.5 Notification of Testing/Inspection

22.5.1 At the discretion of the Engineer, all testing/inspection is subject to the requirement for witnessing by the Engineer or his appointed representative, and as such, notice is required of the commencement of all tests and inspection stages identified in the Inspection and Testing Plan, including the Works Tests, Commissioning Tests, Tests on Completion and Integrated Testing.

22.5.2 A minimum of twenty one (21) days notice in writing shall be given prior to the commencement of any tests or inspection stages (including First Article Inspection) according to the Approved Schedule of Tests (refer to PS 22.3.2). This notice shall state the venue, the starting date and time/duration of the tests.

22.6 Nature of Tests/Inspections

22.6.1 Testing shall be divided into two distinct categories, namely Type Testing and Routine Testing. Type Testing is required to verify that the piece of equipment or system operates in accordance with the Approved Design Data. Routine Testing is required to verify that the equipment or system has been built in such a way that it satisfies the requirements of the Approved Design Data (refer to Appendix N) as verified by the Type Test.

22.6.2 Inspection shall also be divided in a similar manner, namely First Article Inspection and Routine Inspection. The First Article Inspection verifies that the Approved Design criteria have been met and the Routine Inspections ensure that the standard, Approved at First Article Inspection, is being maintained.

22.6.3 To demonstrate consistent production quality these Type and Routine Tests/Inspections shall also be completed in full or in part to the satisfaction of the Engineer at production cycle intervals agreed with the Engineer.

22.7 Tests/Inspections Process

22.7.1 The Contractor shall perform the test/inspection according to the Approved Test and Inspection Specification.

22.7.2 The Engineer shall have the right to witness any of these test/inspection at any stage of test/inspection progress. The Engineer shall also have the right to take independent test/inspection recordings including photographs and videos other than Contractor’s recordings during his witness to any of these test/inspection at any stage of test/inspection progress in the Contractor’s premises or sub-contractor’s premises.

22.7.3 Where a test/inspection stage requires that a measurement be made, then the result of this measurement together with the serial number of the measuring instrument shall be recorded on a suitable results sheet, embodied in the test/inspection specification according to PS 22.2.1 above.

22.8 Acceptance Procedure

22.8.1 Unless otherwise specified, the results of all Type and Routine Inspections/Test shall be submitted for Approval in the form of a report which shall form part of the level 4 design information as defined in the Appendix N Clause 2, no later than ten (10) days following the successful completion of each Type or Routine Inspections/Tests. Approval will only be granted where it is demonstrated to the satisfaction of the Engineer that the passing criteria defined in the Approved test specifications are successfully achieved.

22.8.2 Any subsequent testing which takes place before this Approval is given may result in retesting being required, this retesting being to the cost of the Contractor.

22.8.3 Inspection records from the First Article Inspection shall be submitted for Approval. Approval will only be granted where it is demonstrated to the satisfaction of the Engineer that any areas of non-compliance identified during the FAI have been corrected, and any resultant design changes re-submitted.

22.8.4 Any defects recorded at the First Article Inspection shall be rectified and incorporated in the design and/or manufacturing process at the earliest possible opportunity and shall be fitted retrospectively in an approved manner to all items not thus modified.

22.8.5 Records from Routine Inspection shall be held by the Contractor and made available timely for the Engineer's inspection.

22.8.6 Copies of the Approved routine test results shall be submitted together with the associated train log book (refer to PS 22.8.7).

22.8.7 Train Log Book

In addition to the Configuration Control Program (refer to Appendix P), for each Train Unit of train a Log Book shall be provided which shall include the following items at the point of handover of the associated Train Units of train to the Employer after the completion of the Tests on Completion (refer to PS 22.11.3):

(a) Records of the equipment configurations and serial numbers of all equipment fitted to the train.

(b) Maintain an up-to-date list of outstanding tests, modifications and defects.

(c) Records of all successfully completed vehicle level routine tests.

22.8.8 The acceptance of tests shall be the successful completion of tests, Approval of the test results and receival of the associated train Log Book.

22.8.9 Additional copies of records of all tests/inspections results shall also be held at the Contractors (or subcontractors) works to be made available to the Engineer on demand.

22.9 Works Tests

22.9.1 The Works Tests specified in Appendix C shall constitute the Testing before Delivery of the trains.

22.9.2 The Contractor's attention is drawn to the requirements of COC Clause 57.15.

22.9.3 No Works Tests shall be carried out on the micro-processor based systems, sub-systems or equipment until they are successfully completed all required software tests specified in RS/C6014/05.

22.9.4 In addition to the Works Tests specified in Appendix C, the Contractor shall carry out the following installation tests on a routine basis for each train:

(a) Quality Control Tests which shall include the following test items:

(i) Wire count. A wire count shall be a check of every termination point to ensure that the correct number of wires is terminated. The correct number of wires can be zero, so terminations where no wires are expected are also checked. This check shall be applied on all safety related circuits (refer to PS 9) and the ATC interface circuits (refer to Appendix I Annex 3). If a terminal bar contains spare termination points, then the correct number of wires at these spare terminations shall be zero. The wire count shall include used termination points and spare termination points. The Contractor shall submit the Wire Count Specification for Approval prior to conducting the test. The Wire Count Specification shall indicate the details of the wires to be counted on every termination point for those circuits stipulated above. The result of Wire Count Test shall be submitted for Approval.

(ii) Continuity test. This test shall be carried out to ensure the continuity and correspondence of each individual wire with its wiring diagram.

(iii) Insulation and earth tests. These tests shall be carried out to check both every core of a cable and every other core, and between every core and earth for correct insulation values. For those wires that are impracticable to test between every wire, test on all rack wires to earth shall be applied.

(b) The above Quality Control Tests shall be repeated for any wiring change.

22.10 Commissioning (Tests in Hong Kong)

22.10.1 The Commissioning Tests specified in PS 22.10 shall form part of the Tests on Completion (refer to PS 22.11) of the trains.

22.10.2 The Contractor's attention is drawn to the requirements of GS Section 25. In addition to the Commissioning Tests identified in Appendix C of the PS, the Contractor shall meet the test requirements specified below.

22.10.3 Type Commissioning Tests

(a) On the first train or trains (as convenient) delivered, the Contractor shall undertake at his cost in a comprehensive programme of Type Tests to adequately demonstrate that the requirements of the Specification have been satisfied.

(b) The Contractor shall also participate in system wide integration testing to ensure that the train and its systems do not introduce any adverse effects into the railway and its environment.

(c) This testing shall demonstrate compatibility between the train and the interfacing systems specified in the Appendix I.

(d) Compatibility with the Urban Lines train systems shall be satisfactorily tested.

(e) The Contractor shall be responsible for correcting any interfacing defects thus identified in any equipment or systems included in his scope of supply.

22.10.4 Routine Commissioning Tests

(a) Following delivery of the trains to the Site each train shall be commissioned by the Contractor and at an appropriate time the Engineer will witness certain of these tests to satisfy himself that the trains are acceptable for running in passenger service.

(b) These tests will be a subset of those tests performed at Type Test, to demonstrate that the principal features of the train are compliant with the PS.

(c) This shall include but not be limited to a test of all safety systems.

(d) The Contractor shall provide the Engineer with a full record of the modification status and software versions fitted to a train at the time that the routine commissioning test is conducted.

22.11 Tests on Completion

22.11.1 The Tests on Completion shall include the Commissioning (Tests in Hong Kong)(Refer to PS 22.10) and the Integrated Tests (refer to PS 22.12).

22.11.2 The Contractor's attention is drawn to the requirements of COC Clause 62.1. The Tests on Completion are identified in Appendix C.

22.11.3 Tests on Completion

The Contractor shall demonstrate to the satisfaction of the Engineer in the Tests on Completion that the performance requirements of the train are met and suitable for passenger service in the existing Urban Lines systems.

22.12 Integrated Test

22.12.1 The Integrated Tests specified in PS 22.12 shall constitute the Test Run and Integrated Tests (refer to GS Section 25) of the trains.

22.12.2 According to GS Section 25, the Integrated Tests shall form part of the Tests on Completion of the trains.

22.12.3 The Contractor's attention is drawn to the requirements of GS Section 25. The test requirements for each interfacing systems shall be based on the associated interface specifications under Appendix I and the Approved Integrated Test Schedules (refer to PS 31.3.6).

22.12.4 Integrated Tests

The Contractor shall demonstrate to the satisfaction of the Engineer in the Integrated Tests that the compatibility requirements between the train and the existing Urban Lines systems are met.

22.13 Certificate of Completion for Part of the Works

22.13.1 Upon completion of the following requirements for each train and when it is ready for passenger service, the Contractor may request in accordance with the procedure set out in Clause 74.1 of the COC, a Certificate of Completion for Part of the Works as referred to in Clause 74.3 of the COC:

(a) All tests of Tests on Completion (refer to PS 22.11.4) and integrated tests (refer to PS 22.12.4) are successfully completed and the associated test reports are granted with at least the status of Approved in Principle;

(b) The train Log Book is documented to the satisfaction of the Engineer and delivered to the Engineer;

(c) The following requirements shall be met before over the request of the Certificate of Completion for the first train:

(i) All Approved Type Test results have been delivered to the Engineer;

(ii) All required quantities of Approved spares for running maintenance (refer to PS 24.2.1) have been delivered to the Engineer;

(iii) All required training are satisfactorily implemented; and

(iv) The batch 1 and 2 O&M Manuals are granted with at least the status of Approved in Principle.

22.14 Not Used

SECTION 23

TRAINING REQUIREMENTS

August 2015

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23 TRAINING REQUIREMENTS

23.1 General

23.2 Training Plan

23.3 Training Instructor

23.4 Class Size

23.5 Training Material

23.6 Training Course Content

23.7 Training Course Logistics

23.8 Training Courses

23 TRAINING REQUIREMENTS

23.1 General

23.1.1 The Contractor shall be responsible for providing training for maintenance, operating, training and engineering design staff in all aspects of operations and maintenance of the trains and all their associated equipment, thereafter referred to in this section as the Delivered System.

23.1.2 The targeted training attendees shall include:

(a) First line maintenance staff who are responsible for service checks and corrective maintenance which do not require car lifting

(b) Second line maintenance staff who are responsible for car overhauls, scheduled equipment replacements and corrective maintenance which require car lifting

(c) Third line maintenance staff including staff of Electronic Workshop who are responsible for equipment overhauls which cover the workshop repair, overhaul and testing of all train subsystems / equipment down to Printed Circuit Board (PCB) level

(d) Operating staff including test crew, train operators and supervisors who are responsible for the safe operation of train during test and commissioning and normal passenger service and operating staff from station and Operation Control Centre

(e) Training staff including technical and operating training instructors who are responsible for conducting training sessions to Employer's maintenance and operating staff

(f) Engineering design staff who are responsible for providing technical support to maintenance staff on fault investigation and analysis and future modification

23.1.3 Training shall be designed and delivered to achieve the following objectives:

(a) First line maintenance staff shall acquire sufficient skills and knowledge for carrying out service checks and corrective maintenance which do not require car lifting of the Delivered System to the designed standards.

(b) Second line maintenance staff shall acquire sufficient skills and knowledge for the car overhauls, scheduled equipment replacements and

corrective maintenance which require car lifting of the Delivered System to the designed standards.

(c) Third line maintenance staff (including staff of Electronic Workshop) shall acquire sufficient skills and knowledge for carrying out equipment overhauls to the designed standards.

(d) Operating staff shall acquire sufficient skills and knowledge for operating the Delivered System under normal and equipment failure situations.

(e) Training staff shall acquire sufficient skills and knowledge to conduct future training sessions to other Employer's staff including operating, first line, second line and third line maintenance staff.

(f) Engineering design staff shall acquire sufficient skills and knowledge for providing technical support to the maintenance staff on fault analysis, investigation and modification of the Delivered System to the designed standards.

23.1.4 The objectives shall be achieved in a number of ways including classroom training, hands on practical training and on-the-job maintenance training as specified in PS 23.8.

23.1.5 The Contractor shall provide training material as follows:

(a) a training plan
(b) trainer manuals
(c) trainee manuals
(d) training aids

23.1.6 The training courses (refer to PS 23.8) shall be conducted in accordance with the Approved training programme (refer to PS 23.2.2). If delivery of train is delayed as a result of programme slippage caused by the Contractor, or major changes to the design or performance of equipment after training courses have been conducted, the Contractor shall repeat some or all of the courses at his own expense to the satisfaction of the Engineer.

23.2 Training Plan

23.2.1 The Contractor shall develop and submit a Training Plan for Approval as stipulated in Appendix F.

23.2.2 The Training Plan shall provide a structured training programme to train personnel of the Employer to achieve the objectives as stipulated in PS 23.1.3.

23.2.3 The Training Plan shall include, as a minimum, the following items:

(a) schedule of all training courses / activities including classroom and practical training
(b) objective, syllabus, format, class size, duration of each training course and the trainee's prerequisite
(c) training facilities required to be provided by the Employer
(d) list of training materials and documentation to be included with the training course including trainer and trainee manuals
(e) location of each training course / activity
(f) qualifications and experience level necessary for staff to be trained
(g) the names of training personnel and their qualifications
(h) course evaluation methods

23.3 Training Instructor

23.3.1 Training courses shall be conducted by skilled training instructor who possess good communication skills and are experienced engineers in the subject on which training shall be provided. They shall be thoroughly familiar with the design, installation, operation and maintenance of the Delivered System.

23.3.2 The training instructor shall be a member of the Contractor's staff, subcontractor's staff or equipment supplier’s staff. The training instructor shall conduct the training course(s) in English.

23.4 Class Size

Sufficient number of class(es) shall be conducted for each training course to cater for the number of corresponding attendees with each class accommodating a maximum of fifteen attendees.

23.5 Training Material

23.5.1 The Contractor shall submit all training materials for Approval 18 weeks before the start of the corresponding training course.

23.5.2 The Contractor shall provide materials to support each course in the Training Plan, including trainer manuals, training aids and trainee manuals. All training materials shall become the property of the Employer.

23.5.3 The trainer manuals and trainee manuals shall be submitted in a form that allows easy reproduction. Any transparencies and electronic files used in training shall be supplied along with reproducible copy. Master copies of slides and other audio-visual materials shall also be provided to

allow for reproduction, as necessary. All the above training material shall also be submitted in electronic copies where applicable.

23.5.4 The Contractor shall provide a trainer manual for each training course.

23.5.5 The trainer manual shall include the following:

(a) course agenda
(b) course objectives
(c) lists of resources and facilities required
(d) detailed lesson plan indicating the timing of all training activities and key learning points
(e) training methodologies including outlined presentations, discussion guides, hands on practical training, practical demonstration, fault simulation and rectification, site visit and question and answer
(f) training aids and instructions for using any audio-visual support, mock-ups and simulators
(g) evaluation criteria
(h) evaluation method in the classroom and in the workshop/field

23.5.6 The Contractor shall provide one set of trainee manual to each course attendee for each training course.

23.5.7 The trainee manual shall include the following:

(a) course objectives
(b) course schedule including trainee's prerequisite
(c) course handouts including equipment / system schematic / circuit diagrams
(d) course assignments / exercises
(e) references
(f) evaluation forms

23.5.8 The trainer manuals and trainee manuals shall be submitted in the following format:

(a) all manuals shall be produced as A4 International unless otherwise specified whereas schematic / circuit diagrams shall be produced as A3 or A2 international
(b) the text shall be produced using Microsoft Word for Windows 2003 (or later version, if approved)
(c) graphics and diagrams shall be produced using Microsoft Powerpoint for Windows 2003 (or later version, if approved)
(d) circuit diagrams and engineering drawings shall be produced using AutoCad for Windows 2002 (or later version, if approved)
(e) the paper used shall be good quality, white, and of an adequate thickness for frequent handling and the printing shall not fade with age

(f) each manual shall have a separate binding which shall allow changes and additions to be readily made

(g) each manual shall include a full table of contents and indexing for all key words

23.6 Training Course Content

23.6.1 All training courses shall adopt a top down approach and consists of two parts, where applicable:

(a) Classroom training

A general system overview shall be given indicating the major functions which the system performs and the major items of equipment, then progressing to equipment specific and group or function specific issues and finally a function by function description as necessary for the audience and training objective of the individual training course. Background information, theory, design calculation and analysis, special design features, maintenance philosophy, interfaces between subsystems and written test / exercise if applicable shall be included to facilitate trainees' understanding.

(b) Practical training

Practical training shall be provided which shall include demonstrations of the most commonly performed procedures applicable to the target audience. Simulation exercises including fault simulation and rectification / in-situ recovery, site demonstrations, fault diagnosis and operation of special tools and test equipment (refer to PS 24.3) and hands-on practice / exercise shall be included where applicable and these shall be separately scheduled from classroom training. For Technical Training courses, real equipment / system shall be used for practical training where applicable. Video taken during manufacturing stage shall be used to supplement all the training courses.

23.6.2 Where standard "off-the-shelf" product are used and modified for the application of the system, the general descriptions of these products shall be augmented with full details of the specific modifications in the training course.

23.6.3 The Engineer shall assess the effectiveness of the training course and identify any area to be improved by the Contractor. The Contractor shall take measures to ensure that all specified training requirements shall be achieved to the satisfaction of the Engineer.

23.7 Training Course Logistics

23.7.1 Except for the hands on practical training in the Contractor's Plant and overseas training course(s) in the approved Training Plan, the training courses shall be conducted in the Employer's premises.

23.7.2 Training facilities such as overhead projectors and screens, video recorders and televisions, flip charts and pens, slide projectors and similar items will be made available to the Contractor for the purpose of conducting the training courses. The Contractor shall submit their request to the Engineer at least 30 days in advance for the use of such facilities. Where appropriate, the training courses shall be designed to make effective use of the Delivered System. Any special tools and test equipment (refer to PS 24.3) and train required for training shall be provided by the Contractor.

23.7.3 At the conclusion of each training course, course questionnaires aimed at determining the level of satisfaction of the attendees with the course content, duration and presentation shall be distributed to trainees for completion.

23.8 Training Courses

The Contractor shall provide, as a minimum, the following training courses:

23.8.1 Test Crew and Training Instructors

(a) Objectives

To provide the test crew and training instructors with the skills and knowledge necessary to cope with the test running of trains during the test and commissioning period in Hong Kong.

(b) Course Start Date

This training course shall be conducted not later than 18 weeks after the Approval of the Training Plan.

(c) Course Attendees

A total of 20 experienced train operators, train operating instructors and training instructors of Urban Lines.

(d) Course Content

This training course shall provide attendees with skills and knowledge necessary to cope with the operation of trains for testing and commissioning in Hong Kong. The man-machine interface functions and responses shall be described, explained and demonstrated. Hands-on practical training shall also be provided.

23.8.2 Train Operator Training

(a) Objectives

To provide the train operators with the skills and knowledge necessary to cope with the running of trains for normal passenger service.

(b) Course Start Date

This training course shall be conducted not later than 18 weeks after the Approval of the Training Plan.

(c) Course Attendees

A total of 20 experienced train operators of Urban Lines and train operating instructors.

(d) Course Content

This training course shall provide attendees with skills and knowledge necessary to cope with the operation of trains for passenger service. The train operation and control, man-machine interfaces, special design features, fault handling / backup facilities available shall be described, explained and demonstrated. Hands-on practical training for all topics covered shall also be provided.

23.8.3 Technical Training

(a) Objectives

This training course shall allow the Employer's technical staff including maintenance and engineering design staff to acquire the knowledge and skills necessary to maintain the Delivered System to the designed standards.

(b) Course Start Date

This training course shall be conducted not later than 28 weeks after the Approval of the Training Plan.

(c) Course Attendees

First, second and third line maintenance and engineering design staff

(d) Course Content

This training course shall be structured and conducted in three levels as follows:

(i) Level 1 shall cover background technical information of train including location and general layout of equipment, control logic (input and output), interfaces between subsystems , general performance specifications, special design features and performance (for example self diagnosis capability), description and operating principles of all equipment / systems, basic description of circuits and man-machine interfaces.

A total of 25 first line maintenance staff, 40 second line maintenance staff, 20 third line maintenance staff (including staff of Electronics Workshop) and 5 training instructors will attend the Level 1 technical training.

(ii) Level 2 shall cover all the maintenance activities for each of the equipment / system as stipulated in clause (iii) below which shall include:

(1) preventive maintenance activities
(2) corrective maintenance activities
(3) procedures for replacement of major equipment / components
(4) testing and re-commissioning procedures after maintenance work
(5) overhaul and workshop repair including the use of test and special equipment, sub-assembly bench repair and calibration of all equipment comprising the system (for items of equipment not commercially available)

All installation procedures, testing procedures and the use of special tools and test equipment (refer to PS 24.3) shall be covered to permit the attendees to perform preventive and corrective maintenance activities and to acquire the skills and knowledge to achieve the Maintainability targets (refer to PS 26).

A total of 20 first line maintenance staff, 30 second line maintenance staff, 20 third line maintenance staff (including staff of Electronics Workshop) and 5 training instructors will attend the Level 2 technical training.

(iii) Level 3 shall provide detailed technical information and description of each individual equipment / system down to basic component / PCB level with explanation of the circuitry / logic. One training course for each equipment / system shall be provided and shall be organized based on the Equipment Hierarchy (refer to RS/C6014/12) as follows:

(1) Vehicle Structure
(2) Traction and Braking System
(3) Bogies and Suspension
(4) Auxiliary Electrical System
(5) Pneumatic and Air Distribution System
(6) Air Conditioning System
(7) Door System
(8) Gangway and Couplers
(9) Communications System
(10) Train Management System and Event Recorder
(11) Automatic Train Control
(12) Structure and Vehicle Interior Fittings

A total of 25 first line maintenance staff, 40 second line maintenance staff, 20 third line maintenance staff (including staff of Electronics Workshop) and 5 training instructors will attend the Level 3 technical training.

(iv) Level 4 shall cover all technical support activities to maintenance including :

(1) Fault analysis and investigation
(2) Software training which shall provide attendees with the knowledge and skills necessary for performing parameterisation of the Delivered System and system management. Hands on practical experience on using the software tools, utilities and programming techniques being supplied with the Delivered System shall be included. The Contractor shall be responsible for providing all hardware and software required for software training.

A total of 15 engineering design and software support staff will attend the Level 4 technical training.

23.8.4 Defect Recovery Training - Operation

(a) Objectives

This training course shall allow the Employer's train operator to acquire the knowledge and skills necessary to take appropriate action quickly in event of emergency situations as well as coping with failures of the Delivered System.

(b) Course Start Date

This training course shall be conducted not later than 40 weeks after the Approval of the Training Plan.

(c) Course Attendees

A total of 20 experienced train operators and training instructors of Urban Lines.

(d) Course Content

The Contractor shall be responsible to identify the potential failures of the Delivered System and the correct recovery / handling procedures. Detailed description of the potential failures including the performance of train being affected, audio symptoms and visual symptoms encountered shall be presented and the recovery / handling procedures shall be described in a chronological way. The attendees shall be able to acquire the knowledge and skills in performing these recovery / handling procedures.

23.8.5 Defect Recovery Training - Technical

(a) Objectives

This training course shall allow the Employer's first and second line maintenance staff to acquire the knowledge and skills to correctly diagnose the failures and to take appropriate corrective maintenance.

(b) Course Start Date

This training course shall be conducted not later than 40 weeks after the Approval of the Training Plan.

(c) Course Attendees

A total of 20 maintenance staff and 5 training instructors.

(d) Course Content

The Contractor shall be responsible to identify the potential failures of the Delivered System and the associated corrective maintenance procedures. Detailed description of the potential failures including the performance of train being affected, audio symptoms and visual symptoms encountered shall be presented and the associated corrective maintenance procedures shall be described in a chronological way. At the end of the course, the attendees shall be able to correctly diagnose the failed equipment / systems, replace any defective equipment, verify that the failure is rectified and restore the train to service condition.

23.8.6 On the Job Maintenance Training

(a) Objectives

This training course shall allow the Employer's maintenance staff to gain actual field experience on fault diagnosis, first and second line corrective and preventive maintenance activities, equipment repair and overhaul.

(b) Course Start Date

This training course shall be conducted not later than 44 weeks after the Approval of the Training Plan.

(c) Course Attendees

A total of 16 maintenance staff.

(d) Course Content

This training course shall provide on-the-job training opportunities to the Employer's maintenance staff to gain actual field experience prior to the passenger service of the trains in Urban Lines. The Contractor shall on site transfer the knowledge and skills on fault diagnosis, first and second line corrective and preventive maintenance activities, equipment repair and overhaul to the attendees. A dedicated training instructor from the Contractor shall supervise the attendees and ensure the effective delivery of the necessary information / knowledge / skills to the attendees.

SECTION 24

SPARE PARTS, SPECIAL TOOLS

AND TEST EQUIPMENT

August 2015

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24 SPARE PARTS, SPECIAL TOOLS AND TEST EQUIPMENT

24.1 General Requirements

24.2 Spares Recommendation

24.3 Special Tools and Test Equipment

24.4 Submission and Delivery Schedules

24 SPARE PARTS, SPECIAL TOOLS AND TEST EQUIPMENT

24.1 General Requirements

24.1.1 The Contractor shall recommend to the Engineer all spare, special tools and test equipment (refer to PS 24.3) to facilitate the Employer to maintain, repair and overhaul the trains effectively and efficiently while ensuring the trains maintain a high standard of safety and reliability throughout their lives.

24.1.2 All spare parts shall be identical to the equivalent installed items. All items shall be complete and ready for installation except for wire or cable for external connections.

24.1.3 All spare parts, special tools and test equipment, if purchased by the Employer, shall be delivered to a location in Hong Kong as directed by the Engineer suitably packed for protection against weather, rough handling during transportation and subsequent warehouse storage and clearly marked with a unique identification.

24.1.4 The Contractor shall minimise the number of different types of special tools and test equipment required to meet maintenance requirements.

24.1.5 All test equipment shall have the same design life as that of the equipment or system it tests.

24.1.6 Not later than 52 weeks after the date of the Letter of Acceptance, the Contractor shall submit for Approval the lists of spare parts, special tools and test equipment to be supplied. The lists shall be a amplification and confirmation of the lists referred to in Schedule C of the Pricing Document and shall be subsequently modified and amended as necessary with changes in design according to the requirements of Appendix P - Configuration Control Program.

24.1.7 In the event that modifications are introduced in any part of the cars under the terms of the Contract, the Contractor shall ensure that the delivered spare parts, special tools and testing equipment are identical to the installed items.

24.1.8 The Contractor shall confirm and update as necessary the lists of spare parts, special tools and test equipment to align with the latest Approved design. Copy of each of the updated lists shall be submitted to the Engineer according to the requirements specified in Appendix P.

24.1.9 Based on the recommended lists of spare parts, special tools and test equipment, the Engineer will determine those essential parts or items that are required for delivery prior to the commissioning of the first train at a time as specified by the Engineer and those that can be delivered at a later stage.

24.1.10 Each item of spare parts, sub-assemblies and assemblies shall be clearly and precisely labelled/tagged showing appropriate part numbers and parts descriptions and component/assembly identification codes for unique identification purpose.

24.1.11 The information supplied in respect of each spare part shall include, but not be limited to, the following:

(a) Detailed part description
(b) Unique component/assembly identification code (for easy identification of assembly/module/unit/system it belongs to)
(c) Name and address of the manufacturer and the address of its Hong Kong agent (if any)
(d) Manufacturer's part number
(e) Contractor's part number
(f) Manufacturer/Contractor drawing number
(g) Unit price
(h) Number off per train with special remark on interchangeability of the parts
(i) Estimated service life/annual consumption rate
(j) Shelf life (if any)
(k) Recommended quantity
(l) Minimum order quantity for subsequent orders
(m) Lead time for delivery of additional quantities (n) Overall dimensions including packing (if any)
(o) Special storage requirements (if any)

24.1.12 The information supplied in respect of each special tool and test equipment shall include, but not be limited to, the following:

(a) Full description of the tool/test equipment
(b) Application
(c) Name and address of manufacturer and tool/equipment model number
(d) Delivery period
(e) Recommended quantity
(f) Minimum order quantity for subsequent orders
(g) Power rating (if applicable)
(h) Dimensions, with/without packing
(i) Special storage requirements (if any)
(j) Weight

(k) Unit price
(l) Lead time for delivery of additional quantities

24.1.13 If a spare part, special tool or test equipment is to be produced by the Employer, the Contractor shall provide detailed technical specifications and drawings for the manufacture of the tools.

24.1.14 When a spare part, special tool or test equipment, or any part thereof including any software, is no longer available from the original supplier, the Contractor shall provide the Employer with an equivalent substitute which shall fulfil all the functions of the original item to not worse than the original performance standards.

24.2 Spares Recommendation

24.2.1 Spares for Running Maintenance

The final list shall be submitted for Approval 3 months before delivery of the first train.

24.2.2 Other Maintenance Spares

(a) The list shall also include those major items, such as, traction motors and bogies, which must be held as a float for unit exchange purpose.

(b) The final recommendation shall be submitted for Approval within 2 months following delivery of the first train.

24.2.3 Commissioning/Warranty Spares

(a) The final recommendations shall be submitted for the Engineer's Approval at least 6 months prior to the delivery of the first train and shall be delivered together with the first train.

(b) The Contractor shall provide and maintain this spares holding throughout the Defects Liability Period.

24.2.4 Special Spares

A special spare list for those spare parts/components which require delivery lead time longer than 6 months, such as, wheelset, pantograph or any specifically made parts/component, shall be submitted for Approval at least 6 months prior to the delivery of the first train.

24.2.5 Strategic Spares

A list of strategic spare parts likely to be required for contingency or replacement after major incidents, such as, collision and derailment, shall be submitted for Approval at least 6 months prior to the delivery of the first train.

24.3 Special Tools and Test Equipment

24.3.1 Special tools and test equipment shall be:

(a) those that are not easily acquired from the commercial markets;

(b) those that cannot be found in the reputable tools supplier's catalogues (such as RS Components International and McMaster - Carr Supply Company);

(c) those that are not commonly used in industrial application; or

(d) those that are not included in depot (refer to Appendix I Annex 6).

24.3.2 Special tools and test equipment shall be recommended such as to enable the maintenance personnel of the Engineer to carry out in-house testing and repair of the train and its associated equipment/component. In addition, all special equipment or facilities that are used to test, fault diagnosis and repair the microprocessor based PCBs/equipment shall also be recommended.

24.3.3 The special tools and test equipment recommended shall ensure that all levels of routine maintenance can be carried out to the Approved maintenance schedule with the depot facilities provided.

24.3.4 The recommended special tools and test equipment shall ensure that the maintainability targets specified in PS 25.9 can be achieved.

24.3.5 Where appropriate special tools and test equipment, such as, wheel skates, shall also be recommended for the use of a rescue team during major incidents to achieve fast recovery.

24.3.6 The recommended special tools and test equipment shall be sufficient in number to allow the trains to be maintained and overhauled to the Approved maintenance schedule.

24.3.7 Any recommended additional equipment that are required for the special tools and test equipment to carry out their intended function shall be kept to minimum. Any equipment that uses microprocessor control to analyses the performance of the train system, or its component parts, shall be configured to allow a data download of these test results. This information must provide the date and time of test, the tester's name, type of equipment tested, its modification status and serial number and any test results.

24.3.8 For free standing equipment the Contractor shall advise the storing and fixing arrangements of the special tools and test equipment.

24.3.9 The recommended Special tools and test equipment shall cover, but not be limited to, the following functions:

(a) Special keys and tools for access covers and doors

(b) Operation tools for special equipment and fasteners

(c) Inspection and measuring gauges for preventive and corrective maintenance, including equipment overhauls

(d) Special tools and test equipment required in the installation, removal, repair, adjustment and commissioning of equipment

(e) Test equipment for checking the functions and performance of equipment in-situ on the train

(f) Test equipment for interfacing with the Train Management System and any other microprocessor based equipment on the train to facilitate maintenance for identification of the faulty part down to the LRU level (refer to PS 26.2.5). Such equipment shall provide functions such as downloading fault logs, interrogation and adjustment of parameters.

(g) Test equipment which shall provide simulated inputs to the equipment for accessing its performance in-situ on the train

(h) Test equipment and simulators for checking and verifying the functions and performance of equipment at the workshop in repairs and overhauls

(i) Equipment for programming microprocessor based equipment

(j) Special tools for re-railment and for handling a locked axle

(k) Tools and equipment for supporting any condition-based maintenance schemes

24.3.10 Test equipment and simulators described in (f), (g) and (h) above for electronic equipment shall be so designed that the success rate of fault finding and rectification operations shall not be worse than 95%.

24.3.11 If a portable computer (PC) is recommended for the application of test equipment and simulators described in PS 24.3.9 (f), the Contractor shall ensure that only one single PC running on Windows XP or later operating system shall be recommended for interfacing with all microprocessor controlled equipment on the train, including the TMS, Event Recorder and the control system of other equipment (such as traction converter and doors). All software used for the above test and simulation purpose shall comply with RS/C6014/05.

24.3.12 For Contract purpose, total six (6) nos. of test equipment and simulators and/or PC shall be recommended.

24.3.13 All relevant operation and maintenance information (for example, manuals, drawings, circuit diagrams and etc) for the special tools and test equipment shall be recommended for Approval.

24.3.14 The final list shall be submitted for Approval 6 months before delivery of the first train.

24.3.15 The special tools and test equipment together with the associated operation and maintenance information, if purchased by the Employer shall be delivered not later 3 months after the delivery of the first train.

24.3.15 Training of all special tools and equipment shall be recommended by the Contractor according to the training requirements (refer to PS 23.8).

24.3.16 An additional list of special tools and test equipment which are used in production and are surplus to requirements upon Completion and which the Contractor would be willing to sell to the Employer, may be recommended for the Engineer's review at least 6 months prior to the delivery of the first train.

24.4 Submission and Delivery Schedules

Item	Descriptions	Schedules
1.	Submit the detailed lists of spares, special tools and test equipment	Not later than 52 weeks after the date of the Letter of Acceptance
2.	Update and submit a revised lists of spare parts, special tools and test equipment together with an amplification and confirmation of the lists referred to in Schedule C of the Pricing Document and shall be subsequently modified and amended as necessary with changes in design	SEMP stage 3
3.	Update and submit a revised lists of spare parts, special tools and test equipment	SEMP stage 4
4.	Training of all special tools and equipment if purchased by the Employer	SEMP stage 5
5.	Submit the final list of commissioning/warranty spares	6 months prior to the delivery of the first train
6.	Submit the final list of special and strategic spare	6 months prior to the delivery of the first train
7.	Submit the final list of special tools and test equipment	6 months prior to the delivery of the first train
8.	Submit all relevant operation and maintenance information (for example, manuals, drawings, circuit diagrams and etc) for the special tools and test equipment, if purchased by the Employer	6 months prior to the delivery of the first train
9.	Submit an additional list of special tools and test equipment which are used in production and are surplus to requirements upon Completion and which the Contractor would be willing to sell to the Employer	6 months prior to the delivery of the first train
10.	Submit the final list of spare parts for running maintenance	3 months prior to the delivery of the first train
11.	Submit the final list of other maintenance spares	2 months prior to the delivery of the first train
12.	Delivery of spare parts for running maintenance and commissioning/warranty spares if purchased by the Employer	Together with the first train
13.	Deliver the special tools and test equipment together with the operation and maintenance information if purchased by the Employer	Not later 3 months after the delivery of the first train

SECTION 25

SYSTEM ASSURANCE

August 2015

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25 SYSTEM ASSURANCE

25.1 Introduction

25.2 Key Deliverables

25.3 General System Assurance Requirements

25.4 Contractor's Hazard Registration System

25.5 Specific System Assurance Tasks

25.6 Safety Requirements

25.7 Reliability Requirements

25.8 Availability Requirements

25.9 Maintainability Requirements

25.10 System Assurance Audits

25.11 Not Used

Table 25-1 Summary of System Assurance Tasks and Deliverables by Project Stages

Table 25-2 System Safety Report Structure

Table 25-3 Hazard Log Template

Table 25-4 Deterministic Safety Assessment Template

Table 25-5 Failure Modes Effects and Criticality Analysis Template

Table 25-6 Safety Critical Item Identification Sample Template

Table 25-7 Service Criteria Item identification Sample Template

Table 25-8 Risk Matrix

Table 25-9 Maintenance Requirements Analysis Template

25 SYSTEM ASSURANCE

25.1 Introduction

25.1.1 This Section defines the requirements and techniques for system assurance. The general requirements and specific tasks for the System Assurance Plan (refer to PS 25.2.1) during the design development, production, and initial operation of the train are also provided.

25.1.2 The Contractor shall ensure that all system assurance requirements are met for each System Engineering Management Plan (SEMP) stage. The required tasks and deliverables are summarised against each SEMP stage (refer to PS 21.3.4) in Table 25-1at the end of this Section.

25.1.3 Independent Safety Assessor

(a) The Engineer will retain an Independent Safety Assessor to review all design development processes and system safety analyses, and verify that all safety related requirements have been met. This will include verification that the systems have been developed and validated appropriately for their application to the Employer. The Contractor shall make available to the Assessor any data required in addition to technical submissions specifically identified in this Specification.

(b) The Independent Safety Assessor will conduct audits during the design, construction, testing and commissioning phase of the project at the Contractor’s factories and design offices, the Contractor’s Hong Kong office, the Employer’s design office and work sites in Hong Kong.

(c) The Independent Safety Assessor will develop and submit the audit plan and report for the approval of the Engineer.

25.2 Key Deliverables

25.2.1 System Assurance Plan

(a) As an integral part of the System Engineering Management Plan (refer to PS 21.2.3), the Contractor shall provide a System Assurance Plan which shall detail the Contractor's intended methodology to plan, manage and control the system assurance process.

(b) The objectives of the System Assurance Plan are:

(i) to ensure that the requirements of safety, reliability, availability and maintainability are fulfilled

(ii) to ensure that hazards and RAM problems can be identified early in the project

(iii) to ensure that any improvements found necessary during the system assurance process be included in the design in a timely manner.

(c) The contents of the System Assurance Plan shall consist of, but not be limited to, the following elements:

(i) Organisation, roles and responsibilities of key personnel of the Contractor/ sub-contractors that will carry responsibility for the implementation of the System Assurance Plan and the way of communication

(ii) Resumes covering personal qualification and experience of key personnel of the Contractor/ sub-contractors that will carry responsibility for the implementation of the System Assurance Plan

(iii) Outline of system assurance tasks and the methodologies that will be adopted in safety and RAM analyses

(iv) Procedures for monitoring and control of the system assurance activities of the Contractor/ sub-contractors

(v) Procedures for the integration of system assurance activities within the overall design / construction processes

(vi) Performance targets to be met

(vii) Programme of system assurance tasks (refer to PS 25.3.1)

(viii) Internal audit program

(d) The Contractor shall update and submit the System Assurance Plan as part of the SEMP presentation (refer to PS 21.3.5) for each defined stage.

25.2.2 RAM Demonstration Plan

(a) The Contractor shall provide a RAM Demonstration Plan at SEMP 2 stage and the updated version at the remaining stages to cover testing and demonstrations associated with the reliability, availability and maintainability of the trains and its subsystems. The RAM Demonstration Plan shall address any pre-production and production tests and demonstrations on the achievement of RAM targets after the commencement of the Defects Liability Period.

(b) The contents of the RAM Demonstration Plan shall include, as a minimum, the following:

(i) Organisation and key personnel responsible for RAM demonstration

(ii) Roles and responsibilities of key personnel responsible for RAM demonstration

(iii) RAM targets to be met by demonstration

(iv) Items to which demonstration shall be carried out

(v) Suggested testing methods, format and procedures, consumer and producer's risk and proposed confidence Intervals.

(vi) Techniques and methods to be employed, including allowance for burn-in and reliability growth

(vii) Unequivocal definition of pass and fail criteria including failure counting criteria

(viii) RAM demonstration activity programme, including test period

(ix) Description of the Failure Reporting And Corrective Action System (refer to PS 25.5.18)

25.2.3 System Safety Report

(a) The Contractor shall prepare and submit a draft System Safety Report at SEMP stage 3 and the final version before the delivery of the first train under the Contract.

(b) The System Safety Report shall summarise the system safety activities undertaken, key safety issues and findings. The Contractor shall follow the report structure as shown in Table 25-2.

25.2.4 RAM Demonstration Reports

(a) The Contractor shall submit separate reports on reliability, availability and maintainability demonstrations within 1 month after the completion of the respective demonstrations. The report shall provide evidence that the respective RAM targets have been achieved and shall include any supporting information and calculations.

(b) The Contractor shall submit interim reports to monitor RAM performance, and to determine the effectiveness of corrective actions, if any, on a regular basis. The frequency of submission of the interim reports shall be agreed in the RAM Demonstration Plan.

25.3 General System Assurance Requirements

25.3.1 System Assurance Tasks

(a) The Contractor shall carry out system assurance tasks at different stages of the SEMP and during the Defects Liability Period in order to ensure that all system assurance requirements, in particular, those issues related to software and interface design, can be satisfied.

(b) System assurance tasks shall be integrated into the design, development, manufacturing and installation activities as a systematic approach. Outputs of such tasks shall be fed back to the respective activities and corrective actions shall be developed and implemented where necessary.

(c) The Programme of system assurance tasks shall include, but not be limited to, the following:

(i) Theoretical system assurance analyses, which shall include, but not be limited to:
- Preliminary Hazard Analysis
- Deterministic Safety Assessment
- Interface Hazard Analysis
- System Hazard Analysis
- Operating & Support Hazard Analysis
- Safety Integrity Level Analysis
- Failure Modes, Effects and Criticality Analysis
- Quantified Risk Assessment/Fault Tree Analysis
- Preliminary RAM Analysis
- Derivation and Apportionment of RAM targets
- RAM Modelling and Predictions

The Contractor may propose for Approval alternative techniques to the ones specified provided that they can achieve the same objectives.

(ii) Safety Verification

(iii) RAM Testing/ Commissioning

(iv) RAM Performance Demonstrations

(v) Failure Reporting And Corrective Action System (FRACAS)

(d) The outputs of system assurance tasks shall be submitted as level 4 Design Data (refer to Appendix N Clause 2.5).

25.3.2 Theoretical System Assurance Analyses

(a) The Contractor shall carry out theoretical analyses to assess the safety and RAM performance of the train, its systems and subsystems. The causes, probability and consequences of individual hazard shall be established and evaluated.

(b) Information such as failure modes and probabilities employed in the theoretical analyses shall be based on life experience or properly designed tests. The Contractor shall provide evidence to justify any assumptions adopted in the analyses.

(c) Theoretical system assurance analyses shall be updated to account for any changes in the design of the trains up to SEMP stage 5.

(d) The results of the theoretical system assurance analyses, including updated versions of the Hazard Log (refer to PS 25.3.3) and Register of Train Failures (refer to 25.3.4), shall be submitted according to Table 25-1.

(e) The results of the theoretical safety analyses shall be consolidated into the hazard log (refer to PS 25.3.3).

(f) The following assumptions shall be adopted in all theoretical safety and RAM analyses:

Running distance per car per year: 120,000 km
Distance between station stops: 1 km
Train operating time per day: 19 hours

25.3.3 Hazard Log

(a) The Contractor shall establish a Hazard Log to register hazards identified in the various safety analyses. The Hazard Log shall be submitted at SEMP 2 stage and updated at the remaining stages. Hazard Log is a part of the System Safety Report (refer to PS 25.2.3).

(b) The format of the Hazard Log shall follow the template in Table 25-3.

25.3.4 Register of Train Failures

(a) In addition to the Hazard Log, the Contractor shall also set up and maintain a Register of Train Failures to document all scenarios which will result in a train failure (refer to PS 25.7.4). The causes, consequential effects and impact on train service shall be recorded for each entry in the Register.

(b) The Register of Train Failures shall be submitted in both printed and electronic copies at SEMP 2 stage and updated at the remaining stages. The electronic copy shall be prepared in Microsoft Excel 2003, or a later version as Approved, stored in a CD ROM.

25.3.5 Performance Targets

(a) For the purpose of train service commitment, it is deemed necessary that the train shall achieve performances targets for the following aspects:

(i) Safety (refer to PS 25.6)
(ii) Reliability (refer to PS 25.7)
(iii) Availability (refer to PS 25.8)
(iv) Maintainability (refer to PS 25.9)

(b) The above performance targets shall be achieved under the condition that maintenance is performed by the Employer as follows:

(i) Maintenance work is carried out by skilled and suitably qualified personnel appropriate to the work

(ii) The maintenance team is constituted according to the approved Operation and Maintenance Manual (refer to RS/ C6014/12)

(iii) The work is carried out according to maintenance procedures in the approved Operation and Maintenance Manual (refer to RS/C6014/12)

(iv) Tools and spare parts required by the work are readily available

(v) The work is carried out using the Employer's maintenance facilities as described in Appendix I Annex 6.

(c) Failure to achieve any of the performance targets defined in PS 25.6 to PS 25.9 shall be deemed to be a defect under COC Section 75.

25.4 Contractor's Hazard Registration System

25.4.1 The Contractor shall establish a Contractor's Hazard Registration System to register and control the identified hazards.

25.4.2 In order to ensure that the hazards identified in the Contractor's Hazard Registration System will be given adequate attention early in the design stage and in such a way that changes can be made in a cost effective manner, the Contractor shall carry out a thorough review of the following information:

(a) Employer's Rolling Stock hazards;

(b) Analyses from similar works undertaken before.

25.4.3 The Contractor shall comply with the frequency and consequence and risk acceptance classification system (refer to Table 25-8) when completing the various safety hazard analyses. The Contractor shall be required to submit proposals for mitigation of all risks, other than those classified as "R4 " or outside the Contractor's scope or control, in accordance with the principles given in Table 25-8 Risk Matrix.

25.4.4 Apart from the newly identified hazards, the Contractor shall document hazards from the above information that are deemed applicable to the Works into the relevant hazard analyses. Where practicable, the design shall incorporate the same safeguards for these hazards. The Contractor shall clearly identify the new hazards in the hazard analyses and shall make every effort to avoid duplication of hazards.

25.4.5 The Contractor shall adopt the hazard log template in Table 25-3 to record all the hazards identified in the various hazard analyses. A softcopy of the hazard log shall be submitted to the Engineer.

25.4.6 The hazard log shall be constructed in the format of Microsoft Excel 2003 or a later version as Approved.

25.4.7 The Engineer will from time to time review the Contractor's hazard log and the Contractor shall draw to the attention of the Engineer for any newly identified hazards.

25.4.8 The following areas shall be highlighted in the summary of the respective hazard analysis for the Engineer's attention:

(a) All new hazards identified by the Contractor as a result of the new system design, interfaces, usage or operational environment shall be highlighted with new Contractor's Hazard Identification Numbers

(b) Any potential increase in risk level of existing hazards to an R1 or R2 Level due to change in hazard frequency or consequence;

(c) Proposed design options to mitigate the risk level to as low as reasonably practicable level, together with Cost Benefit Analyses and recommendation;

(d) Any uncontrolled risks that are outside the Contractor's responsibility and require the Engineer or other contractor's actions.

25.5 Specific System Assurance Tasks

25.5.1 Preliminary Hazard Analysis

(a) Preliminary Hazard Analysis shall provide an early, top level assessment of the design for possible hazards and to initiate appropriate actions to mitigate/eliminate hazards.

(b) The Contractor shall submit the Preliminary Hazard Analysis Report at SEMP 1 stage and the final version at SEMP 2 stage. The Preliminary Hazard Analysis Report is a part of the Safety Analysis Report.

(c) The hazards identified in the Preliminary Hazard Analysis shall be reported using the Hazard Log template in Table 25-3.

25.5.2 Deterministic Safety Assessment

(a) At SEMP 2 stage, the Contractor shall assess the design in respect of the application of, and compliance/non-compliance with current design codes and standards. This assessment will include the identification and assessment of any design safety principles associated with each aspect of the design and to confirm compliance/non-compliance with these principles.

(b) The Contractor shall use the Deterministic Safety Assessment template in Table 25-4 to report the Deterministic Safety Assessment and submit at SEMP 2 stage. The updated version of the Deterministic Safety Assessment shall be submitted in the remaining stages.

(c) The Deterministic Safety Assessment Report is a part of the Safety Analysis Report.

25.5.3 Interface Hazard Analysis

(a) The Interface Hazard Analysis shall be conducted upon completion of the Preliminary Hazard Analysis.

(b) The Interface Hazard Analysis identifies and assesses existing or potential hazards between subsystems and/or systems and their effect on overall system safety and operations. The emphasis is on interfaces. The Interface Hazard Analysis shall be conducted on the critical interrelationships of each subsystem and system to determine the cause and effect of possible independent, dependent and simultaneous failures that could present a hazardous condition, including failures of safety devices. When the Interface Hazard Analysis indicates a potential problem, it should be made known to the Engineer immediately.

(c) The Contractor shall submit the Interface Hazard Analysis Report at SEMP 2 stage and the final version at SEMP 3 stage. The Interface Hazard Analysis Report is a part of the Safety Analysis Report

(d) The Interface Hazard Analysis shall be reported using the Hazard Log template in Table 25-3.

(e) All hazards identified in the Interface Hazard Analysis shall be registered in the Hazard Log.

25.5.4 System Hazard Analysis

(a) The System Hazard Analysis shall be conducted upon completion of the Preliminary Hazard Analysis.

(b) The System Hazard Analysis shall identify and assess hazards associated with the design of systems including component failure modes, software errors and hazards resulting from functional relationships between components and equipment comprising each system.

(c) The Contractor shall submit the System Hazard Analysis Report at SEMP 2 stage and the final version at SEMP 3 stage. The System Hazard Analysis Report is a part of the Safety Analysis Report

(d) The System Hazard Analysis shall be reported using the Hazard Log template in Table 25-3

(e) All hazards identified in the System Hazard Analysis shall be registered in the Hazard Log.

25.5.5 Operating & Support Hazard Analysis

(a) The Operating & Support Hazard Analysis shall be conducted upon completion of Preliminary Hazard Analysis.

(b) The Operating & Support Hazard Analysis shall be conducted on all tasks and human actions, including acts of omission and commission, by persons interacting with the system, subsystems and assemblies at any level, and including the public. All human factors and ergonomic aspects of the design and its operation shall be considered. When the Operating & Support Hazard Analysis indicates a potential safety hazard, it shall be made known to the Engineer immediately.

(c) The Contractor shall submit the Operating & Support Hazard Analysis Report at SEMP 2 stage and the final version at SEMP 3 stage. The Operating & Support Hazard Analysis Report is a part of the Safety Analysis Report.

(d) The Operating & Support Hazard Analysis shall be reported using the Hazard Log template in Table 25-3.

(e) All hazards identified in the Operating & Support Hazard Analysis shall be registered in the Hazard Log.

25.5.6 Safety Integrity Level Analysis

(a) A Safety Integrity Level Analysis shall be carried out for all safety related system softwares. The Contractor shall allocate a Safety Integrity Level for each safety related system software based on the various System Requirements Document (refer to Appendix N), PS requirements and hazard analyses. In determining Safety Integrity Level, all causes of failures (including random hardware failures, systematic failures and software errors) which lead to an unsafe state should be included. The Safety Integrity Level assessment shall be produced as part of the Preliminary Hazard Analysis, and shall be used to determine the appropriate design and development techniques. The Safety Integrity Levels (SIL) defined in IEC 61508 shall be used. The software system design and development process shall comply with the relevant requirements stipulated in EN50128 and EN50129.

(b) The Contractor shall demonstrate in the safety analysis that the SIL of the software system shall be able to reduce the risks to As Low As Reasonably Practicable (ALARP). The SIL requirement for software shall apply to all the applicable systems, sub-systems and its interfaces delivering the identified safety functions.

(c) The safety analysis shall be conducted on the interface function in accordance with the EN50129 and IEC61508 and benchmarking with the SIL of similar railway systems shall be carried out. The SIL assessment methodology shall be submitted for the Engineer's review before commencement of the work.

(d) All safety analyses associated with SIL shall be reported in the Safety Integrity Level Analysis Report and submitted at SEMP 2 stage. The final version of this report shall be submitted at SEMP 3 stage.

(e) The Safety Integrity Level Analysis Report is a part of the Safety Analysis Report.

25.5.7 Failure Modes, Effects and Criticality Analysis (FMECA)

(a) At SEMP 2 stage, the Failure Modes, Effects and Criticality Analysis shall be undertaken and highlighted on all components in systems or equipment which are found to have failure modes whose failure consequences are classified as "Serious" or worse in accordance with the Hazard Consequence Categories of Risk Matrix in Table 25-8, or cause train delay greater than two minutes.

(b) FMECA shall adopt a bottom-up approach to identify the effects on the operating railway due to failure of low level equipment. The scope shall also cover software and human factors. The effects of different modes of component failure shall be propagated to the next level of the system or equipment and this process shall be continued until the overall effect on system function can be determined. The effect of any equipment redundancy shall be incorporated into the results.

(c) An estimation of the effects of the failure on passengers and staff shall also be made, including the delay to the service, and an estimation of time taken to restore the system to normal operation will also be required.

(d) The Contractor shall submit the Failure Modes, Effects and Criticality Analysis Report at SEMP 2 stage. The updated version of the Failure Modes, Effects and Criticality Analysis Report shall be submitted in the remaining stages.

(e) The report of the Failure Modes, Effects and Criticality Analysis shall adopt the template in Table 25-5.

25.5.8 Quantified Risk Assessment/Fault Tree Analysis

(a) Quantified Risk Assessment shall be conducted for those hazards which have satisfied the following conditions:

(i) Residual Risk Level is assessed as R1 or R2; and
(ii) Likely to cause fatality of passenger and/or staff

Quantified Risk Assessment can adopt Fault Tree Analysis, Event Tree Analysis or other appropriate methodology.

(b) The Contractor shall conduct Fault Tree Analysis for the following “top events”:

- Train collision on main line
- Train derailment on main line
- Train fire
- Smouldering/Smoke in train
- Train separation on main line
- Undemanded passenger door opening on main line
- Failure to deploy emergency door in ramp or slide mode

Fault Tree Analysis shall involve the preparation of a logic diagram, which traces the events or combinations of contributing events which have led to an undesirable occurrence (referred to as the "top event"). Each of the contributing event(s) shall be also considered in turn, together with the subsidiary events involved in those failures. The process shall be continued with each event being scrutinised for its causes until it is not practical to proceed to a lower level or the process need not be continued because the probability of the occurrence of the event is demonstrably negligible. The effects of software, human factors and environmental factors shall be considered in the analysis.

(c) The Contractor shall submit the Quantified Risk Assessment/Fault Tree Analysis Report at SEMP 2 stage. The updated version of the Quantified Risk Assessment/Fault Tree Analysis Report shall be submitted in the remaining stages. The Quantified Risk Assessment/ Fault Tree Analysis Report is a part of the Safety Analysis Report.

25.5.9 Safety Critical Item

(a) A Safety Critical Item (SCI) is an engineering item whose integrity is critical to the safe operation of the railway. Its failure to perform its functions could lead to an accident involving loss of life or injury to the staff, Contractor, passengers or the public, it requires stringent maintenance controls to ensure that it continues to satisfactorily perform the required safety functions.

(b) A reference list of SCI will be provided by the Engineer containing the relevant SCI records of the existing railway. The Contractor shall review the reference list of SCI and identify those items applicable to the Works. The Contractor shall also identify any further SCIs that are not contained in the reference list. The Contractor shall propose appropriate maintenance control measures during the design stage.

(c) The methodology for the identification of SCIs shall be submitted to the Engineer for Approval before commencing the activity.

The following selection criteria are used to determine the safety consequence of the credible failures of an engineering item being assessed (items that satisfy any of the first three criteria are considered safety critical):

(i) Single failure that leads to Serious (< 5 major injuries) or worse consequence;

(ii) Double independent failures that lead to Critical (< 5 fatalities or 5-50 major injuries) or worse consequence;

(iii) Triple independent failures that lead to Catastrophic (5-50 fatalities or 51-500 major injuries) or worse consequence; and

(iv) Ignore Quadruple (or more) Failures.

(d) The Contractor shall record the SCI identification results in accordance with the SCI sample template as outlined in Table 25-6 and submit (in both hardcopy and softcopy in Microsoft® Excel format) to the Engineer for Approval before the end of detailed design stage.

(e) The Contractor shall review the Hazard Log against the SCI identification results to ensure that all identified SCIs are included within the Hazard Log and the risks of the associated hazards are reduced to ALARP.

25.5.10 Service Critical Item (SeCI)

(a) A Service Critical Item (SeCI) is an engineering item whose integrity is critical to the service performance of the railway. Its failure to perform its intended functions may lead to incident involving disruption to train or station services. (Note: refer to 25.5.9 (e) for the selection criteria).

(b) Each SeCI shall be subject to a vigorous design process with the objectives that:

(i) the availability of the SeCI is maximised; and

(ii) where appropriate, preventive maintenance controls may be considered to assure that it will deliver the required service level.

(c) A reference list of SeCI will be provided by the Engineer containing the relevant SeCI records of the existing railway. The Contractor shall review the reference list of SeCI and identify those items applicable to the Works. The Contractor shall also identify any further SeCIs that are not contained in the reference list. The Contractor shall propose appropriate design and maintenance control measures during the design stage.

(d) The methodology for the identification of SeCIs shall be submitted to the Engineer for Approval before commencing the activity.

(e) The following selection criteria shall be used to determine the service consequence of the credible failures of an engineering item being assessed (items that satisfy any of the following four criteria are considered service critical):

The loss of function that would potentially lead to:

(i) Total suspension of train service > 30 minutes

(ii) Accumulative delay of train service > 60 minutes

(iii) Total suspension of station ≥ 1 day

(iv) Crowd control is triggered inside station of ≥ 1 day

2 types of “loss of function” that shall be considered:

(i) Loss of function caused by single failure

(ii) Loss of function caused by double failures if the first component failure is hidden and the second failure is credible and revealed. In such case, only the first component is considered as a service critical item.

(f) The Contractor shall record the SeCI identification results in accordance with the SeCI sample template as outlined in Table 25-7 and submit (in both hardcopy and softcopy in Microsoft® Excel format) to the Engineer for Approval during the design stage.

25.5.11 Safety Analysis Report

(a) The Safety Analysis Report shall include the following analysis reports:

Section 1: Preliminary Hazard Analysis Report
Section 2: Interface Hazard Analysis Report
Section 3: System Hazard Analysis Report
Section 4: Operating & Support Hazard Analysis Report
Section 5: Safety Integrity Level Analysis Report
Section 6: Deterministic Safety Assessment Report
Section 7: Quantified Risk Assessment/Fault Tree Analysis Report
Section 8: Safety Criteria Item Identification

The Contractor shall submit Section 1 of the Safety Analysis Report at SEMP 1 stage and Sections 2 – 7 at SEMP 2 stage. The Contractor shall also submit the final version or the updated version of the reports in the remaining stages according to the requirements of individual reports. Details refer to Table 25-1.

25.5.12 Derivation and Apportionment of RAM Targets

(a) At SEMP 1 stage, the Contractor shall decide, subjected to the agreement of the Engineer, to what extent the overall targets for RAM of their Works shall be decomposed to sub-system/component level. The Contractor shall then apportion the overall targets among the sub-systems / components. Those aspects of design which are contributing disproportionately high levels of risk to the non-achievement of RAM targets shall be identified.

(b) The Contractor shall submit the RAM Target Apportionment Report at SEMP 1 stage and the final version at SEMP 2 stage.

25.5.13 Preliminary RAM Analysis

(a) At SEMP 1 stage, the Contractor shall conduct a Preliminary RAM Analysis which shall give an initial indication of any RAM problems which may arise.

(b) The Preliminary RAM Analysis shall include a preliminary assessment of the likely levels of RAM to be achieved.

(c) The Contractor shall submit the Preliminary RAM Analysis Report at SEMP 1 stage and the final version at SEMP 2 stage.

25.5.14 RAM Modelling and Predictions

(a) At SEMP 2 stage, the Contractor shall adopt Reliability Block Diagram, Fault Tree Analysis, FMECA or other appropriate methodologies to conduct RAM modelling and predict RAM performance so as to verify that the design of systems/sub-systems on the train can achieve the RAM targets.

(b) The purpose of RAM modelling is to develop a model of the functional interdependencies of the system/sub-system on the train. It shall provide an analytical framework for apportioning the system level RAM targets into lower level estimates to generate design goals.

(c) RAM prediction is a bottom up analytical process which provides quantitative estimates on overall system RAM performance based on estimates of lower level sub-systems.

(d) RAM prediction shall identify weak links in the system, provide quantitative assessment of a design with respect to achievement of the RAM targets and highlight areas having the largest potential for improvement.

(e) Documents shall be provided to show how the configuration of the system contributes to its overall safety and RAM performance, and the trade-off between relevant parameters.

(f) The Contractor shall submit the RAM Modelling and Predictions Report at SEMP 2 stage and the final version at SEMP 3 stage.

25.5.15 RAM Testing/Commissioning

(a) During specific SEMP stages as defined in Table 25-1, individual components and sub-assemblies shall be tested to establish whether they shall be able to achieve the RAM targets established in the design process (refer to PS 25.5.14(a) & (b)).

(b) As a minimum requirement, simulated endurance tests shall be carried out, during SEMP stages 3 and 4, on each of the top 5 items of equipment which are expected to contribute to the greatest number of incidents in accordance with the theoretical analyses (refer to PS 25.7.1).

(c) Such tests shall be carried out on representative samples of the equipment to verify the reliability predicted in the analyses to 90% confidence level single sided lower limit and to the requirements in PS 22.1.

(d) Each item to be tested shall be operated under simulated operation conditions for at least 1.2 times of the number of duty cycles or operating time that it shall experience in actual service between overhauls or replacements. Details of the test and the results shall be submitted as part of the RAM Demonstration Report.

(e) Details of the tests shall be submitted for the Engineer's approval in the RAM Demonstration Plan as defined in PS 25.2.2.

25.5.16 Safety Verification

The objective of Safety Verification is to demonstrate that safety functions / features which are an integral part of the design shall work as intended. The process shall be covered by type test and commissioning tests on items of equipment critical to safety.

25.5.17 RAM Performance Demonstrations

(a) RAM performance demonstrations shall be carried out as defined in the respective RAM requirements (refer to PS 25.7 to 25.9). This shall be a statistical process that requires a predefined and significant period of operation. The information collected shall enable comparison to be made with the theoretical work undertaken during the design through to testing & commissioning stages, with an aim to ensure that the required level of RAM is achieved in service.

(b) The Contractor shall propose for Approval accept / reject criteria in the formulation of the RAM Demonstration Plan (refer to PS 25.2.2), which shall take into account the following factors:

(i) RAM targets specified in the PS;
(ii) Quantity of equipment in operation under scope of supply of the Contract;
(iii) Accumulative operational time or distance travelled;
(iv) The requirement for 90% confidence level single sided lower limit

(c) If the required confidence level of the RAM targets cannot be demonstrated during the Defects Liability Period, then the Contractor shall present an alternative demonstration proposal in the RAM Demonstration Plan.

25.5.18 Failure Reporting and Corrective Action System

(a) The Contractor shall establish a Failure Reporting and Corrective Action System throughout the defined SEMP stages to provide a documented

history of any problems and failures and their associated corrective actions as well as detailing how and why each problem arose, or failure occurred.

(b) The Failure Reporting and Corrective Action System shall monitor the safety and RAM performance of the equipment, from the design (where changes may result from conclusions of the predictive analysis), through testing and commissioning and into operation. The system shall be used to monitor the performance of components and to identify patterns of failures so that corrective action can be taken to improve both current and future systems.

25.6 Safety Requirements

25.6.1 Safety is defined as freedom from those conditions that can cause death, injury, occupational illness, or damage to or loss of equipment or property, or damage to the environment.

25.6.2 Safety performance shall be assessed by the Risk Index of individual hazards identified during the System Assurance process.

25.6.3 The Risk Index of a hazard shall be identified from the Risk Matrix in Table 25-8 in accordance with the following parameters associated with the hazard:

(a) The hazard frequency ranking (A to J), as defined in Table 25-8. This shall be calculated for the entire fleet under the assumptions defined in PS 25.3.2(f); and

(b) The hazard Consequence category (1 to 7), as defined in Table 25-8, based on an average passenger load per train.

25.6.4 The Contractor shall ensure that the Risk Index of all hazards on the train shall not be worse than either "R3" or "R4" as defined in the Risk Matrix in Table 25-8.

25.7 Reliability Requirements

25.7.1 Definition of an Incident

The reliability of the trains shall be measured based on the number of train service disruption incidents, hereafter referred to as incidents, which are caused by train failures during operation. An incident is defined as any one of the following events which are caused by a train failure (refer to PS 25.7.4):

(a) Removal from Service

A train is removed from passenger service.

(b) Delay to Train Service

A train is delayed by 2 minutes or more. Both initial and accumulative delays, whichever is the greater, shall be counted. Initial delay refers to the increase in journey time experienced by passengers on the failed train at the incident location. Accumulative delay refers to the longest increase in journey time experienced by passengers on the failed train and clocked at the terminus.

(c) Failure to be Despatched

A train which is scheduled to enter passenger service cannot be despatched at the scheduled time of departure

Events which have evidence to indicate that a train failure has occurred but which end up with causes unknown shall be included retrospectively as incidents once they are confirmed to have arisen from genuine train failures.

25.7.2 Measurement of Reliability

The reliability of the trains shall be assessed using the following measures:

(a) Number of Incidents per Million Car Kilometres

The average number of incidents per million car kilometres achieved in a given period by all cars supplied under the Contract. It shall be calculated using the following formula:

$$\frac{\text{Total number of incidents in a given period} \times 1{,}000{,}000}{\text{Total running distance in km covered by all cars in the period}}$$

(b) Number of 2-minute Delays per Million Car Kilometres

The average number of delays of or over 2 minutes per million car kilometres achieved by all cars in a given period. It shall be calculated using the following formula:

$$\frac{\text{Total number of delays of or over 2 mins. in a given period} \times 1{,}000{,}000}{\text{Total running distance in km covered by all cars in the period}}$$

(c) Number of 5-minute Delays per Million Car Kilometres

The average number of delays of or over 5 minutes per million car kilometres achieved by all cars in a given period. It shall be calculated using the following formula:

$$\frac{\text{Total number of delays of or over 5 mins. in a given period} \times 1{,}000{,}000}{\text{Total running distance in km covered by all cars in the period}}$$

25.7.3 Reliability Targets

The trains shall achieve the following reliability targets by the end of the reliability demonstration period

(a) not more than 6.0 incidents per million car kilometres

(b) not more than 1.82 cases of delay of or over 2 minutes per million car kilometres

(c) not more than 0.25 cases of delay of or over 5 minutes per million car kilometres

25.7.4 Conditions for Train Failures

A train failure is defined as a failure or deterioration of a system, a function, or a component on a train which renders it unfit for passenger service. Failures due to free issued items on the train shall be excluded.

Trains under the following conditions are deemed to be unfit for passenger service:

(a) A failure, or symptoms that suggest the presence of such failure, which endangers the safe and / or normal operation of the railway.

Examples are:

- a failure in the brake system
- a failure in a safety interlock or protection circuit, such as the door loop
- abnormal noise in the underframe
- smouldering
- serious wheel flat
- arcing on the pantograph
- failure of any emergency equipment
- failure of part of the traction equipment so that the train will not be able to perform emergency push-out duty

(b) A failure, or symptoms that suggest the presence of such failure, which will render the train not able to meet the minimum headway requirement

Examples are:

- a failure in the traction equipment so that the train is not able to meet the service speed profile
- 2 or more doors on a train cannot operate properly
- a failure that requires more than 2 instances of reset or recovery action by the train operator within 30 minutes

(c) A failure, or symptoms that suggest the presence of such failure, which will degrade the quality of passenger or train operator comfort

Examples are:

- more than one air conditioning unit on a train fail
- noisy air conditioning unit
- 1/3 or more of the lighting in a car fail
- cab air conditioning failure
- jerky movement

(d) A failure, or symptoms that suggest the presence of such failure, which will aggravate the damage on the train or other railway equipment if the train remains in service

Examples are:

- wheel flats
- arcing on the pantograph
- brake hanging on

Further failure examples to be agreed with the Engineer.

25.7.5 Recovery from Train Failures

To minimise service disruption incidents caused by train failures, the trains shall be designed to meet the following requirements:

(a) When a failure occurs on a train which may render it unfit for passenger service (refer to PS 25.7.4), the train operator, with the aid of the Train Management System (refer to PS 10), should be able to recover the train from the failure within two minutes so that the train can continue its scheduled service.

(b) In the event that the failure cannot be recovered and the train is required to be withdrawn from service, the train operator shall, within five minutes, be able to carry out failure isolation and start the return journey at fully laden load (refer to PS 4.4.11) under the train's own power, to the nearest depot or refuge siding.

(c) In the event that no tractive power is available from the defective train and an assistance train is required, the train operator shall, within five minutes, be able to prepare the train for emergency push out or pull out operation (refer to PS 4.4.3).

25.7.6 Demonstration of Reliability Performance

(a) The reliability demonstration period shall begin immediately after the commencement of passenger service of the last train in respect of the Sections of the Works and the whole of the Works which are related to the Completion Obligation for Completion of Tests on Completion and ready for Passenger Service referred to in Appendix F.

The trains shall be assessed collectively on per batch basis. Each batch shall comprise the number of trains to be completed for each of the above mentioned Sections of the Works and the whole of the Works. (e.g., 2 trains in Section 4 of the Works, 26 trains in Section 6 of the Works, and so on.) The period of assessment for each batch of trains shall be for at least 12 months and shall end when the reliability targets are achieved.

Systematic failures are failures not caused by failure mechanisms such as component wear out, but by a design defect. All incidents attributed to the systematic failure will be initially chargeable. However, subject to the Engineer’s Approval, they may be re-classified as non-chargeable when the failure mechanism, which is associated with a design defect, is identified and corrective action is satisfactorily retrofitted.

(b) During the Reliability Demonstration Period, the Engineer will maintain records for all incidents and details of train failures. Such records shall be made available to the Contractor.

(c) During the Reliability Demonstration Period, the Engineer will review train failure records and decide whether additional scenarios are to be incorporated into the Register of Train Failures. The Contractor shall then update the Register for the Engineer's Approval within 30 days of the Engineer's notice for updating.

(d) The failure records of same batch of the trains shall be assessed at the end of the 12th month of the reliability demonstration period. The value of each of the three reliability measures defined in PS 25.7.2 shall be

calculated from the records for the preceding 12 consecutive months and compared to the reliability targets.

(e) In the event that any reliability targets are not achieved, the DLP of the trains under the same batch shall be extended at the Contractor's cost and the determination of reliability achievement shall be continued at monthly intervals until all reliability targets are achieved over a 12 consecutive months period.

(f) In the event that any reliability target is not achieved, the Contractor shall, at his own expense, take whatever action is deemed necessary to meet the reliability requirement.

25.7.7 Reliability Growth Management

(a) The Contractor shall during the mock-up development stage incorporate reliability growth management requirements in order to identify any design deficiencies or defects for improvement to ensure that the delivered system will meet relevant reliability requirements.

(b) Reliability growth management shall include but not limit to specifying required system / sub-system tests, test schedules (from prototype development to manufacture), test methods, duration and acceptance criteria.

(c) The Contractor may refer to MIL-STD-189 and MIL-STD-781 for relevant techniques and methods.

(d) The Reliability Growth Management processes shall be completed before the commencement of passenger service.

25.8 Availability Requirements

25.8.1 Measurement of Availability

(a) Availability shall be assessed by the following measure:

$$\text{Availability} = 1 - \frac{DT(RE)/3 + DT(OPM) + DT(CM)}{\text{Total Time}}$$

where:

(i) Total Time is the time in hours in the assessment period multiplied by the number of trains supplied under the Contract.

(ii) DT(RE), or Down Time due to service checks, is the total down time in hours due to service checks (refer to PS 26.3.2), summed over all Train Units supplied under the Contract during the assessment period.

(iii) DT(OPM), or Down Time due to Other Preventive Maintenance, is the total down time in hours due to Preventive Maintenance (refer to PS 26.3) other than service checks (refer to PS 26.3.2), summed over all sessions carried out on the trains supplied under the Contract during the assessment period.

(iv) DT(CM), or Down Time due to Corrective Maintenance, is the total down time in hours due to corrective maintenance (refer to PS 26.4), summed over all sessions carried out on the trains supplied under the Contract during the assessment period. Time spent on train integrity inspections after train reformations arising from corrective maintenance work shall be included.

(b) The above down times shall be counted starting from the moment when work is physically started on a Train Unit or train and shall end when the Train Unit or train is restored to service condition (PS 2.1.6). The time shall cover the full content of the maintenance work concerned, including safety precautions, inspections, servicing, replacement of equipment, defect detection and rectification, testing and restoration to service condition.

25.8.2 Availability Target

The trains supplied shall achieve a minimum availability of 96.5%.

25.8.3 Demonstration of Availability Performance

(a) The Availability Demonstration Period shall begin immediately after the commencement of passenger service of the last train in respect of the Sections of the Works and the whole of the Works which are related to the Completion Obligation for Completion of Tests on Completion and ready for Passenger Service referred to in Appendix F.

The trains shall be assessed collectively on per batch basis. Each batch shall comprise the number of trains to be completed for each of the above mentioned Sections of the Works and the whole of the Works. (e.g., 2 trains in Section 4 of the Works, 26 trains in Section 6 of the Works, and so on.) The period of assessment for each batch of trains shall be for at least 12 months and shall end when the availability target is achieved.

The total maintenance down times for per batch basis will be collected by the Engineer and the average availability during the preceding 12 months, shall be worked out from the above formula.

(b) In the event that any availability targets are not achieved, the DLP of the trains under the same batch shall be extended at the Contractor's cost and the determination of availability achievement shall be continued at monthly intervals until the availability target is achieved over a 12 consecutive months period.

(c) In the event that the availability target is not achieved, the Contractor shall, at his own expense, take whatever action is deemed necessary to meet the availability requirement.

25.9 Maintainability Requirements

25.9.1 Maintainability Target

The maintainability of a given maintenance operation shall be measured by the arithmetic mean of the times required to complete a sample of the same operation. After the maintenance operation the train involved shall be restored to service condition.

The trains shall meet the following maintainability targets:

(a) A Service Check - not more than 6 hours per 4 cars with a team size of not more than 2 persons

(b) B Service Check - not more than 6 hours per 4 cars with a team size of not more than 8 persons

(c) Service Check on a complete train - not more than 6 hours per train with a team size of not more than 10 persons.

(d) General Overhauls - not more than 56 hours (7 working days) per train

(e) Scheduled Equipment Replacements - not more than 6 hours per session

(f) Corrective Maintenance operations (including defect identification, replacement of defective LRUs and restoration to service condition) that do not require car lifting - not more than 4 hours.

(g) Replacement of LRUs that do not require car lifting - not more than 30 minutes.

(h) Corrective Maintenance operations (including defect identification, replacement of defective LRUs and restoration to service condition) that require car lifting, excluding time required for shunting - not more than 6 hours. In this case it is assumed that car lifting is carried out using the underfloor car lifting equipment specified in Clause 3.3 of Appendix I Annex 6.

(i) Internal Light Cleaning - not more than 2.5 hours per train with a team size of 2 persons

(j) Internal Heavy Cleaning - not more than 6 hours per car with a team size of 1 person

(k) Window Cleaning - not more than 2 hours per car with a team size of 1 person

(l) K Service Check - not more than 6 hours per train with a team size of not more than 6 persons.

In addition to the above maintainability targets, the trains shall also satisfy maintenance requirements specified in PS 26. Any replacement of good LRUs due to inaccurate diagnosis shall be included in the maintenance time.

25.9.2 Demonstration of Maintainability Performance

(a) As part of RAM testing / commissioning (refer to PS 25.5.15) and RAM performance demonstration (refer to PS 25.5.17), the Contractor shall carry out tests to show that all maintainability targets are met.

(b) The tests shall cover all preventive maintenance sessions (refer to PS 26.3), cleaning (refer to PS 26.5) sessions and a representative sample of actual or simulated corrective maintenance (refer to PS 26.4) operations for the calculation of the maintainability target specified in the Letter of Clarification. Reference shall be made to MIL-STD-471 in the formulation of the maintainability tests.

(c) All maintainability tests shall be completed within 6 months after the first train is put into passenger service. For General Overhaul Service Check items, the maintainability demonstration shall be completed within 24 months after the first train is put into passenger service. Moreover, all maintainability demonstration shall be performed in Hong Kong.

(d) In the event that any maintainability targets are not achieved, the Contractor shall, at his own expense, take whatever action is deemed necessary to meet the maintainability requirement.

(e) In the event that the maintenance cost of LCC as stipulated in Appendix M is not achieved, the DLP of the trains shall be extended at the Contractor's cost and the determination of maintenance cost achievement shall be continued until the maintenance cost target is achieved.

25.9.3 Maintenance Requirements Analysis

(a) The Contractor shall conduct a structured Maintenance Requirements Analysis to formulate the maintenance requirements and determine the optimum maintenance policy. One possible technique that the Contractor can apply is Reliability Centred Maintenance (RCM), which is a logical process for identifying preventive and corrective maintenance tasks to realise the inherent reliability of equipment at optimum expenditure of resources.

(b) The Maintenance Requirements Analysis shall identify for each system function the potential functional failures, failure consequences, and the appropriate maintenance methods such as visual inspection, condition maintenance, preventive maintenance, hard time replacement, overhaul etc.

(c) The Contractor shall use the template in Table 25-9 for conducting Maintenance Requirements Analysis.

(d) The Maintenance Requirements Analysis results shall include a summary of:

(i) The consolidated maintenance programme;
(ii) A list of tasks to be undertaken at different time intervals and the manning levels required;
(iii) The critical equipment or assembly requiring frequent inspection and maintenance and the justifications;
(iv) The list of equipments that are subject to condition based maintenance.

(e) The Contractor shall, for each maintenance activity, identify maintenance logistics requirements such as

(i) Personnel – skills, training, call-out process, location, crew size;
(ii) Spares – quantity, turnaround times, inventory, etc.;
(iii) Tools & Test Equipment – including computer & software;
(iv) Maintenance facilities – power, compressed air, water, environment controls, lighting, etc;
(v) Transportation & Handling – mode of transportation for personnel, equipment & spares, manual handling requirements.

(f) The Contractor shall submit the Maintenance Requirements Analysis results at SEMP 3 stage and the final version at SEMP 4 stage for the Engineer's Approval, subsequent to which the maintenance requirements derived from the analysis shall be incorporated into the Operating and Maintenance Manuals.

25.10 System Assurance Audits

25.10.1 The Engineer shall conduct audits during design, development, manufacture and testing and commissioning phases to ensure that the Contractor has met all relevant system assurance requirements. The Engineer shall give 7 days notice to the Contractor about the audit arrangement. The Contractor shall provide all necessary assistance to enable the Engineer or his representative complete the audit (e.g. arrange proper staff to attend interviews, provide relevant documents etc.).

25.10.2 After the audit is completed, the Engineer shall recommend various system assurance related improvement actions. The Contractor shall provide evidence (e.g. documents) to ensure that all improvement actions have been completed before agreed completion dates.

25.11 Not Used

Table 25-1 Summary of System Assurance Tasks and Deliverables by Project Stages

Item	System Assurance Tasks / Document	PS Ref	SEMP Stage					
			SEMP 1	SEMP 2	SEMP 3	SEMP 4	SEMP 5	DLP
			Concept Exploration	Design Development and Review	Design Verification and Validation	Engineering and Manufacturing Development Phase	Inspection. Testing, Commissioning, Demonstration and Training	Defects Liability Period
	Safety Management Related Tasks							
1	System Assurance Plan (including RAMS)	25.2.1	D	D	D	D	D	–
2	Safety Analysis Report Section 1: Preliminary Hazard Analysis Report	25.5.11 25.5.1	D	D	-	-	-	-
3	Safety Analysis Report Section 2: Interface Hazard Analysis Report Section 3: System Hazard Analysis Report Section 4: Operating & Support Hazard Analysis Report Section 5: Safety Integrity Level Analysis Report	25.5.11 25.5.3 25.5.4 25.5.5 25.5.6	-	D	D	-	-	-
4	Safety Analysis Report Section 6: Deterministic Safety Assessment Report Section 7: Quantified Risk Assessment/Fault Tree Analysis Report Section 8: Safety Criteria Item Identification	25.5.11 25.5.2 25.5.8 25.5.9	-	D	D	D	D	-
5	Hazard Log	25.3.3	-	D	D	D	D	-
6	Safety Verification	25.5.16	-	–	–	-	A	–
7	System Safety Report	25.2.3	-	–	D	–	D	-
	RAM Management Related Tasks							
1	Preliminary RAM Analysis Report	25.5.13	D	D	-	-	-	-
2	Derivation and Apportionment of RAM Target	25.5.12	D	D	-	-	-	-
3	RAM Modelling and Predictions	25.5.14	-	D	D	-	-	-
4	Failure Modes, Effects and Critically Analysis With Service Criteria Items identification	25.5.7 25.5.10	-	D	D	D	D	-
5	Register of Train Failure	25.3.4	-	D	D	D	D	-
6	RAM Demonstration Plan (including Failure Reporting And Corrective Action System)	25.2.2, 25.5.18	-	D	D	D	D	D
7	RAM Testing / Commissioning	25.5.15	-	-	A	A	A	-
8	RAM Performance Demonstration	25.5.17	-	-	-	-	A	A
9	RAM Demonstration Reports	25.2.4	-	-	-	-	-	D
10	Maintenance Requirements Analysis	25.9.3	-	-	D	D	-	-

Legend: A - Activity
D - Deliverable

Table 25-2 System Safety Report Structure

1. Introduction
    - 1.1 Background
    - 1.2 Definition
    - 1.3 Abbreviations

2. System Description
    - 2.1 Overview
    - 2.2 System and Sub-systems
    - 2.3 Interfaces
    - 2.4 Safety Features
    - 2.5 Backup or Emergency Operations

3. Safety Management
    - 3.1 Safety Policy
    - 3.2 Safety Management Organisation and Responsibilities
    - 3.3 Safety Management Process
    - 3.4 Safety Management Activities in Different Project Phases
    - 3.5 Safety Justification Documentation

4. Hazard Identification & Control
    - 4.1 Introduction
    - 4.2 Hazard Identification and Control
    - 4.3 Summary of Hazard Close-out
    - 4.4 Description of Safety Critical Hazards
    - 4.5 Safety Critical Item Identification List
    - 4.6 Service Criteria Item Identification List

5. Deterministic Safety Assessment
    - 5.1 Introduction
    - 5.2 Methodology
    - 5.3 Summary of Results

6. Quantified Risk Assessment / Fault Tree Analysis (if applicable)
    - 6.1 Introduction
    - 6.2 Methodology
    - 6.3 Summary of Results

7. Operation Safety Assessment
    - 7.1 Summary of Operational Mitigation Measures
    - 7.2 Summary of Maintenance Mitigation Measures
    - 7.3 Training

8. Conclusion
    - 8.1 Safety Management
    - 8.2 Hazard Identification and Control
    - 8.3 Progress of Non-compliance and On-going Items (if applicable)

8.4 Operation Hazards to be Transferred to Operations Division with Residual Risk at R1 or R2 (if applicable)
8.5 Overall Conclusion

9. Appendices (if applicable)

Table 25-3 Hazard Log Template

Hazard I D	System / Activity Category	Sub-system / Specific Activity	Hazard Description	Location	Potential Cause(s)	Affects						Effect(s)/ Consequence(s)	Original Risk			Hazard Controller (Projects)	Proposed Safeguard shall be detail specified by following stage (1) Design - Design submission / specification ref. (2) Construction - Construction Plan (3) Testing & Commissioning - T&C activity / test record / check / procedure ref. (4) O&M - Operation / Maintenance procedure ref.	Residual Risk			Remarks	Target Completion Date	Status update			Closed (Y/N)	Rev. Date
						Public	Passenger	Staff	Contractor	Environment	Service Disruption		Frequency	Severity	Risk Index			Frequency	Severity	Risk Index			Evidence of hazard close-out (e.g.) 1. Design Submission 2. Test Report 3. O&M Procedure 4. Training etc	Individual O - Outstanding C - Completed	Overall O - Outstanding P - Partially Completed C - All Completed		

Table 25-4 Deterministic Safety Assessment Template

Item No.	System	Subsystem	Design Feature	Reference Clause	Associated Potential Safety Hazards	Relevant Design / Operations Safety Principles / Codes of Practice / Legislation Specification Requirements	Current Compliance Status	Verification Method	Compliance Category*

*Key for Compliance Category:
C: Fully compliant – no further action or monitoring required N/C: Non-compliant – subject to rework, re-test, etc.
W: Non-compliant – waiver approved
O/G: On-going action during operations
I/C: Inconclusive – review incomplete, awaiting testing, procedures under review or preparation

Table 25-5 Failure Modes Effects and Criticality Analysis Template

ID	Item	Function	Failure Mode	Cause(s) of Failure	Failure Detection Method			Failure Behaviour (Burn-in, Random, Wear out, Weibull)	Failure Effects / Consequences					Criticality Analysis								Remarks/ Assumptions/ Comments
																Affected categories					Action Necessary to Restore System		
					Detectable means to Operator	Detectable means to Maintainer	Built-in-test Function		Subsystem (Local)	System (Overall)	Safety	Service/ Operation: A. Changeover B. Withdrawal C. Degraded service D. Line disruption E. Station disruption F. Operator actions G. Others (please specify)	Time affected (minutes)	Failure Rate	Severity Class	S-Safety ?	E-Environmental ?	O-Operational (reliability)?	Design Safeguard or Procedures for Hazard Mitigation	Immediate Action during TH	Follow-up Action at NTH	

Table 25-6 Sample Template for Safety Critical Item Identification

(1) SCI Number (To be assigned by ASR tool)	(2) SCI Owner (Select from the pull-down menu)	(3) System (Select from the pull-down menu)	(4) Sub-system (Select from the pull-down menu)	(5) Equipment	(6) Description of SCI	(7) Function of SCI	(8) Parallel System <The system that operates in parallel with the assembly / component which can partially or fully provide the same function as the evaluated system>	(9) Protection System & its Safety Function <The system that provides protection to the assembly / component to prevent the occurrence or adverse consequence>	(10) Description of Failure Scenario	(11) No. of Independent Failure(s) required to cause adverse consequence	(12) Additional Independent Failure(s) <The additional independent failure(s) required to cause adverse consequence> Note: On top of the SCI in column 6, the equipment / parts mentioned here may also be registered as SCI as it has contributed to the failure consequence.	(13) Failure Consequence <The adverse effect if the assembly / component lose its function under the stated failure scenario>	(14) Severity Level of Failure Consequence (Select from the pull down manual)	(15) SCI (Y/N)	(16) Critical Maintenance Task <If item is judged to be an SCI, describe the maintenance task (with ref. no. of the concerned maintenance procedure) that specifically address the relevant failure scenario>	(17) Applicable to Lines (Select from the pull-down menu)

(18) Applicable to Vehicle Types (Select from the pull-down menu)	(19) Type of tests to be done [with cross-reference to Test Specification (Name, Reference, Clause No.)]	(20) Test standard to be met [with cross-reference to Test Specification (Name, Reference, Clause No.)]	(21) Test Record [Report Name, Reference, Clause No.]	(22) Remark	(23) Discipline	(24) Contract Requirements				(25) Contractor design related submission (CSF no.)				(26) Factory related activities (CSF no.)				(27) HK Site related activities (CSF no.)	
						(a) PS	(b) M&W	(c) Specific requirements	(d) Statute related	(a) Equipment / Material submission	(b) Approved Integrated Test Plan	(c) Drawing no	(d) 3rd Party Test Certificate / Report	(a) FAI test record	(b) FAT test record	(c) Factory in-house routine inspection record	(d) Pre-delivery inspection	(a) SAT	(b) system Handover demonstration to Operations

Table 25-7 Sample Template for Service Criteria Item Identification

Service Critical Items review results

Credible scenario: _____
Relevant system: _____
Worst case scenario : _____

		Functional descriptions of item					Failure Effects		To be filled in for items identified as Service Critical Items								
									Existing design / maintenance measures	Analysis of new control measures that can be provided							
										Design mitigations			Maintenance enhancement			Other control measures	Reasons if no new control measures identified
ID	Area of application	Subsystem	Equipment Component (replaceable unit)	Function of component	Failure mode of component	Causes of failure mode	Local effect (system failure)	Final effect (operation impact)		Design-out (eliminate failure mode totally)	Redundancy (provide additional equipment item as redundancy)	Design margin (increase design margin for same equipment item)	CBM (continuous monitoring with alarm triggered if failure detected)	Regular condition tests (scheduled PM check)	Hard time replacement (scheduled replacement based on asset condition)		
							Functional failure of the system due to component failure	>60 min for line disruption or 1 day station disruption? (i.e. Service Critical Item)									

Table 25-8 Risk Matrix

				CONSEQUENCE						
				7	6	5	4	3	2	1
				Trivial	Negligible	Marginal	Serious	Critical	Catastrophic	Disastrous
		Staff/Contractor Safety	Fatality					<5	5 or more	
			Major Injury				<5	5 or more		
			Minor Injury with ≥3 days sick leave			<5	5 or more			
			Minor Injury with < 3 days sick leave		<5	5 or more				
		Passenger/Public Safety	Fatality					<5	5-50	51-500
			Major Injury				<5	5-50	51-500	501 - 5000
			Minor Injury			<5	5-50	51-500	501 - 5000	>5000
		Service	System Disruption			<20 min	1 hour	1 day	1 week	1 month
			Line Disruption		20-60min	few hours	1 day	1 week	1 month	few months
			Station Disruption	<20min	few hours	1 day	1 week	1 month	few months	1 year
FREQUENCY	A	Few times per week or more	≥100 /year	R3	**R1**	**R1**	**R1**	**R1**	**R1**	**R1**
	B	Few times per month	≥10 - <100 /year	R4	**R2**	**R1**	**R1**	**R1**	**R1**	**R1**
	C	Few times per year	≥1 - <10 /year	R4	**R2**	**R2**	**R1**	**R1**	**R1**	**R1**
	D	Few times in 10 years	≥ 0.1 - <1 /year	R4	R3	**R2**	**R1**	**R1**	**R1**	**R1**
	E	Once since operation	≥ 1E-2 - <1E-1 /year	R4	R3	R3	**R2**	**R1**	**R1**	**R1**
	F	Unlikely to occur	≥ 1E-3 - <1E-2 /year	R4	R4	R3	R3	**R2**	**R1**	**R1**
	G	Very unlikely to occur	≥ 1E-4 - <1E-3 /year	R4	R4	R4	R3	R3	**R2**	**R1**
	H	Remote	≥ 1E-5 - <1E-4 /year	R4	R4	R4	R4	R3	R3	**R2**
	I	Improbable	≥ 1E-6 - <1E-5 /year	R4	R4	R4	R4	R4	R3	R3
	J	Incredible	< 1E-6 /year	R4	R4	R4	R4	R4	R4	R3

DEFINITIONS OF RISK INDICES

R1 Risk must be reduced save in exceptional circumstances.
R2 Risk must be reduced if it is reasonably practicable to do so.
R3 Risk is tolerable but should be further reduced if it is cost effective to do so.
R4 Risk is acceptable.

DEFINITIONS OF INJURY:

Major Injury:
- Fracture of any bone (but not a bone in the hand or foot)
- Amputation of hand or foot, or complete severance of a finger or toe
- Penetrating injury or burn to an eye or loss of sight
- Electric shock requiring immediate medical treatment
- Loss of consciousness resulting from lack of oxygen
- Inhalation or ingestion through the skin of any substance leading to acute illness or requirement for medical treatment
- Medical treatment resulting from exposure to a pathogen
- Any other injury requiring admittance to hospital for observation or treatment immediately after an incident

Minor Injury: - Any personal injury which is not a major injury

INSTRUCTIONS FOR USE

1. The worst case and most likely case frequency/consequence pairs shall be classified on the risk matrix. This may result in two different risk classifications being obtained (e.g. worst case is R4(H,4) but most likely case is R3(E,5)). In this case, the most severe classification of the two (R3(E,5)) shall be taken as being the representative risk arising from the hazard.
2. The hazard should be assessed based on its effect on the whole system. For example, a generic station hazard will affect all stations, while a station-specific hazard will only affect 1 station. The hazard rating shall reflect the total frequency of the event and the aggregate effect on all passengers, staff and contractor's employees.

Table 25-9 Maintenance Requirements Analysis Template

Maintenance Requirements Analysis Worksheet

System:

ID	Sub-System	Equipment / Component	Function	Functional Failure	Failure Mode / Cause of Failure	Failure Effects (Applicable Criteria)				Severity Class				Preventive Tasks				Failure Behaviour (Burn-in, Random, Wear out, Weibull)	Quantities of Equipment/Component Per Train	Failure nos. per year						Criticality Rating (C1, C2, C3, C4)	Failure Detection Method			Action Necessary to Restore System				Proposed Tasks / Design Safeguards (Compensating Provisions)	Proposed PM Interval (Maintenance)	Existing Maintenance Programme (Maintenance Contract PM interval)
						Subsystem (Local)	System (Protective device if any)	Service (Withdrawal / Changeover (Immed.) / Changeover (ASAP) / Remain in Service)	Safety	H-Detectable ?	S-Safety ?	E-Environmental ?	O-Operational (reliability) ?	Any measurable condition before failure (e.g. temp, vibration) ?	Regular restoration & inspection reduces failure rate (age limit related failure) ?	Regular replacement reduces failure rate (life limit related failure) ?	Protective device, failure detectable (if applicable) ?			No. of failures without delay (0-2")	No. of failures causing delay 2" - <5 min (C3)	No. of failures causing delay 2.5 hrs - 20 hrs (C2)	No. of failures causing delay > 20 hrs - <48 hrs (C1)	No. of failures causing delay of > 2 days (C1)	Total no. of failures (with and without delay)		Detectable means in Operation	Detectable means in Maintenance	Built-in-test Function	Immediate Action during TH (Recovery)	Primary Recovery Time during TH	Follow-up Action at NTH (Repair)	Repair Time during NTH			

SECTION 26

MAINTENANCE REQUIREMENTS

August 2015

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26 MAINTENANCE REQUIREMENTS

26.1 General

26.2 Design for Maintenance

26.3 Preventive Maintenance

26.4 Corrective Maintenance

26.5 Cleaning

26.6 Equipment Identification Labels

26.7 O&M Manual

26.8 As-built Drawings

26 MAINTENANCE REQUIREMENTS

26.1 General

26.1.1 Maintenance Programme

(a) The maintenance of the trains will be carried out by the Employer. The Contractor shall establish and provide documentation for a comprehensive maintenance programme for upholding the service condition (refer to PS 2.1.6) of the trains. The objective of the maintenance programme shall be to ensure that the trains will satisfy the following requirements throughout their design life:

(i) Operational safety requirements as defined in PS 25.6
(ii) Reliability requirements as defined in PS 25.7
(iii) Availability requirements as defined in PS 25.8
(iv) Maintainability requirements as defined in PS 25.9
(v) Quality of comfort, including cleanliness and appearance, experienced by passengers
(vi) Minimum life cycle cost

(b) The maintenance programme shall cover preventive maintenance, corrective maintenance, cleaning, condition-based maintenance and any other activities necessary to maintain the trains in a condition that can fulfil the above requirements. Within the context of this Specification and unless otherwise specified, the term 'maintenance' shall include all activities covered by the maintenance programme.

26.1.2 Maintenance Policy

(a) The maintenance programme shall be based on a planned preventive maintenance approach. Each train will undergo a series of regular maintenance sessions, the contents of which will be increased progressively in accordance with the amount of service and in line with the maintenance requirements of individual equipment. Where appropriate, condition-based maintenance techniques shall also be adopted to minimise the amount of maintenance work, downtimes and the associated costs.

(b) Service checks and cleaning work shall be so organised that they can be completed within the time limits specified under maintainability requirements.

(c) All corrective maintenance work shall be completed within the time limits specified under maintainability requirement.

26.1.3 Submission

Information pertaining to maintenance requirements shall constitute part of the design documents to be submitted for Approval.

26.2 Design for Maintenance

The Contractor shall ensure that maintenance considerations are duly incorporated into the design of the train. Features that can minimise or facilitate maintenance shall be built into the design as integral elements. As a minimum, the following requirements shall be satisfied:

26.2.1 Health and Safety

(a) The design of the trains shall be such that all maintenance activities can be carried out safely.

(b) The Contractor shall identify all potential hazards to personnel or equipment that may arise during all maintenance activities in Operating and Support Hazard Analyses (refer to PS 25.5.5) or similar studies.

(c) The Contractor shall establish and specify, for each potential hazard, corresponding preventive, mitigative or protective measures to reduce the risk to an acceptable level as defined in the Risk Assessment Matrix in Table 25-4 of PS 25.

(d) The Contractor shall ensure that all maintenance activities shall comply with relevant legislation in Hong Kong regarding health and safety.

(e) Testing procedures shall be built into all maintenance work to ensure that the trains shall be restored to a safe operation condition upon completion of the maintenance work.

26.2.2 Human Factors

(a) Ergonomic principles shall be adopted in the design of the train so that maintenance and cleaning activities are tailored to suit the capability and limitations of the maintenance staff. In general, guidelines in BS EN ISO 6385: 2004 and MOD Defence Standard 00-25: Part 11 shall be adhered to. Anthropometric dimensions for the Hong Kong Chinese population (refer to RS/C6014/14) shall be adopted.

(b) The design of maintenance work shall be such that skills and training requirements are minimised. This shall be achieved with the aid of the Train Management System (refer to PS 10) and other special tools and equipment supplied under the Contract.

26.2.3 Accessibility

(a) Access to equipment shall require minimum effort and shall not impose undue strain to maintenance and cleaning personnel.

(b) Equipment shall be configured in such a way that ease of access corresponds with the frequency of access for both preventive and corrective maintenance, with the most frequently accessed part having the easiest access.

(c) The layout and mounting of equipment shall facilitate inspections, testing and replacement during fault finding. Adequate access shall be provided so that when replacing one particular LRU it will not be necessary to remove other components which may block the access.

(d) Access covers and doors of equipment cases and cabinets shall be provided with quick release fasteners to reduce the time and effort for removal and restoration. Access covers and doors accessible by passengers shall be designed against tampering.

(e) The design of access to underframe mounted equipment shall take account of the fact that personnel working on the underframe will wear bump caps.

26.2.4 Interface with Employer's Maintenance Facilities

The trains will be maintained and stabled at the Employer's maintenance facilities as described in Appendix I Annex 6. The Contractor shall ensure that

(a) The trains and the maintenance programme are designed to interface safely, effectively and efficiently with the maintenance facilities in all aspects

(b) All maintenance activities are so organised that they can be completed to the required standards under the technical and operational constraints imposed by the maintenance facilities

26.2.5 Line Replaceable Units (LRUs)

(a) Equipment shall be constructed in such a way that when a failure occurs, the train can be restored to service condition by replacing the defective equipment items that give rise to the failure. Such defective equipment items are referred to as Line Replaceable Units, or LRUs.

(b) LRUs shall be designed for quick and easy replacement so that maintainability targets for corrective maintenance defined in PS 25.9.1 can be achieved.

(c) Equipment items with a failure rate of more than 1 in 10 million car km (Approx. 10 train running years) shall be designed as LRUs.

(d) In order to avoid replacing unnecessary complete higher level assemblies which will increase the costs in replacement, handling, reconditioning and spares holding, LRUs shall generally be the lowest level items in the equipment system which satisfy one of the following conditions:

(i) Replacement or repair of lower level components in the item will require extensive stripping down and it is not practicable to design the item otherwise

(ii) Replacement or repair of any defective part within the item can only be achieved with proper equipment in a workshop environment and it is not practicable to design the item otherwise

(e) To give some examples, the following items shall be designed for replacement as LRUs:

(i) Contacts of a contactor
(ii) Electronic printed circuit boards
(iii) Electrical relays
(iv) Brake actuators
(v) Air compressors
(vi) Autocouplers
(vii) Bogies
(viii) Window glazing

(f) As far as practicable, quick release connections such as plugs and adapters shall be provided between a LRU and the train to facilitate replacement. Relay connections shall be of the plug-in type such that no wire disconnection and reconnection are required during replacement. All quick release connections shall have a robust design which shall be able to accommodate LRU replacements throughout their design life.

(g) LRUs mounted on the underframe, except for bogies, items on the traction drives and the suspension, shall be designed so that they can be replaced at the Running Maintenance Area of the Employer's depots (refer to Clause 2 of Appendix I Annex 6).

26.2.6 Workshop Replaceable Units (WRUs)

(a) Equipment which are functionally closely related shall be grouped into manageable physical modules, hereafter referred to as Workshop Replaceable Units (WRUs), to minimise the time and effort required by their replacement during car overhauls (refer to PS 26.3.3) and scheduled equipment replacement (refer to PS 26.3.4) sessions.

(b) Examples of WRUs are:

(i) A pneumatic block to hold components in the compressed air system
(ii) A brake equipment module containing valves in the air brake system
(iii) Complete equipment cases containing contactors and relays in the traction inverter or auxiliary converter

(c) WRUs shall be designed in such a way that the time for recommissioning tests on the train is shortened by relocating most of the testing upstream at the overhaul workshop.

(d) Connections, other than mechanical mountings, between a WRU and the train shall be achieved through quick release fittings such as multiway jumper plugs. Such quick release fittings shall have a robust design which shall be able to accommodate WRU replacements throughout their design life.

(e) As far as practicable, WRUs mounted on the underframe shall be designed to allow replacement to be carried out with the train standing at a track at the Running Maintenance Area. Only when this is not feasible, for example bogies, shall replacement be performed at a Lifting / Heavy Maintenance Area described in Clause 3 of Appendix I Annex 6.

(f) Notwithstanding the above requirements, the design of WRUs shall allow any LRU which forms part of the WRU to be replaced, in-situ without replacing the entire WRU, within the time limit specified under relevant maintainability targets (refer to PS 25.9.1).

26.2.7 Lifting and Towing

(a) Proper handles shall be provided on heavy equipment designed for manual lifting.

(b) Equipment or components weighing over 20 kg shall be designed for handling with overhead cranes and forklift trucks. Where necessary, they shall be provided with integral lifting lugs or eyes, or attachment points for similar fittings.

(c) Towing points shall be provided on each car to allow towing as specified in Appendix I Annex 6.

26.2.8 Running Hour Counter

(a) In order to facilitate maintenance scheduling, a running hour counter function shall be provided for each major equipment such as traction motor, air compressor, refrigerant compressor and doors for recording the running hours (or cycles in the case of doors and similar equipment) accumulated on the equipment.

(b) The running hours shall be recorded in the Train Management System (refer to PS 10). Such information will then be downloaded for further processing.

(c) The running hour counter shall be reset when the equipment on the train is replaced by a new item.

26.2.9 Submission

(a) Interface with Employer's Maintenance Facilities

(i) At SEMP stage 3, the Contractor shall submit for Approval any modification necessary to the Employer's maintenance facilities specified in Appendix I Annex 6 in order that the trains can interface with such facilities. All the modifications shall be carried out by the Contractor and shall not adversely affect its use by the Urban Line Trains.

(ii) At SEMP stage 4, the Contractor shall submit for Approval a schedule of tests to demonstrate that the trains shall be compatible with each of the Employer's maintenance facilities in accordance with PS 26.2.4.

(iii) The Contractor shall carry out tests to demonstrate that the trains can interface with each of the Employer's maintenance facilities as specified under PS 26.2.4.

(b) WRUs and LRUs

(i) At each of SEMP stages 3 and 4, the Contractor shall submit an updated list of LRUs and WRUs for Approval.

The list shall identify all LRUs and WRUs on the train as defined in PS 26.2.5 and 26.2.6 respectively. For simplicity, LRUs may be enumerated in generic terms in conjunction with a statement of any exceptions.

Any equipment items that are not able to meet the full requirements specified in PS 26.2.5 and 26.2.6 shall be reported to the Engineer.

(ii) At each of SEMP stages 4 and 5, the Contractor shall, upon the request of the Engineer, demonstrate by physical exercises that the design of specific WRUs or LRUs is able to meet relevant maintainability requirements.

(c) Running Hour Counter

At SEMP stage 2, the Contractor shall submit a list of equipment to be covered by the running hour counter for Approval.

(d) Additional Submissions Related to Design for Maintenance

At the request of the Engineer, the Contractor shall submit additional details regarding Design for Maintenance as defined in PS 26.2 above for Approval, and to demonstrate physically that relevant requirements are satisfied.

26.3 Preventive Maintenance

26.3.1 Organization of Preventive Maintenance Work

The Contractor shall establish and provide documentation for a preventive maintenance programme for the trains in accordance with the following requirements:

(a) Maintenance Action

Maintenance action is defined as the smallest sub-division of maintenance work to be carried out in-situ on the trains, such as bearing lubrication, filter change and relay operation check.

(b) Maintenance Tasks

(i) Preventive maintenance actions to be carried out in-situ on the trains shall be grouped into logical blocks referred to as maintenance tasks.

(ii) The maintenance actions in a maintenance task shall be carried out together as a complete module. They shall either be done on the same equipment / equipment system, such as the pantograph; or at the same location, such as saloon or driving cab.

(iii) Maintenance tasks shall form the basic building blocks of all maintenance sessions other than equipment overhauls. Low level tasks such as basic safety inspections shall be repeated in all preventive maintenance sessions while high level tasks such as bogie replacement shall only be carried out at specific car overhauls.

(iv) Separate tasks shall be provided to cover maintenance actions to be carried out at different stages of a maintenance session.

(c) Maintenance Sessions

(i) Preventive maintenance work to be carried out in-situ on the trains shall be grouped into Maintenance Sessions during which a train will not be available for service. Maintenance sessions shall be designed to maximise availability and reliability while minimizing costs at the same time.

(ii) Each maintenance session shall be divided into a number of logical work stages such as preparation, servicing and inspections, and recommissioning, as defined in RS/C6014/12. Each stage shall consist of individual maintenance tasks.

(iii) The maintenance sessions shall cover the following types of maintenance requirements of trains at different service ages:

- Service Checks
- Car Overhauls

- Scheduled Equipment Replacements

(iv) The minimum requirements for each type of maintenance session are specified in PS 26.3.2 to 26.3.4 below. The Contractor may propose alternatives to such arrangements for Approval.

(d) Equipment Overhauls

Equipment overhauls refers to the following:

(i) scheduled overhauls of individual equipment
(ii) repair of defective equipment removed from the trains during corrective maintenance

Such work shall be carried out outside the trains at a workshop furnished with the required tools and equipment for the work.

26.3.2 Service Checks

(a) General Requirements

(i) Service checks include all regular safety checks, inspections and servicing necessary for maintaining the trains in service condition.

(ii) The interval of B Service Checks shall be integral multiples of that for A Service Checks.

(iii) Service checks shall be designed to be carried out on complete trains so that each train will only be required to visit the depot once within the lowest service check interval. However the design of the trains and the service check contents shall also allow the service checks be carried out separately on individual Train Units at different times.

(iv) The downtime for a service check session on a train shall not be more than the hours stated in PS 26.3.2 (b), (c) and (d).

(v) The team size for a service check session on a train shall not be more than the number of persons stated in PS 26.3.2 (b), (c) and (d). To achieve this, the constituent Train Units of a train may be scheduled for a combination of different A and B Service Checks (for example, A Service Checks for 4 cars and B Service Check for the remaining 4 cars)

(vi) The 'balanced-check' approach shall be implemented in structuring service checks so that the downtimes and manpower for individual service check sessions will not differ by more than 5% from each other.

(vii) 'B type tasks' which need not be carried out in every B Service Check (for example those with maintenance interval of 60,000 km, if any) shall be evenly distributed over the respective maintenance cycles so that the downtimes and manpower requirements for each B Service Check do not differ by more than 5%. To facilitate efficient management, the number of different B Service Checks for each type of Train Unit shall not exceed 4.

(b) A Service Check

Interval:	7,500 km (approx. 24 days) minimum
Downtime:	Not more than 6 hours (including work arising) per 4 cars
Location:	Running Maintenance Area (refer to Appendix I Annex 6)
Work Content:	'A type tasks' - Checks on safety and reliability critical equipment, general visual inspections, and replenishment of items such as lubricants and water.
Team Size:	Not more than 2 persons per 4 cars

(c) B Service Check

Interval:	15,000 km (Approx. 45 days) minimum
Downtime:	Not more than 6 hours (including work arising) per 4 cars
Location:	Running Maintenance Area
Work Content:	'A type tasks' plus items at multiples of 15,000 km intervals ('B type tasks')
Team Size:	Not more than 8 persons per 4 cars

(d) K Service Check

Interval:	120,000 km (Approx. one year) minimum
Downtime:	Not more than 6 hours (including work arising) per train
Location:	Running Maintenance Area
Work Content:	Maintenance items between B Service Check and Overhaul
Team Size:	Not more than 6 persons per train

26.3.3 Car Overhauls

(a) General Requirements

(i) Car overhauls are high level service checks which require the train or cars to be down for more than one day.

(ii) The contents of car overhauls shall be designed to meet the maintenance requirements of individual equipment while making the best use of their service lives between overhauls or replacements.

(iii) To minimise downtime, major equipment shall be replaced on an item-for-item exchange basis. Repair or overhaul of the used equipment shall be carried out independent of the car overhauls.

(iv) The car body shall require minimal attention at overhauls. Pipework and electrical cables shall last for the life of the car.

(v) Car overhauls shall normally be carried out on complete trains. However the design of the trains and the service check contents shall also allow the overhauls be carried out separately on individual Train Units at different times.

(b) General Overhauls

Interval:	480,000 km (approx. 48 months) minimum
Downtime:	Not more than 10 working days (including work arising) per train
Location:	Lifting / Heavy Maintenance Area (refer to Appendix I Annex 6)
Work Content:	'A & B type tasks' plus inspections, equipment replacements and repairs that require extensive stripping down.

(c) Mid-life Refurbishment

Minimum Interval:	2.4 million km (approx. 20 years)
Location:	Lifting / Heavy Maintenance Area
Work Content:	As that of general overhauls plus complete refurbishment and replacements or repairs that require further stripping down

After mid-life refurbishment, the cars shall be returned to a condition which will enable them to run until the expiry of their design lives without major attention.

26.3.4 Scheduled Equipment Replacements

(a) Normally equipment shall be replaced during car overhauls to minimise downtime and overhead. Equipment that are not able to accommodate the 480,000 km car overhaul interval will be replaced according to a separate programme independent of the overhauls. Where possible, such replacements shall be carried out during service checks.

(b) The number of scheduled equipment replacements outside service checks shall not exceed 1 per Train Unit per year, or 3 per train per year.

26.3.5 Submission

(a) General

(i) The Contractor shall submit a Master Maintenance Schedule (refer to RS/C6014/12) in progressive amount of details for Approval at various stages of design development.

(ii) The Master Maintenance Schedule shall contain information for every type of service checks, car overhauls and scheduled equipment replacements, as specified in RS/C6014/12.

(iii) Such information shall be documented systematically in the form of Microsoft Excel 2003 spreadsheet (or a later version as Approved). To facilitate the Engineer's work on maintenance planning, the electronic files for the Master Maintenance Schedule shall also be submitted at each stage.

(b) SEMP Stage 2 - Basic Outline

An outline of each of the preventive maintenance sessions (refer to PS 26.3.1(c)) shall be submitted for Approval at SEMP stage 2. Each outline shall contain the following information:

(i) Name of maintenance session
(ii) Brief description of work content
(iii) Maintenance interval
(iv) Estimated downtime
(v) Estimated manpower and skills requirement

(c) SEMP Stage 3 - Detailed Outline

Preliminary versions of the following documents, as defined in RS/C6014/12, shall be submitted for Approval:

(i) Master Maintenance Schedule
(ii) Maintenance Tasks Matrix
(iii) Maintenance Checklists

(d) SEMP Stage 4 - Full Details

Complete versions of the following documents, as defined in RS/C6014/12, shall be submitted for Approval:

(i) Master Maintenance Schedule
(ii) Maintenance Tasks Matrix
(iii) Maintenance Checklists

26.4 Corrective Maintenance

26.4.1 Corrective maintenance refers to the following works:

(a) Identification and rectification of defects or alleged failures on the trains in order to restore them to service condition

(b) Rectification of defects found during preventive maintenance sessions

(c) Repair of defective equipment at the workshop

26.4.2 The design of equipment on the trains shall facilitate fault finding so that defects can be identified and repaired within the time limits specified under maintainability requirements.

26.4.3 As a basic requirement, fault indicators shall be provided to indicate any failures to both the train operator during service and the maintenance personnel during service checks.

26.4.4 The Train Management System on the train shall provide aids for identifying the source of the failure down to the LRU in which the defect is located.

26.4.5 Major equipment systems on the train shall be equipped with self diagnostics and fault logging systems which can capture relevant information at the time of equipment failure. Such information shall be

made readily available to maintenance personnel for fault finding purposes.

26.4.6 The Contractor shall provide special test equipment which can furnish in-situ assessments of the function and performance of equipment on the train.

26.4.7 The above provisions, together with diagnostics aids in the Train Management System, shall form an integrated system for supporting all corrective maintenance activities on the trains.

26.5 Cleaning

The external and interior of the trains will be cleaned regularly to maintain the trains at a high standard of cleanliness. The Contractor shall develop and specify a comprehensive cleaning programme for the up-keeping of the cleanliness standard. The cleaning programme shall consist of detailed cleaning methods, cleaning procedures, materials, cleaning intervals, train downtimes and the manpower required to carry out the work.

No cleaning work will be carried out when the trains are in passenger service.

26.5.1 External Cleaning

(a) Water / Detergent Washing

(i) The external body of the trains will be cleaned regularly by an automatic water / detergent wash plant described in Appendix I Annex 6.

(ii) The trains shall be designed such that no damage shall be done to any part of the train by the washing process. No water shall be allowed to enter the saloon, the driving cab or any other unintended enclosures on the train.

(iii) The Contractor shall specify the frequency of water / detergent washing, which shall not be more than once per 2 service days.

(iv) The Contractor shall specify the chemicals and the concentration required for the wash process.

(b) Acid Washing

(i) The Contractor shall specify whether acid washing is necessary to maintain the car body at the required standard of cleanliness.

(ii) Acid wash, where required, will be carried out at an automated acid wash plant described in Appendix I Annex 6. The Contractor shall specify details of the acid wash process, which shall include, but not be limited to, the following:

- frequency of washing, which shall not be more than once per 30 days

- chemicals, concentration, soaking period and number of passes

(iii) Where acid washing is required, the train shall be designed such that it is not adversely affected by the acid washing process.

(c) Window Cleaning

(i) The window glass of the trains will be kept free from water stains at all times. Where this cannot be achieved by the automatic external washing defined in PS 26.5.1(a) and (b) above, the Contractor shall develop and specify a cleaning process to remove the stains.

(ii) Where regular cleaning is required, the Contractor shall ensure that parts of the train that will be affected by the process, for example car body finishes, window seals and fittings, will not be adversely affected by the process.

(iii) The cleaning process shall only be carried out during internal heavy cleaning sessions and shall meet the following requirements:

Interval: not less than 60 days
Manpower: not more than 2 manhours per car

26.5.2 Internal Cleaning

The Contractor shall ensure that material finishes in the saloon and driving cab are designed to minimise the downtime and manpower for internal cleaning.

Internal fittings which require cleaning, such as air conditioning air grills and light diffusers, shall be readily accessible to the cleaning personnel and shall be easily cleaned by simple tools.

The material finishes in the saloon and driving cab shall be designed to withstand the action of common cleaning agents and water used during all internal cleaning activities.

(a) Internal Light Cleaning

(i) Internal light cleaning will take place daily in the stabling sidings at night during non-traffic hours. No services will be provided in the siding, hence power assisted cleaning will be limited to that which can be provided from the on board power sockets.

(ii) Such cleaning will be limited to mopping of the floor, cleaning the seats and wiping down internal surfaces. The Contractor shall specify detailed requirements for such cleaning.

(iii) Internal light cleaning shall be completed with not more than 5 manhours per train.

(b) Internal Heavy Cleaning

(i) Internal heavy cleaning will take place in dedicated heavy cleaning tracks (refer to Appendix I Annex 6), which will be equipped with full length, car floor level platforms, with provision for electrical power and water.

(ii) Such cleaning shall be carried out at intervals of not less than 30 days.

(iii) The Contractor shall specify detailed requirements for such cleaning.

(iv) Internal heavy cleaning shall be completed with not more than 6 manhours per car.

26.5.3 Submission

(a) SEMP Stage 2 - Outline

The following information shall be submitted for Approval for each type of cleaning described in PS 26.5.1 and 26.5.2:

(i) Brief description of work contents
(ii) Cleaning intervals
(iii) Estimated downtime

(iv) Estimated manpower requirement

(b) SEMP stage 4 - Details

Information shall be submitted for Approval for each type of cleaning described in PS 26.5.1 and 26.5.2. Such information shall include, but not be limited to, the following:

(i) For external cleaning:

- Specification of chemicals to be used at automated washing plants and for window cleaning (where necessary)
- Cleaning intervals
- Compatibility with existing chemicals for cleaning and the cleaning processes

(ii) For internal cleaning:

- Cleaning methods and procedures
- Specifications for cleaning tools and materials
- Cleaning intervals
- Manpower and skills requirements
- Downtime

26.6 Equipment Identification Labels

26.6.1 General Requirements

(a) The Contractor shall provide equipment identification labels on all items of equipment that are subject to workshop overhauls and repairs, ranging from complete equipment assemblies or WRUs such as bogies and inverter assemblies, down to the lowest component that is to be overhauled or repaired as a single entity, such as brake actuators and electronic printed circuit boards.

(b) Equipment identification labels shall be positioned so that when the equipment is mounted on the train, the markings can be readily read by maintenance personnel during maintenance inspections, without the need for extensive stripping down.

(c) Equipment identification labels shall be designed to last for the life of the equipment on which they are attached. The markings shall withstand the operation and maintenance environment experienced by the equipment

and shall be capable of being updated subsequent to equipment modifications.

(d) Each equipment identification label shall be marked with the part number, serial number, and the version number of any modifications in alphanumeric characters. The part numbers shall be consistent with those given in the Illustrated Parts Catalogue described in RS/C6014/12. Each item of equipment shall have a serial number that is unique to any other items of the same model.

(e) The Contractor shall provide detailed specifications on equipment for producing the equipment identification labels and identify sources where the equipment can be obtained by the Employer.

26.6.2 Submission

The Contractor shall submit the following for Approval:

(a) at SEMP stage 3, a list of equipment on the train to be provided with identification labels.

(b) at SEMP stage 4:

(i) Design of equipment identification labels
(ii) Specification and sources for the equipment for producing the equipment identification labels

26.7 O&M Manual

26.7.1 Deliverables

(a) The Contractor shall provide a comprehensive set of printed Operation and Maintenance Manual for the trains in accordance with the requirements in RS/C6014/12.

(b) The final deliverables shall include the following:

(i) Twenty complete sets of the Approved printed O&M Manual in hard copy

(ii) Two copies of the Approved text and databases for the printed O&M Manual in electronic format on CD-ROM/ DVD-ROM

(iii) Two copies of all Approved illustrations in electronic format in AutoCAD™ 2002 (or later version, if approved), on CD-ROM/ DVD-ROM.

(c) The printed O&M Manual shall be processed in 3 separate batches:

(i) Batch 1 shall consist of the following volumes:

- Volume I, Technical Descriptions Manual
- Volume II, Train Operator's Manual

(ii) Batch 2 shall consist of the following volumes, excluding parts on car overhauls and equipment overhauls:

- Volume III, Equipment Maintenance Manual
- Volume IV, Fault Diagnostics Manual
- Volume V, Illustrated Parts Catalogue
- Volume VII, Special Tools and Test Equipment

(iii) Batch 3 shall consist of the following:

- Volume VI, Software Manual
- Volume VIII, Vendor Documentation
- Remaining parts of Volumes III, IV, V and VII excluded in Batch 2.

26.7.2 Submission

(a) SEMP Stage 3

The Contractor shall submit the following for Approval at SEMP stage 3:

(i) Outline of the structure and contents of individual volumes of the printed O&M Manual. This shall include:

- the titles of all chapters, sections and subsections for each volume
- breakdown of each item in the equipment hierarchy into 2 lower levels of details

(ii) Sample formats and layouts for all parts of the manuals, including items such as text, illustrations, maintenance schedules, work instructions, checklists and illustrated parts catalogues.

(b) SEMP Stage 4

The Contractor shall submit the draft versions of all volumes of the printed O&M Manual at SEMP stage 4. Such submissions shall be provided in the batches defined in PS 26.7.1(c) above. Three copies of the draft documents shall be provided in each submission.

(i) The first draft for Batch 1 of the printed O&M Manual shall be submitted immediately upon commencement of the O&M Manual Programme specified in the Schedule of Key Dates for Design Submissions in Appendix F.

(ii) The first draft for Batch 2 of the printed O&M Manual shall be submitted not later than 2 months after the commencement of the O&M Manual Programme specified in the Schedule of Key Dates for Design Submissions in Appendix F.

(iii) The first draft for Batch 3 of the printed O&M Manual shall be submitted not later than 6 months after the commencement of the O&M Manual Programme specified in the Schedule of Key Dates for Design Submissions in Appendix F.

(c) SEMP Stage 5

(i) The Contractor shall submit the final drafts of the printed O&M Manual in batches as defined in PS 26.7.1(c) at SEMP stage 5. Such submissions shall be provided within 2 months after issue of the Engineer's comments on the respective first drafts of the printed O&M Manual.

(ii) The final version of the printed O&M Manual shall be submitted for Approval within 2 months after the issue of the Engineer's comments on the respective final drafts of the printed O&M Manual.

26.7.3 Amendments

(a) The Contractor shall make any necessary amendments to the printed O&M Manual during testing and commissioning of the trains and the Defect Liability Period. Amendments shall be submitted in the form of replacements leaflets and electronic files. A list summarizing the changes and the reasons shall be submitted with each set of amendments.

(b) Changes to the printed O&M Manual found necessary during testing, commissioning and the Defect Liability Period shall be completed within 2 months after the need for amendment is identified.

(c) Subsequent amendments shall be completed 1 month prior to the issue of the Defects Correction Certificate.

26.8 As-built Drawings

26.8.1 Scope of the As-built Drawings

The Contractor shall provide all drawings necessary for the operation, maintenance and repair of the equipment, by the Employer. Such drawings shall cover, but not be limited to, the following:

(a) Equipment layout drawings for the complete cars and individual equipment

(b) Mechanical drawings of cars, equipment and components, with relevant information such as key dimensions, tolerances, material specifications, quantities, manufacturing and assembly specifications.

(c) System block diagrams for equipment systems and subsystems

(d) Control circuit schematics for all electrical, pneumatic and hydraulic systems.

(e) System architecture, control circuit schematics and signal flow diagrams for electronic equipment. Details provided in electronic circuit diagrams shall be down to circuit board level.

(f) Wiring diagrams detailing the identity and locations of cables, terminal and electrical equipment

(g) Piping diagrams detailing the identity and locations of pneumatic and hydraulic equipment systems

26.8.2 General Requirements

(a) All as-built drawings shall be prepared in AutoCAD™ 2002 or a later version as Approved.

(b) The Contractor shall adopt the Operations Engineering Drawing Numbering Standard (S/NT-prm/CS/01(00)) and the standard title blocks and templates for producing drawings.

26.8.3 Deliverables

The deliverables for as-built drawings shall include the following:-

(a) Three complete sets of full size printed copies of all As-built Drawings

(b) Two complete sets of all As-built Drawings in electronic format onCD-ROM/ DVD-ROM.

(c) Three copies of the schedule of As-built Drawings tabulating the drawing number, title, paper size, revision number and date of all asbuilt drawings.

(d) Two electronic copies of the schedule of As-built Drawings in Microsoft Excel 2003 (or a later version as Approved), stored in CD-ROM/ DVD-ROM.

26.8.4 Submission

(a) At SEMP stage 4, the Contractor shall submit for Approval a list of all As-built Drawings to be delivered.

(b) At SEMP stage 5, the Contractor shall submit the As-built Drawings for Approval not later than the handover of the first train. All submissions shall be completed within 4 months.

26.8.5 Amendments

(a) The Contractor shall make any necessary amendments to the as-built drawings, during testing and commissioning of the equipment and the Defect Liability Period.

(b) Amendments to as-built drawings shall be provided in both printed copies and electronic files as defined in PS 26.8.3. They shall be delivered within 2 months after the change concerned is Approved.

26.8.6 All amendments shall be completed 1 month prior to the issue of the Defects Correction Certificate

SECTION 27

QUALITY MANAGEMENT

August 2015

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27 QUALITY MANAGEMENT

27.1 Quality Plan

27.2 Design Control

27.3 Purchasing

27.4 Process Control

27.5 Corrective Action

27.6 System Engineering Management System

27 QUALITY MANAGEMENT

27.1 Quality Plan

27.1.1 The quality plan shall include, in addition to the requirements as set out in the General Specification, the following:

(a) a statement detailing the records that the Contractor proposes to keep, the time during which they will be prepared and the subsequent period and manner in which they will be stored;

(b) a system to enable the Engineer to conduct compliance audits on any aspect of design and to allow the Engineer to trace the cause of material / workmanship defects back to design, through the manufacturing, installation, testing and setting to work stages. This shall be supported by the Configuration Control Program (refer to Appendix P).

(c) Design verification and validation plan, purchasing plan and process control plan as described below in PS 27.2 to PS 27.4.

27.2 Design Control

27.2.1 The quality plan shall include details on how the Contractor shall develop the Contract requirements into concept design and then detailed design in a systematic manner with the SEMS approach (refer to PS 21).

27.2.2 As part of the quality plan the Contractor shall submit a design verification and validation plan for Approval.

27.2.3 The design verification and validation plan shall include descriptions of the following :

(a) system functional and interface requirements
(b) any assumptions made on system / subsystem parameters / characteristics
(c) technique used in design verification and validation for each system / subsystem that may include calculation, theoretical / numerical analysis, computer simulation, comparison with a similar proven design, tests and demonstrations using prototype or similar design equipment (d) schedule of the design verification and validation activities

27.2.4 The results of the design verification and validation shall form part of the SEMP report and be submitted in accordance with the requirements of the SEMS (refer to PS 21).

27.3 Purchasing

27.3.1 As part of the quality plan the Contractor shall submit a purchasing plan for Approval. The purchasing plan shall identify all products / services to be purchased for the Contract and all activities to be conducted in assuring the quality of the purchased products / services.

27.3.2 The purchasing plan shall include descriptions of the following:

(a) Products/services to be purchased

(b) Purchasing documents describing each product / service to be purchased and all the required product / service quality records including specification, standard, code of practice, certificate and statutory documents

(c) Contractor's review and approval procedures of the purchasing documents in ensuring correctness and adequacy of the specified requirements

(d) Incoming goods / materials inspection procedures together with the inspection sample size and the acceptable quality standard

27.3.3 All the purchasing documents and the related product / service quality records shall be properly maintained by the Contractor and shall be made available to the Engineer on request.

27.3.4 The Contractor shall be responsible for the validation of all subcontracted work.

27.4 Process Control

27.4.1 As part of the quality plan the Contractor shall submit a process control plan for Approval 3 months before the start of any one of the processes.

27.4.2 The process control plan shall include descriptions of the following:

(a) Procedures defining the manner of production, installation and servicing

(b) Equipment used in these processes and the required working environment

(c) Methodology in ensuring compliance with the required standards / codes of practice

(d) Monitoring, control and approval procedures including in-process inspection and final product inspection for the process parameters, product characteristics, equipment and working environment (e) Qualification of equipment and personnel required

27.4.3 Photographic Progress Records

(a) The Contractor shall submit photographic records to illustrate progress of manufacturing whenever appropriate, from SEMP Stage 4 upon completion of the Work.

(b) The photographic records shall be submitted with the monthly progress report.

27.5 Corrective Action

Corrective actions requiring changes to designs / procedures shall be properly documented and submitted for Approval in accordance with the Configuration Control Program (refer to Appendix P).

27.6 System Engineering Management System

As an integral part of the Quality Management System, the Contractor shall operate a System Engineering Management System (SEMS) as described in PS 21.

SECTION 28

ENVIRONMENTAL REQUIREMENTS

August 2015

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28 ENVIRONMENTAL REQUIREMENTS

28.1 Purpose

28.2 Policies

28.3 Environmental Management System (EMS)

28.4 Environmental Management Plan (EMP)

28 ENVIRONMENTAL REQUIREMENTS

28.1 Purpose

28.1.1 The policies and procedures presented in this Section establish a common frame of reference for developing the Environmental Management System (EMS) according to the Environmental Policy of the Employer. Copy of the Employer's Environmental Policy is available for the Contractor's reference.

28.1.2 These policies and procedures establish the basis for a systematic approach to meeting environmental obligations.

28.1.3 This Section supplements the General Specification on the environmental management requirements and shall apply to all subcontractors and suppliers.

28.1.4 The Contractor shall establish and maintain the EMS in accordance with the policies and procedures.

28.2 Policies

28.2.1 In order to ensure that the quality of the Contractor's Works meet the quality requirements and to provide evidence of such quality to the Engineer, a Quality Management System to the ISO 9000 series (refer to PS 27) shall be adopted as an integrated part of the EMS.

28.2.2 The ISO 14000 series, in particular, the ISO 14001: 2004 - Environmental Management System Specification, or the equivalent standards, such as, the National Sanitation Foundation (NSF) 110, the Eco-Management and Audit Scheme (EMAS), the International Chamber of Commerce (ICC) Sustainable Development Principles, and the Global Environmental Management Initiative (GEMI) shall be applied to implement an effective environmental management system.

28.2.3 According to the GS Clause 17.1.2, a policy statement shall be provided to demonstrate the commitment of the top management of the Contractor.

28.2.4 The confirmed commitments shall be able to:

(a) comply with the relevant environmental legislation;

(b) minimise the environmental impact;

(c) comply with the global initiatives, such as, the Montreal Protocol for the elimination of CFCs;

(d) set measurable performance goals for continuous improvement;

(e) audit progress against these goals;

(f) be specific to apply it to the Contract;

(g) be broad enough to meet the site requirements on different locations of production;

(h) protect the health and safety of the users of the trains, including the passengers, train operators and maintainers; and

(i) be updated to reflect all necessary changes.

28.3 Environmental Management System (EMS)

28.3.1 The EMS shall be a systematic approach applied to the management of the Contractor's environment performance i.e. adherence to a suitable environmental policy, the meeting of environmental objectives and the ability to demonstrate to the Engineer that the policy requirements and objectives are met.

28.3.2 The EMS framework shall identify resources for developing, implementing, measuring, and periodically reviewing the Contractor's progress toward achieving the environmental policy.

28.3.3 The EMS framework shall include but not limited to the following items:

(a) the Contractor's organisational structure;

(b) planning activities;

(c) defined responsibilities; and

(d) standard practices, procedures and processes.

28.3.4 The EMS framework shall be recorded in an Environmental Management Plan (refer to PS 28.4) and submitted for Approval (refer to GS Clause 17.1.1).

28.3.5 An environmental performance evaluation mechanism shall be provided in the EMS to measure, analyze, assess and describe the Contractor's environmental performance particularly those associated with pollution preventions.

28.3.6 A life cycle assessment process shall be provided in the EMS to evaluate the environmental attributes, burdens and impacts associated with the product, process or service.

28.3.7 The life cycle assessment shall be able to measure the environmental impact of a product from raw material extraction to final disposal. It shall also include the impact of manufacturing, distribution and transportation, product use and recycling.

28.4 Environmental Management Plan (EMP)

28.4.1 The EMP shall include the following items, in addition to the requirements as set out in the GS Section 17:

(a) defining the overall aims;

(b) understanding the constraints;

(c) identifying the task elements;

(d) setting the overall timetable;

(e) determining the resources needed;

(f) deciding on the project management approach; and

(g) establishing progress monitoring system.

28.4.2 Guidelines or standards on how to manage specific issues, such as, CFC elimination or energy conservation, shall be addressed at the management level. These guidelines or standards shall be formalised into specific procedures at the implementation level.

28.4.3 The general guidelines specified in the ISO 14004: 2004 shall be followed as far as applicable.

28.4.4 In addition to the site arrangements specified in PS 30, the Contractor shall ensure that the legislation and regulations of Hong Kong particularly those listed in the GS Clause 17.1.9 shall be complied with.

SECTION 29

PROGRAMME

August 2015

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29 PROGRAMME

29.1 General

29.2 Delivery, Testing and Commissioning in Hong Kong

29.3 Training and Operation and Maintenance Manuals

29 PROGRAMME

29.1 General

29.1.1 The Contractor's attention is drawn to the requirements of Clauses 15, 64, and 67 of the Conditions of Contract (COC) and Sections 4, 8, 10, 13, 14, 16, 21, 23, 24 and 25 of the General Specification (GS).

29.1.2 The following programming data is included with the Particular Specification :-
Appendix E - Schedule of Delivery
Appendix F - Engineer’s Preliminary Programme, Project Calendar, Schedule of Critical Dates and Schedule of Key Dates

29.1.3 The Contractor shall complete the Works by the completion dates as specified in the Schedule of Critical Dates contained in Appendix F or such other dates as may be determined under the Contract.

29.1.4 Not used.

29.1.5 The Completion Obligations to which liquidated damages or general damages shall apply are identified in the Schedule of Critical Dates. The aggregate of liquidated and general damages (Conditions of Contract - Clause 70.11) and daily rate of liquidated damages (Conditions of Contract - Clause 70.4) are stated in the Appendix to the Form of Tender.

29.1.6 The Contractor's attention is drawn to the provisions of Clause 70.5 of the Conditions of Contract regarding the application of general damages.

29.1.7 The Contractor’s attention is drawn to the provision of Clause 15.3 of the Conditions of Contract on the Schedule of Designs. The Contractor shall allow adequate duration for comment, resubmission and Approval of his Design Data. The Engineer’s Preliminary Programme includes a sub-programme in Appendix F Section 4, Schedule of Key Dates for Design Submissions, which is provided as reference for the Contractor to develop a detailed submission programme.

29.1.8 The Contractor shall plan in detail the full scope of Works taking into account the complex nature and different phases and aspects of the Contract and shall provide programmes which reflect the detail planning undertaken, are realistic, achievable and are accompanied by detailed supporting information. All programmes must clearly identify the critical path.

29.1.9 The Contractor's attention is drawn to the following programme submission as required by the Engineer:

29.1.9.1 Contractor's Design and Manufacturing Programme.

29.1.9.2 Contractor's Preliminary Installation Programme.

29.1.9.3 Contractor's Installation Programme.

29.1.9.4 Software Development Programme.

29.1.9.5 Commissioning Programme in the form of a subprogramme to the Contractor's Preliminary Installation Programme and Contractor's Installation Programme.

29.1.9.6 New Trains Delivery to Siu Ho Wan Depot Programme.

29.1.9.7 Three Month Rolling Programme.

29.1.9.8 Any other programmes required by the Engineer.

29.1.10 The following Interfacing Contractors will complete the following design works no later than the dates shown in the following table:

Interfacing Contract	**Completion of Design Works (Month/Year)**
Train borne ATC equipment	Oct 2016
Electronic Information Display System equipment	Jun 2016
Door Chime System equipment	Dec 2015

29.1.11 The following Interfacing Contractors will deliver the following equipment for type testing no later than the dates shown in the following table. The Contractor shall be responsible to collect these equipment from Hong Kong except for the Electronic Information Display System equipment for the first train which shall be installed in the Contractor's factory:

Interfacing Contract	Interfacing Contractor's Point of Delivery	Interfacing Contractor's Completion of Delivery of Equipment (Month/Year)
Train borne ATC equipment (for 2 trains)	Hong Kong	Apr 2017
Train borne ATC equipment (for remaining trains)	Hong Kong	To be determined based on the detailed Project Programme
Electronic Information Display System equipment (for 1 train)	Contractor's factory	Dec 2016
Electronic Information Display System equipment (for remaining trains)	Hong Kong	To be determined based on the detailed Project Programme
Door Chime System equipment (for 1 train)	Hong Kong	Dec 2016
Door Chime System equipment (for remaining trains)	Hong Kong	To be determined based on the detailed Project Programme

29.1.12 The following Interfacing Contractors will deliver the specific cable and cable harness as specified in Attachment App-I-Annex-4 and Appendix I Annex 4 Clause 5.1 by batches for installation by the Contractor. The first batch for the 2nd to 18th trains will be delivered no later than the dates shown in the following table. The delivery schedule of later batches for remaining trains shall be determined upon the detailed project programme. The Contractor shall be responsible to collect those equipment from Hong Kong to the Contractor's factory for installation.

Interfacing Contract	**Interfacing Contractor's Point of Delivery**	**Interfacing Contractor's Completion of Delivery of Equipment (Month/Year)**
Electronic Information Display System equipment - Cable & cable harness (for 2nd to 18th trains)	Hong Kong	Jul 2017
Door Chime System equipment - Cable & cable harness (for 2nd to 18th trains)	Hong Kong	Jul 2017

29.2 Delivery, Testing and Commissioning in Hong Kong

29.2.1 The Schedule of Delivery in Appendix E and the Engineer's Preliminary Programme and the Completion Obligations shall be planned in accordance with the constrains and requirements specified in PS 30, Appendices G and H, in particular on the availability of works areas, works train and track access. The Contractor shall note the provisions provided for the testing and commissioning of the trains in Siu Ho Wan Depot, Urban Line Depots and Urban Lines and coordinate his activities to optimise the utilisation.

29.2.2 The Contractor shall deliver the trains to Siu Ho Wan Depot according to the Delivery Dates as stipulated in Appendix E. Due to constraints in depot track availability, 4 tracks are reserved for testing and commissioning and stabling at any time. The delivery of new trains shall be at a maximum rate of 2 trains per month. The Contractor shall allow in the programme a duration of four weeks per train for testing and commissioning at Siu Ho Wan Depot. The Contractor shall unload a new train at Siu Ho Wan Depot only when at least 1 of the preceding trains at Siu Ho Wan Depot have completed the required testing and commissioning.

29.2.3 When the trains are delivered, the Contractor shall carry out testing and commissioning of the trains at Siu Ho Wan Depot as much as possible. After the required testing and commissioning is completed at Siu Ho Wan Depot, the Employer will arrange to shunt the trains to Urban Lines at the request of the Contractor. The Contractor shall allow 3 NTH possessions for stock transfer from SHD to URL depots. When shunted to URL, the Contractor shall allow the remaining time before the 'Ready for Passenger Service Dates' referred to the Engineer's Programme in Appendix F for the Employer to arrange for Test Run. Test Run as specified in shall be carried out to make the trains ready for Passenger Service.

29.2.4 The Test Run in URL in item 5.3 of Appendix C shall be conducted on each new train subject to the available non-peak hours daily and subject to traffic conditions of Operation Railways. The Contractor shall make due allowance in the programme when planning for the commissioning works.

29.2.5 The Delivery Dates for the trains in Appendix E may be advanced by up to four weeks subject to the depot track availability and the Approval by the Engineer.

29.3 Training and Operation and Maintenance Manuals

29.3.1 The programme for Training, and Operation and Maintenance Manuals in Appendix F Section 4 shall be coordinated with the handing over of the first train to facilitate the passenger service of the handed over trains.

SECTION 30

SITE ARRANGEMENTS

August 2015

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30 SITE ARRANGEMENTS

30.1 General

30.2 Work Site at Siu Ho Wan Depot

30.3 Work Site at Urban Lines Depots

30.4 Contractor's Staff Training

30 SITE ARRANGEMENTS

30.1 General

30.1.1 The Site

(a) The following two work sites will be provided to the Contractor for the execution of the Contract:

(i) Siu Ho Wan Depot (SHD)

During the period of train delivery and train preparation works before train transfer from SHD to Urban Lines Depots, the Employer will allocate work areas at SHD to the Contractor. The layout and location of the work site within the SHD is specified in Appendix G.

(ii) Urban Lines Depots (CWD, KBD, TKD and TWD)

During the period of testing and commissioning and Integrated Testing of the trains with the Urban Line systems, Test Running and the Defects Liability Periods, the Employer will allocate work areas at URL Depots to the Contractor. The layout and location of the work site within the URL Depots is specified in Appendix G.

(b) At the time of gaining access to the work site the Contractor shall, in the presence of the Engineer, inspect the work site to satisfy himself, inter alia, that:

(i) The area is clean.

(ii) Where access is given the specified services are in place.

(iii) The adjacent works to be protected are all identified.

(iv) The access for staff and materials is agreed.

(c) The Contractor shall refer to GS Section 12, 13, 14 and 16 and Appendix H which set out the rules and procedures which the Contractor shall need to observe while working within or adjacent to the railways and railways under construction.

(d) The Contractor shall submit a Safety Management Plan to the requirements as set out in the GS Section 15. The safety classification of the Contract shall be considered as Classification 2. The Contractor shall

conform to the ”Contractor Fitness for Duty Management” requirements as stipulated in Appendix H Annex 2 under this PS.

(e) The Contractor shall comply with the environmental requirements in PS 30 for any activities on the work site.

(f) The Contractor shall submit a Site Management Plan, during SEMP Stage 3, to analyze the complete range of activities that shall be undertaken to achieve the testing and commissioning programme as specified in PS 29 and subject to the site requirements as specified in PS 30. The Site Management Plan shall include the following details:

(i) Work flow activity programme incorporating timescales and resources level showing all the key activities associated with the delivery, testing and commissioning of all the train sets. The programme shall identify the location, the track occupancy duration and frequency, and the manpower level associated with each activity.

(ii) Method statement on each key activity, including the delivery of the train from the Contractor's site to the work sites.

(iii) All the working assumptions shall be stated.

30.1.2 Contractor's Facilities

(a) The Contractor shall provide any additional facilities required for the Works, such as cranage and lifting jacks, taking into account the facilities to be provided by the Employer as specified in this Section.

(b) Where the Contractor intends to provide additional facilities he shall submit details of the equipment such as loading of the floor or of the depot civil structure, where it is intended to use such equipment, and shall obtain Approval for its use.

(c) Proof-load test certificates of such equipment/ structures shall also be submitted to the Engineer. All such equipment shall meet the statutory requirements of the appropriate Hong Kong Government Department.

(d) The Contractor is responsible, at his own cost, for arranging with the telecom and internet service providers for the installation of telephone and internet lines within the work site.

(e) The Contractor shall not use any accommodation bogie in view of the limited space of the work site.

30.1.3 Site Office

(a) The locations allocated for the site offices have yet to be finalized but will be within the areas shown on the Drawings as specified in Appendix G Clause 1.4. The Contractor shall be responsible for the construction of the office and maintenance of all facilities required by him together with the subsequent removal.

(b) Prior to the construction of the office, detailed layout drawings of the proposed office, utility and storage requirements shall be submitted for Approval. All costs arising from the construction of the site office shall be to the Contractor's account.

30.1.4 Storage Area

(a) The Employer will allocate storage space as specified in Appendix G Clause 1.4.

(b) The Contractor shall be responsible for security of equipment stored.

(c) The Contractor shall obtain Approval on the employment of security staff.

(d) Hazardous Goods Store will be arranged subject to agreement with the Engineer.

(e) No storage of materials and tools shall be allowed outside the designated storage areas.

30.1.5 Controlled Environment

(a) The Contractor shall take every precaution necessary to protect the adjacent equipment, facilities, properties and structures from damage and shall bear all costs incurred in remedying any damage due to the lack of proper care on his part during the execution of the Works.

(b) The Works shall be executed with the minimum of disturbance to surrounding structures, roads, facilities, cables, equipment, services etc. and shall be carried out in such a manner as may be directed by the Engineer.

(c) The installation of any special plant equipment or services at the work site by the Contractor shall be subject to Approval. Approval will be limited to safe operation, and to any modification to finishes, structure or facilities of the work site.

(d) Large scale painting is not allowed at the site.

(e) The Contractor shall be responsible, at his own cost, for the cleaning and house keeping of the work site during his occupancy.

(f) The Contractor shall comply with any related statutory requirements on handling, packaging, storage and conveyance of chemical waste within the work site.

30.1.6 Monitoring and Liaison

(a) The Contractor shall provide upon the work site a competent English or Cantonese speaking representative who shall accept all instructions issued by the Engineer in relation to the execution of the Works.

(b) The Employer reserves the right to inspect and monitor the work site and where necessary, require appropriate actions to be taken by the Contractor relating to safe working practice, site house keeping, noise, working practices, statutory requirements, fire precautions, and effects on Employer's work adjacent to the site (such as dust, fumes and smell).

(c) Regular local liaison meeting will be called by the Engineer as he deems necessary to address such matters. A responsible representative from the Contractor shall attend such meetings. Local liaison meeting will be conducted in Hong Kong at the Engineer’s premises.

(d) The Employer reserves the right to stop the site activity if the Contractor violates the relevant rules and regulations. Any subsequent impact to the Contract shall be the responsibility of the Contractor.

30.1.7 Contractor's Staff Movement

(a) All Contractor's workpeople shall carry and display identity passes provided by the Employer. They shall be produced for inspection upon demand at any time within the work site.

(b) The identity passes issued to the Contractor's workpeople shall be surrendered to the Engineer on the completion of the Works or the ceasing of employment of the Contractor's workpeople whichever occurs earlier. The Contractor shall be responsible for the loss and/or damage of such passes. In such event, the Employer may either refuse to re-issue such passes and/or require the Contractor to pay an amount to be determined by the Employer representing the cost of re-issuing the passes.

(c) The Contractor shall not allow unauthorised visitors on the work site.

(d) The Contractor shall ensure his workpeople do not trespass beyond the limits of the work site or his particular area of operation. The Contractor shall be held responsible for any acts of trespass by his workpeople.

(e) The Employer reserves the right to expel the Contractor's workpeople from the site for their act of mis-conduct.

30.1.8 Road Vehicle Movement

(a) The Contractor shall use only those roads and/or routes within the relevant depot which are designated by the Engineer. The Contractor shall observe all traffic regulations within the relevant depot, particularly where posted speed limits and designated stop signs apply.

(b) Vehicle traffic shall be minimized within the depot. The Contractor shall inform the Employer's Security Section at the relevant depot of the schedule of any pick up and delivery. Vehicles shall be parked in prearranged parking bays only.

30.1.9 Material/Equipment Delivery

(a) Train cars shall only be delivered to the SHD during day time. Other material/equipment will be allowed to deliver during day time hours. All delivery shall require the consent of the Engineer or his representative.

(b) The Contractor shall provide all necessary tools, equipment, lifting gear and labour for the delivery of the material/equipment to the work site and handling of such within the site.

(c) The Contractor shall remove any redundant material and equipment from the working site.

(d) Movement of any goods out of the depot will require a permit from the Employer.

30.1.10 Rail Vehicle Movement

(a) No vehicles shall be allowed to shunt, either by its own power or by other shunting vehicles, unless it has been certified to be safe for movement by the Engineer.

(b) The use of any vehicle shunting device, such as road tractors, shall be subjected to Approval.

(c) The Contractor shall not operate any railed vehicle regardless of whether they belong to the Contractor or not.

(d) All railed vehicle shall be operated by the Employer's train operator only. Advance notice shall be made to the Engineer for any vehicle movement.

30.1.11 Work Site Occupancy

(a) The work site will be made available for use by the Contractor 30 days before the commencement of the relevant activities as described in PS 30.1.1.

(b) The Contractor shall be responsible to reinstate the work site before it is vacated. This includes the removal of special plant, equipment or services and the making good of finishes, structures or facilities which have been modified by the Contractor.

(c) In the event that the Contractor fails to vacate from the work site within the date specified in PS 30.2.4 and PS 30.3.2, the Employer reserves the right to carry out such work necessary to clear and reinstate at the Contractor’s risk and expense.

30.1.12 Restrictions on the Use of the Site

(a) Except with written permission, no radio transmission device shall be used within the work site or the Employer’s premises. Details of such devices shall be submitted for Approval.

(b) The work site is equipped with smoke and fire detection system. Welding and any other activities requiring the use of naked flame shall be reported to the Fire Control Centre of the work site in advance.

(c) None of the Contractor's workpeople shall be permitted to live in the work site at any time throughout the Contract.

(d) Roof access requiring OHL isolation will be permitted subject to 1 day advance notice.

30.1.13 Work Site Capacity

(a) The Engineer reserves the right to stop the delivery of the train to the work sites should all the Employer's facilities in the relevant work site as specified in PS 30 has been fully occupied. If the Engineer would exercise this right, the details and the exact work site will be confirmed to the Contractor 6 months before the delivery of the first train to Hong Kong.

(b) Under situation specified in PS 30.1.13(a), the Engineer may allocate work areas at the URL Depots to enable the Contractor to continue the testing and commissioning works. The Contractor shall undertake the

testing and commissioning works at the URL Depots, if allocated to the Contractor, at no extra cost to the Contract. Details of the work site facilities, such as the office space and the track access, shall be agreed with the Engineer.

30.2 Work Site at Siu Ho Wan Depot

30.2.1 Employer's Facilities

The following facilities will be provided by the Employer at SHD:

(a) Vertical Seawall Facility (refer to Appendix G Clause 3.3)

The vertical seawall will be made available for use by the Contractor subject to 14 days advance notice. The Contractor shall unload the train cars directly onto the rail track adjacent to the seawall.

(b) Site Office and Storage Space

Adequate space for site office and storage will be provided to the Contractor. The details, including the size and the exact location, will be confirmed to the Contractor 6 months before the delivery of the first train to Hong Kong.

(c) Light Maintenance Track

Light maintenance track(s) of 8-car length and with pit and roof access will be made available for use by the Contractor for the assembly of train cars subject to 7 days advance notice.

(d) Stabling Track

Stabling track(s) will be made available for use by the Contractor subject to one day advance notice. The Contractor may be asked to relocate to another track(s) to allow access for depot operations.

(e) Shunting Movements

Provision for shunting movement of cars will be made upon notification to the Engineer, one day in advance.

(f) Depot Test Track

(i) A depot test track will be made available for use by the Contractor during the testing and commissioning period, subject to 7 days advance notice.

(ii) The length of the depot test track is 1500 m and the maximum speed limit is 80 km/h.

(iii) Occupancy of the depot test track shall be limited to 2 days per week.

(g) Power Supplies

A 60 A 3 phase 415 V 50 Hz 4-wire power supply isolator will be located in the assigned work area by the Employer. The Contractor shall be responsible for the outgoing installations from this isolator. All electrical installations shall comply with the relevant statutory requirements and power supply company's regulation.

(h) Compressed Air Supplies

The Contractor may obtain compressed air supplies, of 7.5 bars or less, from the depot existing outlets. The Contractor shall be responsible for any extra requirements for compressed air supplies. Such extra requirement shall be subject to Approval.

(i) Water Supplies

The Contractor may obtain water from the depot existing outlets. The Contractor shall be responsible for any extra requirement for water intending as train loads for commissioning tests, and such requirement shall be subject to Approval.

(j) Access to Canteen, Toilets and Ablutions

The Contractor's staff will be entitled to use the depot existing canteen, toilets and ablution facilities. No shower facilities will be provided.

(k) Waste Disposal

The Contractor may reasonably utilize waste disposal facilities within the premises for office waste.

30.2.2 Train Preparation Works

(a) The Contractor shall perform suitable train preparation works at SHD and shall be responsible to ensure that the train is fit for delivery from SHD to URL Depots in a safe and reliable manner.

(b) The train preparation works shall include, as a minimum, the following:

(i) the security of the equipment installation

(ii) the proper operation of the traction system, braking system, emergency brake system and the associated 110V DC control circuits

(iii) the air tightness of the air brake system

(c) The Contractor shall identify the train preparation requirements in the testing plans as specified in PS 22.1.

(d) The Contractor shall conduct comprehensive hazard analysis to identify and analyze all hazards that may jeopardise the safe and on-time delivery of train from SHD to URL Depots. The Contractor shall implement suitable mitigation measures to ensure that the risks are reduced to an acceptable level (refer to PS 25.6).

30.2.3 Access to Main Running Line for Train Delivery

(a) The train will be driven by the Employer from SHD to URL Depots under traction system fall back operation (refer to PS 9.12.4) during non-traffic hours as specified in Appendix H Clause 4. The Contractor shall make application for access to mainline in accordance with Appendix H Clause 3.

(b) The number of mainline delivery shall be one night per 8-car train.

(c) The Contractor shall provide a competent engineering person on each train consist to attend the train delivery and to provide technical advice to the train operator where necessary.

30.2.4 Work Site Occupancy

The Contractor is required to vacate the site at SHD no later than 30 days after the delivery of the last train to URL Depots.

30.3 Work Site at Urban Lines Depots

30.3.1 Employer's Facilities

The following facilities will be provided by the Employer at Urban Line Depots (CWD, KBD, TKD and TWD):

(a) Site Office

A space for accommodation will be provided to the Contractor subject to agreement by the Engineer.

(b) Storage Space

A storage space will be provided to the Contractor subject to agreement with the Engineer.

(c) Heavy Maintenance Track

Heavy maintenance track(s) with lifting facilities will be made available for use by the Contractor, at the discretion of the Engineer, subject to one day advance notice. The Contractor may be asked to relocate to another track to allow access for depot operations.

(d) Light Maintenance Track

Light maintenance track(s) of 8-car length and with pit and roof access, will be made available for use by the Contractor during the testing and commissioning period. The Contractor may be asked to relocate to another track(s) to allow access for depot operations.

(e) Stabling Track

Stabling track(s) of 8-car length will be made available for use by the Contractor during the testing and commissioning period. The Contractor may be asked to relocate to another track(s) to allow access for depot operations.

(f) Shunting Movements

Provision for shunting movement of cars will be made upon notification to the Engineer, one day in advance.

(g) Not used

(h) Access to Main Running Line for Dynamic Test

(i) Test paths on mainline will only be available during non-traffic hours as specified in Appendix H Clause 4.

(ii) The Contractor shall make application for access to mainline test path in accordance with Appendix H Clause 3.

(iii) Subject to the availability, the main line test path shall be no more than 3 nights per week.

(i) Power Supplies

A 60 A 3 phase 415 V 50 Hz 4-wire power supply isolator will be located in the assigned work area by the Employer. The Contractor shall be responsible for the outgoing installations from this isolator. All electrical installations shall comply with the relevant statutory requirements and power supply company's regulation.

(j) Compressed Air Supplies

The Contractor may obtain compressed air supplies, of 7.5 bars or less, from the depot existing outlets. The Contractor shall be responsible for any extra requirements for compressed air supplies. Such extra requirement shall be subject to Approval.

(k) Water Supplies

The Contractor may obtain water from the depot existing outlets. The Contractor shall be responsible for any extra requirement for water intending as train loads for commissioning tests, and such requirement shall be subject to Approval.

(l) Access to Canteen, Toilets and Ablutions

The Contractor's staff will be entitled to use the depot existing canteen, toilets and ablution facilities. No shower facilities will be provided.

(m) Waste Disposal

The Contractor may reasonably utilize waste disposal facilities within the premises for office waste.

30.3.2 Work Site Occupancy

The Contractor is required to vacate the site no later than 30 days after the issue of the Final Certificate.

30.4 Contractor's Staff Training

30.4.1 Railway Safety Training

(a) Contractor's staff who require to work in the depot operations areas must receive the Safety Induction Training Course in basic railway safety as specified in Appendix H.

(b) The training will be conducted in the Employer's Training Centre and the Contractor's staff shall have to pass relevant tests in order to be given the authority to enter and carry out activity in the depot operations areas. They will be required to undertake a refresher course after twelve months interval.

(c) Some of the Contractor's staff have to attend Competent Person Training Course (refer to Appendix H Clause 2.5) and to be qualified as Competent Person for the supervision of working parties.

30.4.2 Lifting Equipment Operation Training

(a) The lifting facilities shall only be operated by qualified persons who have received and passed the training provided by the Employer's Training Centre in accordance with the relevant rules and regulations as specified in Appendix H.

(b) Contractor's staff who require to operate the Employer's lifting facilities must receive and pass the training in order to be given the authority to operate the equipment.

SECTION 31

INTERFACE ARRANGEMENTS

August 2015

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31 INTERFACE ARRANGEMENTS

31.1 Introduction

31.2 General Requirements

31.3 Detailed Interface Management Requirements

Table 31-1 Interfacing Systems / Designated Contracts

31 INTERFACE ARRANGEMENTS

31.1 Introduction

31.1.1 The interfacing Systems or Designated Contract which have an interface with the Works are listed in Table 31-1. The Contractor shall note that all Designated Contracts have already been completed with the exception of the Cab Simulator System.

31.1.2 The Contractor shall be responsible to undertake all the necessary interfacing duties with the Designated Contractor, Named Suppliers, the Engineer and all third parties in order to ensure complete compatibility with the interfacing systems and setting to work of the Works. Where necessary, the access of design data, personnel, items of plant, equipment and building materials shall be granted.

31.1.3 The detailed interface requirements with the Designated Contractors, Named Suppliers, the Engineer and all third parties are described in details in Appendix I Annex 1 to Annex 10. The annexes cover the following areas:

(a) Annex 1 P-way Interface (Track Data) contains details of the Urban Lines track on which the trains will run.

(b) Annex 2 Overhead Line / Traction Power Supply System Interfaces defines the interface requirements for the overhead line / traction power supply system and the train system. Compatibility of the train with the existing Urban Lines overhead line / traction power supply systems is also specified.

(c) Annex 3 ATC Interfaces defines the interface requirements for the Automatic Train Control (ATC) and the train system. Compatibility of the train with the ATC system is also specified.

(d) Annex 4 Communication Interfaces defines the interface requirements for all Communications Equipment and the train system including Trainborne Radio, In-Cab CCTV, EIDS, Trainborne Video Display, In-Saloon CCTV and Door Chime System.

(e) Annex 5 PSD Interfaces defines the interface requirements for the PSD and the train system.

(f) Annex 6 Depot Interfaces defines the interface requirements for the depots and the train system.

(g) Annex 7 Electric Vehicle Interfaces defines the interface requirements for the existing electric vehicles and the train system.

(h) Annex 8 Not used.

(i) Annex 9 Dynamic Route Map Interfaces defines the interface requirements for the DRM and the train system/equipment including TMS, DVAS & PA, GSM Modem Assemblies and Doors.

(j) Annex 10 Cab Simulator Coordination defines the coordination requirements between the Contractor and the Cab Simulator System Contractor to be developed.

31.1.4 The Drawings issued with the above Annexes are intended to assist the Contractor for liaison and coordination with others. As such, these Drawings shall not reduce the Contractor's responsibility to ensure the compatibility of their Work with that of others.

31.2 General Requirements

31.2.1 As an integral part of the System Engineering Management System (refer to PS 21.2.2), the Contractor shall perform interface management.

31.2.2 The Contractor shall be responsible to purchase the systems/equipment from the Named Suppliers as described in Appendix I.

31.2.3 The Contractor shall be responsible for the system design and integration, purchase, installation, testing, commissioning, training, documentation and warranty of the purchased systems/equipment.

31.2.4 The Contractor shall assume full responsibility in ensuring the proper functioning of the purchased systems/equipment from the Named Suppliers.

31.2.5 The Contractor shall liaise with the Named Suppliers in ensuring that the purchased systems/equipment shall meet the intended functional and performance requirements of the systems/equipment as defined in the PS.

31.2.6 The Contractor shall investigate all interface matters and satisfy himself regarding the availability of the required information for interface designs from the Designated and Interfacing Contractors, Named Suppliers, the Engineer and all third parties. Any interface issues that may affect the performance of the Works shall be brought to the attention of the Engineer.

31.2.7 All changes in interface design shall refer to the Configuration Management detailed in PS 21.3.10.

31.2.8 Any interface issue that is related to system assurance shall refer to PS 25.

31.2.9 Any interface issue that is related to the Electromagnetic Compatibility shall refer to RS/C6014/04.

31.2.10 Any interface issue that is related to the software design shall refer to RS/C6014/05.

31.3 Detailed Interface Management Requirements

31.3.1 The Contractor shall submit an organisation chart together with the associated Curriculum Vitae of the key design personnel of the coordination team which shall be under the responsibility of the System Engineering Management representative (refer to PS 21.2.1).

31.3.2 By the end of the SEMP stage 1, the Contractor shall submit all required interface documentations for Approval.For the above interface documents, there shall be a corresponding reference in an item-by-item manner to the respective interface requirements specified in the PS. In addition, a master interface index to summarise all interface requirements corresponding to the individual systems, shall be provided for easy reference.

31.3.3 By the end of the SEMP stage 2, the Contractor shall submit all required System Specification Documents which will form part of the detailed interface specification for each interfacing system/equipment according to Appendix N Clause 2.3.

31.3.4 By the end of the SEMP stage 3, the Contractor shall submit all required System Design Documents to demonstrate how the proposed design will comply with all interfacing functions according to Appendix N Clause 2.4.

31.3.5 By the end of the SEMP stage 4, the Contractor shall submit all required interface design proposals according to which shall form part of the Level 4 Design Data (refer to Appendix N Clause 2.5).

31.3.6 By the end of the SEMP stage 5, the Contractor shall submit a schedule of Integrated Test (refer to PS 22.12) for each interfacing system/equipment for Approval. The Contractor shall obtain agreement with the associated Designated and Interfacing Contractors, Named Suppliers, the Engineer and all third parties beforehand regarding the scopes of work, methodologies, responsibilities, test site arrangements, expected test date, test procedures, durations and reports beforehand and record in the above Integrated Test Schedule.

Table 31-1 Interfacing Systems / Designated Contracts

Contract Number (if applicable)	Designated Contract or Interfacing Systems	Designated Contract / Interfacing Systems
N/A	Urban Lines Trackwork	Interfacing Systems
N/A	Overhead Line System and Power Supply System	Interfacing Systems
3036	CBTC Signalling System	Designated Contract
N/A	Communication Systems	Interfacing Systems
N/A	Platform Screen Door	Interfacing Systems
N/A	Depots including KBD, TWD, CWD, TKD & SHD	Interfacing Systems
N/A	Electric Vehicle and Existing Train Systems	Interfacing Systems
N/A	Dynamic Route Map System	Interfacing Systems
N/A	Cab Simulator System	Interfacing Systems

SECTION 32

ATTENDANCE

August 2015

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32 ATTENDANCE

32.1 Attendance During Testing, Commissioning and Defects Liability Period

32 ATTENDANCE

32.1 Attendance During Testing, Commissioning and Defects Liability Period

32.1.1 Site Office

(a) During the Testing, Commissioning and the Defects Liability Periods, the Contractor shall maintain a site office (refer to PS 30) with office hours from 08:30 to 17:30 hours Hong Kong time on every day except Sundays or Public Holidays.

(b) The Contractor shall provide a telephone hot line, a fax enquiry service or an internet service in order to maintain a 24-hour contact between the Engineer and the Contractor's representative on all issues regarding train failures and site matters.

32.1.2 Contractor's Representative

(a) The site office shall be manned by a technically competent Contractor's representative.

(b) The Contractor's representative shall represent the Contractor on all matters concerning train reliability, defects liability and site issues. The Contractor's representative shall be required to carry out whatever actions that are necessary to ensure the RAM performance of the train meeting the requirements in PS 25.

32.1.3 Response Time

(a) The Contractor's representative shall respond within ten minutes to a train failure reported by the Engineer.

(b) If required by the Engineer, a technically competent person shall be provided by the Contractor within thirty minutes for an on site repairing work in order to minimise the downtime of the defective train.

(c) Any failure by the Contractor to respond to a train failure reported by the Engineer within the required response time as specified in PS 32.1.3(a) and (b) and cause the train not available for the scheduled service (refer to PS 25.7) will constitute a defect under COC Clause 75.

MTR CORPORATION LIMITED

CONTRACT C6014-14E

PROCUREMENT OF NEW TRAINS

Particular Specification

Volume 2 of 4

August 2015

MTR CORPORATION LIMITED

CONTRACT C6014-14E

PROCUREMENT OF NEW TRAINS

PARTICULAR SPECIFICATION

WORKING DOCUMENT

VOLUME 2 OF 4

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CONTRACT C6014-14E
PROCUREMENT OF NEW TRAINS
PARTICULAR SPECIFICATION
WORKING DOCUMENT

CONTENTS

[VOLUME 1 OF 4]

Section 1: Introduction

Section 2: Definitions and Abbreviations

Section 3: Scope of the Works

Section 4: System Description and Performance Requirements

Section 5: Infrastructure Constraints

Section 6: Car Body Structure and Exterior

Section 7: Interior of Car Body

Section 8: Cab Facilities and Layout

Section 9: Operation and Control

Section 10: Train Management System

Section 11: Traction and Braking Equipment

Section 12: Bogies and Suspensions

Section 13: Pneumatics and Air Distribution Systems

Section 14: Gangways and Couplers

Section 15: Air Conditioning and Ventilation

Section 16: Doors

Section 17: Auxiliary Electrical Supply

[VOLUME 1 OF 4 (CONT'D)]

Section 18: Communications

Section 19: Not Used

Section 20: Materials and Workmanship Requirements

Section 21: Design Requirements

Section 22: Testing Requirements

Section 23: Training Requirements

Section 24: Spare Parts, Special Tools and Test Equipment

Section 25: System Assurance

Section 26: Maintenance Requirements

Section 27: Quality Management

Section 28: Environmental Requirements

Section 29: Programme

Section 30: Site Arrangements

Section 31: Interface Arrangements

Section 32: Attendance

[VOLUME 2 OF 4]

APPENDICES

Appendix A: Schedules of Drawings

Appendix B: Codes and Standards

Appendix C: Schedule of Tests

Appendix D: Not Used

Appendix E: Schedule of Delivery

Appendix F: Engineer's Preliminary Programme, Project Calendar, Schedule of Critical Dates and Schedule of Key Dates

Appendix G: Site Layout and Works Areas

Appendix H: Rules and Procedures for Working Within or Adjacent to the Railway

- Annex 1 P-Licensing System - Caring and Coaching System for New Contractor Workers
- Annex 2 Contractor Fitness for Duty Management

Appendix I: Designated Contracts and Interfacing Systems

- Annex 1 P-way Interface (Track Data)
- Annex 2 Overhead Line/ Traction Power Supply System Interfaces
- Annex 3 ATC Interfaces
- Annex 4 Communications Interfaces
- Annex 5 Platform Screen Door Interfaces
- Annex 6 Depot Interfaces
- Annex 7 Electric Vehicle Interfaces
- Annex 8 Not Used
- Annex 9 Dynamic Route Map Interfaces
- Annex 10 Cab Simulator System Coordination

Appendix J: Not Used

Appendix K: Not Used

Appendix L: Interior Styling Schedule

[VOLUME 2 OF 4 (CONT'D)]

Appendix M: Life Cycle Cost

Appendix N: Design Data

Appendix O: Delivery of Equipment

Appendix P: Configuration Control Programme

Appendix Q: List of Named Suppliers

[VOLUME 3 OF 4]

ROLLING STOCK STANDARDS

RS/C6014/01:	Data Transmission and Management
RS/C6014/02:	Constructional and Workmanship Requirements
RS/C6014/03:	Electrical and Design Requirements
RS/C6014/04:	Electromagnetic Compatibility
RS/C6014/05:	Software
RS/C6014/06:	Cables
RS/C6014/07:	Pneumatic Equipment
RS/C6014/08:	Fire Performance
RS/C6014/09:	Wheelsets
RS/C6014/10:	Pantograph
RS/C6014/11:	Battery
RS/C6014/12:	Operation and Maintenance Manual
RS/C6014/13:	Noise Performance and Measurement
RS/C6014/14:	Operability Design Guidelines
RS/C6014/15:	Keys and Locks
RS/C6014/16:	LED Lighting Standard

[VOLUME 4 OF 4]

Drawings

APPENDIX A

SCHEDULES OF DRAWINGS

August 2015

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APPENDIX A SCHEDULE OF DRAWINGS

GENERAL

COUPLING ARRANGEMENT

TRAIN EXTERIOR DESIGN

CAB INTERIOR DESIGN

SALOON INTERIOR DESIGN

INTERFACE

DEPOT

TRACK DATA

APPENDIX A SCHEDULE OF DRAWINGS

GENERAL		
Drawing No.	**Title**	**Revision**
C6014-14E/TSEG/010/001	Kinematic Envelope and Structure Gauge	A
C6014-14E/TSEG/010/002	Kinematic Envelope in Depot Maintenance Tracks	A
C6014-14E/TSEG/010/003	Rolling Stock Wheel Tread Profile (P8 Modified)	A
C6014-14E/TSEG/010/004	Track Irregularities	A
C6014-14E/TSEG/010/005	Definition of Vehicle on Track Twist	A
C6014-14E/TSEG/010/006	Vehicle Ride - Acceleration Weighting Characteristic	A
C6014-14E/TSEG/010/007	Explanation of Train Speed Profile w.r.t. Change of Speed Code	A
C6014-14E/TSEG/010/008	Cable Ratings	A
C6014-14E/TSEG/010/009	Train Consist and Car Numbering	A
C6014-14E/TSEG/010/010	Bogie, Axle and Wheel Numbering	A
C6014-14E/TSEG/010/011	Doors and Passenger Alarm Layout and Numbering	A
C6014-14E/TSEG/010/012	General Arrangement of Existing M Train	A
C6014-14E/TSEG/010/013	General Arrangement of Cab and Non-cab End Vehicles	A
C6014-14E/TSEG/010/014	Carbody Contour	A
C6014-14E/TSEG/010/015	In-Saloon CCTV Camera Layout and Numbering	A
C6014-14E/TSEG/010/016	Not used	-
C6014-14E/TSEG/010/017	Train Configuration Arrangement	A

COUPLING ARRANGEMENT		
Drawing No.	**Title**	**Revision**
OD4/311/00001/012	Service Loco. Coupler (ALVI Draftgear)	E
OD4/311/00001/014	General Arrangement of Diesel Locomotive	B
OD4/312/00001/008	BE Loco (MK II) Drawgear Arrangement for Dual Mode Locomotive	B
OD4/312/00001/051	BE Loco (MK I) Drawgear Arrangement Showing AL VI Draftgear	B
OD2/301/00015/001	MTR Standard Automatic Coupler for Passenger Cars	C
OD4/361/00715/0003	Automatic Coupler for Cab End	B
C6014-14E/TSEG/115/001	Automatic Coupler for Cab End of C Train	A

TRAIN EXTERIOR DESIGN		
Drawing No.	**Title**	**Revision**
C6014-14E/TSEG/060/001	Train Exterior – Cab Perspective View	A
C6014-14E/TSEG/060/002	Not Used	-
C6014-14E/TSEG/060/003	Train Exterior – Colour Scheme	A
C6014-14E/TSEG/060/004	Cab Exterior – General Arrangement	A
C6014-14E/TSEG/060/005	Train Exterior – General Arrangement	A
C6014-14E/TSEG/060/006	Cab – Vertical Cross Section	A
C6014-14E/TSEG/060/007	Cab – Horizontal Cross Section	A
C6014-14E/TSEG/060/008	Destination and Special Messages For Electronic Destination Display	A
OD1/307/00009/001	General Arrangement of Mock-Up Emergency Cab Door in Deployed Ramp Position	A
OD1/307/00009/002	General Arrangement of Mock-Up Emergency Cab Door in Plug Door Position	A
OD1/307/00009/003	Mock-Up Emergency Cab Door in Ramp Deployment Sequence	A

CAB INTERIOR DESIGN		
Drawing No.	**Title**	**Revision**
C6014-14E/TSEG/110/001	Cab Interior General Arrangement	A
C6014-14E/TSEG/110/002	Train Operator's Console and Window - Zone A	A
C6014-14E/TSEG/110/003	Auxiliary Console and Window - Zone B	A
C6014-14E/TSEG/110/004	A Side Cab Back Wall - Zone C	A
C6014-14E/TSEG/110/005	B Side Cab Back Wall - Zone D	A
C6014-14E/TSEG/110/006	Cab Ceiling - Zone E	A
C6014-14E/TSEG/110/007	Bardic Signal Lamp	A
C6014-14E/TSEG/110/008	Not Used	-
C6014-14E/TSEG/110/009	Train Operator's Seat	A

SALOON INTERIOR DESIGN		
Drawing No.	**Title**	**Revision**
C6014-14E/TSEG/100/001	General Saloon Interior Arrangement – A car	A
C6014-14E/TSEG/100/002	General Saloon Interior Arrangement – B car in 'ACB' Unit	A
C6014-14E/TSEG/100/003	General Saloon Interior Arrangement – B car in 'BC' Unit	A
C6014-14E/TSEG/100/004	General Saloon Interior Arrangement – C car in 'ACB' Unit	A
C6014-14E/TSEG/100/005	General Saloon Interior Arrangement – C car in 'BC' Unit	A
C6014-14E/TSEG/100/006	Saloon Interior – Overall Perspective View	A
C6014-14E/TSEG/100/007	Saloon Interior – Perspective View at Seat Bench Sh 1 of 2	A
C6014-14E/TSEG/100/007	Saloon Interior – Perspective View at Seat Bench Sh 2 of 2	A
C6014-14E/TSEG/100/008	Saloon Interior – Perspective View at Multi-purpose Area	A
C6014-14E/TSEG/100/009	Saloon Interior – Perspective View at Enlarged Multi-purpose Area	A
C6014-14E/TSEG/100/010	Saloon Interior – Perspective View at Cab End Bulkhead	A
C6014-14E/TSEG/100/011	Saloon Interior – Perspective View at Intercar Gangway	A
C6014-14E/TSEG/100/012	Saloon Interior – Colour Scheme	A
C6014-14E/TSEG/100/013	Multi-Purpose Area General Arrangement	A
C6014-14E/TSEG/100/014	Enlarged Multi-Purpose Area General Arrangement	A
C6014-14E/TSEG/100/015	Bodyside Interior Trim General Arrangement Sh 1 of 2	A
C6014-14E/TSEG/100/015	Bodyside Interior Trim General Arrangement Sh 2 of 2	A
C6014-14E/TSEG/100/016	Bodyside Door General Arrangement	A
C6014-14E/TSEG/100/017	Cab End Bulkhead General Arrangement	A
C6014-14E/TSEG/100/018	Intercar Gangway General Arrangement	A
C6014-14E/TSEG/100/019	Vestibule Interior Cross-Section General Arrangement	A
C6014-14E/TSEG/100/020	Ceiling General Arrangement	A
C6014-14E/TSEG/100/021	Seating	A
C6014-14E/TSEG/100/022	Not Used	-
C6014-14E/TSEG/100/023	Floor Covering Arrangement	A
C6014-14E/TSEG/100/024	Priority Seat Graphics General Arrangement	A
C6014-14E/TSEG/100/025	Straphanger	A
C6014-14E/TSEG/100/026	Door Gap Gauge	A
C6014-14E/TSEG/100/027	Door Obstacle Gauge	A
OD4/362/00510/0261	Fire Extinguisher	A

INTERFACE		
Drawing No.	**Title**	**Revision**
C6014-14E/TSEG/077/001	Platform Interface with Vehicle K.E.	A
C6014-14E/TSEG/077/002	Train / PSD Door Opening Scenario	A
C6014-14E/TSEG/077/003	Train / PSD Door Closing Scenario	A
C6014-14E/TSEG/077/004	Platform Screen Door Section for Interface Arrangement	A
C6014-14E/TSEG/157/001	Urban Lines Trains Cab End Coupler Electrical Box Pin Arrangement	A
C6014-14E/TSEG/417/001	Train Conceptual Safety Proving Circuit	A
C6014-14E/TSEG/497/001	Conceptual Architecture of TMS	A
C6014-14E/TSEG/497/002	ATC / Communications System / DRM Interface with TMS	A
C6014-14E/TSEG/497/003	ATC/DVAS/EIDS/DRM Conceptual Data Flow	A
C6014-14E/TSEG/667/008	CCTV Trainborne Equipment Connection Schematics	A
C6014-14E/TSEG/687/001	HPF Applicator	A
OD4/302/00003/0011	Schematic Diagram Of Power Circuit	C
OD4/302/00303/0002	'I' Stock Melco Chopper (248-256) Auxiliary Circuit Diagram "A", "C" & "D" Cars	L
OD4/303/00042/027	Power Circuit Diagram For EMU Cars Chopper/Aux. Inverter	B
OD4/303/00042/108	Circuit Diagram Of Static Auxiliary Inverter Chopper/Aux. Inverter	B
OD4/303/00063/0011	'G' Stock Auxiliary Circuit Diagram., EMU Cars A-CT-D, Chopper/Aux. Inverter (Sheet 1 of 1)	E
OD4/305/00141/001	'M' Stock Chopper Conversion Power Circuit Diagram For EMU Cars	C
OD4/305/00141/0009	'M' Stock 'A'-Car Auxiliary & Control Wiring Diagram (Sheet No.1) Chopper Conversion	E
OD4/305/00162/0001	'M' Stock Chopper Conversion Auxiliary Circuit Diagram A-CT-D Cars	G
OD4/305/00241/004	'T' Stock Chopper Conversion Power Circuit Diagram For EMU Cars	C
OD4/305/00262/0001	'T' Stock Chopper Conversion Auxiliary Circuit Diagram A-CT-D Cars	G
OD4/306/00041/001	Power Circuit Diagram For EMU Cars Additional Rolling Stock	N
OD4/306/00063/003	Circuit Diagram Of Static Auxiliary Converter	B
OD4/306/00063/0004	'H' Stock Auxiliary Circuit Diagram EMU Cars A-CT-D Additional Rolling Stock (1/1)	E
C6014-14E/TSEG/637/001	Schematic Diagram of SIV Power Circuit (Sheet 1 of 2)	A
C6014-14E/TSEG/637/002	Schematic Diagram of SIV Power Circuit (Sheet 2 of 2)	A
C6014-14E/TSEG/637/003	Power Circuit Diagram For EMU Cars	A
C6014-14E/TSEG/637/004	Circuit Diagram Of Auxiliary Static Inverter	A
OD4/312/00005/0001	BE Loco (MK I & II) Power Circuit Diagram Battery Electric Locomotive	D
OD4/312/00005/0002	Dual Mode Locomotive (MK I & II) Auxiliary Circuit Diagram	G
OD4/313/00005/0026	BE Loco (MK III) Power Circuit Diagram	B
OD4/313/00005/0027	BE Loco (MK III) Power Circuit Diagram	B
OD4/313/00005/0028	BE Loco (MK III) Power Circuit Diagram	B
OD4/313/00005/049	BE Loco (MK III) Auxiliary Circuit Diagram	A
OD4/306/00041/0002	H Stock Control Circuit Diagram "A-C_T-D" Cars (SHT. 1 OF 3)	N
OD4/306/00063/0005	H Stock Auxiliary Circuit Diagram EMU Cars "B-C" Additional Rolling Stock	C
OD4/361/00742/0034	Schematic Diagram of Power Circuit	A
OD4/361/00741/9731	SIV Control (C, B, B1, C1 Car)	A

DEPOT		
Drawing No.	**Title**	**Revision**
C6014-14E/TSEG/990/001	Typical Cross Section of Running Maintenance Area in Existing Depots	A
C6014-14E/TSEG/990/002	Typical Cross Section of Heavy Maintenance Area	A
C6014-14E/TSEG/990/003	Position of Jacking Points for Existing URL Train	A
C6014-14E/TSEG/990/004	Typical Dimensions of Lifting Claws of Lifting Jacks	A
C6014-14E/TSEG/990/005	Conceptual Sketch of Underfloor Jacks	A
C6014-14E/TSEG/990/006	Existing Accommodation Bogie at KBD	A
C6014-14E/TSEG/990/007	Typical Arrangement and Details of Towing Points of Existing M Trains	A
C6014-14E/TSEG/990/008	Details of Hold Down Device for Underfloor Wheel Lathe	A
C6014-14E/TSEG/990/009	Not Used	-
C6014-14E/TSEG/990/010	Typical Details of Target	A
C6014-14E/TSEG/990/011	Details of Target Holder	A
C6014-14E/TSEG/990/012	Pneumatic Connector Plug Schrader Plug 1/8"	A
C6014-14E/TSEG/990/013	Typical Recovery Procedure for EMU De-railment	A
C6014-14E/TSEG/990/014	Existing Wheel Skate of Operating Railway	A
C6014-14E/TSEG/990/015	Stripe Pattern For Identification of Jacking Point on Rolling Stock Vehicle	A
C6014-14E/TSEG/990/016	KBD Ground Floor Level Plan	A
520/Z/00/PWY/C30/362	Siu Ho Wan Depot General Arrangement	A
EMS/C3202.A/AFA/02-07	Chai Wan Depot Layout at G/F	-
USP/M/TKD3/XXX/A00/XXX	Tseung Kwan O Depot (TKD) Ground Level (+5.400) Arch- Depot Layout Plan	B
USP/TWD1/A12/001	Tsuen Wan Depot (TWD) Ground Floor Level Architectural Layout-Updated Station Plan	A1

TRACK DATA		
Drawing No.	**Title**	**Revision**
OD8/501/00001/0057	Rail Profile of 60E1, UIC60 and BS 90A(M) Section	D
KTL/M/SQ/W02/301	Yau Ma Tei Station Track Diagrams Volume 1	A
KTL/M/SQ/W02/302	Mong Kok Station – Prince Edward Station Track Diagrams Volume 1	A
OD4/900/00105/0003	Shek Kip Mei Station Track Diagrams Volume 1	E
OD4/900/00105/0004	Kowloon Tong Station – Lok Fu Station Track Diagrams Volume 1	E
OD4/900/00105/0005	Wong Tai Sin Station – Diamond Hill Station Track Diagrams Volume 1	C
KTL/M/SQ/W02/306	Choi Hung Station Track Diagrams Volume 1	A
KTL/SQ/TD1/R38/307	Kowloon Bay Station – Ngau Tau Kok Station Track Diagrams Volume 1	A
OD4/900/00105/0008	Kwun Tong Station Track Diagrams Volume 1	E
KTL/M/SQ/W02/309	Lam Tin Station Track Diagrams Volume 1	A
OD4/900/00105/1031	Yau Tong Station (Kwun Tong Line) Track Diagrams Volume 1	A
KTL/M/SQ/W02/311	Tiu Keng Leng Station and Crossover Track Diagrams Volume 1	A
OD4/501/00104/0003	YMT Sidings – YMT Line Diagram - KTL	B
OD4/501/00104/0004	YMT – MOK Line Diagram - KTL	B
OD4/501/00104/005	MOK Line Diagram - KTL	A
OD4/501/00104/0006	MOK – PRE Line Diagram - KTL	B
OD4/501/00104/0007	PRE – SKM Line Diagram - KTL	B
OD4/501/00104/0008	SKM– KOT Line Diagram - KTL	B
OD4/501/00104/0009	KOT– LOF Line Diagram - KTL	B
OD4/501/00104/0010	LOF – WTS Line Diagram - KTL	B
OD4/501/00104/0011	WTS – DIH Line Diagram - KTL	B
OD4/501/00104/0012	DIH – CHH Line Diagram - KTL	C
OD4/501/00104/013	CHH – KOB Line Diagram - KTL	A
OD4/501/00104/014	CHH – RT1 & 2 Line Diagram - KTL	A
OD4/501/00104/0015	KOB – NTK Line Diagram - KTL	B
OD4/501/00104/0016	Line Diagram - KTL Dep & Reception TK - NTK	A
OD4/501/00104/0017	NTK – KWT Line Diagram - KTL	D
OD4/501/00104/0018	KWT – LAT Line Diagram - KTL	D
OD4/501/00104/0019	LAT – YAT Line Diagram - KTL	C
OD4/501/00104/0020	YAT – TIK Line Diagram - KTL	C
OD4/501/00104/0021	TIK – Overrun Line Diagram - KTL	C
OD4/501/00104/0022	LAT – CVB Line Diagram - KTL LAT Service Connection	A
TWL/M/SQ/W02/201	Central Station – Admiralty Station Track Diagrams Volume 1	A
OD4/900/00205/0002	Immersed Tube Track Diagrams Volume 1	D
OD4/900/00205/0003	Tsim Sha Tsui Station – Jordon Station Track Diagrams Volume 1	D
TWL/M/SQ/W02/204	Yau Ma Tei Station – Mong Kok Station Track Diagrams Volume 1	A
OD4/900/00205/0005	Prince Edward Station – Sham Shui Po Station Track Diagrams Volume 1	D
OD4/900/00205/0006	Cheung Sha Wan Station – Lai Chi Kok Station Track Diagrams Volume 1	C
OD4/900/00205/0007	Mei Foo Station Track Diagrams Volume 1	C
OD4/900/00205/0008	Lai King Station Track Diagrams Volume 1	F
TWL/SQ/TD1/R38/209	Kwai Fong Station Track Diagrams Volume 1	A
OD4/900/00205/0010	Kwai Hing Station – Tai Wo Hau Station Track Diagrams Volume 1	C
TWL/SQ/TD1/R38/211	Tsuen Wan Station Track Diagrams Volume 1	A
OD4/501/00204/0002	CEN – ADM Line Diagram – TWL	D
OD4/501/00204/0003	ADM – SVB Line Diagram – TWL	B
OD4/501/00204/0004	SVB – TST Line Diagram – TWL	B
OD4/501/00204/0005	TST – JOR Line Diagram – TWL	B
OD4/501/00204/006	JOR – YMT Line Diagram – TWL	A
OD4/501/00204/007	YMT – MOK Line Diagram – TWL	A
OD4/501/00204/008	MOK – PRE Line Diagram – TWL	A

TRACK DATA		
Drawing No.	**Title**	**Revision**
OD4/501/00204/009	PRE – SSP Line Diagram – TWL	A
OD4/501/00204/0010	SSP – CSW Line Diagram – TWL	B
OD4/501/00204/011	CSW – LCK Line Diagram – TWL	A
OD4/501/00204/012	LCK – MEF Line Diagram – TWL	A
OD4/501/00204/0013	MEF – LAK Line Diagram – TWL	D
OD4/501/00204/0014	LAK – KWF Line Diagram – TWL	C
OD4/501/00204/0015	KWF – KWH Line Diagram – TWL	B
OD4/501/00204/0016	KWH – TWH Line Diagram – TWL	B
OD4/501/00204/017	TWH – TSW Line Diagram – TWL	A
OD4/501/00204/0018	TSW – H/S Line Diagram – TWL	B
OD4/900/00305/0001	Sheung Wan Station – Central Station Track Diagrams Volume 1	F
ISL/M/SQ/W02/102	Admiralty Station– Wan Chai Station Track Diagrams Volume 1	A
ISL/M/SQ/W02/103	Causeway Bay Station Track Diagrams Volume 1	A
OD4/900/00305/0004	Tin Hau Station – Fortress Hill Station Track Diagrams Volume 1	C
OD4/900/00305/0005	North Point Station – Quarry Bay Station Track Diagrams Volume 1	D
OD4/900/00305/0006	Tai Koo Station Track Diagrams Volume 1	F
OD4/900/00305/0007	Sai Wan Ho Station – Shau Kei Wan Station Track Diagrams Volume 1	C
OD4/900/00305/0008	Heng Fa Chuen Station Track Diagrams Volume 1	G
OD4/900/00305/0009	Chai Wan Station Track Diagrams Volume 1	F
OD4/501/00304/002	Overrun – SHW Line Diagram – ISL	A
OD4/501/00304/003	SHW – CEN Line Diagram – ISL	A
OD4/501/00304/004	CEN – ADM Line Diagram – ISL	A
OD4/501/00304/005	ADM – WAC Line Diagram – ISL	A
OD4/501/00304/006	WAC – CAB Line Diagram – ISL	A
OD4/501/00304/007	CAB – TIH Line Diagram – ISL	A
OD4/501/00304/008	TIH – FOH Line Diagram – ISL	A
OD4/501/00304/009	FOH – NOP Line Diagram – ISL	A
OD4/501/00304/0010	NOP – QUB Line Diagram – ISL	B
OD4/501/00304/0011	QUB – TAK Line Diagram – ISL	B
OD4/501/00304/012	TAK – SWH Line Diagram – ISL	A
OD4/501/00304/0013	SWH – SKW Line Diagram – ISL	B
OD4/501/00304/014	SKW – HFC Line Diagram – ISL	A
OD4/501/00304/015	HFC – CHW Line Diagram – ISL	A
TKL/M/SQ/W02/401	North Point Station Track Diagrams Volume 1	A
TKL/M/SQ/W02/402	Quarry Bay Station Track Diagrams Volume 1	A
TKL/M/SQ/W02/403	Eastern Immersed Tube Track Diagrams Volume 1	A
TKL/M/SQ/W02/404	Yau Tong Station (Tseung Kwan O Line) Track Diagrams Volume 1	A
TKL/M/SQ/W02/405	Tiu Keng Leng Station Track Diagrams Volume 1	A
TKL/M/SQ/W02/406	Tseung Kwan O Station Track Diagrams Volume 1	A
TKL/M/SQ/W02/407	Hang Hau Station Track Diagrams Volume 1	A
TKL/M/SQ/W02/408	Po Lam Station Track Diagrams Volume 1	A
TKL/SQ/TD1/R38/451	LOHAS Park Station Track Diagrams Volume 1	B1
OD4/501/00704/0030	NOP Sidings – NOP Line Diagram – TKL	-
OD4/501/00704/0031	NOP – QVB Line Diagram – TKL	-
OD4/501/00704/0032	QVB – CVB Line Diagram – TKL	-
OD4/501/00704/0033	CVB – YAT Line Diagram – TKL	-
OD4/501/00704/0034	YAT – TIK Line Diagram – TKL	-
OD4/501/00704/0035	TIK – TKO Line Diagram – TKL	-

TRACK DATA		
Drawing No.	**Title**	**Revision**
OD4/501/00704/0036	TKO – HAH Line Diagram – TKL	-
OD4/501/00704/0037	HAH – POA Line Diagram – TKL	-
OD4/501/00704/0038	TKO – PSK Line Diagram - TKL	-
OD4/501/00704/0039	PSK – LHP Line Diagram – TKL	A
715/W/WIL/MTR/C01/001	General Notes	A
715/W/WIL/MTR/C01/002	Legend	A
715/W/WIL/MTR/C01/003	Site Location Plan	A
715/W/WIL/MTR/C01/004	Overall Track Schematic Diagram	A
715/W/WIL/MTR/C01/005	Permanent Speed Restriction Diagram	B
715/W/WIL/MTR/C31/001	Track Schematics – Sheung Wan To Sai Ying Pun	B
715/W/WIL/MTR/C31/002	Track Schematics - Hong Kong University To Kennedy Town	A
715/W/WIL/MTR/C31/003	Track Schematics – Turnback Siding	A
715/W/WIL/MTR/C31/004	Interface Schedule and Buffer Stop Schedule	B
715/W/WIL/MTR/C31/005	Stage Opening of Refuge Siding at SHW	A
715/W/WIL/MTR/C30/001	Alignment - Sheung Wan Station To Sai Ying Pun Station Sheet 1 of 2	A
715/W/WIL/MTR/C30/002	Alignment - Sheung Wan Station To Sai Ying Pun Station Sheet 2 of 2	A
715/W/WIL/MTR/C30/003	Alignment – Sai Ying Pun Station to Hong Kong University Station	A
715/W/WIL/MTR/C30/004	Alignment – Hong Kong University Station to Kennedy Town Sheet 1 of 2	A
715/W/WIL/MTR/C30/005	Alignment – Hong Kong University Station to Kennedy Town Sheet 2 of 2	A
715/W/WIL/MTR/C30/006	Alignment – Kennedy Town Station to Track End Sheet 1 of 2	A
715/W/WIL/MTR/C30/007	Alignment – Kennedy Town Station to Track End Sheet 2 of 2	A
715/W/WIL/MTR/C30/008	Alignment – Sheung Wan Station Crossover Track	A
715/W/WIL/MTR/C30/009	Alignment Data Sheet	A
715/W/WIL/MTR/C33/001	Junction Layouts Track End to KET T 181	A
715/W/WIL/MTR/C32/001	Circular Tunnel Non-Ballasted BCT Trackform (MAB)	A
715/W/WIL/MTR/C32/002	Circular Tunnel Non-Ballasted BCT Trackform (HAB)	A
715/W/WIL/MTR/C32/003	Horseshoe Tunnel Non-Ballasted BCT Trackform (HAB)	A
715/W/WIL/MTR/C32/004	Horseshoe Tunnel Non-Ballasted BCT Trackform (MAB)	A
715/W/WIL/MTR/C33/001	Track End to Kennedy Town Station T 181	A
1020/W/KTE/MTR/C01/005	Permanent Speed Restriction Diagram	B
1020/W/KTE/MTR/C30/001	Yau Ma Tei Station to Ho Man Tin Station Sheet 1 of 4	A
1020/W/KTE/MTR/C30/002	Yau Ma Tei Station to Ho Man Tin Station Sheet 2 of 4	A
1020/W/KTE/MTR/C30/003	Yau Ma Tei Station to Ho Man Tin Station Sheet 3 of 4	A
1020/W/KTE/MTR/C30/004	Yau Ma Tei Station to Ho Man Tin Station Sheet 4 of 4	C
1020/W/KTE/MTR/C30/005	Ho Man Tin Station to Whampoa Station Sheet 1 of 2	A
1020/W/KTE/MTR/C30/006	Ho Man Tin Station to Whampoa Station Sheet 2 of 2	A
1020/W/KTE/MTR/C30/007	Crossover East of HOM	A
1020/W/KTE/MTR/C30/008	Alignment Data Sheet Horizontal Alignment	A
1020/W/KTE/MTR/C30/009	Alignment Data Sheet Vertical Alignment	A
752/DRW/0083	Final Scheme Plan	B
OD1/411/00129/0002	KTL Pre Scheme Plan Sacem Sectors Stopping Points	H
OD1/411/00229/002	TWL Pre Scheme Plan Sacem Sectors Stopping Points	J1
OD1/411/00329/002	ISL Pre Scheme Plan Sacem Sectors Stopping Points	-
752/DRW/1019	Contract No. 752 Final Scheme Plan	B
NOP->QUB->EHJ TKL Line	Contract 652 Track Layout NOP->QUB->EHJ TKL Line	-
EHJ->YAT->TIK->TKO->HAH->POA TKL Line	Contract 652 Track Layout EHJ->YAT->TIK->TKO->HAH->POA	-
TKO->TKS TKL Line	Contract 652 Track Layout TKO->TKS TKL Line	-
LAT->YAT->TIK KTL Line	Contract 652 Track Layout LAT->YAT->TIK KTL Line	-
LAT->EHJ->QUB KTL/TKL Line	Contract 652 Track Layout LAT->EHJ->QUB KTL/TKL Line	-
Depot TKL Line	Contract 652 Track Layout Depot TKL Line	-
C6014-14E/TSEG/080/001	ISL Dwell Time Requirement	A
C6014-14E/TSEG/080/002	KTL Dwell Time Requirement	A
C6014-14E/TSEG/080/003	TKL Dwell Time Requirement	A
C6014-14E/TSEG/080/004	TWL Dwell Time Requirement	A

APPENDIX B

CODES AND STANDARDS

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APPENDIX B CODES AND STANDARDS

1 Rolling Stock Standards

2 International Standards

3 Information on Standards

APPENDIX B CODES AND STANDARDS

1 Rolling Stock Standards

The following Rolling Stock Standards form part of the Particular Specification.

Standard Reference	Title	Current Revision
RS/C6014/01	Data Transmission and Management	A1
RS/C6014/02	Constructional and Workmanship Requirements	A1
RS/C6014/03	Electrical and Electronic Design Requirements	A1
RS/C6014/04	Electromagnetic Compatibility	A1
RS/C6014/05	Software	A1
RS/C6014/06	Cables	A1
RS/C6014/07	Pneumatic Equipment	A1
RS/C6014/08	Fire Performance	A1
RS/C6014/09	Wheelsets	A1
RS/C6014/10	Pantograph	A1
RS/C6014/11	Battery	A1
RS/C6014/12	O&M Manual	A1
RS/C6014/13	Noise Performance and Requirement	A1
RS/C6014/14	Operability Design Guidelines	A1
RS/C6014/15	Keys and Locks	A1
RS/C6014/16	LED Lighting Standard	A1

2 International Standards

The Particular Specification has made reference to following international codes and standards.

British Standards and European Standards	
Standard Reference	**Title**
BS 11: 1985	Railway rails
BS 476: Pt 4: 1970	Fire tests on building materials and structures – Part 4: Non-combustibility test for materials
BS 476: Pt 6: 1989	Fire tests on building materials and structures – Part 6: Method of test for fire propagation for products

BS 476: Pt 7: 1997	Fire tests on building materials and structures – Part 7: Method of test to determine the classification of the surface spread of flame of products
BS 476: Pt 20: 1987	Fire tests on building materials and structures - Part 20: Method for determination of the fire resistance of elements of construction (general principles)
BS 476: Pt 22: 1987	Fire tests on building materials and structures – Part 22: Methods for determination of the fire resistance of nonloadbearing elements of construction
BS 848: Pt 1: 1997	Fans for general purposes – Part 1: Performance testing using standardized airways

British Standards and European Standards	
Standard Reference	**Title**
BS 857: 1967	Specification for safety glass for land transport
BS 1363: Pt 2: 1995	13A plugs, socket-outlets, adaptors and connection units – Part 2: Specification for 13A switched and unswitched socket-outlets
BS 2572: 1995	Specification for phenolic laminated sheet and epoxy cotton fabric laminated sheet
BS 2618: 1975	Electric traction equipment
BS 3682: Pt 1: 1994	Railway brake hose – Part 1: Specification for compressed air brake hose
BS 3692: 2014	ISO metric precision hexagon bolts, screws and nuts.
BS 3693: 1992	Recommendations for design of scales and indexes on analogue indicating instruments
BS 3900: Pt E7: 1974	Methods of test for paints – Part E7: Resistance to impact (falling ball test)
BS 4174: 1972	Self-tapping screws and metallic drive screws
BS 4183: 1967	Machine screws and machine screw nuts. Metric series
BS 4568-1: 1970	Steel conduit and fittings with metric thread of ISO form for electrical installations
BS 5308: 1986	Instrumentation cables
BS 5425: 1986	Coaxial cable for wideband distribution systems
BS 5825: 1991	Low voltage switchgear and control gear for industrial use mounting rails G-profile for the fixing of terminal blocks
BS 6360: 1991	Specification for conductors in insulated cables and cords
BS 6469: 1990	Insulation and sheaths of electric cables

BS 6500: 2000	Electric cables - flexible cords rated up to 300/500 v, for use with appliances and equipment intended for domestic, office and similar environments
BS 6853: 1999	Code of practice for fire precautions in the design and construction of passenger carrying trains
BS 7608: 2014	Guide to fatigue design and assessment of steel products
BS 7671: 2001	Requirements for electrical installations – IEE wiring regulations - Sixteenth edition
BS 8118: Pt 1: 1991	Structural use of aluminium: Part 1: Code of practice for design
BS 9000: Pt 1 to Pt 3: 1996	General requirements for a system for electronic components of assessed quality

British Standards and European Standards	
Standard Reference	**Title**
BS 9522 N003: 1990	Detail specification for Multi-contact circular electrical connectors for d.c. and low frequency applications Bayonet coupling non-barrier sealed, environment resistant with rear insertable, rear release, rear removable crimp contacts also barrier sealed with nonremovable solder contact styles Full plus airframe fit assessment
BS AU 148: Pt 15: 1969	Methods of test for motor vehicle paints – Part 15: Resistance to chipping
BS EN 286: Pt 3: 1995	Steel pressure vessels designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock
BS EN 287-1: 2004	Qualification test of welders – Fusion welding – Part 1: Steels
BS EN 473: 2000	Non-destructive testing – Qualification and certification of NDT personnel – General principles
BS EN 571-1: 1997	Non-destructive testing – Penetrant testing: Part 1: General principles
BS EN 779: 2002	Particulate air filters for general ventilation – Determination of the filtration performance
BS EN 970: 1997	Non-destructive examination of fusion Welds - Visual examination
BS EN 1011-1: 2009	Welding – Recommendations for welding of metallic materials - Part 1: General guidance for arc welding
BS EN 1011-2: 2001	Welding – Recommendations for welding of metallic materials - Part 2: Arc welding of ferritic steels

BS EN 1011-3: 2000	Welding – Recommendations for welding of metallic materials - Part 3: Arc welding of stainless steels
BS EN 1011-4: 2000	Welding – Recommendations for welding of metallic materials - Part 4: Arc welding of aluminium and aluminium alloys
BS EN 1289: 1998	Non-destructive testing of welds – Penetrant testing of welds – Acceptance levels
BS EN 1290: 1998	Non-destructive testing of welds – Magnetic particle testing of welds
BS EN 1291: 1998	Non-destructive testing of welds – Magnetic particle testing of welds – Acceptance levels
BS EN 1418: 1998	Welding personnel – Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials
BS EN 1435: 1997	Non-destructive testing of welds – Radiographic testing of welded joints
BS EN 1712: 1997	Non-destructive testing of welds – Ultrasonic testing of welded joints – Acceptance levels

British Standards and European Standards	
Standard Reference	**Title**
BS EN 1714: 1998	Non-destructive testing of welds – Ultrasonic testing of welded joints
BS EN 10216: Pt 5: 2004	Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 5: Stainless steel tubes
BS EN 12062: 1998	Non-destructive examination of welds – General rules for metallic materials
BS EN 12082: 1998	Railway applications – Axleboxes – Performance testing
BS EN 12449: 1999	Copper and copper alloys – Seamless, round tubes for general purposes
BS EN 12517-1: 2006	Non-destructive testing of welds – Part 1: Evaluation of welded joints in steel, nickel, titanium and their alloys by radiography – Acceptance levels
BS EN 13103: 2001	Railway applications – Wheelsets and bogies – Nonpowered axles – Design method
BS EN 13104: 2001	Railway applications – Wheelsets and bogies – Powered axles – Design method
BS EN 13260: 2003	Railway applications – Wheelsets and bogies – Wheelsets – Product requirements
BS EN 13261: 2003	Railway applications – Wheelsets and bogies – Axles – Product requirements

BS EN 13262: 2004	Railway applications – Wheelsets and bogies – Wheels – Product requirements
BS EN 13979: Pt 1: 2003	Railway applications – Wheelsets and bogies – Monobloc wheels – Technical approval procedure – Part 1: Forged and rolled wheels
BS EN 14752: 2005	Railway applications – Bodyside entrance systems
BS EN 15227: 2009	Railway applications - Crashworthiness requirements for railway vehicle bodies
BS EN 45502-2-1 :2003	Active Implantable Medical Devices Part 2-1
BS EN 45545: 2013	Railway applications — Fire protection on railway vehicles
BS EN 50085-1: 2005	Cable trunking and cable ducting systems for electrical installations - Part 1: General requirements
BS EN 50117-1: 2002	Coaxial cables - Part 1: Generic specification
BS EN 50121-1: 2006	Railway applications - Electromagnetic compatibility - Part 1: General
BS EN 50121-3-1 : 2006	Railway applications - Electromagnetic compatibility Part 3-1 : Rolling stock -Train and complete vehicle
BS EN 50121-3-2 : 2006	Railway applications - Electromagnetic compatibility Part 3-2 : Rolling stock - Apparatus
BS EN 50121-4: 2006	Railway applications – Electromagnetic compatibility Part 4: Emission and immunity of the signalling and telecommunications apparatus
BS EN 50128:2011	Railway applications. Communication, signalling and processing systems. Software for railway control and protection systems
BS EN 50129: 2003	Railway applications. Communication, signalling and processing systems. Safety related electronic systems for signalling
BS EN 50153: 2002	Railway applications - Rolling stock - Protective provisions relating to electrical hazards
BS EN 50155: 2007	Railway applications - Electronic equipment used on rolling stock

British Standards and European Standards	
Standard Reference	**Title**
BS EN 50200: 2006	Method of test for resistance to fire of unprotected small cables for use in emergency circuits
BS EN 50266-1: 2001	Common test methods for cables under fire conditions – Test for vertical flame spread of vertically-mounted bunched wires or cables – Part 1: Apparatus

BS EN 50266-2-1: 2001	Common test methods for cables under fire conditions – Test for vertical flame spread of vertically-mounted bunched wires or cables – Part 2-1: Procedures – Category A F/R
BS EN 50266-2-2: 2001	Common test methods for cables under fire conditions – Test for vertical flame spread of vertically-mounted bunched wires or cables – Part 2-2: Procedures – Category A
BS EN 50266-2-3: 2001	Common test methods for cables under fire conditions – Test for vertical flame spread of vertically-mounted bunched wires or cables – Part 2-3: Procedures – Category B
BS EN 50266-2-4: 2001	Common test methods for cables under fire conditions – Test for vertical flame spread of vertically-mounted bunched wires or cables – Part 2-4: Procedures – Category C
BS EN 50266-2-5: 2001	Common test methods for cables under fire conditions – Test for vertical flame spread of vertically-mounted bunched wires or cables – Part 2-5: Procedures – Small cables - Category D
BS EN 55011: 2007	Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment
BS EN 60061-1: 1997	Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 1: Lamp caps
BS EN 60073: 2002	Basic and Safety Principles for Man-Machine Interface, Marking and Identification - Coding Principles for Indication Devices and Actuators
BS EN 60081: 1998	Double-capped fluorescent lamps – Performance specifications
BS EN 60310: 2004	Traction transformers and inductors on board rolling stock
BS EN 60447: 2004	Basic and Safety Principles for Man-Machine Interface, Marking and Identification – Actuating Principles
BS EN 60529: 1992	Degrees of protection provided by enclosures (IP code)
BS EN 61000-6-2: 2005	Electromagnetic compatibility Part 6-2: Generic standards - Immunity for industrial environments
BS EN 61000-6-4: 2007	Electromagnetic compatibility Part 6-4: Generic standards - Emission standard for industrial environments
BS EN 61386-1: 2008	Conduit systems for cable management - Part 1: General requirements

British Standards and European Standards	
Standard Reference	**Title**
BS EN 61249-2-7: 2002	Materials for printed boards and other interconnecting structures Part 2-7: Reinforced base materials clad and unclad - Epoxide woven e-glass laminated sheet of defined flammability (vertical burning test),copper-clad
BS EN 61373: 2013	Shock and Vibration requirements for rolling stock equipment
BS EN ISO 105-A01: 1996	Textiles – Tests for colour fastness – Part A01: General principles of testing
BS EN ISO 1234: 1998	Split pins
BS EN ISO 1518: 2001	Methods of test for paints – Part E2: Scratch test
BS EN ISO 1520: 2007	Paints and varnishes – Cupping test
BS ISO 1940: Pt 1: 2003	Mechanical vibration – Balance quality requirements for rotors in a constant (rigid) state – Part 1: Specification and verification of balance tolerances
BS EN ISO 2320: 2008	Prevailing torque type steel hexagonal nuts – Mechanical and performance requirements
BS EN ISO 2409: 2013	Paints and varnishes – Cross cut test
BS EN ISO 2439: 2001	Flexible cellular polymeric materials – Determination of hardness (indentation technique)
BS EN ISO 2813: 2000	Paints and varnishes – Determination of specular gloss of non-metallic paint films at 20°, 60° & 85°
EN ISO 3095: 2005	Railway applications - Acoustics - Measurement of noise emitted by railbound vehicles
BS EN ISO 3381: 2005	Railway applications - Acoustics - Measurement of noise inside railbound vehicles
BS EN ISO 4287: 2000	Geometric Product Specification – Surface texture: Profile method – Terms, definitions and surface texture parameters
BS EN ISO 4288: 1998	Geometric Product Specification – Surface texture – Profile method: Rules and procedures for the assessment of surface texture
BS EN ISO 4589-2: 1999	Plastics – Determination of burning behaviour by oxygen index – Part 2: Ambient-temperature test
BS EN ISO 4589-3: 1996	Plastics – Determination of burning behaviour by oxygen index – Part 3: Elevated-temperature test
BS EN ISO 5817: 2003	Welding – Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) – Quality levels for imperfections
BS EN ISO 6385: 2004	Ergonomic Principles in the Design of Work Systems

BS EN ISO 6860: 2007	Paints and varnishes – Bend test (conical mandrel)
BS EN ISO 7010: 2012	Graphical symbols - Safety colours and safety signs - Registered safety signs
BS EN ISO 7042: 2013	Prevailing torque type all-metal hexagonal nuts, style 2 – Property classes 5, 8, 10 and 12
BS EN ISO 7719: 2013	Prevailing torque type all-metal hexagonal nuts, style 1 – Property classes 5, 8 and 10

British Standards and European Standards	
Standard Reference	**Title**
BS EN ISO 9239-1: 2002	Reaction to fire tests for floorings – Part 1: Determination of the burning behaviour using a radiant heat source
BS EN ISO 9606-2: 2004	Qualification test of welders – Fusion welding – Part 2: Aluminium and aluminium alloys
BS EN ISO 10042: 2006	Welding – Arc-welded joints in aluminium and its alloys – Quality levels for imperfections
BS EN ISO 10075-2: 2000	Ergonomic Principles Related to Mental Workload - Part 2: Design Principles
BS EN ISO 12947-1: 1999	Textiles – Determination of the abrasion resistance of fabrics by the Martindale method – Part 1: Martindale abrasion testing apparatus
BS EN ISO 12947-2: 1999	Textiles – Determination of the abrasion resistance of fabrics by the Martindale method – Part 2: Determination of specimen breakdown
BS EN ISO 12947-3: 1999	Textiles – Determination of the abrasion resistance of fabrics by the Martindale method – Part 3: Determination of mass loss
BS EN ISO 12947-4: 1999	Textiles – Determination of the abrasion resistance of fabrics by the Martindale method – Part 4: Assessment of appearance change
BS EN ISO 13934-1: 1999	Textiles – Tensile properties of fabrics – Part 1: Determination of maximum force and elongation at maximum force using the strip method
BS EN ISO 13938-1: 1999	Textiles – Bursting properties of fabrics – Part 1: Hydraulic method for determination of bursting strength and bursting distension
BS EN ISO 13938-2: 1999	Textiles – Bursting properties of fabrics – Part 2: Pneumatic method for determination of bursting strength and bursting distension
BS EN ISO 15607: 2003	Specification and qualification of welding procedures for metallic materials – General rules

BS EN ISO 15609-1: 2004	Specification and qualification of welding procedures for metallic materials – Welding procedure specification – Part 1: Arc welding
BS EN ISO 15609-2: 2001	Specification and qualification of welding procedures for metallic materials – Welding procedure specification – Part 2: Gas welding
BS EN ISO 15609-5: 2011	Specification and qualification of welding procedures for metallic materials – Welding procedure specification – Part 5: Resistance welding
BS EN ISO 15614-1: 2004	Specification and qualification of welding procedures for metallic materials – Welding procedure test – Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys
British Standards and European Standards	
Standard Reference	**Title**
BS EN ISO 15614-2: 2005	Specification and qualification of welding procedures for metallic materials – Welding procedure test – Part 2: Arc welding of aluminium and its alloys
BS EN ISO 15614-12: 2014	Specification and qualification of welding procedures for metallic materials – Welding procedure test – Part 12: Spot, seam and projection welding

IEC Standards	
Standard Reference	
IEC 60051 Part 1 to 9	Direct acting indicating analogue electrical measuring instruments and their accessories
IEC 60077-1: 1999	Railway applications - Electric equipment for rolling stock - Part 1: General service conditions and general rules
IEC 60077-2: 1999	Railway applications - Electric equipment for rolling stock - Part 2: Electrotechnical components - General rules
IEC 60077-3: 2001	Railway applications - Electric equipment for rolling stock - Part 3: Electrotechnical components - Rules for d.c. circuit-breakers
IEC 60077-4: 2003	Railway applications - Electric equipment for rolling stock - Part 4: Electrotechnical components - Rules for AC circuit-breakers
IEC 60077-5: 2003	Railway applications - Electric equipment for rolling stock - Part 5: Electrotechnical components - Rules for HV fuses

IEC 60099-4: 2006	Surge arresters – Part 4: Metal-oxide surge arresters without gaps for A.C. systems
IEC 60269-1: 2006	Low Voltage Fuses – Part 1: General requirements
IEC 60269-2: 2006	Low Voltage Fuses – Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) - Examples of standardized systems of fuses A to I
IEC 60309-1: 2005	Plugs, socket-outlets and couplers for industrial purposes – Part 1 : General requirements
IEC 60322: 2001	Railway applications - Electric equipment for rolling stock - Rules for power resistors of open construction
IEC 60349-1: 2010	Electric traction - Rotating electrical machines for rail and road vehicles - Part 1: Machines other than electronic convertor-fed alternating current motors
IEC 60349-2: 2010	Electric traction - Rotating electrical machines for rail and road vehicles - Part 2: Electronic convertor-fed alternating current motors

IEC Standards	
Standard Reference	
IEC 60494-2: 2002	Railway applications - Rolling stock - Pantographs - characteristics and tests - Part 2: Pantographs for metros and light rail vehicles
IEC 60529: 2001	Specification for classification of degrees of protection provided by enclosures
IEC 60571: 2006	Electronic equipment used on rail vehicles
IEC 60623: 2001	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Vented nickel-cadmium prismatic rechargeable single cells
IEC 60811-1-1: 2001	Common test methods for insulating and sheathing materials of electric cables and optical cables Part 1-1: Methods for general application - Section 1: Measurement of thickness and overall dimensions - Tests for determining the mechanical properties
IEC 60811-1-2: 1985	Common test methods for insulating and sheathing materials of electric cables and optical cables Part 1-2: Methods for general application - Section 2: Thermal ageing methods
IEC 60811-1-3: 2001	Common test methods for insulating and sheathing materials of electric cables and optical cables Part 1-3: Methods for general application - Section 3: Methods for determining the density - Water absorption tests - Shrinkage test

IEC 60811-1-4: 1985	Common test methods for insulating and sheathing materials of electric cables and optical cables Part 1-4: Methods for general application – Section 4: Test at low temperature
IEC 60947-1: 2007	Low-voltage switchgear and controlgear - Part 1 : Circuit-breakers
IEC 60947-2: 2001	Low-voltage switchgear and controlgear - Part 2: Circuit-breakers
IEC 60990: 1999	Methods of measurement of touch-current and protective conductor current
IEC 60993: 1989	Electrolyte for vented nickel-cadmium cells
IEC 61000-4-1: 2006	Testing and measurement techniques section 1 : Overview of IEC 61000-4 series
IEC 61000-4-2: 2001	Testing and measurement techniques section 2 : Electrostatic discharge immunity test
IEC 61000-4-3: 2006	Testing and measurement techniques section 3 : Radiated, radio-frequency, electromagnetic field immunity test
IEC 61000-4-4: 2004	Testing and measurement techniques section 4 : Electrical fast transient / burst immunity test
IEC 61000-4-5: 2005	Testing and measurement techniques section 5 : Surge immunity test
IEC Standards	
Standard Reference	
IEC 61000-4-6: 2006	Testing and measurement techniques section 6 : Immunity to conducted disturbances, induced by radio frequency fields
IEC 61000-4-8: 2001	Testing and measurement techniques section 8 : Power frequency magnetic field immunity test
IEC 61082-1: 2006	Preparation of documents used in electrotechnology – Part 1: Rules
IEC 61133: 2006	Railway applications - rolling stock - testing of rolling stock on completion of construction and before entry into service
IEC 61287-1: 2005	Power converters installed on board rolling stock. Part 1 : Characteristic and test methods
IEC 61287-2: 2001	Power converters installed on board railway rolling stock Part 2: Additional technical information
IEC 61377-1: 2006	Electric traction - Rolling stock - Combined testing of inverter - Fed alternating current motors and their control system

IEC/TR 61508-0: 2005	Functional safety of electrical/ electronic/ programmable electronic safety related systems – Part 0: Functional safety and IEC 61508
IEC 61508-1: 1998	Functional safety of electrical/ electronic/ programmable electronic safety related systems – Part 1: General requirements
IEC 61508-2: 2000	Functional safety of electrical/ electronic/ programmable electronic safety related systems – Part 2: Requirements for electrical/ electronic/ programmable electronic safety-related systems
IEC 61508-3: 1998	Functional safety of electrical/ electronic/ programmable electronic safety related systems – Part 3: Software requirements
IEC 61508-4: 1998	Functional safety of electrical/ electronic/ programmable electronic safety related systems – Part 4: Definitions and abbreviations
IEC 61508-5: 1998	Functional safety of electrical/ electronic/ programmable electronic safety related systems – Part 5: Examples of methods for the determination of safety integrity levels
IEC 61508-6: 2000	Functional safety of electrical/ electronic/ programmable electronic safety related systems – Part 6: Guidelines on the application of IEC 61508-2 and IEC 61508-3
IEC 61508-7: 2000	Functional safety of electrical/ electronic/ programmable electronic safety related systems – Part 7: Overview of techniques and measures

ISO Standards

Standard Reference	
ISO 5660: Pt 1: 2002	Reaction to fire tests - Heat release, smoke production and mass loss rate Part 1: Heat release rate (cone calorimeter method)
ISO 7183: 1986	Compressed air dryers - Specifications and testing
ISO 7183: Pt 2: 1996	Compressed air dryers – Part 2: Performance ratings
ISO 7498: Pt 1: 1996	Information technology - Open systems interconnection, basic reference model : The basic model
ISO 9000: All parts	Quality management and quality assurance standards
ISO 9001: 2000	Quality management systems - Requirements
ISO 9646: Pt 1: 1996	Information technology-open systems interconnectionconformance testing methodology and framework part 1. general concepts
ISO 14001: 2004	Environmental management systems - specification with guidance for use

ISO 14004: 2004	Environmental management systems - general guidelines on principles, systems and supporting techniques
ISO 90003: 2004	Software engineering - guidelines for the application of iso 9001:2000 to computer software

ANSI Standards	
Standard Reference	
ANSI S12.10: 1985	Methods for the measurement and designation of noise emitted by computer and business equipment

RIA Standards	
Standard Reference	
RIA 22: 1990	Technical guide on EMC for electronic equipment used on traction and rolling stock

DIN Standards	
Standard Reference	
DIN 18516-4: 1990	Back-ventilated, non-loadbearing, external enclosures of buildings, made from tempered safety glass panels – Requirements and testing

French Standards	
Standard Reference	
NF X 70-100: 1986	Fire Tests - Analysis of pyrolysis and combustion gases - Tube furnace method
French Standards	
Standard Reference	
NF F 72010: 1991	Point to point bi-directional serial asynchronous transmission procedures
NF C 32-021: 1985	Test methods for cables used under special conditions
NF C 93-522: 1982	Electrical wires for wrapped connections

UIC Codes	
Standard Reference	
UIC ORE B106: 1971 RP2 1980	Loadings of coach bodies and their components
UIC 515: 1984	Coaches running gear (1)
UIC 541-05: 2005	Brakes - Regulations concerning the construction of the various brake components: wheel slip prevention
UIC leaflet no. 861-3: 1969	Standard profiles for point rails adapted to the UIC 54kg/m and 60kg/m rail profiles

Miscellaneous	
Standard Reference	
ASTM D4060 - 2007	Standard test method for abrasion resistance of organic coating by the Taber Abraser
BR 566: 1989 BRB	Specification for high impact resistant windows
GM/RT 2483: 2004	Visibility requirements for trains
NSF 110: 1995	Environmental management systems - guiding principles and generic requirements
EMAS	Eco-management & Audit Scheme
ICC	International chamber of commerce sustainable development principles
GEMI	Global Environmental Management
E1A RS-232C: 1969	Electronic Industries Association Standard
E1A RS-485: 1983	Electronic Industries Association Standard
MIL-STD-471	Maintainability verification / demonstration / evaluation
MIL-STD-1472	Department of Defense Design Criteria Standard: Human Engineering
MIL-HDBK-189	Military Handbook Reliability Growth Management
MIL-HDBK-759	Handbook for Human Engineering Design Guidelines
MIL-HDBK-781	Handbook for Raliability Test Methods, Plans, and Environments for Engineering, Development Qualification and Production
MOD 00-25: Part 11	Design for maintainability
CCITT-Recommendation K.18	Calculation of voltage induced into telecommunication lines from radio station broadcasts and methods of reducing interference
CCITT-Recommendation K.24	Method for measuring radio-frequency induced noise on telecommunication pairs

CCITT-Recommendation K.25	Protection of optical fibre cables - series K
CCITT-Recommendation K.32	Immunity requirements and test methods for electrostatic discharge to telecommunication equipment - Generic EMC recommendation
Miscellaneous	
Standard Reference	
CCITT-Recommendation K.33	Limits for people safety related to coupling into telecommunications system form A.C. electric power and A.C. electrified railway installations in fault conditions
CCITT-Recommendation K.37	High frequency EMC mitigation techniques for telecommunication installations (basic EMC recommendation)
CCITT-Recommendation K.38	Radiated emission test procedure for physically large systems

3 Information on Standards

The information sources for the above standards are listed as below for reference:

3.1 European Standards, British Standards, IEC Standards, ISO Standards, DIN Standards

Customer Services
389 Chiswick High Road
London
W4 4AL

Tel : 0181 996 7000 Fax : 0181 996 7001

3.2 ANSI Standards

The Institute of Electrical and Electronics Engineers, Inc
345 East 47th Street,
New York,
NY 10017

3.3 RIA Standards, BRB Standards

Railway Industry Association
6 Buckingham Gate
London
SW1E 6JP

Tel : 071 834 1426 Fax : 071 821 1640

3.4 French Standards

Bureau de Normalisation des Cheminsde Fer (BNF) et par L'association de Normalisation (afnor) tour Europe
Paris CEDEX 7 La Defense
France

Tel : (1) 42 91 55 55

3.5 UIC Codes

International Union of Railways
16, rue Jean Rey
F-75015 Paris

Tel : (33.1) 44 49 20 20 Fax : (33.1) 44 49 20 29

3.6 MIL Standards, MOD Standards

Ministry of Defence
Room 5138
Kentigern House
65 Brown Street
Glasgow G2 8EX
England

Tel : 041 248 7890 / 041 224 7890

APPENDIX C

SCHEDULE OF TESTS

August 2015

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APPENDIX C SCHEDULE OF TESTS

1 Introduction

2 Works Tests

3 Commissioning (Tests in Hong Kong)

4 Tests on Completion

5 Integrated Testing

Table App-C-1 Table for Summary of Work Tests

Table App-C-2 Table for Summary of Commissioning Tests

Table App-C-3 Table for Summary of Tests on Completion

Table App-C-4 Table for Summary of Integrated Testing

APPENDIX C SCHEDULE OF TESTS

1 Introduction

1.1 According to PS 22, all tests specified in this Appendix shall constitute the Works Tests, Commissioning (Tests in Hong Kong), Tests on Completion and Integrated Testing of the trains as the minimum testing requirements which are acceptable to the Engineer.

1.2 The Contractor may offer alternative testing proposals which are equivalent to or better than those herein, and which the Contractor shall justify to the satisfaction of the Engineer.

1.3 The tests related to the train level shall follow the IEC 61133: 2006 where applicable.

1.4 The tests related to the major system/component level tests shall follow the specified testing requirements of this Appendix and the approved test specifications prepared by the Contractor.

1.5 The tests related to the other system/component level tests which are not mentioned in this Appendix, shall refer to the approved supplier's recommendation provided by the Contractor, individual PS or Rolling Stock Standards where applicable.

2 Works Tests

2.1 Car Body Structure and Exterior

2.1.1 Car Body Structure

(a) The Contractor shall undertake a series of Type Tests to demonstrate that the requirements of PS 6.4 for a service life as defined in PS 4.5.5 have been achieved. The tests shall include, but not be limited to, all the load cases specified in PS 4.5.4.

(b) A preliminary Type Test report which shall detail general stress levels, and shall highlight any areas of excessive stress and explain what corrective action is proposed, shall be submitted for Approval.

(c) Following this corrective action retest shall be required and a final report shall be submitted for Approval.

(d) This report shall contain a full commentary on the test results, together with a comparison of the measured stresses against the stresses

predicted by the Finite Element Analysis (FEA). In all areas where the measured stress differs from the stress predicted by FEA by more than 10% of the predicted value, a detailed explanation for the difference shall be given.

2.1.2 Train Sway Test

The Contractor shall submit for Approval and carry out a static vehicle sway test to verify his method for calculation of the Kinematic Envelope and to confirm that the requirements of the Kinematic Envelope given in PS 5.1 have been achieved.

2.1.3 Water Resistance Test

The Contractor shall submit for Approval and carry out tests to ensure that all trains will remain water tight under all operating conditions. The testing shall confirm that there is no penetration of water into passenger, train operator or equipment areas, or into any area where the presence of water or cleaning fluid may cause malfunction or in any way adversely affect any part of the train.

2.1.4 Window Test

The Contractor shall submit for Approval a procedure and carry out tests to ensure that all windows and glazing meet the requirements of PS 6.11.

2.1.5 Weighing Test

The Contractor shall carry out weighing tests to demonstrate compliance on axle load requirement (refer to PS 5.5) and train weight requirement (refer to PS 5.6).

2.2 Car Body Interior

2.2.1 Ergonomic Trials

The Contractor shall submit for Approval a procedure and carry out ergonomic trials to optimise the design of the saloon interior facilities including the seat profile, passenger retentions, passenger alarm device, passenger information display system and interior maintenance access panels.

2.2.2 Strength Test of Interior Panels, Seats, Passenger Retentions, Straphangers, Draught-screens and PA emergency Handles

The Contractor shall conduct tests to verify the strength requirements as specified in PS 7.5, 7.6.3, 7.7.1, 7.7.7, 7.7.8 and 7.11.4 have been achieved.

2.2.3 Flooring Tests

(a) The floor covering in combination with sub floor shall be tested to RS/C6014/08.

(b) The Contractor shall submit for Approval a full abrasion test programme and carry out tests to confirm that the floor covering show no signs of wear and shall remain colour fast to BS EN ISO 105: Part A01: 1996 test conditions for the specified service life.

2.2.4 Lighting Tests

(a) All light fittings shall be tested to IP 54, BS EN 60529: 1992.

(b) The lighting levels of the normal and emergency lightings shall be tested to confirm that the requirements in PS 7.9.3 have been achieved.

2.2.5 Saloon Smoke Detection Test

The Contractor shall submit for Approval a procedure and carry out tests to demonstrate saloon smoke detection requirements in PS 7.18 have been achieved.

2.3 Cab Facilities and Layout

2.3.1 Ergonomic Trials

The Contractor shall submit for Approval a procedure and carry out ergonomic trials on the foamcore mock-up and the full-scale engineering mock-up with an aim:

(a) to optimise the design of the cab facilities including the driver/auxiliary seats, cab controls, detrainment device and interior maintenance access panels.

(b) to ensure the cab pictograms are fit for purpose and require minimum amount of training.

2.3.2 Panels and Controls

(a) All panels and controls shall be tested to IP 65, BS EN 60529: 1992.

(b) The Contractor shall carry out tests to confirm that the pictograms and legends on the panels, indicators and pushbuttons shall remain colour fast and legible for the whole service life.

2.3.3 Seat Strength and Vibration Type Tests

(a) The Contractor shall perform hardness tests to BS EN ISO 2439: 2001 to establish acceptable values for the hardness of the seat headrest, cushion, squab and lumbar support of the production seat.

(b) The strength of the driver and auxiliary seats shall be tested to UIC ORE B106, Passenger Coaches: 1971 RP2 1980 and BS EN 61373: 2013.

(c) The Contractor shall submit for Approval a procedure and carry out tests to verify the seat life. This shall include a Martindale rub test to BS EN ISO 12947: 1999.

(d) The burst strength of the upholstery shall be tested to BS EN ISO 13938: 1999 and a breaking load to BS EN ISO 13934: Part 1: 1999.

(e) Upholstery shall be tested to confirm that it remains colour fast to BS EN ISO 105: Part A01: 1996 test conditions for the specified service life.

2.3.4 Lighting Tests

The lighting levels of the main, reading and detrainment lights shall be tested to confirm that the requirements in PS 8.14 have been achieved.

2.3.5 Switchgear electrical and mechanical endurance tests to IEC 60077.

2.4 Operation and Control

2.4.1 Test for correct operation to IEC 61133 clause 5.7.

2.4.2 Checks for the prevention of accidents to IEC 61133 clause 5.13.

2.4.3 Test for speed regulation and over speed protection systems to IEC 61133 clause 6.6.

2.5 Train Management System

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/01.

2.6 Traction and Braking Equipment

2.6.1 Traction Equipment

(a) A complete system test is required to be performed on the traction package in order to demonstrate compatibility of all train systems.

(b) The tests shall be conducted using simulated running conditions and as a minimum shall be conducted on one complete traction equipment including all line input protection devices and filters, traction electronics both power and control, traction motors and auxiliary equipment.

(c) The test shall also include all on board and wayside equipment and systems and shall demonstrate that the requirements of the design, to satisfy the requirements of the PS, have been complied with.

(d) At the appropriate stage some of the results obtained shall be used in the energy consumption calculations as detailed in Appendix M Clause 4.

(e) The Contractor shall carry out combined tests on the traction equipment according to IEC 61377-1: 2006.

(f) A site verification test on energy consumption shall be carried out in TWL between KWF to KWH stations. The train shall be driven under the following conditions:

(i) Tare load
(ii) All out running with train motors operating at full power to the maximum designed speed, and running at the maximum designed speed at all times as far as it can be achieved

An energy storage device with 500kVA capacity will be installed in TWD which will be connected to the traction substation responsible for absorbing the regenerative braking energy from the train.

2.6.2 Traction Motors

(a) General

(i) All tests shall be in accordance with IEC 60349-2: 2002. The first two machines of each type of each separate contract, and every fortieth of the remainder, shall be type tested. Routine tests shall be carried out on every machine.

(ii) A characteristic test at 1.5 times the rated voltage as defined in IEC 60349-2: 2002 shall be carried out.

(b) Test Through Gearing

A test shall be carried out with the gear drive assembled to a motor and dummy axle for the purpose of demonstrating that noise and lubrication arrangements are to the satisfaction of the Engineer.

(c) Impedance and Inductance Measurement

The total motor resistance and inductance shall be determined at the propulsion chopper operating frequencies.

2.6.3 Braking Resistors

All braking resistors shall be tested to IEC 60322: 2001.

2.6.4 Transformers and Reactors

All transformers and reactors shall be tested to BS EN 60310: 2004.

2.6.5 Power Converters

The power converters shall be tested to IEC 61287-1:2005 and IEC 61287-2: 2001.

2.6.6 Miscellaneous Electric Traction Equipment

All miscellaneous electric traction equipment shall be tested to IEC 60077.

2.6.7 Brake Equipment

(a) The Contractor shall submit for Approval a dynamometer test to indicate the adequacy of the bogie mounted friction brake equipment.

(b) The tests shall demonstrate that the requirements of PS 11.9 have been satisfied.

2.6.8 Friction Brake Units

Type tests shall comprise:-

(a) Functional checks such as working stroke, slack adjuster operation and action of parking brake.

(b) Recording of brake force against cylinder pressure over the working range.

(c) Plotting of curves of brake force against pressure in all conditions of operation of main cylinder and parking brake.

(d) Carrying out of a vibration test as defined in IEC 60077.

2.6.9 Brake Control Equipment

Individual items of electro-pneumatic equipment shall be type tested as follows:

(a) Mechanical Operation and Endurance

As defined in IEC 60077.

(b) Vibration and Shock

As defined in IEC 60077.

(c) Air Tightness

Generally as IEC 60077 except as varied by particular requirements specified in the Contractor's design specification.

(d) Electrical Tests

These shall be generally in accordance with IEC 60077 and shall include checking operation at lowest permitted voltage at 0°C ambient.

(e) Characteristic Tests

Each item of equipment having a pilot or transducing function, shall be tested to confirm compliance with the Contractor's design data, and oscillogram shall be produced in support.

2.6.10 Wheel Slide Protection System

The wheel slide protection system shall be tested to UIC 541-05: 2005.

2.7 Bogie and Suspension

2.7.1 Bogie Static Test

(a) The Contractor shall carry out a static proof test on a strain gauged bogie to confirm that all the requirements of PS 12.9.3 have been achieved.

(b) Strain gauges shall be placed in any area where the stress level predicted by FEA is greater than 80% of the yield stress or 0.2% proof stress of the material, and where the predicted damage over the life of the bogie computed in accordance with PS 12.9.3(b) is greater than 0.7. The positioning of strain gauges shall be submitted for Approval.

(c) The reporting on the proof test shall include, but not be limited to, a comparison between the stresses measured during the proof test with those predicted by the FEA. In all areas where the measured stress differs from the stress predicted by FEA by more than 10% of the predicted value, a detailed explanation for the difference shall be given.

2.7.2 Bogie Dynamic Test

(a) The Contractor shall carry out a dynamic test on the bogie to demonstrate that the requirements of PS 12.9.3 have been achieved.

(b) Strain gauges shall be placed in all areas where the cumulative fatigue damage, evaluated in accordance with PS 12.9.3(b) is greater than 0.7.

(c) The tests shall be carried out over a representative length of track in both directions at the design speed profile and shall cover all loading conditions from tare to fully laden.

(d) The strain gauge signals collected during the testing shall be counted using the rainflow method, or other counting technique and shall be submitted for Approval.

(e) The results shall then be used in conjunction with the fully laden passenger mass given in PS 4.5.4 to assess the fatigue damage over the life of the bogie.

(f) The bogie shall be assumed to travel 15 million km throughout its life.

2.7.3 Wheel Off-loading Test

The Contractor shall carry out tests to confirm compliance with the wheel off-loading performance specified in PS 12.5.

2.7.4 Bogie Rotational Resistance Test

The Contractor shall carry out a test to measure the rotational resistance of the bogies to confirm that the requirements of PS 12.6 have been achieved.

2.7.5 Train Ride Test

(a) The Contractor shall carry out tests to demonstrate that the stability and ride quality requirements of PS 12.2 have been achieved.

(b) Additionally the train shall be ride tested with the air suspension deflated to demonstrate compliance with PS 12.11.2.

(c) The tests shall be carried out on the Urban Lines in both directions.

2.7.6 Axlebox Bearing Test

The Contractor shall carry out bearing rig performance test and sealing test in accordance with BS EN 12082: 1998 to demonstrate compliance with PS 12.10.6.

2.7.7 Bogie Frame Fatigue Test

The bogie frame shall be subjected to a fatigue test in accordance with UIC 515.

2.7.8 Bogie Suspension Systems Test

(a) The Contractor shall carry out design verification type tests to determine suspension characteristics on various bogie suspension systems including primary suspension, secondary suspension, traction centre system and anti roll bar system to verify his method for calculation of the Kinematic Envelope, bogie stability, ride quality, overturning, wheel off-loading and bogie rotational resistance.

(b) The Contractor shall carry out endurance life tests on various bogie suspension rubber components to demonstrate compliance with PS 12.1.1.

2.8 Pneumatics and Air Distribution Systems

The Contractor shall carry out compressor capacity, duty cycle, charge up time, air dryer test, leakage test, air reservoirs test, Main Reservoir Pipe isolation cock venting time, shock and vibration test to satisfy the requirements of PS 13.

2.9 Gangways and Couplers

2.9.1 Gangways

The Contractor shall carry out Type Tests, including but not be limited to the following, to demonstrate that the gangways are capable of withstanding the movements, loadings, deflections and aerodynamic effects in accordance with the approved Design Data submitted to satisfy the requirements of PS 14.

(a) Strength Test

(b) Water Tightness Test

(c) Impact Test

(d) Endurance Life Test

2.9.2 Couplers

The Contractor shall carry out Type Tests to demonstrate that the couplers are capable of withstanding the movements, loadings and deflections, in accordance with the approved Design Data submitted to satisfy the requirements of PS 14.

2.10 Air Conditioning and Ventilation

2.10.1 Mechanical Endurance, Vibration and Shock Type Tests

With the air conditioning unit mounted in a manner fully representative of the on-car arrangement including any flexible or resilient mounting, the unit shall be subjected to the following tests:

(a) The test shall comprise a minimum of 20 000 start-run-stop cycles with a suitable cycle duration and time interval between each cycle. The timing shall be submitted for Approval.

(b) Routine maintenance shall be carried out at intervals equivalent to the maintenance intervals as defined in PS 26, in line with the specified maintenance instructions. A record of all maintenance activities shall be kept for inspection.

(c) A full report of all failures occurring during testing shall be submitted to the Engineer, who may require that a modification be carried out to rectify any defects thus encountered.

(d) Following such a modification it may be necessary to repeat the endurance test at the discretion of the Engineer and shall be at the cost of the Contractor.

(e) One prototype set of equipment type, fully representative of the production equipment, shall be subjected to vibration and shock tests to BS EN 61373: 2013.

(f) Any module or equipment frame used in the test shall not subsequently be used for a train supplied under this or any subsequent contract.

2.10.2 Pressure Test

Pressure tests shall be carried out before and after the vibration and shock tests of the air conditioning unit for any leakage by an approved method.

2.10.3 Equipment Base Performance Test

(a) The Contractor shall provide facilities to enable an air-conditioning unit to be artificially provided with sensible and latent thermal load so that it may operate at full capacity.

(b) The test shall also include the measurement of air flow to demonstrate the air conditioning unit delivers the specified air flow rates.

(c) Suitable instrumentation shall be provided to permit results to be checked against approved Design Data.

(d) The motor temperature rise shall not exceed 90% of that permitted according to IEC 60349-2: 2002, when tested continuously under the full load conditions.

(e) The Type Test shall also include measurements of equipment noise to meet the equipment noise specifications in accordance with RS/C6014/13.

(f) The Type Test shall also include measurements of equipment vibration levels to meet the requirements of BS EN 61373: 2013.

(g) The Contractor shall carry out the Routine Tests to certify every air conditioning unit achieves the specified cooling capacity.

2.10.4 Vehicle Base System Performance Test

A Type Test on vehicle base shall be carried out with the carbody equipped with all interior finish and underframe mounted equipment

representative to the production vehicle to demonstrate the effectiveness of the equipment in meeting the requirements of the PS. The tests shall include, but not be limited to, the following:

(a) Air Flow Tests

Tests shall be carried out to measure the air flows at the outside air intake, return air inlet and exhaust air outlet under all modes of air conditioning operation to achieve the specified air flow requirements in PS 15.

(b) Air Distribution

Tests shall be carried out to verify the requirements of PS 15.6 for evenly distribution of supply air. The static pressure head inside the car shall be measured and recorded under all modes of air conditioning operation.

(c) Air Conditioning

Tests shall be carried to demonstrate the capability of the air conditioning system to maintain the required saloon conditions as specified in PS 15. This test shall include the artificial generation of sensible and latent heat load inside the saloon and the required ambient conditions outside the car.

2.11 Doors

2.11.1 Endurance Tests on Saloon and Cab Doors

(a) An endurance test shall be performed on two sets of saloon door leaves and their operating mechanisms (refer to PS 16.7) to

(i) identify, analyse and rectify design problems and

(ii) to demonstrate compliance with the reliability target as apportioned from the overall train reliability target (refer to PS 25.5.9 and PS 25.5.10).

The test shall be carried out for a minimum of 500,000 complete open/close cycles for each door set.

(b) Similarly, an endurance test shall be performed on two sets of cab door leaves and their operating mechanisms (refer to PS 16.7) for a minimum of 100,000 complete open/close cycles for each door set.

(c) The endurance test for the saloon door mechanisms shall be designed to simulate a door obstruction every 1,000 cycles.

(d) Routine maintenance shall be carried out at intervals equivalent to the maintenance intervals defined in PS 26, in line with the specified maintenance instructions. A record of all maintenance activities shall be kept.

(e) A record of the door leaf velocity profile shall be taken, at the beginning and end of the test and any maintenance activities, to compare with the profile pre-programmed in the door control unit. Any deviations discovered shall be reported.

(f) The Contractor shall produce a full report of all failures occurring during testing and shall calculate the reliability together with the associated confidence level of the door mechanisms at the completion of the test.

(g) The Contractor shall propose design modifications for Approval should the agreed reliability target has not been met. The Engineer may require that a modification be carried out to rectify any defects encountered during the test. The Engineer may, at his discretion, request the undertaking of a further endurance test sequence to validate the design changes undertaken at the Contractor's cost.

(h) Upon completion of the endurance test, all parts of the doors and their actuators shall be dismantled for inspection by the Engineer. The door components shall be rigorously examined for incipient failure and wear and a report submitted on the condition of all parts. Any parts exhibiting such signs shall be subject to redesign at the discretion of the Engineer following which the endurance test may be required to be repeated at the Contractor's cost.

(i) Any module or equipment used in these tests shall not subsequently be used for a train supplied under this or any subsequent contract.

2.11.2 Mechanical Strength Test

The Contractor shall undertake tests to demonstrate the structural strength and stability of the door leaves and suspensions and their deflection when loaded (refer to PS 16.2.5).

2.11.3 Vibration Tests

Vibration tests to BS EN 61373: 2013 shall be carried out on door leaves, suspensions and operating mechanisms of the saloon door, cab door and the emergency detrainment door systems.

2.11.4 Emergency Detrainment Device Type Test

(a) The Contractor shall perform a Type Test to demonstrate, to the satisfaction of the Engineer, that the detrainment device is fit for purpose and that it satisfies the requirements specified in PS 8.16 for the two basic modes of operation, namely, train-to-train detrainment and train-to-track detrainment.

(b) Load Test

A static load test (refer to PS 8.16.6) shall be performed at fully deployed condition without permanent deformation. The test shall simulate the correct heights relative to the car floor level and the door resting on one rail when the car being stopped on a curve of 300m radius. The device shall continue to function within its prescribed operating parameters on completion of the test.

(c) Endurance Test

The emergency door shall be tested for endurance with a total of 100 cycles for ramp mode and re-stowed back to normal operative state, and 100 cycles for sliding to full open and re-close to normal operative state. The device shall be operated within the specified deployment and stowage time (refer to PS 8.16) throughout the test. The Contractor shall calculate the reliability and the associated confidence level of the detrainment door mechanism.

(d) Any failure of the tests, the Contractor shall make necessary rectification through readjustment or design changes to the satisfaction of the Engineer. The Engineer may, at his discretion, request the undertaking of further test sequence to validate the design changes undertaken at the Contractor's cost.

2.12 Auxiliary Electrical Supply

2.12.1 A complete system test is required to be performed on the auxiliary supply system in order to demonstrate compatibility of all train systems.

2.12.2 The tests shall be conducted using simulated running conditions and as a minimum shall be conducted on one complete auxiliary equipment including all line input protection devices and filters, control electronics both power and control, compressor motors and auxiliary equipment.

2.12.3 The test shall also include all emergency equipment and systems and shall demonstrate that the emergency requirements have been complied with.

2.12.4 The Contractor shall carry out tests on the power converters according to IEC 61287-1: 2005.

2.12.5 Auxiliary Machines (other than compressor sets)

(a) General Remarks

(i) All machinery shall be tested to IEC 60349 insofar as applicable, or if test specifications exist and are already agreed between the Engineer and the Contractor then these tests shall be to these specifications unless otherwise agreed.

(ii) For those auxiliary drives where the actual loading conditions cannot be accurately calculated in advance or conveniently simulated at the manufacturers' work, for example, fans and pumps, the electrical driving motors chosen for the application shall be tested to a declared continuous rating which shall subsequently be verified to be adequate by prototype tests on the train. Similarly, the fan or pump chosen shall be type-tested at the manufacturers' works to prove the design characteristics and their suitability for the application subsequently proved by tests on the train. In the case of components which belong to the manufacturers' standard range, test certificates referring to published performance data may be acceptable at the Engineer's discretion.

(iii) It follows from the preceding paragraph that the appliance and its driving motor need not be tested together as one unit although this method is preferred. If tested separately, due regard must be given to possible interaction between components after assembly, particularly as regards vibration. However, when integral construction is adopted for the appliance and its electric driving motor it shall be tested as a complete unit.

(b) Low Voltage Starting Tests (AC machines only)

It shall be demonstrated that the motor at a starting temperature of $0^{o}C$ and with a load having similar torque/speed characteristic to that with which the motor will operate in service, will start and run up to normal speed when supplied at a voltage corresponding to the lowest specified voltage and frequency.

(c) No Load Run (AC machines only)

This run shall be made at rated voltage and the stator current, watts and the speed shall be recorded.

(d) Locked Rotor Test (AC machines only)

This test shall be made at rated stator current and the terminal voltage and watts shall be recorded.

(e) Compressor and Motor Set

(i) These shall be in accordance with IEC 60349 or if test specifications exist and are already agreed between the Engineer and Contractor then these tests shall be to these specifications.

(ii) Oil consumption tests on two sets selected by the Engineer shall also be required.

2.12.6 Battery Charger

The equipment shall be supplied at nominal supply voltage and a load shall be applied consisting of:

(i) Maximum normal auxiliary load, for example, lighting and control.

(ii) A discharged battery of the type to be used with the charger, when supplied by an auxiliary inverter, also of the type to be used with the charger.

(iii) The test shall be continued until maximum temperature conditions are reached.

(iv) Tests shall be carried out to determine the characteristics of the charger at minimum, nominal and maximum input voltages over the full range of load.

(v) Measurements shall be made of input voltage, input current, input power, output voltage and output current.

(vi) The measurements shall include the conditions with the output terminals open-circuited.

(vii) Cathode ray oscillogram of the output quantities shall be made for selected conditions of supply and load. These shall include

examples of the transient response to switching the supply and the load on and off.

Rating and characteristic type tests shall be made on a completely assembled charger with all covers in position.

2.12.7 Miscellaneous Auxiliary Equipment

All miscellaneous auxiliary equipment shall be tested to IEC 60077.

2.13 Communications Equipment

2.13.1 General

The cars, Train Units and trains shall be tested generally in accordance with the requirements of IEC 61133: 2006 to an approved specification. Unless agreed otherwise the tests required by the approved specification shall be carried out at the Contractor's works, and may be performed either on individual cars, units or trains as appropriate.

2.13.2 Trainborne Radio

(a) The Contractor shall agree with the Engineer, a range of tests as recommended by the Named Supplier to be conducted, prior to the dispatch of any equipment from the Named Supplier's works. Visual, electrical and functional tests shall be conducted for each individual element (refer to Appendix I Annex 4 Clause 2.2) and the assembled system / equipment.

(b) When the equipment is delivered to the Contractor's works, the Contractor shall agree with the Engineer, a range of tests as recommended by the Named Supplier to be conducted, prior to the installation of the equipment on train.

(c) The Contractor shall conduct commissioning tests to demonstrate that all the equipment have been correctly installed and adjusted and that the system fulfils all the requirements as stipulated in this Specification.

(d) The trainborne radio shall be re-programmed to satisfy the frequency plan for the Urban Lines. The Contractor shall undertake tests to demonstrate full functional compliance of the trainborne radio for the Urban Lines, Tseung Kwan O Line Extension and West Island Line.

2.13.3 In-Cab CCTV

(a) The Contractor shall agree with the Engineer, a range of tests as recommended by the Named Supplier to be conducted, prior to the dispatch of any equipment from the Named Supplier's works. Visual, electrical and functional tests shall be conducted for each individual element (refer to Appendix I Annex 4 clause 3.2) and the assembled system / equipment.

(b) When the equipment is delivered to the Contractor's works, the Contractor shall agree with the Engineer, a range of tests as recommended by the Named Supplier to be conducted, prior to the installation of the equipment on train.

(c) The Contractor shall conduct commissioning tests to demonstrate that all the equipment have been correctly installed and adjusted and that the system fulfils all the requirements as stipulated in this Specification

(d) The Contractor shall conduct commissioning tests to demonstrate that the TMS interfaces and trainborne video display interfaces fulfil all the requirements as stipulated in PS 18.3 and Appendix I Annex 4 Clause 6.

2.13.4 DVAS & PA

(a) The Contractor shall undertake tests for DVAS & PA to demonstrate full compliance of PS 18.4 and the tests shall cover Manual Broadcasting, Radio Broadcasting, Broadcasting of pre-recorded announcements initiated by the train operator, Broadcasting of pre-recorded announcements based on real time information received via the interface with TMS, Cab-to-Cab Intercom and Passenger Alarm System.

(b) The Contractor shall agree with the Engineer, a range of tests to be conducted, prior to the installation of the equipment on train. Visual, electrical and functional tests shall be conducted for each individual element (refer to PS 18.4.2) and the assembled system / equipment.

(c) The Contractor shall conduct commissioning tests to demonstrate that all the equipment have been correctly installed and adjusted and that the system fulfils all the requirements as stipulated in this Specification.

2.13.5 EIDS Communication Equipment

(a) Wireless LAN Transmission Link

(i) The Contractor shall agree with the Engineer, a range of tests as recommended by the Employer to be conducted, prior to the

dispatch of any equipment from the Employer. Visual, electrical and functional tests shall be conducted for each individual element (refer to Appendix I Annex 4 Clause 4.5) and the assembled system / equipment.

(ii) When the equipment is delivered to the Contractor's works, the Contractor shall agree with the Engineer, a range of tests as recommended by the Employer to be conducted, prior to the installation of the equipment on train.

(iii) The Contractor shall conduct commissioning tests to demonstrate that all the equipment have been correctly installed and adjusted and that the system fulfils all the requirements as stipulated in this Specification.

(b) GSM Link

(i) The Contractor shall agree with the Engineer, a range of tests as recommended by the Employer to be conducted, prior to the dispatch of any equipment from the Employer. Functional tests shall be conducted for each individual element (refer to Appendix I Annex 4 clause 4.5) and the assembled system / equipment.

(ii) Not used.

(iii) Not used.

(c) Train Network

(i) The Contractor shall agree with the Engineer, a range of tests as recommended by the Employer to be conducted, prior to the dispatch of any equipment from the Employer. Visual, electrical and functional tests shall be conducted for each individual element (refer to Appendix I Annex 4 Clause 4.5) and the assembled system / equipment.

(ii) When the equipment is delivered to the Contractor's works, the Contractor shall agree with the Engineer, a range of tests as recommended by the Employer to be conducted, prior to the installation of the equipment on train.

(iii) The Contractor shall conduct commissioning tests to demonstrate that all the equipment have been correctly installed and adjusted and that the system fulfils all the requirements as stipulated in this Specification.

(d) EID Panels

The Contractor shall conduct commissioning tests to demonstrate that the requirements of PS 18.5 have been satisfied.

2.13.6 In-Saloon CCTV

The Contractor shall agree with the Engineer, a range of tests to be conducted to demonstrate that the requirements of PS 18.7 and Appendix I Annex 4 Clauses 6 and 7 have been satisfied.

2.13.7 Provision for Public WiFi Access

The Contractor shall agree with the Engineer, a range of tests to be conducted to demonstrate that the provisional requirements of PS 18.8 have been satisfied.

2.13.8 Dynamic Route Map

(a) The Contractor shall undertake tests for DRM to demonstrate full compliance of PS 10.4 and the tests shall cover route information, scheduled playback, content update, system status reporting, display control, data transmission, message broadcasting and OCC live messages broadcasting via the interface with TMS, DVAS & PA, GSM Modem Assemblies and Doors.

(b) The Contractor shall agree with the Engineer, a range of tests to be conducted, prior to the installation of the equipment on train. Visual, electrical and functional tests shall be conducted for each individual element and the assembled system / equipment.

(c) The Contractor shall conduct commissioning tests to demonstrate that all the equipment have been correctly installed and adjusted and that the system fulfils all the requirements as stipulated in this Specification.

(d) GSM Link

(i) The Contractor shall agree with the Engineer, a range of tests to be conducted, prior to the installation of the equipment on train. Visual, electrical and functional tests shall be conducted for each individual element (refer to Appendix I Annex 9 clause 2.2.2) and the assembled system / equipment.

(ii) Not used.

(iii) The Contractor shall conduct commissioning tests to demonstrate that all the equipment have been correctly installed and adjusted and that the system fulfils all the requirements as stipulated in this Specification.

2.13.9 Door Chime System

(a) The Contractor shall agree with the Engineer, a range of tests as recommended by the Employer to be conducted, prior to the dispatch of any equipment from the Employer. Visual, electrical and functional tests shall be conducted for each individual element (refer to Appendix I Annex 4 Clause 5) and the assembled system / equipment.

(b) When the equipment is delivered to the Contractor's works, the Contractor shall agree with the Engineer, a range of tests as recommended by the Employer to be conducted, prior to the installation of the equipment on train.

(c) The Contractor shall conduct commissioning tests to demonstrate that all the equipment have been correctly installed and adjusted and that the system fulfils all the requirements as stipulated in this Specification.

2.13.10 RFID for Trainborne Radio

(d) The Contractor shall agree with the Engineer, a range of tests as recommended by the Named Supplier to be conducted, prior to the dispatch of any equipment from the Named Supplier’s works. Visual, electrical and functional tests shall be conducted for each individual element (refer to Appendix I Annex 4 Clause 8) and the assembled system / equipment.

(e) When the equipment is delivered to the Contractor's works, the Contractor shall agree with the Engineer, a range of tests as recommended by the Named Supplier to be conducted, prior to the installation of the equipment on train.

(f) The Contractor shall conduct commissioning tests to demonstrate that all the equipment have been correctly installed and adjusted and that the system fulfils all the requirements as stipulated in this Specification.

2.13.11 RFID Axle Box Temperature Detection System

(a) The Contractor shall agree with the Engineer, a range of tests as recommended by the Named Supplier to be conducted, prior to the dispatch of any equipment from the Named Supplier's works. Visual, electrical and functional tests shall be conducted for each individual element (refer to Appendix I Annex 4 Clause 9) and the assembled system / equipment.

(b) When the equipment is delivered to the Contractor's works, the Contractor shall agree with the Engineer, a range of tests as recommended by the Named Supplier to be conducted, prior to the installation of the equipment on train.

(c) The Contractor shall conduct commissioning tests to demonstrate that all the equipment have been correctly installed and adjusted and that the system fulfils all the requirements as stipulated in this Specification.

2.14 Not Used

2.15 EMC and Software Integration Tests

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/04 and RS/C6014/05.

2.16 Cables

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/06.

2.17 Pneumatic Equipment

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/07.

2.18 Fire Performance

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/08.

2.19 Wheelset

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/09.

2.20 Pantograph

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/10.

2.21 Battery

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/11.

2.22 Noise Performance

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/13.

2.23 Operability Performance

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/14.

2.24 Keys and Locks

The Contractor shall carry out tests to prove that the requirements have been met and that the PS requirements are satisfied according to RS/C6014/15.

2.25 Other Type Tests

2.25.1 Type Tests on Electronic Equipment

Unless otherwise specified, all electronic equipment used in the train system shall be tested to BS EN 50155: 2007 (refer to RS/C6014/03).

2.25.2 Brake System Tests

(a) A complete set of brake equipment comprising all items of equipment from the Brake Controller or ATO signal generator to a transducer, measuring the force at the brake unit push rod, shall be set up. This shall include identical lengths and diameters of pipe to those on an A Car.

(b) The appropriate reservoir volumes shall be included where these are critical in any way to the correct functioning of the system. The rig may be fed from a suitable air supply other than the car compressor if required.

(c) A complete series of tests shall be carried out on this rig to demonstrate the function of the brake system as a whole both in manual and ATO modes.

(d) The Contractor may combine the test of individual items with the system test.

2.25.3 Shock and Vibration Tests

All equipment modules which include the equipment contained in the module, the mounting frame or box, and the mountings, including mounting bushes and fasteners, which will be mounted on the underframe or inside the vehicles, shall be subjected to a shock and vibration test in accordance with BS EN 61373: 2013.

2.26 Completed Car, Train Unit and Train Tests

2.26.1 Train System Performance Test

(a) The train system performance test shall be the testing of a complete function of train from the power collection to its end function, the train operator and train system interface. All individual sub-systems of this function shall be successfully tested before, hence all the sections of system shall be connected together by their intended interfaces.

(b) The tests required by IEC 61133 that are applicable to the train shall be carried out prior to the delivery under the conditions of:

(i) the train under type test shall be equipped with all interior finish and with all underframe mounted equipment; and

(ii) the tests shall be carried out at the nominal system voltage.

(c) Notwithstanding the above requirements, it shall be a requirement that some of the important type and routine tests, such as, the traction and braking tests, shall be repeated in Hong Kong as part of the commissioning tests.

2.27 Tests on Contractor's Track

2.27.1 In order to eliminate the initial design defects and hence reduce the duration of commissioning the trains, the trains manufactured shall undergo the following tests in the Contractor's test track prior to its delivery to Hong Kong.

(a) Adjustment Tests, ATC System Combined Test, Reliability Proving Test and investigation tests for first manufactured train.

(b) ATC System Combined Test and Test Run in Factory for the second manufactured train.

(c) Test Run in Factory for trains other than the first two manufactured trains.

2.27.2 Adjustment Tests

(a) The adjustment tests shall be carried out to prove the complete function of train according to the IEC 61133: 2006 clause 4.2.

(b) The adjustment tests shall include both static and dynamic tests under the conditions of:

(1) with and without loads; and

(2) fully receptive, partial receptive and non-receptive traction power supply.

(c) All individual sub-systems particularly the traction system combined test specified in Clause 2.6.1 above shall be successfully tested beforehand.

(d) The results of the adjustment test, such as the response times and level setting of the individual systems, sub-systems and equipment, shall be recorded and formed the baseline to develop the associated commissioning test specifications, such that all trains shall be properly adjusted according to the above adjustment test results before submitting to the commissioning tests.

2.27.3 ATC System Combined Test

The ATC system combined test shall be carried out to validate the interface design and performance according to the requirements specified in the Appendix I Annex 3.

2.27.4 Reliability Proving Test

(a) Following the completion of the adjustment tests and the ATC system combined test, the reliability proving test shall be carried out according to the following operation profiles in order to simulate the actual service pattern:

(i) with the train under test is in tare load, start the train with maximum motoring demand to its maximum speed and then stop with

maximum service braking demand (note that re-motoring is allowed if necessary and re-generative braking shall be used for this test purpose);

(ii) perform the platform duties during stop i.e. operate the door and DVAS & PA (note that the train shall not be stopped for more than 20 secs);

(iii) repeat (i) and (ii) again until the accumulative mileage of the train runs reached 10,000km which is approximately equal to 1 month of operation cycle.

(b) For training purpose, a team of experienced train operators may be provided to the test site as the testing crews at the discretion of the Engineer (refer to PS 23.8.1).

(c) For the above 10,000km reliability proving runs, there shall be at least 5,000km runs cumulatively is free from any major equipment failure, such as a power device of the traction equipment failed.

(d) In the event that the requirement of 5,000km fault free runs cannot be met due to a major equipment failure, the Contractor shall, at his own expense, investigate the failure, rectify the fault and take whatever action is deemed necessary to meet the requirement.

(e) In the event that the 5,000km fault free runs is not achieved, the 5,000km fault free runs shall be repeated until the 5,000km fault free requirements set out in Clause 2.27.4(a) is achieved.

2.27.5 Investigation Tests

The investigation tests shall be carried out to obtain those essential information of train characteristics according to the IEC 61133: 2006 clause 4.4.

2.27.6 Test Run in Factory

(a) For all trains except for the first train manufactured, Test Run shall be carried out in the Contractor's test track according to the following operation profiles in order to simulate the actual service pattern:

(i) with the train under test is in tare load, start the train with maximum motoring demand to its maximum speed and then stop with maximum service braking demand (note that re-motoring is allowed if necessary and re-generative braking shall be used for this test purpose);

(ii) perform the platform duties during stop i.e. operate the door and DVAS & PA (note that the train shall not be stopped for more than 20 secs);

(iii) repeat (i) and (ii) again until the accumulative mileage of the train runs reached 300km.

(b) For the above 300km reliability proving runs, the test train shall be free from any of the following failures:

(i) failures defined in the Register of Train Failures (PS 25.3.4);

(ii) failures that the Engineer considers would render the train unfit for passenger service, as defined in PS 25.7.4, conditions for train failures; or

(iii) failures that the Engineer considers would endanger the safe operation of the Railway.

(c) In the event that the requirement of 300km fault free runs cannot be met due to any failure specified in Clause 2.27.6(b), the Contractor shall, at his own expense, investigate the failure, rectify the fault and take whatever action is deemed necessary to meet the requirement.

(d) In the event that the 300km fault free runs is not achieved, the 300km fault free runs shall be repeated until the 300km fault free requirements is achieved.

3 Commissioning (Tests in Hong Kong)

3.1 Check Tests

3.1.1 Check tests shall be performed on each car on arrival, first stationary and then running at low speed in the sidings at Siu Ho Wan Depot, to establish that all equipment is operating correctly. The Contractor shall itemise these tests for Approval. Facilities for trial runs (refer to Clause 6) at high speed will be available, subject to Clause 3.2.

3.1.2 During initial trial runs, the Contractor may make adjustments after which the tests below shall be carried out. The ATC Systems shall be checked and adjusted concurrently with these tests and brought into operation in preparation for the acceptance tests on the trains.

3.1.3 An interference test shall be carried out together with the ATC contractor as an acceptance test to ensure the traction equipment will not interfere with the signalling equipment.

3.1.4 Inspections shall be performed on each car after completion of the commissioning tests to verify that the workmanship required by RS/C6014/02 are met and that no deterioration in performance has taken place during the shipping, erection and commissioning processes. The Contractor shall make good any defect thus found at his own cost.

3.2 Site Arrangements for Tests

3.2.1 The availability of track space in Hong Kong will be limited by the fact that passenger train service will be in operation during the testing period.

3.2.2 Such testing may be carried out, of necessity, at night during the period when the service is shut down (from 01:30 to 05:00 hours approx.).

3.2.3 For this reason it is essential that the maximum amount of testing is carried out at or near the Contractor's Works as set out in PS 30.

3.3 Scope of Tests

The tests specified in Clause 4 below shall be carried out by the Contractor to verify the train performance in the Employer's railway systems.

4 Tests on Completion

4.1 Tests on Completion

4.1.1 In addition to the commissioning (tests in Hong Kong) and the integrated testing, the Tests On Completion shall demonstrate that the performance requirements of the train are met and suitable for passenger service in the Urban Lines systems.

4.1.2 The Tests On Completion that shall be carried out in Hong Kong, shall be all relevant tests specified in IEC 61133 which have been passed prior to delivery (refer to Clause 2.26.1(a)), shall be repeated in Hong Kong. The Contractor shall demonstrate by these test results that the train system is applicable to the conditions in Hong Kong and that no deterioration in performance has taken place during the shipping, erection and commissioning processes.

4.1.3 Not used.

5 Integrated Testing

5.1 The Integrated Testing shall consist of Integrated Tests (refer to Clause 5.2) and Test Run (refer to Clause 5.3).

5.2 Integrated Tests

5.2.1 Objective

(a) The Integrated Tests shall verify that the compatibility requirements between the train and the existing Urban Lines systems are met.

(b) The Contractor shall demonstrate by the result of the Integrated Tests that all interface requirements specified in the associated interface specifications are met.

5.2.2 The Contractor shall carry out all required tests according to the relevant approved interfacing specifications of Appendix I in the existing Urban Lines systems. The system interfaces shall include:

(a) P-way Interface (refer to Appendix I Annex 1),

(b) OHL/Traction Power Supply System Interfaces (refer to Appendix I Annex 2),

(c) ATC Interfaces (refer to Appendix I Annex 3),

(d) Communication Interfaces (refer to Appendix I Annex 4),

(e) PSD Interfaces (refer to Appendix I Annex 5),

(f) Depot Interfaces (refer to Appendix I Annex 6),

(g) Electric Vehicle Interfaces (refer to Appendix I Annex 7),

(h) Not used

(i) Dynamic Route Map Interfaces Test (refer to Appendix I Annex 9)

5.2.3 Specific (Type) Interface Tests

In addition to the requirements specified in the interface specifications, the following specific tests shall be carried out on a type test basis to verify the compatibility between the trains and the specific interfacing system/equipment.

5.2.4 OHL/Traction Power Supply System Interface

To measure interference current generated by the traction and braking and auxiliary supply systems when they appear in the traction supply under both normal and worse case conditions.

5.2.5 ATC interface

(a) Rolling Stock / Signalling

(i) Conductive Interference

To measure the spectrum of the traction and braking and auxiliary supply systems generated harmonics for both continuous and transient conditions.

(ii) Inductive (Magnetic) Interference

To measure direct induction effects in track circuits i.e. "close up" conditions.

(iii) Inductive Interference

To measure direct induction effects in ATP and ATO loops.

(iv) To measure the spectrum of disturbance voltage induced in the trainborne ATO and ATP aerial systems for the traction and braking and auxiliary supply systems generated interference.

(b) Rolling Stock / Signalling / OHL

(i) To measure the spectrum of disturbance voltage induced in the trainborne ATO and ATP aerial systems for traction supply generated interference due to the train system.

(ii) Measure the range of ripple voltages over the range of load current to be conducted on site and the simulated failure mode shall be defined.

5.2.6 Depot Interfaces

(a) Compatibility with abovefloor and underfloor lifting equipment (refer to Clause 3.3, Appendix I Annex 6)

(b) Compatibility with existing accommodation bogies (refer to Clause 3.4, Appendix I Annex 6)

(c) Handling of underframe mounted equipment (refer to Clause 3.5, Appendix I Annex 6)

(d) Towing by tractor (refer to Clause 3.6, Appendix I Annex 6)

(e) Automatic external cleaning facilities (refer to Clauses 4.1 and 4.2, Appendix I Annex 6)

(f) Compatibility with underfloor wheel lathe, including towing winch (refer to Clause 5, Appendix I Annex 6)

(g) Compatibility of miscellaneous interfaces (refer to Clause 6, Appendix I Annex 6):

(i) Target holder
(ii) Pneumatic connector
(iii) Shore auxiliary supply
(iv) Recovery equipment for derailment and locked axle

5.3 Test Run in Urban Line

5.3.1 "Test Run" means that period when the Designated Contractors shall be testing their plant and equipment and run the same in conjunction with the Employer.

5.3.2 Test Run

(a) After the completion of the Integrated Tests (refer to Clause 5.2), each train shall undergo a Test Run one by one in the Urban Lines to verify the reliability requirements between the train and the existing Urban Lines systems are met. The Contractor shall provide a competent engineering personnel to attend the Test Run to provide technical advice to the train operator when it is required, such as, during fault recovery of the train.

(b) In order to simulate the actual service pattern, the Test Run shall be carried out according to the following operation profiles:

(i) With the train under test is in tare load, operate the train according to the service schedules provided by the Automatic Train Regulation system of the Urban Lines.

(ii) A special test path will be assigned to the test train during passenger service periods and no passenger shall be allowed to

go abroad of the test train. The Contractor shall provide appropriate means, such as, to erect barriers at all doors, on the test train to prevent passengers from boarding the test train, as shall take any other precautions to meet the Employer's operating requirements, as instructed by the Engineer.

(iii) At the discretion of the Engineer, another special test path may be assigned to the test train during the non-traffic hours at night, the Contractor shall ensure that the required attendant (refer to Clause 5.3.2(a)) is provided;

(iv) perform the platform duties during stop i.e. operate the door and DVAS;

(v) repeat (i) to (iv) above again until the accumulative mileage of the test train runs reached 600km.

(c) For the above 600km reliability proving runs, the test train shall be free from any of the following failures:

(i) failures defined in the Register of Train Failures (PS 25.3.4);

(ii) failures that the Engineer considers would render the train unfit for passenger service, as defined in PS 25.7.4, conditions for train failures; or

(iii) failures that the Engineer considers would endanger the safe operation of the Railway.

(iv) failures to stop within ±500mm of the designated station stopping point under Auto mode operation.

(d) In the event that the requirement of 600km fault free runs cannot be met due to any failure specified in Clause 5.3.2(c), the Contractor shall, at his own expense, investigate the failure, rectify the fault and take whatever action is deemed necessary to meet the requirement.

(e) In the event that the 600km fault free runs is not achieved, the 600km fault free runs shall be repeated until the 600km fault free requirements is achieved.

(f) The distance travelled of the train recorded by the Train Management System (refer to PS 10.6.1(b)) shall be used for the 600km fault free measurement.

5.3.3 In addition during the above periods system-wide tests shall be undertaken that shall require the attendance of the Contractor and the relevant Designated Contractors and or the Employer.

Works Tests

Table App-C-1 Table for Summary of Work Tests

Equipment	Test Contents	Clause Reference / Standards
Car Body Structure and Exterior	1. Car Body Structure	AppC-2.1.1, PS 6.4, PS 4.5.4
	2. Train Sway	AppC-2.1.2, PS 5.1
	3. Water Resistance	AppC-2.1.3
	4. Window	AppC-2.1.4, PS 6.11
	5. Weighing	AppC-2.1.5, PS 5.5, PS 5.6
Car Body Interior	1. Ergonomic Trial	AppC-2.2.1
	2. Strength	AppC-2.2.2, PS 7.5, PS 7.6.3, PS 7.7.1, PS 7.7.7, PS 7.7.8, PS 7.11.4
	3. Flooring	AppC-2.2.3, RS/C6014/08, BS EN ISO 105-A01
	4. Lighting	AppC-2.2.4, PS 7.9.3, IP 54, BS EN 60529
	5. Saloon Smoke Detection	AppC-2.2.5, PS 7.18
Cab Facilities and Layout	1. Ergonomic Trial	AppC-2.3.1
	2. Panels and Controls	AppC-2.3.2, IP 65, BS EN 60529
	3. Seat Strength and Vibration Test	AppC-2.3.3, BS EN ISO 2439, UIC ORE B106, BS EN 61373, BS EN ISO 12947, BS EN ISO 13938, BS EN ISO 13934-1, BS EN ISO 105-A01
	4. Lighting	
	5. Switchgear Electrical and Mechanical Endurance Test	AppC-2.3.4, PS 8.14 AppC-2.3.5, IEC 60077
Operation and Control	1. Correct Operation	AppC-2.4.1, IEC 61133-5.7
	2. Accidents Prevention	AppC-2.4.2, IEC 61133-5.13
	3. Speed Regulation and Over Speed Protection System	AppC-2.4.3, IEC 61133-6.6
Train Management System	TCN network performance, TCN equipment function & performance requirements, all data transmission services and mode of Data	RS/C6014/01-19.2, ISO 9646-1
	Management shall be tested with the following testing strategy :	
	1. Prototype Test	RS/C6014/01-19.3.1, PS 10
	2. TMS System Integration Test	RS/C6014/01-19.3.2, PS 10

Equipment	Test Contents	Clause Reference / Standards
	3. TMS Vehicle Level Test	RS/C6014/01-19.3.3, PS 10
Traction and Braking Equipment	1. Traction Equipment System Combined Test	AppC-2.6.1, AppM-2.2.6, IEC 61377-1
	2. Traction Motors Routine test, Characteristic test, Gearing test and Impedance & Inductance Measurement	AppC-2.6.2, IEC 60349-2
	3. Braking Resistors	AppC-2.6.3, IEC 60322
	4. Transformers and Reactors	AppC-2.6.4, BS EN 60310
	5. Power Converter	AppC-2.6.5, IEC 61287-1
	6. Miscellaneous Electric Traction Equipment	AppC-2.6.6, IEC 60077
	7. Brake Equipment Dynamometer Test	AppC-2.6.7, PS 11.9
	8. Friction Brake Units	AppC-2.6.8, IEC 60077
	9. Brake Control Equipment Mechanical Operation and Endurance Test, Vibration & Shock Test, Air Tightness, Electrical Test and Characteristic Test	AppC-2.6.9, IEC 60077
	10. Wheel Slide Protection System Test	AppC-2.6.10, UIC 541-05
Bogie and Suspension	1. Bogie Static Test	AppC-2.7.1, PS 12.9.3
	2. Bogie Dynamic Test	AppC-2.7.2, PS 12.9.3, PS 4.5.4
	3. Wheel Off-loading Test	AppC-2.7.3, PS 12.5
	4. Bogie Rotational Resistance Test	AppC-2.7.4, PS 12.6
	5. Train Ride Test	AppC-2.7.5, PS 12.2, PS 12.11.2
	6. Axlebox Bearing Test	AppC-2.7.6, PS 12.10.6, BS EN 12082
	7. Bogie Frame Fatigue Test	AppC-2.7.7, UIC 515
	8. Bogie Suspension Systems Test	AppC-2.7.8, PS 12.1.1
Pneumatic and Air Distribution Systems	1. Compressor, Air Dryer, Air reservoirs, Main Reservoir Pipe isolation cock	AppC-2.8, PS 13
Gangways and Couplers	1. Gangway Strength Test, Water Tightness Test, Impact Test and Endurance Life Test	AppC-2.9.1, PS 14
	2. Couplers	AppC-2.9.2, PS 14

Equipment	Test Contents	Clause Reference / Standards
Air Conditioning and Ventilation	1. Mechanical Endurance, Vibration and Shock Type Test	AppC-2.10.1, PS 26, BS EN 61373
	2. Pressure Test	AppC-2.10.2
	3. Equipment Base Performance Test	AppC-2.10.3, RS/C6014/13, IEC 60349-2, BS EN 61373
	4. Vehicle Base System Performance Test, Air Flow Test, Air Distribution Test and Air Conditioning Test	AppC-2.10.4, PS 15
Doors	1. Saloon and Cab Doors Endurance Test	AppC-2.11.1, PS 16.7, PS 25.5, PS 26
	2. Mechanical Strength Test	AppC-2.11.2, PS 16.2.5
	3. Vibration Test	AppC-2.11.3, BS EN 61373
	4. Emergency Detrainment Device Type Test, Load Test, Endurance Test	AppC-2.11.4, PS 8.16
Auxiliary Electrical Supply	1. Auxiliary Supply System Combined Test	AppC-2.12.1
	2. System Test with Simulated Running Conditions and One Full Set Complete Auxiliary Equipment	AppC-2.12.2
	3. System Test with all Emergency Equipment and System	AppC-2.12.3
	4. Power Converters	AppC-2.12.4, IEC 61287-1
	5. Auxiliary Machines, Low Voltage Starting Test, No Load Run, Locked Rotor Test and Compressor and Motor Set	AppC-2.12.5, IEC 60349
	6. Battery Charger	AppC-2.12.6,
	7. Miscellaneous Auxiliary Equipment	AppC-2.12.7, IEC 60077
Communications Equipment	1. Cars, Train Units and Trains General Test	
	- Trainborne Radio	AppC-2.13.2, AppI-Annex4-2.2, IEC 61133
	- In-Cab CCTV	AppC-2.13.3, PS 18.3.7, AppI-Annex4-3.2, IEC 61133
	- DVAS & PA	AppC-2.13.4, PS 18.4.2, IEC 61133
	- EIDS Communication Equipment * Wireless LAN Transmission Link * GSM Link * Train Network * EID Panels	AppC-2.13.5, PS 18.5, AppI-Annex 4-4.5, IEC 61133
	- In-Saloon CCTV	AppC-2.13.6, PS 18.7, AppI-Annex 4-6 and 7, IEC 61133
	- Provision of Public WiFi Access	AppC-2.13.7, PS 18.8, IEC 61133
	- Dynamic Route Map	RS/C6014/01, PS 10.4, AppI-Annex 9, AppC-2.13.8

Equipment	Test Contents	Clause Reference / Standards
	* GSM Link	
	- Door Chime System	AppC-2.13.9, PS 18.6, AppI-Annex 4-5
	- RFID for Trainborne Radio	AppC-2.13.10, PS 18.9, AppI-Annex 4-8
	- RFID Axle Box Temperature Detection System	AppC-2.13.11, PS 18.10, AppI-Annex 4-9
EMC and Software Integration Test	Specific Test	AppC-2.15, RS/C6014/04, RS/C6014/05
Cables	Specific Test	AppC-2.16, RS/C6014/06
Pneumatic Equipment	Specific Test	AppC-2.17, RS/C6014/07
Fire Performance	Specific Test	AppC-2.18, RS/C6014/08
Wheelset	Specific Test	AppC-2.19, RS/C6014/09
Pantograph	Specific Test	AppC-2.20, RS/C6014/10
Batteries	Specific Test	AppC-2.21, RS/C6014/11
Noise Performance	Specific Test	AppC-2.22, RS/C6014/13
Operability Performance	Specific Test	AppC-2.23, RS/C6014/14
Keys and Locks	Specific Test	AppC-2.24, RS/C6014/15
Other Equipment Type Test	1. Electronic Equipment Type Test	AppC-2.25.1, RS/C6014/03, BS EN 50155
	2. Brake System Test	AppC-2.25.2
	3. All Mounted Equipment Shock and Vibration Test	AppC-2.25.3, BS EN 61373
Completed Car, Train Unit and Train Test	1. Train System Performance Test prior to the delivery	AppC-2.26.1, IEC 61133
Test on Contractor's Track	1. Adjustment Test - Static and dynamic test - All individual sub-systems combined test	AppC-2.27.2, IEC 61133-4.2
	2. ATC System Combined Test	AppC-2.27.3, AppI-Annex3
	3. Reliability Proving Test	AppC-2.27.4, PS 23.8.1
	4. Investigation Test	AppC-2.27.5, IEC 61133
	5. Test Run in Factory	AppC-2.27.6

Commissioning Tests

Table App-C-2 Table for Summary of Commissioning Tests

Test	Description	Clause Reference / Standard
Check Test	1. Check tests on each car on arrival, first stationary and running at low speed in KBD sidings. Facilitate trial runs at high speed.	AppC-3.1.1
	2. ATC Systems check in initial trial runs.	AppC-3.1.2
	3. Interference test for ATC Systems and traction system.	AppC-3.1.3
	4. Verify the workmanships on each car after completion of commissioning tests.	AppC-3.1.4, RS/C6014/02

Tests on Completion

Table App-C-3 Table for Summary of Tests on Completion

Test	Description	Clause Reference / Standard
Tests on Completion	1. Demonstrate the performance requirements of the trains are met and suitable for passenger service in Urban Lines systems.	AppC-4.1.1
	2. Repeat the relevant Train System Performance Test in Hong Kong to demonstrate the proper functionality.	AppC-4.1.2, IEC 61133
	3. Carry out reliability tests and maintainability demonstration tests.	AppC-4.1.3, PS 26

Integrated Testing

Table App-C-4 Table for Summary of Integrated Testing

Test	Description	Clause Reference / Standard
Integrated Testing	1. Interface Tests	
	- P-way Interface Test	AppI-Annex1
	- OHL/Traction Power Supply System Interfaces Test	AppI-Annex2
	- ATC Interfaces Test	AppI-Annex3
	- Communication Interfaces Test	AppI-Annex4
	- PSD Interfaces Test	AppI-Annex5
	- Depot Interfaces Test	AppI-Annex6
	- Electric Car Interfaces Test	AppI-Annex7
	- Dynamic Route Map Interfaces Test	AppI-Annex9
	2. Specific (Type) Interface Tests	
	- OHL/traction power supply system interfaces	AppC-5.2.4
	- ATC interfaces	AppC-5.2.5
	- Depot interfaces	AppC-5.2.6, AppI-Annex6
Test Run in Urban Line	1. Undergo Test Run one by one in Urban Lines to verify the reliability requirements between the train and Urban Lines system are met.	AppC-5.4.3, PS 25.3.4, PS25.7.4, PS 10.6.1.(b)

APPENDIX D

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APPENDIX D NOT USED

APPENDIX E

SCHEDULE OF DELIVERY

August 2015

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APPENDIX E SCHEDULE OF DELIVERY

1.1 Delivery Dates for the 78 trains under the Base Contract

Train Number	Completion of delivery to Siu Ho Wan Depot (Week/Year)	Train Number	Completion of delivery to Siu Ho Wan Depot (Week/Year)
1	02/18	23	31/19
2	15/18	24	31/19
3	26/18	25	34/19
4	26/18	26	34/19
5	32/18	27	37/19
6	32/18	28	37/19
7	38/18	29	43/19
8	38/18	30	43/19
9	44/18	31	47/19
10	44/18	32	47/19
11	51/18	33	51/19
12	51/18	34	51/19
13	08/19	35	06/20
14	08/19	36	09/20
15	12/19	37	12/20
16	12/19	38	15/20
17	17/19	39	18/20
18	17/19	40	21/20
19	22/19	41	24/20
20	22/19	42	27/20
21	27/19	43	30/20
22	27/19	44	33/20

Train Number	Completion of delivery to Siu Ho Wan Depot (Week/Year)	Train Number	Completion of delivery to Siu Ho Wan Depot (Week/Year)
45	36/20	70	11/22
46	39/20	71	15/22
47	42/20	72	19/22
48	45/20	73	23/22
49	48/20	74	27/22
50	51/20	75	30/22
51	03/21	76	32/22
52	07/21	77	35/22
53	10/21	78	39/22
54	13/21		
55	16/21		
56	19/21		
57	22/21		
58	25/21		
59	28/21		
60	31/21		
61	34/21		
62	37/21		
63	40/21		
64	43/21		
65	46/21		
66	49/21		
67	52/21		
68	03/22		
69	07/22		

1.2 Delivery Dates for the additional 15 trains under Option 1A

Train Number	Completion of delivery to Siu Ho Wan Depot (Week/Year)	Train Number	Completion of delivery to Siu Ho Wan Depot (Week/Year)
79	46/22	87	20/23
80	49/22	88	23/23
81	01/23	89	26/23
82	05/23	90	29/23
83	08/23	91	32/23
84	11/23	92	36/23
85	14/23	93	39/23
86	17/23		

1.3 Delivery Dates for the additional 15 trains under Option 1B

Train Number	Completion of delivery to Siu Ho Wan Depot (Week/Year)	Train Number	Completion of delivery to Siu Ho Wan Depot (Week/Year)
79	49/28	87	25/34
80	04/29	88	32/34
81	11/29	89	39/34
82	18/29	90	18/35
83	25/29	91	25/35
84	32/29	92	32/35
85	39/29	93	39/35
86	18/34		

Note: The Delivery Dates for the trains may be advanced by up to four weeks subject to depot track availability and the Approval by the Engineer

APPENDIX F

ENGINEER'S PRELIMINARY PROGRAMME,

PROJECT CALENDAR,

SCHEDULE OF CRITICAL DATES AND

SCHEDULE OF KEYDATES

August 2015

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APPENDIX F ENGINEER'S PRELIMINARY PROGRAMME, PROJECT CALENDAR, SCHEDULE OF CRITICAL DATES AND SCHEDULE OF KEY DATES

1 Engineer's Preliminary Programme

2 Project Calendar

3 Schedule of Critical Dates

4 Schedule of Key Dates for Design Submissions

1 ENGINEER'S PRELIMINARY PROGRAMME

1.1 Ready for Passenger Service Dates for the 78 Trains under the Base Contract

Train Number	Ready for Passenger Service (Week/Year)	Train Number	Ready for Passenger Service (Week/Year)
1	39/18	23	45/19
2	39/18	24	46/19
3	43/18	25	47/19
4	46/18	26	48/19
5	49/18	27	50/19
6	52/18	28	52/19
7	03/19	29	06/20
8	06/19	30	09/20
9	09/19	31	12/20
10	12/19	32	15/20
11	16/19	33	18/20
12	19/19	34	21/20
13	25/19	35	24/20
14	27/19	36	27/20
15	29/19	37	30/20
16	32/19	38	33/20
17	34/19	39	36/20
18	36/19	40	39/20
19	39/19	41	42/20
20	42/19	42	45/20
21	43/19	43	48/20
22	44/19	44	51/20

Train Number	Ready for Passenger Service (Week/Year)	Train Number	Ready for Passenger Service (Week/Year)
45	03/21	70	28/22
46	07/21	71	31/22
47	10/21	72	34/22
48	13/21	73	37/22
49	16/21	74	40/22
50	19/21	75	43/22
51	22/21	76	45/22
52	25/21	77	48/22
53	28/21	78	52/22
54	31/21		
55	34/21		
56	37/21		
57	40/21		
58	43/21		
59	46/21		
60	49/21		
61	52/21		
62	03/22		
63	07/22		
64	10/22		
65	13/22		
66	16/22		
67	19/22		
68	22/22		
69	25/22		

1.2 Ready for Passenger Service Dates for the additional 15 trains under Option 1A

Train Number	Ready for Passenger Service (Week/Year)	Train Number	Ready for Passenger Service (Week/Year)
79	07/23	87	33/23
80	10/23	88	36/23
81	15/23	89	39/23
82	18/23	90	43/23
83	21/23	91	46/23
84	24/23	92	49/23
85	27/23	93	52/23
86	30/23		

1.3 Ready for Passenger Service Dates for the additional 15 trains under Option 1B

Train Number	Ready for Passenger Service (Week/Year)	Train Number	Ready for Passenger Service (Week/Year)
79	10/29	87	38/34
80	17/29	88	45/34
81	24/29	89	52/34
82	31/29	90	31/35
83	38/29	91	38/35
84	45/29	92	45/35
85	52/29	93	52/35
86	31/34		

2 PROJECT CALENDAR

2015

	JANUARY					FEBRUARY					MARCH					
Week No.	1	2	3	4	5	5	6	7	8	9	9	10	11	12	13	14
Monday		5	12	19	26		2	9	16	23		2	9	16	23	30
Tuesday		6	13	20	27		3	10	17	24		3	10	17	24	31
Wednesday		7	14	21	28		4	11	18	25		4	11	18	25	
Thursday	1	8	15	22	29		5	12	19	26		5	12	19	26	
Friday	2	9	16	23	30		6	13	20	27		6	13	20	27	
Saturday	3	10	17	24	31		7	14	21	28		7	14	21	28	
Sunday	4	11	18	25		1	8	15	22		1	8	15	22	29	

	APRIL					MAY					JUNE					
Week No.	14	15	16	17	18	18	19	20	21	22	23	24	25	26	27	
Monday		6	13	20	27		4	11	18	25	1	8	15	22	29	
Tuesday		7	14	21	28		5	12	19	26	2	9	16	23	30	
Wednesday	1	8	15	22	29		6	13	20	27	3	10	17	24		
Thursday	2	9	16	23	30		7	14	21	28	4	11	18	25		
Friday	3	10	17	24		1	8	15	22	29	5	12	19	26		
Saturday	4	11	18	25		2	9	16	23	30	6	13	20	27		
Sunday	5	12	19	26		3	10	17	24	31	7	14	21	28		

	JULY					AUGUST						SEPTEMBER				
Week No.	27	28	29	30	31	31	32	33	34	35	36	36	37	38	39	40
Monday		6	13	20	27		3	10	17	24	31		7	14	21	28
Tuesday		7	14	21	28		4	11	18	25		1	8	15	22	29
Wednesday	1	8	15	22	29		5	12	19	26		2	9	16	23	30
Thursday	2	9	16	23	30		6	13	20	27		3	10	17	24	
Friday	3	10	17	24	31		7	14	21	28		4	11	18	25	
Saturday	4	11	18	25		1	8	15	22	29		5	12	19	26	
Sunday	5	12	19	26		2	9	16	23	30		6	13	20	27	

	OCTOBER					NOVEMBER						DECEMBER				
Week No.	40	41	42	43	44	44	45	46	47	48	49	49	50	51	52	53
Monday		5	12	19	26		2	9	16	23	30		7	14	21	28
Tuesday		6	13	20	27		3	10	17	24		1	8	15	22	29
Wednesday		7	14	21	28		4	11	18	25		2	9	16	23	30
Thursday	1	8	15	22	29		5	12	19	26		3	10	17	24	31
Friday	2	9	16	23	30		6	13	20	27		4	11	18	25	
Saturday	3	10	17	24	31		7	14	21	28		5	12	19	26	
Sunday	4	11	18	25		1	8	15	22	29		6	13	20	27	

2016

	JANUARY					FEBRUARY					MARCH				
Week No.	53/15	1	2	3	4	5	6	7	8	9	9	10	11	12	13
Monday		4	11	18	25	1	8	15	22	29		7	14	21	28
Tuesday		5	12	19	26	2	9	16	23		1	8	15	22	29
Wednesday		6	13	20	27	3	10	17	24		2	9	16	23	30
Thursday		7	14	21	28	4	11	18	25		3	10	17	24	31
Friday	1	8	15	22	29	5	12	19	26		4	11	18	25	
Saturday	2	9	16	23	30	6	13	20	27		5	12	19	26	
Sunday	3	10	17	24	31	7	14	21	28		6	13	20	27	

	APRIL					MAY						JUNE				
Week No.	13	14	15	16	17	17	18	19	20	21	22	22	23	24	25	26
Monday		4	11	18	25		2	9	16	23	30		6	13	20	27
Tuesday		5	12	19	26		3	10	17	24	31		7	14	21	28
Wednesday		6	13	20	27		4	11	18	25		1	8	15	22	29
Thursday		7	14	21	28		5	12	19	26		2	9	16	23	30
Friday	1	8	15	22	29		6	13	20	27		3	10	17	24	
Saturday	2	9	16	23	30		7	14	21	28		4	11	18	25	
Sunday	3	10	17	24		1	8	15	22	29		5	12	19	26	

	JULY					AUGUST					SEPTEMBER				
Week No.	26	27	28	29	30	31	32	33	34	35	35	36	37	38	39
Monday		4	11	18	25	1	8	15	22	29		5	12	19	26
Tuesday		5	12	19	26	2	9	16	23	30		6	13	20	27
Wednesday		6	13	20	27	3	10	17	24	31		7	14	21	28
Thursday		7	14	21	28	4	11	18	25		1	8	15	22	29
Friday	1	8	15	22	29	5	12	19	26		2	9	16	23	30
Saturday	2	9	16	23	30	6	13	20	27		3	10	17	24	
Sunday	3	10	17	24	31	7	14	21	28		4	11	18	25	

	OCTOBER						NOVEMBER					DECEMBER				
Week No.	39	40	41	42	43	44	44	45	46	47	48	48	49	50	51	52
Monday		3	10	17	24	31		7	14	21	28		5	12	19	26
Tuesday		4	11	18	25		1	8	15	22	29		6	13	20	27
Wednesday		5	12	19	26		2	9	16	23	30		7	14	21	28
Thursday		6	13	20	27		3	10	17	24		1	8	15	22	29
Friday		7	14	21	28		4	11	18	25		2	9	16	23	30
Saturday	1	8	15	22	29		5	12	19	26		3	10	17	24	31
Sunday	2	9	16	23	30		6	13	20	27		4	11	18	25	

2017

	JANUARY						FEBRUARY					MARCH				
Week No.	52/16	1	2	3	4	5	5	6	7	8	9	9	10	11	12	13
Monday		2	9	16	23	30		6	13	20	27		6	13	20	27
Tuesday		3	10	17	24	31		7	14	21	28		7	14	21	28
Wednesday		4	11	18	25		1	8	15	22		1	8	15	22	29
Thursday		5	12	19	26		2	9	16	23		2	9	16	23	30
Friday		6	13	20	27		3	10	17	24		3	10	17	24	31
Saturday		7	14	21	28		4	11	18	25		4	11	18	25	
Sunday	1	8	15	22	29		5	12	19	26		5	12	19	26	

	APRIL					MAY					JUNE				
Week No.	13	14	15	16	17	18	19	20	21	22	22	23	24	25	26
Monday		3	10	17	24	1	8	15	22	29		5	12	19	26
Tuesday		4	11	18	25	2	9	16	23	30		6	13	20	27
Wednesday		5	12	19	26	3	10	17	24	31		7	14	21	28
Thursday		6	13	20	27	4	11	18	25		1	8	15	22	29
Friday		7	14	21	28	5	12	19	26		2	9	16	23	30
Saturday	1	8	15	22	29	6	13	20	27		3	10	17	24	
Sunday	2	9	16	23	30	7	14	21	28		4	11	18	25	

	JULY						AUGUST					SEPTEMBER				
Week No.	26	27	28	29	30	31	31	32	33	34	35	35	36	37	38	39
Monday		3	10	17	24	31		7	14	21	28		4	11	18	25
Tuesday		4	11	18	25		1	8	15	22	29		5	12	19	26
Wednesday		5	12	19	26		2	9	16	23	30		6	13	20	27
Thursday		6	13	20	27		3	10	17	24	31		7	14	21	28
Friday		7	14	21	28		4	11	18	25		1	8	15	22	29
Saturday	1	8	15	22	29		5	12	19	26		2	9	16	23	30
Sunday	2	9	16	23	30		6	13	20	27		3	10	17	24	

	OCTOBER						NOVEMBER					DECEMBER				
Week No.	39	40	41	42	43	44	44	45	46	47	48	48	49	50	51	52
Monday		2	9	16	23	30		6	13	20	27		4	11	18	25
Tuesday		3	10	17	24	31		7	14	21	28		5	12	19	26
Wednesday		4	11	18	25		1	8	15	22	29		6	13	20	27
Thursday		5	12	19	26		2	9	16	23	30		7	14	21	28
Friday		6	13	20	27		3	10	17	24		1	8	15	22	29
Saturday		7	14	21	28		4	11	18	25		2	9	16	23	30
Sunday	1	8	15	22	29		5	12	19	26		3	10	17	24	31

2018

	JANUARY					FEBRUARY					MARCH				
Week No.		1	2	3	4	5	6	7	8	9		10	11	12	13
Monday		1	8	15	22	29	5	12	19	26		5	12	19	26
Tuesday		2	9	16	23	30	6	13	20	27		6	13	20	27
Wednesday		3	10	17	24	31	7	14	21	28		7	14	21	28
Thursday		4	11	18	25		1 8	15	22		1	8	15	22	29
Friday		5	12	19	26		2 9	16	23		2	9	16	23	30
Saturday		6	13	20	27		3 10	17	24		3	10	17	24	31
Sunday		7	14	21	28		4 11	18	25		4	11	18	25	

	APRIL						MAY					JUNE				
Week No.	13	14	15	16	17	18	18	19	20	21	22		22	23	24	25	26
Monday		2	9	16	23	30		7	14	21	28			4	11	18	25
Tuesday		3	10	17	24		1	8	15	22	29			5	12	19	26
Wednesday		4	11	18	25		2	9	16	23	30			6	13	20	27
Thursday		5	12	19	26		3	10	17	24	31			7	14	21	28
Friday		6	13	20	27		4	11	18	25			1	8	15	22	29
Saturday		7	14	21	28		5	12	19	26			2	9	16	23	30
Sunday	1	8	15	22	29		6	13	20	27			3	10	17	24	

	JULY						AUGUST					SEPTEMBER					
Week No.	26	27	28	29	30	31	31	32	33	34	35		35	36	37	38	39
Monday		2	9	16	23	30		6	13	20	27			3	10	17	24
Tuesday		3	10	17	24	31		7	14	21	28			4	11	18	25
Wednesday		4	11	18	25		1	8	15	22	29			5	12	19	26
Thursday		5	12	19	26		2	9	16	23	30			6	13	20	27
Friday		6	13	20	27		3	10	17	24	31			7	14	21	28
Saturday		7	14	21	28		4	11	18	25			1	8	15	22	29
Sunday	1	8	15	22	29		5	12	19	26			2	9	16	23	30

	OCTOBER						NOVEMBER					DECEMBER					
Week No.		40	41	42	43	44	44	45	46	47	48	48	49	50	51	52	01/19
Monday		1	8	15	22	29		5	12	19	26		3	10	17	24	31
Tuesday		2	9	16	23	30		6	13	20	27		4	11	18	25	
Wednesday		3	10	17	24	31		7	14	21	28		5	12	19	26	
Thursday		4	11	18	25		1	8	15	22	29		6	13	20	27	
Friday		5	12	19	26		2	9	16	23	30		7	14	21	28	
Saturday		6	13	20	27		3	10	17	24		1	8	15	22	29	
Sunday		7	14	21	28		4	11	18	25		2	9	16	23	30	

2019

	JANUARY					FEBRUARY					MARCH					
Week No.	1	2	3	4	5	5	6	7	8	9	9	10	11	12	13	
Monday		7	14	21	28		4	11	18	25		4	11	18	25	
Tuesday	1	8	15	22	29		5	12	19	26		5	12	19	26	
Wednesday	2	9	16	23	30		6	13	20	27		6	13	20	27	
Thursday	3	10	17	24	31		7	14	21	28		7	14	21	28	
Friday	4	11	18	25		1	8	15	22		1	8	15	22	29	
Saturday	5	12	19	26		2	9	16	23		2	9	16	23	30	
Sunday	6	13	20	27		3	10	17	24		3	10	17	24	31	

	APRIL					MAY					JUNE					
Week No.	14	15	16	17	18	18	19	20	21	22	22	23	24	25	26	
Monday	1	8	15	22	29		6	13	20	27		3	10	17	24	
Tuesday	2	9	16	23	30		7	14	21	28		4	11	18	25	
Wednesday	3	10	17	24		1	8	15	22	29		5	12	19	26	
Thursday	4	11	18	25		2	9	16	23	30		6	13	20	27	
Friday	5	12	19	26		3	10	17	24	31		7	14	21	28	
Saturday	6	13	20	27		4	11	18	25		1	8	15	22	29	
Sunday	7	14	21	28		5	12	19	26		2	9	16	23	30	

	JULY					AUGUST					SEPTEMBER					
Week No.	27	28	29	30	31	31	32	33	34	35	35	36	37	38	39	40
Monday	1	8	15	22	29		5	12	19	26		2	9	16	23	30
Tuesday	2	9	16	23	30		6	13	20	27		3	10	17	24	
Wednesday	3	10	17	24	31		7	14	21	28		4	11	18	25	
Thursday	4	11	18	25		1	8	15	22	29		5	12	19	26	
Friday	5	12	19	26		2	9	16	23	30		6	13	20	27	
Saturday	6	13	20	27		3	10	17	24	31		7	14	21	28	
Sunday	7	14	21	28		4	11	18	25		1	8	15	22	29	

	OCTOBER					NOVEMBER					DECEMBER					
Week No.	40	41	42	43	44	44	45	46	47	48	48	49	50	51	52	01/20
Monday		7	14	21	28		4	11	18	25		2	9	16	23	30
Tuesday	1	8	15	22	29		5	12	19	26		3	10	17	24	31
Wednesday	2	9	16	23	30		6	13	20	27		4	11	18	25	
Thursday	3	10	17	24	31		7	14	21	28		5	12	19	26	
Friday	4	11	18	25		1	8	15	22	29		6	13	20	27	
Saturday	5	12	19	26		2	9	16	23	30		7	14	21	28	
Sunday	6	13	20	27		3	10	17	24		1	8	15	22	29	

2020

	JANUARY					FEBRUARY					MARCH					
Week No.	1	2	3	4	5	5	6	7	8	9	9	10	11	12	13	14
Monday		6	13	20	27		3	10	17	24		2	9	16	23	30
Tuesday		7	14	21	28		4	11	18	25		3	10	17	24	31
Wednesday	1	8	15	22	29		5	12	19	26		4	11	18	25	
Thursday	2	9	16	23	30		6	13	20	27		5	12	19	26	
Friday	3	10	17	24	31		7	14	21	28		6	13	20	27	
Saturday	4	11	18	25		1	8	15	22	29		7	14	21	28	
Sunday	5	12	19	26		2	9	16	23		1	8	15	22	29	

	APRIL					MAY					JUNE					
Week No.	14	15	16	17	18	18	19	20	21	22	23	24	25	26	27	
Monday		6	13	20	27		4	11	18	25		1	8	15	22	29
Tuesday		7	14	21	28		5	12	19	26		2	9	16	23	30
Wednesday	1	8	15	22	29		6	13	20	27		3	10	17	24	
Thursday	2	9	16	23	30		7	14	21	28		4	11	18	25	
Friday	3	10	17	24		1	8	15	22	29		5	12	19	26	
Saturday	4	11	18	25		2	9	16	23	30		6	13	20	27	
Sunday	5	12	19	26		3	10	17	24	31		7	14	21	28	

	JULY					AUGUST						SEPTEMBER					
Week No.	27	28	29	30	31	31	32	33	34	35	36	36	37	38	39	40	
Monday		6	13	20	27		3	10	17	24	31			7	14	21	28
Tuesday		7	14	21	28		4	11	18	25			1	8	15	22	29
Wednesday	1	8	15	22	29		5	12	19	26			2	9	16	23	30
Thursday	2	9	16	23	30		6	13	20	27			3	10	17	24	
Friday	3	10	17	24	31		7	14	21	28			4	11	18	25	
Saturday	4	11	18	25		1	8	15	22	29			5	12	19	26	
Sunday	5	12	19	26		2	9	16	23	30			6	13	20	27	

	OCTOBER					NOVEMBER						DECEMBER					
Week No.	40	41	42	43	44	44	45	46	47	48	49	49	50	51	52	53	
Monday		5	12	19	26		2	9	16	23	30			7	14	21	28
Tuesday		6	13	20	27		3	10	17	24			1	8	15	22	29
Wednesday		7	14	21	28		4	11	18	25			2	9	16	23	30
Thursday	1	8	15	22	29		5	12	19	26			3	10	17	24	31
Friday	2	9	16	23	30		6	13	20	27			4	11	18	25	
Saturday	3	10	17	24	31		7	14	21	28			5	12	19	26	
Sunday	4	11	18	25		1	8	15	22	29			6	13	20	27	

2021

	JANUARY					FEBRUARY					MARCH				
Week No.	53/20	1	2	3	4	5	6	7	8		9	10	11	12	13
Monday		4	11	18	25	1	8	15	22		1	8	15	22	29
Tuesday		5	12	19	26	2	9	16	23		2	9	16	23	30
Wednesday		6	13	20	27	3	10	17	24		3	10	17	24	31
Thursday		7	14	21	28	4	11	18	25		4	11	18	25	
Friday	1	8	15	22	29	5	12	19	26		5	12	19	26	
Saturday	2	9	16	23	30	6	13	20	27		6	13	20	27	
Sunday	3	10	17	24	31	7	14	21	28		7	14	21	28	

	APRIL					MAY						JUNE				
Week No.	13	14	15	16	17	17	18	19	20	21	22	22	23	24	25	26
Monday		5	12	19	26		3	10	17	24	31		7	14	21	28
Tuesday		6	13	20	27		4	11	18	25		1	8	15	22	29
Wednesday		7	14	21	28		5	12	19	26		2	9	16	23	30
Thursday	1	8	15	22	29		6	13	20	27		3	10	17	24	
Friday	2	9	16	23	30		7	14	21	28		4	11	18	25	
Saturday	3	10	17	24		1	8	15	22	29		5	12	19	26	
Sunday	4	11	18	25		2	9	16	23	30		6	13	20	27	

	JULY					AUGUST						SEPTEMBER				
Week No.	26	27	28	29	30	30	31	32	33	34	35	35	36	37	38	39
Monday		5	12	19	26		2	9	16	23	30		6	13	20	27
Tuesday		6	13	20	27		3	10	17	24	31		7	14	21	28
Wednesday		7	14	21	28		4	11	18	25		1	8	15	22	29
Thursday	1	8	15	22	29		5	12	19	26		2	9	16	23	30
Friday	2	9	16	23	30		6	13	20	27		3	10	17	24	
Saturday	3	10	17	24	31		7	14	21	28		4	11	18	25	
Sunday	4	11	18	25		1	8	15	22	29		5	12	19	26	

	OCTOBER					NOVEMBER						DECEMBER				
Week No.	39	40	41	42	43	44	45	46	47	48		48	49	50	51	52
Monday		4	11	18	25	1	8	15	22	29			6	13	20	27
Tuesday		5	12	19	26	2	9	16	23	30			7	14	21	28
Wednesday		6	13	20	27	3	10	17	24			1	8	15	22	29
Thursday		7	14	21	28	4	11	18	25			2	9	16	23	30
Friday	1	8	15	22	29	5	12	19	26			3	10	17	24	31
Saturday	2	9	16	23	30	6	13	20	27			4	11	18	25	
Sunday	3	10	17	24	31	7	14	21	28			5	12	19	26	

2022

	JANUARY						FEBRUARY						MARCH					
Week No.	52/21	1	2	3	4	5	5	6	7	8	9		9	10	11	12	13	
Monday		3	10	17	24	31			7	14	21	28		7	14	21	28	
Tuesday		4	11	18	25			1	8	15	22		1	8	15	22	29	
Wednesday		5	12	19	26			2	9	16	23		2	9	16	23	30	
Thursday		6	13	20	27			3	10	17	24		3	10	17	24	31	
Friday		7	14	21	28			4	11	18	25		4	11	18	25		
Saturday	1	8	15	22	29			5	12	19	26		5	12	19	26		
Sunday	2	9	16	23	30			6	13	20	27		6	13	20	27		

	APRIL						MAY						JUNE					
Week No.		13	14	15	16	17	17	18	19	20	21	22	22	23	24	25	26	
Monday			4	11	18	25		2	9	16	23	30		6	13	20	27	
Tuesday			5	12	19	26		3	10	17	24	31		7	14	21	28	
Wednesday			6	13	20	27		4	11	18	25		1	8	15	22	29	
Thursday			7	14	21	28		5	12	19	26		2	9	16	23	30	
Friday		1	8	15	22	29		6	13	20	27		3	10	17	24		
Saturday		2	9	16	23	30		7	14	21	28		4	11	18	25		
Sunday		3	10	17	24		1	8	15	22	29		5	12	19	26		

	JULY						AUGUST						SEPTEMBER					
Week No.		26	27	28	29	30		31	32	33	34	35	35	36	37	38	39	
Monday			4	11	18	25		1	8	15	22	29		5	12	19	26	
Tuesday			5	12	19	26		2	9	16	23	30		6	13	20	27	
Wednesday			6	13	20	27		3	10	17	24	31		7	14	21	28	
Thursday			7	14	21	28		4	11	18	25		1	8	15	22	29	
Friday		1	8	15	22	29		5	12	19	26		2	9	16	23	30	
Saturday		2	9	16	23	30		6	13	20	27		3	10	17	24		
Sunday		3	10	17	24	31		7	14	21	28		4	11	18	25		

	OCTOBER						NOVEMBER						DECEMBER					
Week No.	39	40	41	42	43	44	44	45	46	47	48		48	49	50	51	52	
Monday		3	10	17	24	31			7	14	21	28		5	12	19	26	
Tuesday		4	11	18	25			1	8	15	22	29		6	13	20	27	
Wednesday		5	12	19	26			2	9	16	23	30		7	14	21	28	
Thursday		6	13	20	27			3	10	17	24		1	8	15	22	29	
Friday		7	14	21	28			4	11	18	25		2	9	16	23	30	
Saturday	1	8	15	22	29			5	12	19	26		3	10	17	24	31	
Sunday	2	9	16	23	30			6	13	20	27		4	11	18	25		

2023

	JANUARY						FEBRUARY					MARCH				
Week No.	52/22	1	2	3	4	5	5	6	7	8	9	9	10	11	12	13
Monday		2	9	16	23	30		6	13	20	27		6	13	20	27
Tuesday		3	10	17	24	31		7	14	21	28		7	14	21	28
Wednesday		4	11	18	25		1	8	15	22		1	8	15	22	29
Thursday		5	12	19	26		2	9	16	23		2	9	16	23	30
Friday		6	13	20	27		3	10	17	24		3	10	17	24	31
Saturday		7	14	21	28		4	11	18	25		4	11	18	25	
Sunday	1	8	15	22	29		5	12	19	26		5	12	19	26	

	APRIL						MAY					JUNE				
Week No.		13	14	15	16	17	18	19	20	21	22	22	23	24	25	26
Monday			3	10	17	24	1	8	15	22	29		5	12	19	26
Tuesday			4	11	18	25	2	9	16	23	30		6	13	20	27
Wednesday			5	12	19	26	3	10	17	24	31		7	14	21	28
Thursday			6	13	20	27	4	11	18	25		1	8	15	22	29
Friday			7	14	21	28	5	12	19	26		2	9	16	23	30
Saturday		1	8	15	22	29	6	13	20	27		3	10	17	24	
Sunday		2	9	16	23	30	7	14	21	28		4	11	18	25	

	JULY						AUGUST					SEPTEMBER				
Week No.	26	27	28	29	30	31	31	32	33	34	35	35	36	37	38	39
Monday		3	10	17	24	31		7	14	21	28		4	11	18	25
Tuesday		4	11	18	25		1	8	15	22	29		5	12	19	26
Wednesday		5	12	19	26		2	9	16	23	30		6	13	20	27
Thursday		6	13	20	27		3	10	17	24	31		7	14	21	28
Friday		7	14	21	28		4	11	18	25		1	8	15	22	29
Saturday	1	8	15	22	29		5	12	19	26		2	9	16	23	30
Sunday	2	9	16	23	30		6	13	20	27		3	10	17	24	

	OCTOBER						NOVEMBER					DECEMBER				
Week No.	39	40	41	42	43	44	44	45	46	47	48	48	49	50	51	52
Monday		2	9	16	23	30		6	13	20	27		4	11	18	25
Tuesday		3	10	17	24	31		7	14	21	28		5	12	19	26
Wednesday		4	11	18	25		1	8	15	22	29		6	13	20	27
Thursday		5	12	19	26		2	9	16	23	30		7	14	21	28
Friday		6	13	20	27		3	10	17	24		1	8	15	22	29
Saturday		7	14	21	28		4	11	18	25		2	9	16	23	30
Sunday	1	8	15	22	29		5	12	19	26		3	10	17	24	31

3 SCHEDULE OF CRITICAL DATES

3.1 Date for Commencement

The Date for Commencement of the Works shall be 17 July 2015.

3.2 Completion Obligations for Whole of the Works

The Completion Obligations for the whole of the Works shall be subject to Liquidated Damages as specified in the Appendix to the Form of Tender.

3.2.1 Base Contract: In the event no Option is exercised, the Completion Obligations for the whole of the Works is as follows:

Completion Obligations	Completion Date (Week/Year)
Whole of the Works (Completion of Tests on Completion and ready for Passenger Service for 78 Trains)	52/22

3.2.2 Option 1A: In the event that Option 1A is exercised, the Completion Obligations for the whole of the Works is as follows:

Completion Obligations	Completion Date (Week/Year)
Whole of the Works (Completion of Tests on Completion and ready for Passenger Service for 93 Trains)	52/23

3.2.3 Option 1B: In the event that Option 1B is exercised, the works under the option will be executed under a separate contract. The Completion Obligations for the whole of the Works for the 78 trains and the additional 15 trains (under separate contract) are as follows:

Completion Obligations	Completion Date (Week/Year)
Whole of the Works (Completion of Tests on Completion and ready for Passenger Service for 78 Trains)	52/22
Whole of the Works (Completion of Tests on Completion and ready for Passenger Service for 15 Trains)	52/35

3.3 Completion Obligations for Sections of the Works

The Completion Obligations for the Section 1 of the Works shall be subject to General Damages. The Completion Obligation for remaining Sections of the Works shall be subject to Liquidated Damages as specified in the Appendix to the Form of Tender

3.3.1 Base Contract: In the event no Option is exercised, the Completion Obligations for the Sections of the Works is as follows:

Sections of the Works	Completion Obligations	Completion Date (Week/Year)
1	Completion of Reliability Proving Test at Contractor's Test Facility	52/17
2	Completion of Delivery to Siu Ho Wan Depot for the 1st train	02/18
3	Completion of Delivery to Siu Ho Wan Depot for the 2nd train	15/18
4	Completion of Tests on Completion and ready for Passenger Service for the 1st and 2nd train	39/18
5	Completion of Delivery to Siu Ho Wan Depot for 28 trains (cumulative)	37/19

6	Completion of Tests on Completion and ready for Passenger Service for 28 trains (cumulative)	52/19
7	Completion of Delivery to Siu Ho Wan Depot for 44 trains (cumulative)	33/20
8	Completion of Tests on Completion and ready for Passenger Service for 44 trains (cumulative)	51/20
9	Completion of Delivery to Siu Ho Wan Depot for 61 trains (cumulative)	34/21
10	Completion of Tests on Completion and ready for Passenger Service for 61 trains (cumulative)	52/21
11	Completion of Delivery to Siu Ho Wan Depot for 78 trains (cumulative)	39/22

3.3.2 Option 1A: In the event that Option 1A is exercised, the Completion Obligations for the Sections of the Works is as follows:

Sections of the Works	Completion Obligations	Completion Date (Week/Year)
1	Completion of Reliability Proving Test at Contractor's Test Facility	52/17
2	Completion of Delivery to Siu Ho Wan Depot for the 1st train	02/18
3	Completion of Delivery to Siu Ho Wan Depot for the 2nd train	15/18
4	Completion of Tests on Completion and ready for Passenger Service for the 1st and 2nd train	39/18
5	Completion of Delivery to Siu Ho Wan Depot for 28 trains (cumulative)	37/19
6	Completion of Tests on Completion and ready for Passenger Service for 28 trains (cumulative)	52/19

7	Completion of Delivery to Siu Ho Wan Depot for 44 trains (cumulative)	33/20
8	Completion of Tests on Completion and ready for Passenger Service for 44 trains (cumulative)	51/20
9	Completion of Delivery to Siu Ho Wan Depot for 61 trains (cumulative)	34/21
10	Completion of Tests on Completion and ready for Passenger Service for 61 trains (cumulative)	52/21
11	Completion of Delivery to Siu Ho Wan Depot for 78 trains (cumulative)	39/22
12	Completion of Tests on Completion and ready for Passenger Service for 78 trains (cumulative)	52/22
13	Completion of Delivery to Siu Ho Wan Depot for 93 trains (cumulative)	39/23

3.3.3 Option 1B: In the event that Option 1B is exercised, the Works under the Option will be executed under a separate contract. The Completion Obligations for the Sections of the Works for the 78 trains and the additional 15 trains (under separate contract) are as follows:

Sections of the Works	Completion Obligations (78 Trains)	Completion Date (Week/Year)
1	Completion of Reliability Proving Test at Contractor's Test Facility	52/17
2	Completion of Delivery to Siu Ho Wan Depot for the 1st train	02/18
3	Completion of Delivery to Siu Ho Wan Depot for the 2nd train	15/18
4	Completion of Tests on Completion and ready for Passenger Service for the 1st and 2nd train	39/18
5	Completion of Delivery to Siu Ho Wan Depot for 28 trains (cumulative)	37/19

6	Completion of Tests on Completion and ready for Passenger Service for 28 trains (cumulative)	52/19
7	Completion of Delivery to Siu Ho Wan Depot for 44 trains (cumulative)	33/20
8	Completion of Tests on Completion and ready for Passenger Service for 44 trains (cumulative)	51/20
9	Completion of Delivery to Siu Ho Wan Depot for 61 trains (cumulative)	34/21
10	Completion of Tests on Completion and ready for Passenger Service for 61 trains (cumulative)	52/21
11	Completion of Delivery to Siu Ho Wan Depot for 78 trains (cumulative)	39/22

Sections of the Works	Completion Obligations (Additional 15 Trains)	Completion Date (Week/Year)
1	Completion of Delivery to Siu Ho Wan Depot for 7 trains (cumulative)	39/29
2	Completion of Tests on Completion and ready for Passenger Service for 7 trains (cumulative)	52/29
3	Completion of Delivery to Siu Ho Wan Depot for 11 trains (cumulative)	39/34
4	Completion of Tests on Completion and ready for Passenger Service for 11 trains (cumulative)	52/34
5	Completion of Delivery to Siu Ho Wan Depot for 15 trains (cumulative)	39/35

3.4 Specified Parts of the Works definition in each train

3.4.1 The Completion of Tests on Completion and ready for passenger service for each train is a specified part of the Works.

4 SCHEDULE OF KEY DATES FOR DESIGN SUBMISSIONS

Key Date Number	Activity	Week (Not later than)
KD1	* Approval in Principle (AIP) of major sub-contractors and equipment suppliers	35/15
KD2	* Approval of SEMP Stage 1 * Orders placed for major equipment * Approval of ***specified plans***	52/15
KD3	* Approval in Principle (AIP) of the full-scale foamcore cab mock-up * Approval of Design, Manufacturing & Commissioning Programme and Design Submission Plan	06/16
KD4	* Approval of detailed Manufacturing and Delivery Programme * Approval of material control schedule	09/16
KD5	* Approval of SEMP Stage 2 * Engineer's confirmation of effective operation of programme management system * Engineer's confirmation of effective operation of ***specified plans***	22/16
KD6	* Car shell and sub-assembly tooling complete	26/16
KD7	* Approval in Principle (AIP) of full-scale engineering cab / saloon mock-up	30/16
KD8	* Approval of preliminary test plan * Approval in Principle (AIP) of underframe mock-up and layout * Approval of design for sub-assembly of underframe, roof and bodyside	39/16
KD9	* Complete sub-assembly of car bodyshell and available for test * Delivery of traction equipment including all underframe equipment and motors to Contractor’s works for first train	05/17
KD10	* Approval of structural test report on car body	12/17

Key Date Number	Activity	Week (Not later than)
KD11	* Complete assembly of first manufactured train for testing at Contractor's test track including all systems and sub-systems	21/17
KD12	* Approval of SEMP Stage 3 * Approval of training plan * Commencement of O&M Manual Programme	25/17
KD13	* Approval of combined test	43/17
KD14	* Availability of first train for shipment * Completion of training for test crew, training instructors and train operators	48/17
KD15	* Approval of SEMP Stage 4 * Delivery of critical running, maintenance and commissioning / warranty spares	08/18
KD16	* Completion of technical training * Delivery of critical special tools and testing equipment * Approval of batch 2 printed O&M Manuals * Completion of defect recovery training	25/18
KD17	* Approval of SEMP Stage 5 * Approval of As Built Drawings and O&M Manuals	52/18

Note: Specified plans are defined as Safety Plan, Quality Plan and Environmental Management Plan

APPENDIX G

SITE LAYOUT AND WORKS AREAS

August 2015

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APPENDIX G SITE LAYOUT AND WORKS AREAS

1 Siu Ho Wan Depot (SHD)

1.1 The work site within the SHD as described in PS 30 is as outlined in the Drg. No. 520/Z/00/PWY/C30/362 for your reference. The layout of the SHD may be subjected to some minor changes.

1.2 The following areas outlined in the Drg. No. 520/Z/00/PWY/C30/362 are to be made available for use by the Contractor subject to the conditions stated in PS 30 and to the agreement with the Engineer:

(a) Vertical seawall

(b) Light maintenance track

(c) Stabling track

(d) Depot test track

1.3 Vertical Seawall Facility

(a) The vertical seawall facility is located to the north west of the SHD. This facility is 80 m long and provides direct access to the Seawall Maintenance Access Road and the Main Depot Entry Road.

(b) There is no lifting facility on the seawall and that all lifting from sea transport will be with mobile crane to be provided by the Contractor.

(c) The area adjacent to this facility has no overhead wire. The car will be unloaded directly onto the rail track adjacent to the seawall.

1.4 Site Office and Storage Space

(a) A space for accommodating three 20-fleet containers as site office; and

(b) A space of approximately 210 m^2 as storage area.

2 Urban Lines (URL) Depots

2.1 The work sites within the Urban Lines Depots (CWD, KBD, TKD and TWD) as described in PS 30 are as outlined in the Drg. Nos. OD2/206/40422/0003, C6014-14E/TSEG/990/016, USP/M/TKD3/XXX/A00/XXX and USP/TWD1/A12/001 respectively.

2.2 The area in each depot for the Contractor subject to agreement with the Engineer.

2.3 The tracks in each depot to be made available for the Contractor subject to the conditions stated in PS 30 and agreement with the Engineer:

(a) Heavy maintenance track

(b) Light maintenance track

(c) Stabling track

(d) Depot test track (SHD and KBD)

APPENDIX H

RULES AND PROCEDURES FOR WORKING WITHIN OR ADJACENT TO THE RAILWAY

August 2015

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APPENDIX H RULES AND PROCEDURES FOR WORKING WITHIN OR ADJACENT TO THE RAILWAY

1 Introduction

2 Competent Person

3 Application for Access to Mainline Test Run

4 Working Hours for Mainline Test Run

5 Working Requirements and Restrictions

Annex 1 : P-Licensing System - Caring and Coaching System for new Contractor workers

Annex 2 : Contractor Fitness for Duty Management

1 Introduction

1.1 The principal point for controlling all construction work within or adjacent to the railway is the Mass Transit Railway Corporation Ordinance CAP 270.

"23E (1) A person commits an offence if he wilfully does or omits to do anything in relation to the railway and the safety of any person travelling or being upon the railway is thereby endangered, or likely to be endangered.

(2) A person who commits an offence under subsection (1) is liable to a fine of $5000 and to imprisonment for 6 months."

1.2 The operation of the Railway is subject to independent review by:

(a) The Railway Development Office of the Highways Department

(b) The Safety and Security Co-ordinating Committee (SSCC)

(c) Railway Branch of Electrical and Mechanical Services Department (EMSD-RB)

Each has its own statutory authority.

1.3 To give effect to the Ordinance, the Engineer requires the Contractor to comply with the following:

(a) Advance notice of all intended works shall be given for Approval and modification as required.

(b) All works shall be carried out under supervisors trained in the appropriate discipline(s). A so-called P-Licencing System for caring and coaching of new workers on understanding the safety requirements is established, details refer to Annex 1 of this Appendix.

(c) Strict control shall be maintained on access to all areas where trains are in operation, including platforms.

(d) The shift-in-charge's authority for approving execution of works which affects normal depot operation, on a day to day basis, shall be complied with.

1.4 Legislation and Codes of Practice

The Contractor shall comply with all the current legislation, Codes of Practice and guidance document approved by the Hong Kong Government as specified in GS Section 17.

1.5 Specific procedures "for the safe operation of the Railway" which shall be observed by "contractors, sub-contractors and agents" are laid down in the following Employer's manuals:

(a) Railway Safety Rules for Contractor

(b) Accident, Incident and Emergency Procedures Manual

(c) Project Health and Safety Manual (refer to GS Section 15)

1.6 The Contractor shall comply with the safety and quality standards set out in the Contract, and in addition shall meet the specific safety standards of the Railway.

1.7 Instructions given to the Contractor which are intended to remove a safety hazard shall be complied with if the Contractor is not to commit an offence of the kind covered by section 23E of the Ordinance. Modifications to Approved operations may be necessary where emergencies develop on the Railway or an unforeseen hazard develops.

1.8 Approved Method Statements and contract requirements shall not be deviated from unless for the reasons cited above. Work will be stopped, if such is the case, by a verbal instruction given by the Engineer to the Contractor's person-in-charge, and subsequently confirmed in writing.

2 Competent Persons

2.1 The shift-in-charge at the Depot (refer to PS 30 for the work site arrangement) may issue a verbal instruction to the Contractor to stop work, to be confirmed subsequently in writing. The Contractor shall stop work on receipt of the order and contact the Engineer as soon as practicable, for further instruction from him

2.2 The Contractor shall provide sufficient staff to attend the Competent Person Training Courses organised by the Employer to enable him to have sufficient number of Competent Persons to cover all shifts, holidays and absenteeism.

2.3 Only Competent Person qualified by the Employer can supervise the work on or adjacent to the Railway.

2.4 All the Contractor's staff working within or adjacent to the Railway shall need to attend the Safety Induction Training Course organised by the Employer.

2.5 The regular two-day courses for Competent Persons take up to two months to organise. At the start of the Contract, courses specifically for the Contractors staff may be run at the Contractors request to provide the required number of Competent Persons.

2.6 The Contractor shall bear at his own cost to attend all the courses (e.g. CP(T), CP(NT), RSI, Fire Marshall etc.) provided by the Employer. Notwithstanding the requirement of GS Clause 15.2.4.3(d), the charges for all courses are shown in the below table.

Type of Training Course		Duration of the Course	Duration of Job Attachment	Validity of Qualification	Training Course Fee (HK$ per person per course)
Competent Person (Track)	CP(T)	2 days	4 nights	1 year	1,000
Competent Person (Non-Track)	CP(NT)	1.5 days	2 nights	1 year	800
Railway Safety Induction	RSI	1 day	N/A	1 year	500
Fire Marshall	FM	0.5 day	N/A	2 years	300

Refresher courses at the same rate shall be taken upon expiry of the qualification.

Notwithstanding the provision of GS Clause 15.2.4.3(e), the Contractor shall pay the training fee before submitting their nomination. No refund will be given by the Employer for not passing any of the examinations or for being absent from training courses or the examination.

2.7 Not used.

2.8 The Contractor shall inform the shift-in-charge at the Depot before commencement of work who shall be the Competent Person in charge.

3 Application for Access to Mainline Test Run

3.1 The Contractor shall nominate persons for making applications for access to work on or adjacent to the Railway.

3.2 Applications shall be made through the Engineer to the Chairman of the Engineering Works Meeting 28 days in advance and should state the following details:-

(a) Date and time
(b) Location: (e.g. track chainages, plant room name)
(c) Nature of work
(d) Facilities required from Railway e.g. Works Train, Railway Competent Person (RCP)
(e) Contractor's named supervisor on Site
(f) Contractor's Competent Person (CP)

3.3 Each application shall be accompanied with a five week rolling programme.

3.4 Responses to applications will be sent to the Contractor through the Engineer. In order that Railway resources are deployed efficiently, the "Nature of Work" should be clearly described since work may be permitted without a RCP. This will be made clear to the Contractor in the response.

3.5 Only applications from the Contractor's nominated co-ordinator will be accepted.

3.6 The Employer will not accept the responsibility for delay or additional cost caused by non-availability of the test path resulting from the requirements of the Employer.

4 Working Hours for Mainline Test Run

4.1 Test run on the Urban Lines shall be carried out during non-traffic hours. Non-traffic hours is a duration of up to 3 hours during the period of 0200 to 0500. The actual time of commencement is to be agreed with the Engineer when agreeing possession for the relevant works. The working period of 3 hours shall commence at the nominated location for track access and complete at the nominated location for track egress.

4.2 The Contractor is advised that the actual time available for testing will be reduced by operational handover and possession requirements. The remaining test time on the Urban Lines shall be about 2.5 hours per night.

4.3 On vacating the mainline test path and handing it over to the Engineer at the end of each working period, the Contractor is required to take all necessary measures to protect the works which have been completed. The mainline test path shall be cleared and left tidy to the satisfaction of the Engineer.

5 Working Requirements and Restrictions

1.1 Temporary Works shall comply with structure gauge requirements. (All materials and tools must be totally removed from the track area at the end of each shift).

1.2 Authority of the shift-in-charge at the Depot and Competent Person shall be made known to workforce.

1.3 Workforce shall be instructed not to trespass outside designated works area and not to smoke in premises. Passes, issued by the Employer, shall be worn by all members of the Contractor's workforce when on the Railway.

1.4 Names and trades of all work force shall be forwarded to the Engineer, together with name of the person-in-charge. The person-in-charge shall remain at the site throughout the working period and be responsible for ensuring that the Site is in a safe condition at the end of the working period.

1.5 Protection measures to existing finishes, equipment and installations shall be detailed. Warning signs shall be placed for workforce and passengers.

1.6 The Contractor shall not allow work to commence on any Employer equipment unless prior Approval has been obtained. All existing electric cables shall be considered as "Live" and work shall only commence after the method of working has been Approved.

1.7 Suitable personal protection equipment such as high visibility clothing shall be worn by all workmen when working on or near the tracks. High visibility vests will be provided by the Employer at the Contractor's Cost.

1.8 All persons, tools and materials shall be cleared from the track on completion of each workshift.

1.9 For works to be carried out in close proximity of the tracks and when instructed by the Engineer the provision of Look-out men and Competent Persons will be arranged by the Engineer with the Employer.

1.10 The Contractor shall not carry out any work which may require any part of a person or any tool or material to be used on or adjacent to the overhead line equipment, unless the overhead line equipment has been isolated and earthed in accordance with the Employer's Railway Safety Rules for Contractor. Approval to commence work must be obtained from the RCP prior to the start of each workshift.

Annex 1 P-Licensing System - Caring and Coaching System for New Contractor Workers

1 Aim

The P-Licensing System shall provide first line orientation and guidance to the new workers (or green workers with few experience) to clearly understand the safety requirements of the Employer, and to increase their safety awareness with a view to enhancing site safety, particularly the railway related safety.

2 Categories of New Workers

2.1 Probationer (P) refers to any worker who has less than 6 months' construction site experience and no experience of working at the Site of the Contract with the Employer.

2.2 Newcomer (N) refers to any worker who has attained at least 6 months' construction site experience but no experience of any working in MTR operational premises. Worker who has obtained at least one month past working experience of operational related Site of the Employer could be regarded as waiver to requirements of Newcomer. However, it would be up to Contractor to decide and judge whether a particular worker would require to undergo the familiarization programme same as a "New Comer" notwithstanding that the particular worker concerned has acquired more than 1 month site experience with the operational railway of the Employer.

3 System Implementation

3.1 Probationer

3.1.1 The Probationer will be identified with a "P" sticker label affixed to his/ her safety helmet. If wearing of safety helmet is not mandatory for any contracts (e.g. cleaner contract), the Probationer will be identified with a "P" sticker affixed on the working ID card or badge on his/her chest.

3.1.2 The Contractor shall conduct a min. 1.5-hour briefing to the Probationer on the general principles and practices of site safety and the safety matters which are relevant to the Site of the Contract with the Employer (please refer to para. 5 of this Annex for details).

3.1.3 The Contractor shall appoint a skilled or semi-skilled worker, who has past working experience of the operation related contracts with the Employer, to act as a mentor/ coach.

3.1.4 The Contractor shall arrange a mentor to take care of remind the Probationer of the site safety requirements from time to time for a

minimum period of 3 months.

3.1.5 The mentor will only be permitted to take care of a maximum of 4 Probationers/Newcomers at the same time.

3.1.6 The mentor shall, on full time basis, accompany the Probationer to work including the daily pre-work safety briefing and allocation of work.

3.1.7 A performance review shall be arranged to appraise the general safety performance of the Probationer after 3 months' coaching (please refer to Para. 6 of this Annex for details).

3.1.8 If the general safety performance is satisfactory as determined in the safety performance review, the Probationer will be allowed to work on his / her own without the "P" sticker label on the helmet. Otherwise, the Probationer shall continue with the mentoring/ coaching process until satisfactory performance is achieved.

3.2 Newcomer

3.2.1 The Newcomer will be identified with a "N" sticker on his / her safety helmet. If wearing of safety helmet is not mandatory, the Newcomer will be identified with a "N" sticker label affixed on the working ID card or badge on his/her chest.

3.2.2 The Contractor shall conduct a min. 1 hour briefing to the Newcomer on the safety matters which are relevant to working in the Site of the Contract with the Employer (please refer to para. 5 of this Annex for details).

3.2.3 The Contractor shall appoint a skilled or semi-skilled worker, who has past working experience of the operation related contracts with the Employer, to act as a mentor/ coach.

3.2.4 The Contractor shall arrange a mentor to take care of/ remind the Newcomer of the site safety requirements from time to time for a minimum period of 1 month.

3.2.5 The mentor will only be permitted to take care of a maximum of 4 Probationers/Newcomers at the same time.

3.2.6 A performance review shall be arranged to appraise the general safety performance of the Newcomer after 1 months' coaching period (Please refer to para. 6 of this Annex for details).

3.2.7 With satisfactory safety performance, the Newcomer will be allowed to work on his / her own without the label of "N" affixed on the helmet. Otherwise, the Newcomer shall continue with the mentoring process until satisfactory performance is achieved.

4 Identification Sticker Label

4.1 The sticker labels will be provided by the Employer at a reasonable quantity.

4.2 The sticker labels will be affixed to the safety helmets throughout the mentoring period.

"P" Sticker Label

"N" Sticker Label

5 Training Materials

5.1 A Contractor Information Centre is currently available in the Employer's website http://cic.mtr.com.hk in which many safety related information are uploaded. Details of the P-Licensing System are also uploaded to this website. The Contractor shall prepare the training materials for providing safety briefing to workers based on related P-licensing training materials in the website.

5.2 The safety briefing shall be conducted by the Safety Officer or Safety Supervisor in such a way that the Contractor will address both the general industrial related site safety principles and practices, and the railway related safety matters for working at the Site. The safety briefing should include safety requirements for works under all working locations within the Site, the relevant lesson learnt case(s) extracted from the Construction Industry Council and the sample case(s) provided by the Employer. Both the industrial and railway related safety topics shall carry proper weighting in the safety briefing.

6 Safety Performance Review

6.1 The Safety Performance Review shall be undertaken by two assessors. One Safety Officer and one safety competent supervisory staff of the Contractor shall be nominated as the joint assessors for the Engineer's approval. The assessment result of the Safety Performance Review will be documented in the P-Licensing System as proper records by the Contractor.

6.2 In the event that there are frequent in/out movements of the Probationers or Newcomers under the P-Licensing System during the Contract Period, the related working experience of such workers shall be reviewed by the Contractor's assessors, with the final results of the review endorsed by the Engineer. In any case, no workers shall be considered fulfilling the mentoring requirements unless at least 80% of the mentoring period has been achieved under the P-Licensing System.

6.3 The assessors shall take into account of the different general safety degree/ level of risks and hazards in different locations of the Site in the performance review. For instance, the risks for the works at the running tracks may be higher than those at the station concourse.

Annex 2 Contractor Fitness for Duty Management

1 Definition of Fitness-for duty

Fitness-for-duty means that an employee is in a physical, mental, and emotional state which enables him/her to perform the essential tasks of his or her work assignment in a manner which does NOT threaten the safety or health of oneself, co-workers, property, or the public at large.

2 Contractor Fitness for Duty Management Requirements

2.1 The Contractor shall establish systems for ensuring all direct & in-direct workers performed physical duties not suffering from physical and/or mental conditions, or being taking medical treatment likely to cause:

- sudden loss of consciousness;
- impairment of awareness or concentration;
- sudden incapability;
- impairment of balance or co-ordination
- significant limitation of mobility.

2.2 The Contractor shall set up test system at work site against use of drugs & alcohols.

2.3 The Contractor shall disseminate Information provided by the Employer on any “Contractor Fitness for Duty Management” to workers and other persons that are likely to be affected.

2.4 The GS Section 12 shall serve as a base requirement in addition to this PS.

APPENDIX I

DESIGNATED CONTRACTS AND

INTERFACING SYSTEMS

August 2015

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APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 1 P-WAY INTERFACE (TRACK DATA)

1 Introduction

2 Alignment Data

3 Track Gauge

4 Trackform and Rail Profile

5 Track Tolerances

6 Location of Structures

7 Tunnels

8 Code Speed

9 Supplementary Information

Table App-I-Annex-1-1 Maintenance Tolerances of Track

Attachments - Supplementary Information

Design Standards Manual Section 3.2 Alignment Design

Design Standards Manual Section 3.4 Trackform Design

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 1 P-WAY INTERFACE (TRACK DATA)

1 INTRODUCTION

This Annex of Appendix I contains details of the track over which the trains will run on the Urban Lines. This Annex shall read in conjunction with PS 5, PS 12 and Appendix M.

2 ALIGNMENT DATA

Vertical and horizontal alignment data shall refer to track alignment drawings listed in Appendix A under category of Track Data. Supplementary information for alignment design shall refer to Clause 9.1 of this Annex.

3 TRACK GAUGE

The nominal track gauge of the running lines in the Urban Lines will be 1 432 mm.

4 TRACKFORM AND RAIL PROFILE

4.1 Cross sections of the various types of trackform used in Urban Lines can be found from the supplementary information for trackform design which shall refer to Clause 9.2 of this Annex.

4.2 The rail profile will be type UIC 60 in accordance with UIC leaflet number 861-3: 1969 for LAT to TIK on KTL, ISL, TKL and TCL (refer to Drg. No. OD8/501/00001/0057). The rail profile will be BS rail section no. 90A in accordance with BS 11: 1985 and modified to a common profile (refer to Drg. No. OD8/501/00001/0057) for KBD, TWD, CWD, TKD, SHD, TWL and KTL except LAT to TIK.

4.3 Track parameters are as follows:-

4.3.1 Ballasted Track

(a)	Mass:	565 kg/m	(including rails, fastenings and sleepers)
(b)	Stiffness:	62 kN/mm	(per sleeper end, 650 mm centres)
(c)	Damping:	20%	

4.3.2 Non-Ballasted Track

(a)	Mass:	410 kg/m	(including rails, fastenings and blocks)
(b)	Stiffness:	25 kN/mm	(nominal, per rail support, 650 mm centres)
(c)	Damping:	26% minimum	

5 TRACK TOLERANCES

5.1 Tolerances for track at the maintenance limit are given in Table App-I-Annex-1-1.

5.2 Rail corrugations will be limited to a depth of 0.2 mm on installation and 0.5 mm for the maintenance limit.

6 LOCATIONS OF STRUCTURES

Cross sections and locations of structures (such as stations, tunnels) on Urban Lines shall refer to trackform type drawings and track schematic drawings listed in Appendix A under category of Track Data.

7 TUNNELS

Cross sections and locations of tunnels on Urban Lines shall refer to trackform type drawings and track schematic drawings listed in Appendix A under category of Track Data.

8 CODE SPEED

The details of the maximum allowable speed permitted for trains operating under the control of the signalling system on Urban Lines shall refer to track schematic drawings listed in Appendix A under category of Track Data.

9 SUPPLEMENTARY INFORMATION

9.1 Extract of Section 3.2 Alignment Design from the Employer's Design Standards Manual is reproduced hereafter as supplementary information to give details of the criteria and their application which will be used in the route alignment design.

9.2 Extract of Section 3.4 Trackform Design from the Employer's Design Standards Manual is reproduced hereafter as supplementary information to give details of the criteria and their application which will be used in the trackform design.

URBAN LINES - TRACK MAINTENANCE TOLERANCES				
PARAMETER	MAINTENANCE TOLERANCE			
	Ballasted	Non-ballasted except Straight Platforms	Non-ballasted Straight Platforms	Depot Tracks
Track Gauge[2]	+8/-2	+8/-2	+5/-2	+12/-3
Sidewear (Sidecut)[1]	8	8	0	10
Gauge + Sidewear[1]	+13/-2	+13/-2	+5/-2	+15/-3
Rate of Change of Gauge[2]	1 in 1000	1 in 1000	1 in 1000	1 in 500
Horizontal Position[2]	±15	±5	±5	N/A
Rate of Change of Horiz. Position[2]	1 in 500	1 in 1000	1 in 1000	1 in 250
Vertical Position[3]	+25/-50	±5	±5	N/A
Rail Topwear	15	15	15	20
Cross Level Error - St. & Cir. Curves - Transitions	 ±10 ±10	 ±15 ±15	 ±8 ±8	 ±15 ±15
Twist[4] - 2.5m base - 15m base	 1 in 150 1 in 250	 1 in 150 1 in 250	 1 in 400 1 in 1500	 1 in 150 1 in 150
Rate of Change of Vertical Position[4]	1 in 150	1 in 150	1 in 400	N/A

Table App-I-Annex-1-1 Maintenance Tolerances of Track

[1] Assumes sidewear can only occur on one rail and no sidewear occurs on straight track
[2] Assumed to new rail position (no sidewear)
[3] Assumed to new rail position (no headwear)
[4] Maintenance tolerance includes effect of cant transitions

Attachments – Supplementary Information
Design Standards Manual Section 3.2 Alignment Design
Design Standards Manual Section 3.4 Trackform Design

3.2 ALIGNMENT DESIGN

3.2.1 Introduction

The following criteria apply to the track alignment design for new lines.

3.2.2 Definitions

Civil Engineering and Building terms used within this Section of the Manual are in accordance with BS6100 - Glossary of Building and Civil Engineering Terms unless noted otherwise. Where terms are apparently contradictory or their use is unclear, clarification from the Corporation shall be sought before proceeding with design.

See also definitions in other subsections.

Track Gauge

The distance between the inside (gauge) faces of the rails in the plane tangential to the top of the rails. Track Gauge shall be 1 432 mm in plain line (both straight and curved track), switches and crossings.

Track Centre

The location mid-way between the inside (gauge) faces of the rails in the plane tangential to the top of the rails.

Rail Level

The level of the crown of the lower (grade) rail of the curved/canted track. and either rail in uncanted track.

Grade Rail

The reference rail used for defining the vertical track alignment. The lower rail in canted track.

Track Alignment

The Horizontal Alignment is the longitudinal locus of the track centre.

The Vertical Alignment is the vertical locus of the levels, gradients and vertical curves of the lower rail of the track.

Chainage

The measurement of horizontal distance along a planar centreline track alignment, measured from a reference point such as the centreline of platform. The actual travelled distance will differ when allowance for track gradients is made.

Throw - Horizontal and Vertical

The horizontal throw of a vehicle is the lateral displacement that occurs on a horizontal curve between the centre-line of the vehicle and the co-ordinated track centreline, measured perpendicularly to the track centreline. The vehicle is assumed to be symmetrical on the track with the centres of the bogies coincident with the track centre.

Vertical vehicular throw occurs on vertical curves in a similar manner to horizontal vehicular throw on horizontal curves.

Centre Throw

The centre throw is the distance from the track centreline to the measured perpendicular to the vehicle centreline midway between the bogies and is the maximum displacement that can occur towards the inside of a curve.

End Throw

The end throw is the distance measured at the extreme end of a vehicle and is the maximum displacement that can occur towards the outside of a curve.

Circular Curve

A curve of constant radius.

Transition Curve

A curve of uniformly varying radius linking either a straight and a circular curve or two circular curves.

Compound Curve

A curve formed by two circular curves of different radii but curving in the same direction. They may or may not be joined by a transition curve.

Reverse Curve

A curve formed by two circular curves which curve in opposite directions and may or may not be linked by transition curves.

Horizontal Intersection Point (HIP)

The intersection point of two horizontal curve tangents.

Vertical Curve

A curve of constant radius joining two separate gradients.

Vertical Intersection Point (VIP)

The intersection point of two gradients.

Design Speed

The actual running speed at which trains travel on a section of track under normal operating conditions. It is used for the calculation of applied cant on any curved section of track.

Maximum Speed

The theoretical maximum speed at which any train may travel on a section of track based on the track design criteria.

Code Speed

The maximum speed permitted for trains operating under the control of the signalling system on a section of track.

Maximum Attainable Code Speed

The speed in excess of the Code Speed which a train may attain prior to the application of the brakes. The applied cant on curves shall allow for this condition.

Cant

The amount by which one rail on a curve is raised above the other rail. It is positive when the outer rail of curved track is raised above the inner rail and negative when the inner rail is raised above the outer rail.

Equilibrium Cant

The cant required to enable a train to negotiate a curve at a particular speed without being subjected to an unbalanced centrifugal force such that both rails are loaded equally. The speed at which this condition applies is known as the *Equilibrium Speed.*

Applied Cant

The amount of cant specified for application to a circular curve.

Deficiency of Cant

The amount by which the applied cant is less than that needed to keep a train negotiating a curve at a particular speed in equilibrium.

Excess Cant

The amount by which the applied cant is more than that needed to keep a train negotiating a curve at a particular speed in equilibrium.

Cant Gradient

The rate at which the applied cant is uniformly increased or decreased expressed as a gradient.

Rate of Change of Cant or *Deficiency of Cant*

The rate at which cant or deficiency of cant is increased or decreased relative to the speed of a train.

Civil Speed Restriction

The maximum allowable train speed as determined by constraints on the alignment due to physical features on the infrastructure.

Double Track

Two, essentially parallel single tracks, whose separation is controlled solely by Railway Engineering requirements.

Twin Track

Two, essentially parallel single tracks, whose separation is controlled by an intervening structure.

3.2.3 Abbreviations

CWR - Continuous Welded Rail.

LWR - Long Welded Rail.

HIP - Horizontal Intersection Point.

VIP - Vertical Intersection Point.

WCB - Whole Circle Bearing.

BVC - Beginning of Vertical Curve.

EVC - End of Vertical Curve.

CLM - Centre Line Measure.

3.2.4 Code Speed and Maximum Attainable Code Speed

The Code Speed and Maximum Attainable Code Speed for each project are defined in the Functional Requirements Manual for the particular project.

3.2.5 Overruns and Sidings

Terminal Stations - overrun allowance

3.2.5.1 An overrun allowance of plain track shall be made beyond the terminal station on Running Lines. The allowance shall be:-

a)	stopping distance from station headwall	80m
b)	buffer stop sliding length (from buffer face)	30m
	Total	110m

Turnback Sidings and Refuge Sidings - minimum length

3.2.5.2 The minimum length required for turnback and refuge sidings shall be determined by the following requirements:-

LENGTH REQUIREMENTS	TURNBACK SIDING	REFUGE SIDING
a) Distance from end of turnout (stock rail 'fronts' joint) to start of track circuit	5m	5m
b) Distance from start of track circuit to signal	5m	5m
c) Sighting distance	10m	10m
d) Train length (8-Car consist)	184m	184m
e) Train overhang and allowance for stopping (including distance from headwall or platform end)	10m	10m
f) Overrun allowance	80m	34m
g) Buffer stop track occupation length (from buffer face)	30m	10m
Total	324m	258m

Stabling Sidings

3.2.5.3 Requirements for a stabling siding in the Depot shall be determined as for refuge Sidings 3.2.5.2 above.

3.2.6 Design Criteria - Horizontal Alignment

Applied Cant

3.2.6.1	Desirable maximum	130mm
	Absolute maximum	150mm
	Throughout Station Platforms	0 mm

Deficiency of Cant

3.2.6.2	Plain line (CWR) and main line through turnouts:	
	Maximum	110mm
	Minimum (nominal)	25mm
	Turnout curves - maximum	90mm
	Switch toe effective radius - maximum	125mm

Negative Cant

3.2.6.3	Switches and crossings - maximum	80mm

Rate of Change of Cant

3.2.6.4	Desirable maximum	37.5mm/sec
	Absolute maximum	55mm/sec

Rate of Change of Deficiency of Cant

3.2.6.5	Plain line and main line through turnouts;	
	Desirable maximum	37.5mm/sec
	Absolute maximum	55mm/sec
	Turnout curves - maximum	80mm/sec

Cant Gradient

3.2.6.6	Absolute Maximum	1-in-440
	Absolute Minimum	1-in-1 000

Horizontal Curves

3.2.6.7	Absolute minimum radius on Running Line for maximum speed of 80 km/h	300m
	Absolute minimum radius at Station Platform. Wherever practicable, a straight alignment shall be adopted at Stations. There should be no change of horizontal alignment throughout the platform length plus at least 18 metres beyond the extent of both ends of the platform.	2000 m
	Absolute minimum radius in Depot Connecting Line	300 m
	Absolute minimum radius in Depot	140 m
	Length of circular arc between transitions: - Desirable minimum	25 m

(The specified minimum distance seeks to prevent the car 'bridging' between two adjacent curves, based on a bogie spacing of 15.6m.)

Separation between tracks

3.2.6.8 Reference should be made to subsection 3.3 of this Manual for required separation distances between Double Track and Twin Track, appropriate to the support structure.

3.2.7 Design Criteria - Vertical Alignment

Gradients

3.2.7.1	Running Lines and Depot Connecting Lines	
	Desirable Maximum	±3%
	Minimum	Level
	Absolute Maximum*	±4%

***Note:** To be used when exceptional circumstances dictate and with written Approval only.

Through station platforms	Level
Tunnels, Bridges and Viaducts	
Maximum as Running Lines above	
Minimum	±0.3%
Sidings	
- Maximum	±0.3%
- Minimum	Level
Maintenance sidings	Level
Depot fans:	
- Maximum	±1%
- Minimum	Level

Vertical Curves for Running Lines

3.2.7.2	Desirable minimum radius (max speed 140km/h)	4 800 m
	Desirable minimum radius (max speed 80km/h)	3 000 m
	Absolute minimum radius	1 500 m
	Length of constant gradient between vertical curves:	
	Desirable minimum	50 m
	Absolute minimum	20 m

(The specified minimum distance seeks to prevent the car 'bridging' between two adjacent curves, based on a bogie spacing of 15.6m.)

3.2.8 Design Principles - Horizontal Alignment

Straights

3.2.8.1 Maximum use shall be made of straight track for Running Lines.

Alignments shall be such that Running Lines are straight and parallel through stations, crossover roads and other switch and crossing work unless accepted in writing by the Corporation. Switches and crossings are not to be located on transition curves.

Circular Curves

3.2.8.2 Curve design is based on the relationship between radius R (m), speed V (km/h), applied cant E (mm), and deficiency of cant D (mm). It is quantified by the use of the equation:

$$(E+D) = \frac{11.8\,V^2}{R} \quad \text{.....Eqn 1}$$

Curves shall be designed for near-equilibrium conditions with a nominal deficiency of cant of 25mm to provide a positive wheel guidance force. Cant shall be applied when the nominal deficiency of cant is exceeded and shall then be increased in increments of 5mm to suit the design speed of the curve, maintaining the nominal cant deficiency. When the maximum cant has been applied, increased cant deficiency may be utilised up to the maximum cant deficiency allowable.

At stations, where train speeds are either accelerating or decelerating, the design speed shall be taken as the mean speed of the front and rear of the train. On horizontal curves where the speed varies appreciably between front and near of the train, the cant and cant deficiency may be varied according to the mean train speed at any point on the curve.

Where cant changes within a curve of constant radius, the length over which the change takes place shall conform to the specified rates of change of cant, cant deficiency and limiting cant gradients.

Transition Curves

3.2.8.3 Transition curves take the form of a clothoid spiral where the shift 'S' and the distance of the point of shift from the toe of the transition measured along the extended straight 'C' can be evaluated as follows:

$$S = \frac{L^2}{24R} - \frac{L^4}{2\,688R^3} \quad \text{.....Eqn 2}$$

$$C = \frac{L}{2} - \frac{L^3}{240R^2} \quad \text{.....Eqn 3}$$

For geometrical details of transitions refer to Figures 3.2.1 and 3.2.2.

The desirable length of transition shall be, in practical units, the greater of the lengths obtained from the following equations:

$$L = \frac{(E \text{ or } D_1)\, V_1}{135} \quad \ldots\ldots\ldots\ldots \quad \text{Eqn 4}$$

$$L = \frac{(D_2 \text{ or } E)\, V_2}{198} \quad \ldots\ldots\ldots\ldots \quad \text{Eqn 5}$$

where,

L	=	length of spiral	(m)
V_1	=	design speed	(km/h)
V_2	=	max. attainable speed	(km/h)
E	=	applied cant	(mm)
D_1	=	deficiency of cant at V_1	(mm)
D_2	=	deficiency of cant at V_2	(mm)

When a transition curve is located within an acceleration or a deceleration zone, for example, adjacent to a station, its length shall be determined from Eqn 4 above where:

V_1 = maximum speed of any part of the train obtained at the heel of the transition (i.e. the SC or CS point)

E = the cant applied to the circular curve adjacent to the heel of the transition

D_1 = deficiency of cant obtained with V_1 and E above.

Under no circumstances shall the length of a transition curve be less than:

$$L = 0.44\, E \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad \text{Eqn 6}$$

Where adjacent parallel tracks enter concentric curves, one transition curve shall be adjusted in its length to maintain a constant spacing between tracks throughout the curve. The same shall apply at concentric curves exiting onto parallel tracks.

Transition between Compound Curves

3.2.8.4 For a compound curve where the design speed is constant, the desirable length of transition connecting the two circular curves shall be obtained by substituting differences in cant and deficiency of cant for the two circular curves for E, D_1, and D_2 in Eqn 4 and Eqn 5. For geometrical details refer to Figure 3.2.2.

Transitions between Reverse Curves

3.2.8.5 A length of straight track shall be provided between the toes of transitions of reverse curves as follows:

Desirable minimum	50 m
Absolute minimum	20 m

Where it is not possible to provide this length of straight track, then the transition curves themselves shall be continuous with a common tangent point. The lengths of these transition curves, as calculated from Eqn 4 and Eqn 5, may require adjustment to ensure a uniform cant gradient throughout the transition curves.

Virtual Transition

3.2.8.6 Where it is impossible to provide a transition curve onto or from a circular curve, the concept of virtual transition is employed in the determination of the maximum permissible speed on the affected circular curve.

The length of virtual transition 'L' is deemed to be the length between centres of bogies, which shall be taken as 15.6 m.

Deficiency of cant is considered as being gained over the length of the virtual transition, commencing on the straight 7.8 m before the tangent point and terminating on the curve 7.8 m beyond the tangent point.

Cant, where applied, will normally be gained in the same length and similar manner but the cant gradient must not exceed the permitted maximum. For the absolute maximum cant gradient specified, therefore, the cant on the curve must not exceed 35 mm. Where the cant is in excess of this amount, then either the length of cant run-up shall be extended or the cant on the curve shall be reduced.

The maximum permissible speed over the length of a virtual transition may be evaluated as follows:

a) *Circular Curve - Canted*

The maximum permissible speed V (km/h) over the virtual transition length L (m) shall be obtained when the applied cant E (mm) and deficiency of cant D (mm) are equal. Therefore, if the rates of change of cant and deficiency of cant q (mm/sec) are also equal, then:

$$V = \frac{3.6\ q\ L}{\frac{1}{2}(E+D)} \quad \ldots\ldots\ldots\ldots \quad \text{Eqn 7}$$

b) *Circular Curve - Uncanted*

With circular curve radius R (m)

$$V = \left(\frac{3.6\ q\ L\ R}{11.8}\right)^{1/3} \quad \ldots\ldots \quad \text{Eqn 8}$$

c) *Compound Curve - Uncanted*

As in Eqn 8 above but use equivalent radius R_e in place of R where:

$$R_e = \frac{R_1 \times R_2}{R_1 - R_2} \qquad \text{and } R_1 > R_2$$

d) *Reverse Curve - Uncanted*

As in (Equation 8) above but use equivalent radius R_e in place R where:-

$$R_e = \frac{R_1 \times R_2}{R_1 + R_2}$$

3.2.9 Design Principles - Vertical Alignment

Gradients

3.2.9.1 Accelerating and braking gradients shall be provided adjacent to stations where possible, generally at the maximum permitted gradient. (Refer to Figure 3.2.3.)

A minimum gradient of 0.3% shall be provided at all locations on Running Lines, except station platform areas where the gradient shall be horizontal. (Refer Clause 3.2.7)

Where track support structures have less than 1% gradient, imposed localised falls shall be designed as stated in Clause 4.9.8.2.

Combinations of maximum up gradients and small radius horizontal curves shall be avoided, to prevent potential problems with push-out of disabled trains.

Vertical Curves

3.2.9.2 Vertical curves shall be curves of constant radius. Wherever possible, the radius of a vertical curve shall be greater than the minimum. Switches and crossings shall not be located on vertical curves.

At stations, vertical curves shall not be located within the length of the platform.

A vertical curve within the length of a horizontal transition curve is undesirable.

The length of a vertical curve shall be calculated from the equation:

$$L = \frac{(p-s)R}{100} \quad \ldots\ldots\ldots\ldots \quad \text{Eqn 9}$$

where,

L =length of vertical curve (m)
R =radius of vertical curve (m)
(p-s) =the algebraic difference between the two percentage grades

3.2.10 Turnouts

General

3.2.10.1 Turnouts on Running Lines shall maintain the rail inclination (1:20) and track gauge of plain line throughout. Nomenclature for turnout related items are shown in Figure 3.2.4.

Turnouts for installation on Running Lines shall be selected based on the required speed through the turnout track.

Turnouts shall consist of Circular Curve Turnouts, as shown in Table 3.2.1 or Transitioned Turnouts as shown in Table 3.2.2, as appropriate.

Wherever practicable, the horizontal alignment shall be designed such that a standard Circular Curve Turnout from Table 3.2.1 can be located within straight alignments of track. Transitioned Turnouts shall only be located in straight alignments of track.

Where constraints dictate the use of similar flexure, contra-flexure or equal-split turnouts, they shall be based on Circular Curve Turnouts of Table 3.2.1 and the equivalent radius evaluated in accordance with Clause 3.2.10.5.

Turnouts to be located within Depot Lines shall be standard 1 in 7 Circular Curve Turnouts.

Circular Curve Turnouts

3.2.10.2 The geometry of Circular Curve Turnouts shall be as shown in Figure 3.2.5. and 3.2.6. The range of Circular Curve Turnouts is as follows:-

Table 3.2.1 - Circular Curve Turnouts

Maximum Speed Crossing Type		Turnout Rad. (Centreline)	Turnout Crossing Angle	Turnout Designation
Curved	Straight			
30 Km/h	30 Km/h	140.336m	7	1 in 7
45 Km/h	45 Km/h	315.756m	10.5	1 in 10.5
55 Km/h	50 Km/h	412.416m	12	1 in 12
65 Km/h	60 Km/h	561.344m	14	1 in 14
80 Km/h	70 Km/h	927.936m	18	1 in 18

Transitioned Turnouts

3.2.10.3 The geometry of Transitioned Turnouts shall be as shown in Figure 3.2.7. The range of Transitioned Turnouts is as follows:-

Table 3.2.2 - Transitioned Turnouts

Maximum Speed Crossing Type	Switch Rad. (Centreline)	Crossing Angle	Turnout Designation
Straight			
60 Km/h	561.344m	18	1 in 14/18
80 Km/h	927.936m	24	1 in 18/24
100 Km/h	1386.176m	28	1 in 22/28
135 Km/h	2577.600m	38	1 in 30/38

Diamond Crossings

3.2.10.4 Diamond crossings shall not be located in Running Lines except at terminal stations and depots.

The obtuse crossing of a diamond crossing shall not be flatter than 1 in 7.5.

Speed Through Turnouts

3.2.10.5 The maximum permissible speeds through turnout curves in straight track are given in Tables 3.2.1 and 3.2.2. Values have been obtained by consideration of the maximum permissible deficiency of cant, the maximum rate of change of deficiency, turnout curve radius and the geometric conditions beyond the turnout.

The maximum permissible speed on a turnout where both lines are curved is governed by the amount of applied cant on the through line, the maximum permissible deficiencies on both lines and both curve radii. The equivalent radius (R_e) of a turnout, for calculation of speed through turnouts located on curved through lines, shall be obtained as follows:

a) *Similar Flexure*

$$R_e = \frac{R\,(R_m - G/2)}{R_m + R} \quad \text{where } R_e < R_m$$

$$R_e = \frac{R\,(R_m + G/2)}{R - R_m} \quad \text{where } R_e > R_m$$

b) *Contra-flexure*

$$R_e = \frac{R\,(R_m + G/2)}{R_m - R} \quad \text{where } R_e < R_m$$

$$R_e = \frac{R\,(R_m - G/2)}{R_m - R} \quad \text{where } R_e > R_m$$

c) *Equal Split*

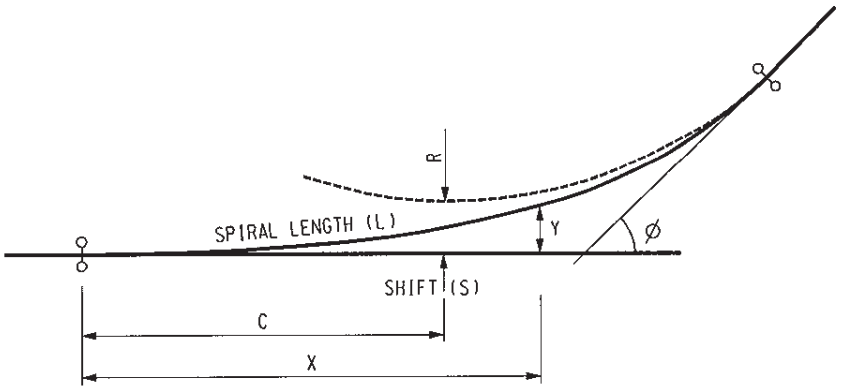
$$R_e = R + [R^2 + R.\,G/2]^{1/2}$$

all where,

R_e = equivalent radius of turnout curve centre line
R_m = centre line radius of main or through line
R = $2\,GN^2$ = centre line radius of turnout curve out of straight
G = track gauge (in metres)
N = turnout crossing angle (CLM)

For a contra-flexure turnout in a canted through-line, negative cant will be present on the turnout curve and, therefore, the maximum permissible speed calculated in accordance with Eqn 1 of Clause 3.2.8.2, shall be governed by a deficiency of cant value of (90-E) where E = negative cant.

Where untransitioned turnouts form a crossover with a length of straight between crossings, the maximum permissible speed through the crossover shall be ascertained by employing the principle of virtual transition : refer clause 3.2.8.6.



CLOTHOID SPIRAL

"l" IS DISTANCE MEASURED ALONG SPIRAL

$$\varnothing = \frac{l^2}{2RL} \text{ RADIANS} \qquad = \frac{90\ L}{\pi\ R} \text{ DEGREES}$$

$$S = \frac{L^2}{24R} - \frac{L^4}{2688\ R^3} \qquad C = \frac{L}{2} - \frac{L^3}{240\ R^2}$$

$$X = l - \frac{l^5}{40\ (RL)^2} \qquad Y = \frac{l^3}{6RL} - \frac{l^7}{336\ (RL)^3}$$

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TRANSITION FROM STRAIGHT TO CIRCULAR CURVE

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DRAWING NO FIGURE 3.2.1 REV A

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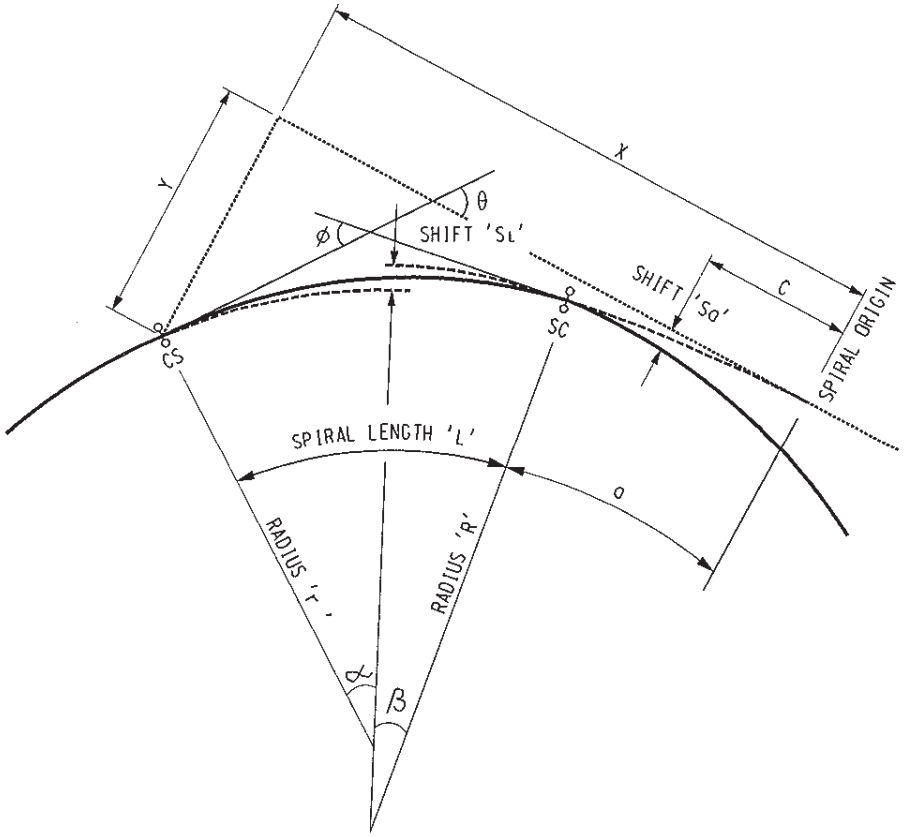

CLOTHOID SPIRAL

$$a = \frac{r\,L}{R - r} \qquad l = a + L$$

$$X = l - \frac{l^3}{40\,r^2} \qquad Y = \frac{l^2}{6\,r} - \frac{l^4}{336\,r^3}$$

$$Sa = \frac{a^2}{24R} - \frac{a^4}{2688\,R^3} \qquad C = \frac{a}{2} - \frac{a^3}{240\,R^2}$$

$$\theta = \frac{90\,l}{\pi\,r} \qquad \phi = \theta - \frac{90\,a}{\pi\,r}$$

$$\alpha = \frac{\phi\,R}{R + r} \qquad \beta = \frac{\phi\,r}{R + r}$$

$$S_L = (R - r) - \sqrt{\{(R+Sa)-(Y+r\cos\theta)\}^2 + \{X - C - r\sin\theta\}^2}$$

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TRANSITION JOINING TWO CIRCULAR CURVES

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DRAWING NO FIGURE 3.2.2 REV A

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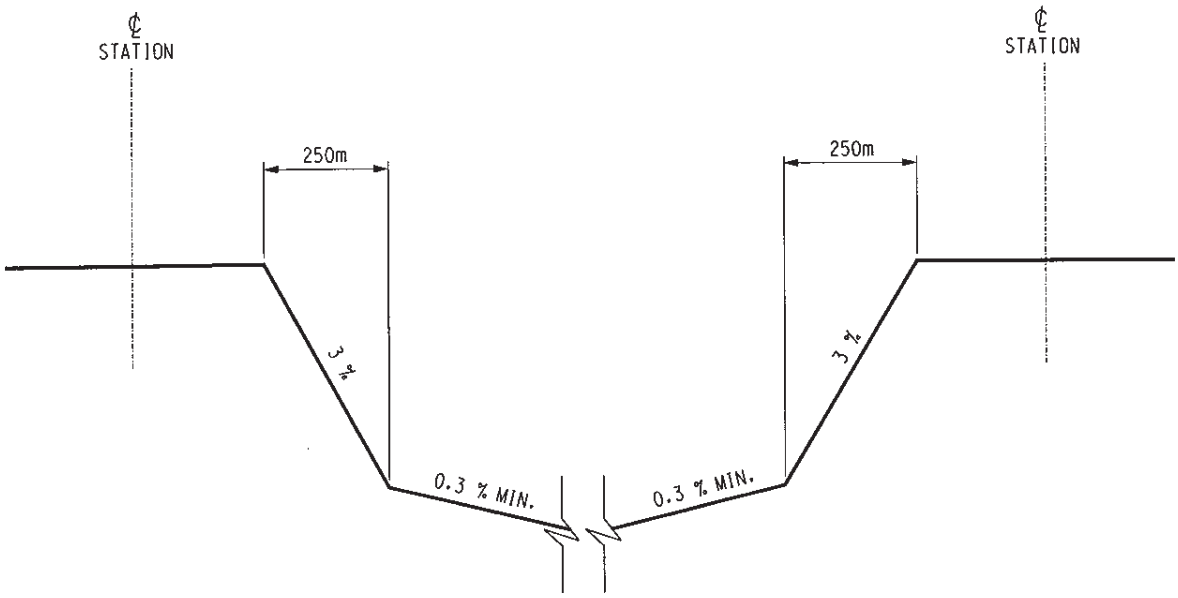
NOTES :

1. THE LENGTHS OF 0.3 % GRADE WILL VARY WITH THE RELATIVE LEVELS OF ADJOINING STATIONS AND THE DISTANCE BETWEEN THEM.

2. REFER TO CLAUSE 3.2.7.1 REGARDING MAXIMUM GRADIENTS FOR RUNNING AND DEPOT CONNECTING LINE.



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PROFILE OF BORED TUNNELS FOR OPTIMUM ENERGY CONSUMPTION

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DRAWING NO FIGURE 3.2.3

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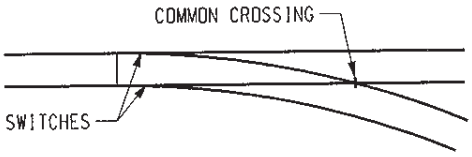
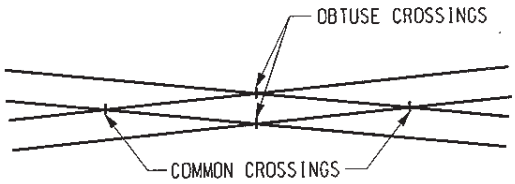
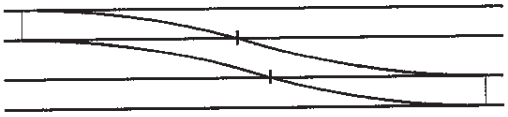
TURNOUT



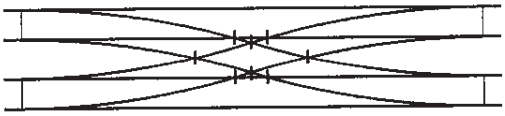
DIAMOND



SINGLE CROSSOVER



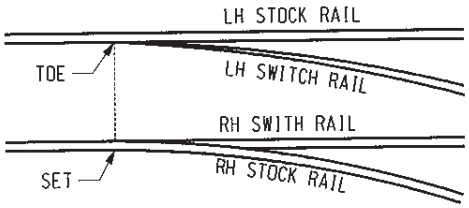
SCISSORS CROSSOVER



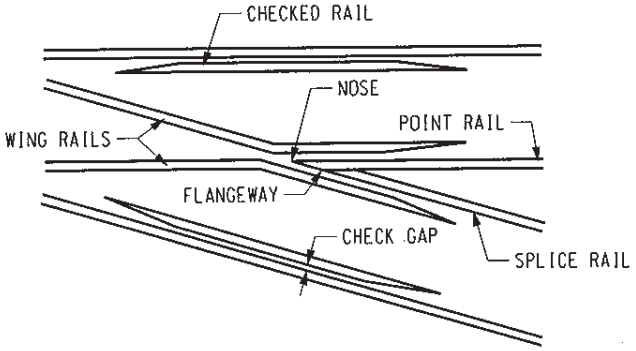
SINGLE SLIP DIAMOND

DOUBLE SLIP DIAMOND

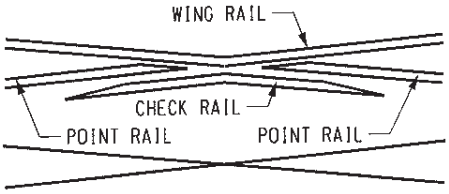
R.H. SWITCHES



R.H. SPLICE COMMON CROSSING



OBTUSE CROSSING



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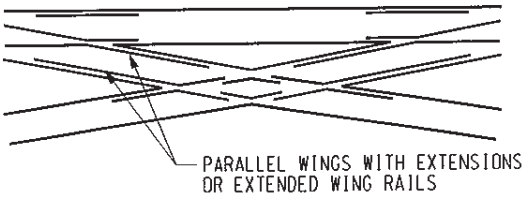

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DRAWING NO FIGURE 3.2.4

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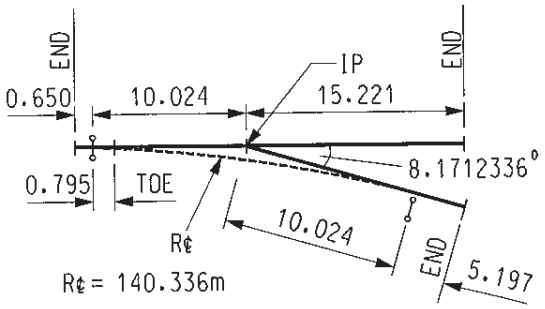
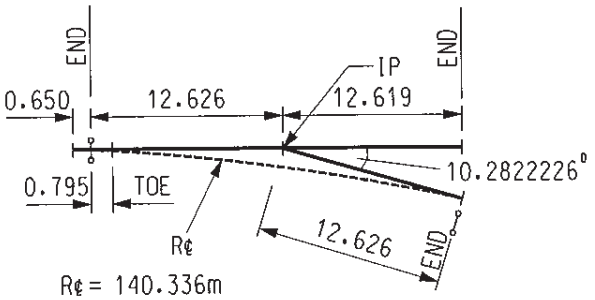
UIC 60 - CIRCULAR CURVE TURNOUTS



R¢ = 140.336m

1 IN 7 (STRAIGHT CROSSING)

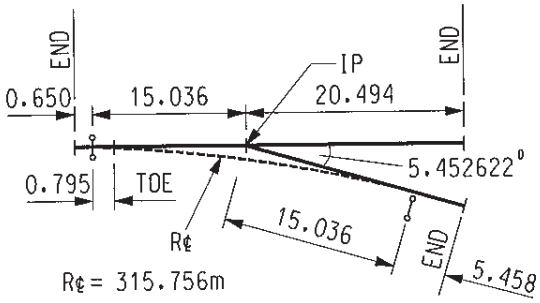
Maximum Speed : 30 km/h



R¢ = 140.336m

1 IN 7 (CURVED CROSSING)

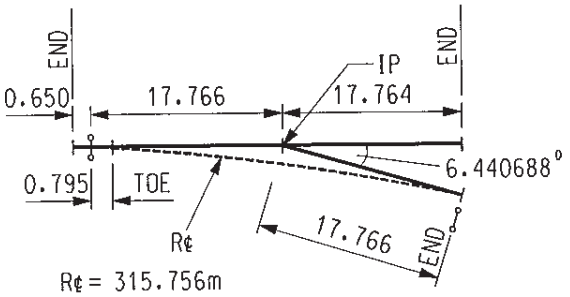
Maximum Speed : 30 km/h



R¢ = 315.756m

1 IN 10.5 (STRAIGHT CROSSING)

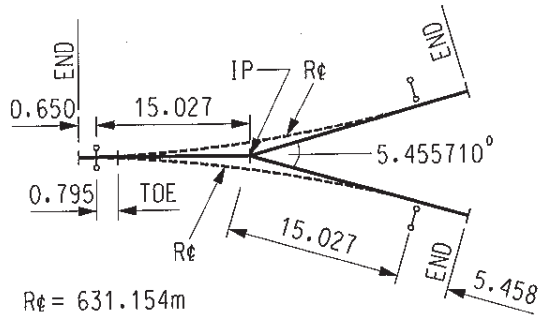
Maximum Speed : 45 km/h



R¢ = 315.756m

1 IN 10.5 (CURVED CROSSING)

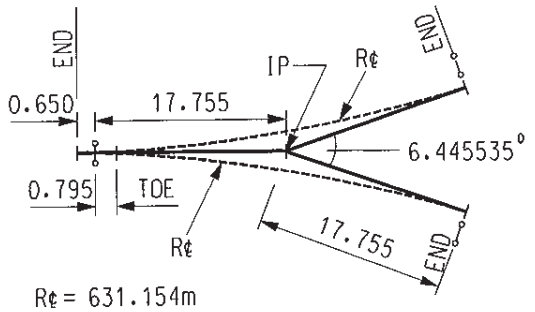
Maximum Speed : 45 km/h



R¢ = 631.154m

1 IN 10.5 EQUAL SPLIT (STRAIGHT CROSSING)

Maximum Speed : 60 km/h



R¢ = 631.154m

1 IN 10.5 EQUAL SPLIT (CURVED CROSSING)

Maximum Speed : 65 km/h

NOTE: ALL DIMENSIONS IN METRES UNLESS SHOWN OTHERWISE.

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CAD REF	FIG325.DGN		

NEW WORKS DESIGN STANDARDS MANUAL ~ FIGURES

TITLE

TURNOUT GEOMETRY
CIRCULAR TURNOUTS
(SHEET 1 OF 2)

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FIGURE 3.2.5	A

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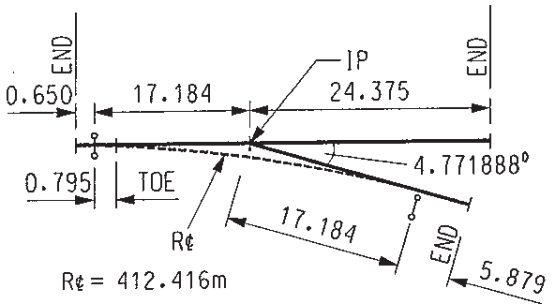
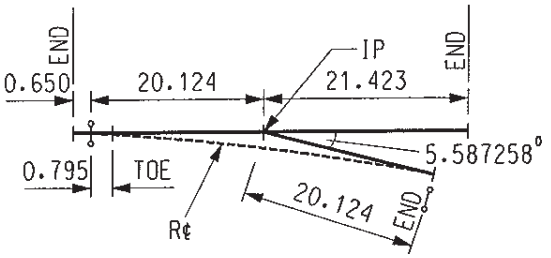
UIC 60 - CIRCULAR CURVE TURNOUTS



R¢ = 412.416m

1 IN 12 (STRAIGHT CROSSING)

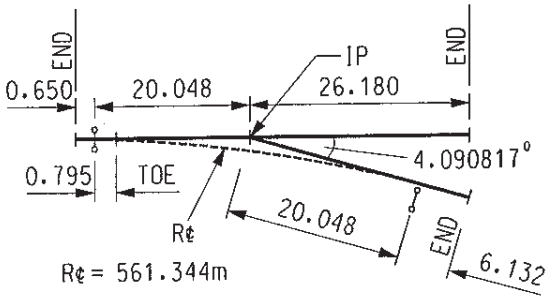
Maximum Speed : 50 km/h



R¢ = 412.416m

1 IN 12 (CURVED CROSSING)

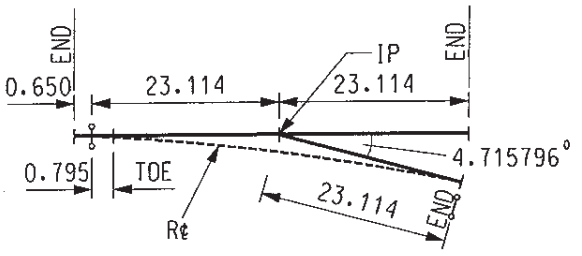
Maximum Speed : 55 km/h



R¢ = 561.344m

1 IN 14 (STRAIGHT CROSSING)

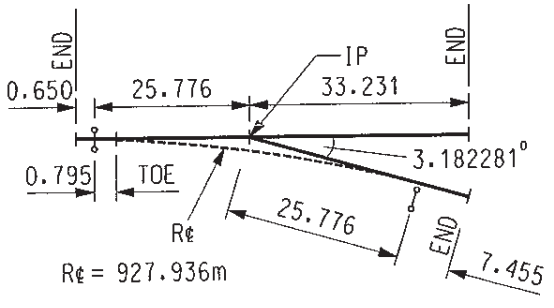
Maximum Speed : 60 km/h



R¢ = 561.344m

1 IN 14 (CURVED CROSSING)

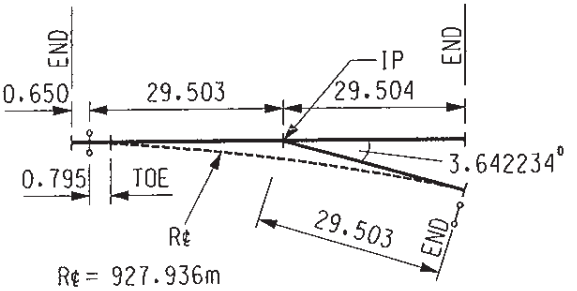
Maximum Speed : 65 km/h



R¢ = 927.936m

1 IN 18 (STRAIGHT CROSSING)

Maximum Speed : 70 km/h



R¢ = 927.936m

1 IN 18 (CURVED CROSSING)

Maximum Speed : 80 km/h

NOTE: ALL DIMENSIONS IN METRES UNLESS SHOWN OTHERWISE.

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MTR TOWER
TELFORD PLAZA - KOWLOON BAY
HONG KONG
TEL : 2993 2111 FAX : 2798 8822

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NEW WORKS DESIGN STANDARDS MANUAL ~ FIGURES

TITLE

TURNOUT GEOMETRY
CIRCULAR TURNOUTS
(SHEET 2 OF 2)

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DRAWING NO FIGURE 3.2.6

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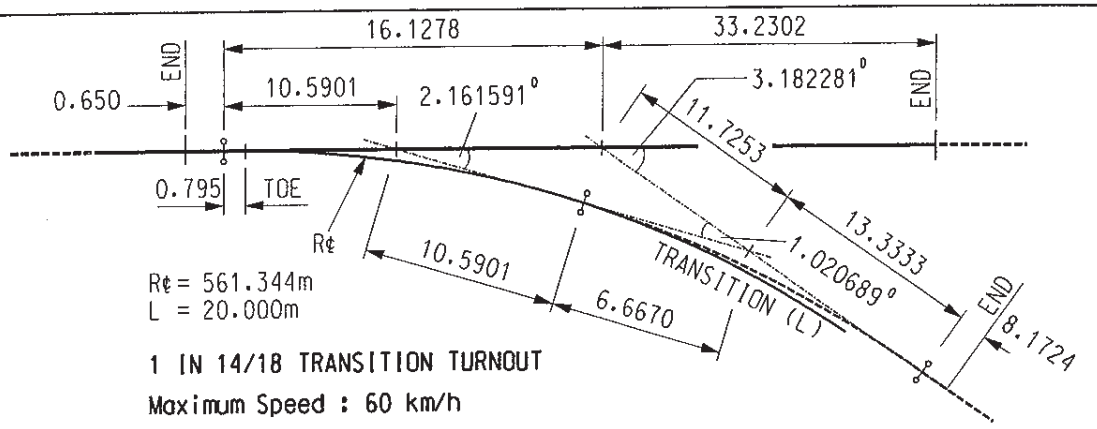
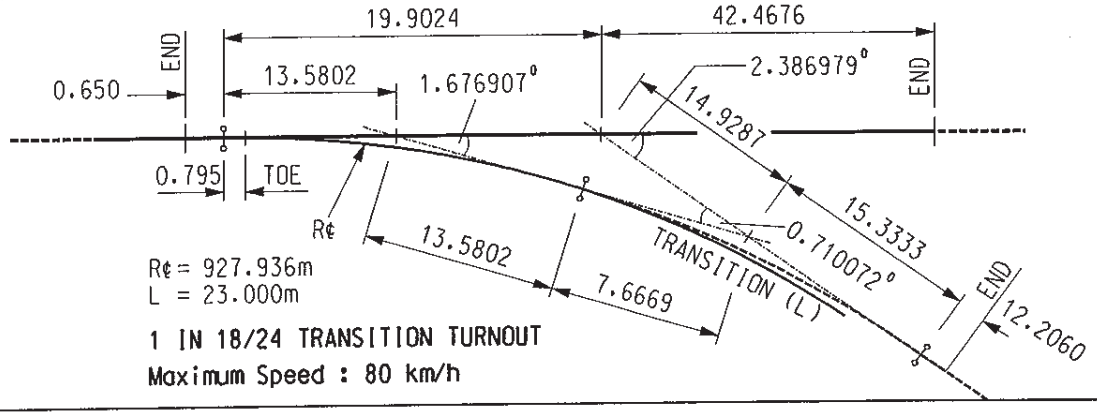


R¢ = 561.344m
L = 20.000m

1 IN 14/18 TRANSITION TURNOUT

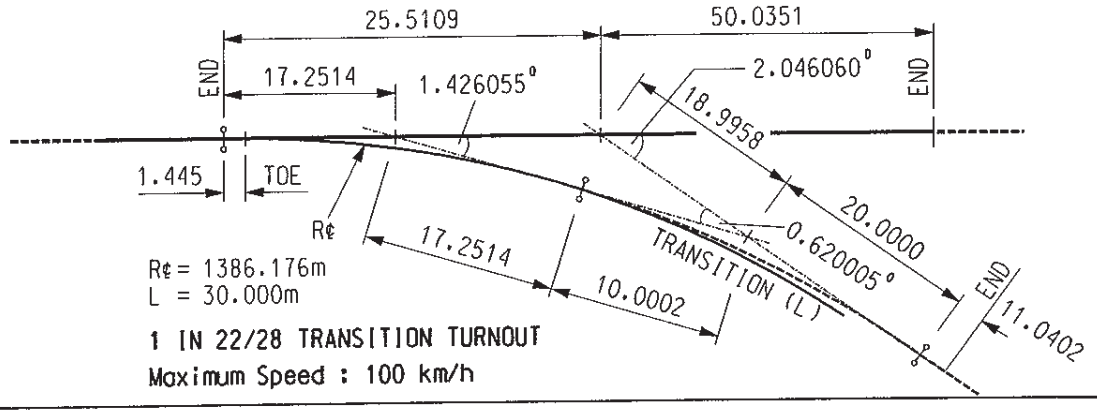
Maximum Speed : 60 km/h



R¢ = 927.936m
L = 23.000m

1 IN 18/24 TRANSITION TURNOUT

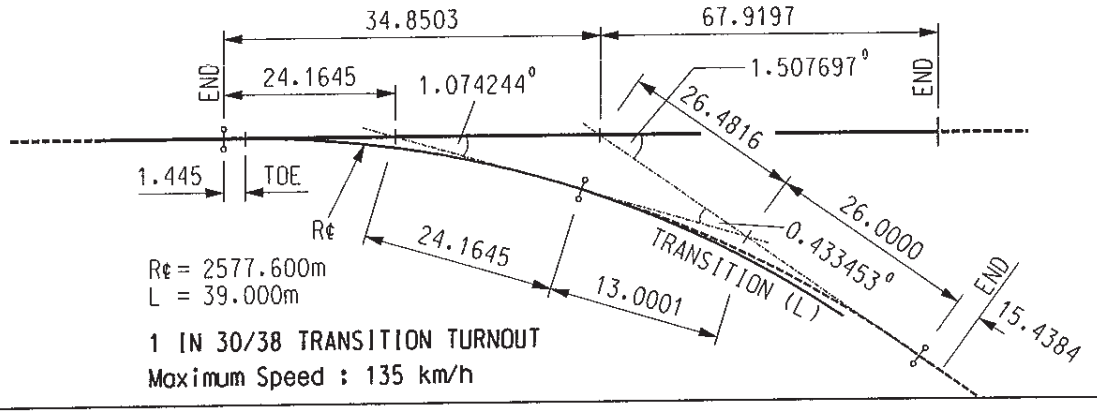
Maximum Speed : 80 km/h



R¢ = 1386.176m
L = 30.000m

1 IN 22/28 TRANSITION TURNOUT

Maximum Speed : 100 km/h



R¢ = 2577.600m
L = 39.000m

1 IN 30/38 TRANSITION TURNOUT

Maximum Speed : 135 km/h

NOTE: ALL DIMENSIONS IN METRES UNLESS SHOWN OTHERWISE.

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TEL : 2993 2111 FAX : 2798 8822

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DATE	13 JUN 2001	ORIGINATOR	MTR Corporation Limited PROJECT DIVISION
CAD REF	FIG327.DGN		

NEW WORKS DESIGN STANDARDS MANUAL ~ FIGURES

TITLE

TURNOUT GEOMETRY TRANSITION TURNOUTS

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DRAWING NO FIGURE 3.2.7

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3.4 TRACKFORM DESIGN

3.4.1 Introduction

3.4.1.1 This section defines the general design criteria and principal design standards for the design of all trackform and associated components comprising the ballasted and non-ballasted trackforms, rail components, fastenings, switches and crossings and track-related items.

3.4.1.2 The Corporation has developed various standard trackform types that shall be used on all new railway extensions in locations approved by the Corporation's Representative. The details of standard trackforms and functional requirements are given in the Standard Details and Functional Requirements Manual respectively.

3.4.1.3 The trackform designer shall use these trackform types accordingly and he shall satisfy himself that all requirements of the Manual shall be achieved in the particular circumstances of the relevant new extension. The supporting structure designer shall similarly satisfy himself for his area of responsibility. In any case of conflict the matter shall be raised with the Corporation's Representative for clarification or approval for alternative schemes.

3.4.2 Definitions and Abbreviations

3.4.2.1 General

This list includes the most commonly used definitions and abbreviations. A full list is given in BS6100 (Subsection 2.4.2).

3.4.2.2 **Rail** - Definitions and Abbreviations

Grade Rail

The reference rail used for defining the vertical track alignment. The lower rail in canted track.

High Rail

Outer running rail of a curved section of track.

3.4.2.3 **Components** - Definitions and Abbreviations

Baseplate

Rolled steel or cast iron rail support mounted on sleepers or concrete base by means of holding-down bolts or sleeper screws.

Vibration Isolating Baseplate

A composite cast iron and rubber rail support in which the upper plate supports the rail foot and is separated by rubber to the lower plate which is mounted on the sleeper or concrete base.

Fishplate

Clamps (pair) with four or six holes, used to connect two ends of rail together by means of nuts and bolts located through the rail webs.

Insulated Rail Joint (IRJ)

An insulated connection between two rail ends comprising of a pair of insulated fishplates connected by bolts located through the rail webs.

Insulator

A non-conductive insert located between the rail fastener and rail foot to prevent stray currents passing through the rail fastener into the supporting structure and to provide adequate rail-rail resistance for signalling purposes.

Rail Pad

A resilient insulating material located between rail foot and baseplate (concrete sleeper or block)

Shoulder

A cast iron component cast in concrete sleeper or block and used to locate rail fastener.

Spring Clip

A metal fastener made of spring steel which clamps the rail foot to the block, sleeper, or baseplate.

3.4.2.4 ***Turnout*** - Definitions and Abbreviations

A set of switches, crossings, stretcher bars, check rails, lead and closure rails which enable trains to diverge from one track to another, or to converge from one track into another.

Turnouts are designated as Left-hand or Right-hand according to the direction of divergence of the curved track away from the straight track when facing the front of the turnout at the stock rail joint.

Equal split indicates a turnout which curves equally in both directions from the front.

Crossing

An assembly to permit the passage of wheel flanges across other rails where tracks intersect.

Junction

A location where running lines converge, diverge or cross. A junction may comprise one or more turnouts, with or without an associated diamond.

Switches

An assembly of moving rail sections and other components for diverting vehicles from one track to another.

Trap Points

A set of switches located on sidings and depot access lines before the junction with the running lines to prevent unauthorised entry of rolling stock onto the primary track.

3.4.2.5 **Trackform** - Definitions and Abbreviations

Ballasted Trackform

Ballasted trackform comprises running rails, rail fastenings, insulators, rail pads, concrete or timber sleepers, ballast and sub-ballast.

Non-ballasted Trackform

Non-ballasted trackform incorporates the track elements comprising running rails, rail fastenings, insulators, rail pads, baseplates or concrete blocks, resilient pads, rubber boots, and concrete trackbase.

Floating Slab Track (FST)

A high-performance trackform, with a precast or insitu cast concrete slab located on elastomeric or rubber support bearings, designed to significantly reduce the transmission of noise and vibration into the surrounding structure. The trackform comprises running rails; resilient baseplates; concrete slab; discrete support bearings, side bearings; end bearings; bearing brackets and concrete upstands.

Isolated Slab Track (IST)

A medium-performance trackform, designed to moderately reduce transmission of noise and vibration into the surrounding structure comprising a resilient layer inserted between an insitu concrete trackbase and the supporting structure.

Trackbase

The track support medium within the trackform that consists of ballast and sub-ballast or concrete.

Track Support Structure

The part of the support structure which supports the trackform which normally comprises:

- prestressed or reinforced concrete members forming bridge decks, station structures, or viaducts for overhead structures;
- the base of cut and cover tunnels, station boxes, or mass concrete inverts to other tunnels;
- reinforced concrete slabs on at grade sections;
- the sub-grade on ballasted track sections.

3.4.2.6 **Derailment Protection** - Definitions and Abbreviations

Derailment Upstand

A structure located outside the running rails at specific locations to provide lateral guidance to derailed vehicles.

Check Rails

Rails provided inside running rails to guide wheels through crossings in junctions.

Guard Rails

Inverted steel channels located on the outside of Running Line track on ballasted and non-ballasted tracks.

'Cut Water' Shaped Protection Structures

Tapered concrete structures (facing the normal direction of running) placed at the base of columns supporting overhead structures.

3.4.2.7 **Movement Joints** - Definitions and Abbreviations

Rail Movement Joint (RMJ)

A joint provided in the running rails to accommodate thermal movements and the relative movements and rotations of a bridge deck or other supporting structure.

Movement Joint (MJ)

A joint between adjacent structural members enabling the movement of one structure relative to another.

3.4.3 Trackform Design - General

3.4.3.1 All trackforms including special trackwork (turnouts, rail movement joints, etc) shall be designed to meet the requirements, criteria and trackform performance and functional provisions detailed in Section 3.1.6 of this Manual.

The trackform to be used on each section of line shall generally be determined by the type of infrastructure on which the trackform is located. Specific requirements (e.g. noise and vibration attenuation) shall determine the use of special resilient trackforms.

3.4.3.2 The trackform shall be designed such that the maximum vertical deflection shall not exceed 7mm with a rail gradient not greater than 1:1000 under the worst live loading conditions. The analyses shall consider normal operations, including the effects of worn rail or broken rail conditions.

3.4.3.3 Reclamation shall be designed and constructed to ensure that a maximum long term vertical settlement shall be limited to 50mm below the trackform, and differential settlement shall not cause a change in longitudinal profile of greater than 1:1000.

3.4.3.4 The trackform design shall ensure that the design life is achieved for each component with due consideration taken of their interaction, the trackform performance requirements, dynamic characteristics of the rolling stock, and any influences due to the type of track support structure.

Ballasted Trackform

3.4.3.5 Ballasted track shall generally be used on at grade sections, to allow for possible ground settlements, on embankments and on structures that do not exceed 300 m in length with adjacent sections of ballasted track.

3.4.3.6 The profile of the ballasted track shall comply with the relevant Standard Detail Drawings which define the relationship between the track, ballast, sub-ballast, drainage, cable troughs, OHL and E&M equipment and fencing.

Should any modifications be required to incorporate any specific site requirements, applications for approval shall be made to the Corporation's Representative.

Non-ballasted Trackform

3.4.3.7 Non-ballasted trackform only shall be used where tracks are located on structures and slabs, except where the provisions of clause 3.4.3.5 apply. Non-ballasted trackform shall only be used at grade where short sections (less than 300m) exist between longer sections of non-ballasted trackform which are on a structure or on a firm sub-base e.g. rock.

3.4.3.8 The standard trackform is either the Precast Concrete Block Trackform (PCBT) or the Vibration Isolating Baseplate Track (VIBT). Vibration isolating baseplates may be used on structures subject to lateral movement or settlement. Resilient baseplates are to be used for special trackwork items.

Refer to Trackwork Standard Details for further information.

Track Installation

3.4.3.9 The design of the trackform shall take into consideration that installation of the non-ballasted trackform will be by the `top-down' method. Therefore, due allowance shall be made in specifying the level of the track support structure to ensure that adequate clearances exist below the rail supports for the bending of rebars and placing and compaction of concrete trackbase.

3.4.3.10 Generic types of trackform are differentiated below. In designing for specific situations, the overall design intent shall be respected which may require detailed amendments with the approval of the Corporation.

3.4.4 Ballasted Trackform

3.4.4.1 *Ballast*

a) *Location*

The ballast layer shall be designed for at grade sections on previously prepared sub-ballast.

b) *Placement*

The ballast layer shall be constructed in layers to enable maximum *in situ* compaction to be achieved.

c) *Purpose*

The ballast layer shall be required to:

- distribute track loads (from supporting sleepers) both laterally and vertically over the sub-ballast layer
- support the trackform to line and level
- provide adequate drainage
- distribute any localised settlement of the formation
- be graded to suit sub-ballast
- be capable of withstanding loads (static and dynamic) for the required design life in the actual location.

d) *Material*

The ballast shall be designed to support the track structure and imposed dynamic loads. The ballast shall consist of crushed, freshly quarried igneous rock to the requirements given in the Materials and Workmanship Specification for Trackwork.

3.4.4.2 *Sub-ballast*

a) *Location*

Sub-ballast shall be designed for placing on prepared sub-grade formation.

b) *Placement*

The sub-ballast shall be designed to enable the compaction stated in the Materials and Workmanship Specification for Trackwork, for the full depth of the sub-ballast layer. The top of the sub-ballast layer shall incorporate a 1-in-40 transverse grade crossfall to provide adequate surface water run-off.

c) *Purpose*

The sub-ballast layer shall be designed to distribute loading from the track and ballast to the prepared sub-grade and to provide adequate drainage.

d) *Material*

Materials acceptable for use as sub-ballast are clean, unweathered, uniformly graded sand/gravel mixtures containing not more than 5% of material finer than silt size. Alternatively, uniformly graded rock may be used but in conjunction with a designed filter layer located between the sub-ballast and the sub-grade and subject to the Engineer's approval. Approved materials and the required particle size distribution are given in the Materials and Workmanship Specification for Trackwork.

e) *Drainage*

Where ballasted track is used on structure or slab, run-off from rainfall may be considered as Foul Water; appropriate instructions for its disposal are to be sought from the Corporation.

The following is applicable to drainage of ballasted trackform on sub-grade, where track run-off from rainfall is to be considered as Surface Water.

Trackform Surface Water and, if necessary, Ground Water drainage systems shall be constructed in the sub-ballast layer, extended and modified as necessary.

They shall be designed in accordance with this Section and Section 4 of this Manual to provide protection against flooding and the degradation effects of water.

Alternatively, where the sub-grade within the railway boundary is already drained by drainage systems (or where such systems may be designed and installed) which satisfy this requirement, the trackform drainage systems may be omitted.

3.4.4.3 *Sub-grade*

The sub-grade (or formation) is the base layer on which the trackform is placed, at the locations shown on the track diagram. The sub-grade requires to consist of either:

a) in situ material with a CBR of 10% or better as tested in accordance with BS1377 - Test No 16.

b) reclaimed material comprising generally sand or silty sand compacted to 95% or better relative compaction as defined in accordance with BS1377 - Test Nos. 12 and 15, above approximately +2.5 mPD, and vibrocompacted to achieve a minimum CPT net tip resistance of 10 MPa below that level; or.

c) selected fill material, compacted to 95% relative compaction or better in accordance with BS1377 - Test Nos. 12 and 15; or

d) the formation level of excavation in rock of grades I to IV.

The Trackform Ground Water drainage system, if required, shall be designed to maintain these properties.

3.4.4.4 The sub-grade shall be graded to fall, transversely to the track centreline, at a minimum slope of 1:25 under the sub-ballast to direct percolating Surface Water to the drainage system.

3.4.5 Non-ballasted Trackform

3.4.5.1 *General*

a) *Location*

Non-ballasted trackform shall be designed for installation on viaducts, in tunnels, and on specified sections at grade as required.

b) *Installation*

Track shall be located and temporarily supported to the correct line and level, including blocks/baseplates and fastenings, and the concrete for the support structure then cast around the suspended trackwork. ('top-down' method of construction)

c) *Purpose*

The trackbase shall be required to:

- distribute track loads from the rail fasteners both laterally and vertically
- maintain uniform line and level of the trackform
- provide adequate drainage.

d) *Quality*

The trackbase shall be designed to support the track structure for a period of 120 years.

3.4.5.2 *Floating Slab Track*

a) Floating Slab Track sections may be required in or near to station areas in order to comply with vibration criteria as defined in Section 2 of this Manual.

b) The arrangement shall be designed as a mass-spring system which will allow for vertical movement of the floating slab on its bearings independent from the supporting structure.

c) Floating Slab Track shall be designed to have a natural frequency at or below 16Hz and to provide a minimum vibration attenuation of 20dB(A) in the frequency range 63-250Hz.

d) Provision shall be made to access the bearings either from the side of the trackform or through centrally located manholes for inspection purposes.

3.4.5.3 *Isolated Slab Track*

a) Isolated Slab Track may be required in or near to station or residential areas to comply with vibration criteria defined in Section 2 of this Manual.

b) The arrangement shall be designed as a mass-spring system which will allow for the vertical movement of the isolated slab on the ballast mat independent from the supporting structure.

c) Isolated Slab Track shall be designed to have a natural frequency at or below 25Hz and to provide a minimum vibration attenuation of 15dB(A) in the frequency range 63-250Hz.

3.4.6 Corrosion Control Design

Stray Current Control

3.4.6.1 Rail to earth resistance shall be increased between track and structure to provide protection to the infrastructure from stray currents. Track components shall be arranged such that all metal components are separated by insulating materials in order to increase the stray current leakage path from the rail to earth. The design shall ensure that moisture and dirt cannot accumulate at the interfaces between the various components. (See Section 7 of this Manual for details.)

3.4.6.2 The design of insulating materials shall ensure a minimum rail-to-earth resistance of 100 ohms km of single track for ballasted tracks and 250 ohms km of single track for non-ballasted tracks.

3.4.6.3 Suitable rail protection against atmospheric corrosion or moisture shall be provided by means of non-carcinogenic paint protection, particularly in areas with an aggressive environment.

3.4.7 Rail Selection

The specified rail section has been selected on the basis of a cost-benefit analysis of the various sections available, due allowance for design axle load, train speed, predicted traffic levels, fatigue loading, sleeper spacing, and relative costs for switches, crossings and rail movement joints. Head hardened rails shall be used on curves to reduce head wear and increase the design life.

Standard rail sections shall be used as follows:

- UIC60 Grade 900A and Grade 900A Heat Treated/Head Hardened - Running Lines
- UIC60 Grade 900A and BS90A(M) Wear Resisting A Grade - Depot Lines

3.4.8 Rail Inclination

Rails shall be inclined at 1:20 on all plain line and in Running Line switches and crossings.

3.4.9 Rail Analyses and Design

3.4.9.1 Rail shall be designed taking due cognizance of the lateral and longitudinal loads induced in the track, both on straight and curved track.

3.4.9.2 Similarly the loads induced in the rail as a consequence of the trackform and supporting structure shall be similarly considered in the rail design.

3.4.10 Continuous Welded Rail

3.4.10.1 Rails shall be flash butt welded into continuous lengths, and welded *in situ* after installation to line and level to form continuous welded rails.

3.4.10.2 The rails shall not include any joints except for Insulated Rail Joints and Rail Movement Joints.

3.4.11 Welding and Destressing

After the rails have been placed to the correct line and level, they shall be destressed, except where located in tunnels, and the closing weld completed, using approved methods within the stress-free temperature range and in accordance with British Railways Engineering Handbook No. 11 or other national railway authority standard approved by the Corporation.

3.4.12 Flash Butt Welding

Except as detailed in Clause 3.4.13 below, all rails shall be flash butt welded by an approved welding process, to ensure consistent quality.

3.4.13 Alumino Thermic Welding

Alumino Thermic Welding shall only be used:

- in isolated locations on site which are inaccessible by mobile flash butt welder
- to install a closure rail e.g. after destressing
- to install an Insulated Rail Joint
- between switches and crossings and on crossovers
- in the Depot
- for remedial works.

3.4.14 Insulated Rail Joints

3.4.14.1 Insulated Rail Joints (IRJs) are required to separate track circuits for signalling purposes, or direct traction return currents between the running rails, and shall be capable of transmitting loads from stressed rails.

a) *Location*

IRJs shall be installed in plain line or within turnouts and in the Depot as defined by signalling and traction return current requirements. Installation in the Depot shall be in accordance with Section 5 of this Manual.

b) *Design*

They shall be to an approved design which has been in satisfactory service in an operating railway.

c) *Specification*

IRJ's shall conform to the requirements given in the Materials and Workmanship Specification for Trackwork and to the details shown in Standard Details.

3.4.15 Turnouts and Trap Points

Turnout Design

3.4.15.1 Turnouts shall be designed to facilitate the operational requirements, taking due cognizance of the alignment and train speed requirements.

3.4.15.2 Turnouts shall be designed for the following criteria:

- design maximum axle load of 20 tonnes
- rail section to be compatible with the running rails
- maximum line speed
- turnout angle to be compatible with junction speed requirement
- 600 switch movements per day
- loads as defined in Subsection 4.3

3.4.15.3 Turnouts shall incorporate the following :

a) Switches and crossings shall be to an inclined design.

b) The design shall include for all component parts and rail fastening assemblies required to enable the turnouts to be manufactured and installed in the track complete.

c) The track gauge through switches and crossings shall be 1 432 mm measured between the gauge corners of the rails in the plane tangential to the crown of the rails.

d) All switches and crossings in running lines shall be designed for installation in continuously welded track with all rail joints through the switches and crossings welded except at IRJ locations.

e) Switches and crossings shall be discretely supported on baseplates.

f) Switches and crossings in at grade sections on formation shall be supported on baseplates on timber or concrete bearers in ballast.

g) Where required, the turnouts shall be based on existing designs, which have been proven under similar service conditions and traffic density loadings and installed in continuously welded track. The slide chairs

shall incorporate low friction inserts or roller bearings.

h) All turnouts and associated components, located on Running Lines shall be designed for the Maximum Speed. Turnout components for use in the depot shall be designed for an operating speed of 45 km/h.

i) Where switches and fixed crossings are to be installed in continuously welded track, the rails in both switches and crossings shall be tied together to control differential movement between rails due to thermal stresses resulting from a variation in rail temperature of 40°C.

j) The geometrical design of the standard turnouts shall be as set out in Figures 3.2.5 and 3.2.6.

k) The transitioned turnouts which incorporate a tangential switch curve with varying turnout radius, shall be as set out in Figure 3.2.7.

l) Crossing angles are defined by Centre Line Measure (CLM).

m) A geometrical detail of each Junction shall be drawn and placed in a volume of Junction Layout drawings.

n) Baseplate assemblies throughout the turnouts shall incorporate the `Pandrol' rail fastening system. They shall be suitable for installation on either concrete or ballasted track. Baseplates shall be located on the concrete by means of cast-in bolts and to timbers by sleeper screws.

Switches

3.4.15.4 a) Each pair of switches consists of one left hand and one right hand stock rail, and one left hand and one right hand switch rail. They shall be designed to suit the UIC 60 section rail profile and be suitable for installation on either a non-ballasted or ballasted trackform.

b) Switch rail shall be designed to suit the special asymmetrical section rail UIC Section 60B (depot lines) or 60D (running lines). The stock rail shall be secured on the inner face by an elastic internal bracing clip located within the switch slide-plate .

c) The design shall provide for suitable flangeway clearance between the stock rail and the switch rail with the switch rail in the open position. The minimum flangeway clearance shall be not less than 56 mm.

d) Switches are required to be designed for installation in the following types of turnouts:

- standard curve out of straight
- similar flexure
- contra-flexure
- equal split

e) Soleplates shall be designed for use with switches on timber bearers. The soleplates shall be insulated. However, when they are for use with manually operated switches the soleplates shall be non-insulated.

f) Soleplates may be required for switches on non-ballasted trackform, depending on the designated Signalling Contractors point machine requirement. Where required, the soleplates shall be insulated.

g) The switch design shall include drilling details for point machines to suit the designated Signalling Contractor's requirement.

h) Stretcher bars shall be designed to be adjustable and insulated.

i) For manually operated switches, a switch hand-lever shall be provided and shall be capable of setting the switches for either the through track or turnout track. The handle shall be of a hinge type construction which will allow it to remain horizontal and below rail level until the switches are required to be operated.

Common Crossings

3.4.15.5 a) Common crossings shall be designed to suit the UIC 60 section rail profile and be suitable for installation on either a non-ballasted or ballasted trackform.

b) Crossings for use in main lines shall be one of the following:

- cast mono-block
- swing nose crossing
- flexibly moveable point rail and splice rail
- flexibly moveable wing rails.

c) The type of crossing to be utilised shall be suitable for the crossing angle of the turnout in which it is to be installed.

d) The crossings for use in depot sidings shall be fabricated spliced nose crossings.

e) Fabricated crossings shall be designed to suit the use of high tension multi-groove friction grip pins.

f) Check rails shall be of UIC 33 section rail and be rigidly fastened to the adjacent running rail to provide adequate flangeway clearance.

g) The length of check rail and the flare at the check rail ends shall be designed to suit the angle of the crossing and the allowable maximum speed.

Obtuse Crossings (in Diamond Crossings)

3.4.15.6 a) Obtuse crossings shall be designed to the rail profile and be suitable for installation on either a non-ballasted or ballasted trackform.

b) Obtuse crossings for use in running lines shall be of mono-block design.

c) Obtuse crossings for use in depot sidings shall be of standard fabricated design and shall be suitable for installation on ballasted track with crossing timbers.

d) Fabricated crossings shall be designed to suit the use of high tension multi-groove friction grip pins.

e) Obtuse crossings are required in diamond crossings with:

- both tracks straight
- both tracks curved

Adequate flangeway clearances shall be provided for both check rails and wing rails.

Trap Points

3.4.15.7 Trap points shall be designed to derail any train proceeding from a secondary line onto a main line without authorization in such a manner that the derailed train is guided parallel or away from the main line, and brought to rest within less than a car length. The infrastructure shall be designed to accommodate the derailed portion of the train accordingly.

3.4.16 Rail Movement Joints

General

3.4.16.1 Rail Movement Joints (RMJs) shall be installed at junctions between continuously welded and jointed track (ballasted trackform), and adjacent to all structural movement joints where shrinkage, creep and/or temperature movements occur.

3.4.16.2 Rail Movement Joints are required to accommodate all longitudinal and rotational movements within the track. They shall be designed to incorporate the full section rail profile.

3.4.16.3 Maximum rail span between baseplate supports on adjacent structures shall be not more than 950 mm (c/c).

Rail Movement Joint Design

3.4.16.4 The design of RMJs shall incorporate all movement ranges of the support structure, train design speed and the requirements of this Manual.

Movement Range

3.4.16.5 RMJs shall be designed for the following range of movements horizontally along the track:

RMJ Type 1 : total movement ≤ 150mm, ie +/- 75mm
RMJ Type 2 : total movement up to 600mm, ie +/- 300mm

3.4.16.6 The range and type of predicted movement of the Movement Joints (MJs) located in the support structure are used to determine the Type of RMJ required.

3.4.16.7 Total structural movements to be accommodated are included in the Schedule of RMJs. The required format for the presentation of the RMJ movement information is given in the Drawing and CADD Manual.

3.4.16.8 For RMJ Type 1 the design shall be suitable for use in both ballasted and non-ballasted trackforms.

3.4.16.9 For RMJ Type 2 the design shall be suitable for use in non-ballasted trackforms only.

3.4.16.10 If the total range of movement for the RMJ exceeds 600mm, the designer shall notify the Corporation's Representative and additionally design a support beam for each rail across the movement joint.

3.4.16.11 RMJ's shall be located on straight track (horizontal and vertical planes) in order to minimise the influence of secondary movements on the design operation and maintenance of the RMJs. Exceptions shall only be permitted with the approval of the Corporation's Representative.

3.4.16.12 Where RMJs are located in curved and canted track the design shall provide for the effects of trains running with the maximum allowable deficiency of cant of 110 mm.

3.4.17 Buffer Stops

a) *Types*

Three types are required. They are as follows:

- Type B1
  Multi-shoe friction type - used on Running Lines, other than terminal station locations and at the Depot except as shown below.
- Type B2
  Fixed buffer stops - on Depot tracks used by Engineers Trains.
- Type B3
  Multi-shoe friction type with hydraulic buffer - used on Running Line terminal stations.

b) *Design*

Buffer stops shall be designed to achieve the following requirements:

- minimise initial impact forces
- apply an acceptable deceleration rate to the rolling stock

c) *Design Criteria*

Buffer stops shall be designed using the following design criteria:

- Mass of train = 511 t (loaded 8-car train: Running Line)
- Mass of train = 331 t (unloaded 8-car train: Sidings and Depot.)
- Maximum impact speed = 25 km/h (Restricted Manual)
- Available sliding length = 30 m

The phased build up of train consists shall be considered in the design of the buffer stops and, if required, friction shoes, shall be added to allow for the increasing train consist length in order to achieve the following buffer stop acceptance criteria :

Table 3.4.17T1 Acceptable Deceleration and Jerk Values

	Deceleration (m/s^2)	**Jerk (m/s^3)**	**Train Loaded State (tonnes)**
1. Free standing passenger	1.2	1.5	511
2. Standing passenger with hand hold	2	3	511
3. Seated passengers	3.5	4	331

The buffer stop deceleration and jerk acceptance values may be combined with the train loaded state as noted above in order to rationalize the design of the buffer stops.

The buffer stop design shall make due allowance for the potential variability of the retardation elements and shall clearly establish the range of retardation factors to be considered in the design. In this respect the likely retardation factor when combined with the above design criteria shall meet the acceptable deceleration and jerk noted above.

The highest retardation factors when similarly applied shall not exceed the above acceptable value by more than 10%.

Consideration of the lowest retardation factor, when similarly applied, shall not cause the buffer stop sliding length to be overrun and in any event shall not give rise to deceleration and jerk values in excess of the acceptance value.

d) *End of Track Clearance*

Wherever buffer stops are located, there shall be a minimum one metre clearance between the end of the track and any solid obstruction, eg. tunnel and wall.

3.4.18 Depot Trackwork

The design of the Depot trackforms shall be fully compatible with the type of supporting structure, and with the requirements of the various activity areas within the Depot. These are defined as follows:

Areas	Trackform Type
Stabling Sidings and Fan Areas	Ballasted track
Main Depot Building	
· Maintenance tracks (at Inspection Pits)	Rails on steel beams supported by columns
· Roadway crossings	Paved/Embedded rails
· Bogie changing tracks	Paved/Embedded rails
· Heavy cleaning track	Non-ballasted baseplated track
Train Wash Facilities	
· Train Wash	Concrete columns
· Underframe Wash	Non-ballasted baseplated track
Permanent Way Depot	
· Arrival Sidings and Fan Area	Ballasted
· Locomotive Maintenance and Inspection Vehicle Maintenance Building	Inspection pit and Paved/Embedded rails.
· Rail Stacking Platform	Paved/Embedded rails
· Ballast Stockpile Siding	Paved/Embedded rails
· Track Machine Sidings	Ballasted track
Level Crossings	Pre-cast concrete panels, pre-formed rubber panels or Embedded Rail

Table 3.4.18T1 - Depot Trackform Types

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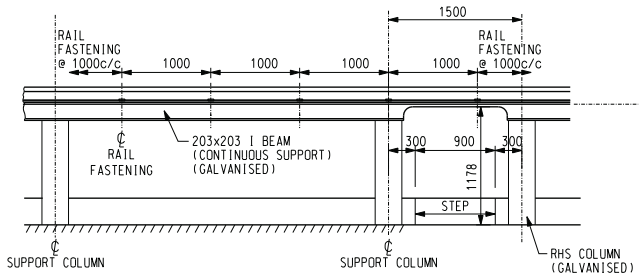
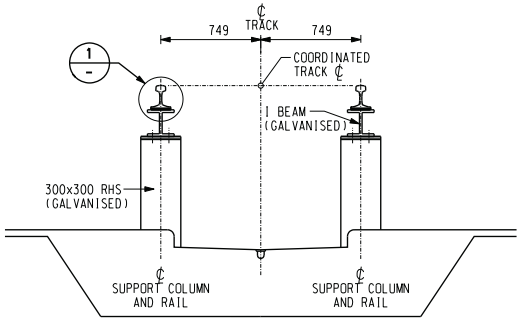
NOTE :

1. BOLT HOLES TO BE DRILLED THOROUGHLY DEGREASED AND CLEANED BEFORE CORROSION PROTECTION BY "GALVAFROID" PAINT OR SIMILAR APPROVED.
2. UIC 60 RAIL SECTION SHOWN ON ALL DETAILS.



MAINTENANCE PIT - ELEVATION
SCALE 1 : 60



TYPICAL SECTION BETWEEN SUPPORTS
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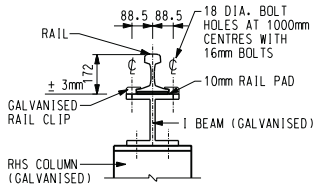
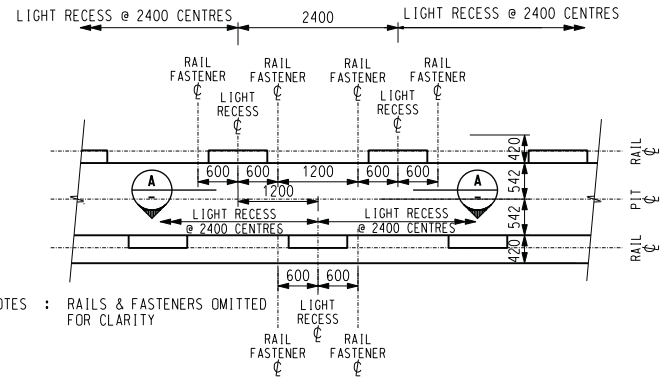


RAIL FIXING LOCATION
DETAIL 1
SCALE 1 : 20

DEPOT MAINTENANCE PIT TRACKFORM



NOTES : RAILS & FASTENERS OMITTED FOR CLARITY

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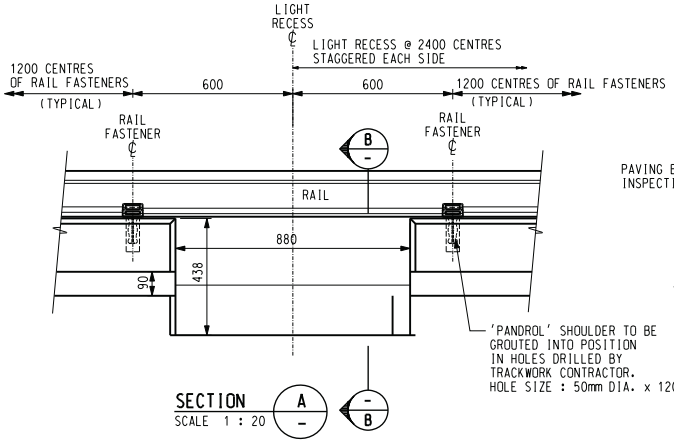
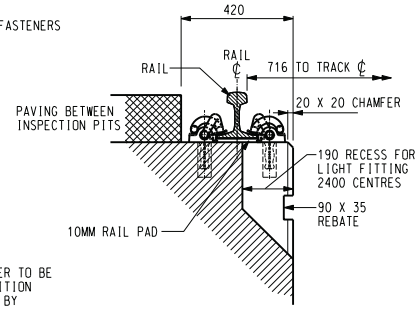
SCALE 1 : 80



SECTION A-B
SCALE 1 : 20



SECTION B
SCALE 1 : 20

DEPOT INSPECTION PIT TRACKFORM

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Signed:

A.M.Gibson (CDM)

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TITLE
PERMANENT WAY
DEPOT TRACKFORM -
MAINTENANCE PIT TRACKFORM &
INSPECTION PIT TRACKFORM

SCALE	AS SHOWN	CAD REF	C04001.DGN	AS BUILT APPROVED	
DATE	OCTOBER 2005	AS BUILT DWG NO	-	-	
DRAWN	LFB	DESIGNED	TC	DRAWING NO	REV
CHECKED	TC	APPROVED	DE	NWS/S/GEN/PPW/C04/001	A

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PLOTTING TIME 1to1 mm

CADD REF *grspec

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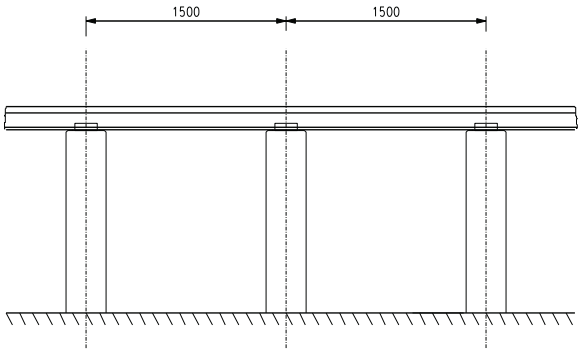
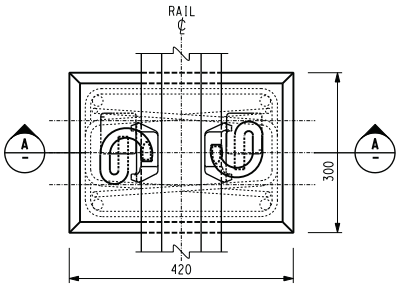
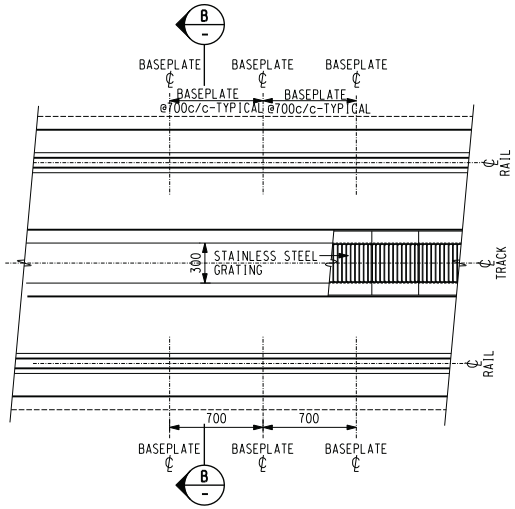


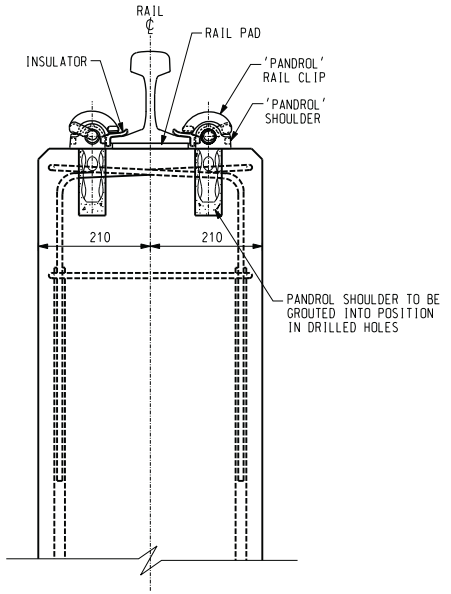
UNDERFRAME WASH - CONCRETE COLUMNS
(FASTENING DETAILS NOT SHOWN)
SCALE 1 : 40



PLAN
SCALE 1 : 10



TYPICAL PLAN OF ACID WASH/WATER WASH
SCALE 1 : 40



SECTION A
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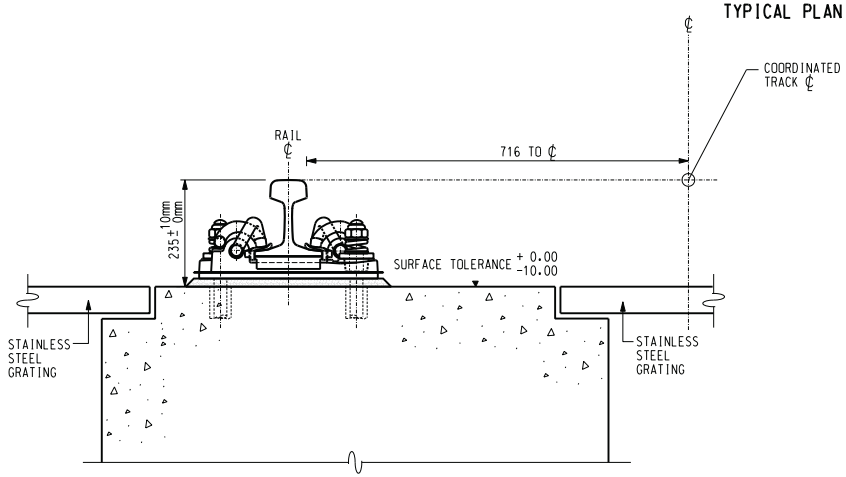
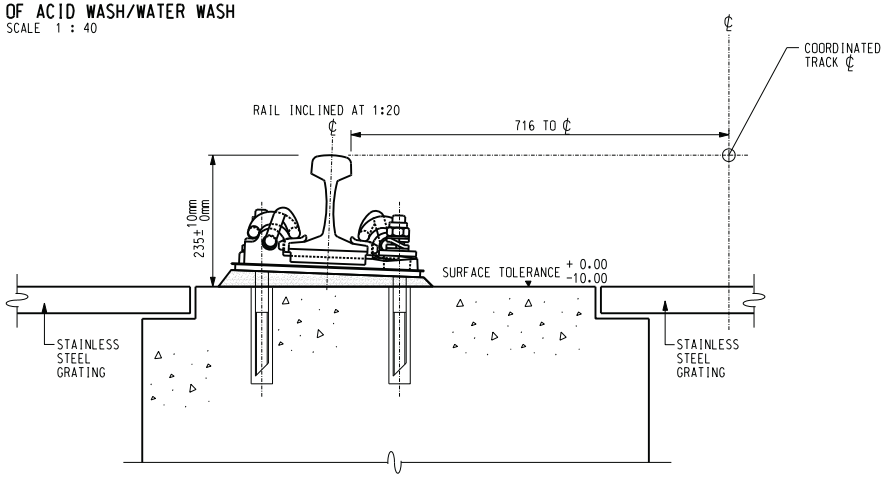


DEPOT ACID WASH



DEPOT WATER WASH

SECTION B
SCALE 1 : 10

NOTES :

1. UIC 60 RAIL SECTION SHOWN ON ALL DETAILS

This drawing is approved
on 10 October 2005

Signed:

A.M.Gibson (CDM)

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TITLE
PERMANENT WAY
DEPOT TRACKFORM -
UNDERFRAME WASH &
DEPOT ACID WASH / WATER WASH

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DATE	OCTOBER 2005	AS BUILT DWG NO	-	-	
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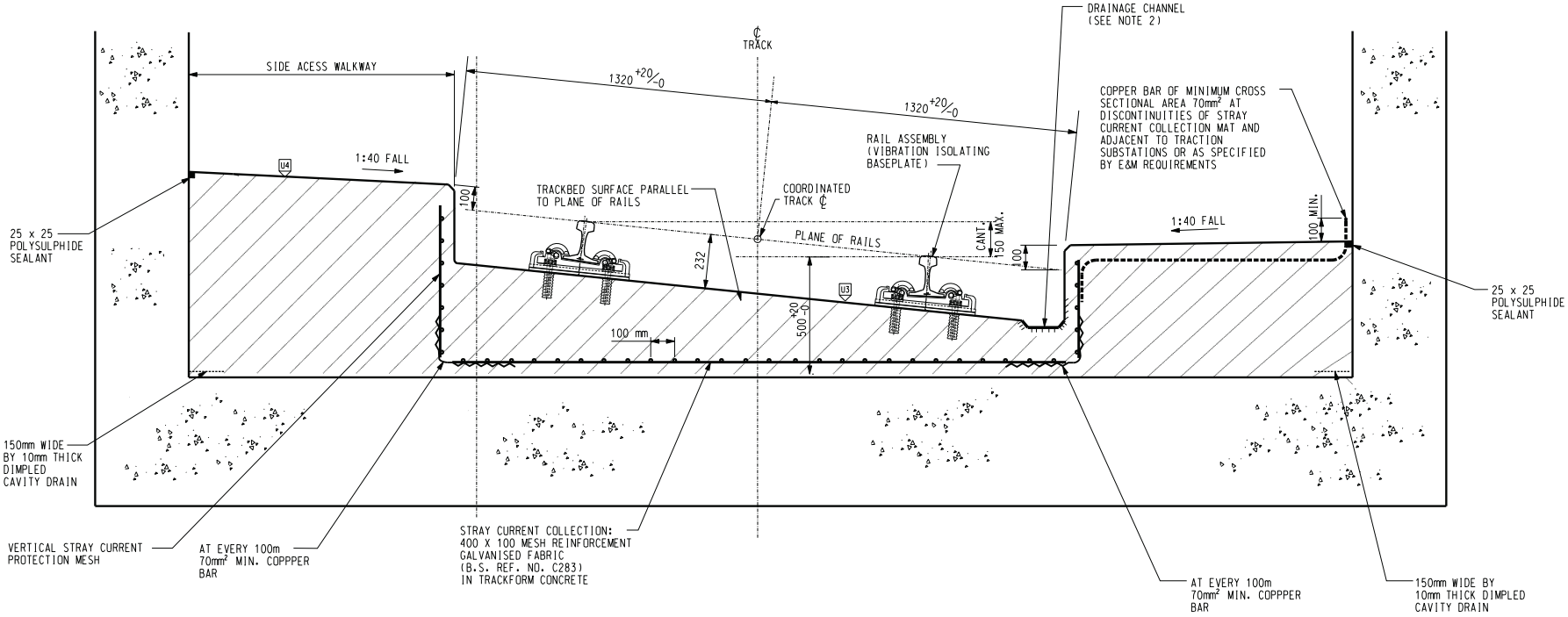

TYPICAL CROSS SECTION THROUGH RECTANGULAR TUNNEL WITH CANTED TRACK

SCALE 1:20

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NOTES:

1. NOMINAL CONCRETE COVER TO STRAY CURRENT COLLECTION MAT SHALL BE 50mm.
2. SURFACE DRAINAGE TO FLOW BY GRAVITY TO TUNNEL LOW POINT AND TO BE CONNECTED INTO MAIN DRAINAGE.
3. TRACKFORM CONCRETE TO BE CLASS 30/20 CATEGORY 'B' NON-METALLIC FIBRE REINFORCED CONCRETE IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS.
4. THE LOCATION OF THE SIDE ACCESS WALKWAY IS INDICATIVE ONLY. EXACT LOCATION OF SIDE ACCESS SHALL BE DETERMINED BY THE DESIGNATED CONTRACTOR FOR TRACKSIDE AUXILIARIES.
5. TRANSVERSE JOINTS AND MOVEMENT JOINTS TO BE PROVIDED TO THE TRACKFORM CONCRETE AS PER M & W SPECIFICATION FOR TRACKWORK.
6. AT EVERY 100 METRES, THE TRACKWORK CONTRACTOR IS REQUIRED TO CONNECT VERTICAL STRAY CURRENT MESH AND HORIZONTAL MESH WITH COPPER BAR BY BRAZING OR SIMILAR MEANS APPROVED.
7. LAP LENGTH OF COPPER BAR TO BE 300 MIN.

LEGEND :

SUPPORT STRUCTURE CONCRETE

TRACKFORM CONCRETE

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Signed:

A.M.Gibson (CDM)

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VIBT TRACKFORM – RECTANGULAR TUNNEL

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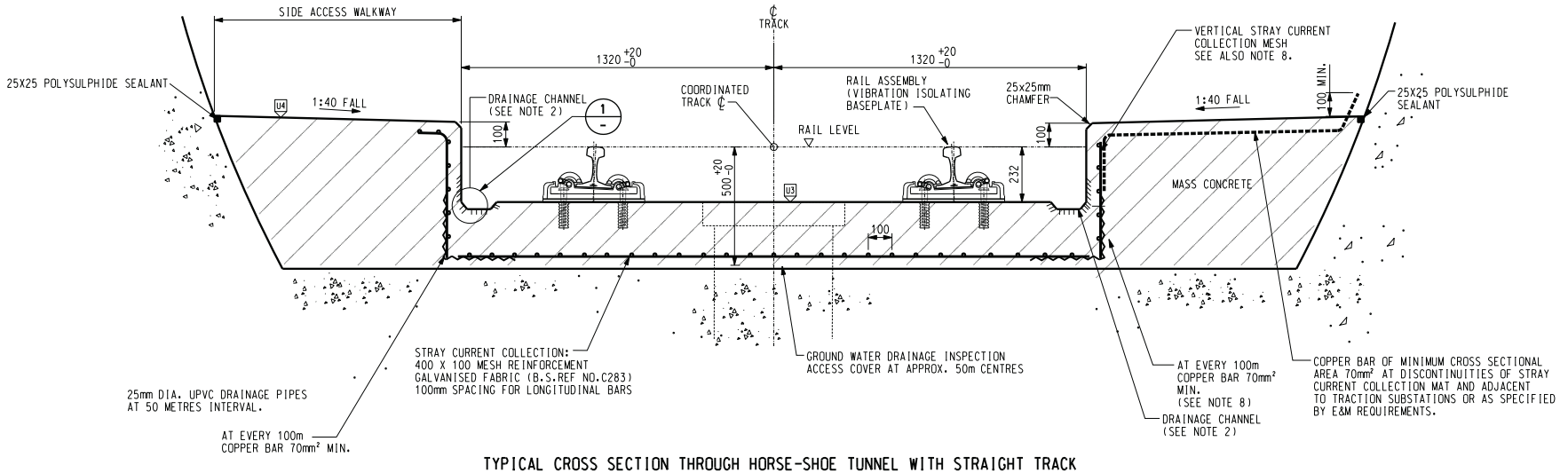
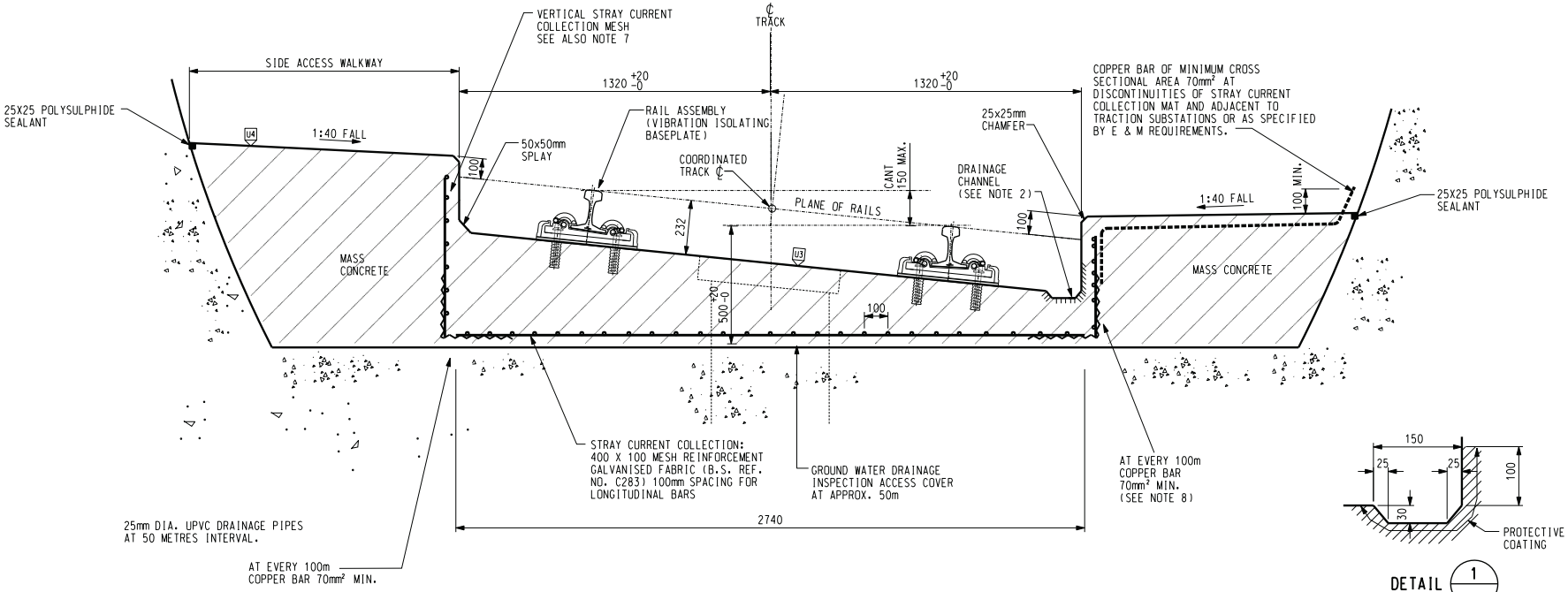


TYPICAL CROSS SECTION THROUGH HORSE-SHOE TUNNEL WITH STRAIGHT TRACK

SCALE 1:20



TYPICAL CROSS SECTION THROUGH HORSE-SHOE TUNNEL WITH CANTED TRACK

SCALE 1:20

DETAIL 1

SCALE 1:2.5

NOTES:

1. NOMINAL CONCRETE COVER TO STRAY CURRENT REINFORCEMENT SHALL BE 50mm.
2. TUNNEL SURFACE DRAINAGE TO FLOW BY GRAVITY TO LOW POINT AND TO BE CONNECTED INTO MAIN DRAINAGE.
3. TRACKFORM CONCRETE TO BE CLASS 30/20 CATEGORY 'B' NON-METALLIC FIBRE REINFORCED CONCRETE IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS.
4. TUNNEL SECTIONS SHOWN ARE FOR HORSE-SHOE TUNNEL. SIMILAR DETAILS SHALL APPLY TO CIRCULAR TUNNEL.
5. THE LOCATION OF THE SIDE ACCESS WALKWAY IS INDICATIVE ONLY. EXACT LOCATION OF SIDE ACCESS WALKWAY SHALL BE DETERMINED BY THE DESIGNATED CONTRACTOR FOR TRACKSIDE AUXILIARIES.
6. TRANSVERSE JOINTS AND MOVEMENT JOINTS TO BE PROVIDED TO THE TRACKFORM CONCRETE AS PER THE M & W SPECIFICATION FOR TRACKWORK.
7. AT EVERY 100 METRES, THE TRACKWORK CONTRACTOR IS REQUIRED TO CONNECT VERTICAL STRAY CURRENT MESH AND HORIZONTAL MESH WITH COPPER BAR BY BRAZING OR SIMILAR MEANS APPROVED.
8. LAP LENGTH OF COPPER BAR TO BE 300 MIN.

LEGEND :

SUPPORT STRUCTURE CONCRETE

TRACKFORM CONCRETE

This drawing is approved on 10 October 2005

Signed:

A.M.Gibson (CDM)

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PERMANENT WAY

VIBT TRACKFORM –
HORSE SHOE & CIRCULAR TUNNEL

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DATE	OCTOBER 2005	AS BUILT DWG NO	–	–	
DRAWN	LFB	DESIGNED	TC	DRAWING NO	REV
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CADD REF *grspec

PLOTTING TIME 1to1=1me

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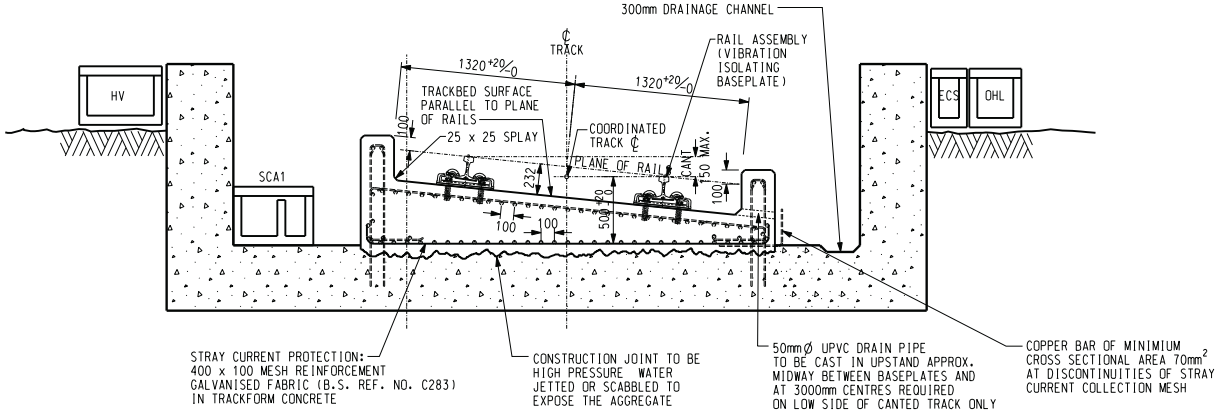
2. TRACKFORM CONCRETE TO BE CLASS 40/20 CATEGORY 'A' IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS.
3. TRACK BASE TO BE IN DISCRETE LENGTHS IN ACCORDANCE WITH M&W SPECIFICATION FOR TRACKWORK.
4. FOR REINFORCEMENT DETAILS REFER TO DRAWING No. NWS/S/GEN/PPW/C04/007.



TYPICAL CROSS SECTION THROUGH CANTED VIBT TRACK AT OPEN TRACK SECTION

SCALE 1:40

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TITLE
PERMANENT WAY
VIBT TRACKFORM – OPEN SECTION

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DATE	OCTOBER 2005		AS BUILT DWG NO	–	–
DRAWN	LFB	DESIGNED TC	DRAWING NO	NWS/S/GEN/PPW/C04/006	REV A
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DRAWING NO NWS/S/GEN/PPW/C04/006

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CADD REF *gnspec

PLOTTING TIME Skyline

0 100mm ON ORIGINAL

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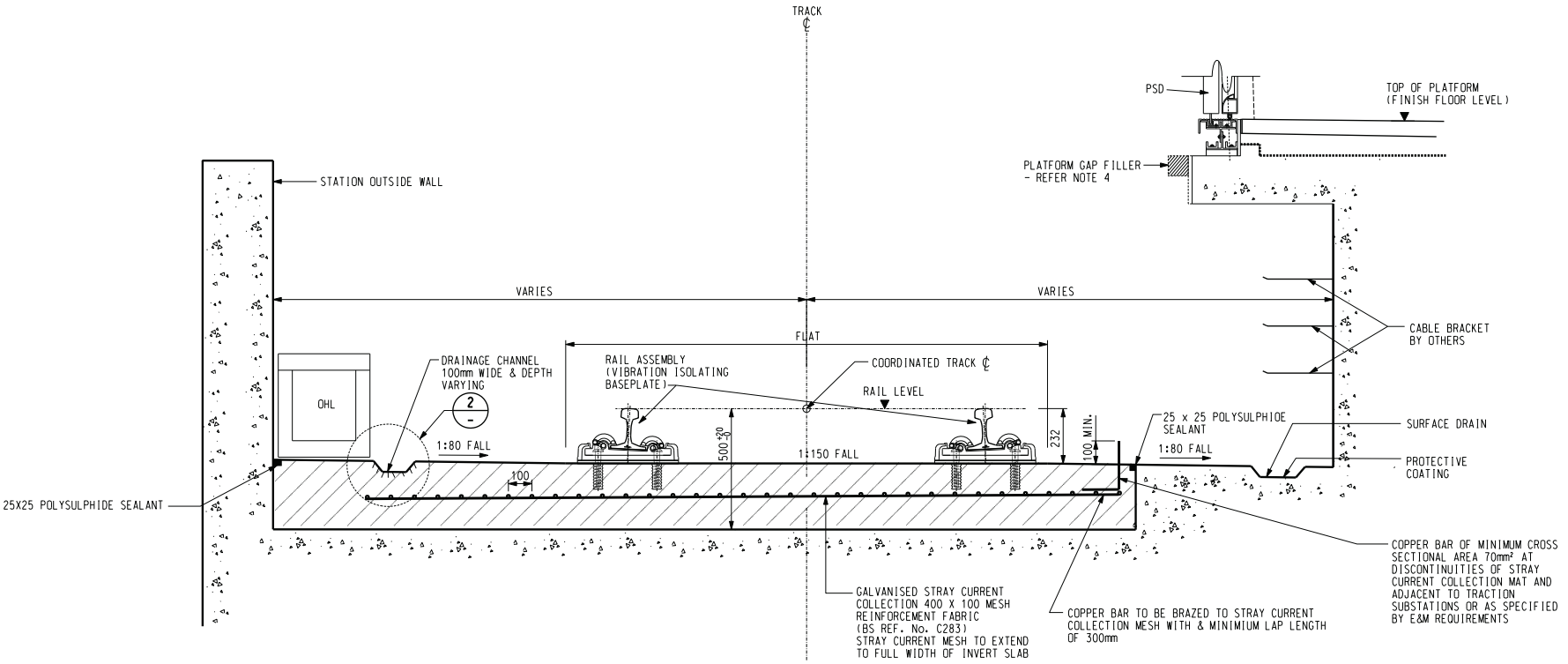
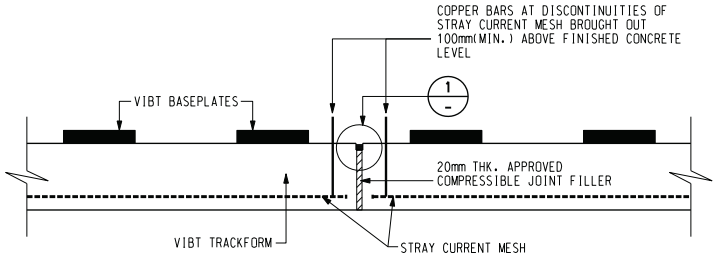
DRAWING NO
NWS/S/GEN/PPW/C04/008



TYPICAL SECTION THROUGH STATION VIBT TRACKFORM

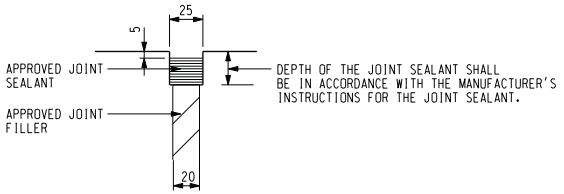
SCALE 1 : 20



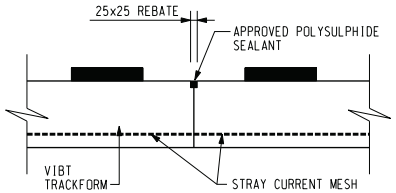
MOVEMENT JOINT

(TO BE PROVIDED AT MOVEMENT JOINTS OF SUPPORTING STRUCTURE AND AT LOCATIONS AS SPECIFIED IN THE M&W FOR TRACKWORK)

N.T.S.



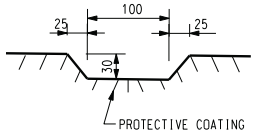
DETAIL 1 — SCALE 1 : 4



TRANSVERSE CONSTRUCTION JOINT

(TO BE PROVIDED AT A TYPICAL SPACING OF APPROX. 11.9m TO THE TRACKFORM CONCRETE. DETAILS AS PER M&W SPECIFICATION FOR TRACKWORK SECTION 4)

N.T.S.



DETAIL 2

NOTES :

1. NOMINAL CONCRETE COVER TO STRAY CURRENT REINFORCEMENT SHALL BE 50mm.
2. TRACKFORM CONCRETE TO BE CLASS 30/20 CATEGORY 'B' NON-METALLIC FIBRE REINFORCED CONCRETE IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS.
3. DRAINAGE TO BE CONNECTED TO THE UNDER PLATFORM DRAIN FORMED.
4. PLATFORM GAP FILLER TO BE INSTALLED TO EDGE OF PLATFORM COPING IF GAP BETWEEN TRAIN AND PLATFORM EXCEEDS 115mm. FOR FURTHER DETAIL REFER TO DRAWING No. NWS/S/GEN/PPW/C04/018.

LEGEND :

SUPPORT STRUCTURE CONCRETE

TRACKFORM CONCRETE

This drawing is approved on 10 October 2005

Signed:

A.M.Gibson (CDM)

REVISION	DESCRIPTION	BY	DATE	APPROVED
A	FIRST ISSUE	TC	10/05	AMG

地鐵公司 MTR Corporation
MTR TOWER
TELFORD PLAZA – KOWLOON BAY
HONG KONG
TEL : 2993 2111 FAX : 2798 8822

NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE

PERMANENT WAY

VIBT TRACKFORM – STATION

SCALE	AS SHOWN	CAD REF	C04008.DGN	AS BUILT APPROVED	
DATE	OCTOBER 2005	AS BUILT DWG NO	–		–
DRAWN	LFB	DESIGNED	TC	DRAWING NO	REV
CHECKED	TC	APPROVED	DE	NWS/S/GEN/PPW/C04/008	A

17/10/2005 .. 09:40:59 f:\nws\sgen\PPW\C04008.dgn

PLOTTING TIME 1to1=1me

CADD REF *grispec

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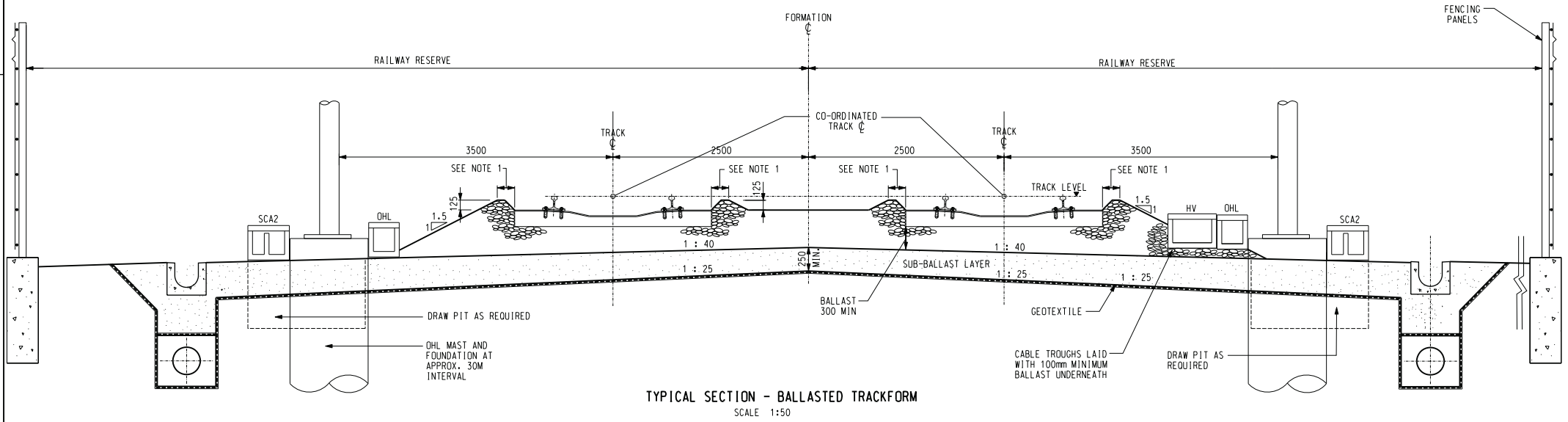
DRAWING NO
NWS/S/GEN/PPW/C04/009

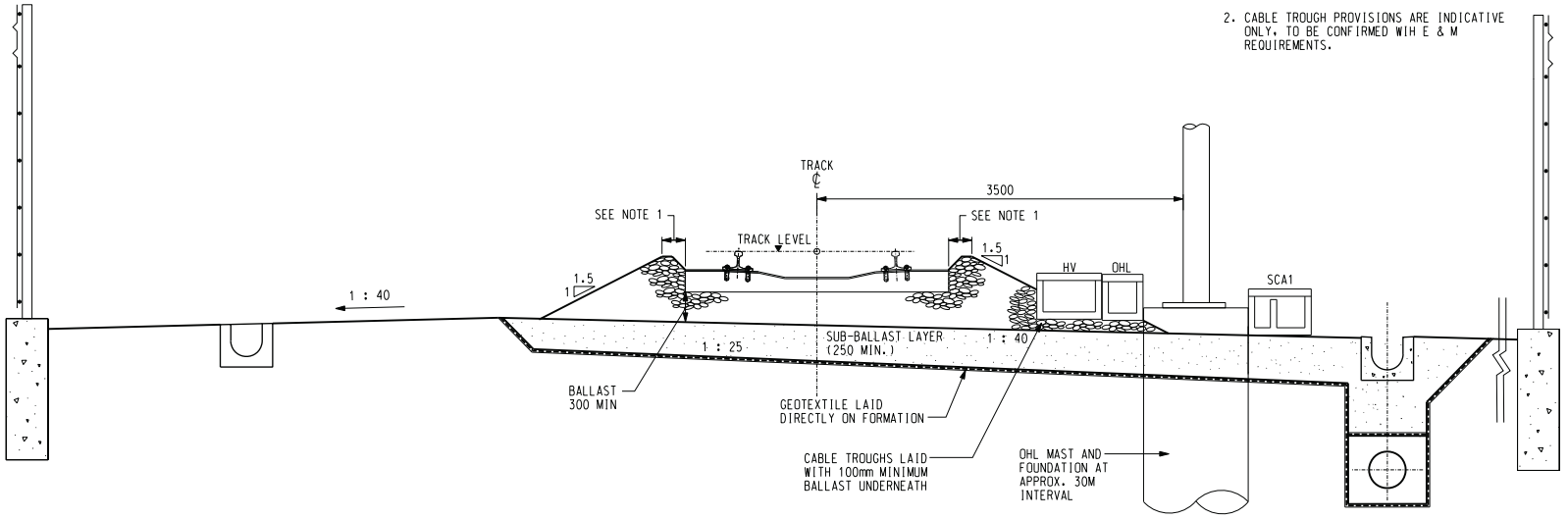


TYPICAL SECTION - BALLASTED TRACKFORM
SCALE 1:50

NOTES:

1. BALLAST SHOULDERS SHALL BE :-
   - STRAIGHT TRACK = 380mm
   - CURVES LARGER THAN 800 m RADIUS = 460mm
   - CURVES EQUAL AND LESS THAN 800 m RADIUS = 530 mm
   - ALL SHOULDERS TO BE HEAPED 125 mm ABOVE THE SLEEPER TOP LEVEL.

2. CABLE TROUGH PROVISIONS ARE INDICATIVE ONLY, TO BE CONFIRMED WIH E & M REQUIREMENTS.



TYPICAL SECTION - SINGLE BALLASTED TRACK
SCALE 1:50

This drawing is approved on 10 October 2005

Signed:
A.M.Gibson (CDM)

REVISION	DESCRIPTION	BY	DATE	APPROVED
A	FIRST ISSUE	TC	10/05	AMG

地鐵公司 MTR Corporation
MTR TOWER
TELFORD PLAZA - KOWLOON BAY
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NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE
PERMANENT WAY
BALLASTED TRACKFORM

SCALE	AS SHOWN	CAD REF	C04009.DGN	AS BUILT APPROVED	
DATE	OCTOBER 2005	AS BUILT DWG NO	-		-
DRAWN	LFB	DESIGNED	TC	DRAWING NO	REV
CHECKED	TC	APPROVED	DE	NWS/S/GEN/PPW/C04/009	A

CADD REF *gnspec

17/10/2005 ** 09:43:31 f:\nws\sgen\PPW\C04009.dgn

PLOTTING TIME Tay:rme

0 100mm ON ORIGINAL

DRAWING NO
NWS/S/GEN/PPW/C04/010

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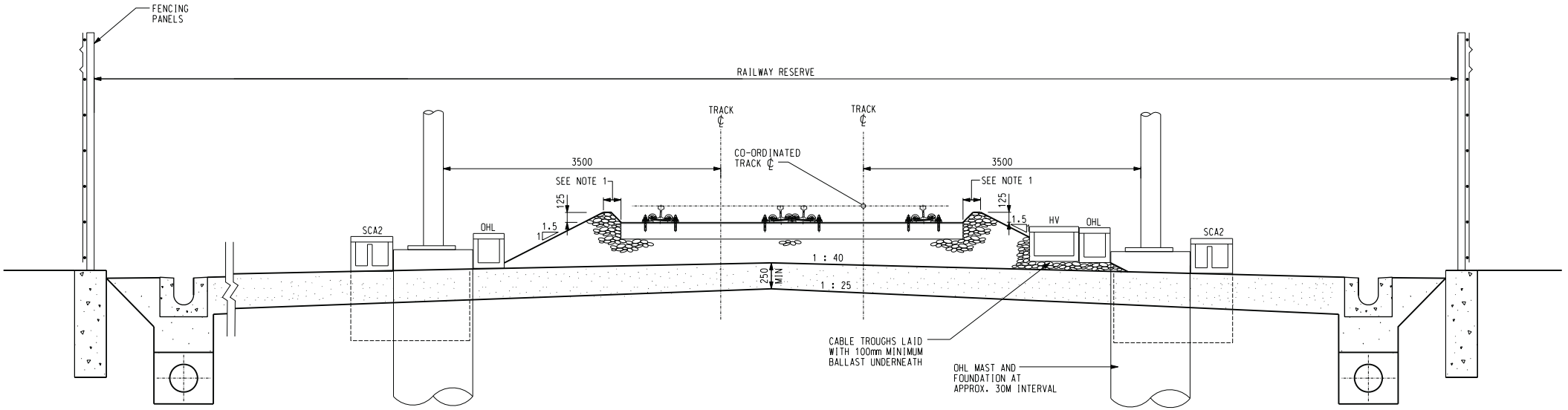
NOTES:

1. BALLAST SHOULDERS WERE :-
   - STRAIGHT TRACK = 380mm
   - CURVES LARGER THAN 800m RADIUS = 460mm
   - CURVES EQUAL AND LESS THAN 800m RADIUS = 530mm
   - ALL SHOULDERS WERE HEAPED 125mm ABOVE THE SLEEPER TOP LEVEL.

2. CABLE TROUGHS PROVISIONS ARE INDICATIVE ONLY, TO BE CONFIRMED BY E & M REQUIREMENTS.



TYPICAL SECTION - BALLASTED TURNOUT TRACKFORM

SCALE 1:50

This drawing is approved on 10 October 2005

Signed:

A.M.Gibson (CDM)

REVISION	DESCRIPTION	BY	DATE	APPROVED
A	FIRST ISSUE	TC	10/05	AMG

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NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE
PERMANENT WAY
BALLASTED TRACKFORM - TURNOUT

SCALE	AS SHOWN	CAD REF	C04010.DGN	AS BUILT APPROVED	
DATE	OCTOBER 2005	AS BUILT DWG NO	-		-
DRAWN	LFB	DESIGNED	TC	DRAWING NO	REV
CHECKED	TC	APPROVED	DE	NWS/S/GEN/PPW/C04/010	A

17/10/2005 .. 09:45:33 f:\nws\sgen\PPW\C04010.dgn

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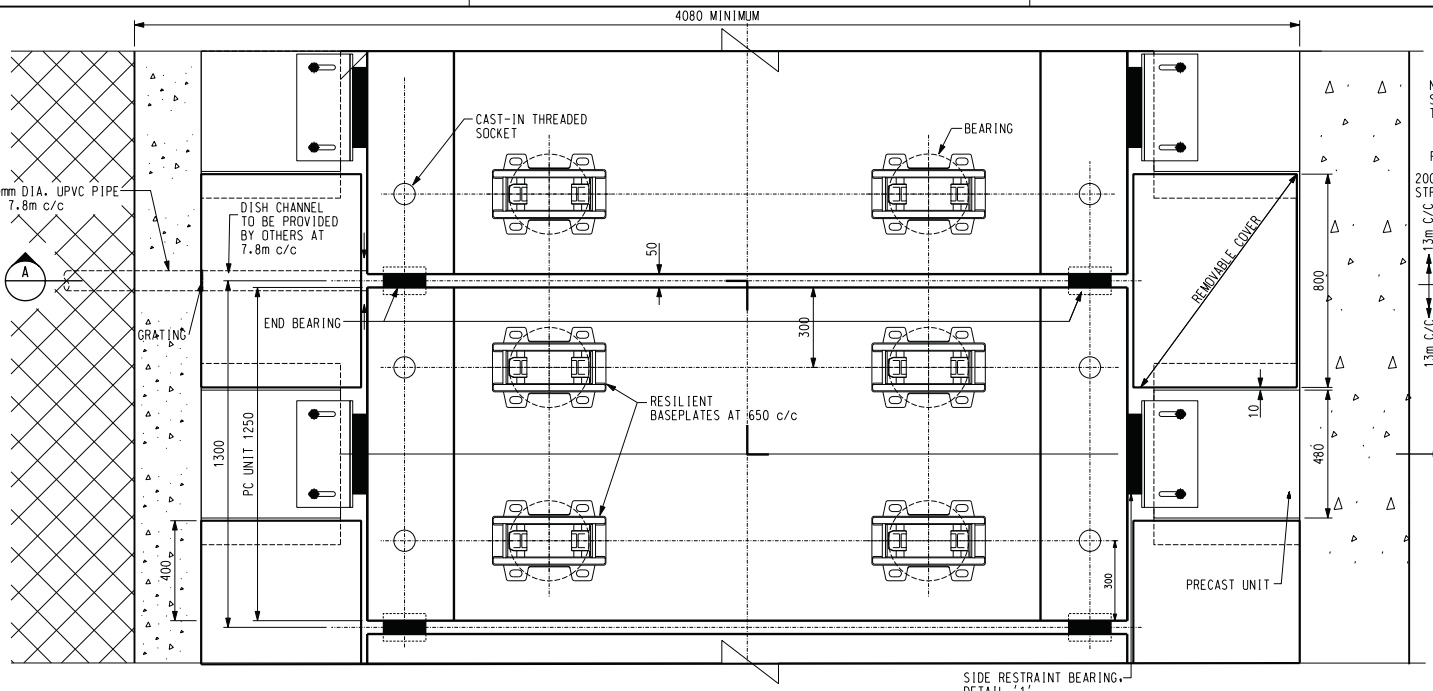
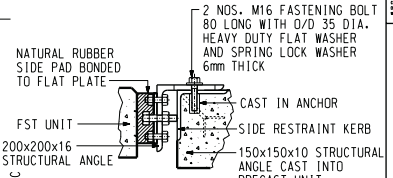
CADD REF *grspec

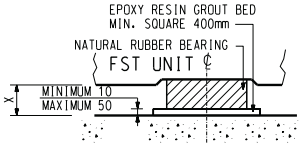
PLOTTING TIME 1to1=1me



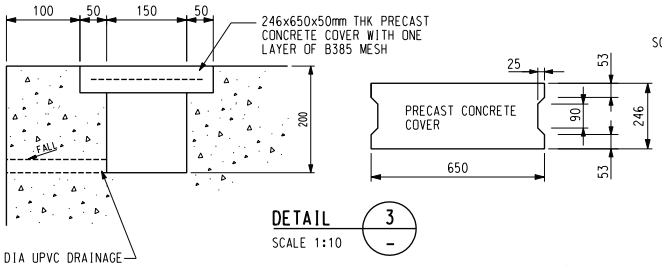
PLAN
SCALE 1:20



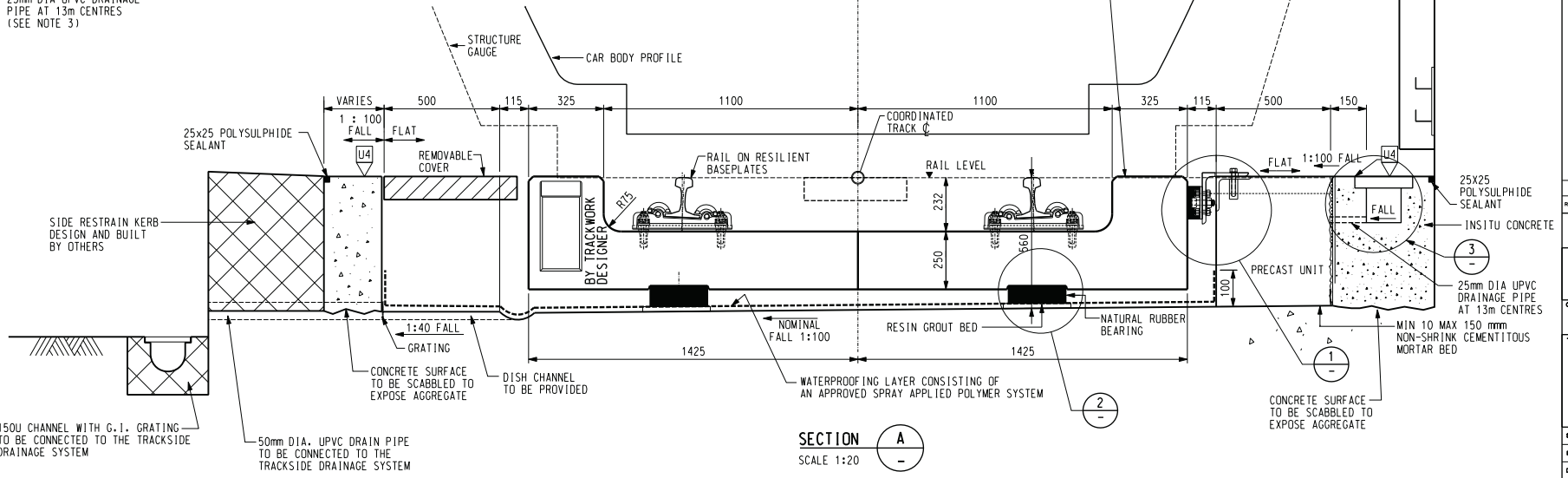
DETAIL 1
SCALE 1:20



DETAIL 2
SCALE 1:20
(WHERE 70 < X < 110)



DETAIL 3
SCALE 1:10



SECTION A
SCALE 1:20

NOTES:

1. A WATERPROOFING LAYER IS REQUIRED WITHIN THE STATION STRUCTURES.
2. BASEPLATES SHOWN ARE INDICATIVE ONLY.
3. DRAINAGE PIPES ARE TO BE LOCATED BETWEEN PRECAST SIDE RESTRAINT UNITS.
4. INSITU CONCRETE TO BE CLASS 30/20 CATEGORY "B" IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS.
5. PLATFORM GAP FILLER TO BE INSTALLED TO EDGE OF PLATFORM COPING IF GAP BETWEEN TRAIN AND PLATFORM EXCEEDS 115mm. FOR FURTHER DETAILS REFER TO DRAWING No. NWS/S/GEN/PPS/C04/018.

This drawing is approved on 10 October 2005

Signed:

A.M.Gibson (CDM)

REVISION	DESCRIPTION	BY	DATE	APPROVED
A	FIRST ISSUE	TC	10/05	AMG

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MTR TOWER
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HONG KONG
TEL : 2993 2111 FAX : 2798 8822

NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE
PERMANENT WAY
FLOATING SLAB TRACKFORM – STATION

SCALE	AS SHOWN	CAD REF	C04011.DGN	AS BUILT APPROVED	
DATE	OCTOBER 2005	AS BUILT DWG NO	-	-	
DRAWN	LFB	DESIGNED	TC	DRAWING NO	REV
CHECKED	TC	APPROVED	DE	NWS/S/GEN/PPW/C04/011	A

DRAWING NO NWS/S/GEN/PPW/C04/011

17/10/2005 ** 09:47:03 f:\nws\sgen\PPW\C04011.dgn

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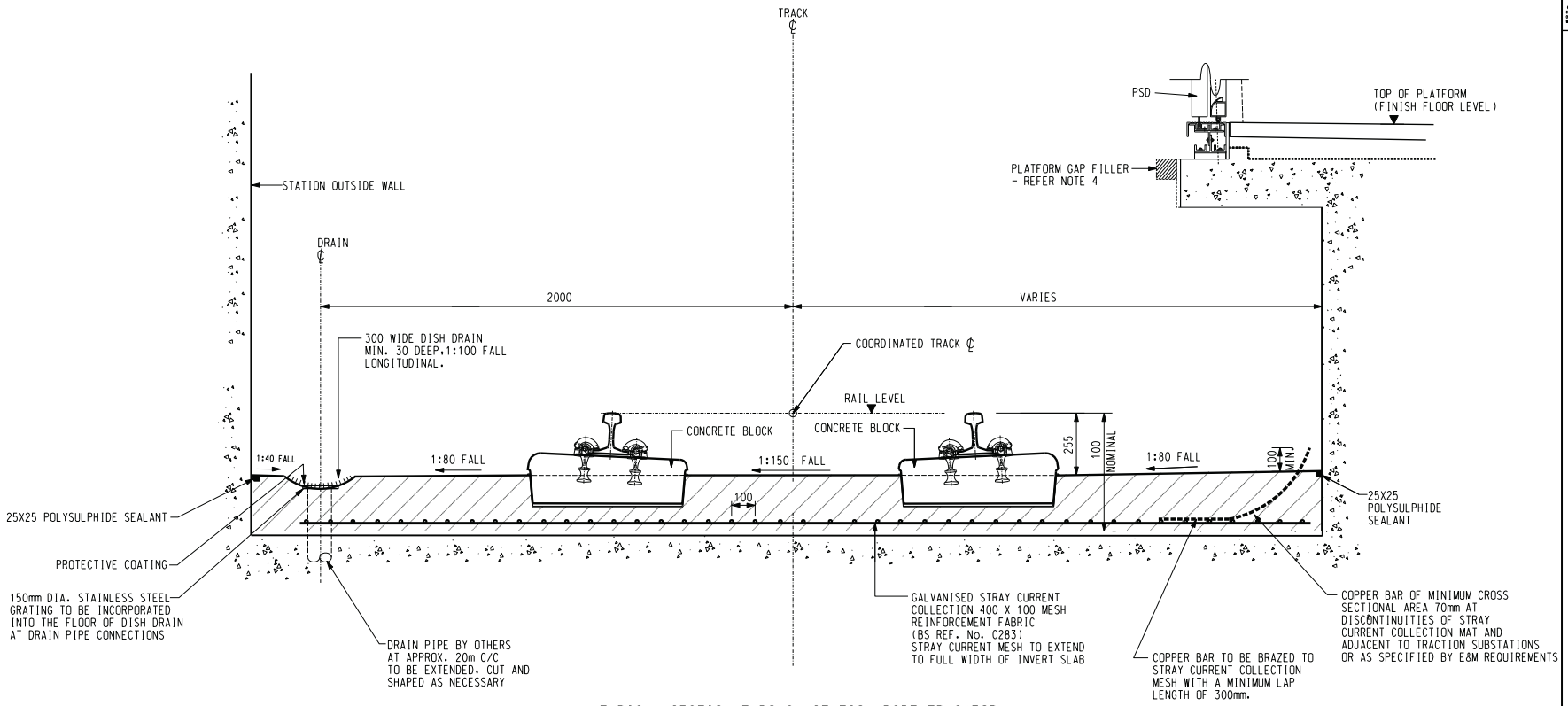
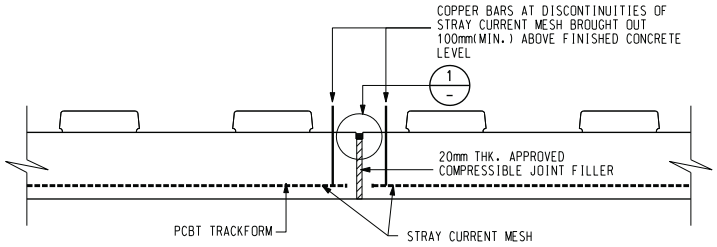
PLOTTING TIME 16:17:11

CADD REF *grspec

DRAWING NO
NWS/S/GEN/PPW/C04/012



TYPICAL SECTION THROUGH STATION PCBT TRACKFORM
SCALE 1 : 20



MOVEMENT JOINT
(TO BE PROVIDED AT MOVEMENT JOINTS OF SUPPORTING STRUCTURE AT LOCATIONS AS SPECIFIED IN THE M&W FOR TRACKWORK)
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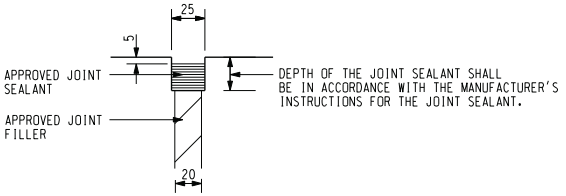
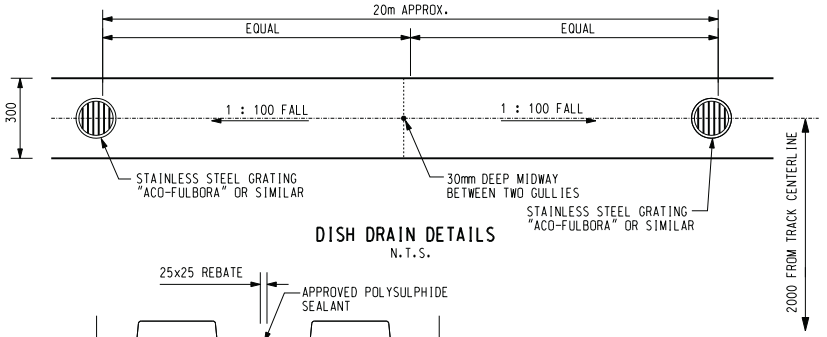
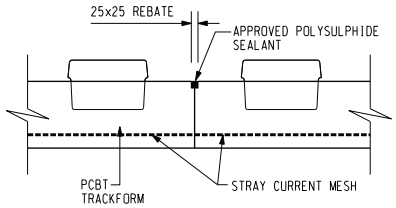


DETAIL 1
SCALE 1 : 4



DISH DRAIN DETAILS
N.T.S.



TRANSVERSE CONSTRUCTION JOINT
(TO BE PROVIDED AT A TYPICAL SPACING OF APPROX. 11.9m TO THE TRACKFORM CONCRETE AS PER M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS VOLUME 1 SECTION 8)
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NOTES :

1. NOMINAL CONCRETE COVER TO STRAY CURRENT REINFORCEMENT SHALL BE 50mm.
2. TRACKFORM CONCRETE TO BE CLASS 30/20 CATEGORY 'B' NON-METALLIC FIBRE REINFORCED CONCRETE IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS
3. LAP LENGTH OF COPPER BAR TO BE 300mm MIN.
4. PLATFORM GAP FILLER TO BE INSTALLED TO EDGE OF PLATFORM COPING IF GAP BETWEEN TRAIN AND PLATFORM EXCEEDS 115mm. FOR FURTHER DETAILS REFER TO DRAWING No. NWS/S/GEN/PPW/C04/018.

LEGEND :

SUPPORT STRUCTURE CONCRETE

TRACKFORM CONCRETE

This drawing is approved on 10 October 2005

Signed:

A.M.Gibson (CDM)

REVISION	DESCRIPTION	BY	DATE	APPROVED
A	FIRST ISSUE	TC	10/05	AMG

地鐵公司 MTR Corporation
MTR TOWER
TELFORD PLAZA - KOWLOON BAY
HONG KONG
TEL : 2993 2111 FAX : 2798 8822

NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE
PERMANENT WAY
PCBT TRACKFORM - STATION

SCALE	AS SHOWN	CAD REF	C04012.DGN	AS BUILT APPROVED	
DATE	OCTOBER 2005	AS BUILT DWG NO	-	-	
DRAWN	LFB	DESIGNED	TC	DRAWING NO	REV
CHECKED	TC	APPROVED	DE	NWS/S/GEN/PPW/C04/012	A

17/10/2005 .. 09:48:07 f:\nws\sgen\PPW\C04012.dgn
PLOTTING TIME Skyline
CADD REF *grspec
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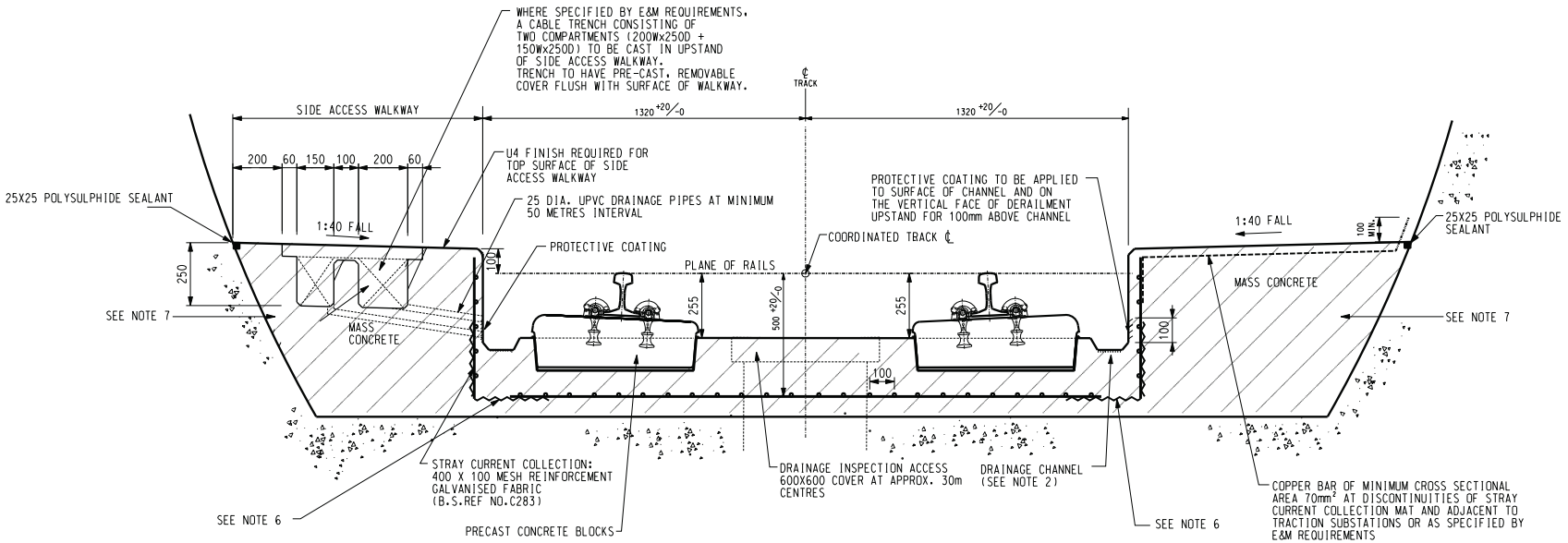
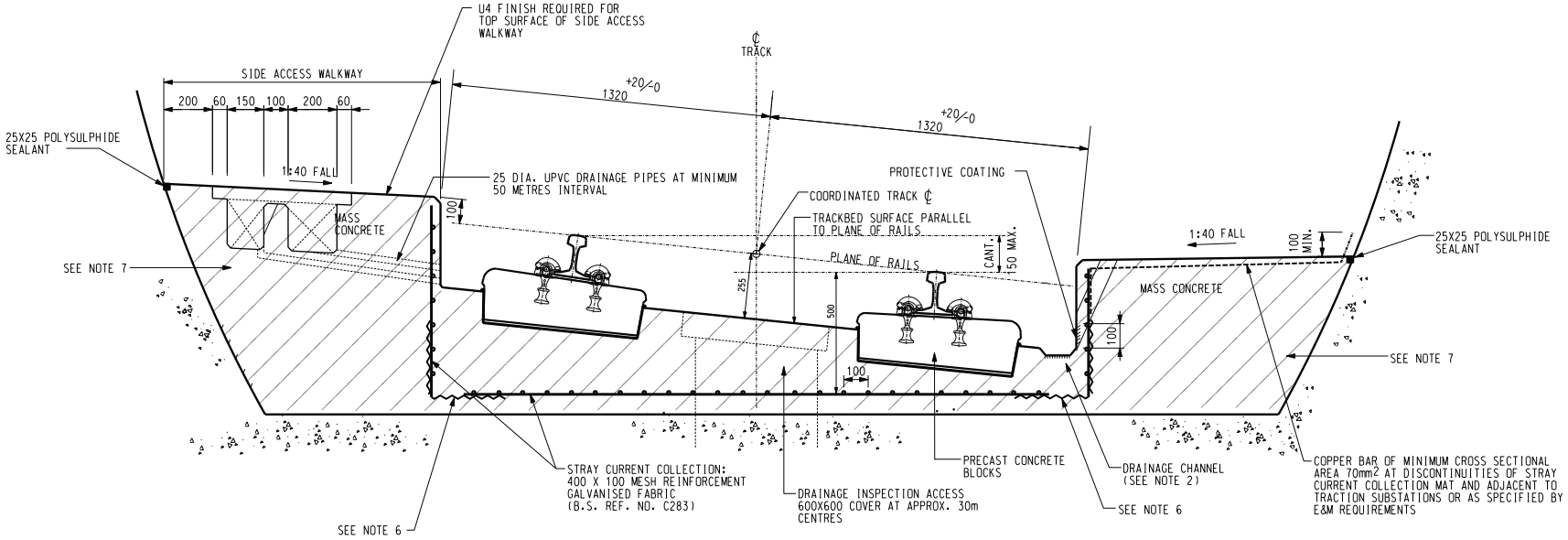


TYPICAL CROSS SECTION THROUGH HORSE-SHOE TUNNEL WITH STRAIGHT TRACK

SCALE 1:20



TYPICAL CROSS SECTION THROUGH HORSE-SHOE TUNNEL WITH CANTED TRACK

SCALE 1:20

NOTES:

1. NOMINAL CONCRETE COVER TO STRAY CURRENT REINFORCEMENT SHALL BE 50mm.
2. TUNNEL SURFACE DRAINAGE TO FLOW BY GRAVITY TO LOW POINT AND TO BE CONNECTED INTO MAIN DRAINAGE.
3. TRACKFORM CONCRETE TO BE CLASS 30/20 CATEGORY 'B' NON-METALLIC FIBRE REINFORCED CONCRETE IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS.
4. TUNNEL SECTIONS SHOWN ARE FOR HORSE-SHOE TUNNEL. SIMILAR DETAILS SHALL APPLY TO CIRCULAR TUNNEL.
5. THE LOCATION OF THE SIDE ACCESS WALKWAY IS DEFINED ON SEPARATE DRAWING.
6. AT EVERY 100 METRES, THE CONTRACTOR IS REQUIRED TO CONNECT VERTICAL STRAY CURRENT MESH TO HORIZONTAL STRAY CURRENT MESH USING A COPPER BAR OF MIN. CROSS SECTIONAL AREA 70mm² ATTACHED BY BRAZING OR A MEANS APPROVED BY THE ENGINEER.
7. THE SIDE ACCESS WALKWAY AND THE DERAILMENT UPSTAND SHALL BE CONSTRUCTED, INCLUDING ALL CAST IN ITEMS SHOWN, BY THE CONTRACTOR AT ALL TEMPORARY ACCESS SHAFT OPENINGS
8. LAP LENGTH OF COPPER BAR TO BE 300mm MIN.

LEGEND :

SUPPORT STRUCTURE CONCRETE

TRACKFORM CONCRETE

This drawing is approved on 10 October 2005

Signed:

A.M.Gibson (CDM)

REVISION	DESCRIPTION	BY	DATE	APPROVED
A	FIRST ISSUE	TC	10/05	AMG

地鐵公司 MTR Corporation
MTR TOWER
TELFORD PLAZA – KOWLOON BAY
HONG KONG
TEL : 2993 2111 FAX : 2798 8822

NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE
PERMANENT WAY
PCBT TRACKFORM –
HORSE-SHOE AND CIRCULAR TUNNEL

SCALE	AS SHOWN	CAD REF	C04013.DGN	AS BUILT APPROVED	
DATE	OCTOBER 2005	AS BUILT DWG NO	-		-
DRAWN	LFB	DESIGNED	TC	DRAWING NO	REV
CHECKED	TC	APPROVED	DE	NWS/S/GEN/PPW/C04/013	A

DRAWING NO NWS/S/GEN/PPW/C04/013

17/10/2005 .. 09:49:21 f:\nws\sgen\PPW\C04013.dgn

PLOTTING TIME 1to1=1me

CADD REF *grspec

0 100mm ON ORIGINAL

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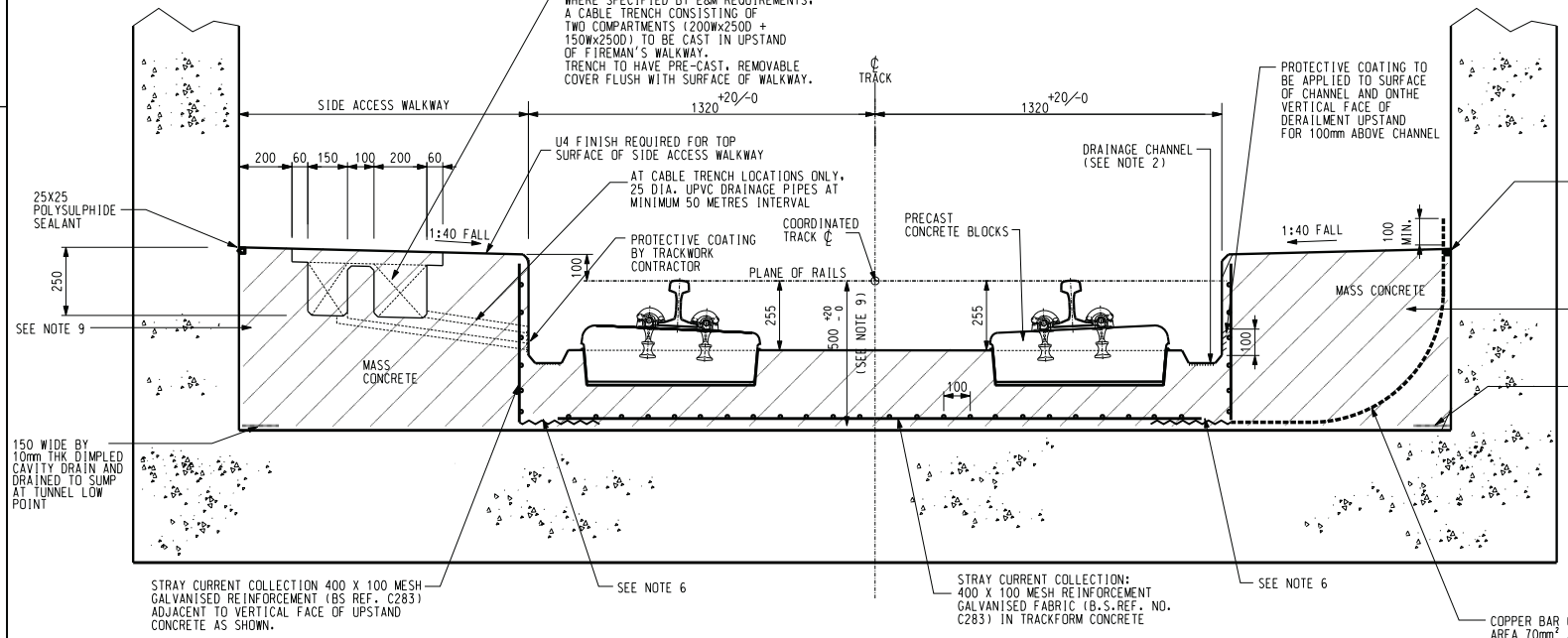
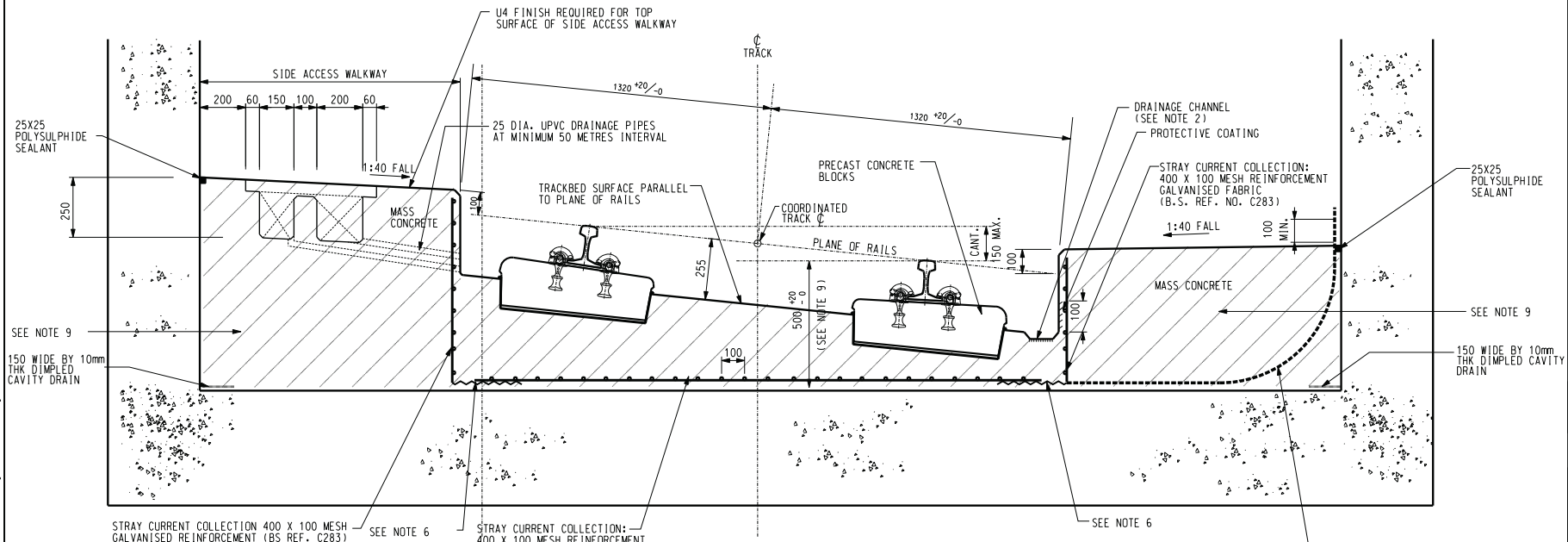
DRAWING NO
NWS/S/GEN/PPW/C04/014



TYPICAL CROSS SECTION THROUGH CUT AND COVER TUNNEL WITH STRAIGHT TRACK

SCALE 1:20



TYPICAL CROSS SECTION THROUGH CUT AND COVER TUNNEL WITH CANTED TRACK

SCALE 1:20

NOTES:

1. NOMINAL CONCRETE COVER TO STRAY CURRENT REINFORCEMENT SHALL BE 50mm.
2. TUNNEL SURFACE DRAINAGE TO FLOW BY GRAVITY TO TUNNEL LOW POINT AND TO BE CONNECTED INTO MAIN CIVIL CONTRACT DRAINAGE.
3. TRACKFORM CONCRETE TO BE CLASS 30/20 CATEGORY 'B' NON-METALLIC FIBRE REINFORCED CONCRETE IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS.
4. DETAILS SHOWN ARE APPLICABLE TO CUT AND COVER TUNNELS ONLY.
5. THE LOCATION OF THE SIDE ACESS WALKWAY IS DEFINED ON INDIVIDUAL CIVIL CONTRACT DRAWINGS.
6. AT EVERY 100 METRES, THE TRACKWORK CONTRACTOR IS REQUIRED TO CONNECT VERTICAL STRAY CURRENT MESH AND HORIZONTAL MESH WIDTH COPPER BAR BY BRAZING OR SIMILAR MEANS APPROVED.
7. TRANSVERSE JOINTS AND MOVEMENT JOINTS TO BE PROVIDED TO THE TRACKFORM CONCRETE AS PER THE M & W SPECIFICATION FOR TRACKWORK. 2
8. THE MIN. DEPTH REQUIRED IS 500mm.
9. THE SIDE ACCESS WALKWAY AND THE DERAILMENT UPSTAND SHALL BE CONSTRUCTED, INCLUDING ALL CAST IN ITEMS SHOWN, BY THE CONTRACTOR AT ALL TEMPORARY ACCESS SHAFT OPENINGS.
10. LAP LENGTH OF COPPER BAR TO BE 300mM MIN.

LEGEND :

SUPPORT STRUCTURE CONCRETE

TRACKFORM CONCRETE

This drawing is approved on 10 October 2005

Signed:

A.M.Gibson (CDM)

REVISION	DESCRIPTION	BY	DATE	APPROVED
A	FIRST ISSUE	TC	10/05	AMG

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NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE
PERMANENT WAY
PCBT TRACKFORM - CUT AND COVER TUNNEL

SCALE	AS SHOWN		CAD REF	C04014.DGN	AS BUILT APPROVED
DATE	OCTOBER 2005		AS BUILT DWG NO	-	-
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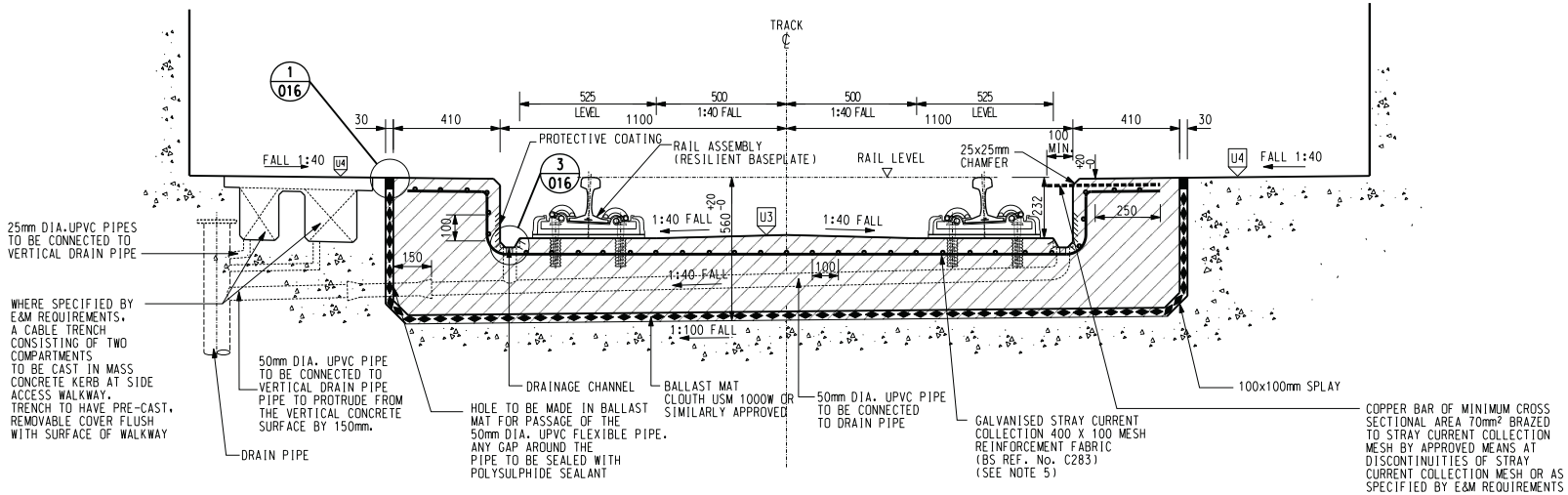
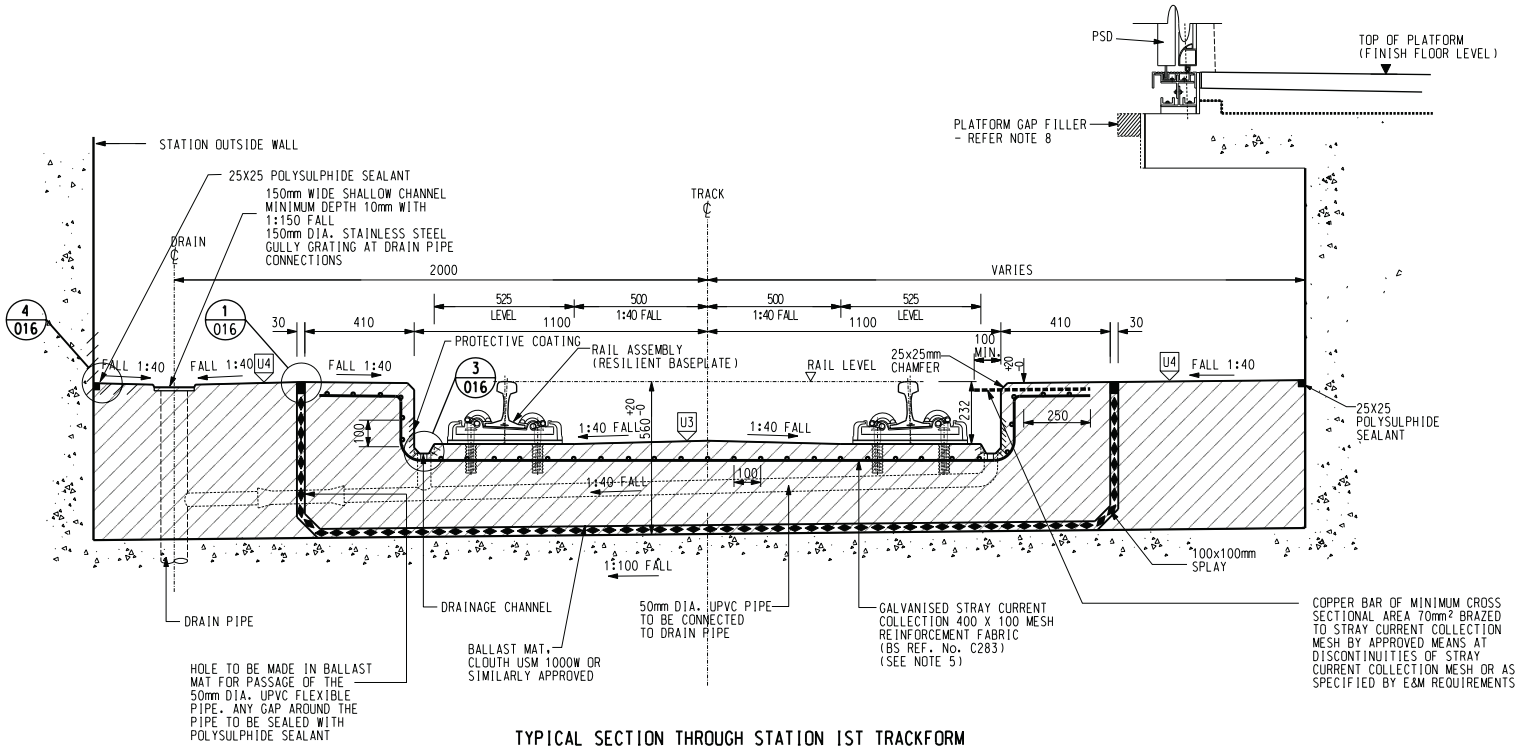


SECTION THROUGH IST TRACKFORM AT STATION PLANT ROOM AREA

SCALE 1 : 20



TYPICAL SECTION THROUGH STATION IST TRACKFORM

SCALE 1 : 20

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NOTES:

1. NOMINAL CONCRETE COVER TO STRAY CURRENT REINFORCEMENT SHALL BE 50mm.
2. TRACKFORM CONCRETE TO BE CLASS 30/20 CATEGORY 'B' NON-METALLIC FIBRE REINFORCED CONCRETE IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS.
3. A SHEET OF PLASTIC FILM IS TO BE LAID OVER THE WHOLE BALLAST MAT AREA AND CLAMPED UNDER THE 'Z' PROFILE BEFORE TRACKFORM CONCRETING. (REFER TO M & W SPECIFICATIONS FOR TRACKWORK)
4. CONCRETE FINISHES FOR SURFACES RECEIVING THE BALLAST MAT SHALL BE F3 FOR FORMED SURFACES AND U3 FOR UNFORMED SURFACES.
5. MESH TO BE MADE CONTINUOUS BY BRAZING OF COPPER BARS AT ALL LOCATIONS THAT HAVE TO BE CUT FOR HOLDING DOWN ASSEMBLIES OR DRAINAGE PIPES.
6. CONSTRUCTION JOINT TO BE FORMED IN ACCORDANCE WITH THE M&W SPECIFICATION FOR TRACKWORK.
7. LAP LENGTH OF COPPER BAR TO BE 300mm MIN. UNLESS NOTED OTHERWISE.
8. PLATFORM GAP FILLER TO BE INSTALLED TO EDGE OF PLATFORM COPING IF GAP BETWEEN TRAIN AND PLATFORM EXCEEDS 115mm. FOR FURTHER DETAILS REFER TO DRAWING No. NWS/S/GEN/PPS/C04/018.

LEGEND :

SUPPORT STRUCTURE CONCRETE

TRACKFORM CONCRETE

U4 CONCRETE SURFACE FINISH

This drawing is approved on 10 October 2005

Signed:

A.M.Gibson (CDM)

REVISION	DESCRIPTION	BY	DATE	APPROVED
A	FIRST ISSUE	TC	10/05	AMG

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NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR: PROJECT DIVISION

TITLE: PERMANENT WAY
IST TRACKFORM – STATION (SHEET 1 OF 2)

SCALE	AS SHOWN	CAD REF	C04015.DGN	AS BUILT APPROVED	
DATE	OCTOBER 2005	AS BUILT DWG NO	–	–	
DRAWN	LFB	DESIGNED	TC	DRAWING NO	REV
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PLOTTING TIME 1to1 time

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DRAWING NO
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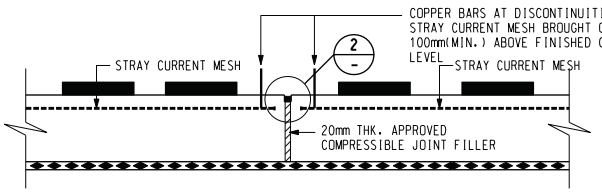
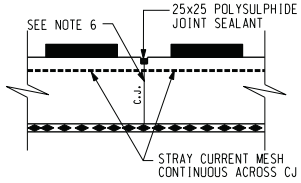
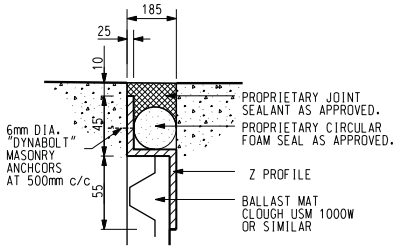


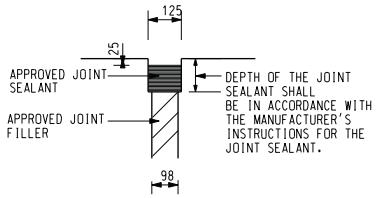
MOVEMENT JOINT
(TO BE PROVIDED IN ACCORDANCE WITH M & W SPECIFICATIONS FOR TRACKWORK)
N.T.S.



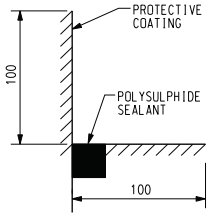
TRANSVERSE CONSTRUCTION JOINT
(TO BE PROVIDED AT A SPACING OF 21m MAXIMUM)
N.T.S.



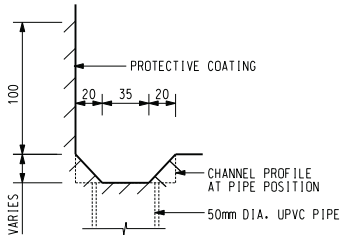
DETAIL 1 / 015
SCALE 1:4



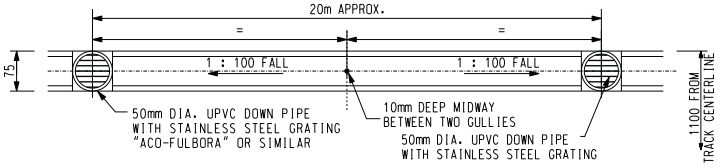
DETAIL 2 / –
SCALE 1:4



DETAIL 4 / 015
SCALE 1:4



DETAIL 3 / 015
SCALE 1:4



DRAINAGE CHANNEL DETAILS N.T.S.

NOTES:

1. NOMINAL CONCRETE COVER TO STRAY CURRENT REINFORCEMENT SHALL BE 50mm.
2. TRACKFORM CONCRETE TO BE CLASS 30/20 CATEGORY 'B' NON-METALLIC FIBRE REINFORCED CONCRETE IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS.
3. A SHEET OF PLASTIC FILM IS TO BE LAID OVER THE WHOLE BALLAST MAT AREA AND CLAMPED UNDER THE 'Z' PROFILE BEFORE TRACKFORM CONCRETING. (REFER TO M & W SPECIFICATIONS FOR TRACKWORK)
4. CONCRETE FINISHES FOR SURFACES RECEIVING THE BALLAST MAT SHALL BE F3 FOR FORMED SURFACES AND U3 FOR UNFORMED SURFACES.
5. MESH TO BE MADE CONTINUOUS BY BRAZING OF COPPER BARS AT ALL LOCATIONS THAT HAVE TO BE CUT FOR HOLDING DOWN ASSEMBLIES OR DRAINAGE PIPES.
6. CONSTRUCTION JOINT TO BE FORMED IN ACCORDANCE WITH THE M&W SPECIFICATION FOR TRACKWORK.
7. LAP LENGTH OF COPPER BAR TO BE 300mm MIN. UNLESS NOTED OTHERWISE.

LEGEND :

SUPPORT STRUCTURE CONCRETE

TRACKFORM CONCRETE

U4 — CONCRETE SURFACE FINISH

C.J. — CONSTRUCTION JOINT

This drawing is approved on 10 October 2005

Signed:
A.M.Gibson (CDM)

REVISION	DESCRIPTION	BY	DATE	APPROVED
A	FIRST ISSUE	TC	10/05	AMG

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NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE
PERMANENT WAY
IST TRACKFORM –
STATION (SHEET 2 OF 2)

SCALE	AS SHOWN		CAD REF	C04016.DGN	AS BUILT APPROVED
DATE	OCTOBER 2005		AS BUILT DWG NO	–	–
DRAWN	LFB	DESIGNED TC	DRAWING NO	NWS/S/GEN/PPW/C04/016	REV A
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PLOTTING TIME Tasy time

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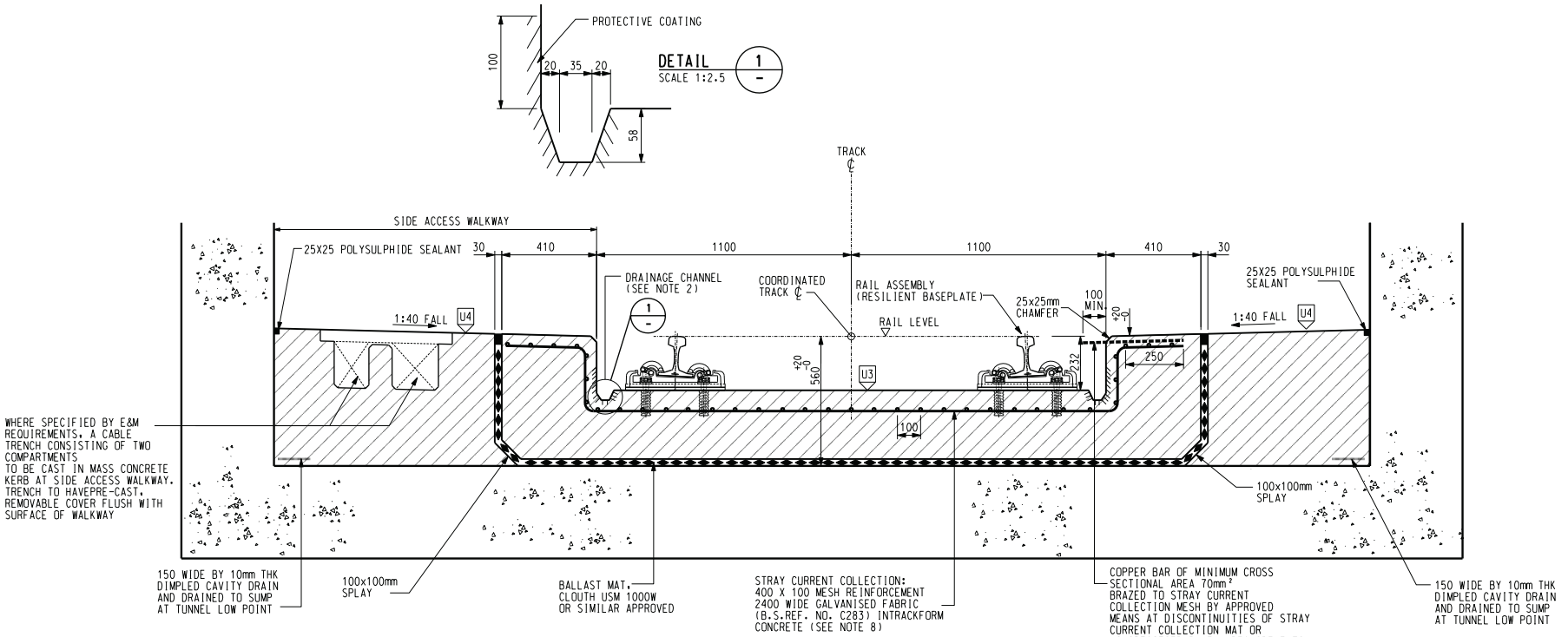
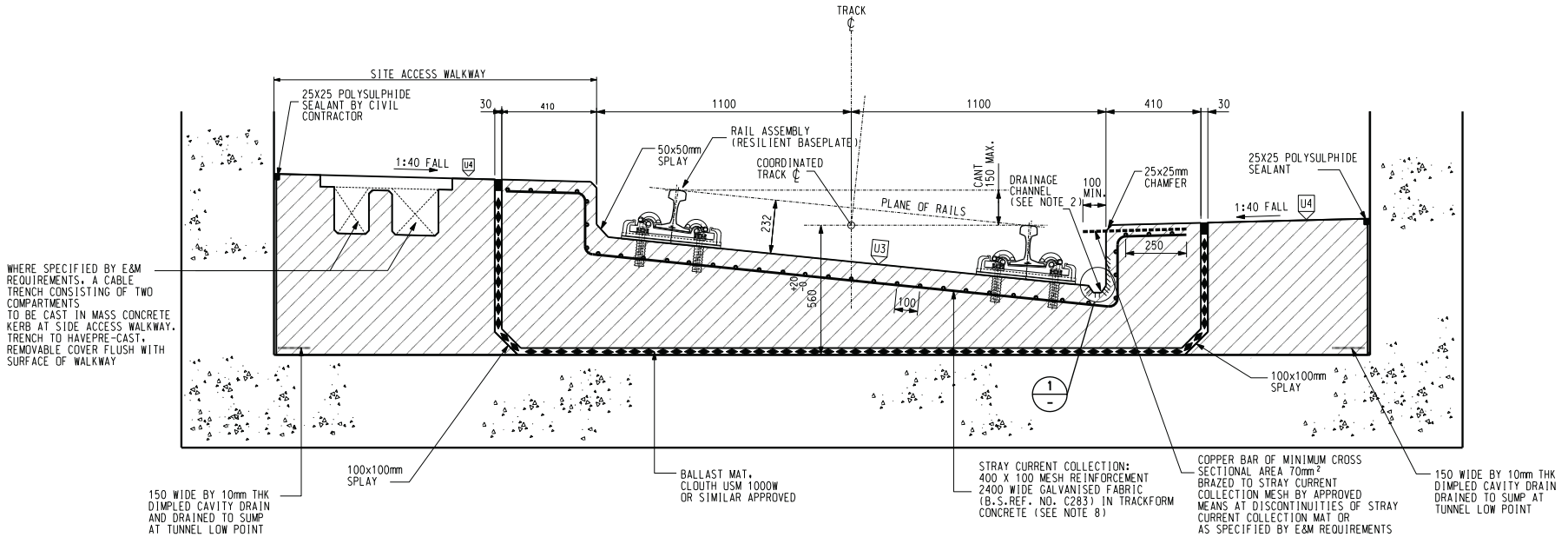
NWS/S/GEN/PPW/C04/017



TYPICAL CROSS SECTION THROUGH STRAIGHT CUT & COVER TUNNEL

SCALE 1 : 20



TYPICAL CROSS SECTION THROUGH CANTED CUT & COVER TUNNEL

SCALE 1 : 20

NOTES:

1. NOMINAL CONCRETE COVER TO STRAY CURRENT REINFORCEMENT SHALL BE 50mm.
2. TUNNEL SURFACE DRAINAGE TO FLOW BY GRAVITY INTO MAIN CIVIL CONTRACT DRAINAGE AT TUNNEL LOW POINTS.
3. TRACKFORM CONCRETE TO BE CLASS 30/20 CATEGORY 'B' NON-METALLIC FIBRE REINFORCED CONCRETE IN ACCORDANCE WITH M&W SPECIFICATION FOR CIVIL ENGINEERING WORKS.
4. AT EVERY 100 METRES, THE TRACKWORK CONTRACTOR IS REQUIRED TO CONNECT VERTICAL STRAY CURRENT MESH AND HORIZONTAL MESH WIDTH COPPER BAR BY BRAZING OR SIMILAR MEANS APPROVED.
5. TRANSVERSE JOINTS AND MOVEMENT JOINTS TO BE PROVIDED TO THE TRACKFORM CONCRETE AS PER THE M & W SPECIFICATION FOR TRACKWORK.
6. A SHEET OF PLASTIC FILM IS TO BE LAID OVER THE WHOLE BALLAST MAT AREA AND CLAMPED UNDER THE 'Z' PROFILE BEFORE TRACKFORM CONCRETING. (REFER TO M & W SPECIFICATIONS FOR TRACKWORK).
7. CONCRETE FINISHES FOR SURFACES RECEIVING THE BALLAST MAT SHALL BE F3 FOR FORMED SURFACES AND U3 FOR UNFORMED SURFACES.
8. MESH TO BE MADE CONTINUOUS BY BRAZING OF COPPER BARS AT ALL LOCATIONS THAT HAVE TO BE CUT FOR HOLDING DOWN ASSEMBLIES OR DRAINAGE PIPES.
9. LAP LENGTH OF COPPER BAR TO BE 300mm MIN. UNLESS NOTED OTHERWISE.

LEGEND :

SUPPORT STRUCTURE CONCRETE

TRACKFORM CONCRETE

U4 CONCRETE SURFACE FINISH

This drawing is approved on 10 October 2005

Signed:

A.M.Gibson (CDM)

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A	FIRST ISSUE	TC	10/05	AMG

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NEW WORKS STANDARD DETAILS
CIVIL INFRASTRUCTURE & TRACKWORK
GEN-DS-MTR-CS-0001A (OCTOBER 2005)

ORIGINATOR
PROJECT DIVISION

TITLE
PERMANENT WAY
IST TRACKFORM –
CUT AND COVER TUNNEL

SCALE	AS SHOWN	CAD REF	C04017.DGN	AS BUILT APPROVED	
DATE	OCTOBER 2005	AS BUILT DWG NO	-		-
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APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 2 OVERHEAD LINE / TRACTION POWER SUPPLY SYSTEM INTERFACES

1 Introduction

2 General Description of the OHL System

3 Performance Requirements of the OHL and Train System Interfaces

4 Design Constraints

5 Confirmation of Design Information

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 2 OVERHEAD LINE / TRACTION POWER SUPPLY SYSTEM INTERFACES

1 Introduction

1.1 This Annex defines the interface requirements for the overhead line / traction power supply system (hereafter referred as the OHL system) and the train system.

1.2 The physical interface point for the Contract shall be defined as the point of contact between the head of the pantograph and the OHL contact wire.

1.3 Detailed requirements of the pantograph shall be referred to RS/C6014/10.

1.4 The 1500VDC bus is fed from the overhead traction power supply through a pantograph via the OHL contact wire. Three pantographs shall be provided on an 8 car train consist.

1.5 The train consist is depicted in Drg. No. C6014-14E/TSEG/010/009. A single pantograph shall be provided on each C car.

2 General Description of the OHL System

2.1 The supply of traction power to the train will be at a nominal voltage of 1,500VDC derived from the 33kVAC supply via the Rectifier Transformer and Rectifiers (T-R) units at traction substations. Normally two T-R units are operated in parallel, each rectifier transformer will have + or - 7.5 degree phase shift arrangement on the primary side of the transformer to enable an overall 24 pulses rectification output voltage. However, when only one T-R unit will be in service, it results in 12 pulses rectification output voltage

2.2 Currents will be supplied to the train by the OHL and will return to the traction substations via the running rails. The OHL system will be connected such that the OHL contact wire will be the positive pole and the running rails the negative pole.

2.3 The OHL system will consist of a number of traction substations such that it forms a continuous system which will supply power to the trains without interruption under normal conditions. The OHL system will, however, be divided into a number of electrical sections between the traction substations to meet the operational requirements.

2.4 The majority of the electrical sections are fed by two DC track feeder circuit breakers connected to substation 1500VDC busbars, while the remainder are fed

by single DC track feeder circuit breakers connected to 1500VDC busbars. In the later case, the distant ends of parallelled electrical sections may be connected by a tie breaker.

3 Performance Requirements of the OHL and Train System Interfaces

3.1 Supply Voltage

The nominal OHL catenary voltage is 1500V DC. All train performance requirements, except as otherwise stated, shall be met or surpassed at all voltages from 1000V to 1800VDC.

3.2 Supply Transient

Whilst the terms "nominal OHL voltage" or "1500VDC" are used in this Specification, these shall be construed as intending to describe circuits with design voltage range of 900V to 1900VDC inclusive. All train equipment shall be protected from damage resulting from transient over and under-voltage conditions which may occur in the actual operating environment or as a result of the train design. The Contractor shall provide suitable transient suppression.

3.3 Supply Surge

All sections of the OHL system will be subjected to surges of both polarities up to 5kV. Outdoor sections will be subjected to lightning surges, and all outdoor insulation shall be designed to withstand 75kVp, 1/50 μs waveform impulse tests of both polarities. The Contractor shall provide suitable surge protection to the train equipment.

3.4 Overcurrent Protection

The maximum fault level appearing at any one DC busbar is expected to be 54kA steady state and 76kA peak asymmetric. Each DC track feeder circuit breakers will be fitted with instantaneous overcurrent trips having a maximum setting of 10kA, and a time delayed overcurrent relay having a maximum setting of 3.6kA for a maximum time of 25s; it is expected they will clear the maximum short circuits within 20ms. In view of the fact that severe service interruption will be caused by the operation of the DC track feeder circuit breaker due to an overcurrent fault, the design of the train system shall be capable to clear the overcurrent fault of the train equipment, such as, the traction system (refer to PS 11), without causing superfluous operation the OHL DC track feeder circuit breaker.

3.5 Current Limit

In order to avoid nuisance tripping of the OHL DC track feeder breaker, the design of the traction system (refer to PS 11) of the train shall ensure that the maximum peak current of 3.6 kA per train is not exceeded. The duration of line current remains at maximum peak during motoring shall not exceed 10 seconds at all out running.

3.6 Radio Frequency Interference

The Contractor shall ensure that the pantograph system shall not radiate radio frequency interference (RFI) or cause RFI to be generated by the OHL system. A RFI filter shall be fitted to suppress the above interference.

3.7 Compatibility Test

3.7.1 An interface test to confirm the compatibility of the pantograph with the OHL system under the worst operating conditions shall be carried out by the Contractor.

3.7.2 This test shall include a measurement of each individual and the total cumulative arcing times.

3.7.3 It is a requirement that for each arcing time, it shall be less than 0.1s.

3.7.4 For the total cumulative arcing time, it shall be less than 1.0% of the total run time.

4 Design Constraints

4.1 Temperature Rise Limit

4.1.1 The maximum allowable temperature rise above the ambient for the OHL contact wire is 65°C and the maximum spot temperature on any OHL equipment other than the OHL contact wire above the train roof is 55°C at standstill. The Contractor shall demonstrate to the satisfaction of the Engineer that under all worse conditions, the train shall not cause excessive OHL equipment temperature rise specified above.

4.1.2 The carbon strip material shall meet the above requirements at a temperature not exceeding its maximum allowable temperature at any point of contact.

4.1.3 No lubrication of the contact material shall be necessary.

4.2 Corrosion and Moisture inside Tunnel

4.2.1 Equipment mounted in the roofs of the train will be subjected to saline dripping which may include other salts that can be deposited on the pantograph, for example, lime. In addition, air in tunnels carries a heavy dust content, both induced by the ventilation system and caused by the railway operation. The combination of the above will have an adverse effect on the insulation creepage surfaces and the life of the metal components.

4.2.2 The general atmosphere contains a high level of industrial pollutants and salt spray.

4.2.3 The pantograph shall be surface treated against the above environmental impacts.

4.3 Contact Wire Position

4.3.1 Contact wire locations shall be referred to GS Clauses 6.3.1 and 6.3.2.

4.3.2 Contact Wire Sweep

(a) Sweep is defined as the lateral movement of the contact wire across the pantograph during its travel between any two registration points and is the sum of such movement, either from one side of the track centre to the other, or from one side toward the track centre and back towards the same side.

(b) Sweep will be sufficient to ensure that the contact wire continually slides across the pantograph and will be at the rate of at least 150mm per 100m movement along track and not more than 750mm per 100m movement along track on all lines.

4.3.3 The current collectors shall maintain adequate contact pressure as specified in RS/C6014/10 with the contact wire under conditions specified above and the most adverse combination of all manufacturing and service tolerances, dynamic movements and maximum wear on all related components on both the train and the overhead wire.

4.4 Pantograph Kinematic Envelope

The pantograph shall not infringe the Kinematic Envelope as shown in Drg. No. C6014-14E/TSEG/010/001 with the pantograph in both operating and stowed positions.

5 Confirmation of Design Information

5.1 For the purpose of OHL design study, the Contractor shall ensure that the performance parameters as specified in RS/C6014/10 are achieved.

5.2 Any change to the above pantograph performance parameters shall be submitted for Approval according to the configuration control program (refer to Appendix P).

5.3 The Contractor shall finalise the pantograph characteristics after taking into account the OHL system characteristics during the design interface by SEMP stage 3 (refer to PS 21.3.4).

5.4 The following additional information shall be submitted before the end of SEMP stage 3:

5.4.1 Actual distance between pantographs in a train consist.

5.4.2 Actual head mass.

5.4.3 Actual maximum lateral displacements of the pantograph from the track centre line under all defined track conditions and confirmation that they shall not infringe the Kinematic Envelope as shown in Drg. No. C6014-14E/TSEG/010/001

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 3 ATC INTERFACES

1 General

2 Performance Requirements of the ATC and Train System Interfaces

3 Inter-system Electromagnetic Compatibility (EMC)

4 Design Constraints

5 Confirmation of Design Information

Attachment App-I-Annex-3 Interface Requirements Specification

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 3 ATC INTERFACES

1 General

1.1 Introduction

1.1.1 This Annex defines the interface requirements for the Automatic Train Control (ATC) and the train systems.

1.1.2 The train is required to work with the Urban Lines track side and trainborne ATC equipment, in order to ensure the compatibility between the ATC and the train systems, the following system requirements and design constraints for the ATC interface are specified according to the Urban Lines ATC trackside equipment and the ATC trainborne equipment.

1.1.3 Not used.

1.1.4 Unless it is requested by the Contractor by the end of SEMP 2, all ATC interface design information will be made available to the Contractor prior to the commencement of SEMP 4. The Contractor shall carry out final design and vehicle build according to the information given beforehand.

1.2 General System Requirements

1.2.1 Each A-car with driving cab shall be equipped with one set of ATC equipment i.e. Trainborne CBTC Controller to be installed in the B side of the driving cab, one Primary Train Operator Display and one Secondary Train Operator Display to be installed on the driver's desk, two radio antennas, one 4G/LTE antenna (if applicable) to be installed at the roof of A-car, CBTC antennas / radars / tags to be installed at A-car underframe, two speed sensors to be installed on two motor and service brake free axle ends per A-car. Each B-car shall be equipped with two sets of Ethernet Repeater in gangway cubicles.

1.2.2 The Contractor shall provide accommodation including mounting points, equipment cabinets and cable access for the installation of the ATC equipment in line with the requirements specified by the Engineer.

1.2.3 The Contractor shall be responsible for providing an interface circuit between the ATC and the train systems as specified in the PS.

1.2.4 Due consideration shall be given to ensure that no wiring fault of this interface circuit shall cause a wrong side failure.

1.2.5 The Contractor shall be responsible for providing the appropriate DC power supply, including the power supply interface and the protection device, to the ATC equipment, in accordance with RS/C6014/03.

1.2.6 The Contractor shall ensure that the equipment can be easily operated, removed and replaced.

1.3 Extent of Work

The Contractor shall liaise with the Engineer to incorporate appropriate interfaces, power supply, delivery schedule, installation, testing and setting to work.

1.4 Contract Demarcations

1.4.1 Based on the interface requirements stipulated in this Annex, a detailed interface specification shall be provided with the liaison of the Engineer (refer to PS 31.3).

1.4.2 The Contractor shall specify in the above detailed interface specification all additional design information required on system interfaces which are not provided in this Annex. A programme for the submission of interface design information shall also be submitted for Approval.

1.4.3 For those interface designs that may affect the manufacturing programme shall be finalised prior to the commencement of SEMP 4. In the event that the required interface design information are not available from the Engineer by the period specified in the above programme, the Contractor shall carry out interface design based on his own judgement and submit for Approval.

1.4.4 Subject to the detailed interface specification, the contract demarcations specified in this Clause shall be complied with.

1.4.5 The Contractor shall provide the following items, as a minimum requirement:

(a) Accommodation of the ATC equipment according to Clause 4.1.

(b) All cables with cable identifications for the functional links between the ATC cubicle and others ATC equipment according to Attachment App-I-Annex-3. Unless otherwise specified, all cables shall be adequately rated according to the voltage free contact specified in Clause 1.4.5(d) and comply with RS/C6014/06. Special attention shall be paid on the identification of safety wires and the shielding requirements for EMI protection.

(c) Except those special electrical plugs and sockets that are directly connected to the ATC equipment, all interconnections and the associated cable terminals and electrical connections for the above ATC equipment shall be provided. All these electrical connections mounted in the external area, including underframe, shall be sealed to IEC 60529:2001 IP65 (refer to RS/C6014/02 Clause 10.1).

(d) Interfacing signals for the ATC cubicle according to Clause 2. Unless otherwise specified, a voltage free contact rated at least 2 A DC inductive loads with a time constant of 15ms at 110 VDC shall be provided for the above signal interfaces. Interface cable terminal bars and all associated cables and terminals of the above interfacing signals shall be provided nearby the ATC cubicle. Cables from the ATC cubicle to the interface terminal bars shall not exceed 2.5m in length.

(e) All remaining cables together with the cable identifications between the interconnection points (refer to Clause 1.4.5(c)) or interface terminal bars (refer to Clause 1.4.5(d)) and the ATC equipment shall be provided, properly secured, protected and cable end capsulated.

(f) The following in accordance with Attachment App-I-Annex-3:

- Installation, testing and commissioning of full set trainborne ATC equipment on first two trains in Contractor's factory
- Installation of equipment, cables and accessories as identified in the ATC Connectors & Tail Cables Specifications table in Attachment A of Attachment App-I-Annex 3, Appendix 3, Annex C13
- Installation of roof mounted equipment , i.e. radio antennas and LTE antennas on all trains in Contractor's factory
- All necessary inspections, checks and testing for ensuring the quality of workmanship of these installation works

(g) Proper delivery of trainborne ATC equipment from Hong Kong to Contractor's factory for installation at Contractor's own cost.

(h) Supervision on the installation, testing and commissioning of trainborne ATC equipment on all trains in Employer's premises.

(i) A competent testing engineer throughout the period of the tests and commissioning to participate all ATC system related interface tests.

1.4.6 The Employer will provide the following items:

(a) All ATC equipment in Hong Kong according to Attachment App-I-Annex-3.

(b) All electrical plugs and sockets that are directly connected to the ATC equipment.

(c) Interfacing signals for the ATC cubicle according to Clause 2.

(d) Not used.

(e) Not used.

(f) Supervision on the installation, testing and commissioning of trainborne ATC equipment on the first two trains in Contractor's factory.

(g) A competent testing engineer throughout the period of the tests and commissioning to participate and facilitate all ATC system related interface tests.

(h) Not used.

(i) Not used.

(j) Not used.

(k) Not used.

(l) All required instructions, drawings and special tools (if necessary) to facilitate the Contractor to perform the works as specified in Clause 1.4.5(f).

(m) Site supervision and training to facilitate the Contractor to perform the works as specified in Clause 1.4.5(f) in order to ensure the Contractor's workmanship meets the quality of work as required by the Engineer.

1.5 Interface Design Management

The Contractor shall comply with the following specific arrangements in order to maintain an effective interface design management with the Engineer:

(a) At SEMP stage 1, upon receiving the finalized Electro-Magnetic Disturbance Level (EMDL) from the Engineer, the Contractor shall incorporate this EMDL into the EMC plan according to Clause 9.1 of RS/C6014/04.

(b) At SEMP stages 2 to 4, the Contractor shall carry out all required EMC study and submit the associated results according to Clauses 9.2 to 9.4 of RS/C6014/04. The Contractor shall ensure that a mutual agreement on the detailed interface specification is reached with the Engineer.

(c) Before SEMP stage 5, the Contractor shall obtain agreement with the Engineer on the test case for test and commissioning purpose according to PS 31.3.6.

(d) At SEMP stage 5, the Contractor shall conduct on-site tests and measurements to validate the ATC interface including the EMC performance. The above activities shall be performed at:

(i) Contractor's test track;

(ii) SHD test track and Urban Lines depot test tracks; and

(iii) Main running line in Urban Lines.

2 Performance Requirements of the ATC and Train System Interfaces

The Contractor shall refer to Attachment App-I-Annex-3 "Interface Requirement Specification" and Attachment A of Attachment App-I-Annex-3 "Detailed Interface Design Specification for Automatic Train Control". The Contractor shall ensure the trains are fully adapted to the ATC equipment.

2.1 Use of Attachment App-I-Annex-3 and Attachment A of Attachment App-I-Annex-3

Attachment App-I-Annex-3 and Attachment A of Attachment App-I-Annex-3 shall be read in conjunction with other Clauses in the PS Appendix I Annex 3. To the extent that any provision of Attachment App-I-Annex-3 and Attachment A of Attachment App-I-Annex-3 is inconsistent with any provision of other Clauses in PS Appendix I Annex 3, the provisions of the Attachment App-I-Annex-3 and Attachment A of Attachment App-I-Annex-3 shall prevail.

2.2 The requirements in Attachment App-I-Annex-3 and Attachment A of Attachment App-I Annex-3 are applicable to the Contractor with the following interpretation:

(a) The New Train Contractor, the New Train and RS shall be interpreted as the Contractor or the train.

(b) Not used

(c) Not used

(d) Door Open Enable, Door Open authorization and ATC door enable are referring to the same signal provided by ATP to the door control circuit when ATP considers it is safe to open the passenger doors.

2.3 Not used

2.4 The car numbering arrangement shall follow Drg. No. C6014-14E/TSEG/010/009.

2.5 Not used.

2.6 The actual distance travelled by the train under worst wheel slide scenario shall not be longer than 15% of the distance measured by the ATP system via the tachogenerators.

2.7 Status of the following ATP vital outputs shall be monitored by TMS and recorded in Event Recorder:

(a) EBR1;
(b) EBR2;
(c) ZVR1;
(d) ZVR2.

2.8 In conjunction with PS 9.9.11(b), when the train is operating from a driving cab with mode selector moved at “reverse” position, the head lights of this active cab car shall be automatically turned off and its tail lights shall be automatically turned on. Meanwhile, the head lights of the rear cab car shall be automatically turned on and its tail lights shall be automatically turned off.

2.9 The circuit integrity of brake signal distributed to traction and brake system shall be properly maintained in order to prevent no single point failure resulting in signal interruption, i.e. bad contact or etc.

3 Inter-system Electromagnetic Compatibility (EMC)

3.1 The Contractor shall ensure that all train equipment are designed and constructed in accordance with RS/C6014/04 or equivalent, to ensure proper functioning.

3.2 Consideration shall be given to the EMC of the complete ATC and train systems.

3.3 The Contractor shall interface with the Engineer to ensure that EMC is achieved between all ATC and train systems.

3.4 The Contractor shall, through this interface, develop an EMC interface specification including a Signalling Compatibility Specification. This shall define the levels of susceptibility and emissivity for all the trainborne equipment which will guarantee compatibility.

3.5 Equipment shall be EMC tested to the requirements of the PS. An appropriate technical construction file shall be developed in accordance with the EC EMC Directives and be certified by an appropriate Competent Body for the compliance of the EMC Directives.

3.6 The following electro-magnetic disturbance sources shall be taken into account in the interface design:

3.6.1 harmonics generated by rectifiers in the traction substation;

3.6.2 main frequency harmonics in the traction supply;

3.6.3 transients generated by switching action of the inverter controlled traction and auxiliary equipment;

3.6.4 magnetic sources of the train, for example, chokes;

3.6.5 magnetic field generates by the current in the catenary;

3.6.6 radiated electric field from the trainborne equipment; and

3.6.7 radiated field from the catenary.

3.7 The Contractor shall submit a computer simulation result to predict the expected magnitudes of the above electro-magnetic disturbances, normal and fault conditions shall be considered, at SEMP stage 2, verify these simulation results by test during SEMP stage 3 and conduct an on-site measurement to validate the actual train performance by SEMP stage 5.

3.8 The total electromagnetic interference induced by the trainborne equipment to the ATC equipment shall be regarded as permissible conducted current on rail and permissible radiated emissions from train. The particular requirements are specified below:

3.8.1 The total permissible conducted current on rail due to the trainborne equipment (including the traction inverters, auxiliary converters and auxiliary inverters) of a train shall not be greater than the threshold limits of the signalling systems as specified in Clause 4.2. This current shall be measured under worst case scenario on any section of rail, like in front of, underneath and behind the train.

3.8.2 Permissible radiated emissions measured at a distance of 0.5m in any direction from any component of the rolling stock equipment shall be:

50 Hz to 1K Hz <62dBμA/m

1K Hz to 500K Hz <27dBμA /m

Band width of measurement shall ±100Hz

4 Design Constraints

4.1 Accommodation of the ATC Equipment

4.1.1 Typical dimensions of the ATC equipment are shown in Attachment App-I-Annex-3.

4.1.2 As a minimum requirement, the following mounting arrangements shall be provided:

(a) For the ATC cubicle:

(i) a removable steel support framework with adequately sized shall be provided for mounting the ATC cubicle in a vertical plane;

(ii) shall be adequately shielded to withstand a minimum level of 20V/m RF radiated interference over frequency range 27MHz to 2 GHz;

(iii) the front panel and side covers shall be removable for easy maintenance access; and

(iv) mechanical ventilation by the air inside the driving cab shall be provided (refer to PS 15.8.2).

(b) For the antenna and beacon sensor, pick up coils and tachogenerators, the mounting arrangements shall comply with the typical dimensions of the bogie/axle mounted equipment as shown in the Attachment App-I-Annex-3. The Contractor shall ensure that the strength requirements for all bogie and axle mounted equipment as specified in PS 12.9.3 are met.

4.2 EMC Constraints

The total emission from all components of the train equipment shall not be greater than the maximum allowable electro-magnetic interference (EMI) shown in the following table:

Permissible EMI Emissions from the Train Equipment

Item	SACEM ATC Equipment or Operation	Mode or Source of Disturbance	Maximum Allowable EMI
1.	Track circuits	Traction return current	
1.a	50Hz track circuit	Traction return current	Total rail current at 50Hz shall not exceed 10A with a bandwidth of 10Hz
1.b	CVCM circuit track	Traction return current	a) Total rail current shall not exceed 50mA at 8.2kHz, 8.6kHz, 9.2kHz, 10.0kHz, 10.6kHz, 11.0kHz and 12.3kHz with a bandwidth of 200Hz. b) The magnitude of rail to rail voltage shall not exceed 70mVrms at 8.2kHz, 8.6kHz, 9.2kHz, 10.0kHz, 10.6kHz, 11.0kHz and 12.3kHz with a bandwidth of 200Hz.
1.c	FTGS track circuit	Traction return current	Total rail return current shall not exceed: a) 600mA at 4.75kHz with a bandwidth of 240Hz b) 350mA at 5.25kHz with a bandwidth of 240Hz c) 250mA at 5.75kHz with a bandwidth of 240Hz d) 150mA at 6.25kHz with a bandwidth of 240Hz e) 40mA at 9.5kHz with a bandwidth of 500Hz f) 35mA at 10.5kHz with a bandwidth of 500Hz g) 30mA at 11.5kHz, 12.5kHz, 13.5kHz, 14.5kHz, 15.5kHz and 16.5kHz with a bandwidth of 500Hz
2.	SACEM track to train continuous transmissions	Traction return current	The magnitude of resultant in-band interference signals produced by the disturbance sources in Clause 3.6 of this Annex shall not exceed at all times for a level equivalent to the loop-feeding of 15mA in the frequency ranges of 45 to 65kHz.
3.	Track to train and train to track transmissions	Traction return current	Return current of whole train shall be less than 250mA in the frequency range of 50kHz to 80 kHz. Asymmetry current in the rail shall be less than 5%.

Permissible EMI Emissions from the Train Equipment			
Item	SACEM ATC Equipment or Operation	Mode or Source of Disturbance	Maximum Allowable EMI
4.	Not used	Not used	Not used
5.	Beacon sensors	Close-up effect	Susceptibility threshold for vertical polartisation of H field is 125mA/m at operating frequencies of 90, 110 and 124kHz, and 4A/m in the frequency range of 3 to 7kHz. The susceptibility limits shall not be exceeded and all sensitive magnetic sources shall be magnetically shielded.
6.	Trainborne ATC cubicle	Radiated field from other trainborne equipment	The trainborne ATC cubicle meets the susceptibility limits as specified in BS EN 50121-4. Radiated field from other trainborne equipment shall be at least 3dB below the susceptibility limits.

4.3 Wheelset Impedance

The maximum impedance per wheelset assembly shall be not greater than 0.2 ohms from DC to a frequency ranges of 13 to 140 kHz and capable of operating the track circuits and axle counters.

4.4 Accuracy of Station Stopping

Trains shall respond to ATC commands and shall consistently stop within ± 500mm of the designated station stopping point for 99.99% of stops utilising service brake only.

4.5 Train Formation

Trains consists shall be formed by an 8 car basis according to the Drg. No. C6014-14E/TSEG/010/009.

4.6 Communication Interfaces Between the ATC and TMS

It is a requirement that the trainborne ATC shall interface with the train management system (TMS). In order to ensure the compatibility between the train and the trainborne ATC sub-system, the communication interface shall comply with the requirements as specified in Attachment App-I-Annex-3.

4.7 Power Supply Interfaces Between the ATC and Auxiliary Supply System

4.7.1 A DC power supply shall be continuously provided to supply the ATC equipment, the DC power supply shall meet the requirements as specified in Attachment App-I-Annex-3.

4.7.2 The DC power supply shall be supplied from the D1 wire (refer to PS 17.4.1(e)) and D2 wire (refer to PS 17.4.1(d)) where appropriate via a dedicated miniature circuit breaker (MCB). This MCB shall be calibrated according to the ATC power supplies characteristics as shown in Attachment App-I-Annex-3.

4.8 Performance Interfaces Between the ATC and Traction and Braking System

4.8.1 The Contractor shall ensure that no roll-back more than 1 m shall be allowed in any case, especially when the train starts. The design of this feature shall assume that the predefined state of the brake is maximum service brake and the traction is set in the way to limit the jerk at the maximum value (0.8 m/s^3) in the worst gradient of -3%.

4.8.2 Characteristic for both friction and electric brakes shall be identical for the same order of both positive and negative accelerations.

4.8.3 Brake blending between friction and electric brakes shall be as smooth as possible for the ATO.

4.8.4 The jerk limitation of 0.8 m/s^3 shall be identical in both motoring and braking operations.

4.8.5 In the AUTO mode only, the ATO shall directly control the brake deceleration and no feed back loop from the braking equipment shall be required.

4.8.6 The acceleration and deceleration signal from the ATC to the traction and braking system will be measured in m/s^2 compensated with gradient.

4.8.7 Not used.

4.9 Maintenance Performances

4.9.1 The maintenance access to the ATC equipment shall be restricted by means of a lockable cubicle.

4.9.2 Access to the compartments of ATC equipment shall only be gained from the front and by the means of an approved key as defined in RS/C6014/15.

4.9.3 All electronic racks of the ATC equipment inside the driving cab shall be removed by the front.

4.9.4 The ATC equipment inside the driving cab shall be accessible by the front and the right side (related to the front view of ATC cubicle) to remove relays and to disconnect connectors.

4.9.5 Access, disconnection and connection of ATC wires on the interface terminal bars shall be gained from the right side (related to the front view of ATC cubicle). Easy access for depot maintenance operation shall be provided.

4.10 Safety Related Performances

4.10.1 In addition to the required rate of deceleration of train under a normal operating condition as specified in PS 11.14, for the purpose of interface design with the ATC system and in order to ensure sufficient safety margins are provided in the integrated system design, the following emergency braking performance of train under all predictable worse case scenario, for example, single point failure of brake equipment and excessive loss of adhesion, shall be met:

If an emergency brake is requested by ATP, the worse case deceleration rate and the response time shall be at least:-

(a) 1.3 m/s^2 with a degradation of 25% (0.975 m/s^2) in tunnel and 40% in open section (0.78 m/s^2) excluding the response time; and

(b) maximum time delay of 1.6s from emergency brake to be triggered to emergency brake to be applied.

4.10.2 Passenger doors shall not be opened unless the signals of both ATC door enable and zero velocity (refer to PS 16.2.6) are delivered from the ATC.

4.10.3 At station stops, no traction effort shall be provided to the traction equipment while the passenger doors are not fully closed (refer to PS 9.9.7(f)).

4.10.4 No failure shall result in energising of any ATC vital input via the voltage free contacts which will be used as the ATC input.

4.10.5 Holding brake shall be performed according to Attachment App-I-Annex-3.

4.11 Not used.

4.12 Control Interface with the Safety Cut-Out Switch

For illustration purpose, the conceptual circuit arrangements are depicted in Drg. No.C6014-14E/TSEG/417/001.

4.12.1 The Safety Cut-Out Switch (SCOS) shall be a sealed rotary switch which consists of four rotary positions as below:

Angular Position	Description	Detailed in
0°, vertical up	Normal (N) (rotary movement R↔N↔TFB	4.12.2
$+90^{o}$, clockwise	Traction Fall-back (TFB) (sealed by breakable seal wire; rotary movement N↔TFB)	4.12.4
-90°, anticlockwise	Reset (R) (rotary movement R↔N)	4.12.5

4.12.2 Normal position

When the SCOS is stayed in the normal position which shall be the defaulted position, the safety proving circuit shall be operated according to PS 9.9.5.

4.12.3 Not used.

4.12.4 Traction fall-back position

(a) Traction fall-back mode will be used when the ATC system has completely failed.

(b) When the SCOS is operated to the traction fall-back position, a speed detection circuit shall be provided by the traction and braking system which shall respond according to the following requirements:

(i) The safety proving circuit shall be operated according to PS 9.9.5 via the contacts of RS1 or RS2 which shall provide the zero velocity proving function from the traction and braking system of the individual motor cars of B or C to the safety proving circuit.

(ii) The train movement shall be obtained according to PS 9.6.

(iii) The traction and braking system shall check that the speed of the train is less than or equal to 22 km/h and emergency brake shall be applied if the speed limit is exceeded by opening the contacts of RS3 or RS4 which shall provide the overspeed protection from the traction and braking system of the individual motor cars of B or C.

(c) The system integrity of the above speed detection circuits particularly the correct contact states of RS1 to RS4 provided by the traction and braking system shall be continuously monitored by the TMS disregard the SCOS position. Any abnormality occurred in these speed detection circuit shall be reported to the train operator and logged into the Event Recorder. The Contractor shall demonstrate that no single point failure of the speed detection circuits shall lead to an unsafe condition. The failure mode of this speed detection circuit shall be a right side failure and self-manifesto.

(d) Detailed operation of traction fall-back mode shall refer to PS 9.12.4.

4.12.5 Reset position

When the SCOS is operated to the reset position, the power supply (refer to Clause 4.7) shall be interrupted for resetting the ATC system. The power supply shall be resumed normal when the SCOS position is switched back to the normal position.

4.12.6 Operating the SCOS directly from the reset position to the traction fallback position and vice versa, shall not be allowed.

4.12.7 Operation of the Safety Cut-Out Switch shall be reported to the Event Recorder.

4.13 Not used.

4.13.1 Not used.

4.13.2 Not used.

4.13.3 Not used.

4.13.4 Not used.

4.13.5 Not used.

5 Confirmation of Design Information

5.1 In addition to the train performance requirements specified in PS 4, for the purpose of ATC compatibility, the Contractor shall ensure that the train performance parameters are as the same as the list of the parameters and their values shown in Attachment App-I-Annex-3.

5.2 Not used

5.3 The following additional information shall be submitted before the end of SEMP stage 3:

5.3.1 Not used.

5.3.2 Not used.

5.3.3 Not used.

5.3.4 Motor characteristic curves showing:

(a) Tractive effort (kN) at wheel tread against train speed (km/h); and

(b) Motor current (A) against train speed (km/h).

5.3.5 Coefficient of rotating mass:

(a) for motor car (%)

(b) for trailer car (%)

5.3.6 Maximum train length (m)

5.3.7 Minimum train length (m)

5.3.8 Technical specification of the safety interlock relays.

5.3.9 Train mass data

5.3.10 Train resistance formulae

5.4 ATC System Combined Test

5.4.1 In order to validate the interface design, an ATC system combined test shall be carried out on the first two trains manufactured at the Contractor's test track which shall form part of the Tests on Contractor's Track (refer to Appendix C Clause 2.27) during the SEMP stage 5.

ATTACHMENT APP-I-ANNEX-3 INTERFACE REQUIREMENTS SPECIFICATION

Interface Requirements Specification between Replacement of Signalling Systems for ISL, KTL, TWL, TKL, AEL, TCL & DRL (Contract 3036) and the New Train (Contract C6014)

CONTENTS

1.GENERAL

2.DEFINITION

3.EQUIPMENT SPACE

4.TRAINLINES

5.CABLE CONDUITS PROVISION

6.FUNCTIONAL INTERFACE

7.INSTALLATION ARRANGEMETN AND PROVISION

8.INTERFACE DOCUMENTATION

ATTACHMENT A – DETAILED INTERFACE DESIGN SPECIFICATION FOR AUTOMATIC TRAIN CONTROL

ATTACHMENT B – NOT USED

ATTACHMENT C – NOT USED

ATTACHMENT D – NOT USED

ATTACHMENT E – NOT USED

ATTACHMENT F – NOT USED

ATTACHMENT G – NOT USED

ATTACHMENT H – SECONDARY TOD

ATTACHMENT I – PRIMARY TOD

1. GENERAL

1.1 This Interface Requirements Specification (IRS) outlines the interface requirements between Replacement of Signalling Systems for ISL, KTL, TWL, TKL, AEL, TCL & DRL (Contract 3036) and the New Train (Contract C6014) including the scope of work of the SIG Contractor and the New Train Contractor specified in Attachment A.

1.2 In this IRS the Contractor for Contract 3036 shall be the “SIG Contractor” and the Contractor for the New Train (Contract C6014) shall be the "New Train Contractor".

1.3 The New Train Contractor shall follow the same interfacing design as specified in Attachment A. “RS” in Attachment A shall be interpreted as the New Train Contractor / The New Train. The New Train Contractor’s scope in the New Train/SIG interface shall follow the scope of Contract 6554-07E for existing C-Train as specified in Attachment A. The Train performance parameters shall not be modified in the course of this Works.

1.4 The SIG Contractor will adopt the same interfacing design in the course of the Works to fulfil all functional, mechanical, electrical and electromagnetic compatibility requirements as specified in Particular Specification (PS) of Contract 3036. All equipment, components, systems, subsystems, cables, wires, parts supplied under Contract 3036 will be fully compatible with the New Train and its environment.

1.5 The interfaces and requirements detailed in this IRS are not exhaustive, and the nature and full extent of the Works to be performed in connection with each interface are to be ascertained by referring to the Drawings, the Contract 6014 PS, the General Specification for E&M Works (GS) and the Conditions of Contracts.

1.6 The SIG Contractor will be responsible for all design, installation, modification, Testing and Commissioning of the interfacing systems/equipment.

1.7 The SIG Contractor will develop the interface documents to cover all aspects of the implementation of the interface works stipulated in this IRS.

2. DEFINITION

2.1 The term “momentary” is referred to a signal which is activated (logic 1) for a short period of time and then de-activated (logic 0) even all required conditions for activation of this signal have been met.

2.2 The term “continuous” is referred to a signal which is activated (logic 1) as far as all required conditions for activation of this signal are met.

2.3 The term “vital output” is referred to an output that is required to be implemented in a safety-critical system in a fail-safe manner.

2.4 The term “vital input” is referred to an input that is required to be implemented in a safety-critical system in a fail-safe manner.

2.5 The term “non-vital output” is referred to an output that is required to be implemented in either non-safety-critical system or safety-critical system.

2.6 The term “non-vital input” is referred to an input that is required to be implemented in either non-safety-critical system or safety-critical system.

2.7 The term “fully redundant output” is referred to an output that is driven by two different and individual Train-borne CBTC Controllers configured in hot-standby redundancy manner. When either one of the Train-borne CBTC Controllers fails the output is still under controlled by the remaining healthy Train-borne CBTC Controller.

2.8 The term “fully redundant input” is referred to a signal feeding to two different and individual Train-borne CBTC Controllers (configured in hot-standby redundancy manner) at the same time without any time delay. When either one of the Train-borne CBTC Controllers fails the signal is still detected by the remaining healthy Train-borne CBTC Controller for maintaining CBTC functions.

3. EQUIPMENT SPACE

3.1 Equipment space in New Train shall be provided by the New Train Contractor for the installation of CBTC Train-borne Subsystem supplied by the SIG Contractor. The demarcation of the Works shall follow tab.Infs.SIG.New Train.01 and Fig.infs.SIG.New Train.02.

3.2 All underframe mounted equipment supplied by the SIG Contractor will comply with IP66 and IEC61373 requirements.

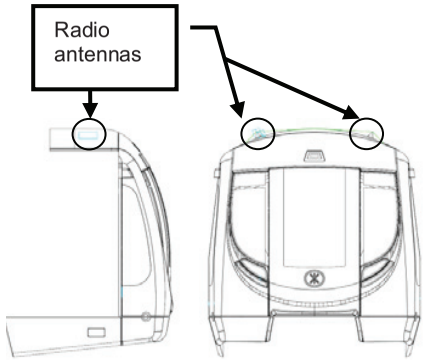
3.3 All underframe mounted equipment supplied by the SIG Contractor will be designed to withstand, or be protected from, repeated impacts from ballast up to 75 mm in diameter at speeds of up to 80 km/h.

3.4 Anti-loosen mounting fixture shall be used for all underframe mounted equipment supplied by the SIG Contractor.

3.5 All external CBTC train-borne equipment shall fulfil the Kinematic Envelope requirements specified in PS Clauses 5.1, 5.2 and 5.3.

Space Identity	Description	Works by the New Train Contractor	Works by SIG Contractor
SIG.New Train.P.1	Secondary Train Operator Display (STOD) Space	a) To provide mounting including mounting brackets, hinge, etc. for the installation of Secondary Train Operator Display (STOD) provided by SIG Contractor in each Train Operator's Cab with maximum dimensions of 350mm (L) x 250mm (H) x 100mm (W) and maximum weight of 5kg. b) To liaise with the SIG Contractor through the Engineer for finalising the mounting detail and clearance requirement of the STOD. 	To design, supply, install, Testing and Commissioning the Secondary Train Operator Displays in two Train Operator's cabs of New Train with dimensions not exceeding the 350mm (L) x 250mm (H) x 100mm (W) and maximum weight of 5kg as illustrated in Attachment H of this IRS.

Space Identity	Description	Works by the New Train Contractor	Works by SIG Contractor
SIG.New Train.P.1.1	Primary Train Operator Display (PTOD) Space	a) To modify the mounting hole for signalling speedometer as illustrated below for the installation of Primary Train Operator Display (PTOD) provided by the SIG Contractor. b) To liaise with the SIG Contractor through the Engineer for finalising the mounting detail and clearance requirement of the PTOD. c) The mounting hole dimensions shall be at least 90mm (L) x 80mm (H). d) The dimensions of the space reserved for the display panel of the PTOD shall be at least 120mm (L) x 120mm (H). 	To design, supply, install, Testing and Commissioning the Primary Train Operator Display in two Train Operator's cabs of New Train with the dimensions as illustrated in Attachment I of this IRS.
SIG.New Train.P.2	Radio Antenna Space	a) To provide space and mounting for two individual overhead radio antennas (include cable pass-through) located at the roof of A-car. Each radio antenna space shall be 260mm (L) x 100mm (W) x 90mm (H) with metal-free area of 60 degree	a) To design, supply, install, Testing and Commissioning the IEEE 802.11 radio antennas, coaxial cables, connectors and cable glands. The dimensions of each antenna shall not exceed 260mm (L) x 100mm (W) x 90mm (H) and weight of 2kg each.

Space Identity	Description	Works by the New Train Contractor	Works by SIG Contractor
		measured from the sensitivity axis of the radio antenna. b) To provide space and mounting for the third overhead radio antenna (include cable pass-through) located at the roof of A-car in the event that the 4G/LTE radio antennas are externally mounted. c) To liaise with the SIG Contractor through the Engineer for finalising the mounting detail, cable routing and clearance requirement of the radio antennas. 	b) The lateral spacing between the two adjacent radio antennas shall be at least 1648mm apart if the radio antenna height is 90mm. c) To design, supply, install, Testing and Commissioning the 4G/LTE radio antennas, coaxial cables, connectors and cable glands. d) In the event that the 4G/LTE radio antennas are externally mounted, the SIG Contractor shall liaise with the Engineer on the mounting detail. The dimension and weight of the 4G/LTE radio antenna shall not exceed those requirements for the IEEE 802.11 radio antenna.
SIG.New Train.P.3	Ethernet Repeaters Space	a) To provide two individual Ethernet Repeaters Space inside each B-car and mounting including mounting brackets, hinge etc. for the installation of two Ethernet Repeaters provided	a) To design, supply, install, Testing and Commissioning the Ethernet Repeaters, all applicable coaxial cables, connectors and cable glands. The dimensions of each repeater shall not exceed 300mm (L) x 300mm (W) x 200mm

Space Identity	Description	Works by the New Train Contractor	Works by SIG Contractor
		by SIG Contractor. (Four Ethernet Repeaters are to be installed inside two B-car of each 8 car train consist. The dimensions of each repeater shall not exceed 300mm (L) x 300mm (W) x 200mm (H) and weight of 5kg each.) b) To liaise with the SIG Contractor through the Engineer for finalising the mounting detail, cable routing and clearance requirement of the Ethernet Repeaters.	(H) and weight of 5kg each.

tab.Infs.SIG.New Train.01 – Equipment Space Schedule

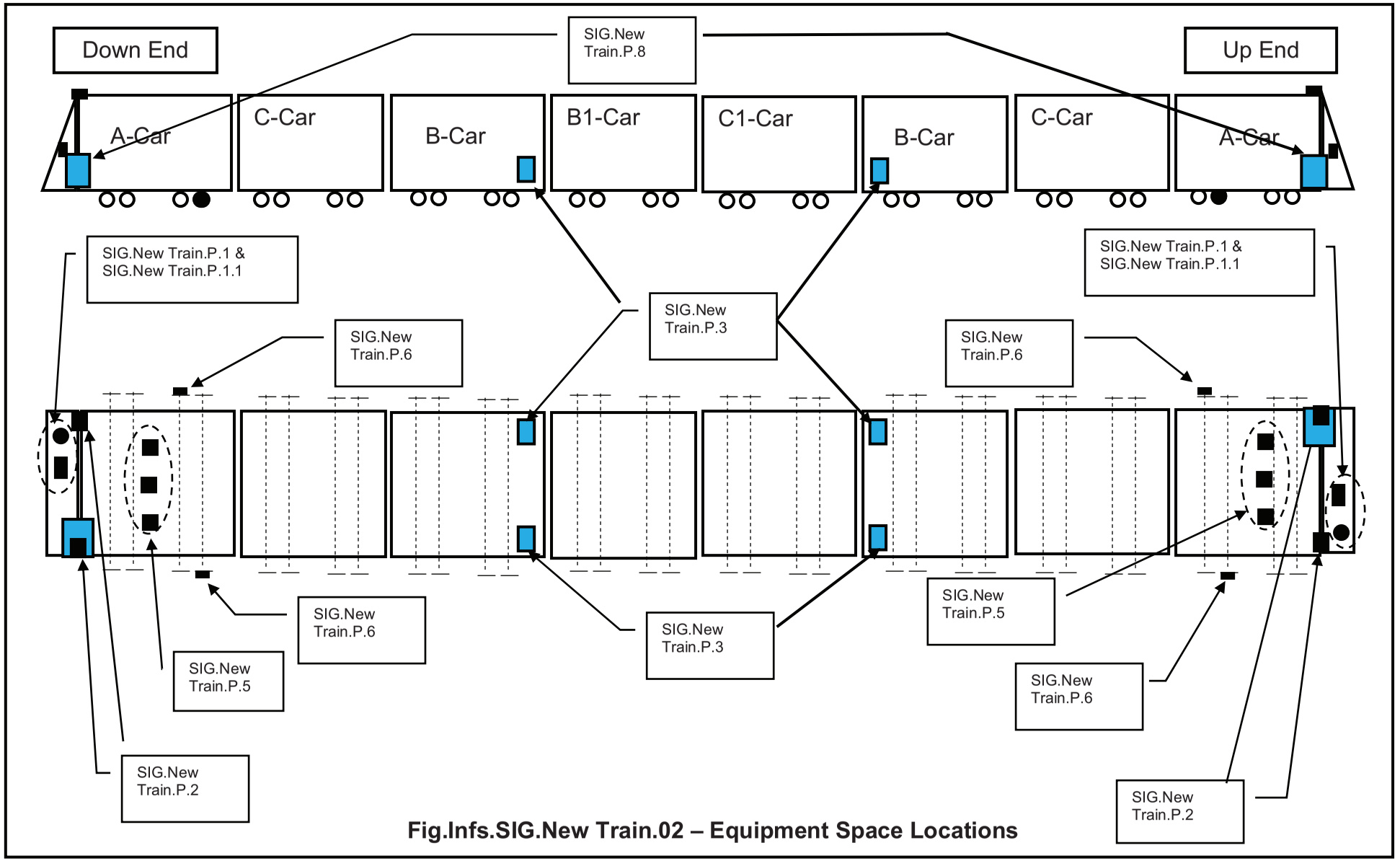


Fig.Infs.SIG.New Train.02 – Equipment Space Locations

4. TRAINLINES

4.1 The New Train Contractor shall provide all the additional trainlines required for the functioning of CBTC Train-borne Subsystem and to achieve the hot-standby redundancy configuration of CBTC Train-borne Subsystem.

4.2 In order to provide redundancy and to avoid single point failure affecting the reliability performance of the CBTC Train-borne Subsystem, the New Train Contractor shall provide four separate trainline paths to avoid common mode failure due to bad contact, short circuit and open circuit of the trainlines.

4.3 The trainline cables shall be routed to interface the underframe mounted and inside car mounted CBTC equipment located at A-cars and B-cars as specified in Fig.Infs.SIG.New Train.02. The exact cabling paths shall be proposed by the New Train Contractor and subject to approval by the Engineer.

Trainlines Identity	Description	Works by New Train Contractor	Works by SIG Contractor
CA1, CA5 & CA9	Trainline Cable Bundle No.1	a) To design, supply, install, Testing and Commissioning 25 x single core 1.5mm^2 AWG15 trainlines (21 cores for CBTC functions and 4 cores for spare) including all pins, connectors, connection boxes, cable conduits, PMA sheath and cable glands. b) The trainline cable CA1 shall be routed from the Down End A-car Driver Cab CBTC equipment compartment to the Down End B-car Underframe. c) The trainline cable CA5 shall be routed from the Down End B-car Underframe to the Up End B-car Underframe. d) The trainline cable CA9 shall be	a) The SIG Contractor shall use the single core trainlines for vital inputs and outputs as specified in this IRS. b) The SIG Contractor shall be responsible for design, supply, install, Testing and Commissioning of the required terminals, terminal lugs, connectors, sockets, connector pins for termination of trainlines and complete for the intended functions of the CBTC equipment.

Trainlines Identity	Description	Works by New Train Contractor	Works by SIG Contractor
		routed from the Up End B-car Underframe to the Up End A-car Driver Cab CBTC equipment compartment.	
CA2, CA6 & CA10	Trainline Cable Bundle No. 2	a) To design, supply, install, Testing and Commissioning 3 Cat 5 trainline cables with conductor size of AWG20 (each CAT5 cable shall comprise 4 cores shielded twisted pairs) including all pins, connectors, connection boxes, cable conduits, PMA sheath and cable glands. b) The trainline cable CA2 shall be routed from the Down End A-car Driver Cab CBTC equipment compartment through A-C-B car underframe to the Ethernet Repeater installed in Down End B-car equipment compartment. c) The trainline cable CA6 shall be routed from the Ethernet Repeater installed in Down End B-car equipment compartment through B1-C1 car underframe to the Ethernet Repeater installed in Up End B-car equipment compartment. d) The trainline cable CA10 shall be routed from the Ethernet Repeater installed in Up End B-car	a) The SIG Contractor shall be responsible for all wire termination b) The SIG Contractor shall be responsible for design, supply, install, Testing and Commissioning of the required terminals, terminal lugs, connectors, sockets, connector pins for termination of trainlines and complete for the intended functions of the CBTC equipment.

Trainlines Identity	Description	Works by New Train Contractor	Works by SIG Contractor
		equipment compartment through A-C-B car underframe to the Up End A-car Driver Cab CBTC equipment compartment. e) All shields of the trainline cables shall be earthed at both ends in the same car.	
CA3, CA7 & CA11	Trainline Cable Bundle No. 3	a) To design, supply, install, Testing and Commissioning 3 Cat 5 trainline cables with conductor size of AWG20 (each CAT5 cable shall comprise 4 cores shielded twisted pairs) including all pins, connectors, connection boxes, cable conduits, PMA sheath and cable glands. b) The trainline cable CA3 shall be routed from the Down End A-car Driver Cab CBTC equipment compartment through A-C-B car underframe to the Ethernet Repeater installed in Down End B-car equipment compartment. c) The trainline cable CA7 shall be routed from the Ethernet Repeater installed in Down End B-car equipment compartment through B1-C1 car underframe to the Ethernet Repeater installed in Up End B-car equipment compartment. d) The trainline cable CA11 shall be	a) The SIG Contractor shall be responsible for all wire termination b) The SIG Contractor shall be responsible for design, supply, install, Testing and Commissioning of the required terminals, terminal lugs, connectors, sockets, connector pins for termination of trainlines and complete for the intended functions of the CBTC equipment.

Trainlines Identity	Description	Works by New Train Contractor	Works by SIG Contractor
		routed from the Ethernet Repeater installed in Up End B-car equipment compartment through A-C-B car underframe to the Up End A-car Driver Cab CBTC equipment compartment. e) All shields of the trainline cables shall be earthed at both ends in the same car.	
CA4, CA8 & CA12	Trainline Cable Bundle No. 4	a) To design, supply, install, Testing and Commissioning 25 x single core 1.5mm2 AWG15 trainlines (21 cores for CBTC functions and 4 cores for spare) including all pins, connectors, connection boxes, cable conduits, PMA sheath and cable glands. b) The trainline cable CA4 shall be routed from the Down End A-car Driver Cab CBTC equipment compartment to the Down End B-car Underframe c) The trainline cable CA8 shall be routed from the Down End B-car Underframe to the Up End B-car Underframe. d) The trainline cable CA12 shall be routed from the Up End B-car Underframe to the Up End A-car	a) The SIG Contractor shall use the single core trainline for vital inputs and outputs as specified in this IRS. b) The SIG Contractor shall be responsible for design, supply, install, Testing and Commissioning of the required terminals, terminal lugs, connectors, sockets, connector pins for termination of the trainlines and complete for the intended functions of the CBTC equipment.

Trainlines Identity	Description	Works by New Train Contractor	Works by SIG Contractor
		Driver Cab CBTC equipment compartment.	
J1 & J2	Inter-car Jumpers	a) To design, supply, install, Testing and Commissioning 7 pairs of inter-car jumpers cables including all pins, connectors, connection boxes, cable conduits, PMA sheath and cable glands. b) Each jumper cable shall carry 25 single cores with conductor size of 1.5mm^2 AWG15 and 3 CAT 5 AWG20 cables. The two types of cables shall be individual screened and single-end earthed. c) The connector design shall be child and parent type. The connector shall ensure that individual and dedicated connectors provided for respective Cat 5 cables and the single core cable.	Not applicable

tab.Infs.SIG.New Train.02 – Trainlines Schedule

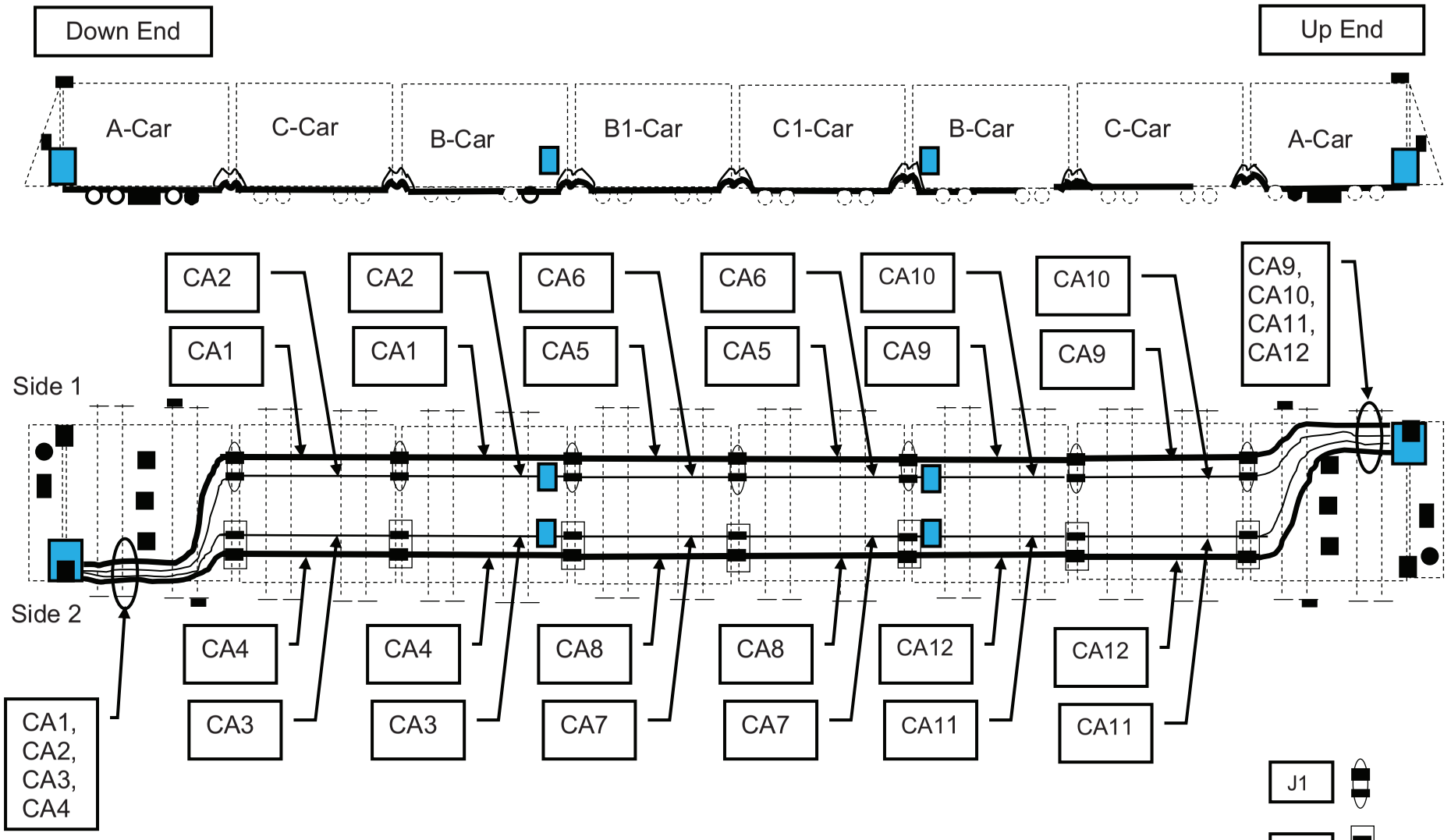


Fig.Infs.SIG.New Train.03 – Trainlines Provision

5. CABLE CONDUITS PROVISION

5.1 The scope of provision of cable conduits for the Train-borne CBTC Controller shall be in accordance with tab.Infs.SIG.New Train.03 and Fig.infs.SIG.New Train.04. The New Train Contractor shall liaise with the SIG Contractor through the Engineer for finalising the material, dimension, bending radius and clearance requirements of the cable conduits.

Cable Conduit Identify	Description	Works by New Train Contractor	Works by SIG Contractor
CC1	Flexible cable conduit CC1	a) To design, supply, and install one flexible cable conduit including draw wires and cable glands (i.e. two per New Train) b) The flexible cable conduit CC1 shall be routed from the CBTC equipment compartment to the locations of the Primary and Secondary Train Operator Displays.	a) To design, supply, install, Testing and Commissioning all required cables for the Primary and Secondary Train Operator Displays.
CC2	Not used		
CC3	Not used		
CC4	Underframe cable conduit CC4	a) To design, supply, install, Testing and Commissioning all underframe cable conduits including all mounting, junction boxes, PMA sheath and cable glands.	a) To design, supply, install, Testing and Commissioning all required cables, wires, terminal lugs, terminals, terminal blocks, flexible cable conduits and connectors for the Underframe antennas/tag readers/radars, proximity sensor, speed sensors in A-car.
CC5	Flexible cable conduit CC5	a) To design, supply, and install six flexible cable conduits including draw wires and cable glands (i.e. six per New Train)	a) To design, supply, install, Testing and Commissioning all required cables, wires, terminal lugs, terminals and connectors for connecting the radio

Cable Conduit Identify	Description	Works by New Train Contractor	Works by SIG Contractor
		for the use of CBTC Train-borne Subsystem. b) Two flexible cable conduits CC5 shall be routed from each CBTC equipment compartment to the overhead radio antennas locations. c) One flexible cable conduits CC5 shall be routed from each CBTC equipment compartment to 4G LTE radio antenna location in the Train Operator's Cab or overhead radio antennas location in the event that the 4G/LTE radio antennas are externally mounted.	antennas.

tab.Infs.SIG.New Train.03 – Cable Conduit Schedule

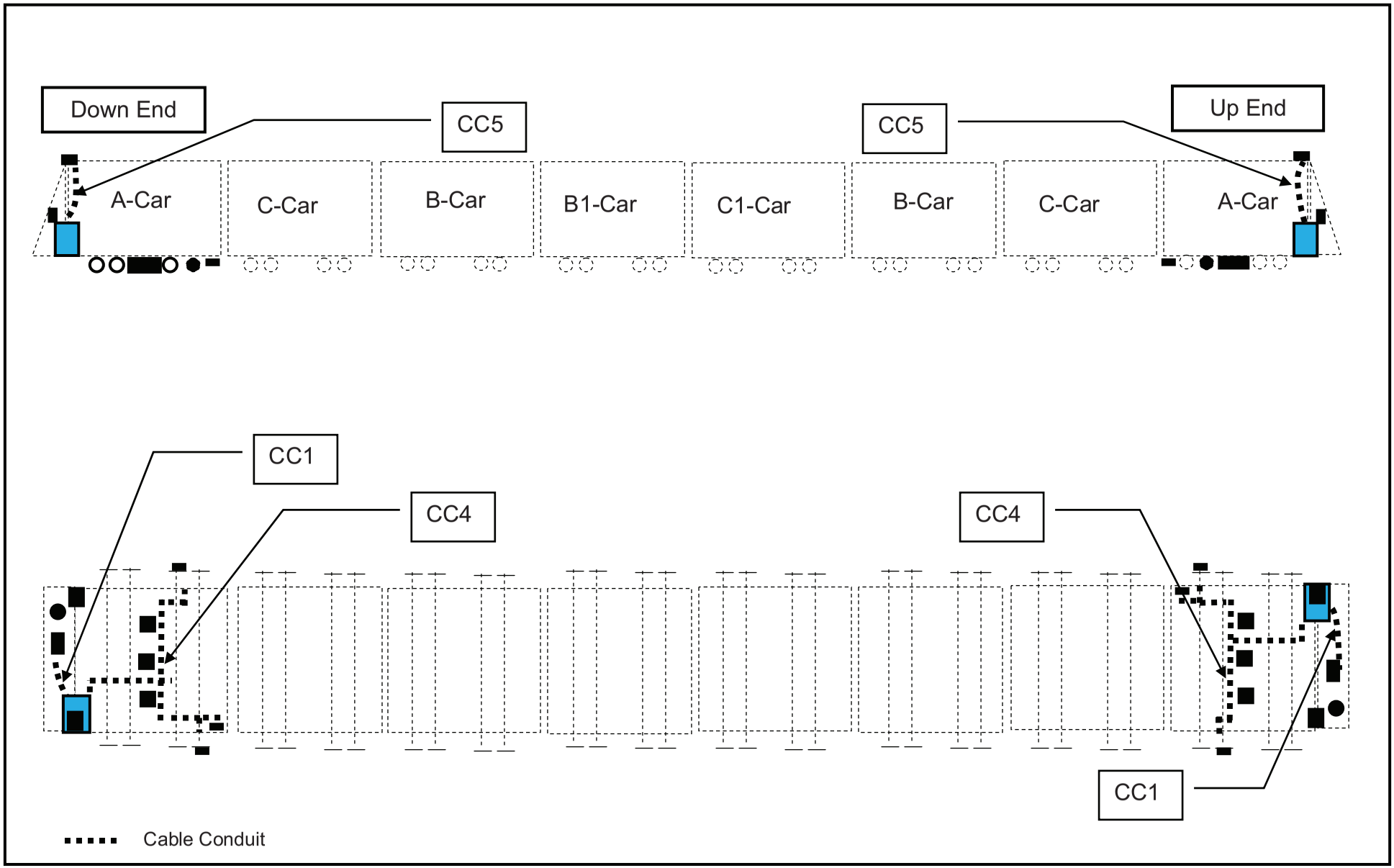

Down End
CC5
CC5
Up End
A-Car
C-Car
B-Car
B1-Car
C1-Car
B-Car
C-Car
A-Car
CC1
CC4
CC4
CC1
Cable Conduit

Fig.Infs.SIG.New Train.04 – Cable Conduits Provision

6. FUNCTIONAL INTERFACE

6.1 The New Train's additional functional requirements are specified in tabl.infs.SIG.New Train.04.

Functional Input Identity	Signal name	Functional Requirements	Works by New Train Contractor	Works by SIG Contractor
SIG.New Train.F.IN.6	Power Supply for A-car	To provide power supply to the train-borne CBTC equipment located at A-car	To provide power supply to the train-borne CBTC equipment located at A-car. There are two sets of train-borne CBTC equipment to be installed at respective A-car of New Train. Each power supply shall comply with the following: i. Nominal Voltage: 110Vdc (77Vdc to 137.5Vdc) ii. Maximum Power: 520W iii. Sleep Mode Power: 100W for at least 12 hours iv. 6 MCBs for over current protection	To design, supply, install, Testing and Commissioning the train-borne CBTC equipment not exceeding the power supply provided including sleep mode power supply.

Functional Input Identity	Signal name	Functional Requirements	Works by New Train Contractor	Works by SIG Contractor
SIG.New Train.F.IN.7	Power Supply for B-car	To provide power supply to two Ethernet Repeaters located inside each B-car.	To provide 110Vdc power supply with separate and independent MCB to each of two Ethernet Repeaters located inside B-car. Four Ethernet Repeaters are to be installed inside two B-cars of 8 car train consist. The power rating of each Ethernet Repeater is to be determined by SIG contractor. Each power supply shall comply with the following: i. Nominal Voltage: 110Vdc (77Vdc to 137.5Vdc) ii. Maximum Power: to be determined by SIG Contractor iii. One independent MCB for each repeater for over current protection iv. The power supply shall be available at all times regardless of the Mode Selector position and the up/down status of pantographs.	a) To design, supply, install, Testing and Commissioning the Ethernet Repeaters, all applicable coaxial cables, connectors and cable glands. The dimensions of each repeater shall not exceed 300mm (L) x 300mm (W) x 200mm (H) and weight of 5kg each. The power rating of each repeater shall not exceed 100W.

tab.Infs.SIG.New Train.04

7. INSTALLATION ARRANGEMENT AND PROVISION

7.1 Except as identified in the ATC Connectors & Tail Cables Specifications table in Attachment A of Attachment App-I-Annex 3, Appendix 3, Annex C13, the SIG Contractor will provide all CBTC train-borne equipment.

7.2 New Train Contractor shall collect and arrange delivery of all train-borne CBTC equipment for first two trainsets from Hong Kong to car-builder factory for installation. The installation of all train-borne CBTC equipment for first two trainsets (T1 and T2) of New Trains shall be completed in car-builder factory by the New Train Contractor. The SIG Contractor will provide installation specification, method statement and site supervision in car-builder factory according to implementation programme approved by the Engineer.

7.3 New Train Contractor shall provide Stabling Track and Test Track with OHL supply for carrying out static test, interface test and low speed dynamic test in car-builder factory for the first two trainsets (T1 and T2). The Test Track shall be at least 500m in length and allow train running at speed of 40Kph for both directions. The details of Test Track design, power supply provision and installation of signalling facilities shall be finalised separately according to the implementation programme approved by the Engineer.

7.4 For the third train onwards, all the CBTC train-borne equipment shall be installed, tested and commissioned by the SIG Contractor in Hong Kong except the roof top mounted radio antennas in A-car in section 3 and as identified in Attachment A of Attachment App-I-Annex 3, Appendix 3, Annex C13 “ATC Connectors & Tail Cables Specifications table” which shall be installed by the New Train Contractor. Trainlines in section 4, cable conduits in section 5 and power supply & sleep mode power in section 6 as specified in this Interface requirement Specification shall be supplied & installed by the New Train Contractor. New Train Contractor shall collect and arrange delivery of all roof top mounted radio antennas (and accessories if applicable) in one batch provided by the SIG Contractor 3 months in advance the installation programme for remaining 76 trainsets from Hong Kong to car-builder factory for installation by the New Train Contractor.

7.5 New Train Contractor shall be the lead contractor to make the train ready for CBTC Systems Tests and set up applicable protections or test conditions in Test Track and in car side to enable the SIG contractor to carry out all approved Test and commissioning activities for all New Trains.

8. INTERFACE DOCUMENTATION

8.1 The SIG Contractor will be responsible for preparing the interface documents related to the interface in accordance with table tab.Infs.SIG-New Train.11 below. The interface documents of the New Train Contractor shall be submitted to the Engineer for approval.

Ref. No.	Documents
12.1.1	Detailed Interface Specification
12.1.2	Detailed Interface Test Plan
12.1.3	Interface Test Specifications

tab.Infs.SIG.New Train.11

---------- End of the Contract 6014 - SIG and New Train Interface Requirements Specification ----------

Attachment A – Detailed Interface Design Specification for Automatic Train Control

Attachment A
_20141124

Detailed Interface Design Specification for Automatic Train Control

Contents

1 Introduction.....3
1.1 Abbreviations and Acronyms.....3
Appendices.....4

1 Introduction

This document describes the detailed interfaces between Rolling Stock (RS) and the Automatic Train Control (ATC). The document will reflect the design in how the interface requirements are met.

1.1 Abbreviations and Acronyms

ATC	Automatic Train Control
ATO	Automatic Train Operation
ATP	Automatic Train Protection
RS Contractor	Rolling Stock Contractor
DDS	Detailed Design Specification
DID	Detailed Interface Document (including the Interface Design Specification)
EMC	Electromagnetic Compatibility
GS	General Specification
IMP	Interface Management Plan
MTR	Mass Transit Railway
PIP	Project Interface Plan
PS	Particular Specification
PSD	Platform Station Doors
RS	Rolling Stock
SACEM	Système d'Aide à la Conduite à l'Entretien et à la Maintenance
TBC	Traction Brake Controller
TKE	Tseung Kwan O Extension
TMS	Train Management System
TSE	Trainborne Signalling Equipment

Appendices

Appendix 1	Not Used
Appendix 2	Comparison Table between PS Requirements and DIS-ATC
Appendix 3	Detailed Interface Specification Ver.2.5

Appendix 2
Signal/RS Electrical Interface Comparison Table Between PS Requirements and ATC

OBCU Name (PS)	Type	ATC Name	Remarks
NORMAL	INPUT	ATC Mode	
REMD	INPUT	--	Not REMD in ATC
NSD	INPUT	NOT_SD	
RMF	INPUT	Forward	
RMR	INPUT	Reverse	
DCCSA	INPUT	--	
DCCSB	INPUT	--	
DOCSA	INPUT	DOSA	
DOCSB	INPUT	DOSB	
ADC	INPUT	Door Status	To check door operation sequence
SIR1_Status	INPUT	SIR1 Status	
SIR2_Status	INPUT	SIR2 Status	
EB_applied	INPUT	EMPB	
TRS_Status	INPUT	--	
DTO_Command	INPUT	DKPB	Driverless Control Push Button
AM	INPUT	AUTO	
CM	INPUT	CM	
SB	INPUT	SB	
Start_Command	INPUT	AUTO Start PB	AUTO Start Pushbutton
Holding_Brake	INPUT	--	
RX_TMS	INPUT	RX_TMS	
--	INPUT	DT_SD	ATC monitors the SD position
--	INPUT	EBR1 status	1=EB, 0=NO EB by ATC monitor
--	INPUT	EBR2 status	1=EB, 0=NO EB by ATC monitor
--	INPUT	ZVR1 Status	1=moving, 0=zero speed
--	INPUT	ZVR2 Status	1=moving, 0=zero speed
--	INPUT	EMPB	1=EB not applied, 0= EB applied
DOEA	OUTPUT	DERA	
DOEB	OUTPUT	DERB	
PSDC	OUTPUT	--	Monitor by software
EBR1	OUTPUT	EBR1	1=NO EB, 0=EB applied by ATC
EBR2	OUTPUT	EBR2	1=NO EB, 0=EB applied by ATC
ZVAR	OUTPUT	--	No such requirement
ZVR1	OUTPUT	ZVR1	1=Zero Speed, 0=Train Move
ZVR2	OUTPUT	ZVR2	1=Zero Speed, 0=Train Move
DTO_SR	OUTPUT	DCR/2	When MS at SD position, 1=DT & 0= Not DT
DTO_MSS	OUTPUT	SSIR/1	To reset SIR circuit in DT mode
DTO_Mode_Indicator	OUTPUT	Driverless Ind.	
AM_Fault_Indicator	OUTPUT	AUTO Fault Ind.	
CM_Fault_Indicator	OUTPUT	CM Fault Ind.	
RM-Fault_Indicator	OUTPUT	RM Fault Ind.	
EB_Application_Indicator	OUTPUT	EB Triggered Ind.	
Locked_Axle_Indicator	OUTPUT	Locked Axle Ind.	
Train_Hold_Indicator	OUTPUT	Train Hold Ind.	
REMD_Mode_Indicator	OUTPUT	--	

PSD_Open_Indicator	OUTPUT	--	
Overspeed_Alarm	OUTPUT	Overspeed Alram	
DTO_DOCA-1	OUTPUT	DORA/1	
DTO_DOCA-2	OUTPUT	DORA/2	
DTO_DOCB-1	OUTPUT	DORB/1	
DTO_DOCB-2	OUTPUT	DORB/2	
Brake_demand	OUTPUT	Brake Demand	
Motor_demand	OUTPUT	Motor Demand	
ATO_PWM Level	OUTPUT	ATO_PWM	
TX_TRS	OUTPUT	--	Not TRS requirement in PS
TX_TMS	OUTPUT	TX_TMS	
--	OUTPUT	DCR/1	When MS at SD position, 1=DT & 0= Not DT
--	OUTPUT	DCR/3	When MS at SD position, 1=DT & 0= Not DT
--	OUTPUT	DCR/4	When MS at SD position, 1=DT & 0= Not DT
--	OUTPUT	DCR/5	When MS at SD position, 1=DT & 0= Not DT
--	OUTPUT	ATC Fault	ATC fault indicator
--	OUTPUT	Start Hold Fault	1=ATO Start authorized, 0=ATC Start not authorized
--	OUTPUT	Door Test Ind.	1=Door Test faulure, 0=Door Test Passed
--	OUTPUT	SIR1 Ind	SIR1 Indicator
--	OUTPUT	SIR2 Ind.	SIR2 Indicator
--	INPUT	FB110	

DETAILED INTERFACE SPECIFICATION

TABLE OF CONTENTS

1. INTRODUCTION 6

2. ABBREVIATIONS AND DEFINITIONS 7

3. REFERENCE 9

4. SYSTEM CONFIGURATION 10

4.1 TRAIN CONSIST 10

4.2 TRACTION AND BRAKE PERFORMANCE 10

4.3 ROLLING STOCK CHARACTERISTICS 10

4.4 SYSTEM DEFINITION 10

4.5 CAR / SACEM/ A-CAR PLUG NUMBERING 13

5. GENERAL INTERFACE PRINCIPLES 14

5.1 MODE SELECTION EQUIPMENTS 14

5.2 NORMAL DRIVING MODES 14

5.2.1 AUTOMATIC Mode 14

5.2.2 CODED MANUAL Mode 14

5.3 SPECIFIC DRIVING MODES 14

5.3.1 Restricted Manual Forward / Reverse Mode 14

5.3.2 Driverless Turnaround Mode 15

5.3.3 Traction Fall-back Mode 15

5.4 NON-DRIVING MODE 15

5.4.1 Standby Mode 15

5.4.2 Shutdown Mode 15

5.4.3 Reset Mode 15

6. CONTROL SYSTEM BLOCK DIAGRAM 16

7. GENERAL SAFETY DEFINITIONS AND CONSTRAINTS 17

7.1 DEFINITION 17

7.2 CONSTRAINTS 17

7.3 EMC REQUIREMENTS 17

7.3.1 EMC requirements concerning the wiring between the signaling equipment 17

7.3.2 Class of signal 19

7.3.3 Protection of cables from noisy trainborne equipment 20

7.4 EARTHING POLICY 20

7.4.1 Serial links 20

7.4.2 Pick-up coils and odometer 21

8. MECHANICAL INTERFACE 22

8.1 EQUIPMENT WEIGHT 22

DETAILED INTERFACE SPECIFICATION

8.2 RC ANTENNA & CT SENSORS 22
8.2.1 Metal Free Zone 22
8.2.2 RC Antenna Installation Constraints 22
8.2.3 CT Sensor Installation Constraints 22
8.2.4 Mounting Arrangement 22
8.3 ATC CUBICLE 22
8.3.1 Mounting Arrangement 22
8.4 SPEEDOMETER 22
8.4.1 Mounting Arrangement 22
8.5 ODOMETER 22
8.5.1 Odometer Main Specifications 22
8.5.2 Odometer Environmental Specifications 22
8.5.3 Odometer Mounting Precautions 23
9. ELECTRICAL INTERFACE 24
9.1 ATC INPUTS AND OUTPUTS ELECTRICAL CHARACTERISTICS 24
9.2 CABLE SPECIFICATIONS 24
9.3 SCOS REQUIREMENTS 24
9.4 ATC POWER SUPPLY REQUIREMENTS 24
9.5 ATC I/O CIRCUITS 24
10. FUNCTIONAL INTERFACE 25
10.1 TRACTION AND SERVICE BRAKE CONTROLS 25
10.1.1 ATC Outputs 25
10.1.2 Functional Description 25
10.1.3 Remarks 27
10.1.4 Holding Brake Management 27
10.2 EMERGENCY BRAKE CONTROL 30
10.2.1 ATC Outputs 30
10.2.2 Functional Description 30
10.2.3 Remarks 30
10.3 ZERO VELOCITY RELAY CONTROL 30
10.3.1 ATC Outputs 30
10.3.2 Functional Description 30
10.3.3 Remarks 31
10.4 DOOR AUTHORIZATION 31
10.4.1 ATC Outputs 31
10.4.2 Functional Descritption 31
11. ANNEX 32

DETAILED INTERFACE SPECIFICATION

1. INTRODUCTION

This interface specification defines the detailed interface arrangement between Signalling Contractor – Trainborne Signalling Equipment and RS Contractor – Rolling Stocks.

The Trainborne Signalling Equipment (TSE) supplied by Signalling Contractor is the on-board ATC system namely SACEM currently used in M-train on URL.

The TSE consists of (i) one ATC cubicle which contains all electronic processor modules to monitor, compute and command all ATP and ATO functions, (ii) two CT sensors which are used to prick up the track-to-train signaling message from the CT loops mounted on both rails, (iii) one SACEM odometer located at axle end 4B for speed and distance measurement, (iv) one tacho-generator located at axle end 3A for zero speed detection, (v) one RC antenna to determine the train position as well as sending train-to-track message to the trackside return channel for PSD controls and this RC antenna is also used to report ATC faults via the trackside return channel and (vi) one speedometer to indicate the current and target speed to the train drivers.

Each train consists of two TSEs and each TSE is working independent from the other.

This document covers the detailed mechanical, electrical and functional interfaces.

DETAILED INTERFACE SPECIFICATION

2. ABBREVIATIONS AND DEFINITIONS

ADC	All Doors Closed
ATC	Automatic Train Control
ATO	Automatic Train Operation
ATP	Automatic Train Protection
AM	Automatic mode
CM	Coded Manual
CT	Continuous Transmission
DC	Direct Current
DCCA/ DCCB	Door Close Control– Side A / Side B
DCCSA/ DCCSB	Door Close Control State – Side A / Side B
DOCA/ DOCB	Door Open Control– Side A / Side B
DOCSA/ DOCSB	Door Open Control State – Side A / Side B
DOEA / DOEB	Door Open Enable – Side A / Side B
DTO	Driverless Turnround Operation
EB	Emergency Brake
ESS	Emergency Stop Switch
EBR	Emergency Brake Relay
EMC	Electromagnetic Compatibility
FSK	Frequency Shift Keying
MCB	Micro Circuit Breaker
MS	Mode Selector
MTBF	Mean Time Between Failure
MTRC	Mass Transit Railway Corporation
PSD	Platform Station Doors
PSDC	Platform Station Doors Closed
PTO	Passenger Train Operator
RC	Return Channel
REMD	Rear End Mode Driving
RM	Restricted Manual mode
RMF	Restricted Manual mode – Forward direction
RMR	Restricted Manual mode – Reverse direction
RS	Rolling Stock
SACEM	Système d'Aide à la Conduite à l'Entretien et à la

DETAILED INTERFACE SPECIFICATION

	Maintenance
SIR	Safety Interlock Relay
SCOS	Safety Cut Out Switch
TBC	Traction Brake Controller
TBD	To Be Defined
TKE	Tseung Kwan O Extension
TMS	Train Management System
TSE	Trainborne Signalling Equipment
TRS	Train Radio System
URL	Urban Line
ZVR	Zero Velocity Relay

DETAILED INTERFACE SPECIFICATION

3. REFERENCE

1. General Specification
2. Particular Specification

DETAILED INTERFACE SPECIFICATION

4. SYSTEM CONFIGURATION

4.1 TRAIN CONSIST

The train-consist for the new EMU supplied under contract comprises 8 cars. 6 motor cars and 2 driving trailer cars. The configurations are shown on the General Arrangement Concept drawing and Train Formation drawings in Annex A1. General Arrangement of the cars is shown in Annex A2.

4.2 TRACTION AND BRAKE PERFORMANCE

The traction and brake performance of the new EMU are specified in Annex A3 – Traction Motor Characteristic Curve and Annex A4 – Braking Performance Curve.

4.3 ROLLING STOCK CHARACTERISTICS

The characteristics of the new EMU related the ATC are specified in Annex A5 – Rolling Stock Parameters.

4.4 SYSTEM DEFINITION

The labelings rules concerning the motion direction and the door control side definition depend upon the selected cab of the train (see figures 4.4.1 and 4.4.2)

- The **Selected cab** is the cab where the Mode Selector switch is NOT at SHUTDOWN position, or at SHUTDOWN position if "Driverless Turnround Operation" is in operation; the ATC is then **active**.
- The Front **car** is the A-car of the train whose cab is selected.
- The Front **cab** is the cab of the Front car.
- The **Rear car** is the A-car opposite the Front car.
- The **Rear cab** is the cab of the Rear car.
- The **Forward direction** is the direction given by the front cab.
- The **Reverse direction** is the back direction given by the front cab.

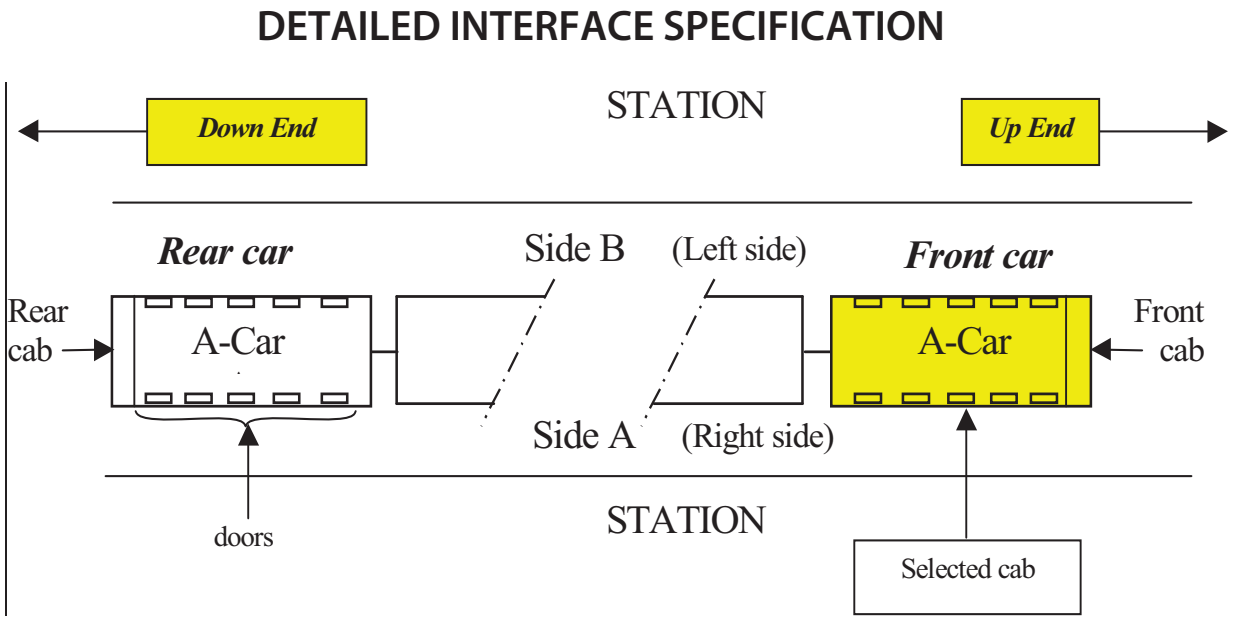


Figure 4.2.1: labelling for A-car facing Up End of the line (top view)

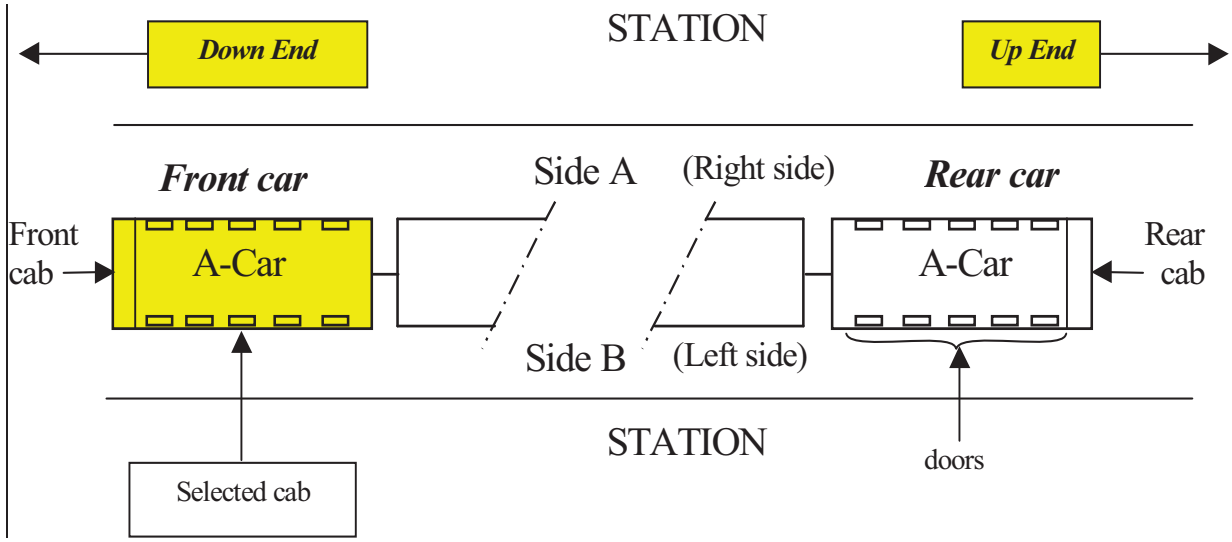


Figure 4.2.2 : labelling for A-car facing Down End of the line (top view)

In this document, as far as signalling equipment is named, we will speak about:

- The **ATC**, as the generic term for the whole signalling equipment.
- The **ATC Cubicle**, as the unit that manages the Automatic Train Control and Monitoring functions
- The **ATP**, as **the** unit that manages the ATC Cubicle vital functions (and some non vital

DETAILED INTERFACE SPECIFICATION

functions)

- The **ATO**, as the unit that manages the ATC Cubicle regulation functions

DETAILED INTERFACE SPECIFICATION

4.5 Not Used

DETAILED INTERFACE SPECIFICATION

5. GENERAL INTERFACE PRINCIPLES

5.1 MODE SELECTION EQUIPMENTS

There are three Rolling Stock equipments used to select the operating modes of the ATC. They are Mode Selector (MS) handle, Traction and Brake Controller (TBC) and Safety Cut-out Switch (SCOS).

The MS handle has six selectable positions namely SD – Shutdown, REV – RMR, SB – Standby, FOR – RMF, CM – Coded Manual and AUTO – Automatic.

The TBC has six fixed positions namely EM – Emergency Brake, Maximum Service Brake, Minimum Service Brake, COASTING, Minimum Motoring and Maximum Motoring. Furthermore, the TBC can be moved freely between (i) Maximum Service Brake and Minimum Service Brake to command different braking efforts, and (ii) Minimum Motoring and Maximum Motoring to command different traction efforts.

Annex A6 – Traction Brake Controller Out Line illustrates the operation of the MS handle and the Traction and Brake Controller.

The SCOS has three selectable positions namely Normal, Reset and Fallback.

5.2 NORMAL DRIVING MODES

Two operating modes, Automatic Mode and Coded Manual Mode, are used for normal train operation. A driving cab is said to be active if its MS handle is switched to any positions rather than Shutdown.

5.2.1 AUTOMATIC Mode

This mode is selected when the MS handle is switched to AUTO position (the TBC must at Maximum service brake position before the MS handle can be switched to AUTO position) and the Safety Cut-out Switch (SCOS) is at Normal position. In this mode, the ATO takes control of the train's traction and service brake system in order to perform train starting, precise station and signal stops, regulate the train speed and apply coasting order under the protection of the ATP.

5.2.2 CODED MANUAL Mode

This mode is selected when the MS handle is switched to CM position and the SCOS is at Normal position. In this mode, the PTO takes control of the train's traction and service brake system for train starting, precise station and signal stops, regulate the train speed and apply coasting under the protection of the ATP.

5.3 SPECIFIC DRIVING MODES

There are other specific operating modes can be selected by the MS handle and the SCOS for degraded mode operation or for driverless turning around.

5.3.1 Restricted Manual Forward / Reverse Mode

DETAILED INTERFACE SPECIFICATION

This mode is selected when (i) SCOS at Normal position and (ii) the MS handle is switched to FOR position for Restricted Manual Forward mode or the MS handle is switched to REV position for Restricted Manual Reverse Mode. In these modes, the PTO can drive the train without any signalling authorization but the on-board ATP will restrict the train speed to 22kph. All the train movement are controlled and responsible by the PTO.

5.3.2 Driverless Turnaround Mode

This mode is selected when (i) SCOS at Normal position, (ii) the MS handle is switched to Shutdown position and (iii) PTO action on the DTO button. This particular operating mode allows turning around of train at the end of the line without train driver. This mode will be terminated automatically when the train arrive the departure platform and the train doors are opened.

5.3.3 Traction Fall-back Mode

This mode is selected when fatal ATC equipment failure occurs. It can be selected by putting the SCOS to Fallback position. In this mode, the ATC is powered off and its outputs are put at the most restrictive states. The ATC speedometer will not show any train speed nor target speed. The PTO can drive the train with RMF or RMR modes only. The Rolling Stock's TMS will display the train speed information to the PTO and the Rolling Stock equipment will limit the train speed to 22kph and will apply emergency brake if the train speed over 22kph.

5.4 NON-DRIVING MODE

5.4.1 Standby Mode

This mode is selected by putting the MS handle to SB position in order to allow preparation of the train.

5.4.2 Shutdown Mode

This mode is selected by putting the MS handle to SD position when driver leave the driving cab and the train is withdrawn from service.

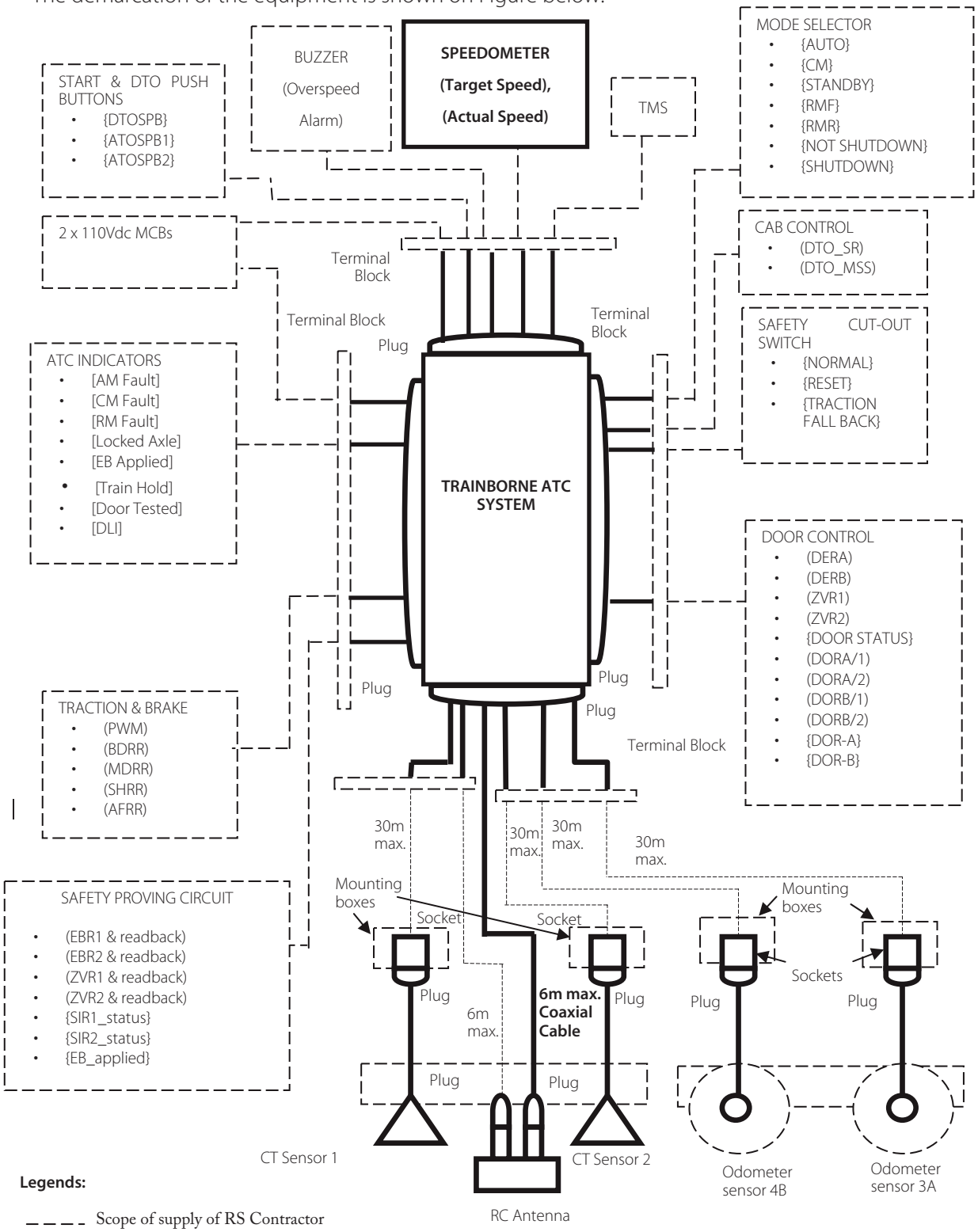
5.4.3 Reset Mode

This mode is selected by putting the SCOS switch to Reset position, this mode allows to reset the ATC in case of ATP blockage control because of failure detection (ex: CKD fall,…).

DETAILED INTERFACE SPECIFICATION

6. CONTROL SYSTEM BLOCK DIAGRAM

The demarcation of the equipment is shown on Figure below.



Legends:

Scope of supply of RS Contractor

Scope of supply of Signalling Contractor

( ) supplied by Signalling Contractor; [ ] outputs supplied by Signalling Contractor & indicators supplied by RS Contractor ; { } inputs supplied by Signalling Contractor & voltage free contacts supplied by RS Contractor ;

DETAILED INTERFACE SPECIFICATION

7. GENERAL SAFETY DEFINITIONS AND CONSTRAINTS

7.1 DEFINITION

"Vital" or "fail-safe" : such that in the event of a failure, it enters or remains in a safe state.
"0" is the safe state
"1" means : close contact or high voltage (e.g. 24V or 110V)
"0" means : open contact or low voltage (0V)

7.2 CONSTRAINTS

Some of ATC/RS interfaces are safety links which requires special cares.

- For those RS requirements defined in the present spec, that refer to vital interfaces, RS must maintain a high standard of manufacturing quality,
- Vital inputs shall be generated and provided in an appropriate safe manner by RS. In case of failure in the RS circuits, a false "1" delivered to the ATC is not acceptable. RS design must guarantee this.
- Vital output shall be processed in an appropriate safe manner by RS. In case of failure in the RS circuit, a "0" output command delivered by the ATC must not be realized as it was a "1". RS design must guarantee this.
- During normal operation, RS must ensure that doors will not be opened unless doors opening enable (vital information) is delivered from ATP (i.e.: previous state is "doors closed"),
- Vital inputs for Mode selection and for Door Closed functions have to be provided in an appropriate safe manner by RS.

7.3 EMC REQUIREMENTS

7.3.1 EMC requirements concerning the wiring between the signaling equipment

EMC rules must be applied to the cabling, wiring and installation of signaling equipment. This section is intended to stand by itself.

The electrical links between the signaling equipment must comply with the following requirements:

- In twisted pair lead, twisting of the signal high lead with its low (return) lead results in less loop area for inductive pick-up and lower inductance per foot. Lower inductance allows higher frequencies to be transmitted over a longer distances before signal loss and distortion become significant. In addition, inductive loading effects on the signal source are reduced. The minimal spacing of the high and low (return) signal leads affects cancellation of magnetic fields of the conductor currents. Cancellation of the conductor fields reduces inductive coupling with other signal leads. For these reasons twisted leads must be used wherever and whenever possible instead of non-twisted signal leads.

- Multiple conductor cable used for the transmission of several individual signals shall consist of twisted pair signal leads. Each twisted pair shall have an electrostatic shield.

DETAILED INTERFACE SPECIFICATION

- Multiple conductor cables must have an overall electrostatic shield.
- Unused conductors and shields shall be terminated. Where multiple conductors cables are involved, half of unused conductors and shields shall be terminated at one end of the cable and the remainder at the other end of the cable.
- High power leads (for example 96V DC equipment power) must be kept closely spaced to maximize the cancellation of conductor magnetic fields (magnetic loops).
- All shields must be terminated at both ends.
- Where twisted shielded leads must be broken (for example, input-output terminal boards), minimize the untwisted, unshielded lead length.
- Whenever possible, low-level signal lines shall be run unbroken from signal source to signal receiver.
- Cable routing must be utilized. Cables shall be routed around than through high-noise areas. If two cables carrying signals of different classifications must cross, they must cross at 90 ° rather than gradually over a long distance. Some sensitivity classes of the electrical circuits are defined :
    - Class 1: AC power conductors
    - Class 2: DC power conductors
    - Class 3: Conductors for sensitive digital and analogue signals
    - Class 4: Conductors for communication
    - Class 5: High Voltage and High power signals
- Low voltage cables of unlike classification must be kept physically separated – see chapter 7.3.2 for Class of signal
- Low voltage cables (lower than 100V) must be kept apart from high voltage cables. High voltage and low voltage cables must be installed in two separate trays (approx. 0,2 m).
- Each circuit must include in the same cable strand the two polarities of the signal: power supply and its common (0V), signals group and their electrical reference, pairs of wires for each output signals (relay free contact). Nevertheless vital output signals are wired with shielded mono-wire to avoid unwanted supply.
- Cables must laid on metallic support (tray, conduit) to reduce capacitive and inductive coupling.
- Cables trays are interconnected and bonded to the ground.
- Impedance of the ground and zero network is minimized.
- The grounding of following equipment : ATC cubicle and antenna, must be achieved with single or multiple braided wires. The braid must be as short as possible between the grounding screw of the equipment and the driving car frame.

DETAILED INTERFACE SPECIFICATION

7.3.2 Class of signal

1. Class 1 - High Susceptibility :

Analogue signals with AC<50V

- A : Audio and video analogue circuits
- B : HF transmitting / receiving circuits HF

2. Class 2 - Medium Susceptibility :

Digital signals, and analogue signal with AC > 50 V

- A : Digital circuits (Ethernet network,…)
- B : Transducer circuits (power supply and measurement signals)

3. Class 3 - Low Susceptibility :

Semi-conductor firing control circuits

4. Class 4 - Medium Emittivity :

Battery referenced circuits

- A : Power Input of apparatus (Electronics power suppl)
- B : Relay logic input/output
- C : Battery charger output (Control signals for relays, switchgears, magnet valves)

5. Class 5 - Power lines :

DC or AC power supply lines, with voltage higher than 75V or current higher than 20A.

- A : Catenary's voltage
- B : Propulsion current
- C : Auxiliary power supplies, 500V, 380V, etc.
- D : Battery charging lines, etc.

6. Class 6 :

Special circuits

The equipment cable class is defined below:

- **antenna :**

- analogical link and power signal (in two cables) : class 2B and 1B

- **Pick up coil (CT sensor) :**

- analogical link and power signal (in same cables) :class 2B

- **Odometer :**

- 0-24VDC signal link: class 2B

DETAILED INTERFACE SPECIFICATION

In case of long cables (above 1 meter) , the cables of different classes shall be separated. The separation distance shall depend on the type of classes:

Classes	1	2	3	4	5	6
1	0					
2	3-6cm	0				
3	3-6cm	3-6cm	0			
4	9cm	9cm	9cm	0		
5	15-20cm	15-20cm	15-20cm	15-20cm	0	
6	3-6cm	3-6cm	3-6cm	9cm	15-20cm	0

Figure 1 : Segregation classes

The cable laying design shall be submitted to ALSTOM by RS.

7.3.3 Protection of cables from noisy trainborne equipment

- Braid shield cables shall be used for the sensitive cable such as communication and signal lines
- Separate connectors shall be used for different functions such as high-level signals, low-level signals and protection of cables from noisy trainborne equipment ower supplies. If low and high-level signals have to be taken through the same connector, it shall be segregated with grounded connections between the groups.
- Corrugated tube with braid and cable duct shall be used to reduce interference from noisy equipment and cables

7.4 EARTHING POLICY

7.4.1 Serial links

The earthing policy concerning the serial lines is to connect the shield of the cable to the frame of the equipment on each side of the serial link as described in the following sketch:

DETAILED INTERFACE SPECIFICATION

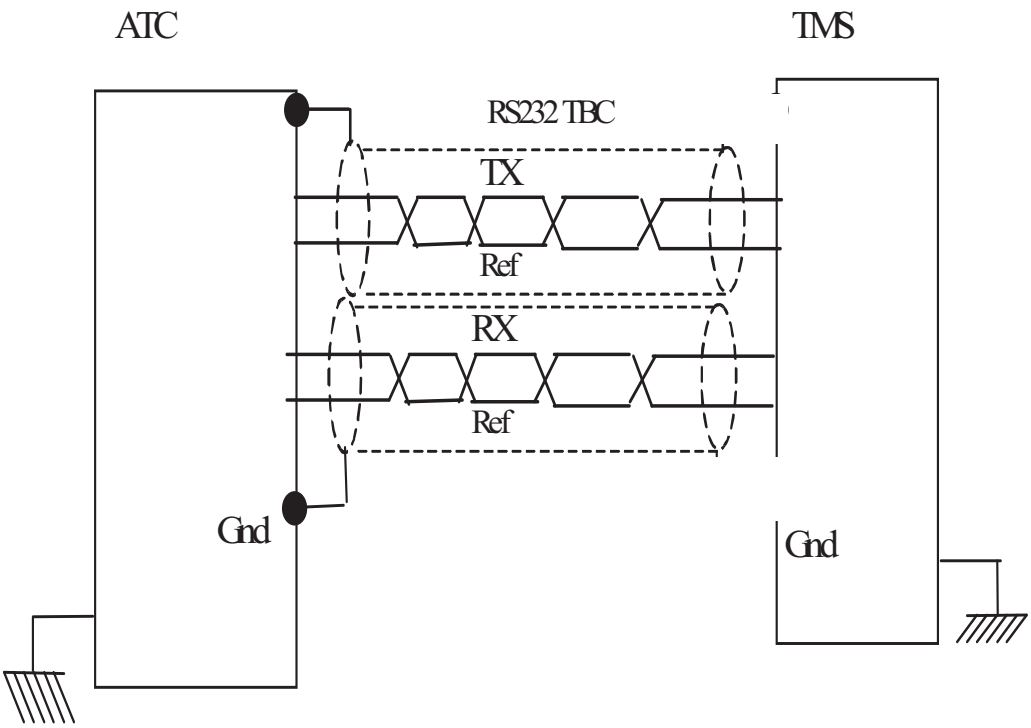


Figure 2 : Earthing policy concerning serial link

Note: Assumption : ATC and TMS are in same car.

7.4.2 Pick-up coils and odometer.

This Shields must be isolated from any potential at train level.
(Shields for this links are managed inside the ATC cubicle)

DETAILED INTERFACE SPECIFICATION

8. MECHANICAL INTERFACE

8.1 EQUIPMENT WEIGHT

The general location of the ATC equipment and their weight are specified in Annex B1, figure UF1.

8.2 RC ANTENNA & CT SENSORS

8.2.1 Metal Free Zone

The description of metal free zone for the RC antenna and CT sensors are specified in Annex B1, figure B1.U.1.1.

8.2.2 RC Antenna Installation Constraints

The RC antenna installation constraints are specified in Annex B1, section B1.U.1.2

8.2.3 CT Sensor Installation Constraints

The CT Sensor installation constrains are specified in Annex B1, section B1.U.1.3.

8.2.4 Mounting Arrangement

The detail mounting requirements of the RC antenna and CT sensors are specified in figures UF2, UF3, UF4, RC1, RC2, CT1 and CT2 of Annex B1.

8.3 ATC CUBICLE

8.3.1 Mounting Arrangement

The detailed installation and mounting requirements of the ATC cubicle are specified in figures ATC1, ATC2 and ATC3 of Annex B1.

8.4 SPEEDOMETER

8.4.1 Mounting Arrangement

The detailed installation and mounting requirements of the speedometer are specified in figure SP1 of Annex B1.

8.5 ODOMETER

8.5.1 Odometer Main Specifications

The specifications of the odometer are specified in section B1.O.1.1 of Annex B1.

8.5.2 Odometer Environmental Specifications

The environmental specifications of the odometer are specified in section B1.O.1.2 of Annex B1.

DETAILED INTERFACE SPECIFICATION

8.5.3 Odometer Mounting Precautions

The detail mounting requirement and mounting precautions of the odometers are specified in section B1.O.1.3, figures OD1, OD2, OD3, OD4, OD5 1 and OD5 2 of Annex B1.

DETAILED INTERFACE SPECIFICATION

9. ELECTRICAL INTERFACE

9.1 ATC INPUTS AND OUTPUTS ELECTRICAL CHARACTERISTICS

The details of ATC Inputs and Outputs Electrical Characteristics are specified in section C1.1 of Annex C1.

9.2 CABLE SPECIFICATIONS

The details of cables are specified in section C1.2 of Annex C1.

9.3 SCOS REQUIREMENTS

The requirements of SCOS are specified in section C1.3 of Annex C1.

9.4 ATC POWER SUPPLY REQUIREMENTS

The ATC Power Supply requirements are specified in section C1.4 of Annex C1.

9.5 ATC I/O CIRCUITS

The details of ATC I/O circuits are specified in Annex C2.

DETAILED INTERFACE SPECIFICATION

10. FUNCTIONAL INTERFACE

10.1 TRACTION AND SERVICE BRAKE CONTROLS

10.1.1 ATC Outputs

MDR, BDR and ATO_PWM

10.1.2 Functional Description

When the ATO drives the train in automatic mode (AUTO mode), the traction and brake commands are sent to RS by using MDR, BDR and ATO PWM signals.

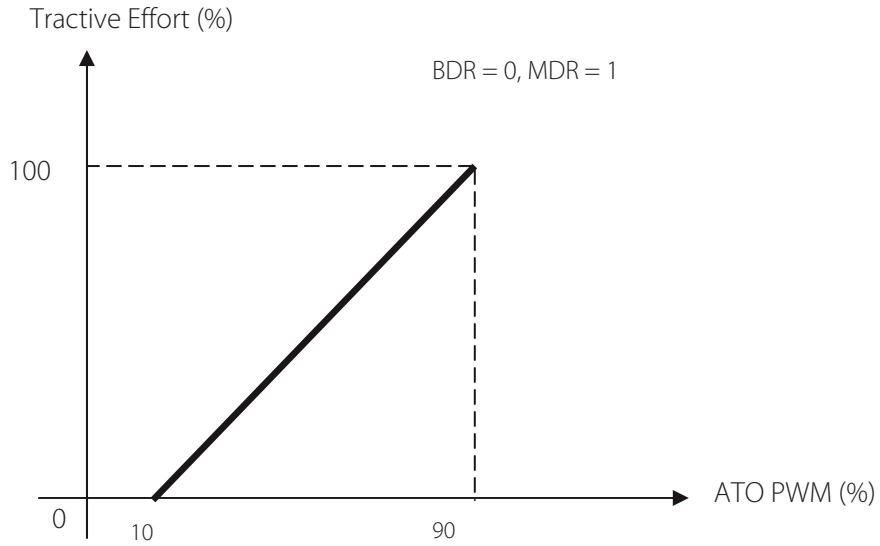
- MDR is for motoring action
- BDR is for braking action.
- ATO PWM is the variable effort level for braking and motoring action.

	MDR	BDR	ATO PWM	Driving order for RS	Traction & Brake System Responses
Normal	0	0	**10%.**	Coasting order	Coasting
	1	0	from **10% to 90%.**	Motoring order	Motoring and the traction effort is linear proportional to the PWM rate.
	0	1	from **10% to 90%.**	Braking order	Braking and the braking effort is linear proportional to the PWM rate.
Abnormal Operation	1	1	from **10% to 90%.**	Normally not commanded by ATO except under failure scenario.	Brake mode and the braking effort are in accordance with the PWM rate.
	1	1	Out of range (i.e. 0%-3%, 97%-100%)	Normally not commanded by ATO except under failure scenario.	Full Service Brake
	0	1	Out of range (i.e. 0%-3%, 97%-100%)	Normally not commanded by ATO except under failure scenario.	Full Service Brake
	1	0	Out of range (i.e. 0%-3%, 97%-100%)	Normally not commanded by ATO except under failure scenario.	Full Service Brake
	0	0	Out of range (i.e. 0%-3%, 97%-100%)	Normally not commanded by ATO except under failure scenario.	Full Service Brake

ATC Traction and Brake Orders Definition

DETAILED INTERFACE SPECIFICATION

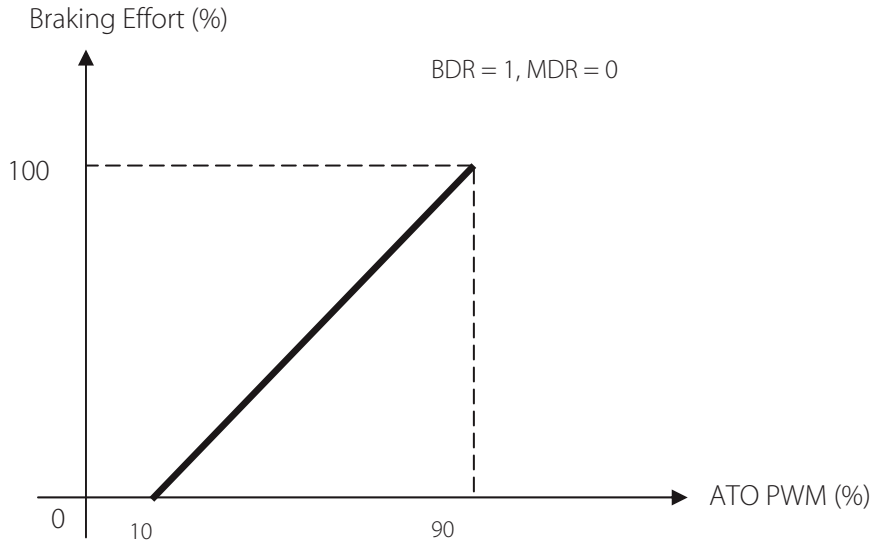
When motoring is requested (MDR=1 and BDR=0), ATO PWM indicates the level of motoring effort requested to RS as follows:



Tractive Effort vs ATO PWM

Tractive effort and ATO PWM output

ATO PWM= 10% corresponds to the zero tractive effort
ATO PWM = 90% correspond to the maximal tractive effort
When braking is requested (MDR=0 and BDR=1), ATO PWM indicates the level of braking effort requested to RS as follows:



Braking Effort vs ATO PWM

ATO PWM = 10% corresponds to the zero braking effort
ATO PWM = 90% corresponds to the maximal braking effort

DETAILED INTERFACE SPECIFICATION

10.1.3 Remarks

- MDR, BDR are discrete non-vital outputs and ATO PWM is an analogical output.
- There are two ATOs located at the UP and DN ends respectively.
- Only the active ATO will command the motoring and braking commands in AUTO and Driverless Turnaround mode.
- In AUTO mode, the ATO is activated by the AUTO position of the Mode Selector Switch.
- In Driverless Turnaround mode, the ATO is activated by the trackside signaling system.
- In RM, CM modes, the motoring command, braking command and PWM signal are driven by the Traction and Brake Controller of the RS.

10.1.4 Holding Brake Management

When a train is at standstill, there shall be sufficient retention of brakes such that the train does not roll back at a gradient. The brake application shall be retained while traction power is applied and the train takes forward movement.

R0052	A load weighing holding brake application must be applied with brake demand of **A_HB_LEVEL** when **HoldingBrakeState** is active. If any other higher brake demand than **A_HB_LEVEL** is requested, this higher brake demand request must be applied.	KB

R0053	During **HoldingBrakeState,** the **EDBrakeEffort** shall be ignored.	KB

The signal **'HoldingBrake'** will be taken not only to judge when the holding brake should be released, but also to apply the holding brake.

For applying the holding brake, we take not only the information of **'HoldingBrake'** signal from VVVF into consideration, but also use the information from EBCU's own reference speed.

It means, in the normal **ServiceBrakeState** or **Driving_CoastingState**, holding brake will be applied only when EBCU detects the **StandStill** state as well as **'HoldingBrake'** signal from VVVF is set in case of a correct '**HoldingBrake**' signal.

In the diagram A, the red line marked the point when the holding brake will be applied.

Regarding with the concept for the holding brake release. The information of the **'HoldingBrake'** signal is needed since it tells the moment when the enough traction torque is build up to avoid the rollback.

For releasing the holding brake, there is only one possible transition for this project, from the **HoldingBrakeState** to **Driving_CoastingState.**

In case of no braking or emergency brake signal, the holding brake will be released as soon as **'HoldingBrake'** signal from VVVF is reset.

In the diagram A, the green line marked the point when the holding brake will be released.

In case of a failure of 'HoldingBrake' signal from VVVF ('HoldingBrake' always low), EBCU will only apply the holding brake in the ServiceBrakeState, **not** in **Driving_CoastingState.** During

DETAILED INTERFACE SPECIFICATION

ServiceBrakeState, the EBCU will apply the holding brake when the '**StandStill**' status is detected for a period of time '**T_HB_APPLY**'. And the holding brake will be released as soon as the **Driving_CoastingState** is entered.

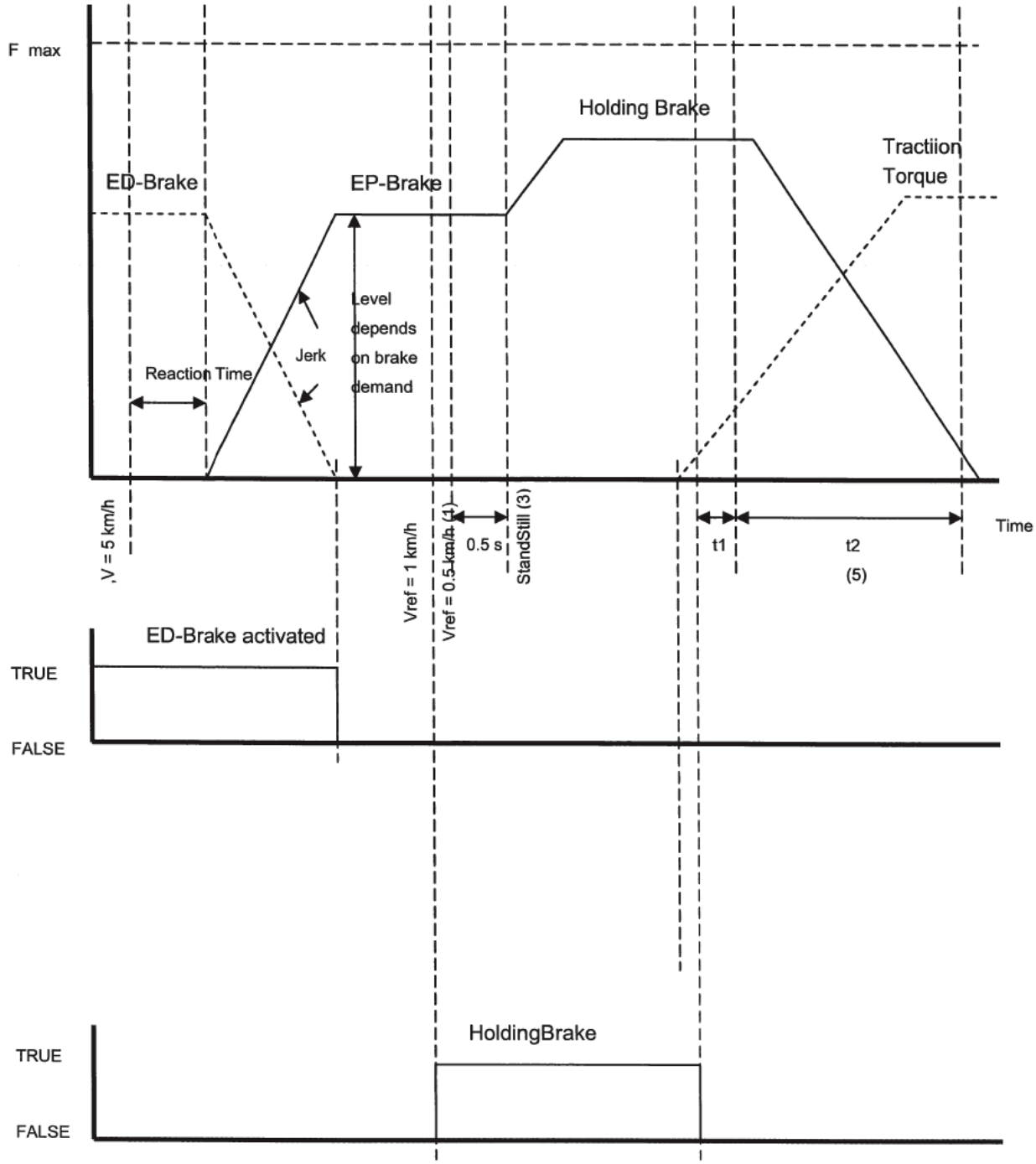
Please refer to Schematic Diagram B.

In case of a failure of **'HoldingBrake'** signal from VVVF ('**HoldingBrake**' always high), the holding brake will be released if the train reach a certain speed, e.g. 5km/h (**V_HB_RELEASED**).

Please refer to Schematic Diagram C.

1) This parameter is **V_STANDSTILL**
2) This parameter is **T_STANDSTILL_ON**
3) **StandStill** is set inside the software of EBCU
4) t1 : reaction time, including the signal processing time as well as the DCL regulating time for the BCP. (about 0.8s)
5) t2: releasing time for the EP brake (about 4.0s)
6) This parameter is **T_HB_APPLY**
7) This parameter is **V_HB_RELEASED**

DETAILED INTERFACE SPECIFICATION



DETAILED INTERFACE SPECIFICATION

10.2 EMERGENCY BRAKE CONTROL

10.2.1 ATC Outputs

EBR1 and EBR2

10.2.2 Functional Description

The ATC system will de-active the EBR1 and EBR2 when the conditions to trigger emergency brake are met.

The EBR1 and EBR2 should not directly control the emergency brake loop but to condition the Safety Interlock Circuit (refer to Annex D3 for detail).

Once the emergency brake is triggered by ATC, it can only be reset when the train is completely stopped and the condition to trigger the emergency brake is removed.

10.2.3 Remarks

- Once the emergency brake is triggered by ATC, after train has come to completely stop, driver needs to put the MS to FOR or REV positions and put the TBC to emergency brake position in order to reset the emergency brake.
- Zero Velocity Relay ZVR1 and ZVR2 are used to condition the zero speed condition in the Safety Interlock Circuit.

10.3 ZERO VELOCITY RELAY CONTROL

10.3.1 ATC Outputs

ZVR1 and ZVR2

10.3.2 Functional Description

Relays ZVR1 and ZVR2 are controlled by the on-board ATP safety-related output namely ZVR. These relays are used to reset the Emergency Braking.

The controls of ZVR1 and ZVR2 are independent of the driving mode.

If ATC does not apply emergency brake, the ZVR1 and ZVR2 are activated when train speed is under 0.9 kph.

If ATC applies emergency brake, the ZVR1 and ZVR2 are activated only when train is confirmed to be complete stop (i.e. no any cog is detected in one ATP cycle).

DETAILED INTERFACE SPECIFICATION

10.3.3 Remarks

- ZVR1 and ZVR2 are also used to condition (i) the opening of cab door, (ii) opening of saloon door and (iii) Automatic Door Opening system. Thus, sufficient numbers of spare contacts should be provisioned in these two relays.

10.4 DOOR AUTHORIZATION

10.4.1 ATC Outputs

DERA and DERB

10.4.2 Functional Description

The following conditions must be met in order to activate the DERA and DERB:

1) Train is confirmed to be complete stop (i.e. no any cog is detected in one ATP cycle),
2) The train type is EMU,
3) The train is localized or pre-localized in station,
4) ATC modes is RM or CM or AUTO,
5) The train is stopped within the docking window of the station,
6) If A side is authorized then DERA is activated. If B side is authorized then DERB is activated.

DETAILED INTERFACE SPECIFICATION

ANNEX A1
GENERAL ARRANGEMENT CONCEPT DRAWING AND TRAIN FORMATION DRAWINGS

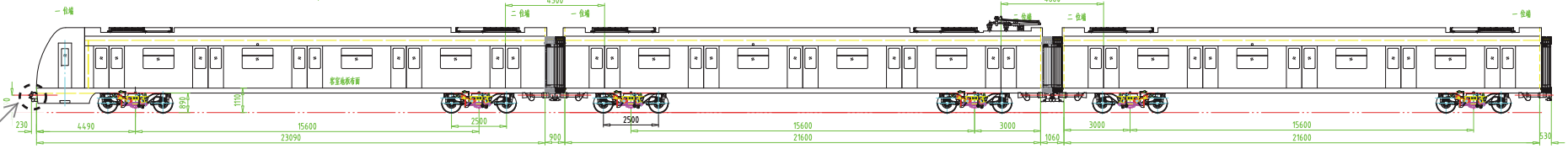
DKZZ28-00-00-000

Down End

A Car:UNLADEN WEIGHT = 37.846 tons
DK108 A 车

C Car:UNLADEN WEIGHT = 42.341 tons
DK105 C 车

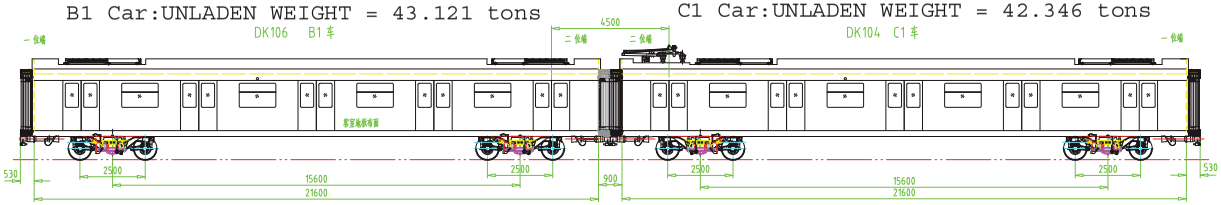
B Car:UNLADEN WEIGHT = 41.079 tons
DK107 B 车



Coupler face to coupler extremity = 115mm

B1 Car:UNLADEN WEIGHT = 43.121 tons
DK106 B1 车

C1 Car:UNLADEN WEIGHT = 42.346 tons
DK104 C1 车

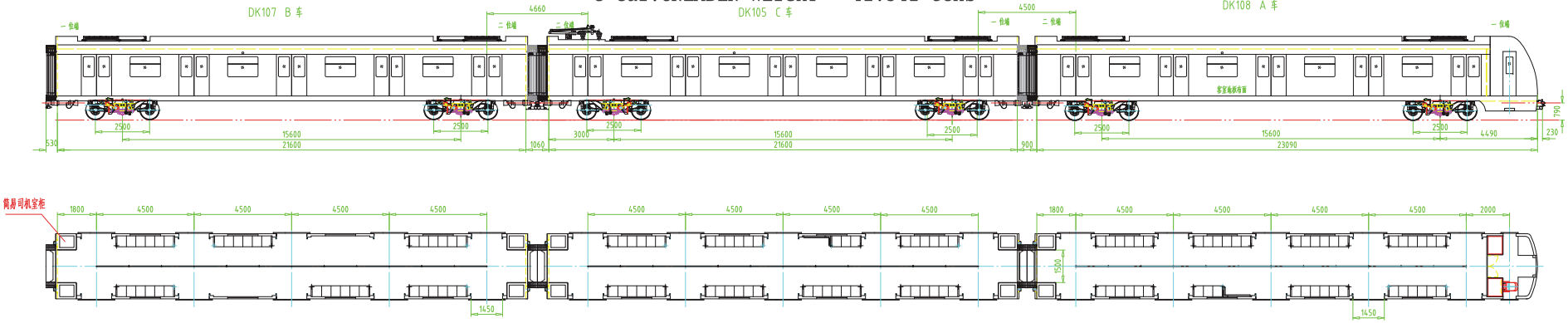


B Car:UNLADEN WEIGHT = 41.079 tons
DK107 B 车

C Car:UNLADEN WEIGHT = 42.341 tons
DK105 C 车

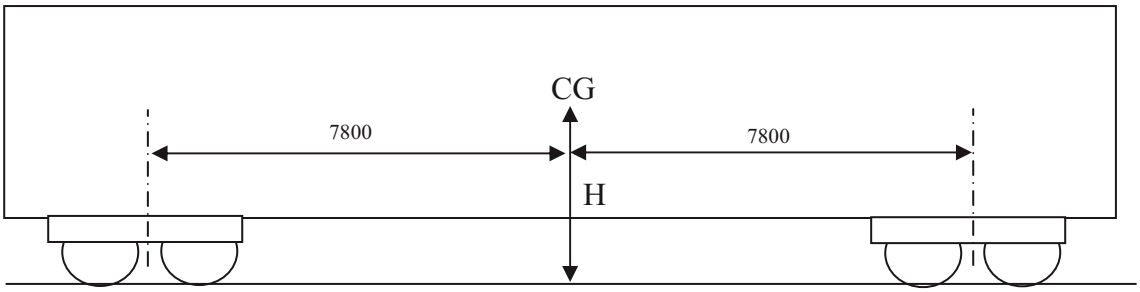
A Car:UNLADEN WEIGHT = 37.846 tons
DK108 A 车

Up End



Remark: 1) Passenger weight = 60 kg x 450 = 27 tons/car
2) Train Composition : A - C - B - B1 - C1 - B - C - A

设计	关凯	2009-1-16		对称件	
审核		标准		列车编组图	
主管		校工		版本 A	重量	比例 1:100	图幅 A1
工艺		绘图软件 AutoCAD2006 SP1		共 1 张 第 1 张	DKZ28-00-00-000



CAR	Load	Height (H) (mm)
A	M1	1350 +/-100
A	M5	1516 +/-100
B	M1	1350 +/-100
B	M5	1516 +/-100
B1	M1	1350 +/-100
B1	M5	1516 +/-100
C	M1	1350 +/-100
C	M5	1516 +/-100
C1	M1	1350 +/-100
C1	M5	1516 +/-100

Remark:

M1 Train in tare condition

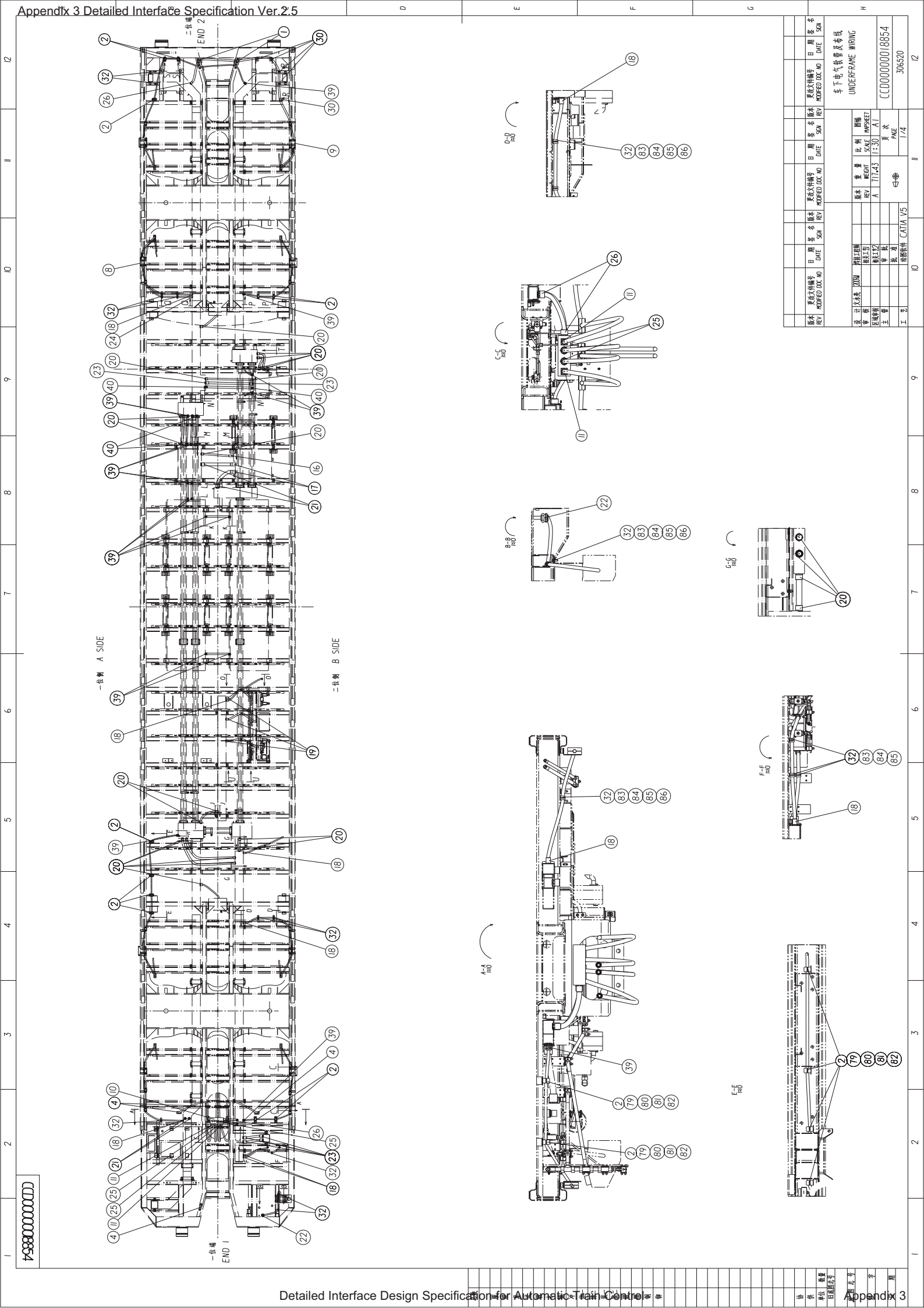
M2 Train in average load condition with 60kg x 200 passengers per car

M4 Train in fully laden condition with 60kg x 312 passengers per car

M5 Train in fully laden condition with 60kg x 450 passengers per car

DETAILED INTERFACE SPECIFICATION

ANNEX A2
GENERAL ARRANGEMENT OF THE CARS

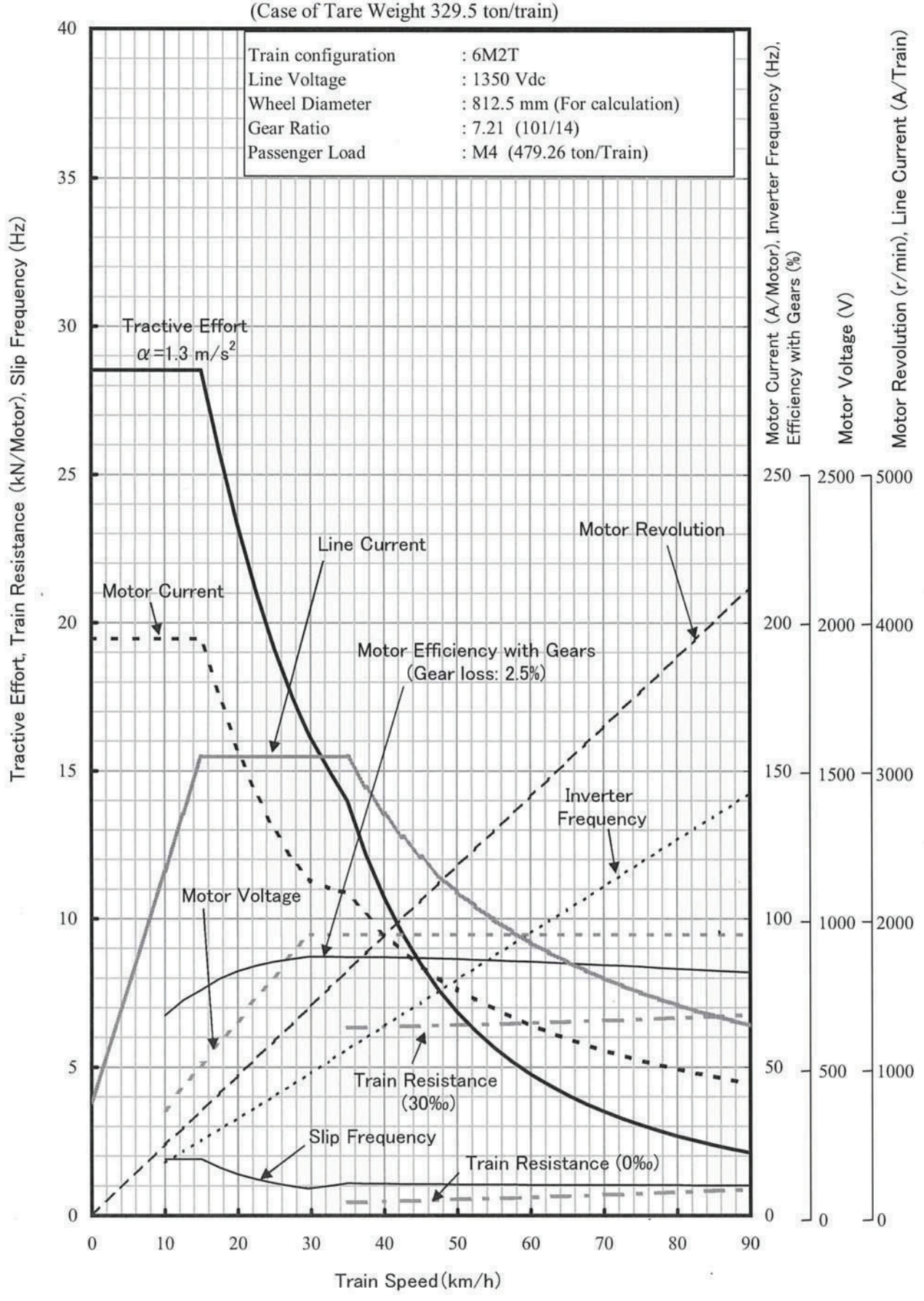

一位端 END 2
一位侧 A SIDE
一位侧 B SIDE
一位端 END 1
D-D
C-C
B-B
G-G
F-F
A-A
E-E
车下电气管线布线
UNDERFRAME WIRING
CCD0000008854
306520

DETAILED INTERFACE SPECIFICATION

ANNEX A3
TRACTION MOTOR CHARACTERISTIC CURVE

Powering Performance Curve (M4 Load)

(Case of Tare Weight 329.5 ton/train)



RC-B308

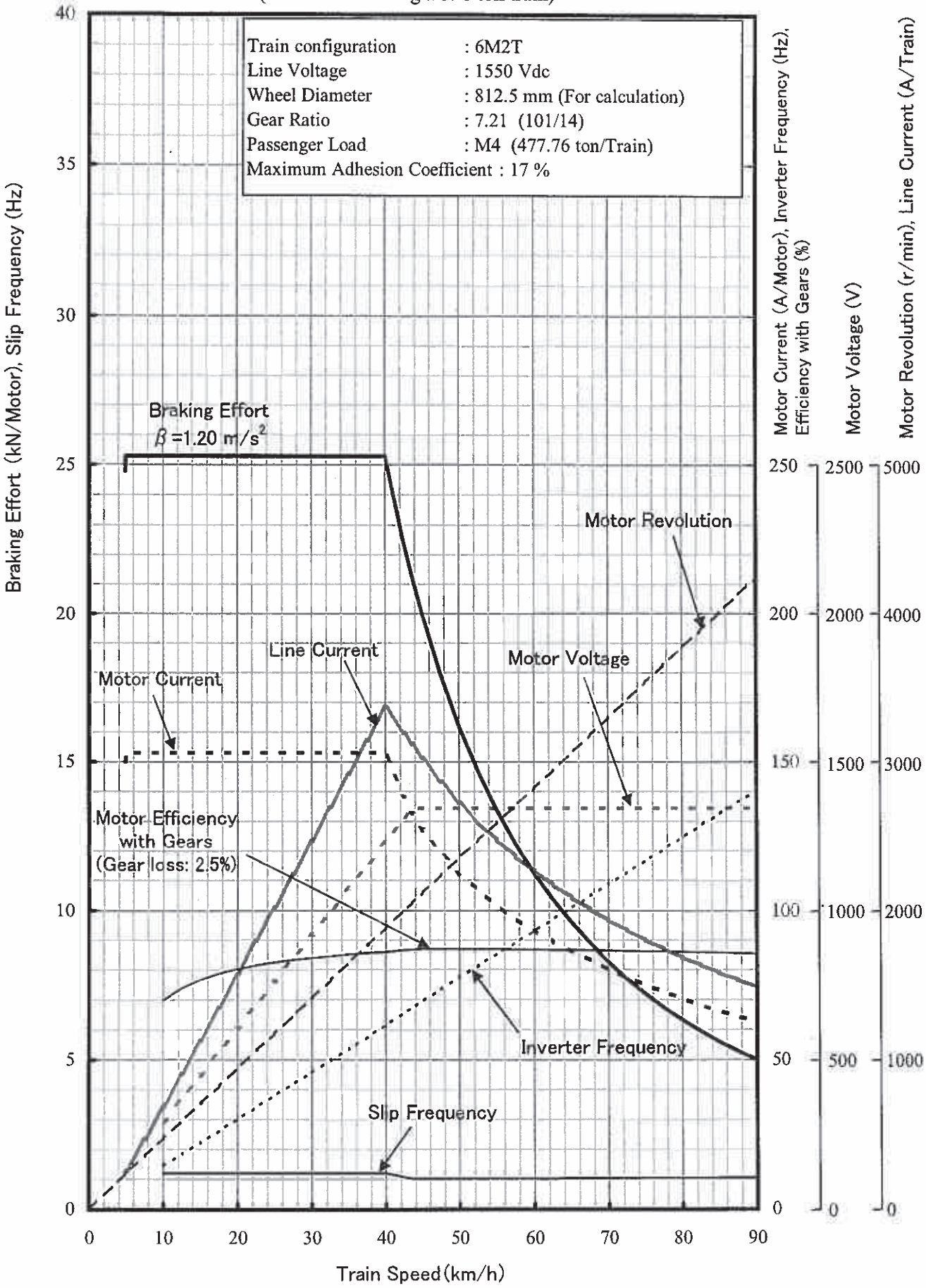
2012/2/3 K.Otsu

DETAILED INTERFACE SPECIFICATION

ANNEX A4
BRAKING PERFORMANCE CURVE

Braking Performance Curve (M4)

(Case of Tare Weight 328 ton/train)



RC-A354

2009/9/14 S.Nakai

DETAILED INTERFACE SPECIFICATION

ANNEX A5
ROLLING STOCK PARAMETERS

Rolling Stock Parameters

Description	SACEM ATC Abbreviation	M-Train[i] Value	C-Train Value	Unit	Remark
Maximum Train Length	MaxTrainLength	182	183.41 (+0.096, -0.000)	m	This is the maximum length of the train measured from the front end coupler extremity to another end's coupler extremity.
Maximum Train Speed	Maximum train speed	80	80	km/h	This is the maximum operating speed of the train.
Position of the CT sensors		2360	2987 (-15, 30)	mm	This is the CT sensors position measured from the centre line of the CT sensor to the extremity of the front end coupler.
Position of the RC antenna	$DistHeadAntenna_{EMU}$	2360	2987 (-15, 30)	mm	This is the RC antenna position measured from the centre line of the RC antenna to the extremity of the front end coupler. (The SACEM on-board parameter "$DistHeadAntenna_{EMU}$" is set to 2.512m in order to ensure the new train door centre align with PSD centre on existing URL stations)
Guaranteed Emergency Brake Rate	γEB	Tunnel Section: 1	Tunnel Section: 0.975	m/s^2	The maximum emergency brake rate is 1.4 m/s^2. This is the Guaranteed Emergency Brake Rate (GEBR) in (i) Tunnel section and (ii) Open section.
		Open Section: 0.83	Open Section: 0.78		
Maximum Traction Acceleration	γtr	1.35	1.3	m/s^2	This is the maximum acceleration of the train.

Description	SACEM ATC Abbreviation	M-Train[i] Value	C-Train Value	Unit	Remark
Maximum Tractive Effort Cut Response Time	t1	0.7	In emergency brake case: 200ms In other case: 2.2s	sec.	This is the maximum time delay to cut off the tractive effort.
Maximum emergency brake response time	t2	1.6	1.6	sec.	This is the maximum time delay for emergency brake application.
Coefficient of rotating mass (α)	α	1.075	1.0593 (M5) 1.0675 (M4) 1.0983 (M1)		This is the maximum value of the coefficient of the train mass and is used by the SACEM ATC to compensate the processing delay in ATC speed computation.
Full Service Brake Rate	service_braking_max	1	1.35	m/s^2	This is the maximum service brake rate achievable by the train.
Service Brake Control Response Time	Tbrake_stop	0.7	N/A	Sec.	This is the maximum time delay of the braking system when switching from coasting to braking or braking to heavier braking.
Service Brake Response Time when the train is motoring	Tbrake_traction	2.1	2.0	Sec.	This is the maximum time delay of the braking system when switching from motoring to braking.
Minimum Wheel diameter	ϕ_{min}	775	775	mm	This is the minimum wheel diameter.
Maximum Wheel diameter	ϕ_{max}	860	850	mm	This is the maximum wheel diameter.
Position of the axle 1 from		3145	3470 (-10,+20)	mm	This is the location of the 1st axle measured from the

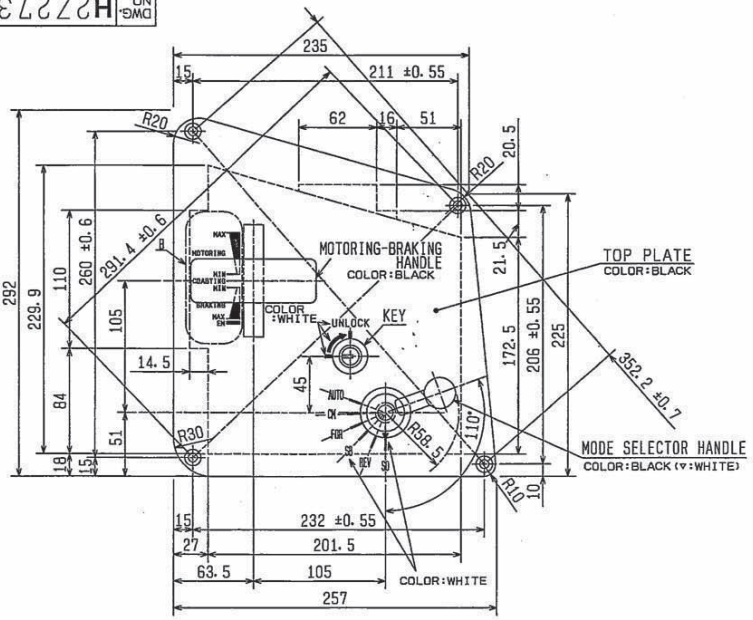
Description	SACEM ATC Abbreviation	M-Train[i] Value	C-Train Value	Unit	Remark
coupler face					front end coupler face.
Position of the axle 2 from coupler face		5645	5970 (-10,+20)	mm	This is the location of the 2nd axle measured from the front end coupler face.
Position of the 1st Saloon Door Centre from the coupler face		3195	3520 (-10,+20)	mm	This is the location of the 1st Saloon Door Centre line measured from the front end coupler face.

[i] Information captured from Appendix C. List of parameters used, On-board ATP Software Specification Document, ref. 782M00/DL/DSL/0520/1.8.3 dated 12.09.2002

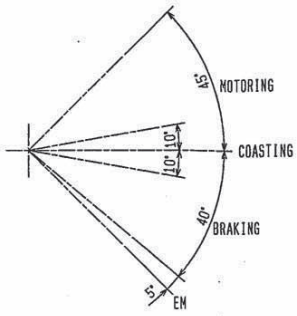
DETAILED INTERFACE SPECIFICATION

ANNEX A6
TRACTION BRAKE CONTROLLER OUT LINE

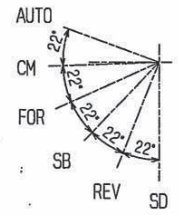
DWG. NO. H2Z2733

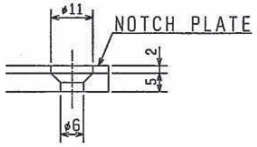


HANDLE OPERATING ANGLE OF MOTORING-BRAKING HANDLE

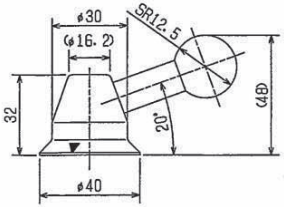


HANDLE OPERATING ANGLE OF MODE SELECTOR HANDLE

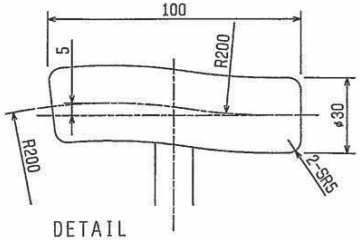




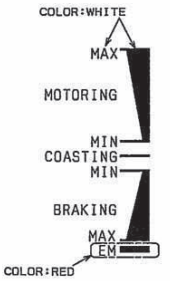
DETAIL A
(1/1)



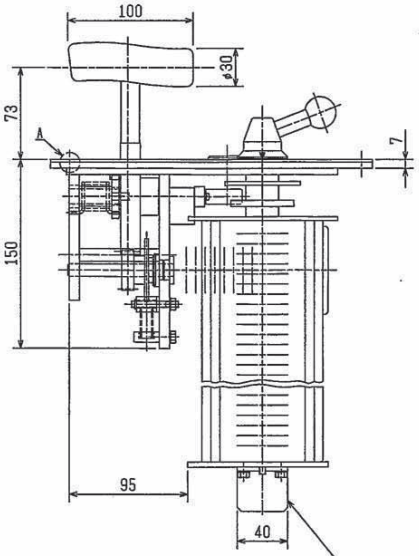
DETAIL
MODE SELECTOR HANDLE

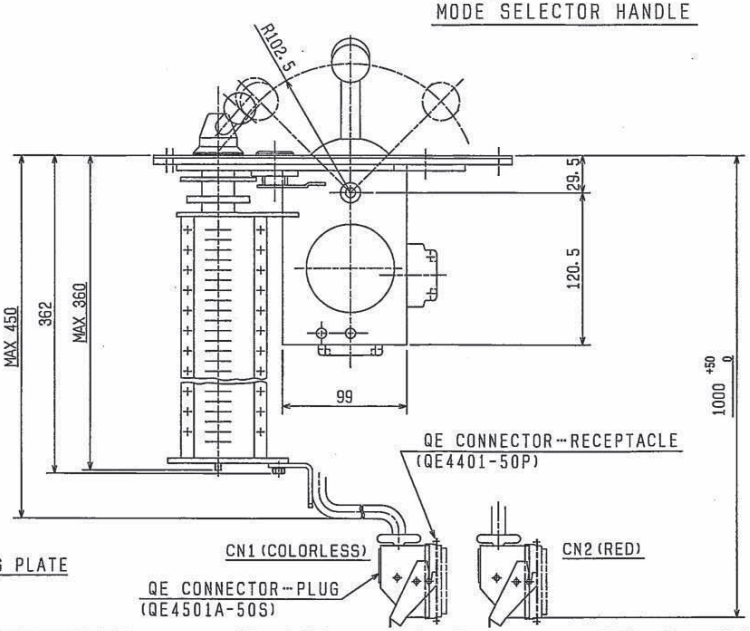


DETAIL
MOTORING-BRAKING HANDLE



DETAIL B





NOTE
1. KEY CAN BE TURNED TO "LOCK" POSITION AND REMOVED ONLY WHEN MODE SELECTOR HANDLE IS AT "SD" POSITION AND TBC IS AT "BRAKE MAX" POSITION.
2. CONTROLLER IS UNLOCKED WHEN KEY IS TURNED CLOCKWISE THROUGH 90 DEGREES FOR "UNLOCK" POSITION.
3. MODE SELECTOR HANDLE CAN BE OPERATED ONLY WHEN
   (1) KEY IS AT "UNLOCK" POSITION.
   (2) MOTORING-BRAKING HANDLE IS AT "BRAKE MAX" POSITION.
4. MOTORING-BRAKING HANDLE CAN BE OPERATED ONLY WHEN MODE SELECTOR HANDLE IS AT "REV" "SB" "FOR" "CM" POSITION.
5. UPON RELEASING THE CONTROL AT POSITION POWERING AREA, OFF AND BRAKING AREA . IT WILL RETURN TO BRAKE MAX POSITION.
6. CAMLOCK NUMBER IS "KV33.231.102" AND KEY NUMBER IS "FA136448BH".
7. A RED MARK OF CAM SWITCH COVERS SHOWS THE DISPLAY OF THE POLARITY.

APPROX MASS 11kg
DECISION MASS 11kg

改	年	CHANGE
A	APR-23-'08	FX4:DIM.382 WAS ADDED. FX7:DIM.122 WAS REVISED TO 120.5 GX5:SKETCH OF QE CONNECTOR WAS CHANGED. GX3.5:CABLE MTG PLATE WAS ADDED. GX3:DIM.40 WAS ADDED. NOTE.6 WAS CHANGED. DECISION MASS WAS ADDED. FEB-26-'10 M.TAKABE

Ref:H2S3977

FR. NO. OF	R. DATE	DWG. SEC.	2 SYM.	SPECIAL CODE	K.	S.	PRINT	DUP. DIST.
SKIP DUP —		839Y	76	KL6024B N	0	2		

MITSUBISHI ELECTRIC CORPORATION

尺度 SCALE	1 : 3 NTS	設計 DESIGNED	T. OKAI, R. SEO
作成 DRAWN	T. TOKUAMI	製図 CHECKED	I. OKUI, N. TERAGUCHI
作成日 DATE	APR-23-'08	承認 APPROVED	I. OKUI, H. OKAYAMA

DIM. IN mm

TITLE
TRACTION BRAKE CONTROLLER OUT LINE

DWG. NO. H 2Z2733

DETAILED INTERFACE SPECIFICATION

ANNEX A7
SPECIFICATION OF PWM GENERATOR

To		Rev	Date	Written	Checked	Approved
		A	'09/8/3	R.Seo	A.Murahashi	H.Okayama
Project		B	'09/8/19	R.Seo	A.Murahashi	H.Okayama
Title	**Specification of PWM Generator**					

Ref. No. : HCN-L6195-3

Revision : B

In this document specification of PWM Generator.

Table of contents

1. General
2. Functions
 2-1. Block diagram
 2-2. Specification
3. Construction

Copies to		Traction Systems Department Itami Works Mitsubishi Electric Corporation	Date	22 Apr. 2008
			Written	R.Seo
		Issued by : Power Electronics Systems Designing Section-A	Checked	A.Murahashi
			Approved	H.Okayama

Our Ref. No. HCN-L6195-3	Revision No. B	Total pages : 4

Specification of PWM Generator

HCN-L6195-3 Revision : B

Document Revisions

Revision	Date (yyyy.mm.dd)	Description of changes
0	2008-4-22	Original Issue
A	2009-8-3	2-2 (3) Input voltage and PWM ratio were revised at +10° of powering. 2-2 (3) Note was revised. 2-2 (4) PWM ratio of Hostler mode was revised.
B	2009-8-19	2-2 (3) and (4) were revised.

Specification of PWM Generator

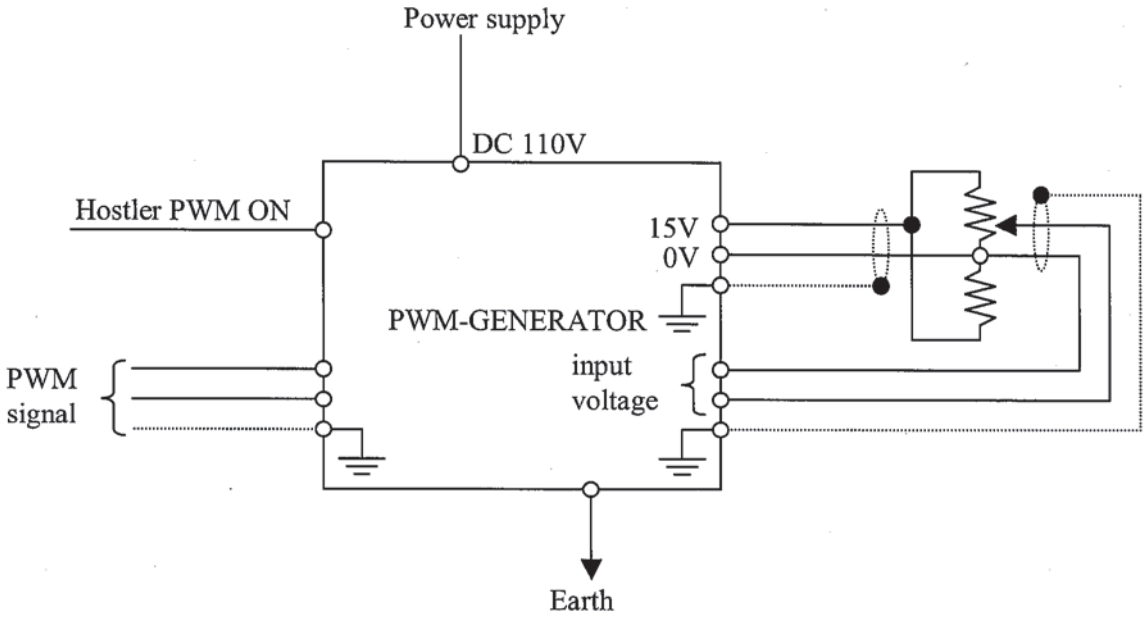
HCN-L6195-3
Revision : B

1. General

PWM Generator provides the regulated voltage (15 VDC) to the potentiometer and receives the voltage signal that is corresponded to the TBC position.
PWM Generator converts this voltage signal to the pulse-modulated signal.

2. Functions

2-1. Block diagram



2-2. Specification

(1) Voltage of power supply : 110 VDC (77 VDC to 137.5 VDC)

(2) Output voltage for TBC : 15 VDC (14.85 VDC to 15.15 VDC)

(3) Characteristic of PWM signal :

	Angle of traction brake handle	Input voltage (V)	PWM signal (%)
Powering	+ 45°	15.0	93 ± 3
	+ 10°	5.0 A B	41 ± 3 A B
Coasting	0°	0.0	15 ± 3
Braking	- 10°	0.0	15 ± 3
	- 40°	15.0	93 ± 3
	- 45° (Emergency)	15.0	93 ± 3

Note) Input voltage of PWM Generator is decided by output signal of the potentiometer described in HCN-L6195-4 section 4-9. A

(4) Hostler PWM ON signal :

When this signal is received, the PWM signal of 41 ± 3% is generated. A B

(5) PWM frequency : 97.7 Hz ~ 98.3 Hz

(6) Output current

for TMS : 3.3 mA × 4 car = 13.2 mA

for VVVF : 3.3 mA × 12 car = 39.6 mA

for Pneumtic Brake : 3.3 mA × 16 car = 52.8 mA

Total = 105.6 mA

Over current protection (200mA) of the output is provided.

3. Construction

Degree of protection provided by enclosure (IEC529).

IP20

This unit is designed to mount in the electric cubicle which protect a ingress of dust and water.

DETAILED INTERFACE SPECIFICATION

ANNEX A8
SPECIFICATION OF TRACTION BRAKE CONTROLLER

To		Rev	Date	Written	Checked	Approved
		C	'09/9/15	R.Seo	A.Murahashi	H.Okayama
Project		D	'09/10/26	R.Seo	A.Murahashi	H.Okayama
		E	'10/2/4	Y.Kono R.Seo	A.Murahashi	H.Okayama
Title	**Specification of Traction Brake controller**	F	'10/3/1	Y.Kono R.Seo	K.Kusano	H.Okayama
		G	'10/7/12	Y.Kono R.Seo	A.Murahashi	K.Kusano
		H	'10/09/22	R.Seo		

Ref. No. : HCN-L6195-4

Revision : H

In this document, specification of Traction Brake controller is described.

Table of contents

1. General
2. Mode selector
3. Key switch
4. Controller handle

Attachment

Specification of Cam diagram for mode selector switch and traction brake controller for TKE

Copies to				
		Traction Systems Department Itami Works Mitsubishi Electric Corporation	**Date**	22 Apr. 2008
			Written	R.Seo
		Issued by : Power Electronics Systems Designing Section-A	**Checked**	A.Murahashi
			Approved	H.Okayama
Our Ref. No. HCN-L6195-4		Revision No. H	**Total pages :**	17

Specification of Traction Brake controller

HCN-L6195-4 Revision : H

Document Revisions

Revision	Date (yyyy.mm.dd)	Description of changes
0	2008.04.22	Original Issue
A	2009.08.3	2-3 Maximum current of S826a was revised. 2-5 Destinations from cam switches and line numbers were deleted except Traction control and TMS. 4-1 Contact No.5-a Line number was revised. 4-8 (2) Potentiometer was revised. 4-9 Output signal of the potentiometer was revised. 4-11 Destinations from cam switches and line numbers were deleted except Traction control and TMS. 4-12 Maximum current was revised. Attachment (Specification of Cam diagram for mode selector switch and traction brake controller for TKE) was added.
B	2009.08.19	4-8 was revised. 4-9 was revised.
C	2009.09.15	2-7 was added. 4-14 was added.
D	2009.10.26	4-8 (1) was revised.
E	2010.2.4	2-5 Cam diagram of Mode Selector Switch was revised. Clause number of 2-7 was revised to 2-6. 4-11 Cam diagram of Traction Braking Controller was revised. 4-12 Line number was added. 4-15 was added.
F	2010.3.1	2-5 Cam diagram of Mode Selector Switch was revised. (Spare wiring numbers of SP1~SP8 were added.) 4-11 Cam diagram of Traction Braking Controller was revised (Spare wiring numbers of SP9~SP12 were added.) and the number of used S800a contact was corrected.
G	2010.7.12	3-4 Key Number was revised. 4-11 Line number M6121 at Cam No.6-a was changed to M6921. 4-12 Line number M6120 was changed to M6104.
H	2010.9.22	3-4 Key Number was changed.

Specification of Traction Brake controller

HCN-L6195-4 Revision : H

1. General

This specification describes on the Traction Brake Controller which consists of Mode selector, Controller handle and Key switch.

2. Mode selector

2-1 The mode selector has the following six valid sequential positions.

(a) Shutdown

All controls except the auxiliary function is inoperative. Emergency brake is applied in this mode of operation.

(b) Reverse

Manual driving in a reverse direction without any guidance provided by the automatic train control system and the maximum speed is limited to 22 km/h.

A maximum distance to travel will be limited to 44m by the ATC system when the train is operated in the driving cab under the Reverse mode.

(c) Standby

Minimum control function of some train systems, such as, train management, door and communication, is provided for train standing by purpose.

In this mode of operation:

(1) the traction controls are inoperative; and

(2) emergency brake is applied, if the safety proving circuit is not energized or the brake loop circuit is not completed; or

(3) full service brake is applied, if the safety proving circuit is energized and the brake loop circuit is completed.

(d) Forward

Manual driving in a forward direction without any supervision provided by the automatic train control system other than a maximum speed limit of 22 km/h.

(e) Coded Manual

Manual driving in a forward direction with speed control provided by the Automatic Train Control system. ATP protection is provided.

(f) Auto

Automatic driving in a forward direction by the Automatic Train control system.

2-2 It is not possible to directly select Auto mode from the Shutdown position, or vice versa, without previously having selected each of the other modes:

2-3 Specification of Cam switch
Diagram : shown in Figure 1
Specification of Cam switch

for normal load

Type	: S826a
Manufacturer	: Schaltbau
Voltage	: DC 110 V
Maximum Current	: 0.3 A
Minimum Current	: 1 mA (at DC 6 V)
Contact Resistance	: 10 mΩ
Mechanical life time	: 10,000,000 times
Electrical life time	: 1,000,000 times

A

for heavy load

Type	: S800a
Manufacturer	: Schaltbau
Voltage	: DC 110 V
Maximum Current	: 3.5 A (L/R Load with surge absorber)
Minimum Current	: 10 mA (at DC 20 V)
Contact Resistance	: 10 mΩ
Mechanical life time	: 10,000,000 times
Electrical life time	: 1,000,000 times

Cam switch is not overlapped.

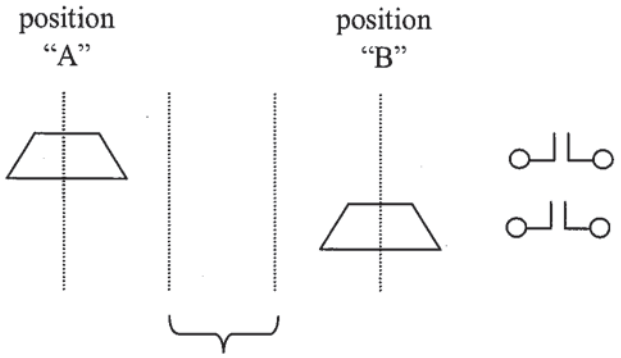


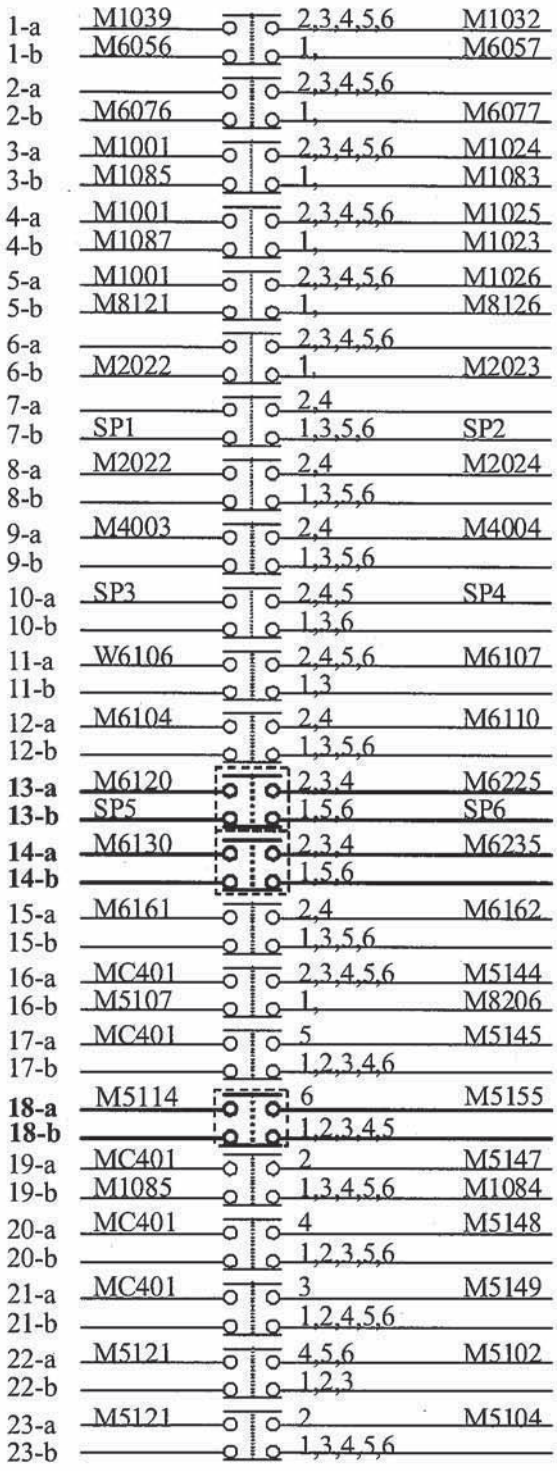
Fig.1 Cam switch

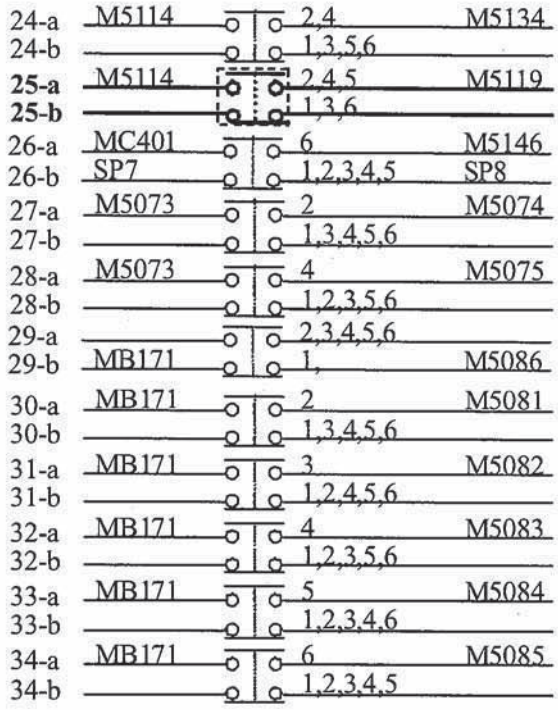
(Note) If the contact is closed at both position "A" and "B", then the contact will be continuously closed when moving from "A" to "B".

2-4. Mode selector handle can be operated only when
(1) The key is inserted and rotated to the unlocked position.
(2) The position of traction brake controller is brake max.

2-5 The supply voltage of control lines connecting to the mode selector switch is 110VDC.

MODE SELECTOR SWITCH





TRACTION CONTROL

TRACTION CONTROL

TO TMS

TO TMS

TO TMS

TO TMS

TO TMS

TO TMS

A

E

F

---- 1 = SHUTDOWN
---- 2 = REVERSE
---- 3 = STANDBY
---- 4 = FORWARD
---- 5 = CODED MANUAL
---- 6 = AUTO

a : a-contact
b : b-contact

for normal load
Type : S826a
Manufacturer : Schaltbau
Voltage : DC 110 V
Current : 0.3A

for heavy load
Type : S800a
Manufacturer : Schaltbau
Voltage : DC 110 V
Current : 3.5 A
(L/R Load with surge absorber)

	S826a		S800a	
	Cam	Contact	Cam	Contact
Used	30	37	4	5
Spare	0	23	0	3
Total	30	60	4	8

Fig.2 Diagram of the mode selector switch.

2-6 Moving force of the mode selector switch C

Moving force of the mode selector switch is shown as follows.

SD → REV	: 28N	REV→SD	: 21N
REV → SB	: 21N	SB→REV	: 24N
SB → FOR	: 24N	FOR→SB	: 23N
FOR → CM	: 20N	CM→FOR	: 25N
CM → AUTO	: 20N	AUTO→CM	: 11N

3. Key switch

3-1 The mode selector includes a key switch mechanism, incorporating two positions (Locked and Unlocked) that is controlled only by the approved train operator key.

3-2 The key switch mechanically inhibits the rotation of the mode selector, unless the train operator key is inserted and rotated to the unlocked position.

3-3 The train operator key is physically retained in the unlocked position, thus removal of the key is only possible in the locked position.
The selection of the locked position is only possible with the mode selector in the shutdown position and Traction Brake Controller in the brake max position.

3-4 Specification of Key Switch
KABA Key (Masterkeying) will be applied.
KV 33.231.102 Camlock
Key Number: 6087-0001 | H
Diameter 23 mm (single flat)
Two key entry, 90° movement
Finish :
• Cylinder – Bright nickel plated.
• Cam (C227) – Nickel plated.
Fixing :
• Flange (3.0 mm)

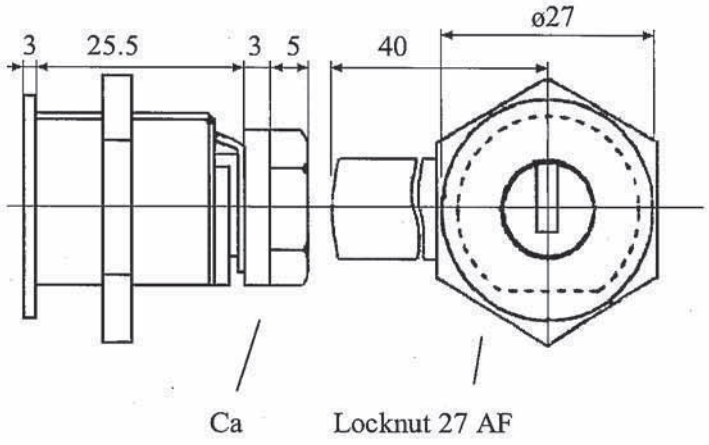


Fig. 3 Key switch.

4. Controller handle .

4-1 The controller handle incorporates four distinct positions or operating ranges:

(1) Coasting
This position inhibits the power contactors control and also provide a zero traction/braking effort demand.
(2) Motoring
This range initiate the power contactor control and provide the tractive effort demand.
(3) Braking
This range initiate the power contactor control and provide the brake effort deadman.
(4) Emergency
This position initiates the emergency brake application.

4-2 The characteristics of the tractive effort/braking effort output versus the traction brake controller position is according to Table 9-1 of the particular specification.

4-3 All positions are visually identified by an engraved position identifications.
And notch feeling is required at +45° , +10° , 0° , -10° , -40° , and -45° .

The traction brake controller is unlocked when
(1) the key is turned to the unlocked position.
(2) the mode selector handle is turned to REV, SB, FOR and CM position.

4-4 The controller handle is spring biased towards the full service braking position when unattended.

4-5 The level of spring force and the operating resistance of the controller handle and the deadman device doesn't causes any stress or fatigue hazard to the train operator for an average 8 hours of continuous train operation by using the traction brake controller. As a minimum requirement, for the controller handle, a maximum operating resistance by whole hand grip of 120N and angular displacement of 45° for both direction of motion is adopted. Limb support by using the arm rest of the train operator's seat is adopted if necessary. For the deadman safety device, thumb operated type or press down type is applied.

4-6 The length of the lever of the controller handle is determined by the mechanical advantage of the system according to the train operator position and the limitations of the 5th percentile female train operator. Handle sharp is cylindrical, spherical or shaped to fit the hand grip but with no sharp edges. Anti-slip texturing is applied.

4-7 Schematic diagram of the connection of the potentiometer.

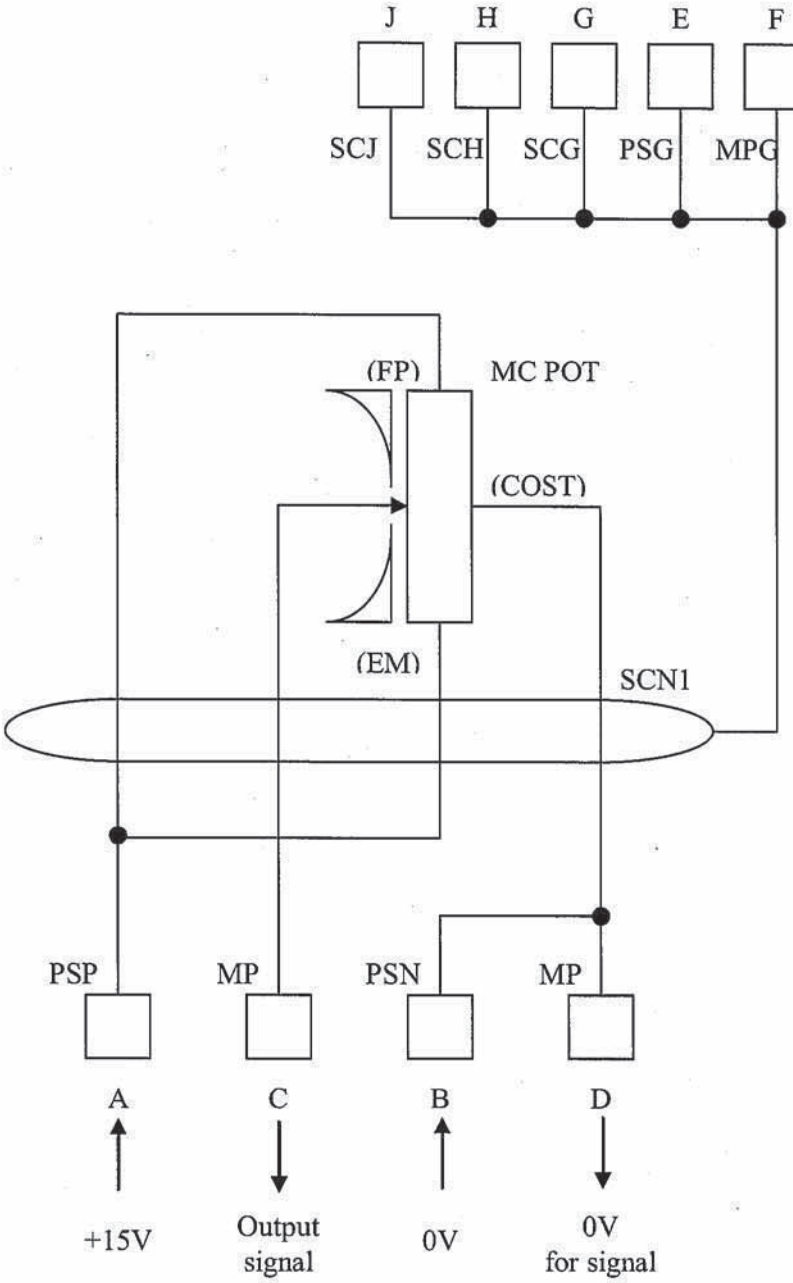


Fig. 4 Schematic diagram of the connection of the potentiometer

4-8 Specification of the potentiometer

(1) Type: PW70 series, Oil type (Corresponding to high humidity)
(2) Construction

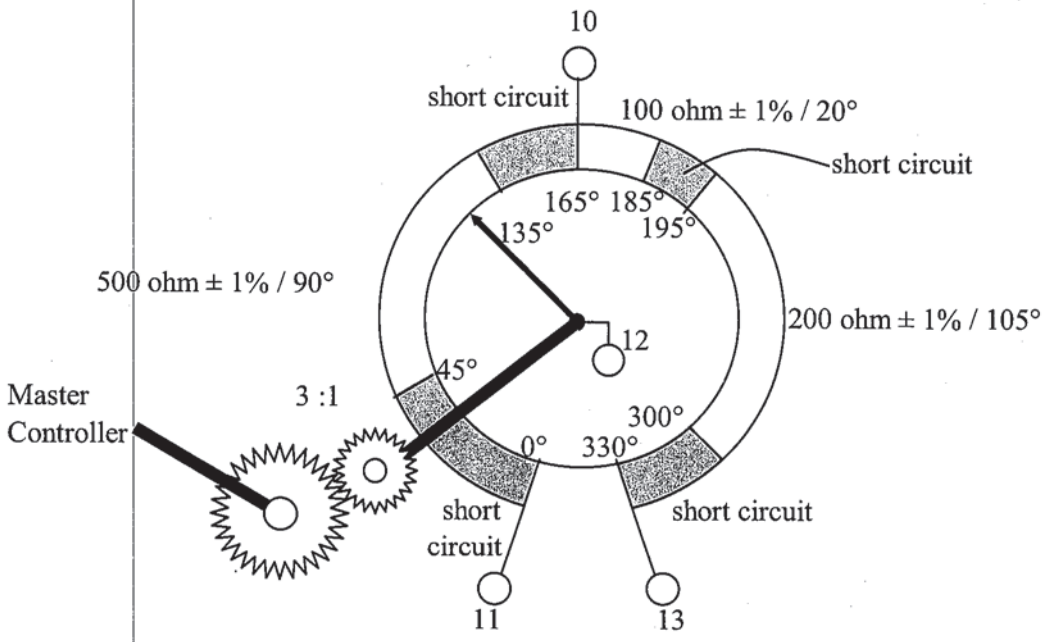


Fig. 5 Potentiometer

(3) Winding angle : 330°
(4) Resistance

Angle (degree)	Resistance
0 ~ 45	short circuit
45 ~ 135	500 ohm ± 1% / 90°
135 ~ 165	short circuit
165 ~ 185	100 ohm ± 1% / 20°
185 ~ 195	short circuit
195 ~ 300	200 ohm ± 1% / 105°
300 ~ 330	short circuit

(5) Resistance element : Constantan
(6) Surface of contact chip : Gold
(7) Life time : 100 million operations
(8) Operating temperature :- 50 ~ +80 °C
(9) Maximum load : 6 W (at 20 °C)
(10) Maximum operating voltage : 60 VDC

A
B
D

4-9 Output signal of the potentiometer

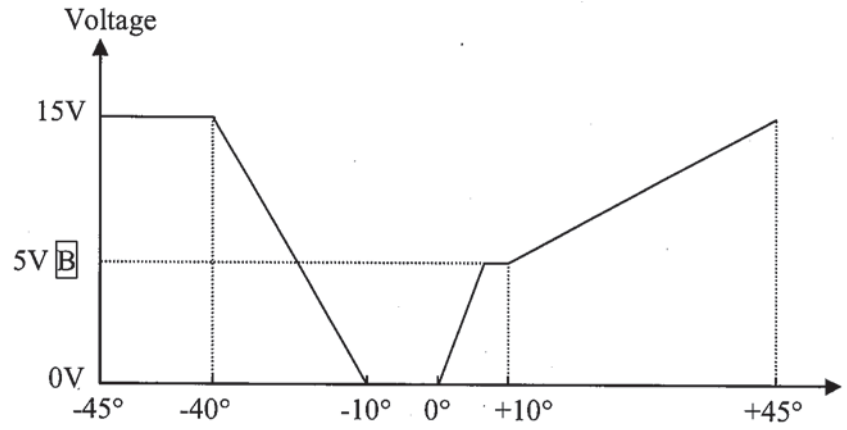


Fig. 6 Output signal of the potentiometer

A
B

Note) According to PS 9.6.3 (f) (ii) at +10° of inclination of the traction brake controller handle, the unit/train should forward at a 3 % up gradient.
Output signal value of the potentiometer at +10° of inclination is decided as follows.

Minimum necessity tractive effort at 3% gradient for 3 car unit and tare load is 6.42kN per 1 motor. (Starting acceleration is 0.083m/s^2)
On the other hand maximum tractive effort at tare load is 19.5kN.

Therefore Equivalent PWM ratio is as follows in the above condition.
(x[%]-10[%])/(90[%]-10[%])=6.42[kN]/19.5[kN]
x=37[%]

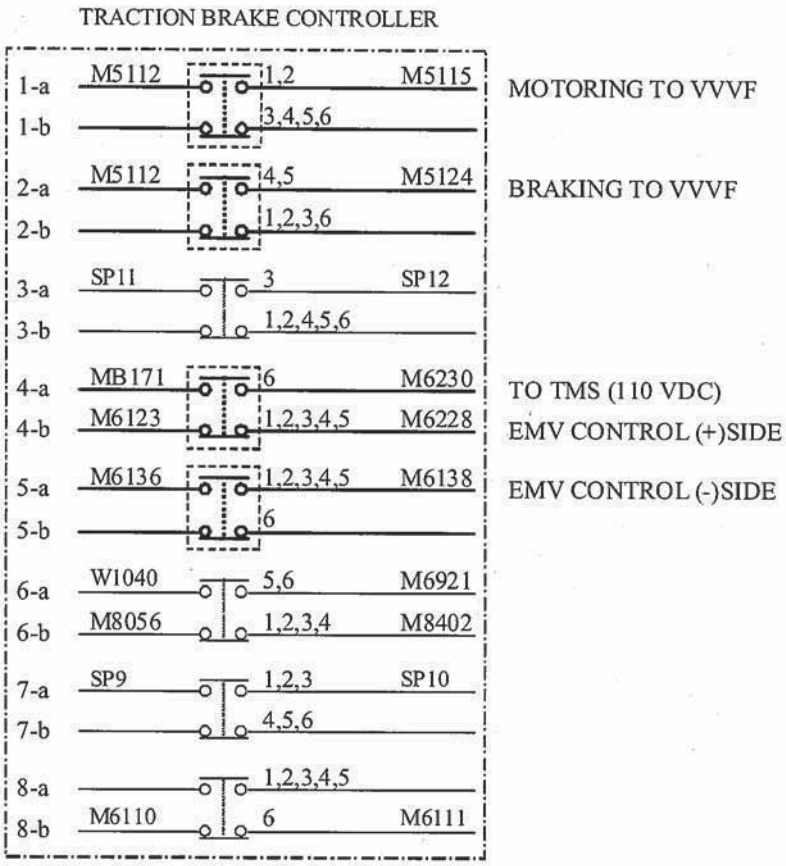
If PWM ratio of 37% is secured in any condition, PWM signal should be set to 41% in consideration for error of PWM signal and output signal of potentiometer.

For output PWM ratio of 41% is output from PWM Generator, output signal value is calculated as follows.
(15[V]-0[V])×(41[%]-15[%])/(93[%]-15[%])=5.0[V]

4-10 Specification of Cam Switch for the controller handle.
Type : S826a

4-11 Traction Braking Controller

The supply voltage of all control lines connecting to the traction braking controller is 110 VDC but the control line interfacing with TMS is supplied with 24 VDC.



----- 1 = FULL MOTORING
----- 2 = LIMITED MOTORING
----- 3 = COASTING
----- 4 = MINIMUM BRAKING
----- 5 = FULL SERVICE BRAKING
----- 6 = EMERGENCY BRAKING

for normal load
Type : S826a
Manufacturer : Schaltbau
Voltage : DC 110 V
Current : 0.3A

for heavy load
Type : S800a
Manufacturer : Schaltbau
Voltage : DC 110 V
Current : 3.5 A
(L/R Load with surge absorber)

	S826a		S800a	
	Cam	Contact	Cam	Contact
Used	4	5	4	5
Spare	0	3	0	3
Total	4	8	4	8

Fig. 7 Diagram of the traction braking controller

A
E
F
G

4-12 Deadman safety device

The traction brake controller provides deadman safety device to the safety proving system.

Type	: S826a
Manufacturer	: Schaltbau
Voltage	: DC 110V
Maximum Current	: 0.3A [A]
Minimum Current	: 1mA (at DC 6V)
Contact Resistance	: 10mΩ
Mechanical life time	: 10,000,000 times
Electrical life time	: 1,000,000 times

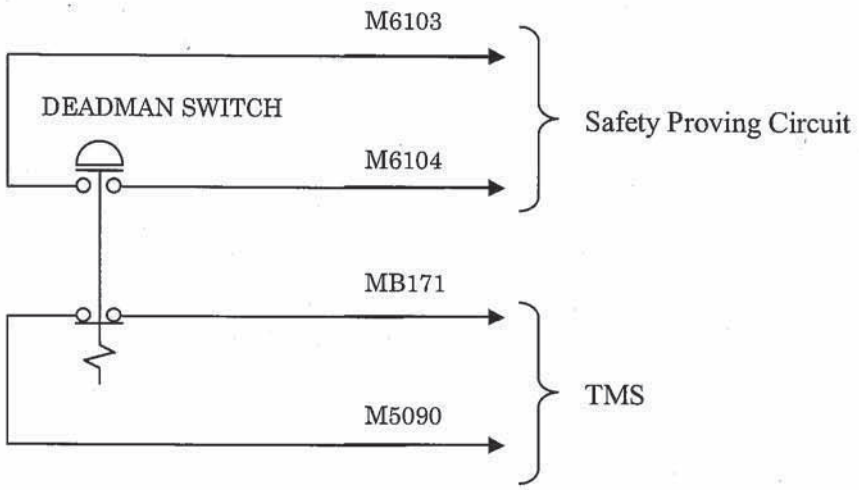


Fig. 8 Schematic diagram of the Deadman switch.

[E]
[G]

4-13 Connector

Type : QE4401-50P × 2 pieces

4-14 Moving force of the traction brake controller [C]

Moving force of the traction brake controller is shown as follows.

Emergency → Bmax	: 95N	Bmax → Emergency	: 113N
Bmax → Bmin	: 10N	Bmin → Bmax	: 4N (for holding the handle)
Bmin → COAST	: 14N	COAST → Bmin	: 4N (for holding the handle)
COAST→Pmin	: 15N	Pmin → COAST	: 4N (for holding the handle)
Pmin → Pmax	: 18N	Pmax → Pmin	: 4N (for holding the handle)

4-15 Pin assignment [E]

Refer to the drawing of H9F0751 "PIN ARRANGEMENT OF CONNECTOR PLUG".

Specification of Traction Brake controller

HCN-L6195-4 Revision : H

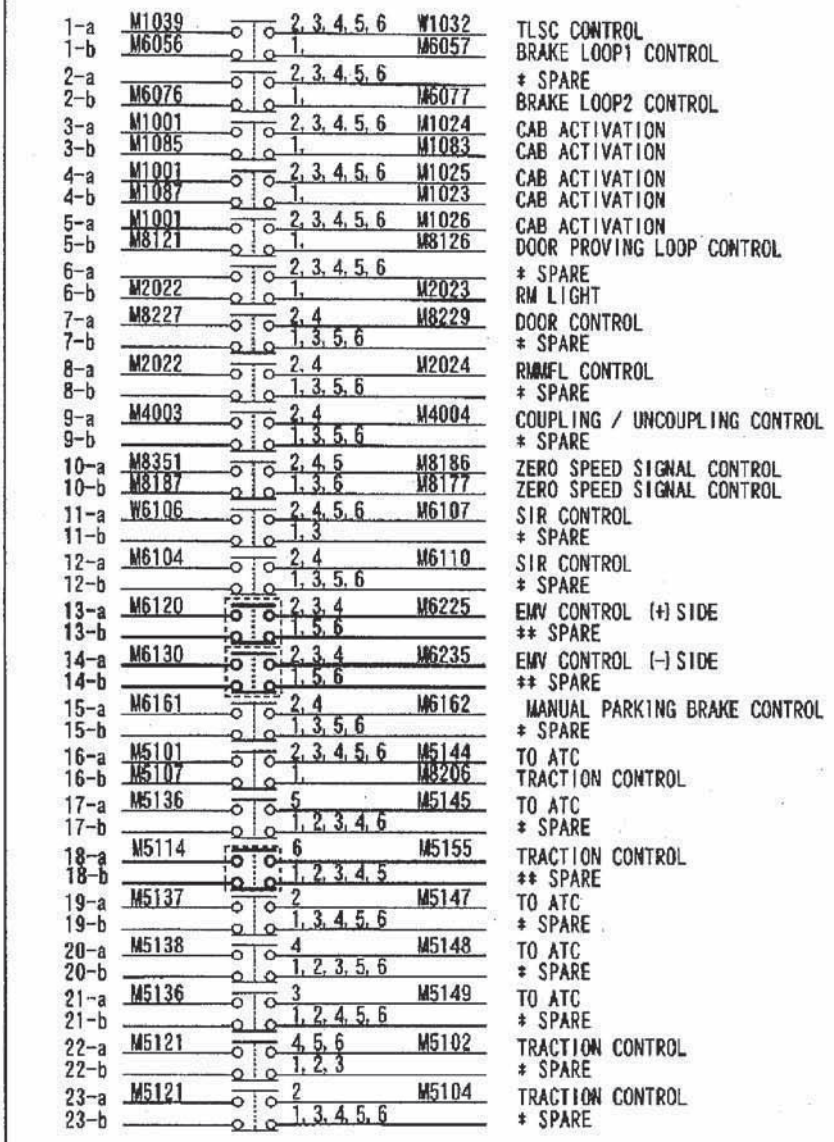
Attachment

Specification of Cam diagram for mode selector switch and traction brake controller for TKE is shown in the following.

3-4 The supply voltage of control lines connecting to the mode selector switch is 110 VDC.

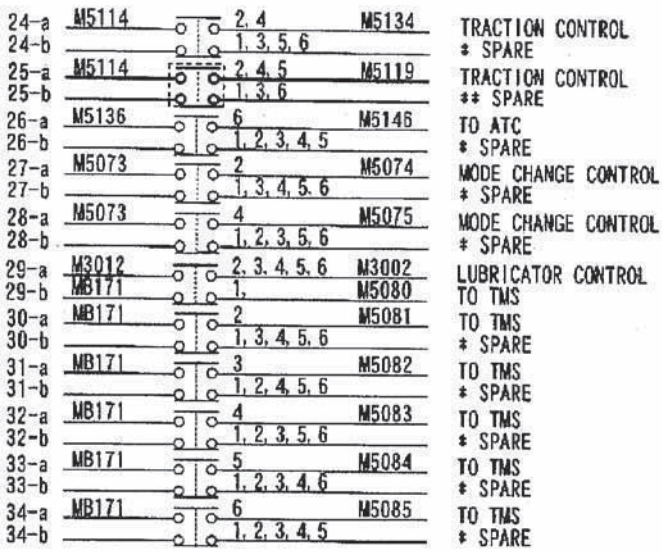
L K J G F C B

MODE SELECTOR SWITCH



Ref. No.	HCN-L5551-46N	Page	8

A



A

---- 1 = SHUTDOWN
---- 2 = REVERSE
---- 3 = STANDBY
---- 4 = FORWARD
---- 5 = CODED MANUAL
---- 6 = AUTO

a:a-contact
b:b-contact

for normal load
Type : S826a
Manufacturer : Schaltbau
Voltage : DC 110 V
Current : 0.4 A

for heavy load
Type : S800a
Manufacturer : Schaltbau
Voltage : DC 110 V
Current : 3.5 A
(L/R Load with surge absorber)

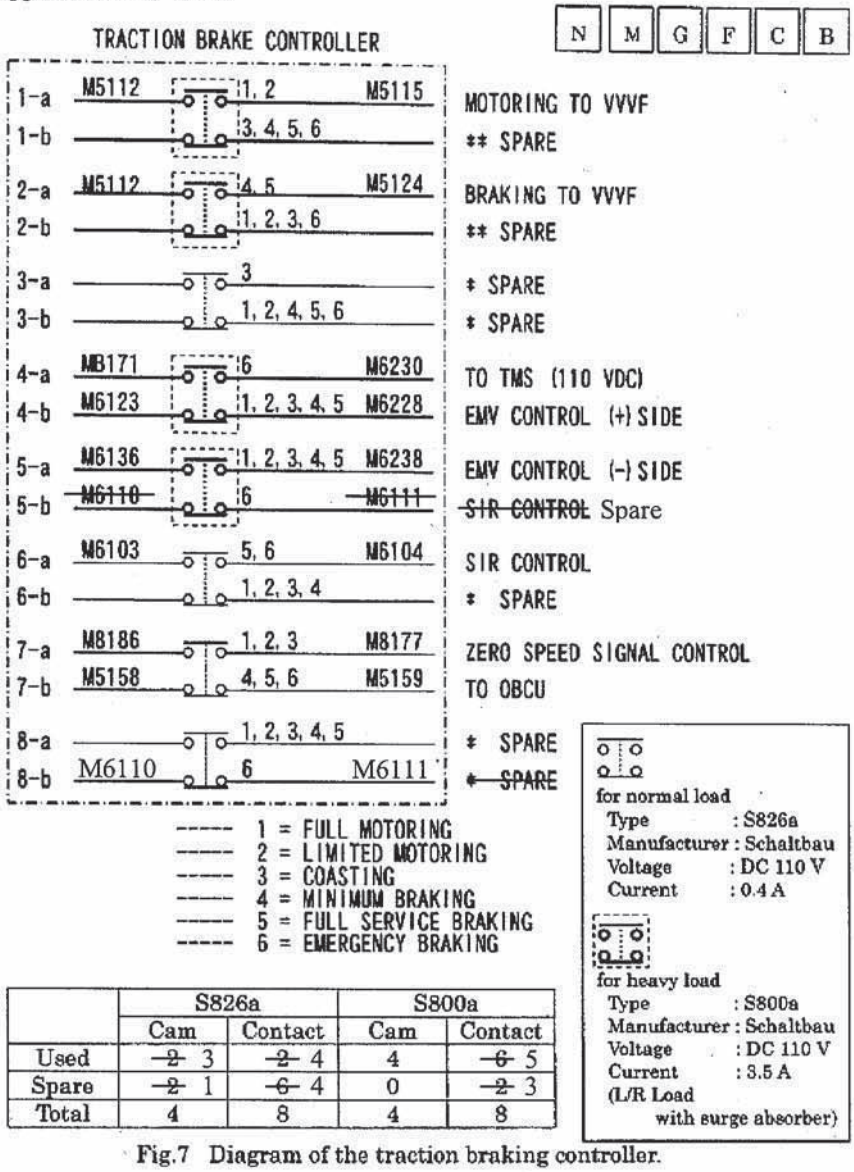
	S826a		S800a	
	Cam	Contact	Cam	Contact
Used	~~29~~ 30	~~32~~ 37	4	4
Spare	~~1~~ 0	~~28~~ 23	0	4
Total	30	60	4	8

Fig.2 Diagram of the mode selector switch.

Ref. No.	HCN-L5551-46N	Page	9

5-11 Traction Braking Controller

The supply voltage of all control lines connecting to the traction braking controller is 110 VDC but the control line interfacing with TMS is supplied with 24 VDC.



	S826a		S800a	
	Cam	Contact	Cam	Contact
Used	~~2~~ 3	~~2~~ 4	4	~~6~~ 5
Spare	~~2~~ 1	~~6~~ 4	0	~~2~~ 3
Total	4	8	4	8

Fig.7 Diagram of the traction braking controller.

Ref. No.	HCN-L5551-46N	Page	15

A

DETAILED INTERFACE SPECIFICATION

ANNEX A9
DESIGN NOTE – 772DN001
ATC INDICATORS AND ATC ALARMS FOR NEW TRAIN

DESIGN NOTES

1. Background

In the Signalling Preliminary Hazard Identification Workshop held on 18th September 2009, Train Crew Representatives expressed their concerns on the proposed ATC indicators and AFI Codes arrangements due to the adoption of ALSTOM SACEM on-board signalling equipment instead of Siemens OBCU. Further discussions were made via e-mail exchanges and another meeting was held on 2nd October 2009 to conclude the design.

The purpose of this design note is to form the traceability of the design requirements and to formalize the agreement between project teams and the end users.

Subsequent to the discussion in the Interface Hazard Analysis held on 20th October 2009, some new suggestions were raised in regard to the ATC indicators and the AFI codes. This design note is thus updated and supersedes the previous version dated 9 October 2009.

2. Design Requirements

2.1 ATC Indicators

2.1.1 The Door Tested indicator currently used in M-stock will be maintained in order to detect contact jam of the Door Proving Relay (DPR) in accordance with the train preparation procedure. This indicator will be driven by the ATC 110Vdc output.

2.1.2 The FB FAULT indicator currently used in M-stock is no longer required as the on-board ATC system for the train will not provide the fall back protection. Instead, the train's traction and brake systems and the TMS display will provide the required fall back functions.

2.1.3 The REMD FAULT indicator currently used in K-stock is not required as the ALSTOM on-board ATC cannot provide this function.

2.1.4 The CKD Indicator currently used in K-stock is not required as the ALSTOM on-board ATC will provide the same function by AFI code AF0

DESIGN NOTES

via the ATC-TMS serial link.

2.1.5 The ATC General Fault Indicator will be replaced by the TMS level 1 alarm namely SACEM HARDWARE FAULT in order to prompt the train driver immediately. See paragraph 2.2.1, 2.2.2 and 2.2.3 for detail description.

2.1.6 The on-board ATC will provide 110Vdc/10mA outputs to drive the AUTO FAULT, CM FAULT, RM FAULT, LOCKED AXLE, TRAIN HOLD and EMERGENCY BRAKE indicators. Furthermore, the on-board ATC will provide 24Vdc to drive a reed relay namely DLIRR which, in turn, drives the 110Vdc DLI indicator.

2.1.7 The SIR1 and SIR2 indicators will be driven by voltage free contacts in SIR1 relay and SIR2 relay, respectively.

2.1.8 All indicators are provided by RS Contractor.

2.1.9 The finalised layout of the required ATC indicators and their general arrangement on driver desk is shown in Figure 1 below.

Figure 1 – ATC Indicators Layout

DESIGN NOTES

2.1.10 The decals, colours and the location sequences of the ATC Indicators and the Cab Occupied indicator are detailed in Table 1 below:

Location Sequences (From Left to Right)	Decal	Type	Colour
1	AUTO FAULT	ATC Indicator	Red
2	CM FAULT	ATC Indicator	Red
3	RM FAULT	ATC Indicator	Red
4	LOCKED AXLE	ATC Indicator	Red
5	TRAIN HOLD	ATC Indicator	Red
6	SIR1	ATC Indicator	Yellow
7	SIR2	ATC Indicator	Yellow
8	EMERGENCY BRAKE	ATC Indicator	Yellow
9	DOOR TESTED	ATC indicator	Yellow
10	CAB OCCUPIED	Train Indicator	Amber

Table 1

2.1.11 One yellow colour Driverless Operation Pushbutton is provided to inform the ATC system that the train is ready for the driverless turnaround operation. The pushbutton is integrated with the DLI indicator. The pictogram of the pushbutton is shown in Figure 2 below.

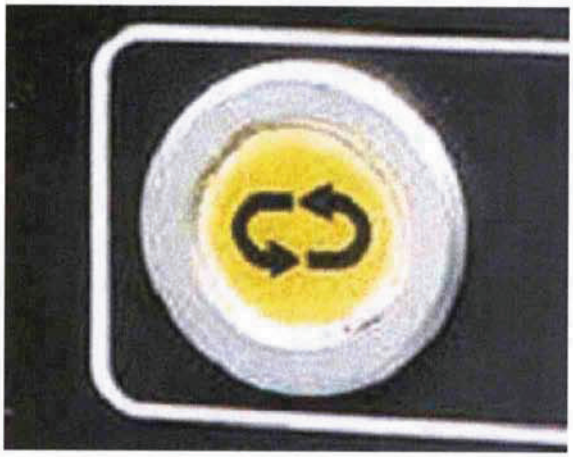


Figure 2 – Driverless Operation Pushbutton Pictogram

DESIGN NOTES

2.1.12 The Driverless Operation Pushbutton is installed on the A side front wall as highlighted in red in Figure 3 below.

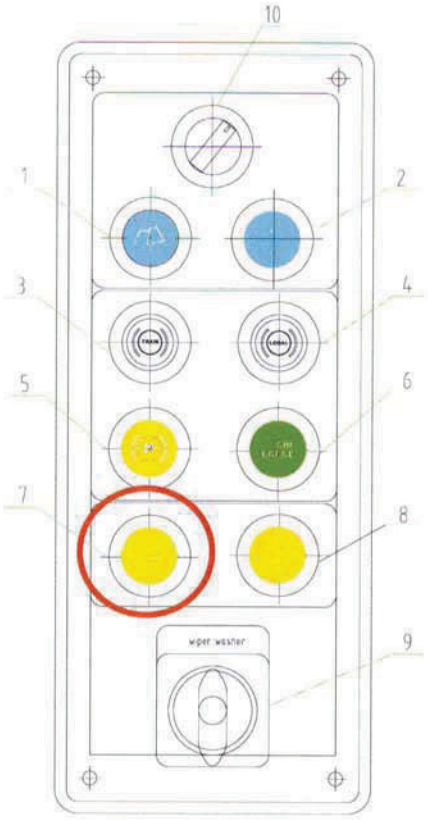


Figure 3 – Driverless Operation Pushbutton Layout

2.2 ATC Alarms

2.2.1 A new level 1 TMS Alarm namely "SACEM Hardware Fault" will be added in TMS system. This alarm will be triggered by one of 110Vdc input port number DIH21 which was previously reserved for the PSD Opened status in K-stock.

2.2.2 The 110Vdc voltage free contact in AFRR reed relay provided by ALSTOM currently used to drive the ATC General Fault indicator will be used to drive the TMS input port number DIH21.

2.2.3 The logical conditions and the definition of the SACEM Hardware Fault alarm are specified in Table 2 below.

DESIGN NOTES

ATC Condition	AFRR	TMS input	Level	TMS Display
The same conditions used to drive the ATC General Fault Indicator in M-stock will be used to drive the AFRR (i.e. ATP/ATO HW Failure detected OR no messages received from ATO OR CKD detected low)	Close	Logical = 1 (i.e.110Vdc)	1	Fault Name: **SACEM HARDWARE FAULT** TO Hint: Obtain authorization for Startup
ATC is normal	Open	Logical = 0 (i.e. 0Vdc)		

Table 2

2.2.4 A new AFI code AF0 will be sent by ATC to TMS via the ATC-TMS serial link in order to trigger a level 1 TMS alarm namely SACEM Computer Lock-up. This AF0 is conditioned by the ATO variable namely CKD_LOW.

2.2.5 A new AFI code AF1 will be sent by ATC to TMS via the ATC-TMS serial link in order to trigger a level 1 TMS alarm namely SACEM Delocalized. This AF1 is conditioned by the ATP variable namely Delocalized. When this variable is set the AF1 is triggered.

2.2.6 A new AFI code AF2 will be sent by ATC to TMS via the. ATC-TMS serial link in order to trigger a level 1 TMS alarm namely PSD Open Failure. This AF2 is conditioned by one of the existing ATC alarm (Set ID = 28 & Event ID = 129). In addition, the ATP parameter namely WaitAlarmPSD will be changed from 15 sec. to 10 sec. in order to compromise the required failure detection and the sensitivity of this failure.

DESIGN NOTES

2.2.7 A new AFI code AF3 will be sent by ATC to TMS via the. ATC-TMS serial link in order to trigger a level 3 TMS alarm namely PSD Closed.

DESIGN NOTES

2.2.8 The detail description of the new AFI codes is specified in Table 3 below.

AFI Codes	Messages	Triggering Conditions	Failure Meaning	TMS Criticality Level	TMS Display
AF0	ATC Halt	This AFI code is set when the ATP or the ATO detects the CKD state is low which means CKD is low. This AFI code is unset when ATC is normal	ATC is halt 1 = ATC is halt 0 = ATC is normal	1	Fault Name: **SACEM COMPUTER LOCKED UP** TO Hint: Obtain authorization for Startup
AF1	ATC Delocalized	This AFI code will be set if ATP is delocalized. This AFI code is unset when ATP are localized. The ATP is localized means the ATP is at the following localization states: 2: " Waiting for departure" after the ATP founds a Stationary Initialization Beacon in the invariants 3: " Waiting for MTIB beacon": the ATP has read a STIB and waits a Moving Train Initialization Beacon 5: " Total localization": The ATP has found the Moving Train Initialization	ATC is delocalized 1 = ATC is delocalized 0 = ATC is localized	1	Fault Name: **SACEM DELOCALIZED** TO Hint: Obtain TC authorization for RM

		Beacon in the invariants 6: " Pre-localized state" : during change ends": the ATP waits for invariants 7: "Waiting for active cab" : Active cab has become inactive and complete stop is lost (change ends finalized) [Remark: the ATP is considered delocalized in the states 0, 1 & 4 (see details in ATP SwRS §6.3.4.1)]			
AF2	PSD Failed to Open	SetID = 28 & EvenID=129 PSD is not detected opened 10 seconds after driver pressing the door open button in PSD/APG fitted platform	PSD Failed to Open 1 = PSD is not opened after an expected delay 0 = PSD open normally	1	Fault Name: **PSD FAILED TO OPEN** TO Hint: Press PDOB. If Fail, use PSL
AF3	PSD Closed	This AFI code is set to 1 when the PSD variant is received and equal to 1.	PSD Closed 1 = PSD closed 0 = PSD opened or unknown	3	Fault Name: PSD Closed

DESIGN NOTES

		This AFI code is set to 0 when either the PSD variant is not received or it is received and equal to 0.			
AF4			Reserved AFI code	-	Nothing
AF5			Reserved AFI code	-	Nothing
AF6			Reserved AFI code	-	Nothing
AF7			Reserved AFI code	-	Nothing
AF8			Reserved AFI code	-	Nothing
AF9			Reserved AFI code	-	Nothing
AF10			Reserved AFI code	-	Nothing
AF11			Reserved AFI code	-	Nothing
AF12			Reserved AFI code	-	Nothing
AF13			Reserved AFI code	-	Nothing
AF14	COMPLETE_STOP	This AFI code is set when ATO detected train is completely stopped (i.e. < 0.5kph). This AFI code is unset when ATO is not detected completely stopped	Complete Stop 1 = Complete Stop 0 = moving	-	Nothing
AF15			Reserved AFI code	-	Nothing

Table 3

DETAILED INTERFACE SPECIFICATION

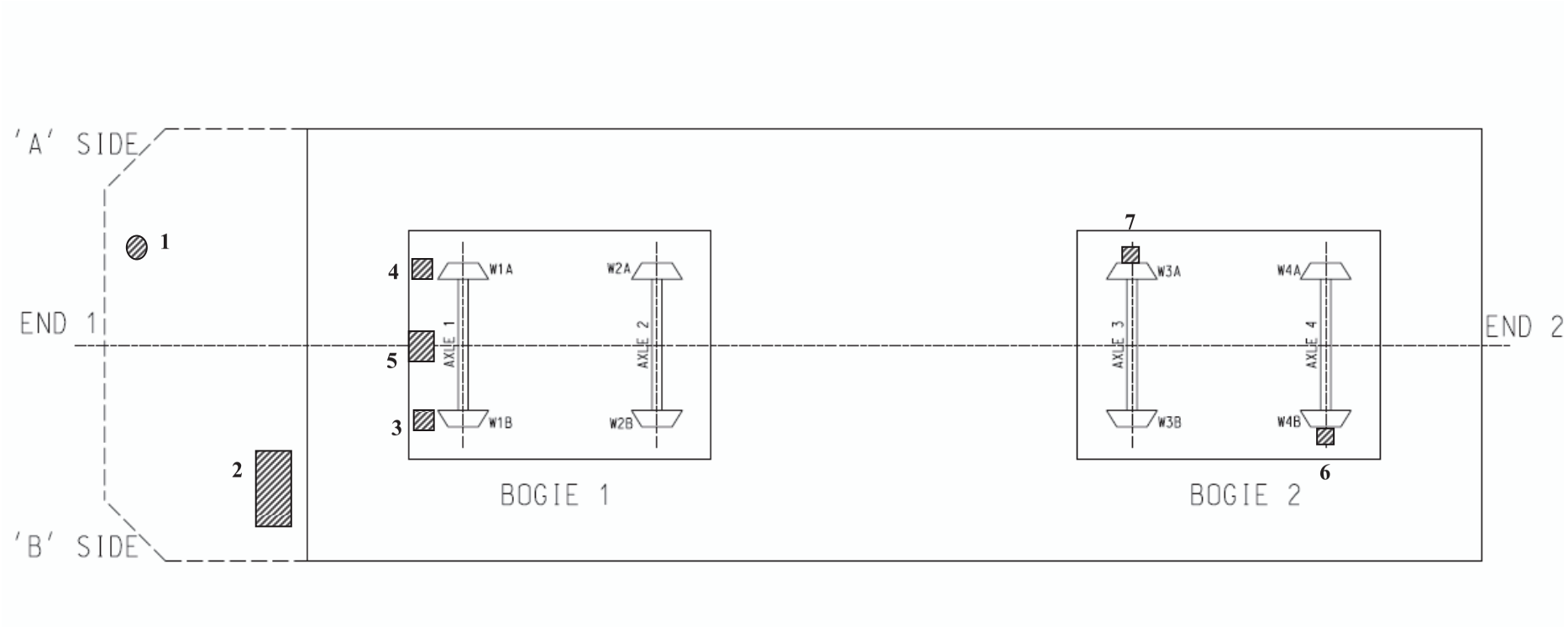
ANNEX B1
ATC MECHANICAL INTERFACE REQUIREMENTS

ANNEX B1 - ATC Mechanical Interface Requirement

AMENDMENT RECORDS

Author	Version	Date	§	Modifications
Joseph Sin	1.0	11 May 09	All	First issue
Joseph Sin	1.1	13 May 09	All	Second issue
Joseph Sin	1.2	19 May 09	All	Third issue
Joseph Sin	1.3	27 May 09	All	Fourth issue
Joseph Sin	1.4	29 May 09	All	Fifth issue
Joseph Sin	1.5	8 Jun 09	All	Sixth issue
Joseph Sin	1.6	17 Jun 09	All	Seventh issue
Joseph Sin	1.7	2 Jul 09	All	Eighth issue
Joseph Sin	1.8	3 Jul 09	All	Ninth issue
Joseph Sin	1.9	16 Jul 09	Fig. UF1 - revised, Fig. RC2 - revised, Fig. CT2 - revised, Fig. ATC1 - revised, Fig. ATC2 - revised, Fig. ATC4 - removed, Odometer Photo 1 - revised, Fig. OD7 – removed.	Tenth issue
Joseph Sin	2.0	21 Aug 09	Page 2, 15, Figures OD5 & OD6	Eleventh issue
Joseph Sin	2.1	10 Sep 09	1. Rename Figure OD5 to OD5_1 and updated with new version due to change on number of teeth and diameter of the pole wheel. 2. Add Figure OD5_2 to show the detail of adaptation shim. 3. Odometer 3B => Odometer 4B, Odometer 4A=>Odometer 3A 4. Figure OD6 removed.	Twelfth issue
Joseph Sin	2.3	10 May 10	1. Figure RC2, CT2, ATC3, OD4, OD5_1 and OD1 are updated. 2. Figure OD5 is removed.	Fourteenth issue
Joseph Sin	2.4	14 Jan 11	1. Figure OD5_1 is revised.	Fifteenth issue

ANNEX B1 - ATC Mechanical Interface Requirement



Location of on-board ATC equipment					
Items	Description	Weight	Items	Description	Weight
1	Speedometer	1 kg	6	Odometer 4B (with cable & plug)	3.2 kg +/- 0.1 kg
2	ATC Cubicle (without cable & plug)	78 kg +/- 1 kg	7	FAIVELEY Odometer 3A (with cable & plug)	0.8 kg +/- 0.1 kg
3	CT Sensor 1B (without cable & connector)	4.5 kg +/- 0.1 kg			
4	CT Sensor 1A (without cable & connector)	4.5 kg +/- 0.1 kg			
5	RC Antenna (without cable & connector)	8.8 kg +/- 0.1 kg			

FIGURE UF 1 – ATC Equipment Locations

ANNEX B1 - ATC Mechanical Interface Requirement

B1.U.1 RC ANTENNA & CT SENSORS

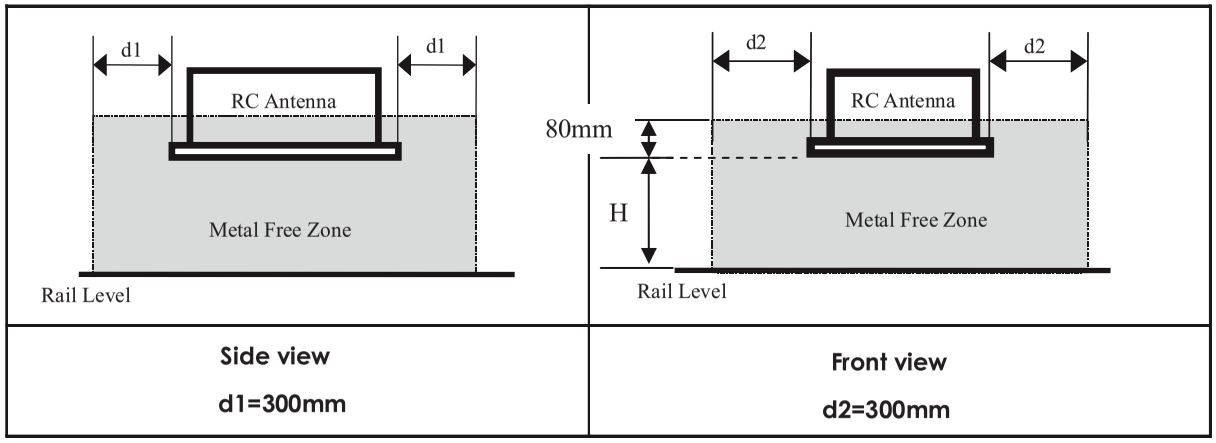
The RC Antenna is used for data transmission between the trackside beacons and the ATC. The length of cable between antenna and ATC cubicle shall not exceed 6m.

The RC antenna is made up of a sturdy body enclosing PCBs with transmission and logical electronic components. The other parts of the antenna are the non-metallic emitting face, the two connectors sockets and the mechanical interface including the shock absorbers. See Figures B1.U.1.1, UF2, UF3, UF4, RC1 and RC2 for details.

Its electrical interface with the ATC cubicle is made with two specific cables equipped with plugs.

B1.U.1.1 Metal Free Zone

To ensure clearance of the antenna in dynamic operations, no metallic parts shall be fixed around the antenna and its mechanical interface. The antenna must be positioned in an area without metallic parts as illustrated in figures below.



Note: refer to Figure B1.U.1.2 for value of H

ANNEX B1 - ATC Mechanical Interface Requirement

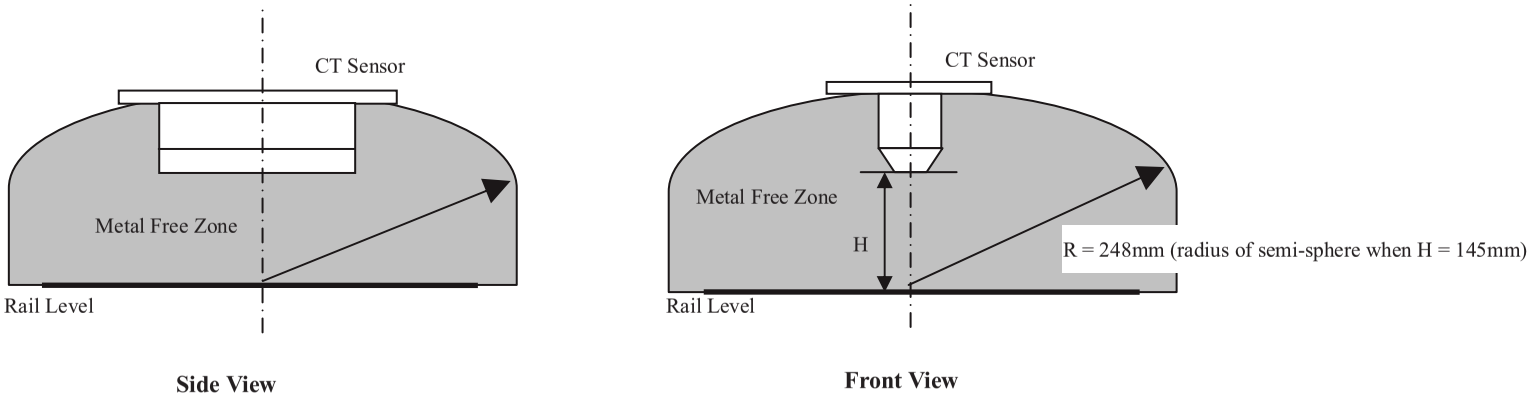
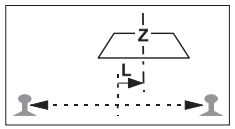
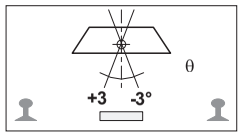
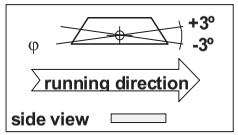
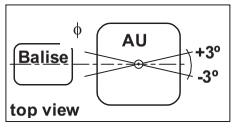


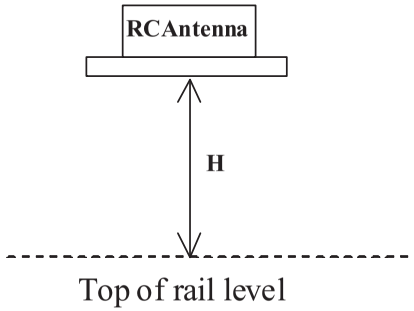
Figure B1.U.1.1 – RC antenna and CT Sensor Metal Free Zones

B1.U.1.2 RC Antenna Installation Constraints

The longitudinal axis of the RC antenna is centered with the track axis. The following figures illustrates the installation constrains of the RC antenna. The minimum and maximum dimensions are the extreme dimensions insuring the good functioning of the devices, and should be respected whatever the dynamics conditions.

ANNEX B1 - ATC Mechanical Interface Requirement

Description	minimum	typical	maximum	
Lateral gap with the longitudinal track axle = L	0 mm	(±10 mm)	±60 mm	
Tilting = θ	0°	(±1°)	±3°	
Pitching = φ	0°	(±1°)	±3°	
Yawing = ϕ	0°	(±1°)	±3°	



Value of H:

Maximum: 145mm

Nominal: 135mm – 140mm

Minimum: 75mm

FIGURE B1.U.1.2 – RC Antenna Installation Constraints

ANNEX B1 - ATC Mechanical Interface Requirement

B1.U.1.3 CT Sensor Installation Constraints

The CT sensor acquires the continuous track to train transmission for the on-board ATP/ATO cubicle. It is made up of a pair of sensors installed over each rail in front of the first axle of the first bogie of the train. Each sensor is equipped with one coil for loop transmission reception. It is mechanically coupled with the bogie with a specific mounting, and it is equipped with one connector socket for electrical interface with the train body. The dimensions and mounting details are given in Figures B1.U.1.3, UF2, UF3, UF4, CT1 and CT2.

Value of H:
Maximum: 150mm
Nominal: 140mm-145mm
Minimum: 75mm

Value of L:
Towards Rail: +20mm
Nominal: 0mm
Towards Track Centre: -60mm

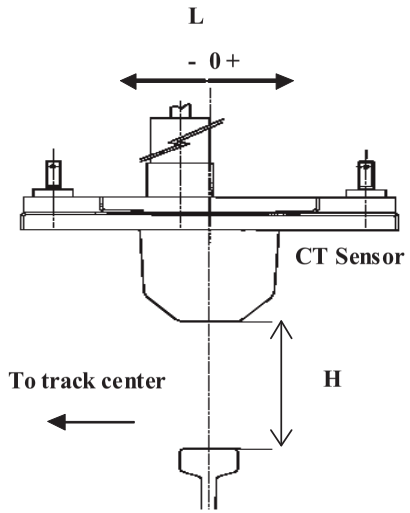
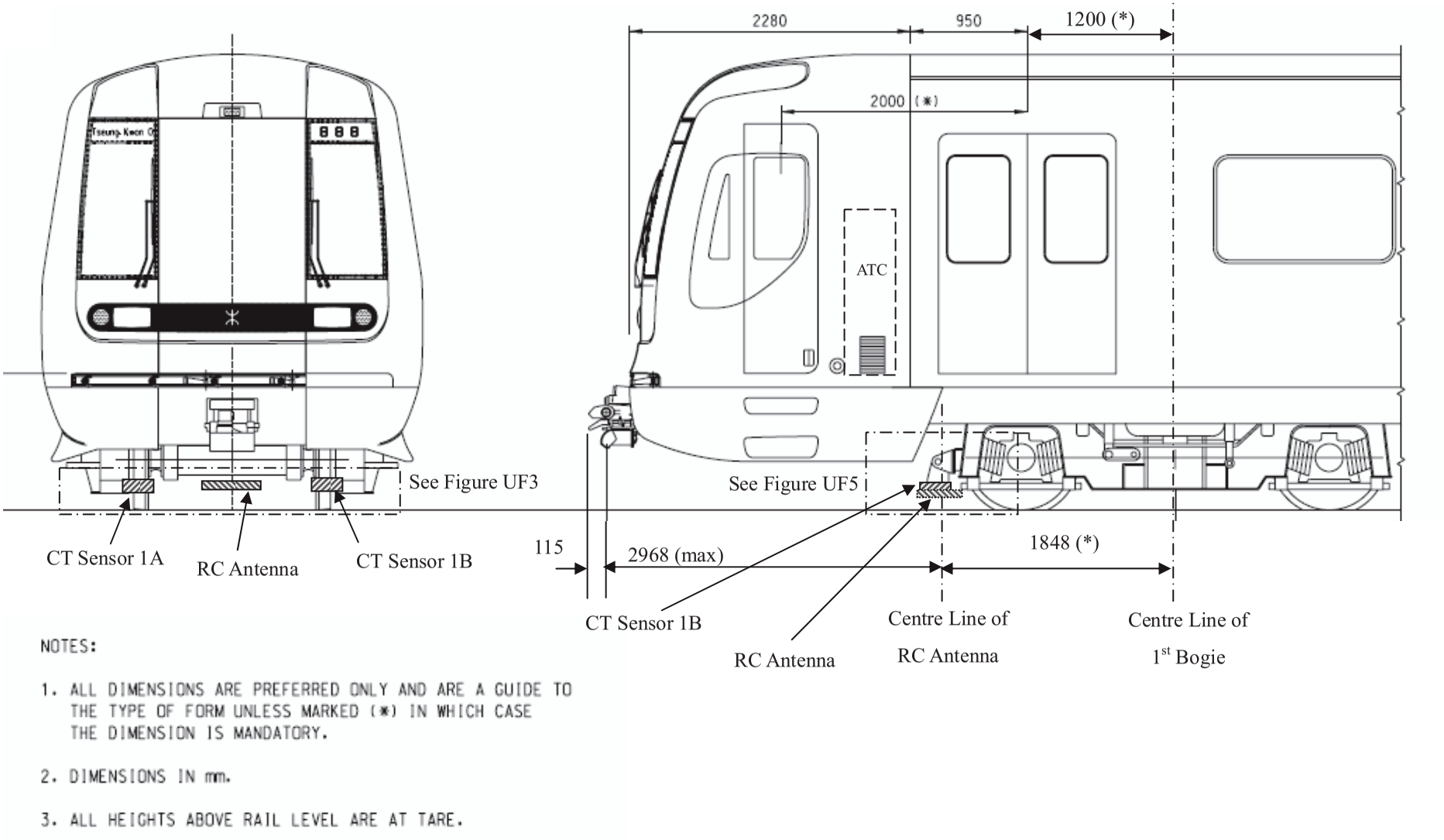


Figure B1.U.1.3 – CT Sensor Installation Constraints

ANNEX B1 - ATC Mechanical Interface Requirement



NOTES:

1. ALL DIMENSIONS ARE PREFERRED ONLY AND ARE A GUIDE TO THE TYPE OF FORM UNLESS MARKED (*) IN WHICH CASE THE DIMENSION IS MANDATORY.

2. DIMENSIONS IN mm.

3. ALL HEIGHTS ABOVE RAIL LEVEL ARE AT TARE.

FIGURE UF 2 –Proposed Locations of RC Antenna & CT Sensors

ANNEX B1 - ATC Mechanical Interface Requirement

Notes:

1. **ALL ARRANGEMENTS ARE FOR ILLUSTRATION & REFERENCE ONLY.**
2. **DIMENSIONS MARED WITH (*) ARE MANDATORY.**
3. **DIMENSIONS IN mm.**
4. **ALL HEIGHTS ABOVE RAIL LEVEL ARE TARE**

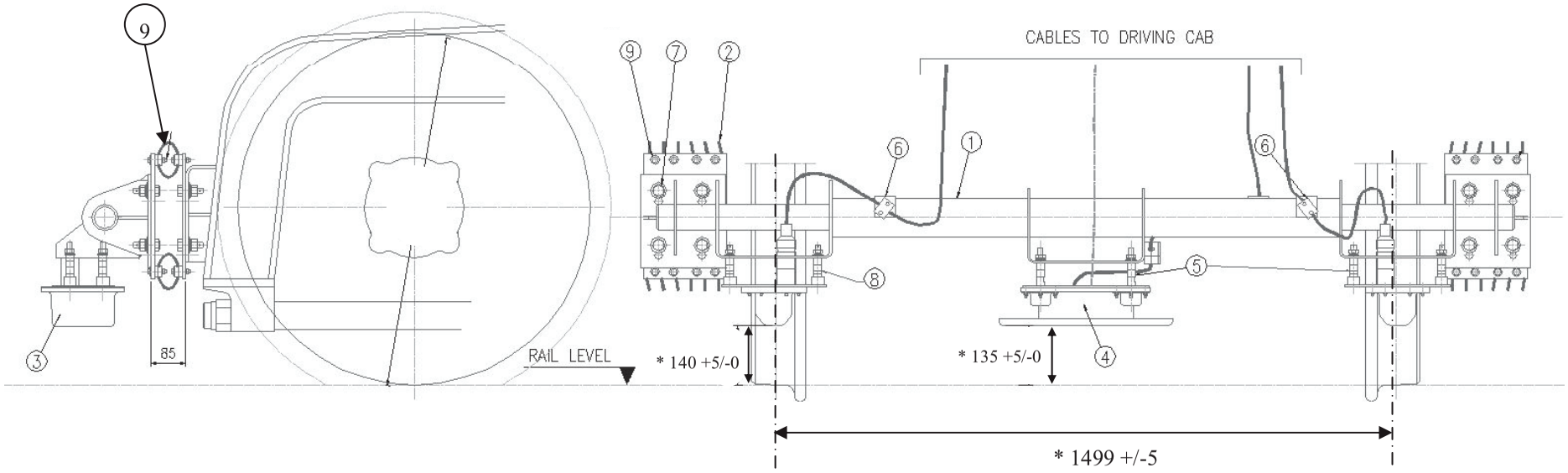


FIGURE UF 3 - Beam for R.C. Antenna & C.T. Sensor (For Reference Only)

ANNEX B1 - ATC Mechanical Interface Requirement

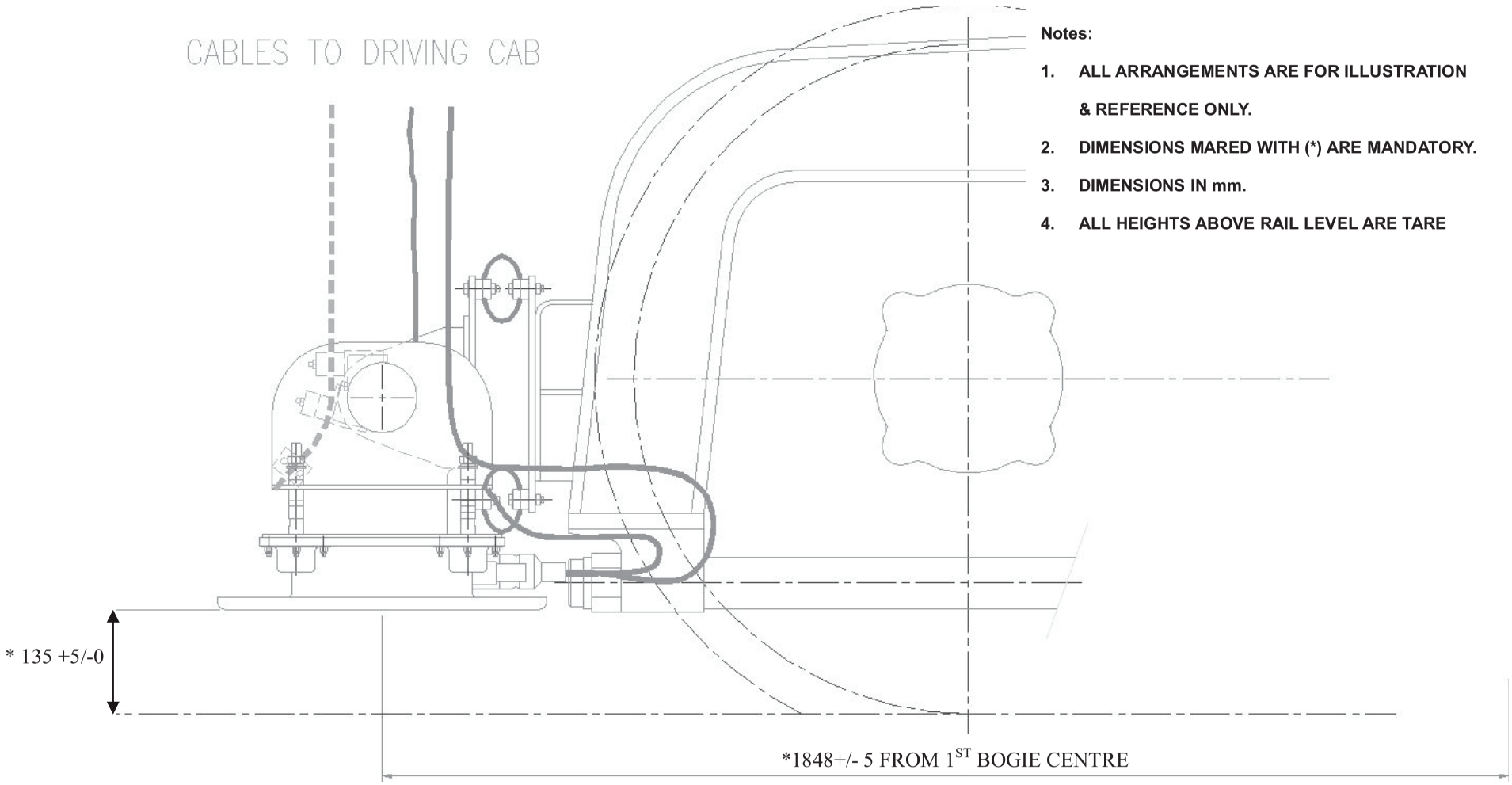


FIGURE UF 4 - RC Antenna Underframe Arrangement

ANNEX B1 - ATC Mechanical Interface Requirement

B1.U.2 RC ANTENNA & CT SENSOR SPACERS REQUIREMENTS

- Max (new) wheel diameter = 850mm, Min wheel diameter = 775mm
- Max bogie suspension compression/ vertical displacement = 30mm (tare to crush load) + 20mm (knematic movement)
- Nominal height of RC antenna (from rail top) = 135mm
- Nominal height of CT sensor (from rail top) = 140mm
- Kinematic envelope (from rail top) = 75mm
- If the CT sensor starts at 140mm from rail top with new wheels, the min. height of the CT sensor due to vertical displacement of the suspension is (140-50) = 90mm with 15mm margin before hitting the K.E..
- If the RC antenna starts at 135mm from rail top with new wheels, the min. height of the RC is (135-50) = 85mm with 10mm margin before hitting the K.E..
- The current URL maintenance regime is to adjust the antenna height after wheel wear of 10mm. The range of wheel wear is (850-775)/2 = 37mm. As a result, the numbers and size of the spacers required for the RC antenna and CT Sensors are 3 x 10mm and 1 x 7mm.

ANNEX B1 - ATC Mechanical Interface Requirement

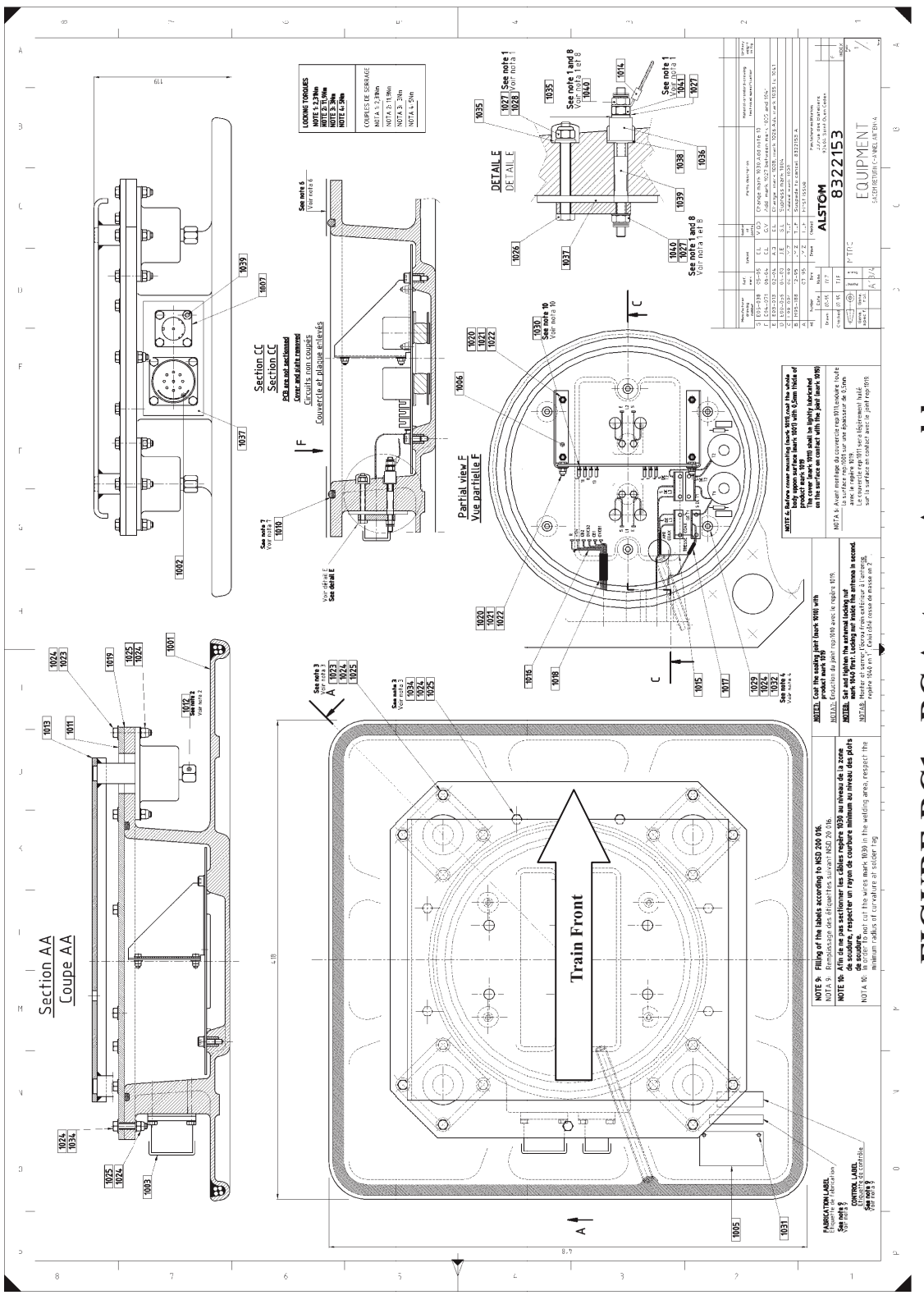
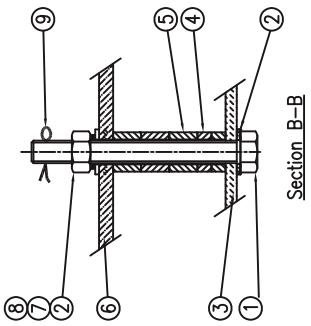


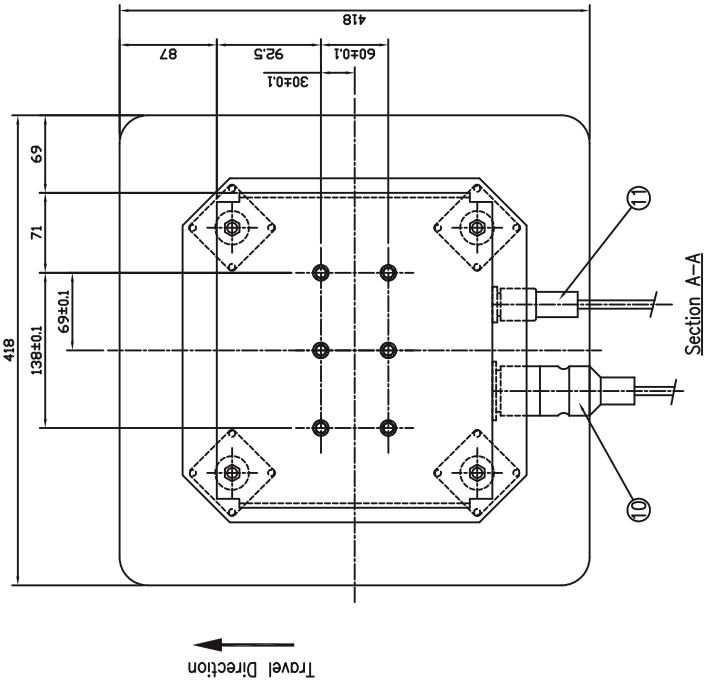
FIGURE RC1 - RC Antenna Assembly

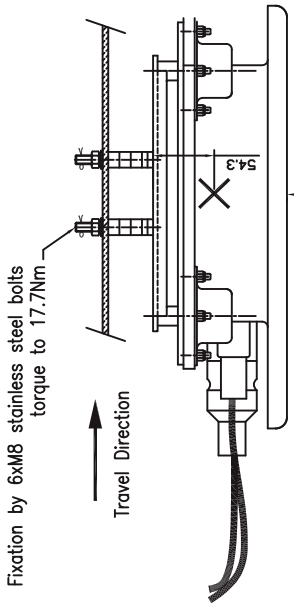
ANNEX B1 - ATC Mechanical Interface Requirement

Item	Description	Qty	Supplied by
1	Hex M8x80mm stainless steel bolt	6	772
2	Plain washer	12	C6554-07E
3	Plaque support	1	772
4	5mm stainless steel spacer	12	C6554-07E
5	10mm stainless steel spacer	18	C6554-07E
6	Mounting bracket	1	C6554-07E
7	Spring washer	6	C6554-07E
8	Nylon lock nut	6	C6554-07E
9	Split pin	6	C6554-07E
10	SOURIAU Plug/ socket	1 set	772
11	JUPITER Coaxial plug/ socket	1 set	772
12	RC antenna assembly	1	772

Note
For dynamic gauge add ±6mm displacement in 3 directions.







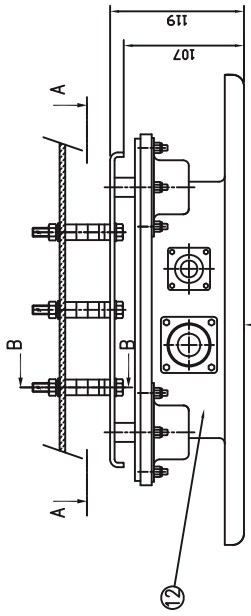


FIGURE RC2 - RC Antenna Mounting

Iss	Date	Designed	Drawn	Checked	Approved	Description
1.2	20/04/10	E.L.	R.AY.	I.T.		ISSUE FOR 772/C6554-07E DIS AS ANNEX B1
1.1	04/08/09	E.L.	R.AY.	I.T.		ISSUE FOR 772/C6554-07E DIS AS ANNEX B1
1.0	17/06/09	E.L.	R.AY.	I.T.		ISSUE FOR 772/C6554-07E DIS AS ANNEX B1

Iss	Date	Designed	Drawn	Checked	Approved	Description

ALSTOM

MTR Corporation

CONTRACT 772-TRAINBORNE SIGNALLING EQUIPMENT

RC Antenna Interface
Mounting Arrangement

CAT No. 772/C6554-07E/INT/MEC/RC001
CAD No. RC001.DWG
Sht. No.

SIZE A3

ANNEX B1 - ATC Mechanical Interface Requirement

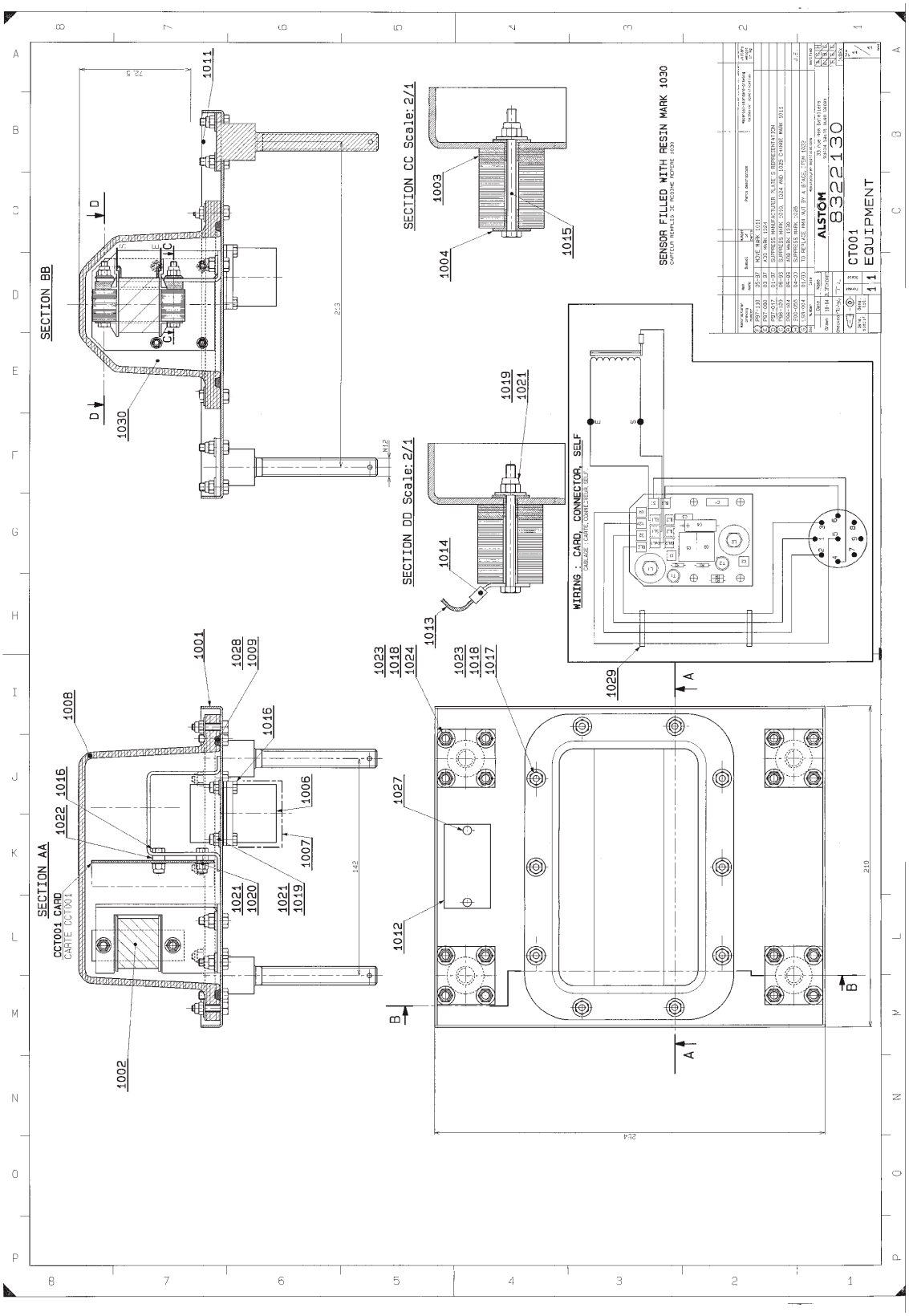


FIGURE CT1 - CT Sensor Assembly

Annex B1 rev. 2.4
Date: 14 Jan 11

ANNEX B1 - ATC Mechanical Interface Requirement

ITEM	DESCRIPTION	Qty	SUPPLIED BY
1	10mm Stainless steel spacer	12	C6554-07E
2	5mm Stainless steel spacer	8	C6554-07E
3	Plain washer	4	C6554-07E
4	Spring washer	4	C6554-07E
5	M12 nylon lock nut	4	C6554-07E
6	Split pin	4	C6554-07E
7	M12 stud	4	772
8	Mounting bracket	1	C6554-07E
9	CT sensor assembly	1	772
10	Cable plug	1	772

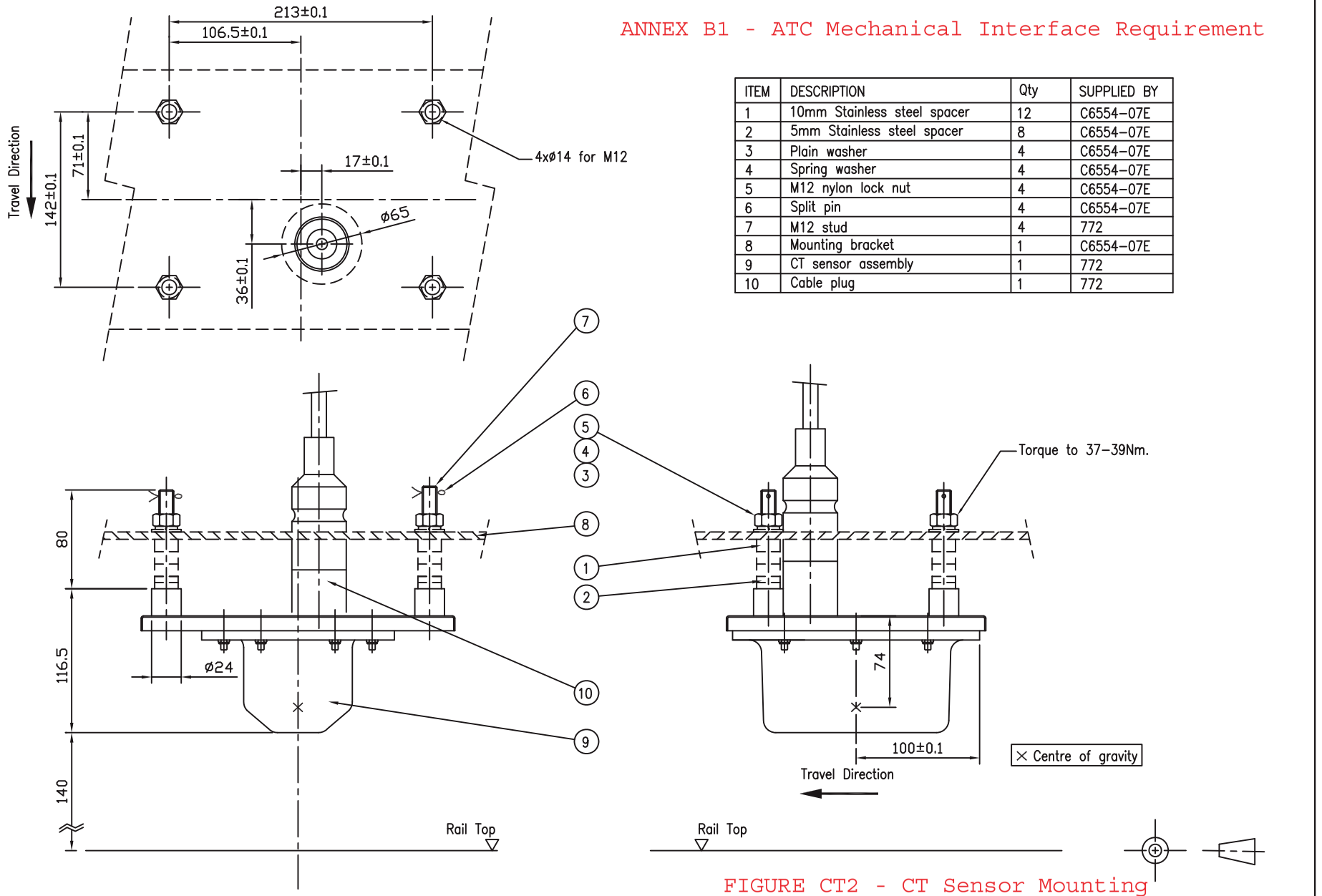


FIGURE CT2 - CT Sensor Mounting

Iss	Date	Designed	Drawn	Checked	Approved	Description
1.2	14/04/10	E.L.	R.AY.	I.T.		ISSUE FOR 772/C6554-07E DIS AS ANNEX B1
1.1	04/08/09	E.L.	R.AY.	I.T.		ISSUE FOR 772/C6554-07E DIS AS ANNEX B1
1.0	17/06/09	E.L.	R.AY.	I.T.		ISSUE FOR 772/C6554-07E DIS AS ANNEX B1

ALSTOM

CONTRACT 772-TRAINBORNE SIGNALLING EQUIPMENT

CT Sensor Interface Mounting Arrangement

MTR Corporation

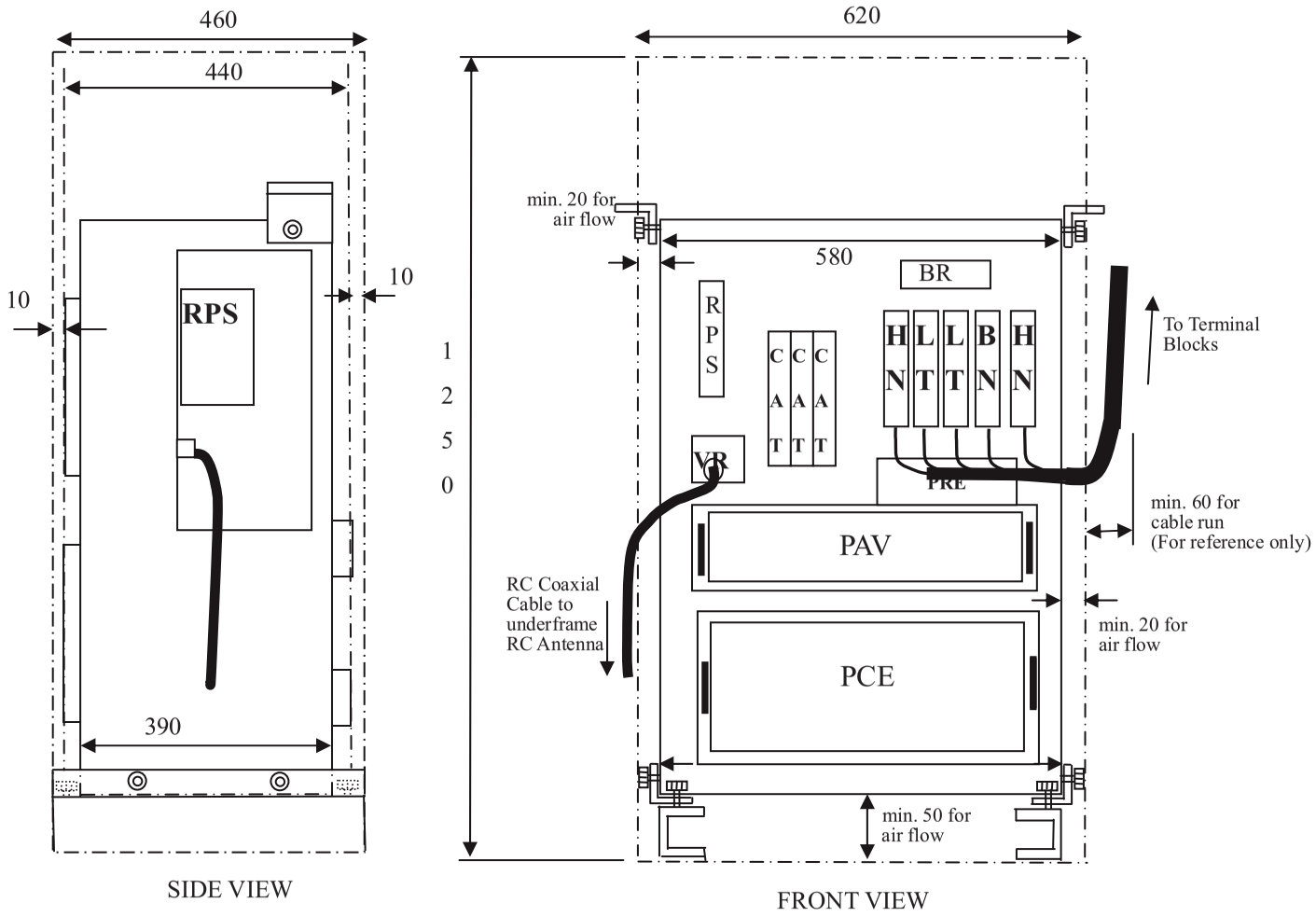
GAT No. 772/6554-07E/INT/MEC/CT001

CAD No. CT001_1.2.DWG

Sht.No.

SIZE A3

ANNEX B1 - ATC Mechanical Interface Requirement

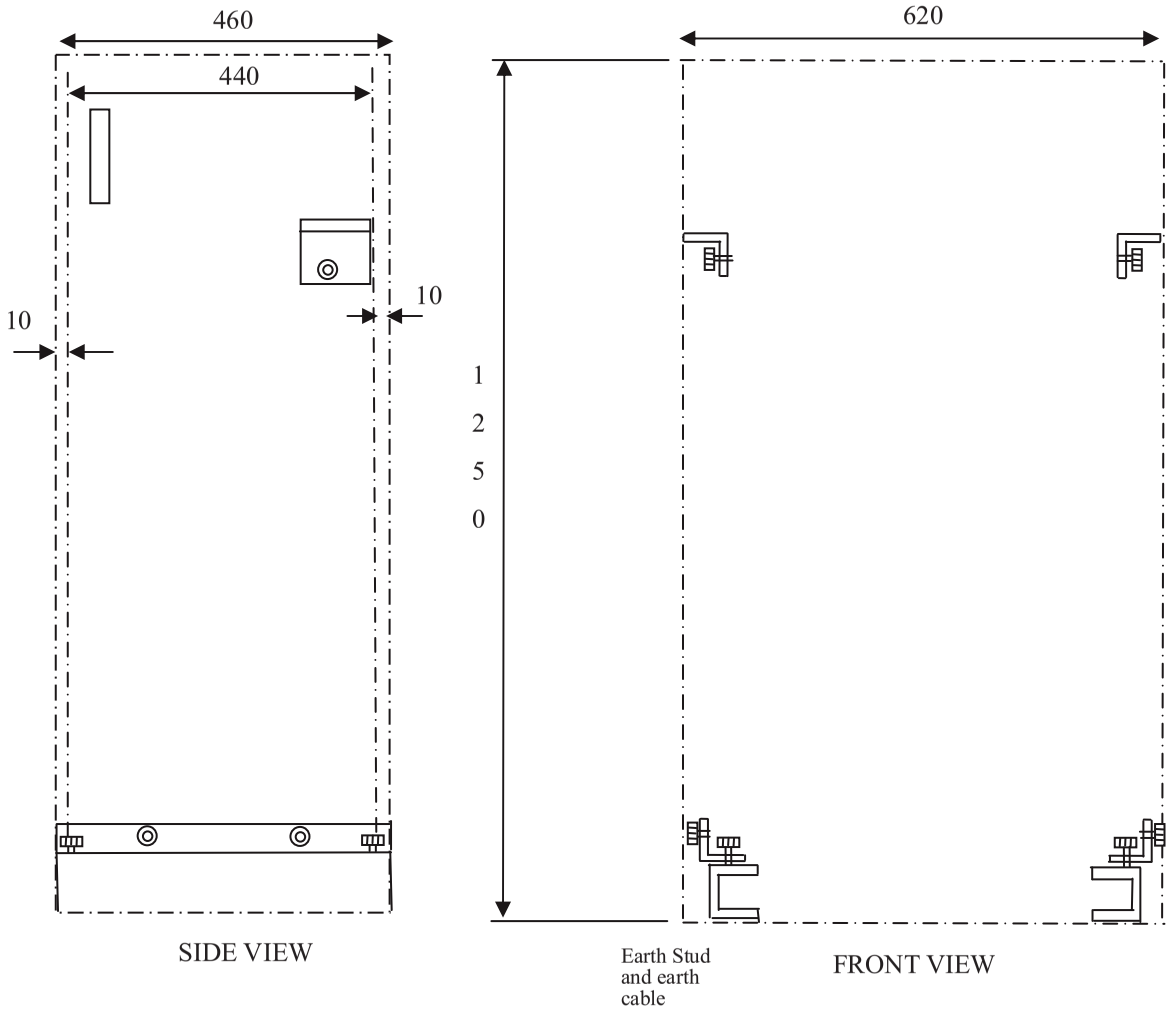


Notes:

DIMENSIONS IN mm.

FIGURE ATC1 - Proposed ATC Cubicle Arrangement

ANNEX B1 - ATC Mechanical Interface Requirement



Notes:

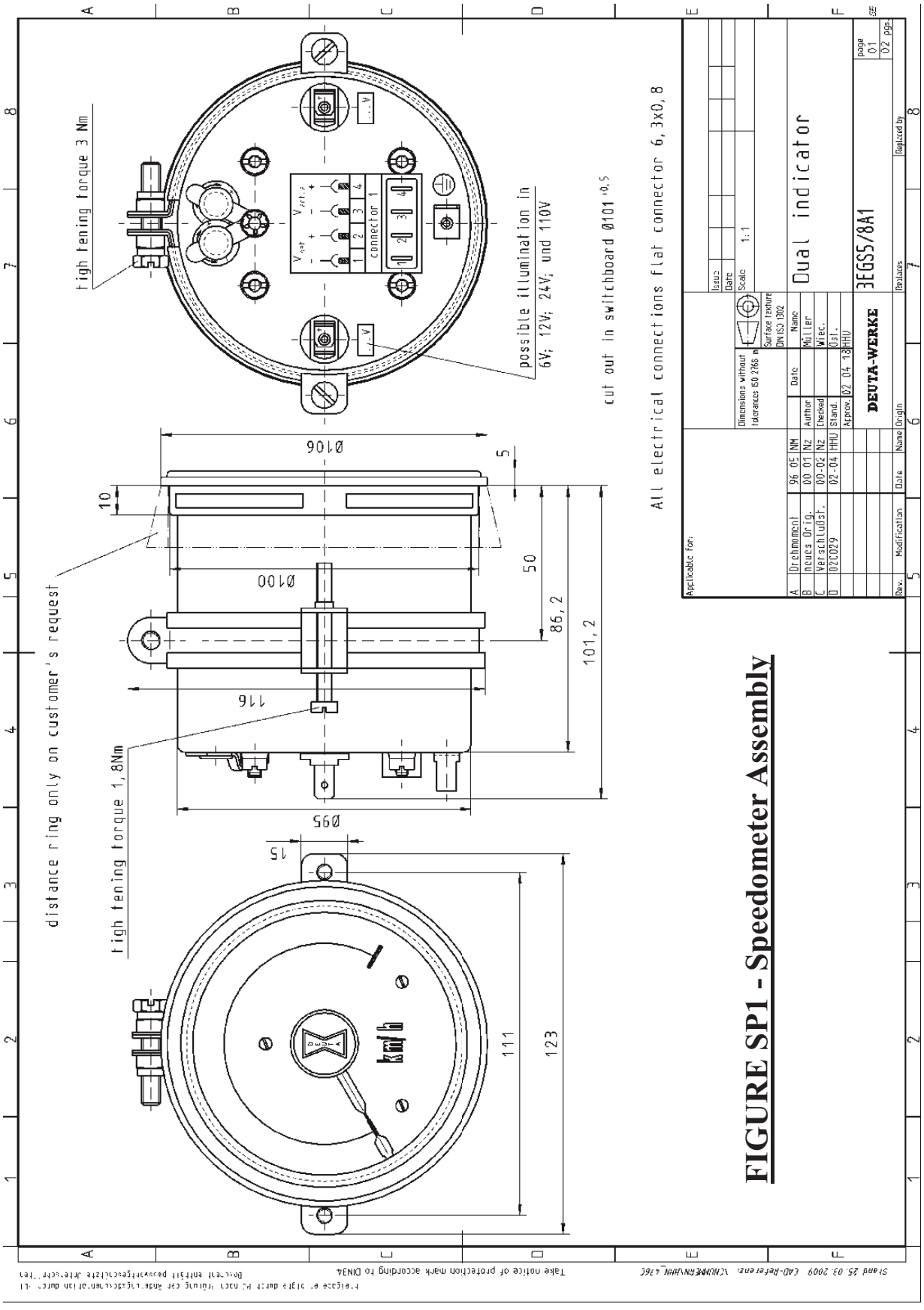
DIMENSIONS IN mm.

FIGURE ATC2 – SCOPE OF SUPPLY

SIZE A3 PLOTTED $$$DATE$$$TIME$$$ USER $$USER$$ FILENAME $$$$DGNSPEC$$$

ATC Cubicle

ANNEX B1 - ATC Mechanical Interface Requirement



Speedometer
110V
110V
V-Real
V-Set
1-
2+
3-
4+
Approvals
Casing
Additional indicator
sheet steel
depending on anode or
depending on cathode

Speedometer
110V
110V

Speedometer

Speedometer
0
20
40
60
80
100
km/h
Back Light On

ANNEX B1 - ATC Mechanical Interface Requirement

B1.O.1 ODOMETER

The odometer 4B acquires speed and displacement information of the train, for electronic processing by the ATC. It is made up of a sturdy equipment case, Hasler type 5.8600.034, containing 4 optical sensors and a punched disc. The length of interface cable between odometer 4B and ATC cubicle inside the driving cab shall not exceed 30m.

The odometer 4B is mechanically coupled with the bogie axle with a specific coupling system, and it is equipped with one connector plug for electrical interface with the train body. All the dimensions are given on the manufacturer drawings, see Figure OD1. The Odometer 4B is mounted on axle end, on the axle box, with a metallic interface part. The speed acquisition with the axle is made with a single fork coupling system.

B1.O.1.1 Odometer 4B Main Specifications

Coded Odometer (Haslerrail ref. 5.8600.034)	
type	with 4 sensors and ATP/ATO coded disk
dimensions	diameter 155mm, thickness 130mm (without cable and coupling)
weight	about 4.5kg (without cable and connector)
Body	aluminum casting
Connector	Aluminum with surface treatment
Coupling speed maxi	2000 rpm
Cable bending radius (mini)	150mm
Cable	Huber+Suhner cable
Connector (plug)	SAIB connector 123-319-04 ind C –

ANNEX B1 - ATC Mechanical Interface Requirement

	AUD-SP-ADPE-004 ind C (Alstom ref. 22905)

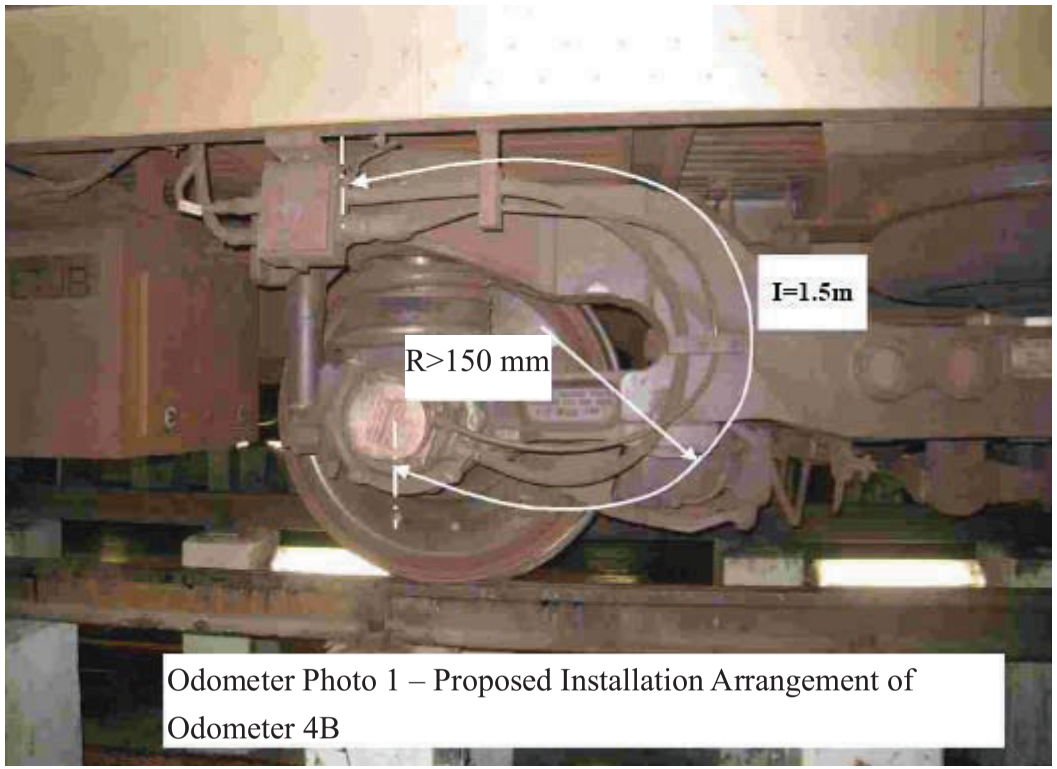
B1.O.1.2 Odometer 4B Environmental Specifications

Temperature (EN 50-155 Class T3)	-40°C / +70°C
Hygrometry	95% RH
Dielectric strength (EN 50-155)	1000V RMS, 50Hz, for 1 minute
EMC	according EN50121-3-2
Vibrations (IEC 61373) (Cat3) 300 m.s	300 m.s-2 RMS, 10Hz<f<500Hz on vertical axis 270 m.s-2 RMS, 10Hz<f<500Hz on transverse axis 135 m.s-2 RMS, 10Hz<f<500Hz on longitudinal axis
Shocks (IEC 61373)	1000 m.s-2 (peak), 6ms on 3 axis (Half sine pulse, 6 directions)
Protection (EN60529)	IP68
Salt spray (IEC68-2-11)	500 hours
Fire and smokes	according NFF16101, NFF16102 (Requirement 0)

B1.O.1.3 Odometer 4B Mounting precautions

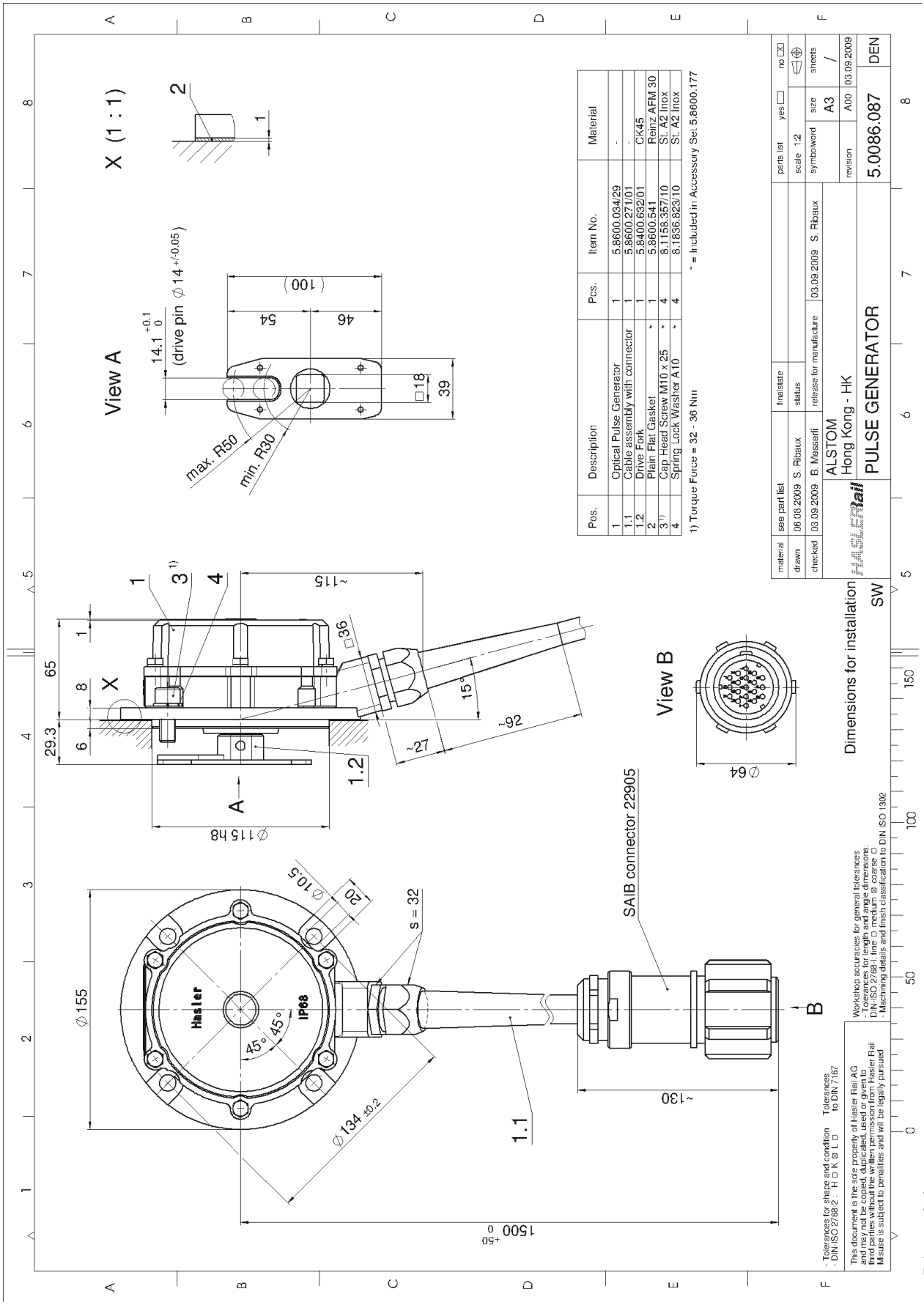
The cable must be attached to the bogie frame, near the Odometer body. Its connection with the under frame of the car must be made as short as possible, according its minimal bending radius and movement of the bogie in relation to the body. The under frame position of the socket is chosen to reduce the clearance between body car and bogie frame. The odometer must be mounted on a free axle (not motorized and not service braked).

ANNEX B1 - ATC Mechanical Interface Requirement



Odometer Photo 1 – Proposed Installation Arrangement of Odometer 4B

ANNEX B1 - ATC Mechanical Interface Requirement



Pos.	Description	Pcs.	Item No.	Material
1	Optical Pulse Generator	1	5.8600.034/29	-
1.1	Cable assembly with connector	1	5.8600.271/01	-
1.2	Drive Fork	1	5.8400.632/01	CK45
2	Plain Flat Gasket	* 1	5.8600.541	Reinz AFM 30
3 1)	Cap Head Screw M10 x 25	* 4	8.1158.357/10	St. A2 Inox
4	Spring Lock Washer A10	* 4	8.1836.823/10	St. A2 Inox

1) Torque Force = 32 - 36 Nm

* = Included in Accessory Set 5.8600.177

FIGURE OD1 – Odometer 4B Assembly

Annex B1 rev. 2.4
Date: 14 Jan 11

ANNEX B1 - ATC Mechanical Interface Requirement

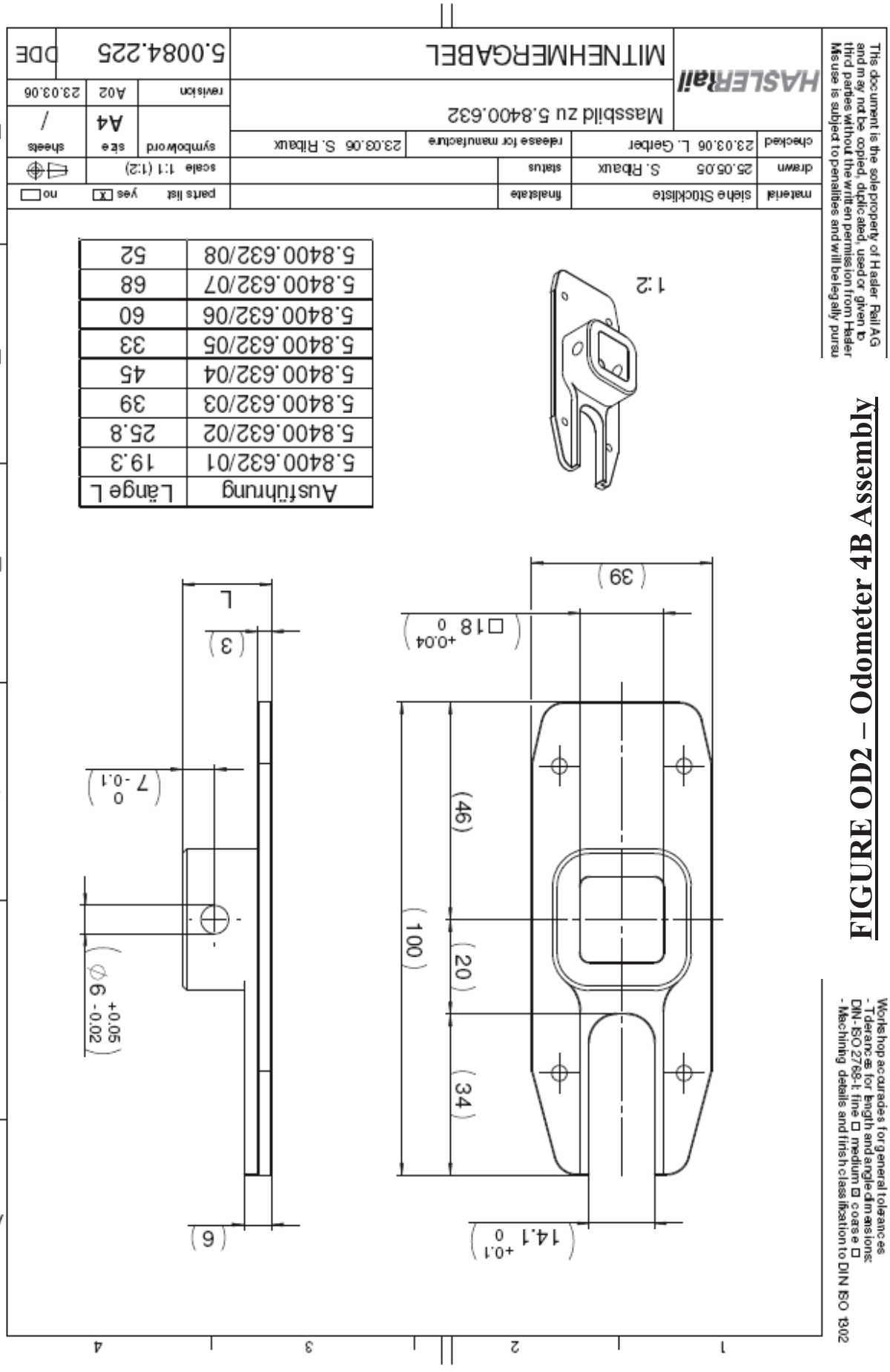
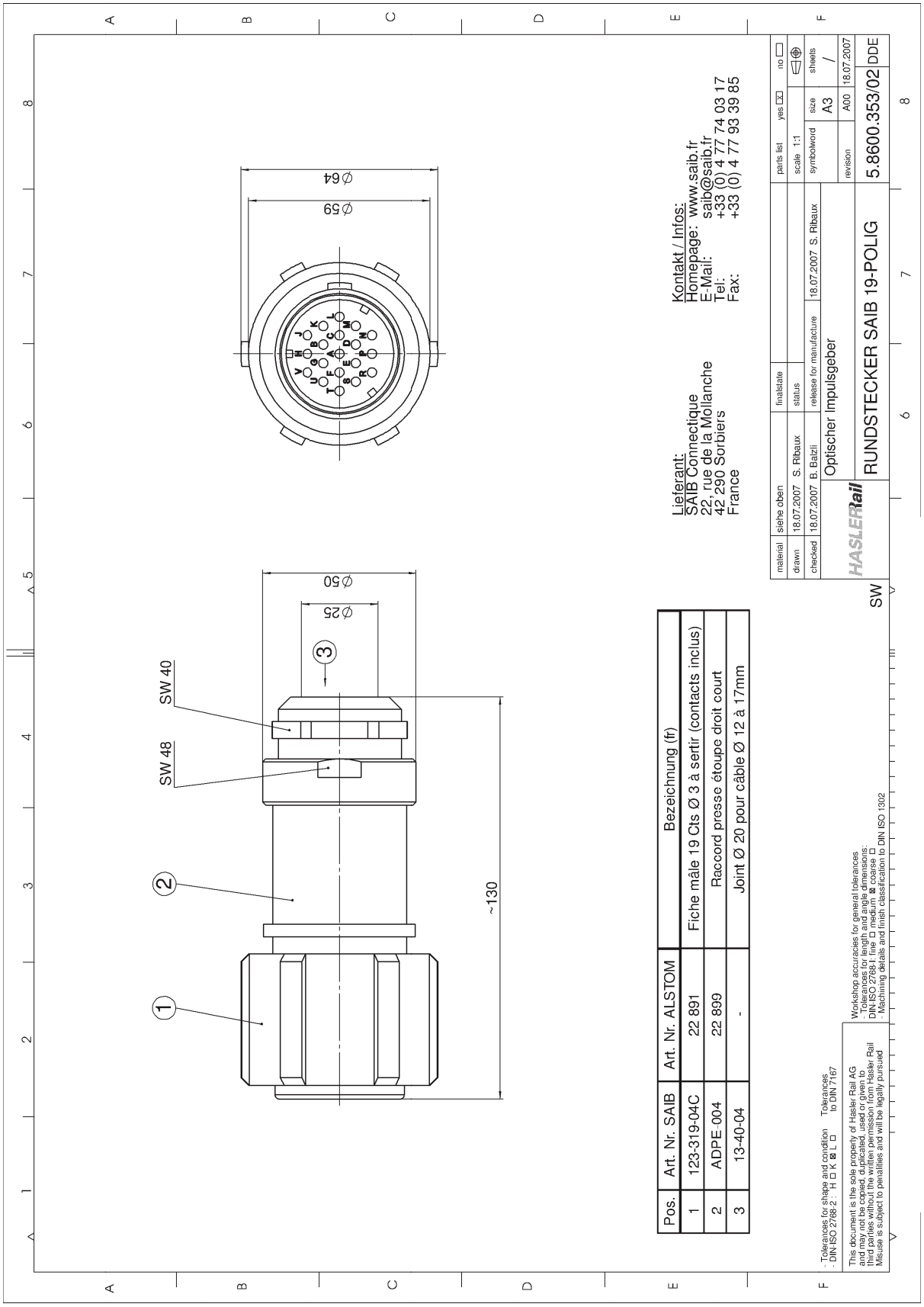


FIGURE OD2 – Odometer 4B Assembly

Annex B1 rev. 2.4
Date: 14 Jan 11

ANNEX B1 - ATC Mechanical Interface Requirement



Pos.	Art. Nr. SAIB	Art. Nr. ALSTOM	Bezeichnung (fr)
1	123-319-04C	22 891	Fiche mâle 19 Cts Ø 3 à sertir (contacts inclus)
2	ADPE-004	22 899	Raccord presse étoupe droit court
3	13-40-04	-	Joint Ø 20 pour câble Ø 12 à 17mm

FIGURE OD3 – Odometer 4B Plug

Annex B1 rev. 2.4
Date: 14 Jan 11

HASLERRail

ANNEX B1 - ATC Mechanical Interface Requirement

Security Class
EXTERN

1. Generator data

Outline drawing: *5.0086.087DEN*

Sensor location:

☒ Outer track	☒ Inner track	Sensor type *5.8600.120/..*
☒ A	☐ A	*47 rev. B00*
☒ B	☐ B	*47 rev. B00*
☒ C	☐ C	*47 rev. B00*
☐ D	☒ D	*47 rev. B00*
☐ E	☐ E	

Electrical adjustement:
(Sensor stagger)

Adjustments, connection and test according to Test Rule document 5.8602.034/05JEN
Test Protocol according to 5.8602.034/05QML
Assembly according to drawing 5.8600.010 Bl.1

No. of pulses:

	Outer track	Inner track
5.8600.809 rev. A	*100*	*special code*

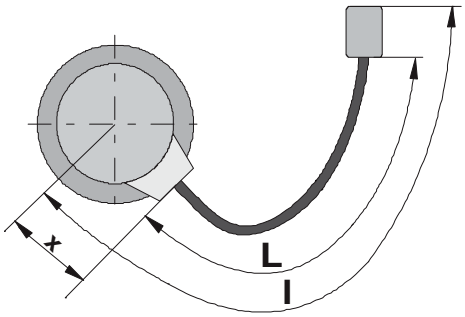
NT8540158/02

Cable set: *5.8600.271/01 rev. A* ☐ Free end cut ☒ With connector

Connector type: *5.8600.353/02* *SAIB 19 pole / pos.* Coding:

Cable length:

Customer length (l)	Free cable length (L)
1500 mm	*1255 mm*



l = Axle-center to connector output or cut end
L = Generator output to connector inlet or cut end

x = 115mm for 5.8600
135mm for 5.8604

Driver: *5.8400.632/01 rev. A*

2. Accessory data

Accessory set:

5.8600.177 rev. A	☐ fixed	☒ not fixed
	☐ fixed	☐ not fixed
	☐ fixed	☐ not fixed
	☐ fixed	☐ not fixed

3. Comments

Dielectric test 1500V/50Hz/1min
Cable length tolerance 0/+50mm
Alstom code-number “DTR211653" entered in customer number field of type plate.

FIGURE OD4 - Odometer 4B Cable Assembly

Author	S. Ribaux	06.08.2009
Reviewed	B. Messerli	03.09.2009
Released	S. Ribaux	03.09.2009
Version	**A01, 2009-09-03 SRi**	

ALSTOM **HONG KONG - HK**

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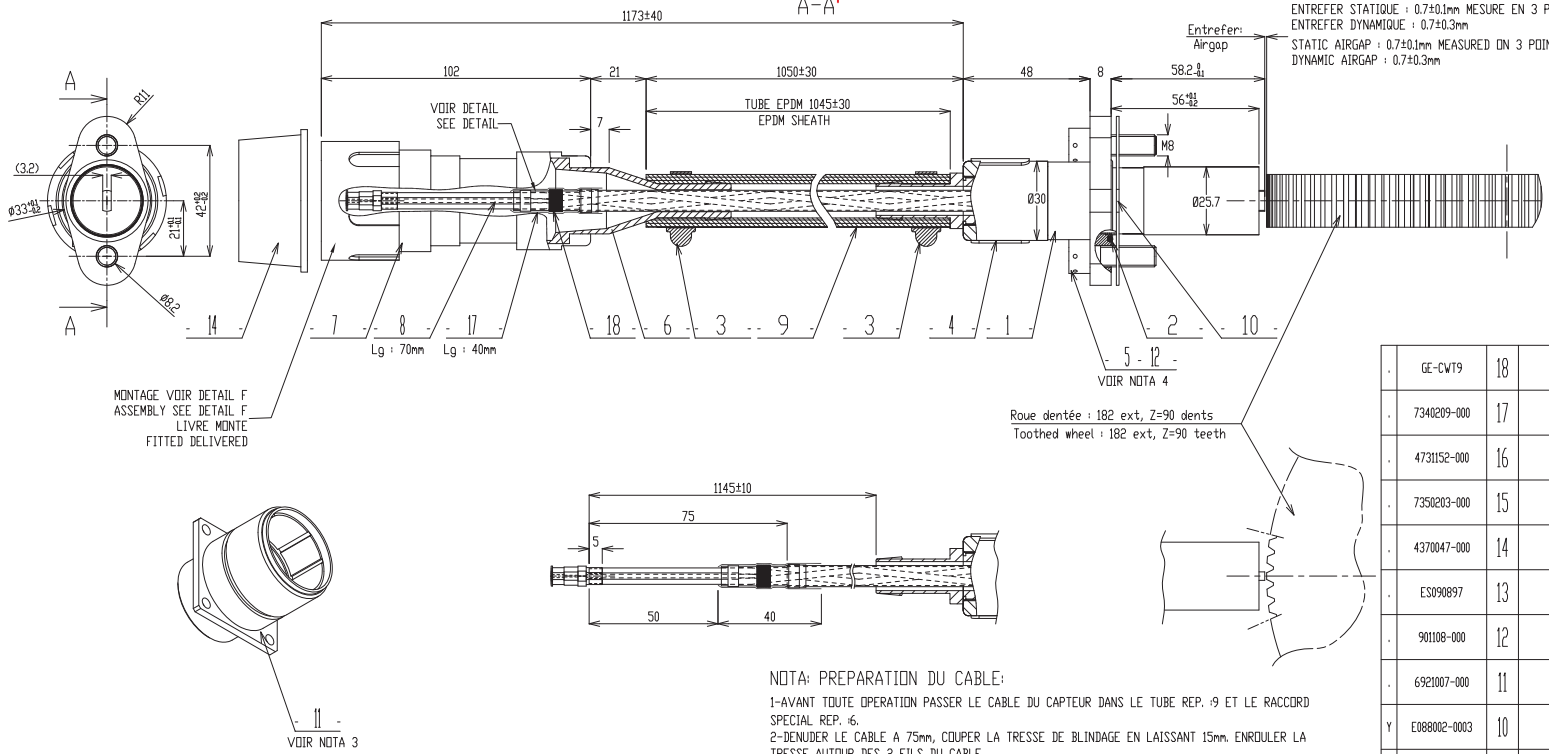
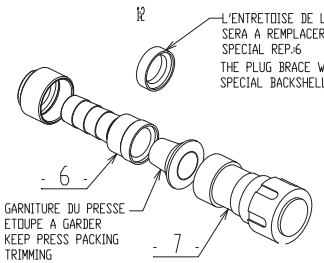
5.8600.034/29 **KEN**

Annex B1 - ATC Mechanical Interface Requirement



.	GE-CWT9	18		1	SOLDER SLEEVE MANCHON AUTOSOUDEUR	.	RAYCHEM : CWT-9	0.001
.	7340209-000	17		1	HEAT SHRINKABLE SHEATH GAINE THERMO RETRACTABLE	Lg:40mm	REF HELLERMAN HLR3050537	0.001
.	4731152-000	16		2	1.6 A 45 COLLAR COLLIER DE SERRAGE 1.6 A 45	.	PA AUTOEXT.TY-RAP-25M MIL M24693 A - S23190 B	0.001
.	7350203-000	15		1	50-70 SHEATH GAINE PLASTIQUE A MAILLES 50a70	.	PA AUTOEXT.TY-RAP-25M MIL M24693 A - S23190 B FILPACK PM15 JAUNE	0.000
.	4370047-000	14		1	CAP N100 BOUCHON N100	.	POLYETHYLENE ROUGE PLASTIMAR REF:460	0.000
.	ES090897	13		2	MALE CONTACT CONTACT MALE	.	REF KHEOPS : SNC 524 150-0083	0.000
.	901108-000	12		1	STEEL WIRE Ø0.8 FIL D'ACIER Ø0.8	Lg:150mm	SOFT STAINLESS Z2CN18 NF L 23320 INOX Z2CN18 ADOUCI NF L 23320	0.000
.	6921007-000	11		1	KHEOPS RECEPTACLE CMC 32 EA 07-13PN EMBASE KHEOPS CMC 32 EA 07-13PN	.	NF F 61-030	.
Y	E088002-0003	10		1	PELLING WEDGE CALE PELABLE	.	ALUMINUM LAMELLE JICEY	.
.	8458043-000	9		1	EPDM TUBE Ø13x20.5 TUBE EPDM Ø13x20.5	Lg:1045mm	CLIFCO REF: 13 GP 40 EPDM NOIR CLIFCO REF: 13 GP 40 EPDM NOIR	0.150
.	6831458-000	8		1	CABLE 44A0211AWG169 CABLE 44A0211AWG169	Lg:70mm	RAYCHEM	.
.	6921210-000	7		1	KHEOPS PLUG CMC 36 RD07-13SNL FICHE KHEOPS CMC 36 RD07-13SNL	.	NF F 61-030	0.156
Y	E088172-0002	6		1	SPECIAL BACKSHELL RACCORD SPECIAL		EN 10025-S235JR STEEL NF EN 10025 ACIER EN 10025-S235JR NF EN 10025	0.004
.	1870825-054	5		2	M8-25 HSHC SCREW VIS CHC A TROU DE FREINAGE M8-25	Fe/Zn8c2B Fe/Zn8c2B	8-8 STEEL NF L 22-222 ACIER CLASSE 8-8 ST1 NF L 22-222	0.015
Y	E078027-002	4		1	IDENTIFICATION LABEL PLAQUE FIRME	.	EN AW-1050A H111 ALU NF EN 485 ST 390 ALU EN AW-1050A H111 NF EN 485 ST 390	0.004
.	4740104-000	3		2	12-22 COLLAR COLLIER DIAM. 12-22	.	18-09 STAINLESS STEEL ACIER INOX 18-09 CAILLAU 082520022N	0.001
.	4542228-000	2		1	Øint 27.5-1.78 O RING JOINT TORIQUE Øint 27.5-1.78	.	CAT. 70 TR3 70 SH A LJF PD 7014 NF T 47-503 CAT. 70 TR3 70 SH A LJF	0.001
X	E088059-1006	1		1	OVERMOLDED AND EQUIPED BODY CORPS EQUIPE SURMOULE			0.5605
		.			FYCAP 88059 CAPTEUR 1CM1S (ASSEMBLY INCLUDING: FYCAP 88059 CAPTEUR 1CM1S (ENSEMBLE COMPRENANT:	VOIR NOTA		C 0.7625
Drawing supplier code Dessins ou codes constructeur	Items Repere	Symbole	Qty of part Nbre de pieces	Description of part Designation des pieces	Notes Indications particul. de fabric.	Material,norme,drawing technical specification Matiere,norme,dessin specification technique	KG unit weight Masse unitaire en KG	

DETAIL F



L'ENTRETOISE DE LA FICHE REP.:7
SERA A REMPLACER PAR LE RACCORD
SPECIAL REP.:6
THE PLUG BRACE WILL BE REPLACED BY
SPECIAL BACKSHELL REP.:6.

GARNITURE DU PRESSE
ETOUPE A GARDER
KEEP PRESS PACKING
TRIMMING

NOTA: PREPARATION DU CABLE:

1-AVANT TOUTE OPERATION PASSER LE CABLE DU CAPTEUR DANS LE TUBE REP. :9 ET LE RACCORD SPECIAL REP. :6.
2-DENUDER LE CABLE A 75mm, COUPER LA TRESSE DE BLINDAGE EN LAISSANT 15mm. ENROULER LA TRESSE AUTOUR DES 2 FILS DU CABLE.
3-LE FIL REP.:8 SERA DENUDE SUR 10mm COTE MANCHON ETAME ET SOUDE SUR LA TRESSE DE BLINDAGE LORS DU RETREIND DU MANCHON AUTO-SOUDEUR REP. : 18.
4-LE MANCHON AUTO-SOUDEUR REP. : 18 EST RECOUVERT DE GAINE THERMO-RETRACTABLE REP. : 17.
5-DENUDER LES 3 FILS A 5mm ET SERTIR LES COSSES.

NOTE: CABLE PREPARE:

1-BEFORE ANY WORK PUT THE CABLE THROUGH THE EPDM SHEATH REP.:9 AND THROUGH SPECIAL BACKSHELL REP.:6.
2-STRIP THE CABLE AT 75mm LENGTH, CUT THE SHIELDING BRAID BY RESERVING 15mm LENGTH. ROLLUP THE BRAID AROUND THE 2 WIRES OF THE CABLE
3-THE WIRE REP.:8 WILL BE STRIPPED ON 10mm ON SOLDER SLEEVE SIDE AND WELDED ON SHIELDING BRAID REP.:18.
4-THE SOLDER SLEEVE REP.:18 IS COVERED WITH THERMOSHRINKABLE SHEATH REP.:17
5-STRIP THE WIRES AT 5mm AND CRIMP THE TERMINALS.

NOTE:

CE PRODUIT FAIT L'OBJET D'UN PLAN DE CONTROLE PC E088059-F103-PC

NOTE:

THIS PRODUCT IS ASSEMBLED ACCORDING TO PC E088059-F103-PC CONTROL PLAN

NOTA:

1-LA PLAQUE FIRME REP: 4 SERA CINTREE ET COLLEE AU TEROSTAT 33
CODE FY 9510214-000 SUIVANT INS-06011 ET REMPLIE SUIVANT INS-07095.
2-LE BOUCHON PLASTIQUE REP.:14, LA GAINE PLASTIQUE REP.15 et LES COLLIERS REP.16 SERVENT POUR L'EMBALLAGE DU CABLOT.
3-LES REP.11 ET 13 SONT LIVRES EN KIT NON MONTES
4-COUPLE DE SERRAGE 22 N.m + FREIN FILET MOYEN (EXEMPLE LOCTITE 243)
BLOQUER LES VIS AVEC UN FIL INOXYDABLE REP.: 12.

NOTE:

1-THE IDENTIFICATION LABEL REP.:4 WILL BE CURVED AND STICKED WITH TEROSTAT 33. (FY9510214-000) ACCORDING TO INS-6011 AND FULL FILLED ACCORDING TO INS-07095
2-THE PLASTIC CAP REP.:14, PLASTIC SHEATH AND COLLERS ARE USED FOR CABLET PACKING.
3-THE PARTS REP.:11 AND REP.:13 ARE DELIVERED NOT ASSEMBLIED.
4-TIGHTENING TORQUE 22N.M MEDIUM THREAD LOCKING GLUE (EX:LOCTITE 243)
LOCK THE SCREWS WITH STAINLESS WIRE REP.:12.

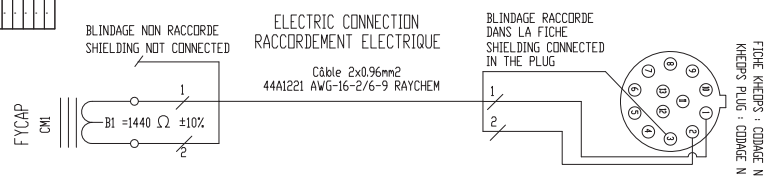


Figure OD5_1 Odometer 3A Assembly

B2	BDD N°100130 BMA	DATE	NOM		
B1	BDD N°100118 BMA	DRAWN 19-02-18	BMA		
A2	BDD N°100315 BMA	DESIGN			
A1	BDD N°100303 BMA	CHECKED 30-11-18	AMA		
Modifications		APPROVED			

Specif. gene. NF F 00-037 MOYEN

Replace/Remplace

DATE	NOM

CHECKED / VERIFIE / APPROVED / APPROUVE

	SCALE / ECH.	1 : 1
A1		

	V E088059-2106
	FYCAP 88059 CAPTEUR 1CM1S
	FYCAP 88059 SENSOR 1CM1S

Detailed Interface Design Specification for Automatic Train Control
Appendix A

DETAILED INTERFACE SPECIFICATION

ANNEX B2
ATC EQUIPMENT ENCLOSURE - CAB LAYOUT

提 供 资 料 通 知 单

共 3 页 第 1 页

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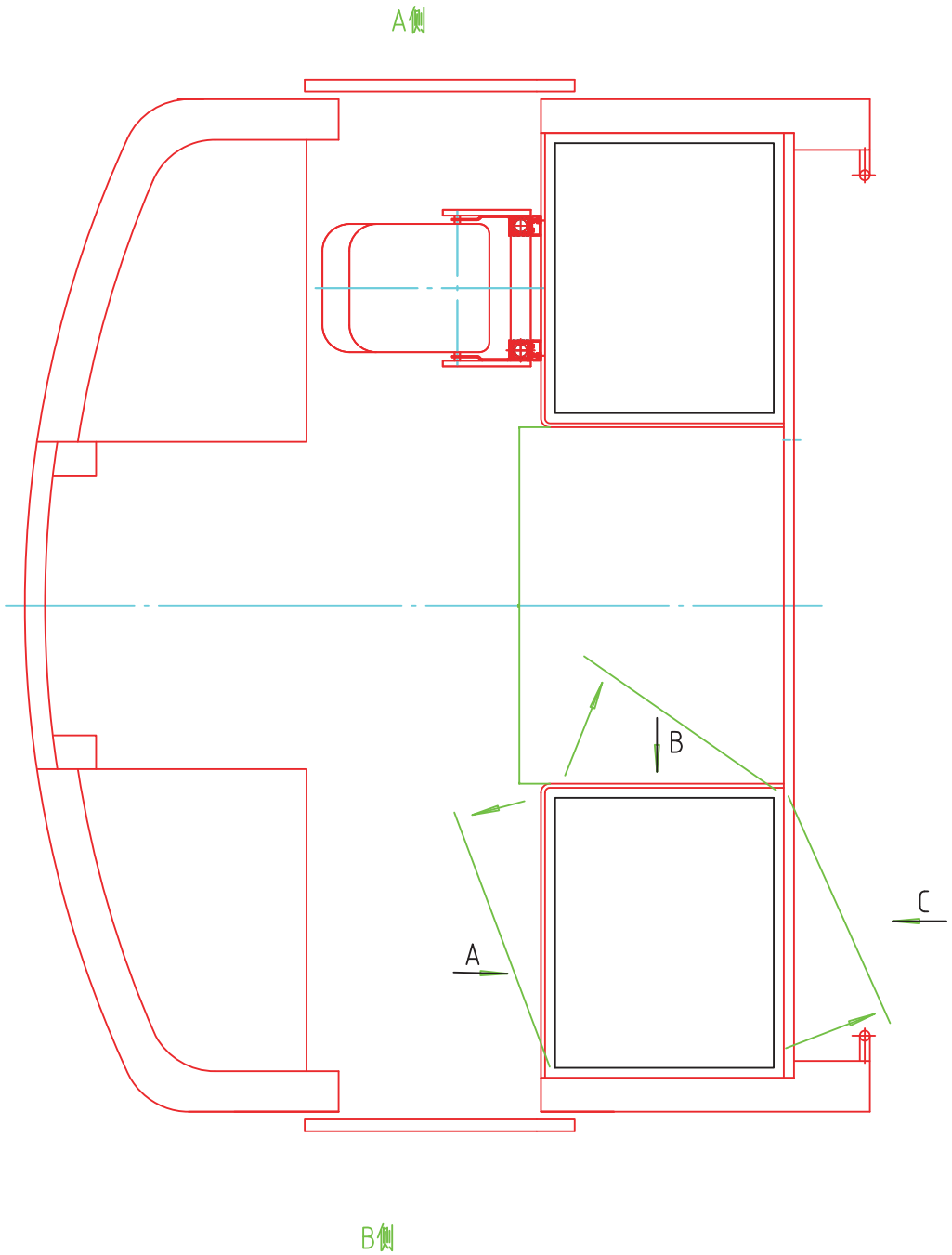
编号: DK108-44-001.3



提供者	日期	资料审核	日期	接收负责者	日期	接收处理者	日期		签收
王 莉	09.8.13								
主管设计师	日期	接口经理	日期	处理意见:					

提 供 资 料 通 知 单

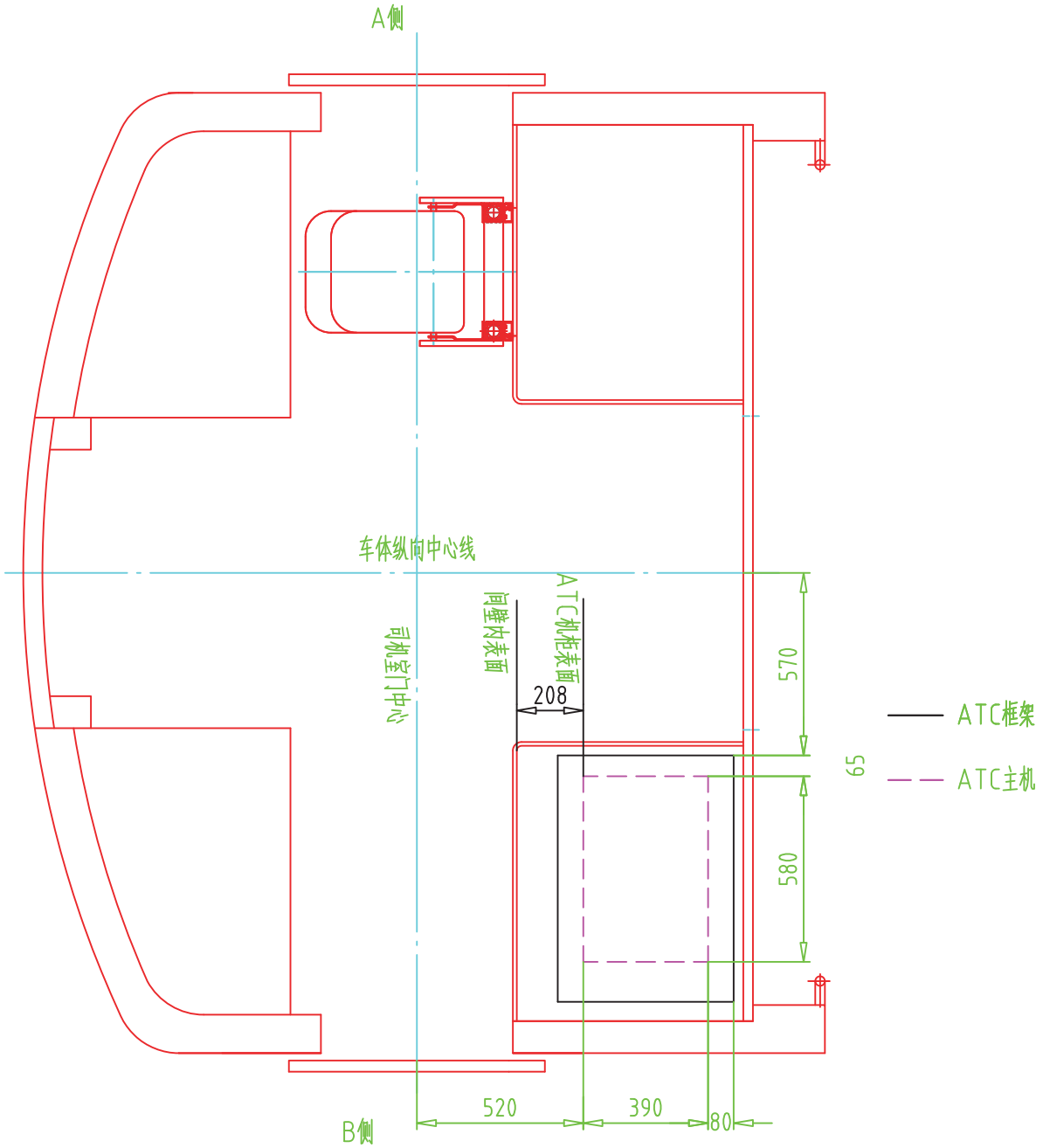
共 3 页 第 1 页

修改标记	处数	签名	日期

编号: DK108-44-0012

为开司机室电气柜检查门

1、请在司机室电气柜立罩板上开如C/D/E向视图所示的检查门,检查门尺寸均为净开度。



提供者	日期	资料审核	日期	接收负责者	日期	接收处理者	日期		签收
王 莉	10.3.15								
主管设计师	日期	接口经理	日期	处理意见:					

提供资料通知单

修改标记	处数	签名	日期

编号：DK108-44-0012

B侧电气柜：

1）C向开如图所示的两体检查门，上部为折页门，折页靠近侧墙。下部为可摘卸的检查门。

2）D向开如图所示的两体检查门，上部与下部均为折页门，折页在靠近间壁门侧。

3）E向开如图所示的折页门，折页在靠近车体中心侧。折页门能打开130度。

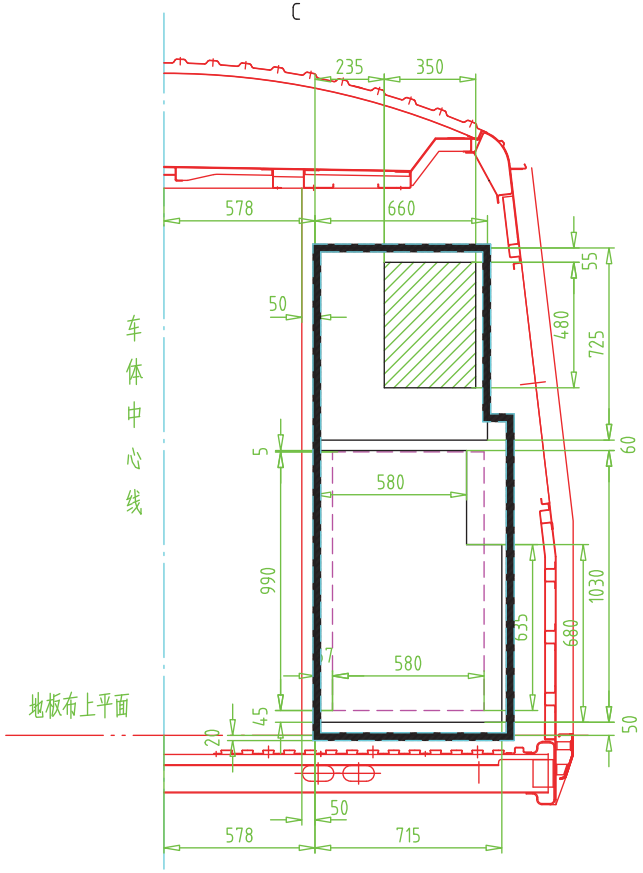
ATC 主机

ATC 框架

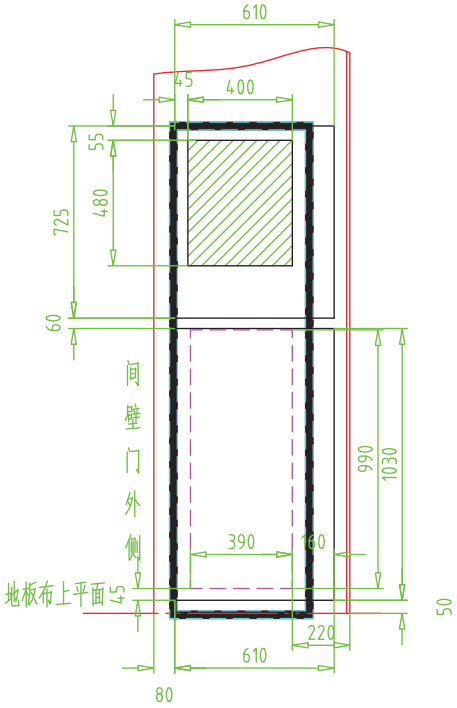
检查门边缘

车体及内装

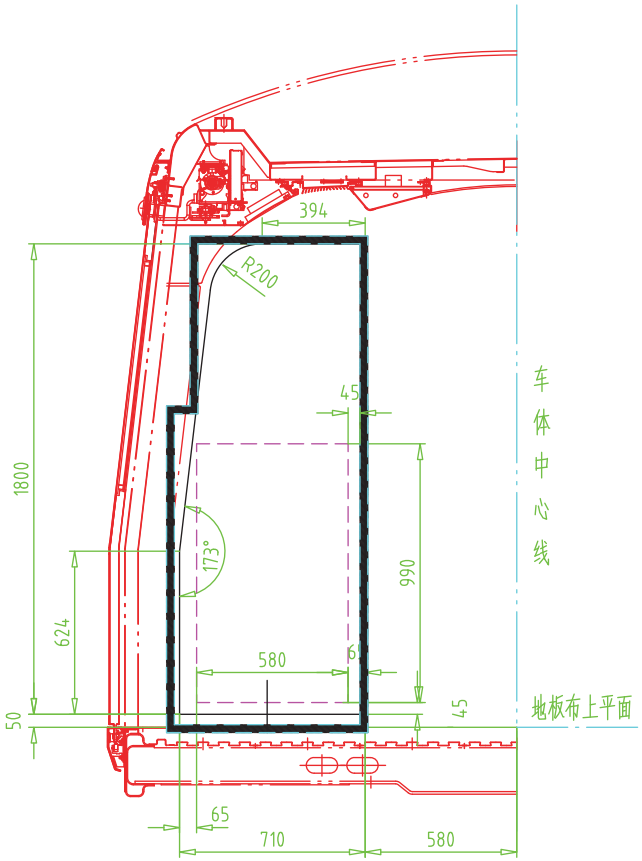
C



D



E



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主管设计师	日期	接口经理	日期	处理意见：					

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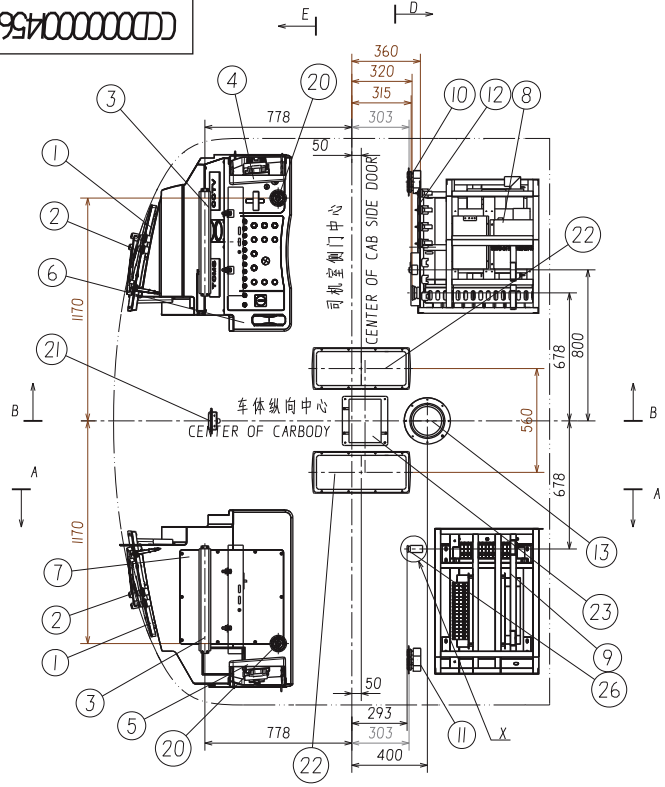

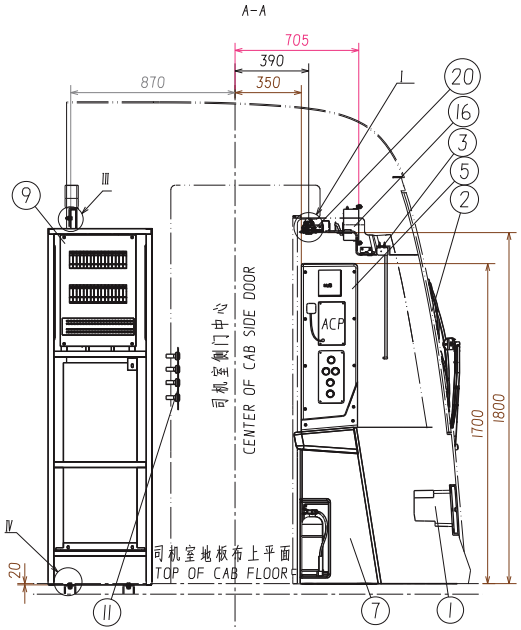

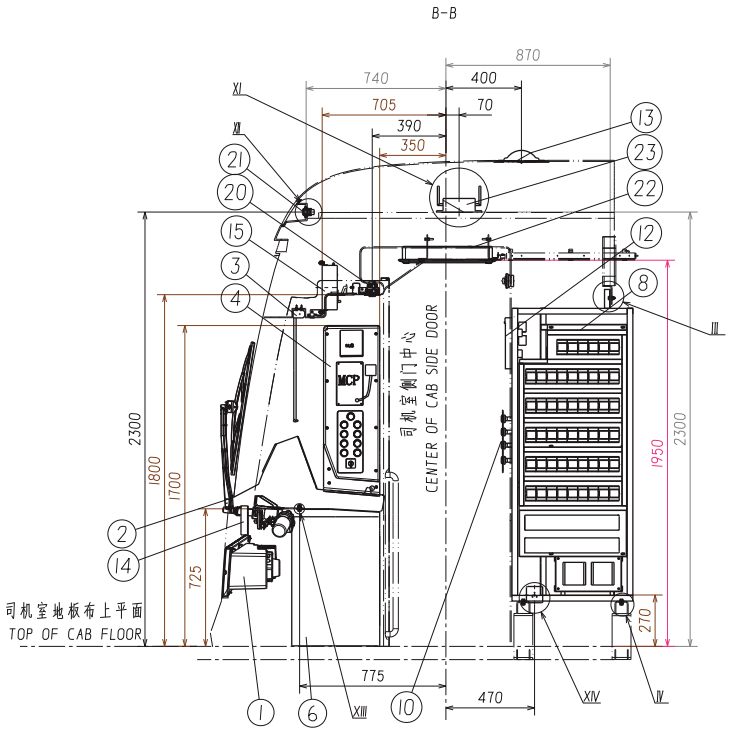

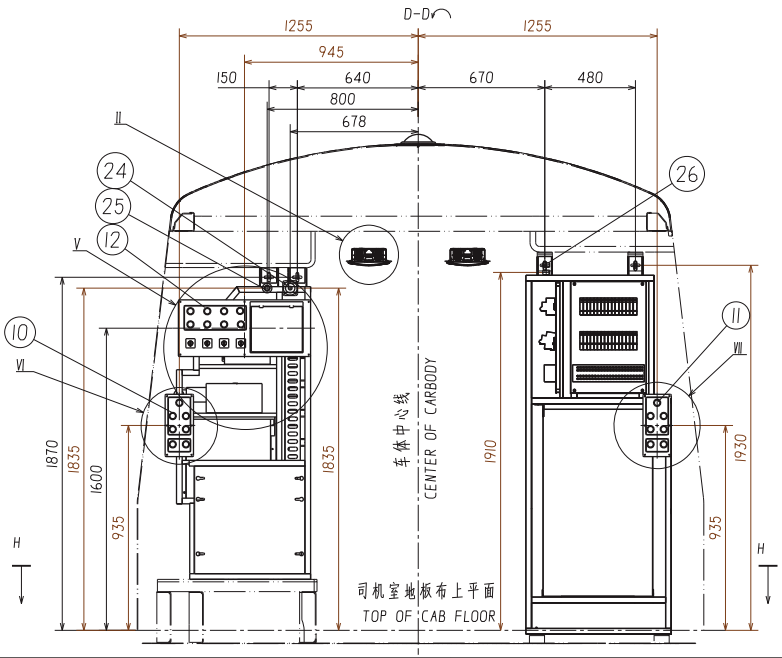

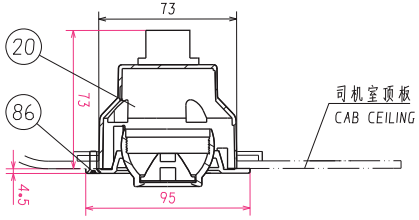

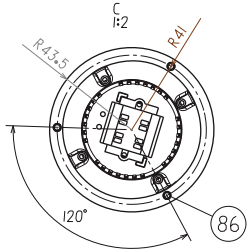

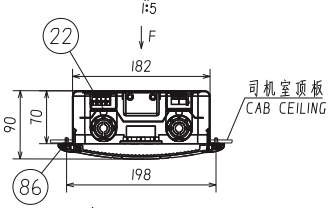

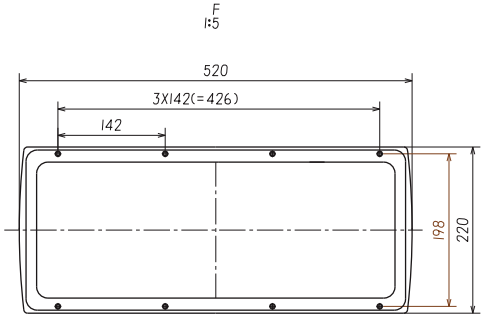

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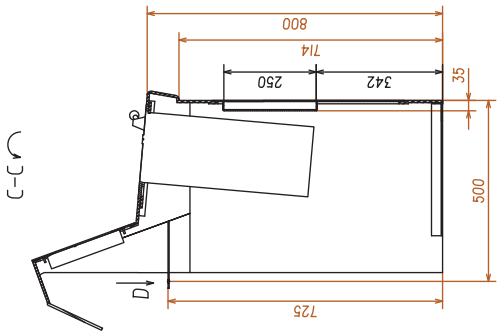
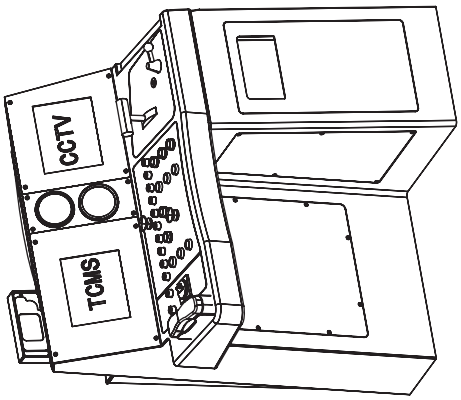
设计		焊接工程师		版本 REV	重量 WEIGHT	比例 SCALE	图幅 MAPSHEET	司机室电气安装 CAB ELECTRICAL ASSEMBLY
审核		相关工艺1			939.279	1:20	A2	
区域审核		相关工艺2						CCD00000014560
主管		审批				页次 PAGE		303845
		批准				1/4		
工艺		绘图软件 CATIA V5						

Detailed Interface Design Specification for Automatic Train Control

Appendix 3





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主司机台
MAIN CONSOLE

CCD000000015726

306432

设 计	焊接工程师	版本 REV	重 量 WEIGHT	比 例 SCALE	图幅 MAPSHEET
审 核	相关工艺	A	87	1:10	A2
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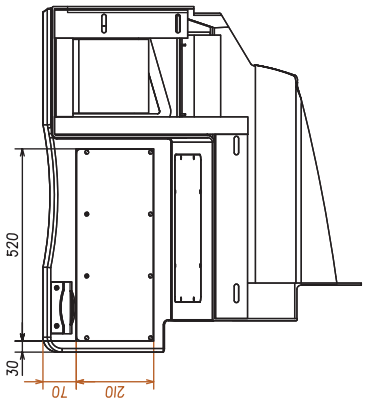

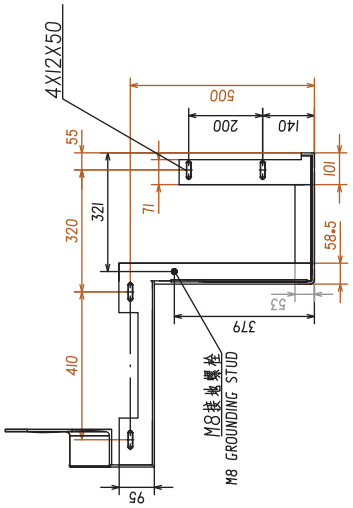

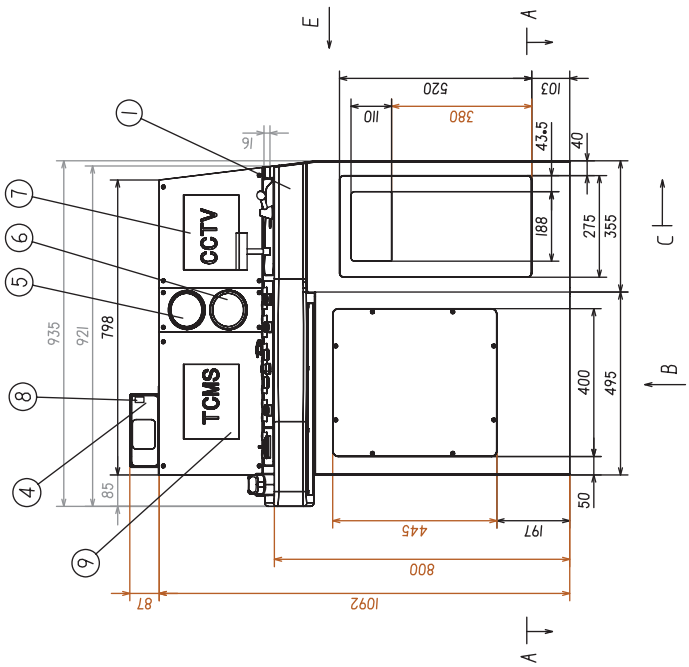

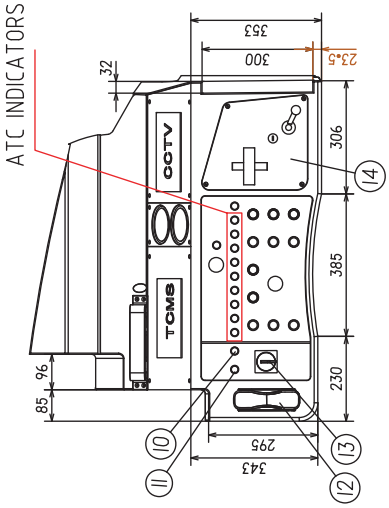

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	旧底图总号				

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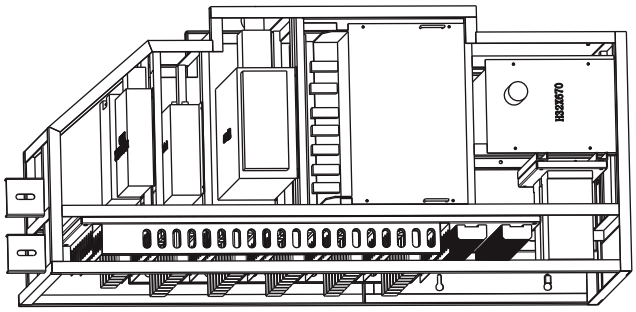
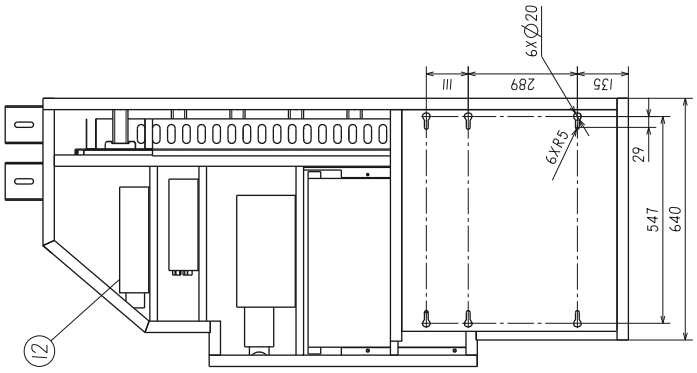
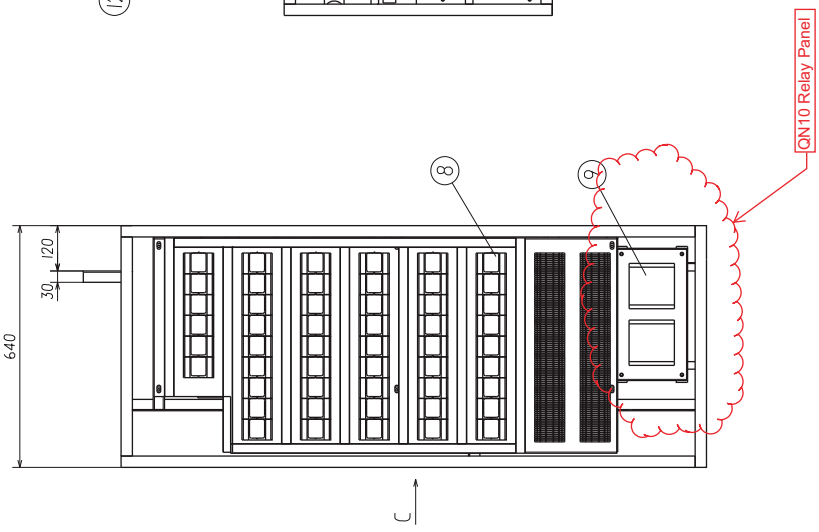
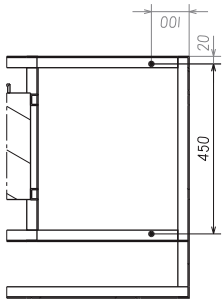
DETAILED INTERFACE SPECIFICATION

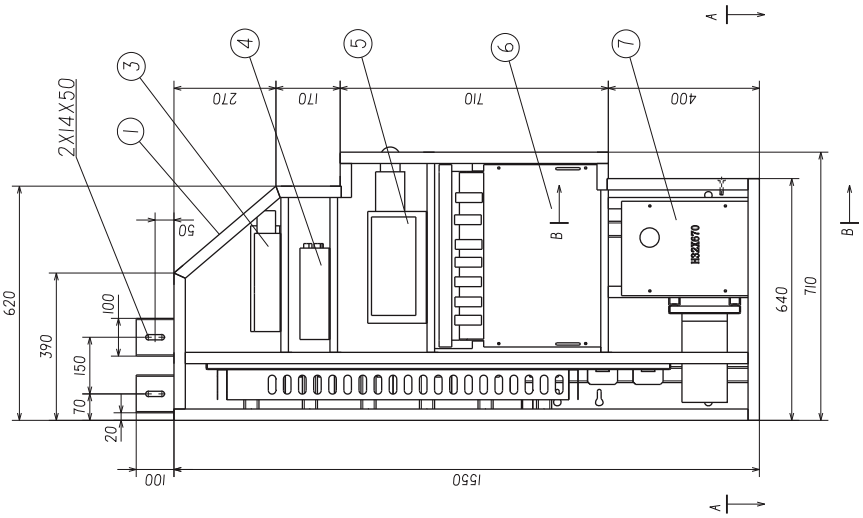
ANNEX B3
ATC RACK INSTALLATION

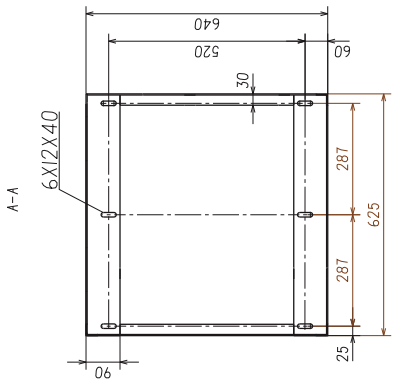












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审 核	付春风	20D-3-20	相关工艺
区域审核			相关主管
主 管	周 勇	20D-3-20	审 批
工 艺	赵锋林	20D-4-30	绘图软件 CATIA V5

版本 REV	更改文件编号 MODIFIED DOC NO	日 期 DATE	签 名 SIGN

版本 REV	更改文件编号 MODIFIED DOC NO	日 期 DATE	签 名 SIGN

综合电气柜
INTEGRATED ELECTRICAL CUBICLE

CCDDOOOOOOO18633

306429

版本 REV	重 量 WEIGHT	比 例 SCALE	图幅 MAPSHEET
A	175.6	1:10	A2

页 次 PAGE 1/2

供	单位	数量
	旧底图总号	
底图总号		
字		
期		

技术要求

1、颜色见本车油漆技术条件。
2、明细表中所有设备要组成一体后整体供货。
3、件号17为接地栓，不要喷漆，保证有良好的接触面。

NOTES

1. THE COLOR SHALL COMPLY WITH THE PAINTING TECHNICAL REQUIREMENT.
2. ALL THE EQUIPMENTS IN THE LIST SHALL BE SUPPLIED AFTER BEING ASSEMBLED AS A WHOLE.
3. ITEM 17 IS GROUNDING STUD.DON'T PAINT IT TO MAKE SURE IT HAS GOOD TOUCH SURFACE.

序号 ITEM	物料码 PARTCODENUMBER	图文档码 DOC NUMBER	物料名称 DESCRIPTION	数量 QTY	材料 MATERIAL	单重 WEIGHT	附注 REMARKS
20	305644		电缆(骨连接器)PMU-102 CABLEWITH CONNECTOR	10M		1.08	用户提供 SUPPLIED BY CUSTOMER
19							
18							
17							
16	305764		PWM插针6412 16.31 PIN	30		0.001	三菱 MELCO
15	302138		PWM连接器MS05CW-24-31PN PWM CONNECTOR	1		0.01	三菱 MELCO
14							
13							
12	306695		24V直流电源模块 24VDC CONVERTER	1		3	柜体自带 SUPPLIED WITH CUBICLE
11							
10							
9	295018		ATC QN10继电器屏 ATC QN10 RELAY PANEL	1		10	用户提供 SUPPLIED BY CUSTOMER
8	295020		ATC继电器 ATC RELAY	4		0.04	用户提供 SUPPLIED BY CUSTOMER
7	295016		PWM产生器 PWM GENERATOR	1		8	三菱 MELCO
6	295014		TMS主控单元 CU	1		17	三菱 MELCO
5	295017		自动门控器 ATDC	1		13	用户提供 SUPPLIED BY CUSTOMER
4	295034		无线系统主机 TRAIN HOST UNIT	1		6	中电 CLPE
3	295015		TMS显示控制器 DC	1		2.6	三菱 MELCO
2							
1	295010		柜体组成 CUBICLE BRACKET	1		105	柜体自带 SUPPLIED WITH CUBICLE

序号 ITEM	物料码 PARTCODENUMBER	图文档码 DOC NUMBER	物料名称 DESCRIPTION	数量 QTY	材料 MATERIAL	单重 WEIGHT	附注 REMARKS

版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN

设计	王莉	2010-3-19	焊接工程师				
审核	付春风	2010-3-20	相关工艺1				
区域审核			相关工艺2				
主管	周勇	2010-3-20	审批				
			批准				
工艺	赵锡林	2010-4-30	绘图软件 CATIA V5				

版本 REV	重量 WEIGHT	比例 SCALE	图幅 MAPSHEET
A	175.6	1:10	A2

页次 PAGE 2/2

综合电气柜
INTEGRATED CUBICLE

CCD00000018633

306429

数	
协供	
单位	数量
旧底图总号	
底图总号	
字	
日期	

修改标记	处数	签名	日期

编号：DK108-44-0012

B侧电气柜：

1）C向开如图所示的两体检查门，上部为折页门，折页靠近侧墙。下部为可摘卸的检查门。

2）D向开如图所示的两体检查门，上部与下部均为折页门，折页在靠近间壁门侧。

3）E向开如图所示的折页门，折页在靠近车体中心侧。折页门能打开130度。

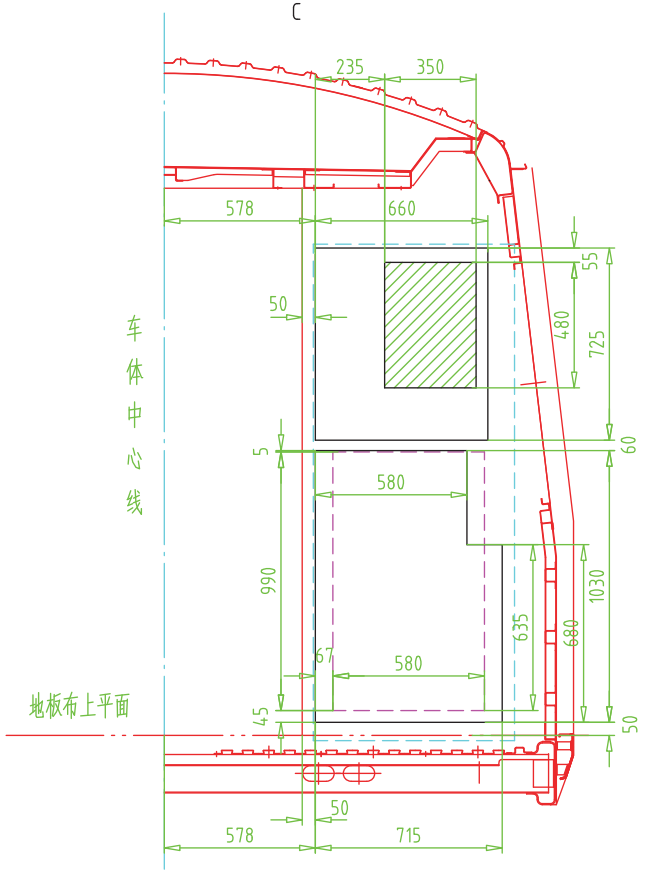
ATC 主机

ATC 框架

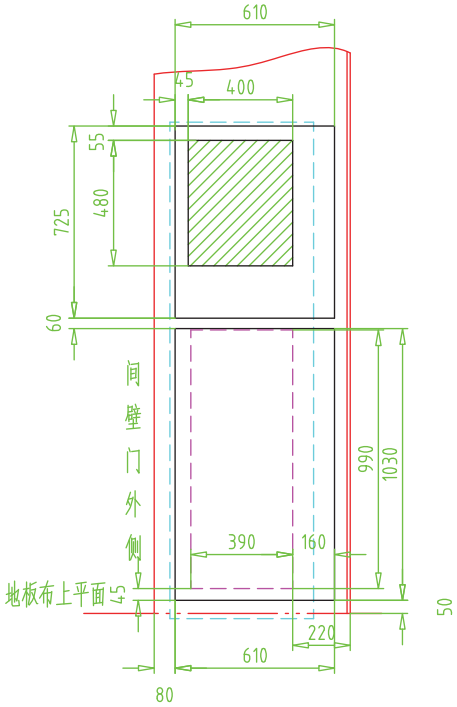
检查门边缘

车体及内装

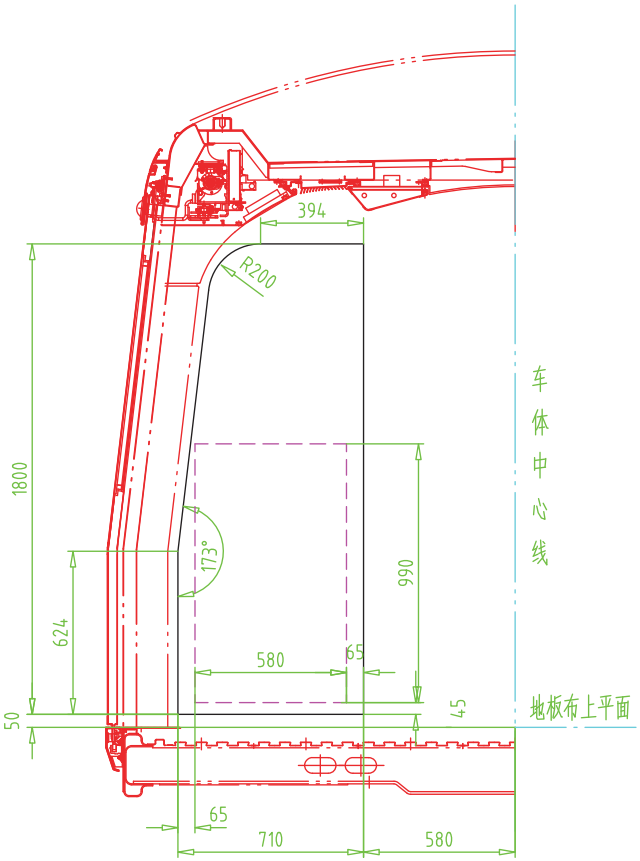
C



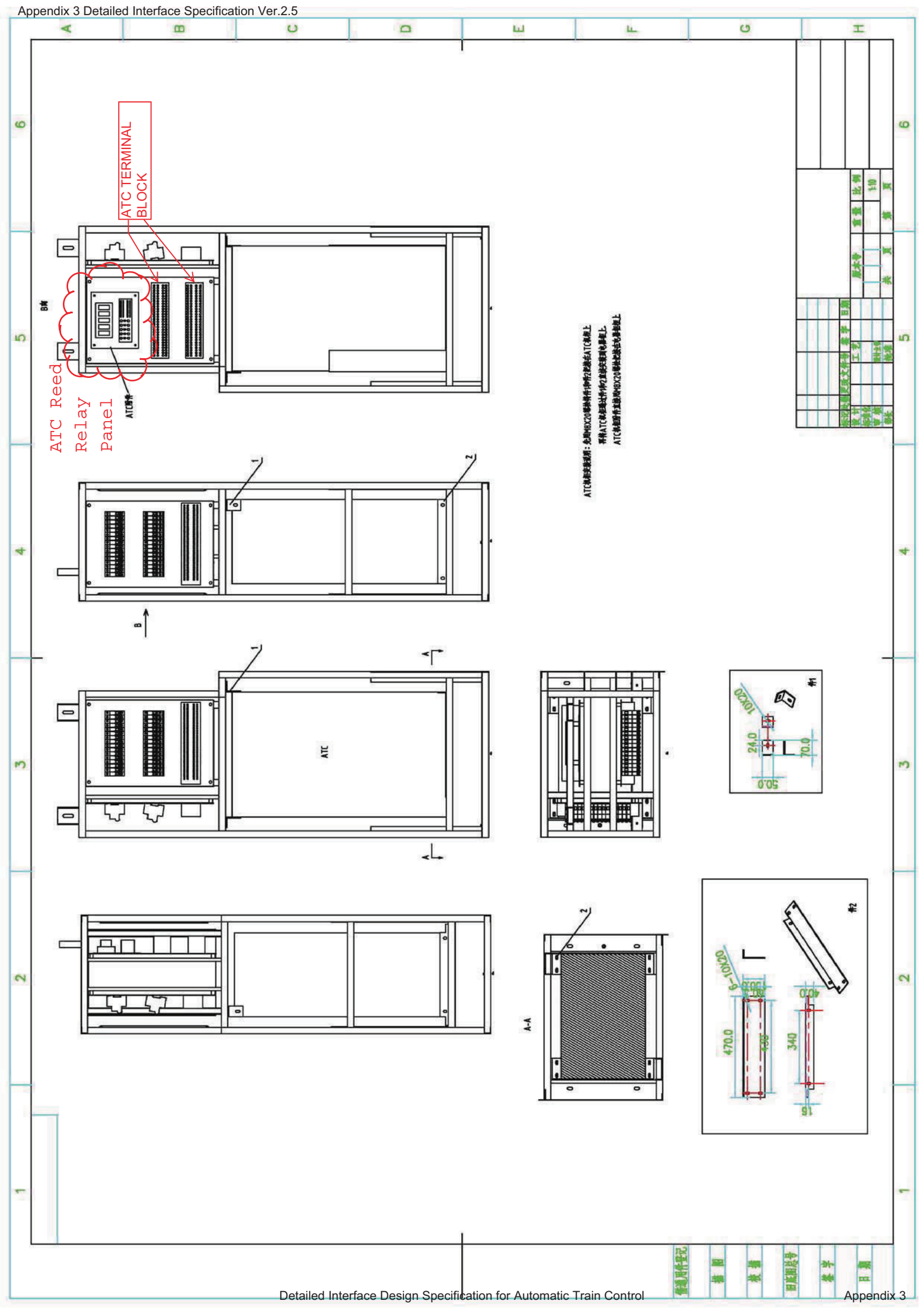
D



E

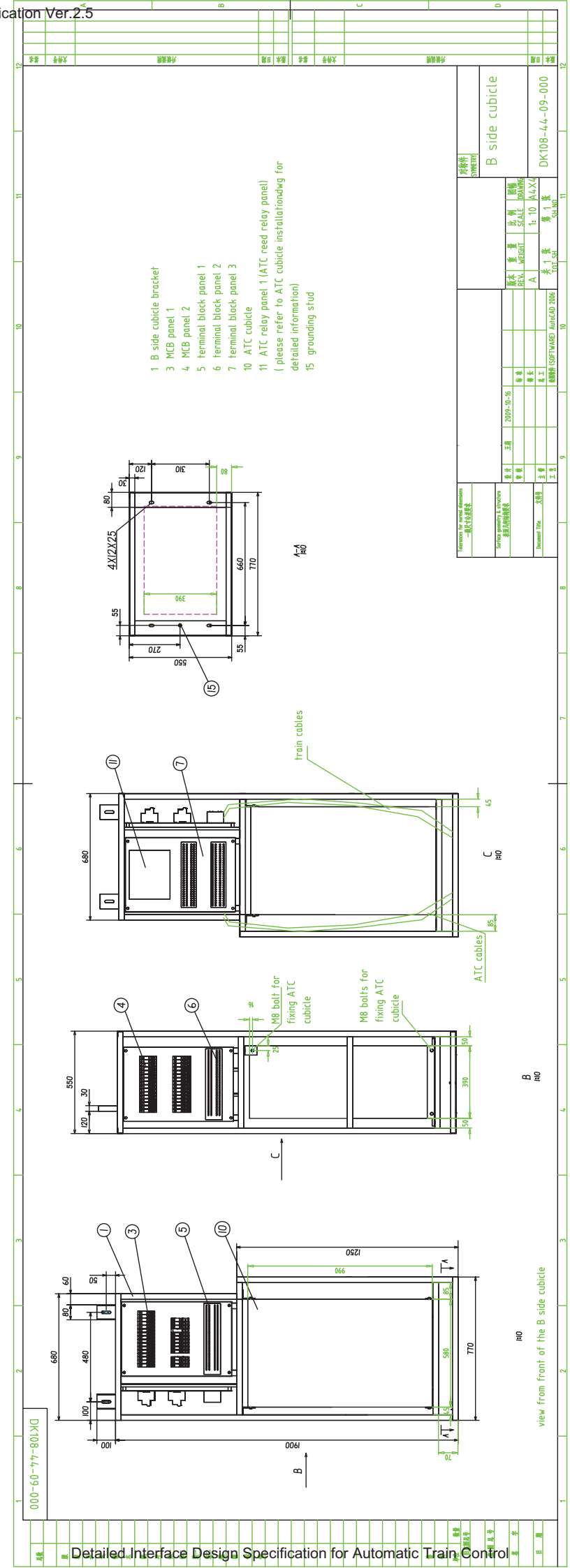


提供者	日期	资料审核	日期	接收负责者	日期	接收处理者	日期		签收
王莉	10.01.28								
主管设计师	日期	接口经理	日期	处理意见：					


ATC TERMINAL BLOCK
ATC Reed Relay Panel
ATC
A-A
B
A
1
2

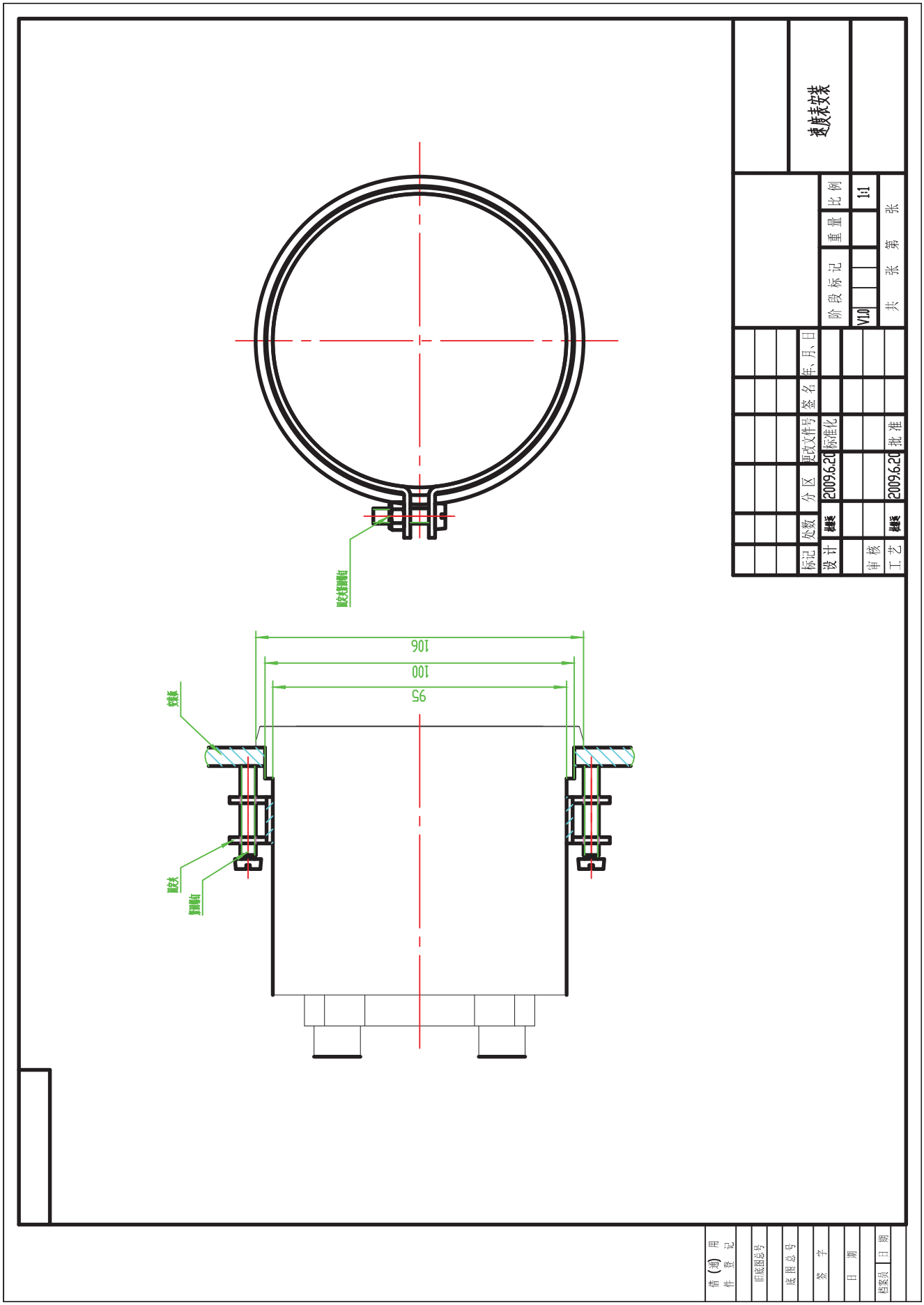
DETAILED INTERFACE SPECIFICATION

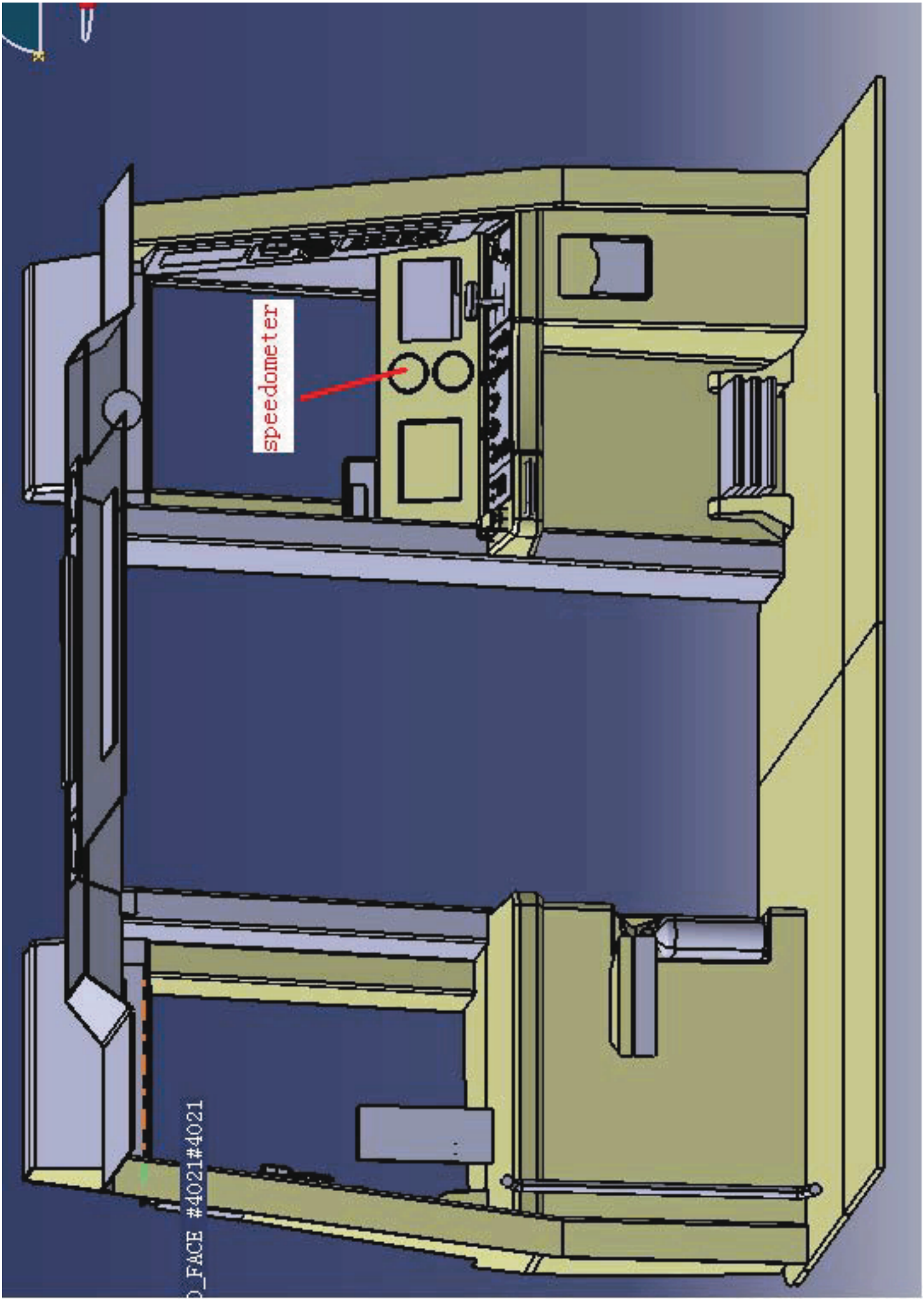
ANNEX B4
ATC RACK CABLING


B side cubicle
DK108-44-09-000
1 B side cubicle bracket
3 MCB panel 1
4 MCB panel 2
5 terminal block panel 1
6 terminal block panel 2
7 terminal block panel 3
10 ATC cubicle
11 ATC relay panel 1 (ATC reed relay panel)
(please refer to ATC cubicle installationdwg for detailed information)
15 grounding stud
4X12X25
train cables
ATC cables
M8 bolt for fixing ATC cubicle
M8 bolt's for fixing ATC cubicle
view from front of the B side cubicle

DETAILED INTERFACE SPECIFICATION

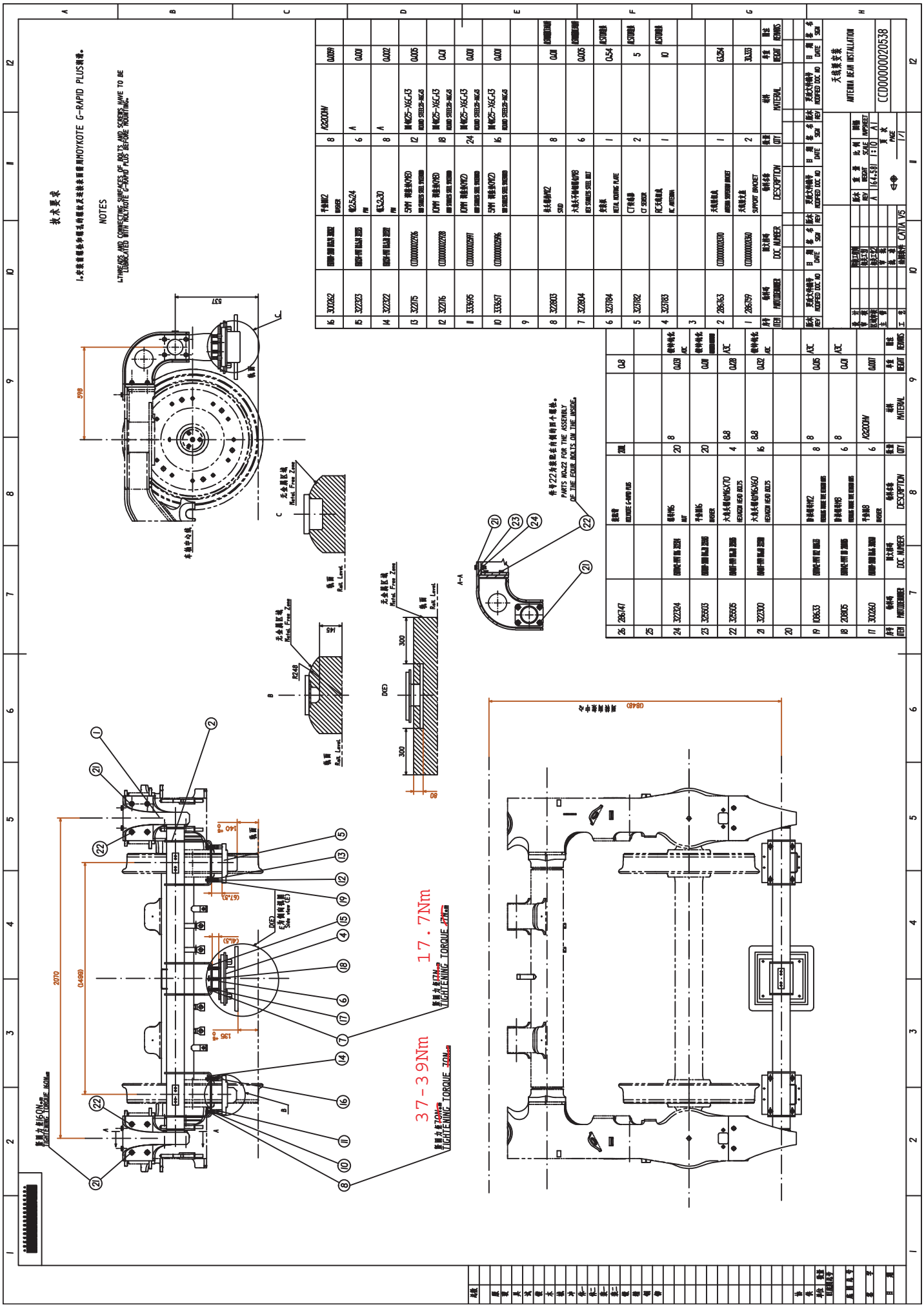
ANNEX B5
SPEEDOMETER INSTALLATION

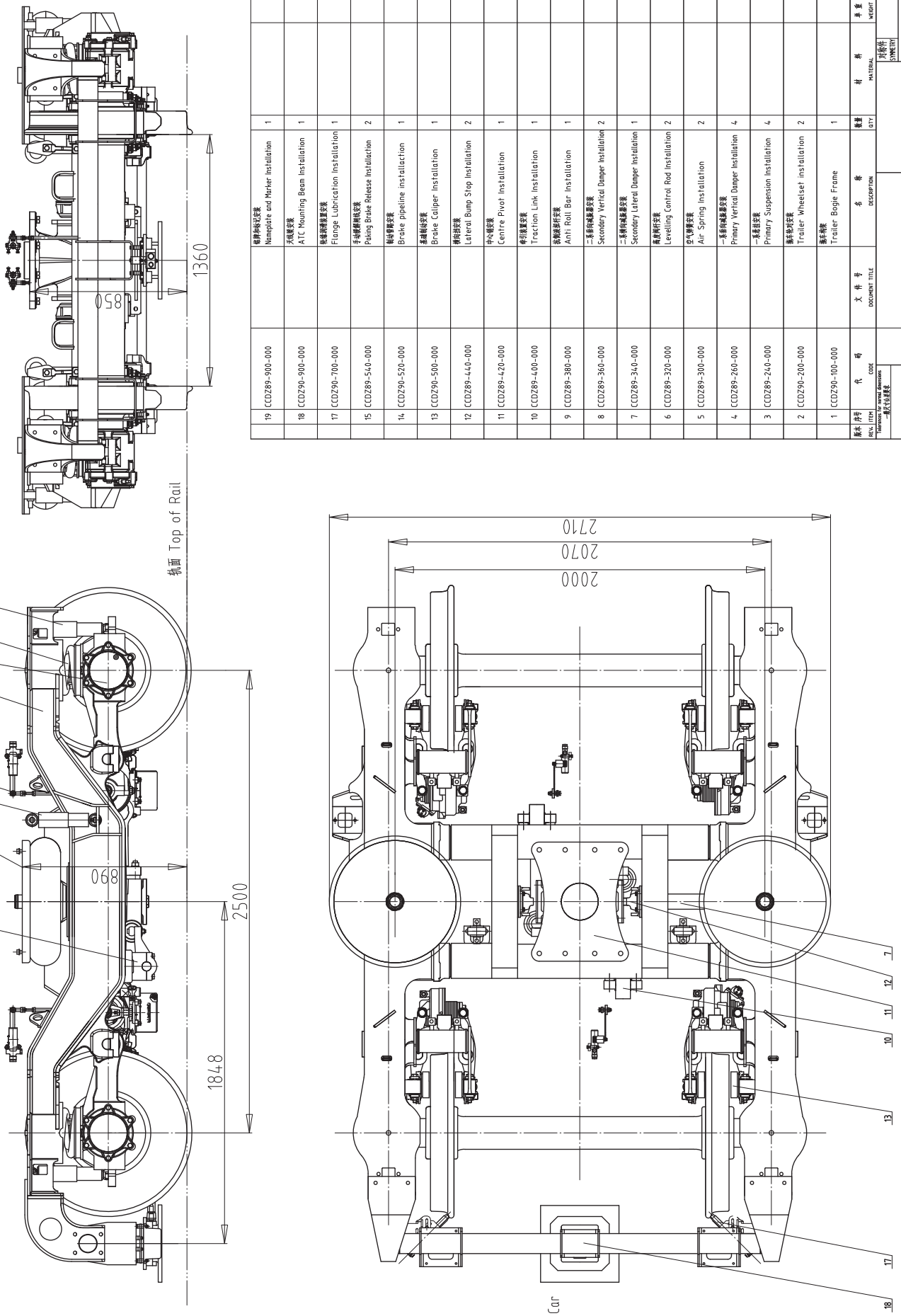

速度传感安装
比例 1:1
重量
阶段标记 V1.0
共 张 第 张
标记 处数 分区 更改文件号 签名 年、月、日
设计 2009.6.20 标准化 批准
审核 2009.6.20
工艺
106
100
95


speedometer
D_FACE #4021#4021

DETAILED INTERFACE SPECIFICATION

ANNEX B6
ANTENNA BEAM ARRANGEMENT


技术要求
1.螺纹连接表面和螺栓螺钉表面涂MOLYKOTE G-RAPID PLUS润滑。
NOTES
1.THREADS AND CONNECTING SURFACES OF BOLTS AND SCREWS HAVE TO BE LUBRICATED WITH MOLYKOTE G-RAPID PLUS BEFORE MOUNTING.
天线安装
ANTENNA BEAM INSTALLATION
CCD0000000020538
17.7Nm
37-39Nm
Metal Free Zone
Rail Level
Side view (E)
PARTS NO.22 FOR THE ASSEMBLY OF THE FOUR BOLTS ON THE INSIDE.



序号 ITEM	代号 CODE	文件号 DOCUMENT TITLE	名称 DESCRIPTION	数量 QTY	材料 MATERIAL	单重 WEIGHT	附注 REMARK
19	CCDZ89-900-000		铭牌和标记安装 Nameplate and Marker Installation	1			
18	CCDZ90-900-000		天线支架 ATC Mounting Beam Installation	1			
17	CCDZ90-700-000		轮缘润滑装置安装 Flange Lubrication Installation	1			
15	CCDZ89-540-000		手制缓解阀组安装 Pulling Brake Release Installation	2			
14	CCDZ90-520-000		制动管路安装 Brake pipeline installation	1			
13	CCDZ90-500-000		基础制动安装 Brake Caliper Installation	1			
12	CCDZ89-440-000		横向挡安装 Lateral Bump Stop Installation	2			
11	CCDZ89-420-000		中心销安装 Centre Pivot Installation	1			
10	CCDZ89-400-000		牵引拉杆安装 Traction Link Installation	1			
9	CCDZ89-380-000		抗侧滚扭杆安装 Anti Roll Bar Installation	1			
8	CCDZ89-360-000		二系垂向减振器安装 Secondary Vertical Damper Installation	2			
7	CCDZ89-340-000		二系横向减振器安装 Secondary Lateral Damper Installation	1			
6	CCDZ89-320-000		高度调整杆安装 Levelling Control Rod Installation	2			
5	CCDZ89-300-000		空气弹簧安装 Air Spring Installation	2			
4	CCDZ89-260-000		一系垂向减振器安装 Primary Vertical Damper Installation	4			
3	CCDZ89-240-000		一系悬挂安装 Primary Suspension Installation	4			
2	CCDZ90-200-000		拖车轮对安装 Trailer Wheelset installation	2			
1	CCDZ90-100-000		拖车构架 Trailer Bogie Frame	1			

Surface geometry & structure 表面几何结构要求

Tolerances for normal dimensions 一般尺寸公差要求

设计		2009-12-24	
审核			
标准			
审定			
批准			
主管			
工艺			

软件版本 SOFTWARE AutoCAD 2006

Document Title 文件名

版本 REVs	重量 WEIGHT	比例 SCALE	图幅 DRAWING
V6	6300	1:10	A1

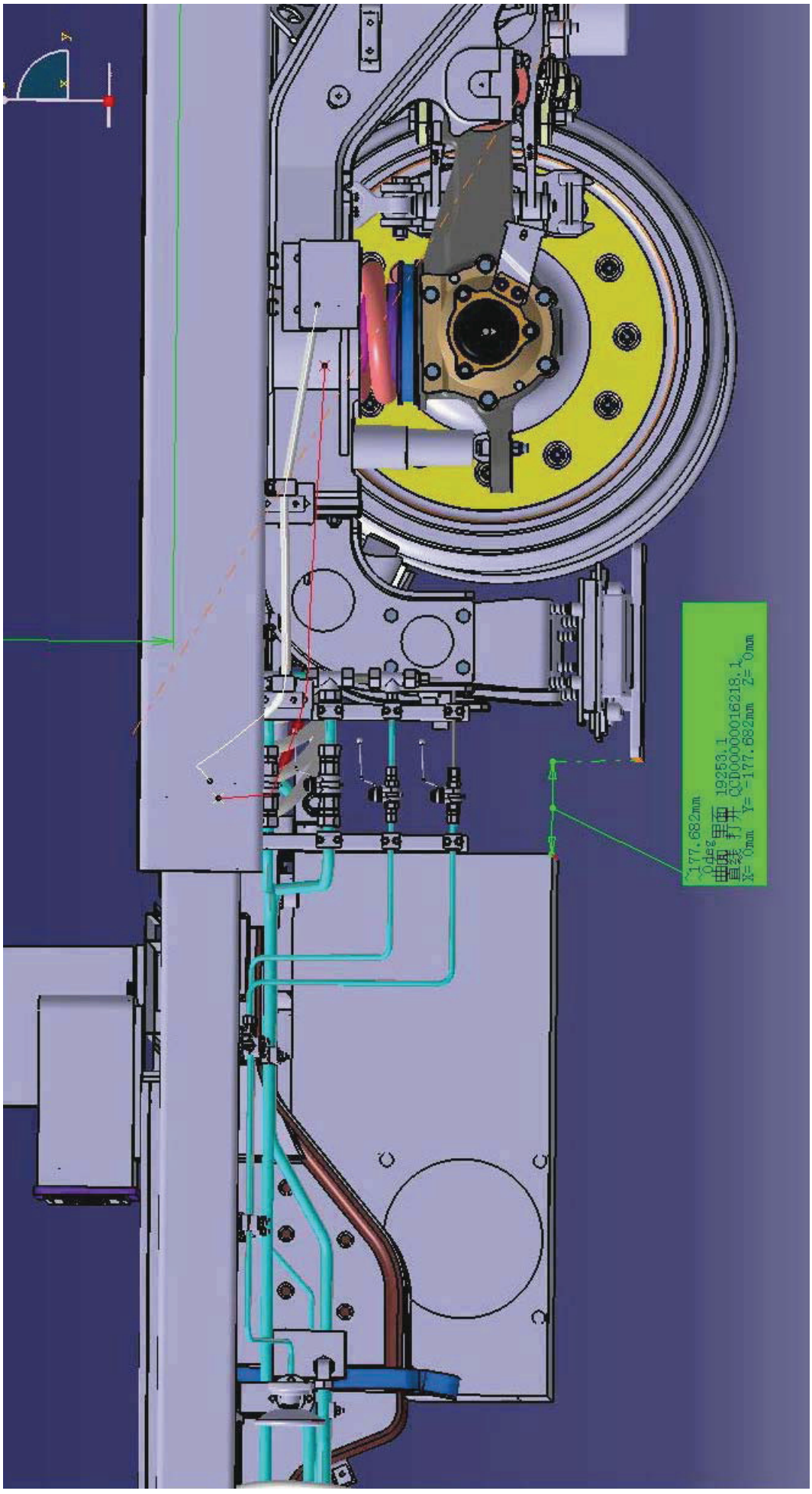
共 1 张 TOT SHT 第 1 张 SH NO

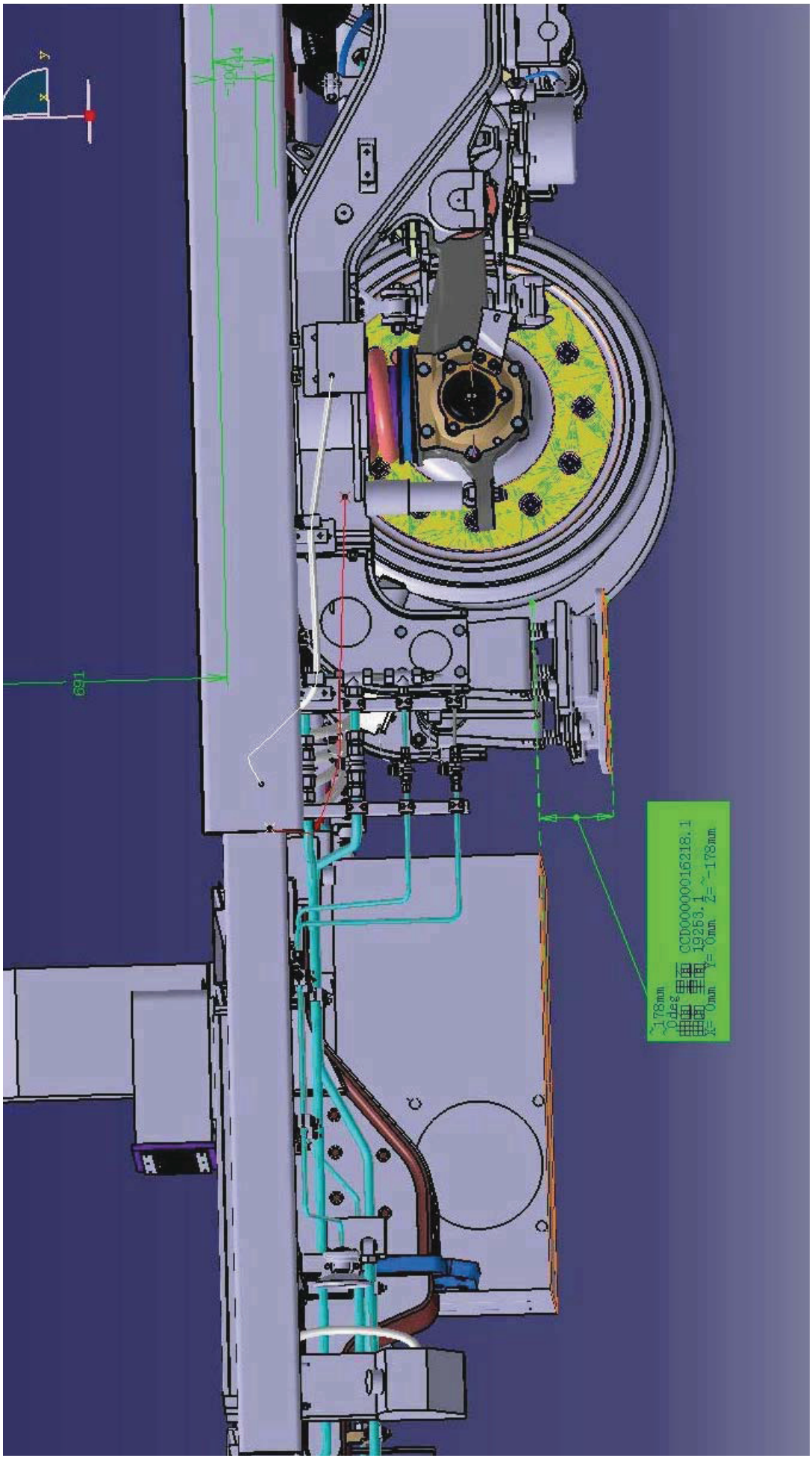
对称件 SYMMETRY

拖车转向架 Trailer Bogie

CCDZ90-000-000

CCDZ90-000-000


177.682mm
0deg
19253.1
X= 0mm Y= -177.682mm Z= 0mm


Y
X
~178mm
0deg
CCD0000016218.1
19268.1
X= 0mm Y= 0mm Z= ~-178mm

CCD000000021370

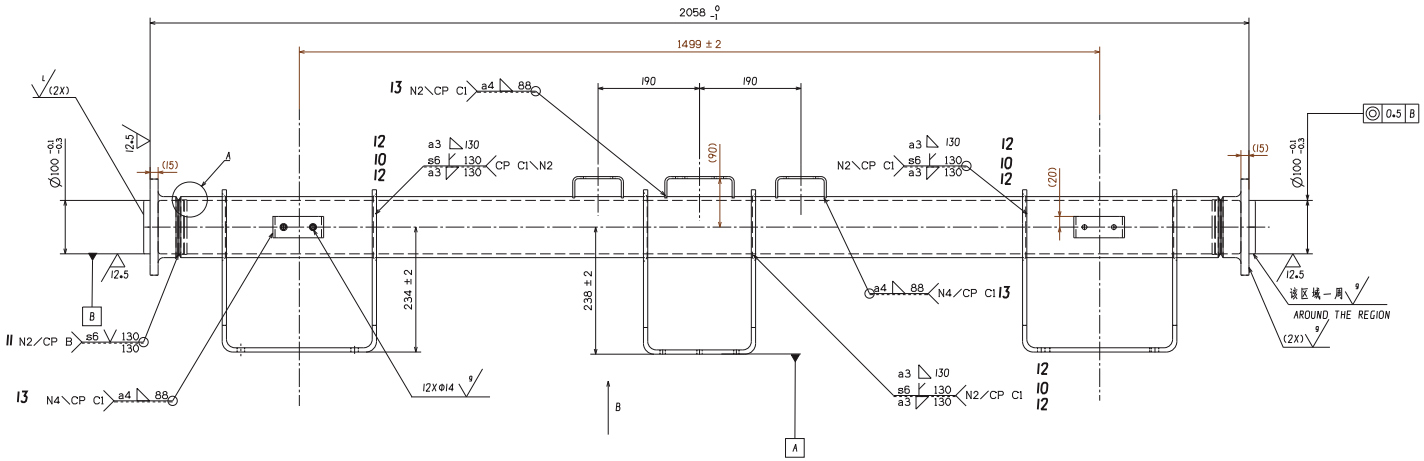
其余 OTHERS

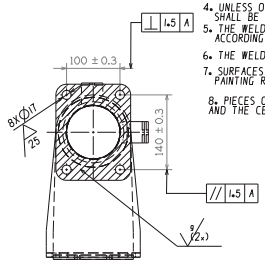
技术要求

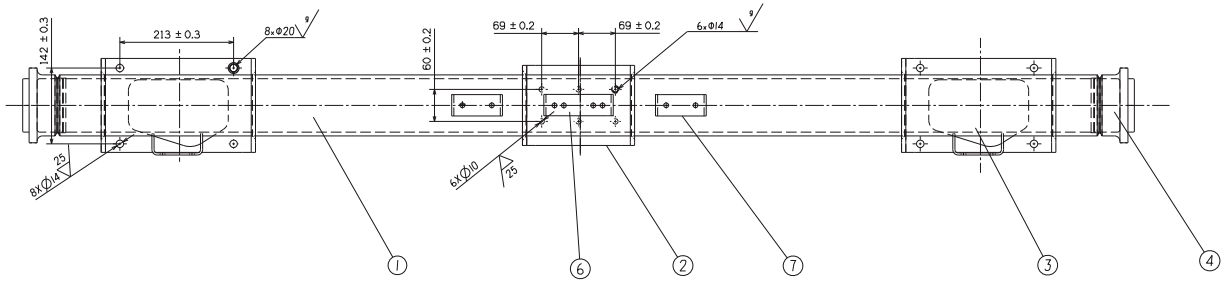
1. 企业认证等级执行 EN15085-2 中的 CLI 级。
2. 除特殊规定外，焊缝质量等级执行 EN15085-3 中的 CP CI 级。
3. 除特殊规定外，焊缝检验等级执行 EN15085-3中的 CT2 级。
4. 除特殊规定外，焊接公差执行 ISO 13920 中的 BF 级。
5. 焊缝缺陷等级执行ISO 5817:2003的B级。
6. 除特殊规定外，焊缝进行100%磁粉探伤。
7. 焊接后零件表面涂底漆及面漆，涂漆要求见CCD000000019272.JT。
8. 件号4处允许有中心孔存在，且中心孔应按照GB/T145-2001B型加工。

NOTES

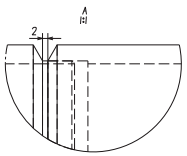
1. THE MANUFATURER'S QUALIFIED LEVEL SHALL BE EN15085-2 CLI.
2. UNLESS OTHERWISE STATED, THE WELD QUALITY LEVEL SHALL BE EN15085-3 CP CI.
3. UNLESS OTHERWISE STATED,THE WELD INSPECTION LEVEL SHALL BE EN15085-3 CT2.
4. UNLESS OTHERWISE STATED,THE WELD TOLERENCE SHALL BE ISO 13920 BF.
5. THE WELDING IMPERFECTION CLASS SHALL BE ACCORDING TO ISO 5817:2003,CLASS B.
6. THE WELD SHALL BE 100% MT, UNLESS OTHERWISE STATED.
7. SURFACES TO BE PAINTED WITH PRIMER AND TOP COAT. PAINTING REQUIREMENTS SEE CCD000000019272.JT.
8. PIECES OF NO.4 CENTER HOLE ALLOWS THE EXISTENCE , AND THE CENTER HOLE SHOULD BE IN ACCORDANCE WITH GB/T145-2001B .

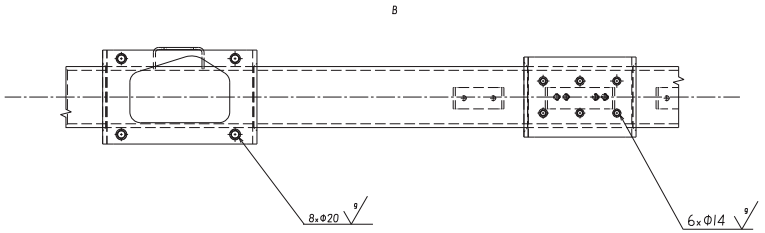






车辆端部
END OF CAR





序号 ITEM	物料号 PARTCODENUMBER	图文档号 DOC NUMBER	物料名称 DESCRIPTION	数量 QTY	材料 MATERIAL	单重 WEIGHT	附注 REMARKS
13	36487		角焊缝a4CP CI FILLET WELD a4	IM	钢	0.1256	
12	36478		角焊缝a3CP CI FILLET WELD a3	IM	钢	0.0707	
11	36738		Y型对接焊缝s6CP B Y BUTT WELD s6	IM	钢	0.1632	
10	36795		单侧Y型对接焊缝s7CP CI SINGLE-Y BUTT WELD s7	IM	钢	0.3331	
9							
8							
7	324280	CCD000000023939	线缆卡座 CABLE BRACKET	4	钢板4-S355J2W+N STEEL PLATE4-S355J2W+N	0.197	
6	324395	CCD000000023979	线缆卡座 CABLE BRACKET	1	钢板4-S355J2W+N STEEL PLATE4-S355J2W+N	0.237	
5							
4	309126	CCD000000021369	连接座 BRACKET	2	S355J2+N S355J2+N	4.188	
3	309125	CCD000000021368	CT 传感器吊座 CT SENSOR BRACKET	2	钢板8-S355J2W+N STEEL PLATE8-S355J2W+N	5.98	
2	309124	CCD000000021367	RC 天线吊座 RC BRACKET	1	钢板8-S355J2W+N STEEL PLATE8-S355J2W+N	6.408	
1	309123	CCD000000021366	端梁钢管 TUBE FOR ATC BEAM	1	无缝钢114.3X7.1-S355J2H TUBE 114.3X7.1-S355J2H	4.654	

版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN

设计	张文康	2020-10-28	焊接工程师	于传颖	2021-3-30	版本 REV	重量 WEIGHT
审核	梁云	2020-10-28	相关工艺	尹立成	2021-3-30		
区域审核			相关工艺	程志义	2021-3-29	C	33.116
主管	薛世海	2020-10-28	审批				
			批准				
工艺	杨智勇	2020-11	绘图软件	CATIA V5			

比例 SCALE	图幅 MAPSHEET
1:5	A1

页次 PAGE
1/1

天线梁组成
ANTENNA SUSPENSION BRACKET

CCD000000021370

286763

总数 | 服 | 玻 | 具 | 试 | 镀 | 木 | 机 | 冲 | 体一 | 体二 | 装一 | 装二 | 锻 | 精 | 铜 | 铆

协 | 供 | 单位 | 数量 | 旧底图总号 | 底图总号 | 签字 | 日期

CCD00000045482

总数	
服	
玻	
具	
试	
镀	
木	
械	
冲	
体一	
体二	
装一	
装二	
锻	
精	
钢	
铆	
协	
供	
单位	数量
旧底图总号	
底图总号	
签字	
日期	

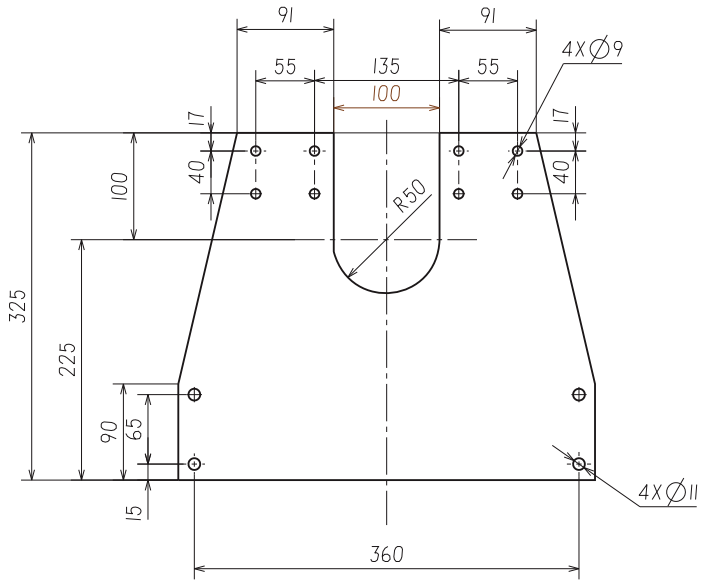
其余 50
OTHERS

技术要求

1.去除毛刺及锐楞。

NOTES

1.NO BUR AND SHARPNESS.



CT Mounting Bracket

版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN

设计	文永亮	2001-12-20	焊接工程师				
审核	米志宏	2001-12-20	相关工艺				
区域审核			标准审查				
主管			审批				
			批准				
工艺	王洋	2001-12-23	绘图软件	CATIA V5			

06Cr19Ni10
06Cr19Ni10

版本 REV	重量 WEIGHT	比例 SCALE	图幅 MAPSHEET
A	1.722	1:5	A3

页次 PAGE 1/1

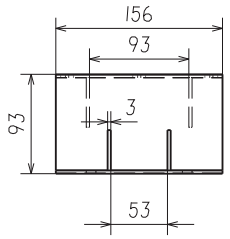
ATC电缆固定座
FIX BRACKET

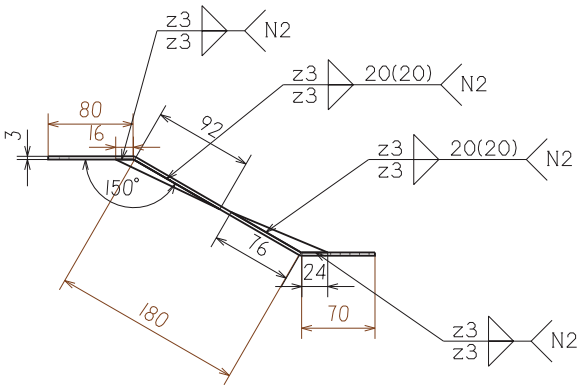
CCD00000045482

386405

CCD00000045483

总数	
服	
玻	
具	
试	
镀	
木	
械	
冲	
体一	
体二	
装一	
装二	
锻	
精	
钢	
铆	
协	
供	
单位	数量
旧底图总号	
底图总号	
签字	
日期	





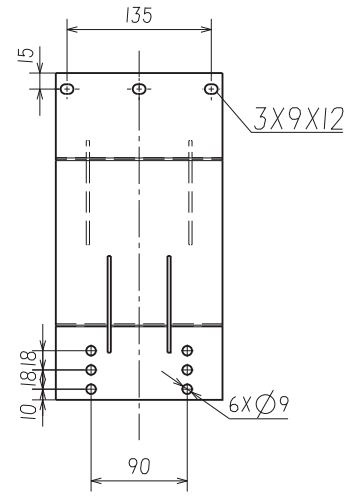
其余 50
OTHERS

技术要求

1.去除毛刺及锐楞。

NOTES

1.NO BUR AND SHARPNESS.



RC Mounting Bracket

版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN

设计	文永亮	2010-12-23	焊接工程师				
审核	米志宏	2010-12-23	相关工艺				
区域审核			标准审查				
主管			审批				
			批准				
工艺	王洋	2010-12-23	绘图软件	CATIA V5			

06Cr18Ni10
06Cr18Ni10

版本 REV	重量 WEIGHT	比例 SCALE	图幅 MAPSHEET
A	1.34	1:5	A3

页次 PAGE 1/1

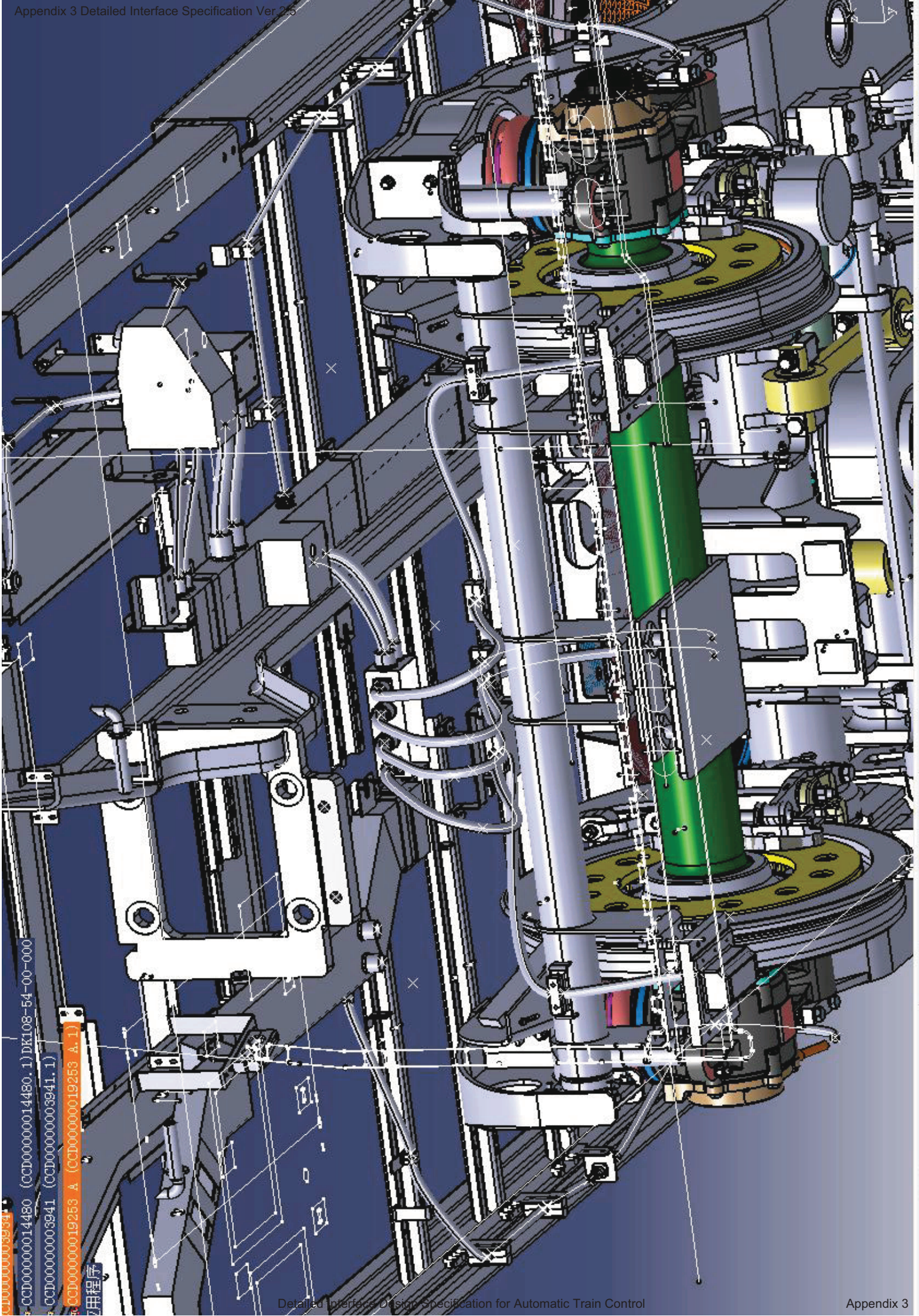
ATC电缆固定座
FIX BRACKET

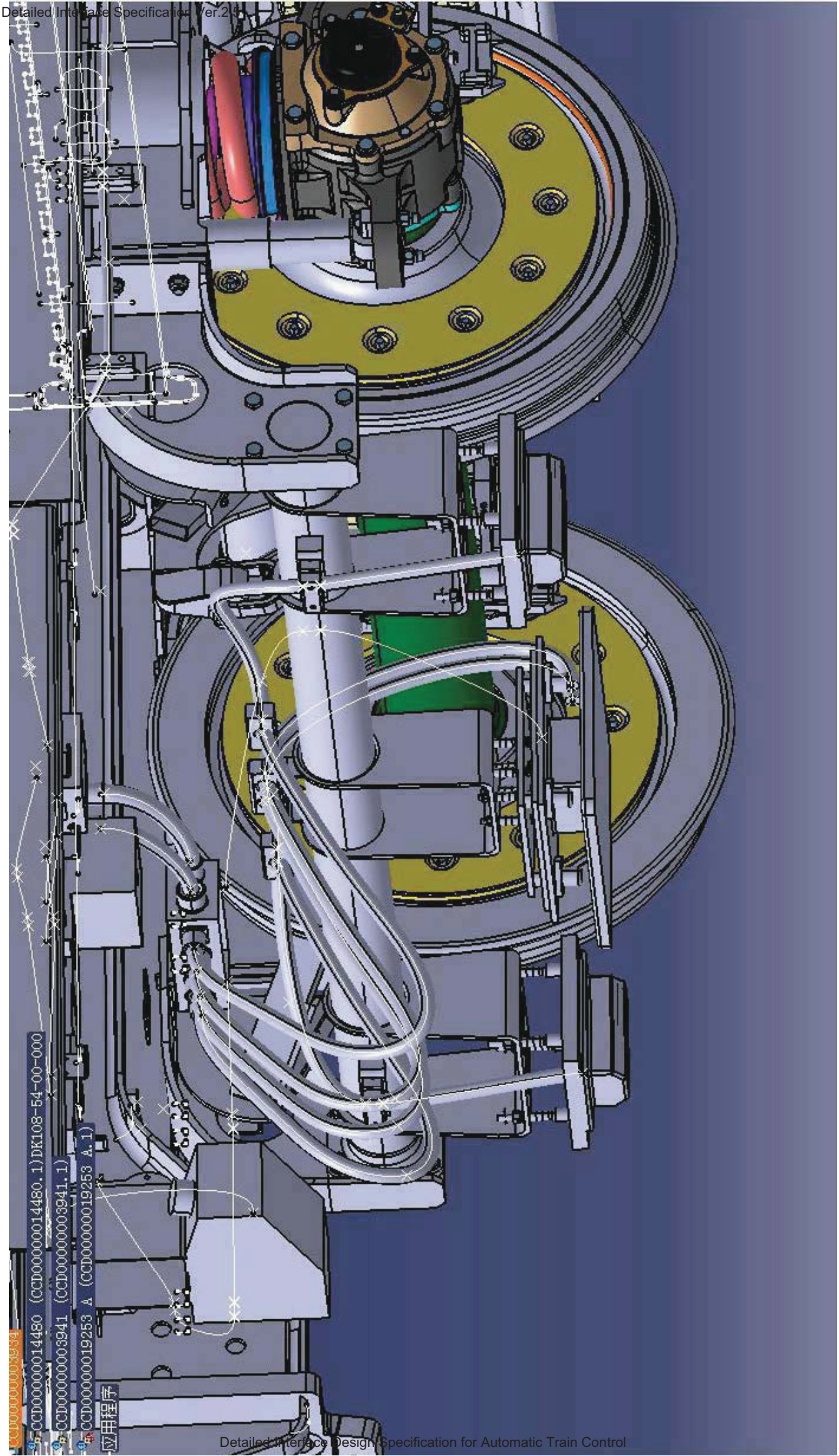
CCD00000045483

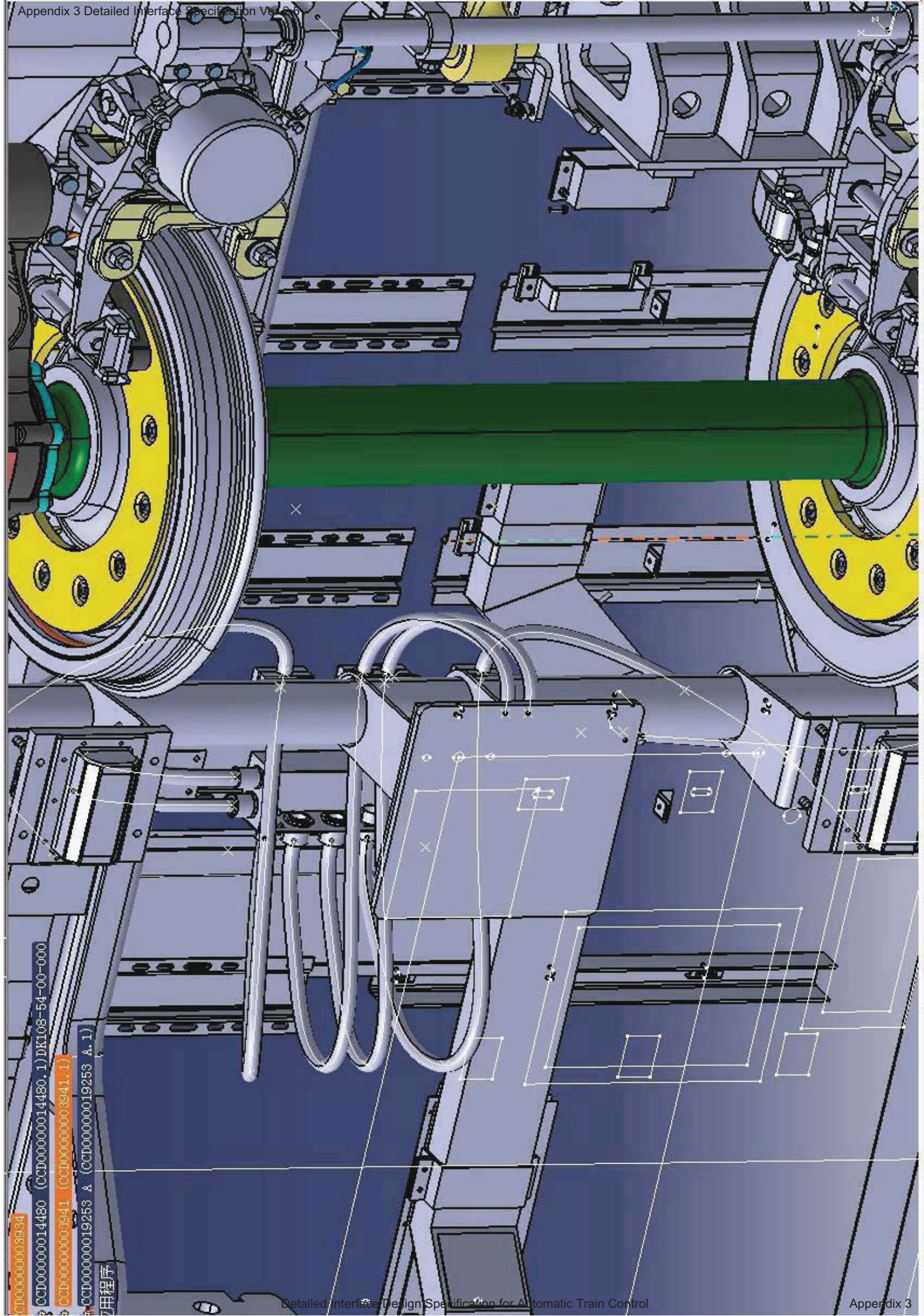
386406

DETAILED INTERFACE SPECIFICATION

ANNEX B7
BOGIE CABLE ARRANGEMENT

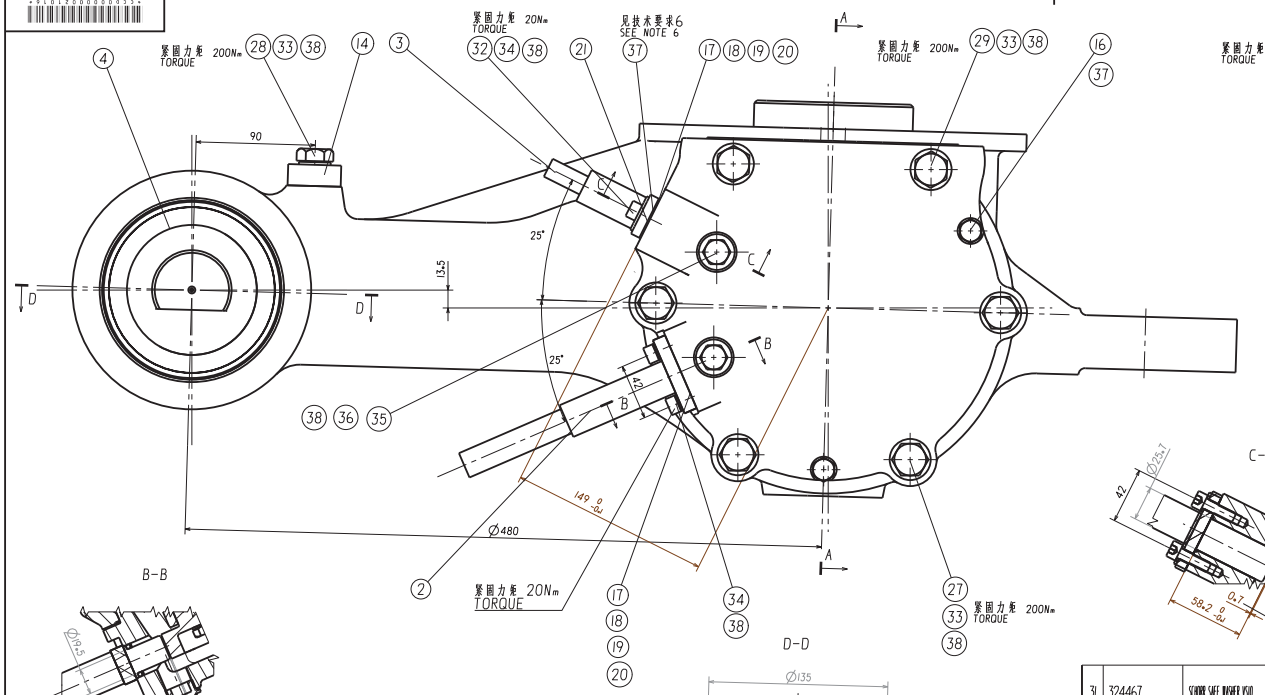

CCD000000014480 (CCD000000014480.1)DK108-54-00-000
CCD000000003941 (CCD000000003941.1)
CCD000000019253 A (CCD000000019253 A.1)
应用程序

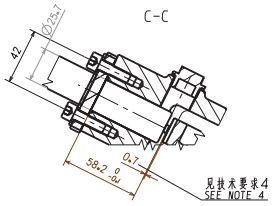

CCD00000014480 (CCD00000014480.1)DK108-54-00-000
CCD00000003941 (CCD00000003941.1)
CCD00000019253 A (CCD00000019253 A.1)
应用程序

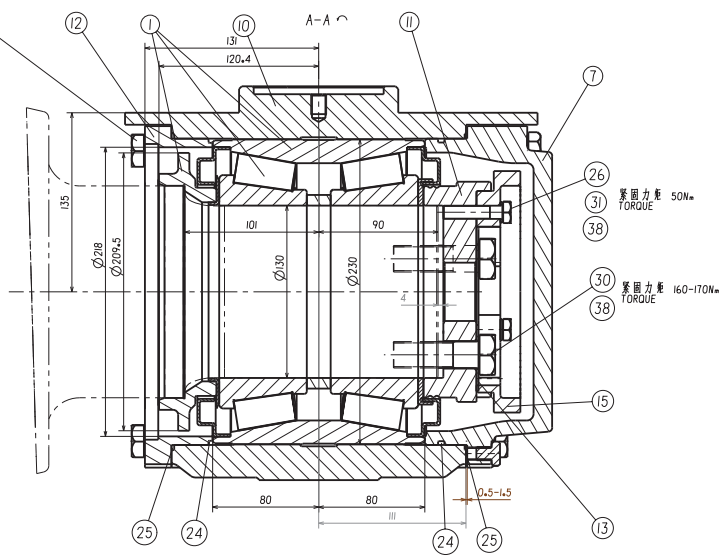

CCD0000003934
CCD0000014480 (CCD0000014480.1)DK108-54-00-000
CCD0000003941 (CCD0000003941.1)
CCD0000019253 A (CCD0000019253 A.1)
应用程序

DETAILED INTERFACE SPECIFICATION

ANNEX B8
ODOMETER INSTALLATION







技术要求

1 按照SKF轴承组装及拆卸指导书对轴承进行组装及维护。
2 在组装件号16前，在周边涂抹密封胶(件号37)。
3 在调整测速齿轮外径与防滑传感器之间的间隙时，需要对测速齿轮进行三点测量（每点之间相距120°），保证三次测量的间隙平均值公差在±0.1范围内，最大值公差在±0.5范围内。
4 在调整测速齿轮外径与信号传感器之间的间隙时，需要对测速齿轮进行三点测量（每点之间相距120°），保证三次测量的间隙平均值公差在 0.1范围内，最大值公差在±0.3范围内。
5 安装前在螺栓和螺钉的螺纹及装配表面上涂抹润滑膏 MOLYKOTE G-RAPID PLUS(件号38)。
6 在信号传感器与测速齿轮之间的间隙调整好之后，在垫圈周边涂抹密封胶（件号37）。
7 本图纸所示为AWO载荷工况。
8 轴箱节点在与构架组装完成后，外露的金属表面进行防腐保护。
9 除特殊要求外，安装完成后所有外露底漆或者没有油漆的外露表面处须按照涂漆技术要求CCD000000019272.JT进行补漆。

NOTES:

1 BEARING INSTALLATION AND MAINTENANCE PROCEDURE IN ACCORDANCE WITH BEARING INTALLATION AND MAINTENANCE INSTRUCTION.
2 APPLY SILICONE SEALANT (ITEM 37) TO RIM OF PLUG, ITEM 16, PRIOR TO FITTING INTO FRONT END COVER.
3 MEASURE THE CLEARENCE BETWEEN ANTI-SKID SENSOR AND OUTER DIAM.OF SPEED WHEEL (THREE POINTS,EQUIANGLE 120°),MAKE SURE THE AVERAGE VALUE WITHIN ±0.1, THE MAXIMUM VALUE WITHIN ±0.5.
4 MEASURE THE CLEARENCE BETWEEN SPEED SENSOR AND OUTER DIAM.OF SPEED WHEEL(THREE POINTS,EQUIANGLE 120°),MAKE SURE THE AVERAGE VALUE WITHIN 0.1, THE MAXIMUM VALUE WITHIN ±0.3.
5 THREADS AND CONNECTING SURFACES OF BOLTS AND SCREWS HAVE TO BE LUBRICATED WITH MOLYKOTE G-RAPID PLUS (ITEM 38) BEFORE MOUNTING.
6 APPLY SILICONE SEALANT (ITEM 37) AROUND THE WASHERS AFTER THE CLEARENCE BETWEEN SPEED SENSOR AND OUTER DIAM. OF SPEED WHEEL IS SETTLEED DOWN.
7 THIS DRAWING SHOWS AWO CONDITION.
8 THE BLANK SURFACES OF AXLEBOX JOINT BUSH WILL BE PRETEDCTED AFTER FITTED INTO BOGIE.
9 AFTER ASSEMBLY ALL VISIBLE SURFACES WHICH ARE BLANK OR PRIMED MUST BE PAINTED ACC. TO PAINTING SPECIFICATION CCD000000019272.JT, UNLESS SATED.

序号 ITEM	物料号 PART/CODE/NUMBER	图文档号 DOC NUMBER	物料名称 DESCRIPTION	数量 QTY	材料 MATERIAL	单重 WEIGHT	附注 REMARKS
38	286747		装配膏 MOLYKOTE G-RAPID PLUS	IML		0.8	
37	322486		硅密封胶LOCTITE 5699 SILICON SEALANT	IML		0.8	
36	322296	DIN1463-2001 R22.27-Vr	密封垫A 22.27 SEALING RING	2	Vf	0.3	
35	313899	DIN934-1997-A M22X1.5	六角头螺母A-M22X1.5 Light duty hexagon head screw drop.	2	St	0.034	A3C
34	305976	SCHORR SAFE WASHER X58	防松垫圈B SAFETY WASHER	4		0.4	SCHORR垫圈
33	305980	SCHORR SAFE WASHER VS16	防松垫圈VS16 SAFETY WASHER	14	FSr	0.002	镀锌 ZINC PLATED
32	322719	ISO4762-2004 M8X25 12.9	内六角螺钉M8X25 HEXAGON SOCKET HEAD CAP SCREWS	2	8.8	0.02	A2C
31	324467	SCHORR SAFE WASHER VS10	防松垫圈VS10 SAFETY WASHER	3	FSr	0.8	磷化 PHOSPHATED
30	300252	ISO4017-1999 M20X65 300252	六角头螺钉M20X65 HEXAGON HEAD SCREWS	3	A2-70	0.204	
29	322300	ISO4017-1999 M16X60 322300	六角头螺钉M16X60 HEXAGON HEAD BOLTS	2	8.8	0.132	A3C
28	322244	ISO4017-1999 M16X50 322244	六角头螺钉M16X50 HEXAGON HEAD BOLTS	2	8.8	0.102	A3C
27	322321	ISO4017-1999 M16X45 322321	六角头螺钉M16X45 HEXAGON HEAD BOLTS	10	8.8	0.108	A3C
26	324591	ISO4017-1999 M10X45 324591	六角头螺钉M10X45 HEXAGON HEAD BOLTS	3	A2-70	0.038	
25	322297		O型圈224.2.65-A-N O-RING	2	T腈橡胶 70 SH NITRILE 70 SH	0.004	
24	322298		O型圈218.3.55-A-N O-RING	2	T腈橡胶 70 SH NITRILE 70 SH	0.006	
23							
22							
21	335170		调整垫（1mm） WASHER (1mm)	1		0.006	ALSTOM 提供 SUPPLIED BY ALSTOM
20	324703	CCD000000024096	工艺轴 PLATE USED DURING ASSEMBLY	2	ABS	0.1	
19	322543		调整垫（0.5mm） WASHER (0.5mm)	2		0.002	KNORR 提供 SUPPLIED BY KNORR
18	322542		调整垫（0.3mm） WASHER (0.3mm)	2		0.9	KNORR 提供 SUPPLIED BY KNORR
17	322541	CCD000000023536	调整垫（0.1mm） WASHER (0.1mm)	2	钢板Q+-06C+N960 STEEL PLATE Q+-06C+N960	0.6	根据需要制作 MADE AS REQUIRED
16	321993	CCD000000023206	螺堵 PLUG	2	塑料 PLASTIC	0.003	外购 BUY
15	315740	CCD000000020016	测速齿轮 SPEED WHEEL	1	C45	4.5	
14	315734	CCD000000019749	轴箱转臂安全挡 EMERGENCY CATCH	1	钢板16-S355J2W+N STEEL PLATE 16-S355J2W+N	0.845	
13	315737	CCD000000019950	防松片 LOCKING PLATE	1	钢板2-Q195 STEEL PLATE 2-Q195	0.073	
12	315736	CCD000000019949	后盖 BACK COVER	1	EN-GJS-400-18-LT	4	外购 BUY
11	315735	CCD000000019946	轴端压板 END CAP	1	S355 J2+N	4.6	
10	315738	CCD000000020009	轴箱体（右） RIGHT AXLEBOX BODY	1	EN-GJS-400-18-LT	75.85	外购 BUY
9							
8							
7	321403	CCD000000021029	前端盖 FRONT END COVER	1	EN-GJS-400-18-LT	13.7	外购 BUY
6							
5							
4	315733	CCD000000019494	轴箱节点 AXLEBOX JOINT BUSH	1		13.2	外购 BUY
3	323718		信号速度传感器组成 SPEED SENSOR	1		4.6	ALSTOM
2	323883		防滑速度传感器FSO1B ANTI-SKID SPEED SENSOR	1		0.4	KNORR
1	322501		轴承(包括防止挡环)NJ312-E-M5-C3 AXLE BEARING	1		28.8	SKF

序号 ITEM	物料号 PART/CODE/NUMBER	图文档号 DOC NUMBER	物料名称 DESCRIPTION	数量 QTY	材料 MATERIAL	单重 WEIGHT	附注 REMARKS

版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN

设计	高建宝	2013-3-11	焊接工程师				
审核	王安国	2013-3-11	郁关工艺	尹立成	2013-3-30		
区域审核			郁关工艺2				
主管	林 勉	2013-3-29	审 批				
			批 准				
工艺	杨智勇	2013-3-30	绘图软件 CATIA V5				

ATP和防滑轴端安装（3A）
AXLEBOX ASS'Y WITH ATP AND ANTI-SKID DEVICE

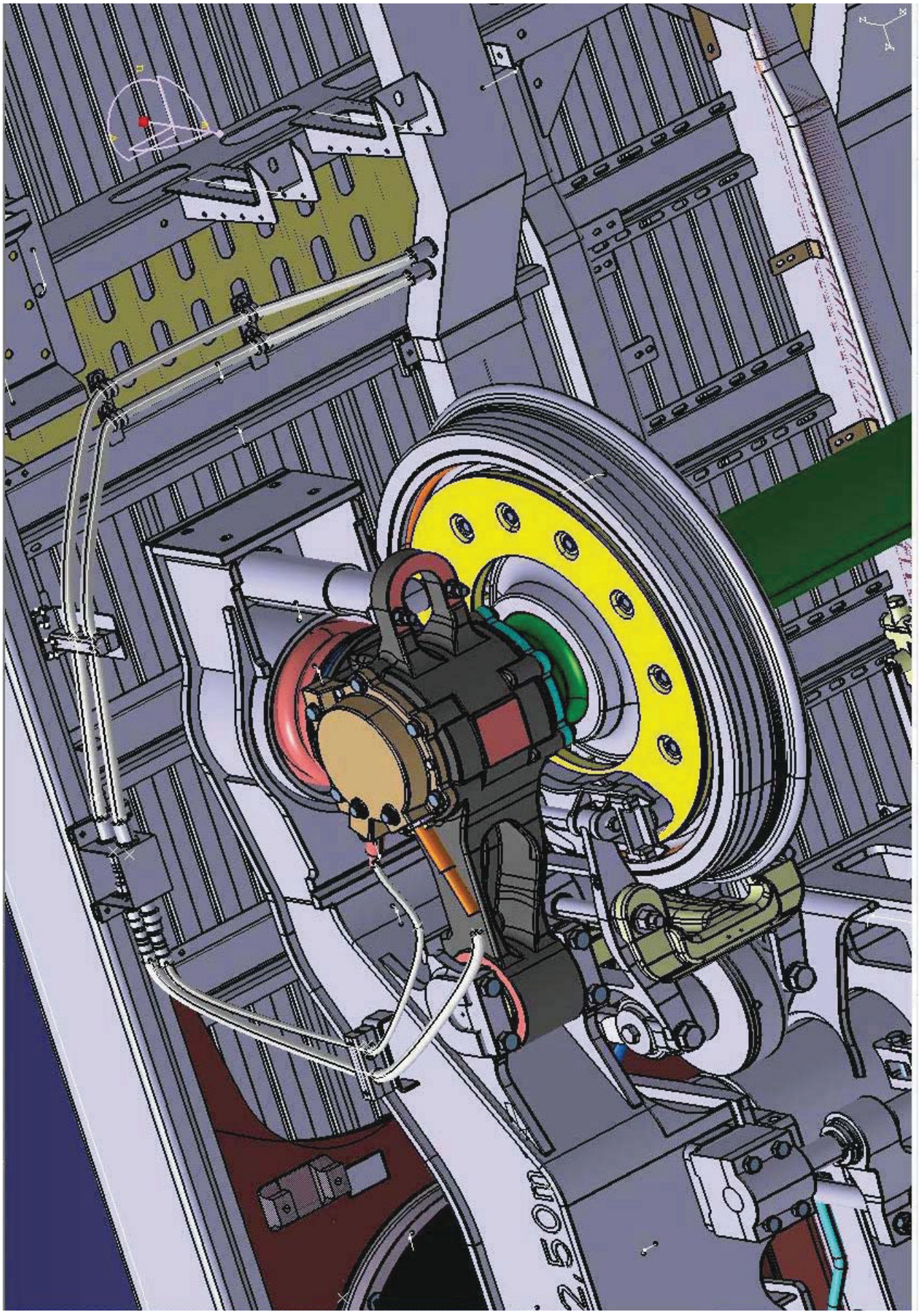
版本 REV	重量 WEIGHT	比例 SCALE	图幅 MAP/SHEET
A	159.408	1:2	A1

CCD000000021016
324816

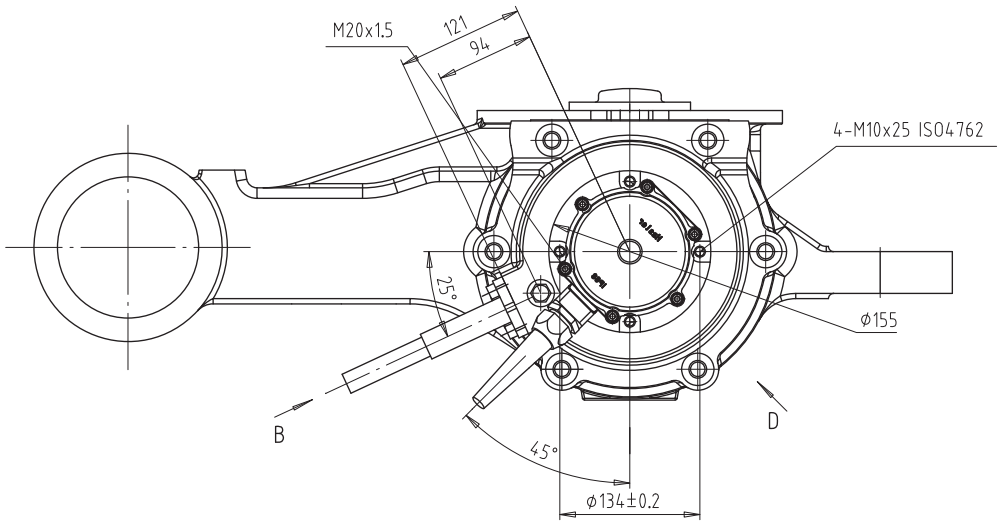
页次 PAGE 1/1

Detailed Interface Design Specification for Automatic Train Control System

Appendix 3

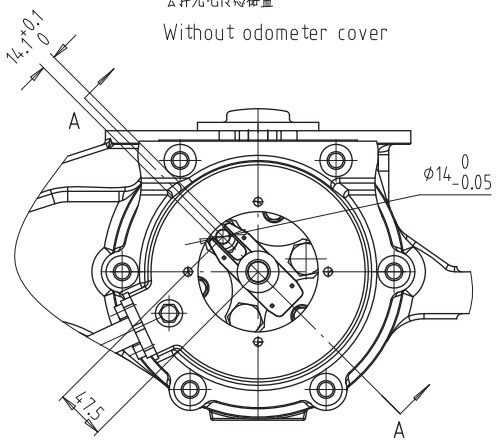


CCDZ90-215-000

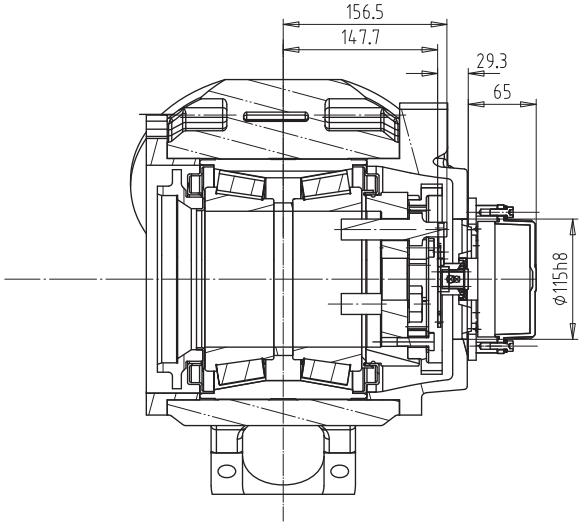


去掉光电传感器盖

Without odometer cover

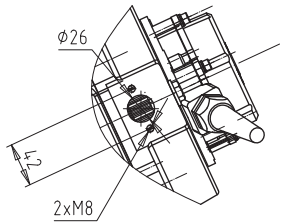


A-A

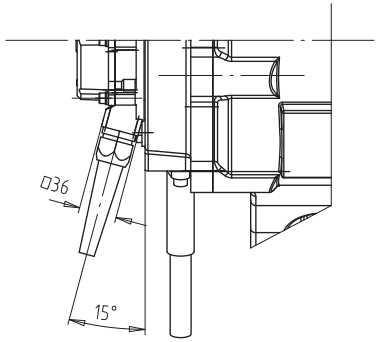


去掉防滑传感器 Without anti-skid sensor

B



D



Tolerances for normal dimensions 一般尺寸公差要求					
Surface geometry & structure 表面几何结构要求					
Document Title 文件号					
设 计	高建宝	2009-10-16			
审 核			标 准		
			部 长		
主 管			总 工		
工 艺			绘图软件 (SOFTWARE) AutoCAD 2006		

版本 REV.	重 量 WEIGHT	比 例 SCALE	图幅 DRAWING
V3		1: 5	A3
共 1 张 TOT SH		第 1 张 SH NO	

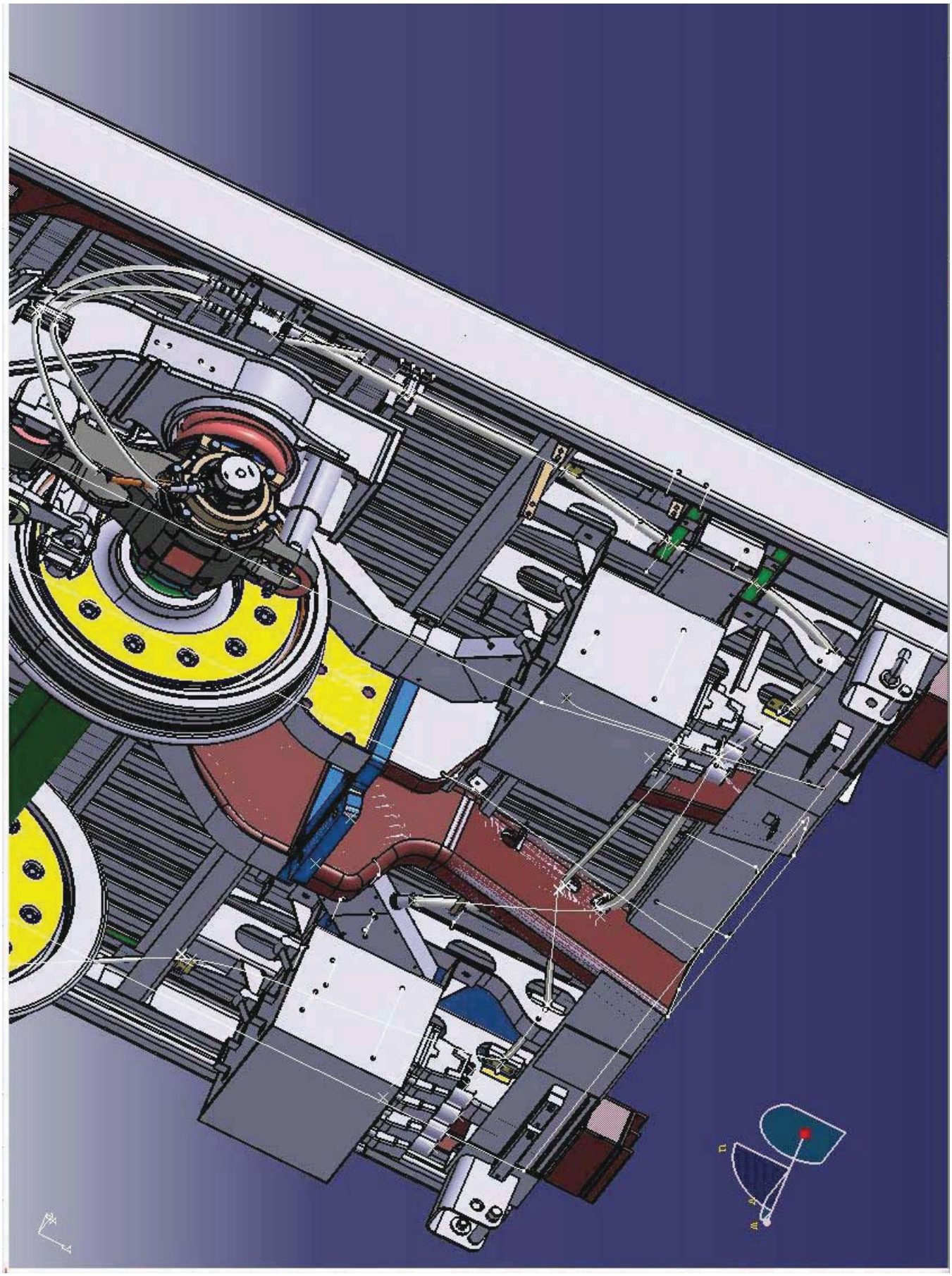
对称件 SYMMETRY

ATC轴端安装（4B）
ATC axle end ass'y(4B)

CCDZ90-215-000

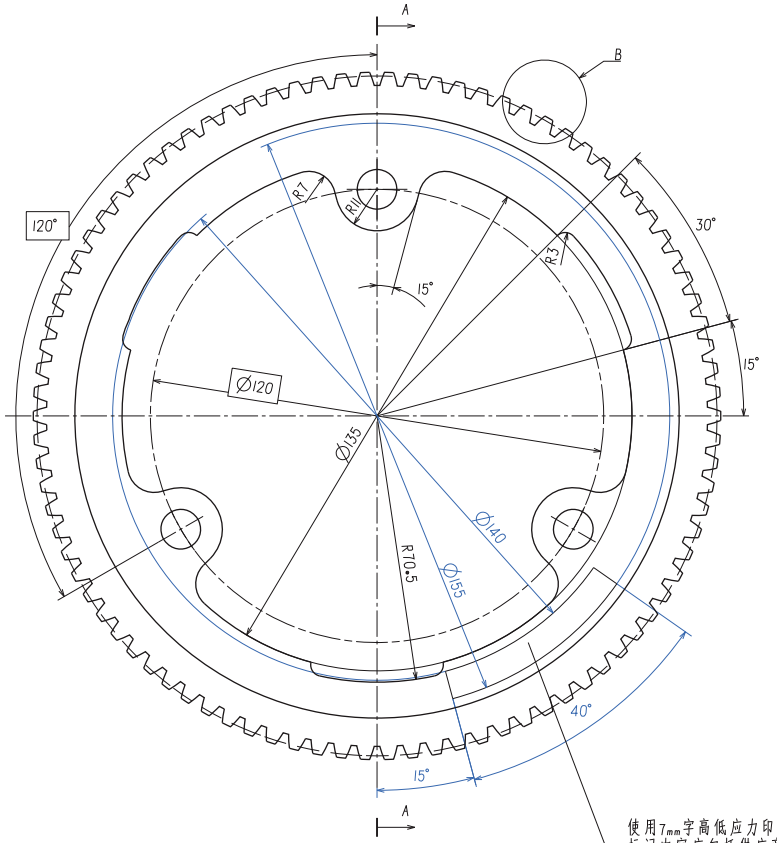
总数 | 服 | 玻 | 具 | 试 | 镀 | 木 | 械 | 冲 | 体一 | 体二 | 装一 | 装二 | 锻 | 精 | 钢 | 铆 | 协 | 供 | 单位 数量 | 旧底图总号 | 底图总号 | 签字 | 日期

签名 | 文件号 | 升级说明 | 日期 | 版本

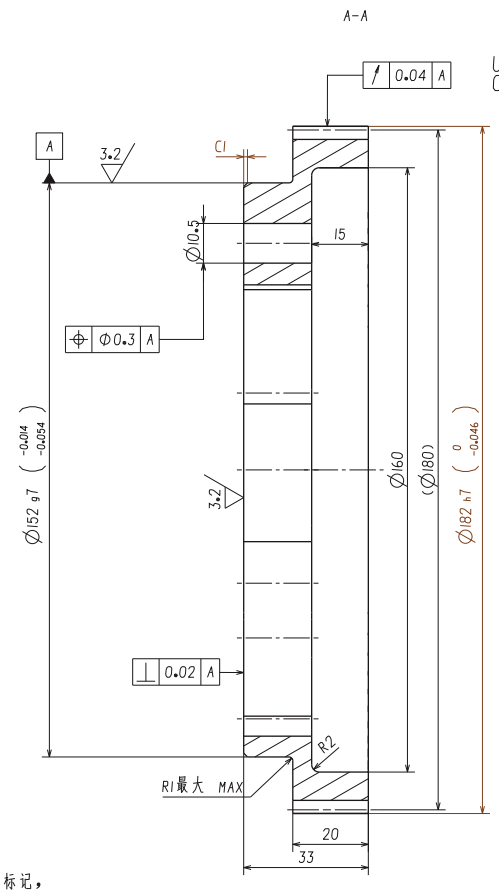


DETAILED INTERFACE SPECIFICATION

ANNEX B9
SPEED WHEEL FOR FAIVELEY SPEED SENSOR



使用7mm字高低应力印模在此区域刻打标记，标记内容应包括供应商名称、生产日期、炉次号及序列号。



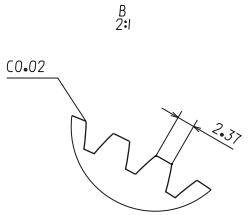
其余 6.3

UNLESS OTHERWISE STATED

技术要求

1 零件表面进行发黑处理。
2 未注锐楞倒角0.5。
3 未注尺寸公差：ISO 2768-mk。

NOTES:
1 THE SURFACES SHOULD BE BLACKENED.
2 SHARP EDGES SHOULD BE CHAMFERED TO BE 0.5mm UNLESS OTHERWISE STATED.
3 GENERAL TOLERENCE TO BE ISO 2768-mk.



齿数 NUMBER OF TEETH	Z	90
模数 MODULE	m	2
分度圆 REFERENCE CIRCLE DIAMETER	d	180
齿形标准 TOOTH FORM STANDARD	DIN 867	
齿形角 TOOTH PROFILE ANGLE	α	20°

版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN	版本 REV	更改文件编号 MODIFIED DOC NO	日期 DATE	签名 SIGN

				C45 EN 10083-2				测速齿轮 SPEED WHEEL	
设计	高建宝	2020-3-16	焊接工程师	版本 REV	重量 WEIGHT	比例 SCALE	图幅 MAPSHEET		
审核	王安国	2020-3-16	相关工艺1	A	1.5	1:1	A2		
区域审核			相关工艺2						
主管			审批			页次 PAGE		CCD00000020016	
			批准			1/1		315740	
工艺	杨智勇	2020-3-24	绘图软件 CATIA V5						

DETAILED INTERFACE SPECIFICATION

ANNEX C1
ATC ELECTRICAL INTERFACE REQUIREMENTS

Annex C1 – ATC Electrical Interface Requirements

Section C1.1 ATC Inputs and Outputs Electrical Characteristics

SACEM ATC Outputs / Inputs		Electrical Characteristics								Functions
		Type	Loads / Input Name	Connector pin number	Rated Control Circuit Voltage	Rating Current (*) [A]	Max	L/R [ms]	Relay Spec.	
ATC Mode	Non – Vital Binary Input	Opto – coupler	SCOS (NORMAL Position)	ATC/MOD HN2-J2 & J4	DC110V	2 x 0.015	130V	-	-	The on-board ATC monitors the Normal position of the SCOS.
AUTO	Non – Vital Binary Input	Opto – coupler	Mode Selector (AM Position)	MS/AUTO2 HN2-E2 MS/AUTO1 HN2-K1	DC110V	0.015	130V	-	-	The on-board ATC monitors the AUTO position of the Mode selector. 2 inputs in //
CM	Non – Vital Binary Input	Opto – coupler	Mode Selector (CM Position)	MS/CM HN2-E4	DC110V	0.015	130V	-	-	The on-board ATC monitors the CM position of the Mode selector.
Forward	Vital Binary Input	Opto – coupler	Mode Selector (RMF Position)	MS/FOR HN2-A2 OVB1 HN2-B2	DC110V	0.015	130V	-	-	The on-board ATC monitors the FOR position of the Mode selector.
Reverse	Vital Binary Input	Opto – coupler	Mode Selector (RMR Position)	MS/REV HN2/A3 OVB1 HN2-B3	DC110V	0.015	130V	-	-	The on-board ATC monitors the Reverse position of the Mode selector.

Annex C1 – ATC Electrical Interface Requirements

SB	Non – Vital Binary Input	Opto – coupler	Mode Selector (Standby Position)	MS/SB HN2-E3	DC110V	0.015	130V	-	-	The on-board ATC monitors the Standby position of the Mode selector.
__ SD	Vital Binary Input	Opto – coupler	Mode Selector (Not Shutdown Position)	MS/SD HN2-A4 OVB1 HN2-B4	DC110V	0.015	130V	-	-	The on-board ATC monitors the Mode selector is NOT at Shutdown position.
DT_SD	Vital Binary Intput	Opto – coupler	Mode Selector (Shutdown Position)	DT_SD+ DTJ3-b20 DT_SD- DTJ3-b22	DC110V	0.015	130V	-	-	The on-board ATC monitors the Shutdown position of the Mode selector.
SSIR/1	Vital Binary Output	Relay Contact	SSIR1_P SSIR1_M	DTJ3- z30 DTJ3-b32	DC110V	0.5 @ 120V	140V	15	-	Momentary signal used to reset SIR circuit in Driverless Turnaround mode
DCR/1	Vital Binary Output	Relay Contact	DCR1_M DCR1_P	DTJ2-Z8 DTJ2-Z26	DC110V	1.1 @ 120V	140V	15	-	Continuous signal: 1=DT, 0 = Not DT, used to activate the cab control circuit with MS at Shutdown position in Driverless Turnaround mode
DCR/2	Vital Binary Output	Relay Contact	DCR2_M DCR2_P	DTJ2-b8 DTJ2-b2	DC110V	2.9 @ 120V	140V	15	-	Continuous signal: 1=DT, 0 = Not DT, used to activate the cab control circuit with MS at Shutdown position in Driverless Turnaround mode
DCR/3	Vital Binary Output	Relay Contact	DCR3_M DCR3_P	DTJ2_z24 DTJ2-z28	DC110V	1.8 @ 120V	140V	15	-	Continuous signal: 1=DT, 0 = Not DT, used to activate the cab control circuit with MS at Shutdown position in Driverless Turnaround mode
DCR/4	Vital Binary Output	Relay Contact	DCR4_M DCR4_P	DTJ2-z30 DTJ2-b32	DC110V	0.5 @ 120V	140V	15	-	Continuous signal: 1=DT, 0 = Not DT, used to activate the cab control circuit with MS at Shutdown position in Driverless Turnaround mode

Annex C1 – ATC Electrical Interface Requirements

DCR/5	Vital Binary Output	Relay Contact	DCR5_M DCR5_P	DTJ2-z32 DTJ2-b30	DC110V	0.06 @ 120V	140V	15	-	Continuous signal: 1=DT, 0 = Not DT, used to activate the cab control circuit with MS at Shutdown position in Driverless Turnaround mode
Motor Demand (previous Shunt Series output)	Non - Vital Binary Output	Reed Relay Drive	MDRR	HN1-E2	DC24V	0.024	-	-		Continuous signal: 1=Powering, 0 = Braking and Coasting, used to activate the Motor Demand trainline in AUTO and DT modes.
Brake Demand	Non - Vital Binary Output	Reed Relay Drive	BDRR	HN1-F3	DC24V	0.024	-	-		Continuous signal: 1=Braking, 0 = Powering and Coasting, used to activate the Brake Demand trainline in AUTO and DT modes.
ATC Fault	Non-vital Binary Output	LED	ATO General Fault (ATX/FLT)	HN1-F2	DC24V	0.024	-	-		Continuous signal: 1=ATO Fault, 0 = Normal, used to indicate general failure of ATO.
Start Hold Fault	Non vital Binary Output	Reed Relay Drive	SHRR	HN1-E3	DC24V	0.024	-	-		Continuous signal: 1=ATO Start authorized, 0 = ATO Start not authorized, used to check the door / close sequence.
Overspeed Alarm	Non vital Binary Output	Static Output	OV/SP/AL 24VRR	HN1-E4 HN/1-F1	DC24V “1” = Buzzer ON “0” = Buzzer OFF	0.024	-	-	-	Continuous signal: 1=Buzzer on, 0 = Buzzer off, used to warn the driver when speeding.
TMS (DVAS TX)	SERIAL LINK	RS232	TX/DEST+ OV/DEST	BN-J3 BN-K3		0.010				
TMS (DVAS RX)	SERIAL LINK	RS232	RX/DEST OV/DEST	BN-M3 BN-N3		0.010				

Annex C1 – ATC Electrical Interface Requirements

ATO PWM	Non – Vital PWM Signal	Electronic	TMS / VVVF / Pneumatic Brake	LEVEL+ HN1-J4 LEVEL- HN1-K4	DC110V (DC77V to DC137.5V) (Frequency: 97.7 Hz ~ 98.3 Hz)	0.106	0.9A	-	-	PWM signal to drive the traction and brake system in AUTO and DT modes. Nominal Output Current for 8 cars: For TMS: 3.3mA x 2 cars = 6.6mA For VVVF: 3.3mA x 6 cars = 19.8mA For Pneumatic Brake: 3.3mA x 8 cars = 26.4mA Total = 52.8mA
DERA	Vital Binary Output	Relay Contact	DERA/1+ DERA/1-	LT2-N1 LT2-P1	DC110V	0.350	140V	30	-	Continuous signal: 1= A side door authorized, 0 = A side door not authorized, used to authorize door opening in AUTO, CM and RM (if localised) modes.
DERB	Vital Binary Output	Relay Contact	DERB/1+ DERB/1-	LT2-N2 LT2-P2	DC110V	0.350	140V	30	-	Continuous signal: 1= B side door authorized, 0 = B side door not authorized, used to authorize door opening in AUTO, CM and RM (if localised) modes.
DORA/1	Vital Binary Output	Relay Contact	DORA1_M DORA1_P	DTJ3-b2 DTJ2-b26	DC110V	0.25 @ 120V	140V	15	-	Momentary signal (1sec. duration): 1= A side door open, 0 = A side door not open, used to open train door in DT mode.
DORA/2	Vital Binary Output	Relay Contact	DORA2_M DORA2_P	DTJ3-b6 DTJ3-z2	DC 110V	0.25 @ 120V	140V	15	-	Momentary signal (1sec. duration): 1= A side door open, 0 = A side door not open, used to open train door in DT mode.
DORA/3	Vital Binary Output	Relay Contact	DORA3_M DORA3_P	DTJ3-b4 DTJ2-b28	DC 110V	0.25 @ 120V	140V	15	-	Momentary signal (1sec. duration): 1= A side door open, 0 = A side door not open, used to open train door in DT mode.
FB 110V			+110VB2 0VB2	HN1-N1 HN1-P1						Fall back power supply
DORB/1	Vital Binary Output	Relay Contact	DORB1_M DORB1_P	DTJ3-z12 DTJ3-z8	DC 110V	0.25 @ 120V	140V	15	-	Momentary signal (1sec. duration): 1= B side door open, 0 = B side door not open, used to open train door in DT mode.
DORB/2	Vital Binary Output	Relay Contact	DORB2_M DORB2_P	DTJ3-z14 DTJ3-z6	DC 110V	0.25 @ 120V	140V	15	-	Momentary signal (1sec. duration): 1= B side door open, 0 = B side door not open, used to open train door in DT mode.

Annex C1 – ATC Electrical Interface Requirements

DORB/3	Vital Binary Output	Relay Contact	DORB3_M DORB3_P	DTJ3-z10 DTJ3-z4	DC 110V	0.25 @ 120V	140V	15	-	Momentary signal (1sec. duration): 1= B side door open, 0 = B side door not open, used to open train door in DT mode.
DOSA	Viital Binary Input	Opto – coupler	DOSA OVDOSA	HN2-C2 HN2-D2	DC110V	0.015	130V	-	-	A Toggle input to monitor the door opening and closing commands of the train in order to open and close PSD. Requires a continuous signal input: 1=A side door is commanded to open, 0 = A side door is commanded to close.
DOSB	Vital Binary Input	Opto – coupler	DOSB OVDOSB	HN2-C1 HN2-D1	DC110V	0.015	130V	-	-	A Toggle input to monitor the door opening and closing commands of the train in order to open and close PSD. Requires a continuous signal input: 1=B side door is commanded to open, 0 = B side door is commanded to close.
AM Fault Indicator	Non – Vital Binary Output	LED	AM	HN1-C4	DC110V	0.01	-	-	-	An Indicator: 1 = Auto Mode not allowed, 0 = Auto mode is allowed.
CM Fault Indicator	Non – Vital Binary Output	LED	CM	HN1-C3	DC110V	0.01	-	-	-	An Indicator: 1 = CM Mode not allowed, 0 = CM mode is allowed.
RM Fault Indicator	Non – Vital Binary Output	LED	RM	HN1-C2	DC110V	0.01	-	-	-	An Indicator: 1 = RM Mode not allowed, 0 = RM mode is allowed.
Locked Axle Indicator	Non – Vital Binary Output	LED	AXLE/LOC	HN1-D3	DC110V	0.01	-	-	-	An Indicator: 1 = Axle locked detected, 0 = Normal.
EB Triggered Indicator	Non – Vital Binary Output	LED	EB/TRIG	HN1-D2	DC110V	0.01	-	-	-	An Indicator: 1 = EB Triggered, 0 = Normal.

Annex C1 – ATC Electrical Interface Requirements

Door Tested Indicator	Non – Vital Binary Output	LED	DOOR/FLT	HN1-D1	DC110V	0.01	-	-	-	An Indicator: 1 = Door Test Failure, 0 = Door Test Passed.
Train Hold Indicator	Non – Vital Binary Output	LED	TRAIN/HD	HN1-D4	DC110V	0.01	-	-	-	An Indicator: 1 = Train is hold, 0 = Normal.
Driverless Indicator	Non – Vital Binary Output	LED	DLI+ DLI-	DTJ3-b28 DTJ3-z28	DC24V	0.024	-	-	-	An Indicator: 1 = DT mode is engaged, 0 = DT mode is not engaged.
Driverless Control Push Button DKPB	Non-vital Binary Input	Opto – coupler	DKPB+ DKPB-	DTJ3-b24 DTJ3-b26	DC110V	0.015	130V	-	-	Momentary button input used to engage the DT mode.
AUTO Start push button	Non-vital Binary Input	Opto-coupler	SPB	HN2-P3	DC110V	0.015	-	-	-	Momentary button input used for ATO start in AUTO mode.
Door Status	Vital Binary Input	Opto – coupler	DPR/2 OVB1	HN2-A1 HN2-B1	DC110V	0.015	-	-	-	Door Loop Status input to check the door operation sequence in platform in AUTO mode and to check the door loop integrity during door test routine.
EBR1	Vital Binary Output	Relay Contact	EBR1+ EBR-	HN1-A4 HN/1-B4	DC50V	0.035	-	-	QNC10 or EN50205 compatible Relay	Continuous signal: 1= NO EB, 0 = EB applied by ATP, used to command the trains emergency brake in AUTO, CM and RM modes.
EBR2	Vital Binary Output	Relay Contact	EBR2+ EBR-	HN1-A2 HN/1-B4	DC50V	0.035	-	-	QNC10 or EN50205 compatible Relay	Continuous signal: 1= NO EB, 0 = EB applied by ATP, used to command the trains emergency brake in AUTO, CM and RM modes.
ZVR1	Vital Binary Output	Relay Contact	ZVR1+ ZVR-	HN1-A3 HN/1-B3	DC50V	0.035	-	-	QNC10 or EN50205 compatible Relay	Continuous signal: 1= Zero speed, 0 = train moves, used to reset the SIR circuit.

Annex C1 – ATC Electrical Interface Requirements

ZVR2	Vital Binary Output	Relay Contact	ZVR2+ ZVR-	HN1-B2 HN/1-B3	DC50V	0.035	-	-	QNC10 or EN50205 compatible Relay	Continuous signal: 1= Zero speed, 0 = train moves, used to reset the SIR circuit.
EBR1 Status	Non Vital Binary Input	Opto - coupler	EBR1/2	HN2-M4	DC110V	0.015	130V	-	-	The on-board ATC monitors the state NC of the EBR1. Continuous signal: 1= EB, 0 = NO EB.
EBR2 Status	Non Vital Binary Input	Opto - coupler	EBR2/2	HN2-M3	DC110V	0.015	130V	-	-	The on-board ATC monitors the state NC of the EBR2. Continuous signal: 1= EB, 0 = NO EB.
ZVR1 Status	Non Vital Binary Input	Opto - coupler	ZVR1/6	HN2-N4	DC110V	0.015	130V	-	-	The on-board ATC monitors the state NC of the ZVR1. Continuous signal: 1= moving, 0 = zero speed.
ZVR2 Status	Non Vital Binary Input	Opto - coupler	ZVR2/6	HN2-N3	DC110V	0.015	130V	-	-	The on-board ATC monitors the state NC of the ZVR2. Continuous signal: 1= moving, 0 = zero speed.
SIR1 Status	Non Vital Binary Input	Opto - coupler	SIR1/4	HN2-M2	DC110V	0.015	130V	-	-	The on-board ATC monitors the state NO of the SIR1.
SIR2 Status	Non Vital Binary Input	Opto - coupler	SIR2/7	HN2-M1	DC110V	0.015	130V	-	-	The on-board ATC monitors the state NO of the SIR1.
EMPB	Vital Binary Input	Opto - coupler	EB PB	HN2-P4	DC110V	0.015	-	-	-	The on-board ATC monitors the EB loop state to disengage the DT mode. Continuous signal: 1 = EB not applied, 0 = EB applied.

Notes:

1) For the details of MDR, BDR, SHR, DTSDR and AFRR, please refer to Annex C2 ATO I/O circuit.

2) Each safety input have it's dedicated reference input except EMPB

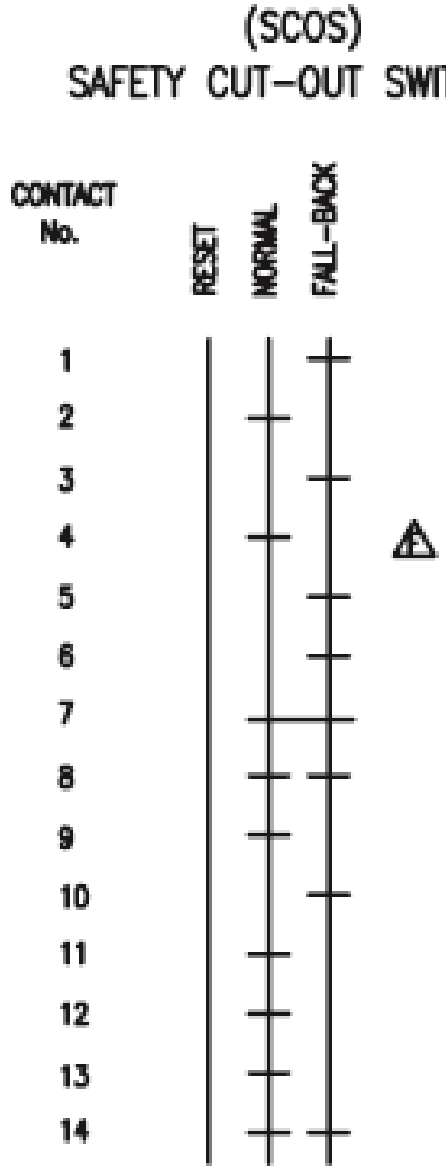
Annex C1 – ATC Electrical Interface Requirements

Section C1.2 Cable Specifications

Location	Reference	From to	Comment
Odometer	Flamex 24 16 0.6BLG	TB to underframe connection box	screened pair with solder sleeve joint
CT sensor & RC antenna	Flamex 24 16 3x1.34BLG	underframe connection box to CT sensor and RC antenna	screened pair with solder sleeve joint
	Flamex 24 16 0.6BLG	TB to underframe connection box	screened pair with solder sleeve joint
speedometer	Flamex 24 16 0.6BLG		screened pair with solder sleeve joint
speedometer bulb	Flamex 24 1.34		
ATO PWM	Flamex 24 16 0.6BLG		screened pair with solder sleeve joint
TMS	Flamex 24 1.34		
power supply	Flamex 24 10	MCB to TSE	
Others non-safety I/O	Flamex 24 1.34		unscreen
Saferty I/O	Flamex 24 2.62		unscreen

Annex C1 – ATC Electrical Interface Requirements

Section C1.3 SCOS Requirements



Annex C1 – ATC Electrical Interface Requirements

Section C1.4 ATC Power Supply Requirements

ATC Power Supply

Electrical Figures	110V DC (nominal), Max. 3A in-rush current: 170A / 40us, 8A / 40ms

Name file : Cable specification_V3.XLS 22/02/2011

Cable type for on board ATC installation						
		DESCRIPTION	WHERE	Nominal section area mm2	conductor stranding-Nominal diam mm	Cable Nominal external diameter in mm
	Type 1	Single Wire cable	see next folio	1	19x0.25- 1,21	****
	Type2	Non shielded Twisted pair cable	see next folio	2x1	19x0.25- 1,21	****
	Type 3	Shielded Twisted pair cable	see next folio	2x1	19x0.25- 1,21	*****
	Type 4	3 shielded Twisted Pairs Cable each pair individually shielded	Between BS connector to terminal block	3x2x1.34	19x0.3- 1,47	13

Cable type from Cubicle connectors to Terminal block.			
	Type 1	Single Wire cable	
	Type2	Non shielded Twisted pair cable	
	Type 3	Shielded Twisted pair cable	

HN/1	4	3	2	1
A	**EBR1+[3]**	**ZVR1+[3]**	**EBR2+[3]**	SMR6[3]
B	**EBR-[3]**	**ZVR-[3]**	**ZVR2+[3]**	C/IND
C	AM[3]	CM[3]	RM[3]	FB/UNS[3]
D	TRAIN/HD[3]	AXLE/LOC[3]	EB/TRIG[3]	DOOR/FLT[3]
E	OV/SP/AL[2]	SHRR[2]	SSRR[2]	PRR[2]
F	WFRR[2]	BDRR[2]	ATX/FLT[2]	+24VRR
G	nc	nc	nc	nc
H	nc	nc	nc	nc
J	LEVEL+[3]	TACHO1+[3]	TACHO2+[3]	+24VRR
K	LEVEL-[3]	TACHO1-[3]	TACHO2-[3]	0VRR
L	BL/M	BL/M	BL/M	EARTH
M	**SSR+[3]**	**SSR-[3]**	nc	nc
N	+110VB1	+110VB1	+110VB1	+110VB2
P	0VB1	0VB1	0VB1	0VB2

HN/2	4	3	2	1
A	**MS/SD[3]**	**MS/REV[3]**	**MS/FOR**	**DPR/2[3]**
B	**0VB1[3]**	**0VB1[3]**	**0VB1[3]**	**0VB1[3]**
C	nc	nc	**DOSA**	**DOSB**
D	nc	nc	**0VDOSA[3]**	**0VDOSB[3]**
E	MS/CM	MS/SB	MS/AUTO2	nc
F	nc	nc	nc	nc
G	nc	nc	nc	nc
H	nc	nc	nc	nc
J	ATC/MOD	nc	ATC/MOD	0VB1
K	**ZVR3/1+**	**EBR3/1+**	C/RAD	MS/AUTO1
L	**ZVR3/1-**	**EBR3/1-**	RAD/ST	0VB1[3]
M	EBR1/2	EBR2/2	SIR1/4	SIR2/7
N	ZVR1/6	ZVR2/6	+110VB2	0VB1
P	EMPB	SPB	C/R1	C/R2

BN	4	3	2	1
A	C1[2]	C3[2]	D1[2]	D3[2]
B	C2[2]	C4[2]	D2[2]	0VTEST[2]
C	BL/0V2	BL/0V2	BL/0V2	BL/0V2
D	CB1[1]	CB2[1]	RCDB[1]	RCGB[1]
E	0VCB1[1]	0VCB2[1]	0V3	0V3
F	BL/OV3	BL/OV3	BL/OV3	BL/OV3
G	nc	BL/0V2	0V2[2]	+24V2[2]
H	0V/RAD	BL/OV3	0V3	+12V3
J	T/SP+[1]	TX/DEST[1]	TX+/RAD[1]	TX/DVAS[1]
K	T/SP-[1]	0V/DEST[1]	TX-/RAD[1]	0V/DVAS[1]
L	BL/M	BL/M	BL/M	BL/M
M	A/SP+[1]	RX/DEST[1]	RX+/RAD[1]	RX/DVAS[1]
N	A/SP-[1]	0V/DEST[1]	RX-/RAD[1]	0V/DVAS[1]
P	BL/M	BL/M	BL/M	BL/M

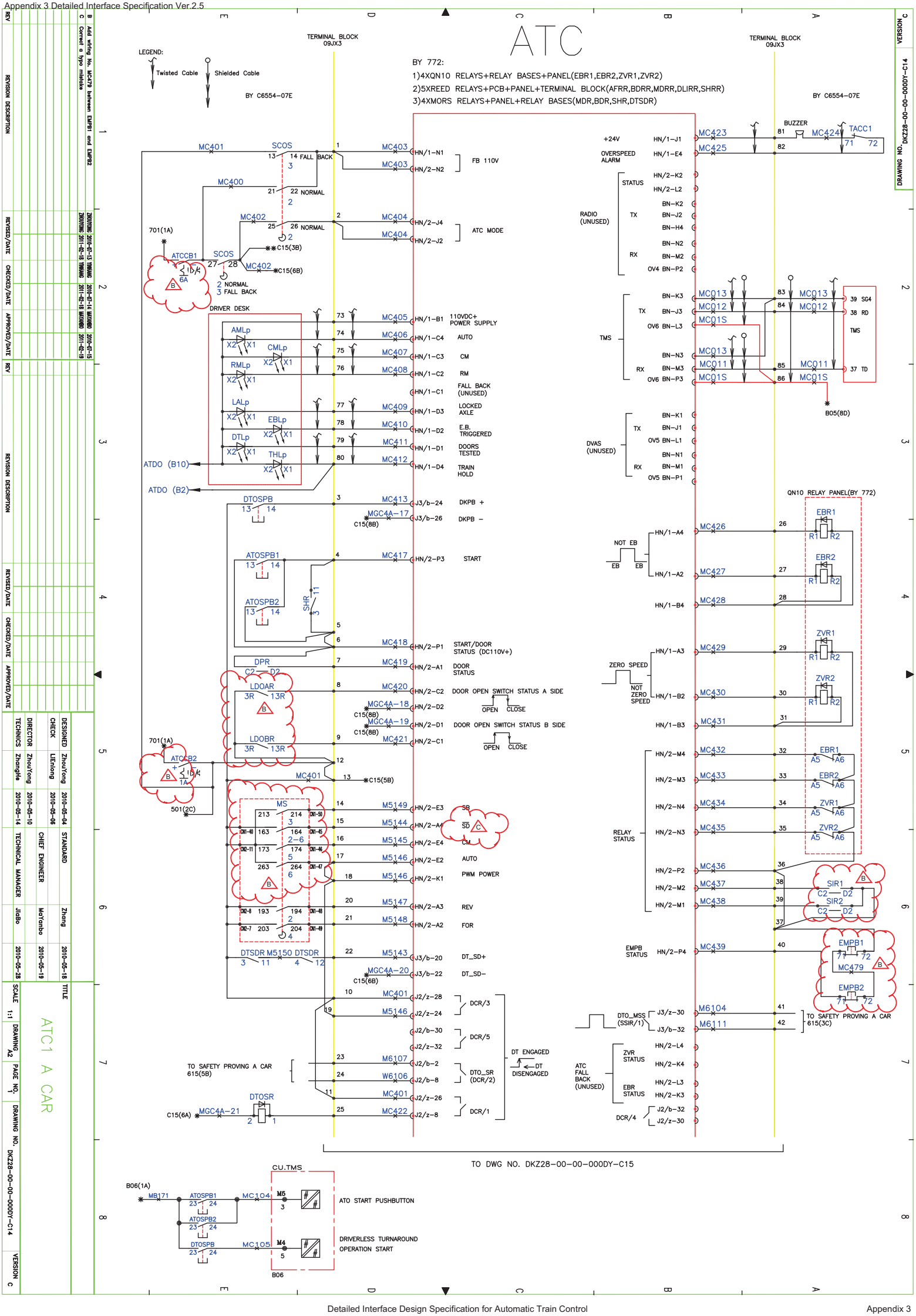
LT/1	4	3	2	1
A	AL4[3]	AL3[3]	AL2[3]	AL1[3]
B	AL8[3]	AL7[3]	AL6[3]	AL5[3]
C	AL12[3]	AL11[3]	AL10[3]	nc
D	AL16[3]	AL15[3]	AL14[3]	AL13[3]
E	AL20[3]	AL19[3]	AL18[3]	AL17[3]
F	nc	nc	nc	nc
G	nc	nc	nc	nc
H	nc	nc	nc	nc
J	nc	nc	nc	nc
K	AL24[3]	AL23[3]	AL22[3]	AL21[3]
L	AL28[3]	AL27[3]	AL26[3]	AL25[3]
M	AL32[3]	AL31[3]	AL30[3]	AL29[3]
N	0VB1	nc	nc	nc
P	0VB1	LT32	nc	nc

LT/2	4	3	2	1
A	AL36[3]	AL35[3]	AL34[3]	AL33[3]
B	AL40[3]	AL39[3]	AL38[3]	AL37[3]
C	AL44[3]	AL43[3]	AL42[3]	AL41[3]
D	AL48[3]	AL47[3]	AL46[3]	AL45[3]
E	AL52[3]	AL51[3]	AL50[3]	AL49[3]
F	nc	nc	nc	nc
G	nc	nc	nc	nc
H	nc	nc	nc	nc
J	nc	nc	nc	nc
K	AL56[3]	AL55[3]	AL54[3]	AL53[3]
L	AL60[3]	AL59[3]	AL58[3]	AL57[3]
M	AL64[3]	AL63[3]	AL62[3]	AL61[3]
N	0VB1	nc	**DERB/1+[3]**	**DERA/1+[3]**
P	0VB1	0VB1	**DERB/1-[3]**	**DERA/1-[3]**

DT J2					DT J3		
Range b		Range z		Range b		Range z	
2	**DCR2_P**	2	**SPARE13_P**	2	**DORA1_M**	2	**DORA2_P**
4	**SPARE23_M**	4	**SPARE12_P**	4	**DORA3_M**	4	**DORB3_P**
6	**SPARE13_M**	6	**SPARE11_P**	6	**DORA2_M**	6	**DORB2_P**
8	**DCR2_M**	8	**DCR1_M**	8		8	**DORB1_P**
10		10	**SPARE12_M**	10		10	**DORB3_M**
12		12	**SPARE11_M**	12		12	**DORB1_M**
14		14	**SPARE23_P**	14		14	**DORB2_M**
16		16	**SPARE22_P**	16		16	**S_ES1-**
18		18	**SPARE21_P**	18		18	**S_ES1+**
20		20	**SPARE22_M**	20	**DT_SD+**	20	**S_ES2-**
22		22	**SPARE21_M**	22	**DT_SD-**	22	**S_ES2+**
24		24	**DCR3_M**	24	DKPB+	24	**S_ES3-**
26	**DORA1_P**	26	**DCR1_P**	26	DKPB-	26	**S_ES3+**
28	**DORA3_P**	28	**DCR3_P**	28	DLI+	28	DLI-
30	**DCR5_P**	30	**DCR4_M**	30	**SPARE31_P**	30	**SSIR1_P**
32	**DCR4_P**	32	**DCR5_M**	32	**SSIR1_M**	32	**SPARE31_M**

DETAILED INTERFACE SPECIFICATION

ANNEX C2
ATC I/O CIRCUIT

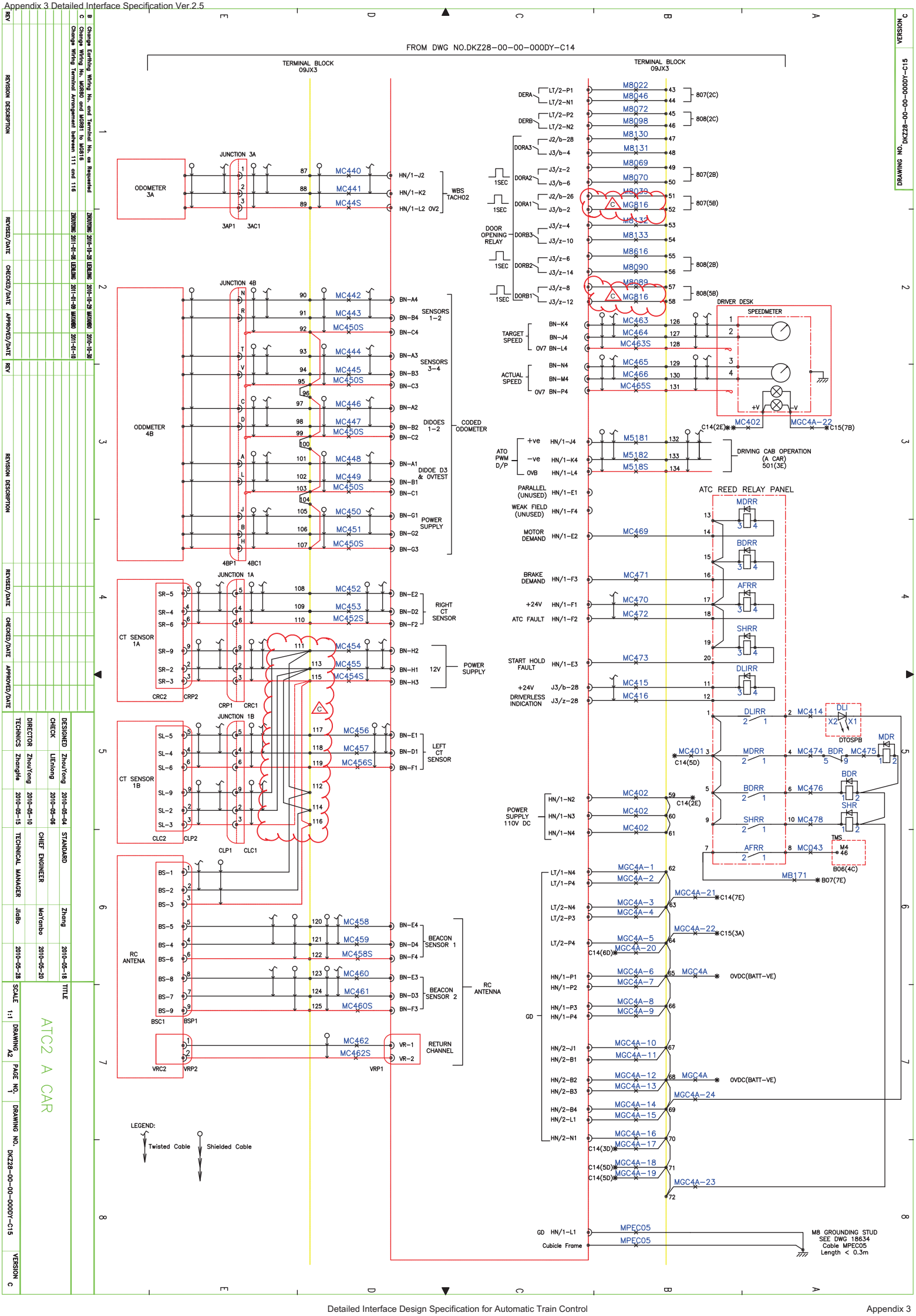


REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Add wiring No. MC479 between EMPB1 and EMPB2	ZHOUYONG 2010-07-13	TANGMG 2010-07-14	MAYANBO 2010-07-15
C	Correct a typo mistake	ZHOUYONG 2011-02-16	TANGMG 2011-02-16	MAYANBO 2011-02-19

DESIGNED	CHECK	DIRECTOR	TECHNICS
ZhouYong	LiHenlong	ZhouYong	ZhangHe
2010-05-04	2010-05-06	2010-05-10	2010-05-14
STANDARD		CHIEF ENGINEER	TECHNICAL MANAGER
Zhang		MaYanbo	JiaBo
2010-05-18		2010-05-19	2010-05-28

TITLE	SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
ATC1 A CAR	1:1	A2	1	DKZ28-00-00-000DY-C14	C

VERSION C
DRAWING NO. DKZ28-00-00-000DY-C14



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
C	Change Earthing Wiring No. and Terminal No. as Requested	ZHOUYONG 2010-10-26	LIENLONG 2010-10-29	WANGMING 2010-10-30
B	Change Wiring No. M0980 and M0981 to M0816 Change Wiring Terminal Arrangement between 111 and 116	ZHOUYONG 2011-01-06	LIENLONG 2011-01-09	WANGMING 2011-01-10

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

DESIGNED	ZhouYong	2010-05-04	STANDARD
CHECK	LiEnlong	2010-05-06	
TECHNICS DIRECTOR	ZhouYong	2010-05-10	
TECHNICAL MANAGER	JiaBo	2010-05-15	CHIEF ENGINEER
	MoYanbo	2010-05-18	Zhang
		2010-05-20	
		2010-05-28	

TITLE	ATC2 A CAR
SCALE	1:1
DRAWING A2	
PAGE NO.	1
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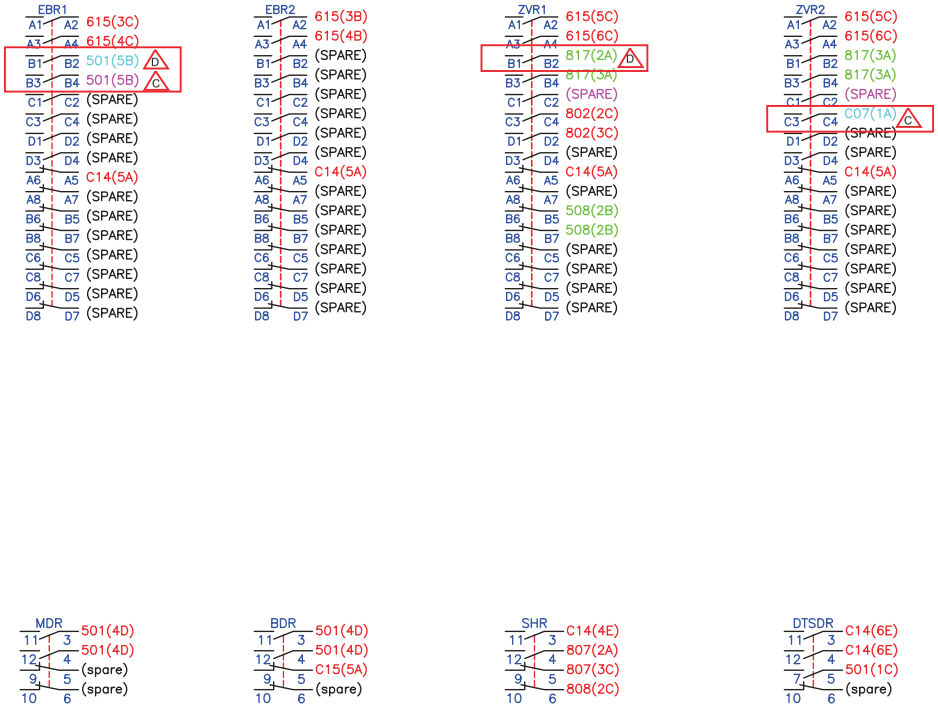
VERSION	C

VERSION C
DRAWING NO. DKZ28-00-00-000DY-C15

A CAR



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Add C07(1A) on ZVR2 C3—C4 Contact	ZHOUYONG 2011-01-09	LIENLONG 2011-01-10	MAYANBO 2011-01-11
C	Add 501(5B) on EBR1 B3—B4 Contact	ZHOUYONG 2011-01-09	LIENLONG 2011-01-10	MAYANBO 2011-01-11
D	Correct a typo mistake	ZHOUYONG 2011-02-18	LIENLONG 2011-02-18	MAYANBO 2011-02-19
	Add 501(5B) on EBR1 B1—B2 Contact			

DESIGNED	ZhouYong	2010-05-27	STANDARD	
CHECK				
			CHIEF ENGINEER	
DIRECTOR				
TECHNICS			TECHNICAL MANAGER	

TITLE: ATC3 A CAR

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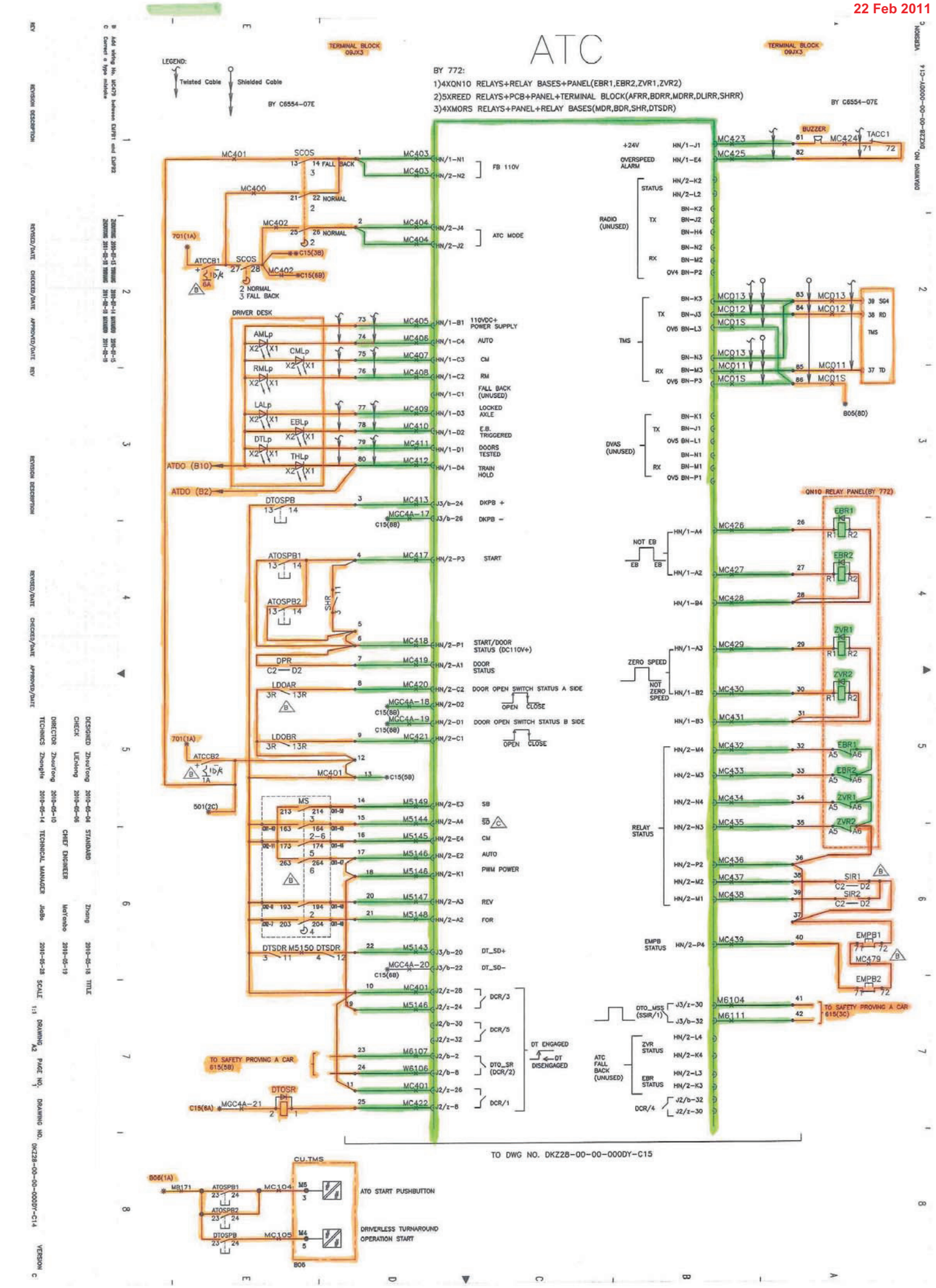
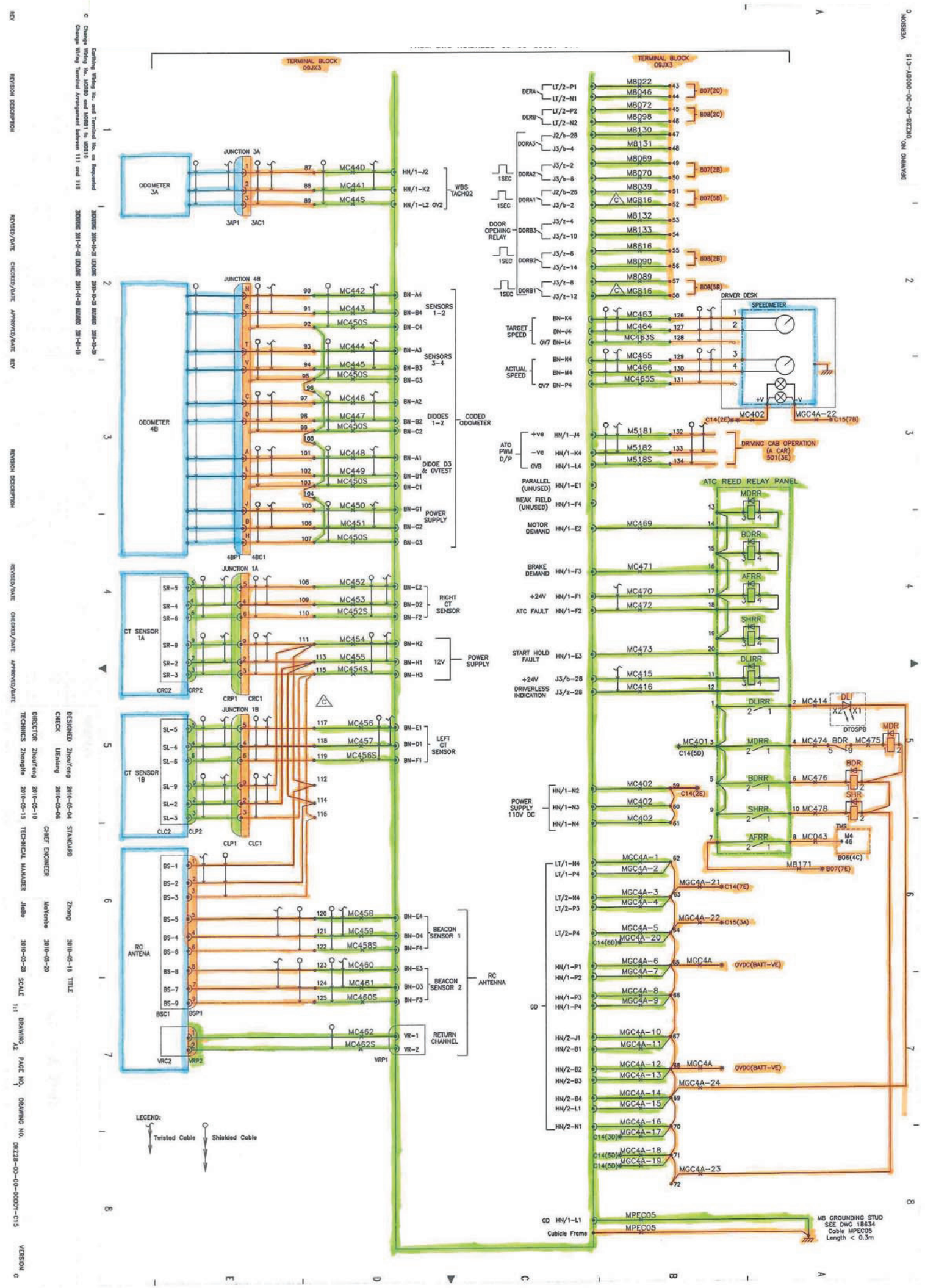
22 Feb 2011


ATC
BY 772:
1)4XQN10 RELAYS+RELAY BASES+PANEL(EBR1,EBR2,ZVR1,ZVR2)
2)5XREED RELAYS+PCB+PANEL+TERMINAL BLOCK(AFRR,BDRR,MDRR,DLIRR,SHRR)
3)4XMORS RELAYS+PANEL+RELAY BASES(MDR,BDR,SHR,DTSDR)
LEGEND:
Twisted Cable
Shielded Cable
BY C6554-07E
TERMINAL BLOCK 09JX3
DRIVER DESK
AMLp
CMLp
RMLp
LALp
EBLp
DTLp
THLp
DPR
LDOAR
LDOBR
ATOSPB1
ATOSPB2
DTOSPB
DTSDR M5150 DTSDR
MS
SCOS
ATCCB1
ATCCB2
DTOSR
110VDC+ POWER SUPPLY
AUTO
CM
RM
FALL BACK (UNUSED)
LOCKED AXLE
E.B. TRIGGERED
DOORS TESTED
TRAIN HOLD
DKPB +
DKPB –
START
START/DOOR STATUS (DC110V+)
DOOR STATUS
DOOR OPEN SWITCH STATUS A SIDE
DOOR OPEN SWITCH STATUS B SIDE
SB
CM
AUTO
PWM POWER
REV
FOR
DT_SD+
DT_SD–
DCR/3
DCR/5
DCR/2
DCR/1
DT ENGAGED
DT DISENGAGED
DTO_SR (DCR/2)
TO SAFETY PROVING A CAR 615(5B)
ATO (B10)
ATDO (B2)
FB 110V
ATC MODE
BUZZER
TACC1
+24V
OVERSPEED ALARM
RADIO (UNUSED)
TMS
DVAS (UNUSED)
QN10 RELAY PANEL(BY 772)
EBR1
EBR2
ZVR1
ZVR2
NOT EB
ZERO SPEED
NOT ZERO SPEED
RELAY STATUS
EMPB STATUS
SIR1
SIR2
EMPB1
EMPB2
MC479
DTO_MSS (SSIR/1)
ATC FALL BACK (UNUSED)
ZVR STATUS
EBR STATUS
TO SAFETY PROVING A CAR 615(3C)
TO DWG NO. DKZ28-00-00-000DY-C15
CU-TMS
ATO START PUSHBUTTON
DRIVERLESS TURNAROUND OPERATION START

22 Feb 2011


TERMINAL BLOCK 09JX3
TERMINAL BLOCK 09JX3
ODDOMETER 3A
JUNCTION 3A
3AP1
3AC1
MC440
MC441
MC445
HN/1-J2
HN/1-K2
HN/1-L2 OV2
WBS TACH02
ODDOMETER 4B
JUNCTION 4B
4BP1
4BC1
MC442
MC443
MC444
MC445
MC446
MC447
MC448
MC449
MC450
MC451
SENSORS 1-2
SENSORS 3-4
DIODES 1-2
DIDOE D3 & OVTEST
POWER SUPPLY
CODED ODOMETER
CT SENSOR 1A
JUNCTION 1A
CRC2
CRP2
CRP1
CRC1
MC452
MC453
MC454
MC455
MC454S
RIGHT CT SENSOR
12V
POWER SUPPLY
CT SENSOR 1B
JUNCTION 1B
CLC2
CLP2
CLP1
CLC1
MC456
MC457
MC456S
LEFT CT SENSOR
RC ANTENA
BSC1
BSP1
MC458
MC459
MC458S
MC460
MC461
MC460S
BEACON SENSOR 1
BEACON SENSOR 2
RC ANTENNA
VRC2
VRP2
VRP1
MC462
MC462S
RETURN CHANNEL
LEGEND:
Twisted Cable
Shielded Cable
DERA
DERB
DORA3
DORA2
DORA1
DORB3
DORB2
DORB1
DOOR OPENING RELAY
1SEC
M8022
M8046
M8072
M8098
M8130
M8131
M8069
M8070
M8039
MG816
M8132
M8133
M8616
M8090
M8089
B07(2C)
B08(2C)
B07(2B)
B07(5B)
B08(2B)
B08(5B)
DRIVER DESK
SPEEDMETER
TARGET SPEED
ACTUAL SPEED
MC463
MC464
MC463S
MC465
MC466
MC465S
MC402
MGC4A-22
C14(2E)
C15(7B)
ATO PWM D/P
+ve
-ve
OVB
M5181
M5182
M5185
DRIVING CAB OPERATION (A CAR) 501(3E)
PARALLEL (UNUSED)
WEAK FIELD (UNUSED)
MOTOR DEMAND
BRAKE DEMAND
+24V
ATC FAULT
START HOLD FAULT
DRIVERLESS INDICATION
ATC REED RELAY PANEL
MDRR
BDRR
AFRR
SHRR
DLIRR
MC469
MC471
MC470
MC472
MC473
MC415
MC416
DLI
DTOSPB
MDR
BDR
SHR
MC414
MC401
MC474
MC475
MC476
MC478
MC043
C14(5D)
POWER SUPPLY 110V DC
MC402
MGC4A-1
MGC4A-2
MGC4A-3
MGC4A-4
MGC4A-5
MGC4A-20
MGC4A-6
MGC4A-7
MGC4A-8
MGC4A-9
MGC4A-10
MGC4A-11
MGC4A-12
MGC4A-13
MGC4A-14
MGC4A-15
MGC4A-16
MGC4A-17
MGC4A-18
MGC4A-19
MGC4A-21
MGC4A-22
MGC4A-23
MGC4A-24
MB171
B07(7E)
B06(4C)
C14(7E)
C15(3A)
C14(6D)
C14(3D)
OVDC(BATT-VE)
GD
MPEC05
MB GROUNDING STUD
SEE DWG 18634
Cable MPEC05
Length < 0.3m
Cubicle Frame

DETAILED INTERFACE SPECIFICATION

ANNEX C3
ATC POWER SUPPLY CHARACTERISTICS

Annex C3: ATC Power Supply Characteristics

Cantenary Voltage Characteristics

Taction Power Supply at the Pantograph has the following Characteristics accordingly to PS Appendix I Annex 2 Overhead Line / Traction Power Supply System Interfaces:

Rated Voltage: 1,500 VDC

Operating Voltage
- Minimum: 1,000 VDC
- Maximum: 1,900 VDC

Supply Surge: subjected to surges of both polarities up to 5kV.

Auxiliary Power Supply Characteristics

Auxiliary Power Supply will be used for the control of equipment and power feed for auxiliary equipment. Voltage characteristics are defined at the input side of equipment.

1. DC 110V Power Supply

   Rated Voltage: 110VDC
   Operating Voltage
   - Maximum: 137.5VDC
   - Minimum: 77 VDC

   This power source battery is floating and it is not expected to suffer from catenary power interruption

2. AC 415V Power Supply

   Rated Voltage: 415VAC, 50Hz
   Operating Voltage
   - Maximum: 394.25 VAC
   - Minimum: 435.75 VAC

   Frequency Change: 50 Hz ± 1%

   This power source battery will be interrupted due to pantograph bounce

DETAILED INTERFACE SPECIFICATION

ANNEX C4
MCB CHARACTERISTICS

Multi 9 C65系列小型断路器

尖端技术 领先一步

产品目录

Schneider Electric

目录

C65系列介绍

概述 2
C65系列产品一览表 6

C65系列断路器

C65N断路器 8
C65H断路器 10
C65H ICB单磁式断路器 12
C65L断路器 14

C65系列直流专用断路器

C65H-DC断路器 16
C65L-DC断路器 19

C65系列剩余电流动作保护附件

Vigi C65 ELE (G) 电子式剩余电流动作保护附件（AC类） 22
Vigi C65 ELE电子式剩余电流动作保护附件（A类） 24
Vigi C65 ELM电磁式剩余电流动作保护附件（AC类） 25

C65系列电气附件

指示与脱扣附件# 26
远程控制附件# 28
重合控制附件# 30

C65系列机械辅助装置

机械辅助装置 31

附录

脱扣曲线 32
限流 35
级联和选择性 36
温度修正系数表 60
直流应用 63
尺寸 64

#进口产品

C65系列介绍

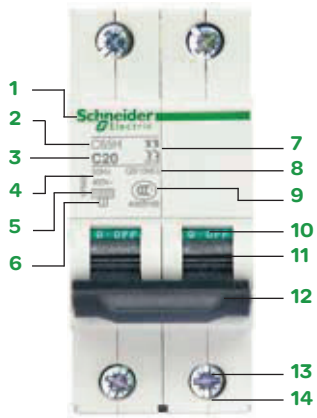
概述

继往开来，再铸辉煌

在中国低压电器的历史上，没有一种产品像施耐德电气生产的小型断路器那样拥有如此巨大的影响，它已不仅仅作为产品服务于我们，更重要的是带给我们观念的深刻改变和整个行业的彻底变革。同时也使施耐德电气成为国内低压电器行业最为耀眼和客户最为信赖的公司。

施耐德电气一直站在低压电器制造业的最前列。2001年，代表当代最新技术的C65N/H小型断路器正式推向市场，C65N/H的投产，标志着国内低压终端制造业步入新的时代。2004年4月C65L面世。随后C65N B曲线、Vigi C65 A型、100mA、100mA🅂、300mA、300mA🅂 剩余电流动作保护附件的相继推出更加充实了C65系列。现在的C65系列扩大了产品的适用范围，充分体现了施耐德电气“以客户为中心”的理念，使客户在不同的市场、不同的应用场合都可以选择适用其需求的具有最大性能价格比及最优技术的产品。我们坚信，凭借领先的技术，凭借我们不懈的追求，凭借广大客户的无比信赖，C65必将铸就新的辉煌。

认识C65



1 断路器品牌
2 断路器类型
3 脱扣曲线及额定电流
4 频率及额定电压
5 分断能力
6 限流等级
7 接线图
8 符合标准
9 CCC认证标志
10 绿色指示条指示内部触头位置状态
○ "I·ON"表示触头闭合状态位置
○ "O·OFF" 表示触头断开状态位置
11 锁定槽
12 操作手柄
13 紧固螺钉
14 热塑外壳

注：2007年7月1日起，C65全系列产品符合欧盟RoHS指令。

C65系列型号标注

C65 N - C 20A / 2P + VE + 300 mA + SD

N	C	20A	2P	VE	300 mA	SD
分断能力	脱扣曲线	额定电流	极数	可配剩余电流动作保护附件	额定剩余动作电流	可配电气附件
N: 6000A	B 型曲线	1A, 2A, 3A*	1P	VE: Vigi C65 ELE	30 mA	MX或MX+OF: 分励脱扣单元
H: 10000A	(保护短路电流较小的负载)	4A, 6A	2P	VEG: Vigi C65 ELE G	100 mA	MN: 欠压脱扣单元 (瞬动型)
L: 15000A	C 型曲线	10A, 16A	3P	VM: Vigi C65 ELM	300 mA	MN 🅂: 欠压脱扣单元 (延时型)
	(配电保护)	20A, 25A	4P	VEA: Vigi C65 ELE (A类)	100 mA🅂	MV: 过压脱扣单元
	D 型曲线	32A, 40A			300 mA🅂	SD: 报警接点
	(动力保护)	50A, 63A				OF: 辅助接点
						OF+SD/OF: 双重切换接点

*: C65N/H B曲线有3A的产品

C65 H - DC 1 C 10 MN

H	1	C	10			MN
分断能力	极数	脱扣曲线	额定电流			配电气附件
H：10000A	1：1P	B 型曲线	1:1A	10:10A	40:40A	OF
L：20000A	2：2P	(保护短路电流较小的负载)	2:2A	16:16A	50:50A	SD
			3:3A	20:20A	63:63A	OF+SD/OF
		C 型曲线	4:4A	25:25A		MX
		(保护常规负载)	6:6A	32:32A		MX+OF
						MN

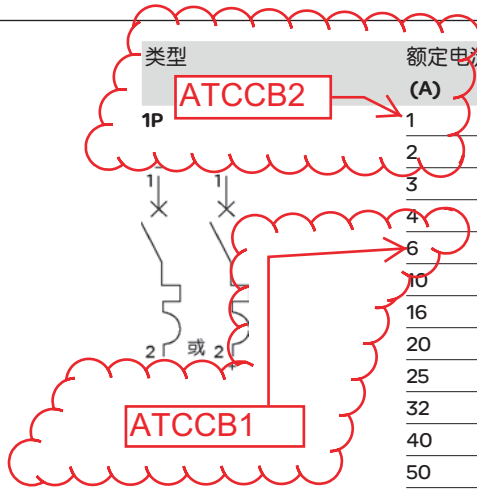
C65系列直流专用断路器

C65H-DC断路器

B型和C型脱扣曲线

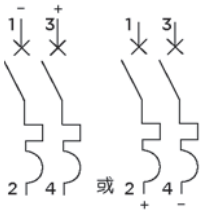
IEC 60947-2 / GB 14048·2: 10kA

MGN22056



类型	额定电流 (A)	宽度 (mm)	产品号 B型	C型
1P	1	18	MGN22000	MGN22050
	2	18	MGN22001	MGN22051
	3	18	MGN22002	MGN22052
	4	18	MGN22003	MGN22053
	6	18	MGN22004	MGN22054
	10	18	MGN22005	MGN22055
	16	18	MGN22006	MGN22056
	20	18	MGN22007	MGN22057
	25	18	MGN22008	MGN22058
	32	18	MGN22009	MGN22059
	40	18	MGN22010	MGN22060
	50	18	MGN22011	MGN22061
	63	18	MGN22012	MGN22062

MGN22076



2P	1	36	MGN22020	MGN22070
	2	36	MGN22021	MGN22071
	3	36	MGN22022	MGN22072
	4	36	MGN22023	MGN22073
	6	36	MGN22024	MGN22074
	10	36	MGN22025	MGN22075
	16	36	MGN22026	MGN22076
	20	36	MGN22027	MGN22077
	25	36	MGN22028	MGN22078
	32	36	MGN22029	MGN22079
	40	36	MGN22030	MGN22080
	50	36	MGN22031	MGN22081
	63	36	MGN22032	MGN22082

附录

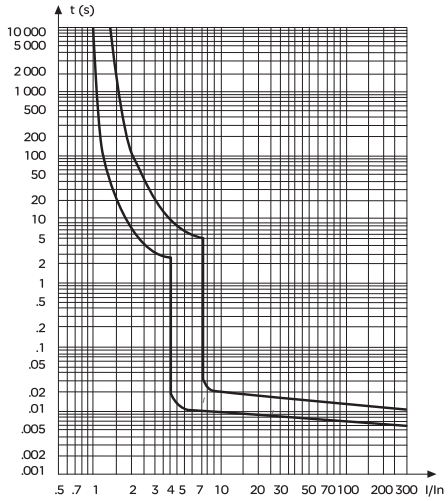
脱扣曲线

C65H-DC / C65L-DC直流小型断路器

C65系列断路器符合IEC 60947-2/GB14048.2标准，其瞬时磁脱扣动作范围如下：

B型曲线：5.5 In ± 20%

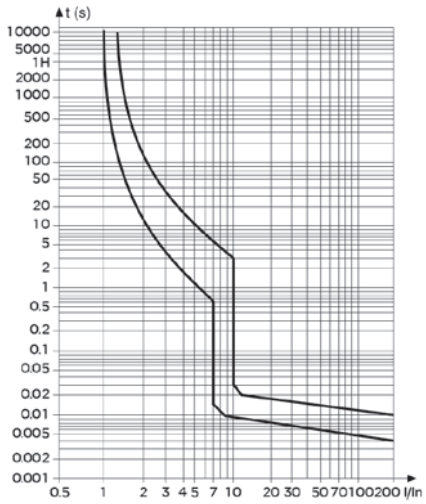
C型曲线：8.5 In ± 20%



C65H-DC

B型脱扣曲线

ATCCB1,
ATCCB2



C65H-DC / C65L-DC

C型脱扣曲线

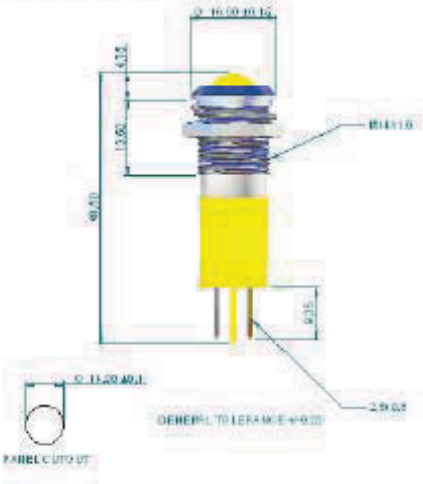
DETAILED INTERFACE SPECIFICATION

ANNEX C5
MODE SELECTION SWITCH CHARACTERISTICS
(REMOVED)

DETAILED INTERFACE SPECIFICATION

ANNEX C6
ATC INDICATORS CHARACTERISTICS

RS ITEM NO 210-169

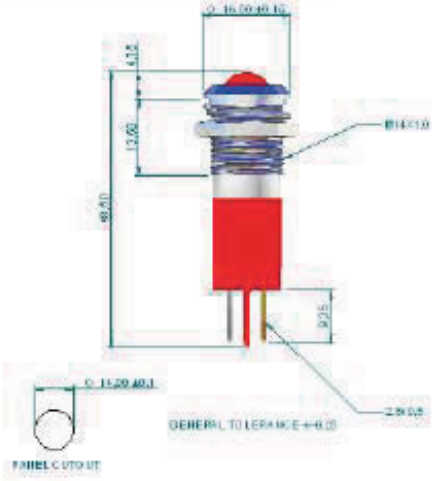


LED/Multiled	*LED*	Optimum voltage (V)	*110Vac*	Intensity	
Mounting Size	*14mm*	Rectifier	-	Reverse Voltage	*5V (max)*
Mounting Finish	*Prominent*	AC current	*6mA (max)*		
Protection	*IP67*	DC current	-		
Mount Holder	*Black Bezel*	Voltage Tolerance(%)	*10%*		
Chip Qty	*1*	Optimum temperature (°C)	*-25°C...+60°C*		
Indicator colour	*Yellow*	Storage temperature (°C)	*-25°C...+60°C*		
Wavelength (nm)	*588*	Contact Tab x 2	*2.8x0.8mm*		

RoHS

We reserve the right to make changes without further notice to this product to Improve reliability, function or design.
Dimensions in mm (typical) not to scale.

RS ITEM NO 210-175



LED/Multiled	*LED*	Optimum voltage (V)	*110Vac*	Intensity	
Mounting Size	*14mm*	Rectifier	-	Reverse Voltage	*5V (max)*
Mounting Finish	*Prominent*	AC current	*6mA (max)*		
Protection	*IP67*	DC current	-		
Mount Holder	*Black Bezel*	Voltage Tolerance(%)	*10%*		
Chip Qty	*1*	Optimum temperature (°C)	*-25°C...+60°C*		
Indicator colour	*Red*	Storage temperature (°C)	*-25°C...+60°C*		
Wavelength (nm)	*625*	Contact Tab x 2	*2.8x0.8mm*		

RoHS

We reserve the right to make changes without further notice to this product to Improve reliability, function or design.
Dimensions in mm (typical) not to scale.

DETAILED INTERFACE SPECIFICATION

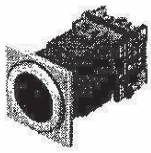
ANNEX C7
ATO DEPART BUTTON CHARACTERISTICS

Devices flush mounting

ATC START PUSH SWITCH
EAO P/N: 704.012.518
704.900.3

Pushbutton actuator, flush mounting

non-illuminative



Essential Accessories:

Switching element page 50

	Front protection	Switching action	Frontbezel/-ring	Lens	□ 35 x 35 mm Typ-Nr.	Ø 35 mm Typ-Nr.	Mounting dimensions	Technical drawing	Circuit drawing	⚖
Pushbutton actuator, flush mounting	IP 65	MA	Plastic black	Plastic black	**704.239.000**		12	22	3	0.051
				Plastic blue	**704.239.600**		12	22	3	0.051
				Plastic colourless	**704.239.700**		12	22	3	0.051
				Plastic green	**704.239.500**		12	22	3	0.051
				Plastic red	**704.239.200**		12	22	3	0.051
				Plastic yellow	**704.239.400**		12	22	3	0.051
			Plastic silver	Plastic black	**704.240.008**		12	22	4	0.051
				Plastic blue	**704.240.608**		12	22	3	0.051
				Plastic colourless	**704.240.708**		12	22	3	0.051
				Plastic green	**704.240.508**		12	22	3	0.051
				Plastic red	**704.240.208**		12	22	3	0.051
				Plastic yellow	**704.240.408**		12	22	3	0.051
		M	Plastic black	Plastic black	**704.209.000**		12	22	4	0.051
				Plastic blue	**704.209.600**		12	22	4	0.051
				Plastic colourless	**704.209.700**		12	22	4	0.051
				Plastic green	**704.209.500**		12	22	4	0.051
				Plastic red	**704.209.200**		12	22	4	0.051
				Plastic yellow	**704.209.400**		12	22	4	0.051
			Plastic silver	Plastic black	**704.210.008**		12	22	4	0.051
				Plastic blue	**704.210.608**		12	22	4	0.051
				Plastic colourless	**704.210.708**		12	22	4	0.051
				Plastic green	**704.210.508**		12	22	4	0.051
				Plastic red	**704.210.208**		12	22	4	0.051
				Plastic yellow	**704.210.408**		12	22	4	0.051
		MA	Aluminium natural	Aluminium black		**704.041.018**	7	22	3	0.051
				Aluminium blue		**704.041.618**	7	22	3	0.051
				Aluminium gold		**704.041.418**	7	22	3	0.051
				Aluminium natural		**704.041.818**	7	22	3	0.051
				Aluminium olive-green		**704.041.518**	7	22	3	0.051
				Aluminium red		**704.041.218**	7	22	3	0.051
				Plastic black		**704.042.018**	7	22	3	0.051
				Plastic blue		**704.042.618**	7	22	3	0.051
				Plastic colourless		**704.042.718**	7	22	3	0.051
				Plastic green		**704.042.518**	7	22	3	0.051
				Plastic red		**704.042.218**	7	22	3	0.051
				Plastic yellow		**704.042.418**	7	22	3	0.051

Continuation see next page

Devices flush mounting 04

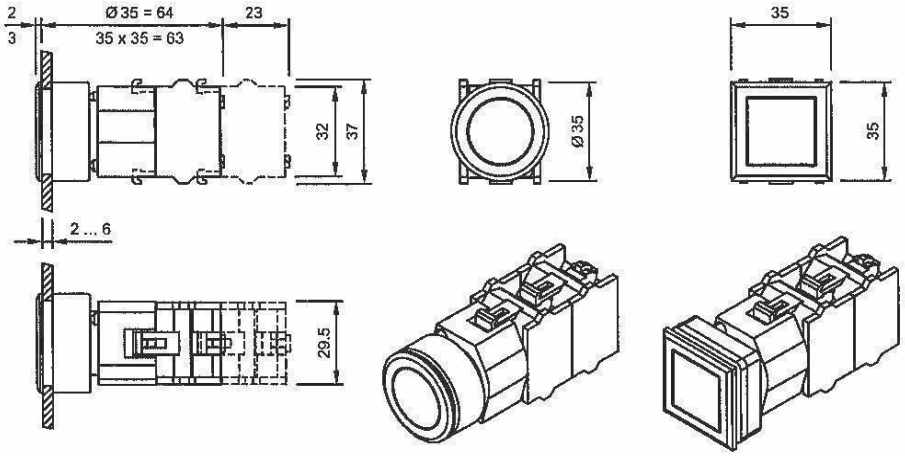
Continued from previous page

	Front protection	Switching action	Frontbezel/-ring	Lens	⌀ 35 x 35 mm Typ-Nr.	Ø 35 mm Typ-Nr.	Mounting dimensions	Technical drawing	Circuit drawing	kg
Pushbutton actuator, flush mounting	IP 65	M	Aluminium natural	Aluminium black		**704.011.018**	7	22	4	0.051
				Aluminium blue		**704.011.618**	7	22	4	0.051
				Aluminium gold		**704.011.418**	7	22	4	0.051
				Aluminium natural		**704.011.818**	7	22	4	0.051
				Aluminium olive-green		**704.011.518**	7	22	4	0.051
				Aluminium red		**704.011.218**	7	22	4	0.051
				Plastic black		**704.012.018**	7	22	4	0.051
				Plastic blue		**704.012.618**	7	22	4	0.051
				Plastic colourless		**704.012.718**	7	22	4	0.051
				Plastic green		**704.012.518**	7	22	4	0.051
				Plastic red		**704.012.218**	7	22	4	0.051
				Plastic yellow		**704.012.418**	7	22	4	0.051

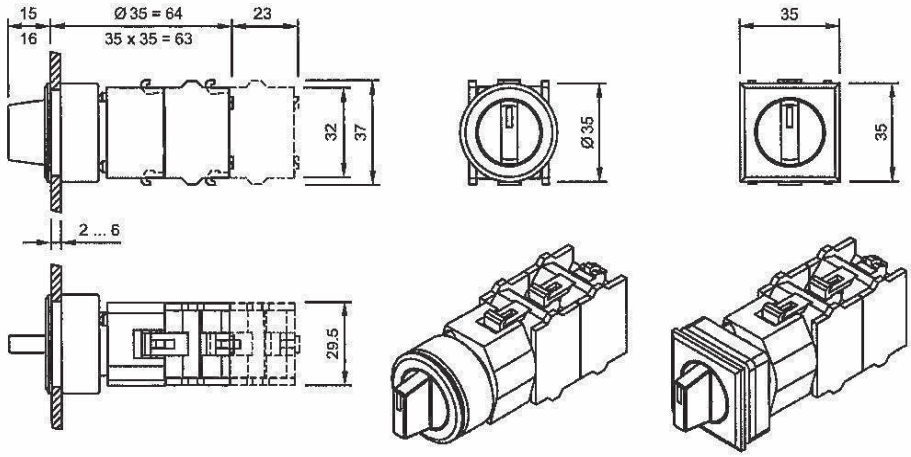
Switching action: MA = Maintained action, M = Momentary action
Mounting dimensions from page 87, Technical drawing from page 91, Circuit drawing from page 110

Drawings 04

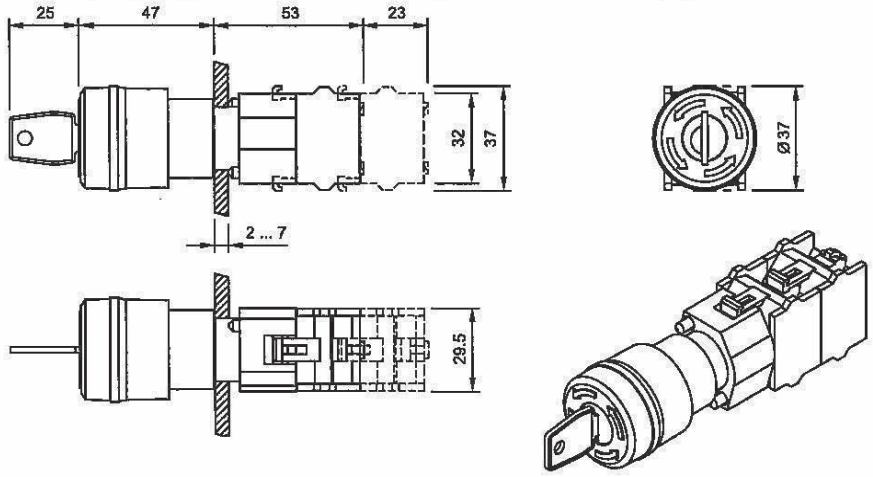
22 Pushbutton actuator, flush mounting page 33



23 Selector switch actuator 2 positions, short lever, flush mounting page 39 | **Selector switch actuator 3 positions, short lever, flush mounting** page 41 | **Selector switch actuator 3 positions, long lever, flush mounting** page 42



24 Emergency-stop pushbutton actuator, foolproof EN IEC 60947-5-5 page 21



Accessories

Switching element

	Switching system	Contacts	Contact material	Terminals	Typ-Nr.	Technical drawing	Circuit drawing	kg
Switching element	SM	1 NC	Au-Ag	ST	**704.911.2**	28	7	0.021
			Ag-Cu	D-PT 6.3	**704.915.2/D**	30	7	0.025
				PT 6.3	**704.915.2**	29	7	0.021
				ST	**704.910.2**	28	7	0.021
			Ag-Pd	ST	**704.912.2**	28	7	0.021
		1 NC + 1 NO	Au-Ag	ST	**704.911.5**	28	48	0.028
			Ag-Cu	D-PT 6.3	**704.915.5/D**	30	48	0.032
				PT 6.3	**704.915.5**	29	48	0.028
				ST	**704.910.5**	28	48	0.028
			Ag-Pd	ST	**704.912.5**	28	48	0.028
		1 NO	Au-Ag	ST	**704.911.1**	28	8	0.021
			Ag-Cu	D-PT 6.3	**704.915.1/D**	30	8	0.025
				PT 6.3	**704.915.1**	29	8	0.021
				ST	**704.910.1**	28	8	0.021
			Ag-Pd	ST	**704.912.1**	28	8	0.021
		2 NC	Au-Ag	ST	**704.911.4**	28	50	0.028
			Ag-Cu	D-PT 6.3	**704.915.4/D**	30	50	0.032
				PT 6.3	**704.915.4**	29	50	0.028
				ST	**704.910.4**	28	50	0.028
			Ag-Pd	ST	**704.912.4**	28	50	0.028
		2 NO	Au-Ag	ST	**704.911.3**	28	49	0.028
			Ag-Cu	D-PT 6.3	**704.915.3/D**	30	49	0.032
				PT 6.3	**704.915.3**	29	49	0.028
				ST	**704.910.3**	28	49	0.028
			Ag-Pd	ST	**704.912.3**	28	49	0.028
	SA	1 NC	Au-Ag	D-PT 6.3	**704.901.2/D**	30	7	0.026
				ST	**704.901.2**	28	7	0.021
			Ag-Cu	D-PT 6.3	**704.905.2/D**	30	7	0.026
				PT 6.3	**704.905.2**	29	7	0.021
				ST	**704.900.2**	28	7	0.021
			Ag-Pd	ST	**704.902.2**	28	7	0.021
		1 NC + 1 NO	Au-Ag	D-PT 6.3	**704.901.5/D**	30	48	0.033
				ST	**704.901.5**	28	48	0.028
			Ag-Cu	D-PT 6.3	**704.905.5/D**	30	48	0.033
				PT 6.3	**704.905.5**	29	48	0.028
				ST	**704.900.5**	28	48	0.028
			Ag-Pd	ST	**704.902.5**	28	48	0.028
		1 NO	Au-Ag	D-PT 6.3	**704.901.1/D**	30	8	0.026
				ST	**704.901.1**	28	8	0.021
			Ag-Cu	D-PT 6.3	**704.905.1/D**	30	8	0.026
				PT 6.3	**704.905.1**	29	8	0.021
				ST	**704.900.1**	28	8	0.021
			Ag-Pd	ST	**704.902.1**	28	8	0.021
		2 NC	Au-Ag	D-PT 6.3	**704.901.4/D**	30	50	0.033
				ST	**704.901.4**	28	50	0.028
			Ag-Cu	D-PT 6.3	**704.905.4/D**	30	50	0.033
				PT 6.3	**704.905.4**	29	50	0.028
				ST	**704.900.4**	28	50	0.028
			Ag-Pd	ST	**704.902.4**	28	50	0.028

Continuation see next page

Accessories

Continued from previous page

	Switching system	Contacts	Contact material	Terminals	Typ-Nr.	Technical drawing	Circuit drawing	g
Switching element	SA	2 NO	Au-Ag	D-PT 6.3	**704.901.3/D**	30	49	0.033
				ST	**704.901.3**	28	49	0.028
			Ag-Cu	D-PT 6.3	**704.905.3/D**	30	49	0.033
				PT 6.3	**704.905.3**	29	49	0.028
				ST	**704.900.3**	28	49	0.028
			Ag-Pd	ST	**704.902.3**	28	49	0.028

For the 3rd switching element per switch the terminal marking insert is to be ordered separately.
Switching system: SM = Slow-make switching element, SA = Snap-action switching element
Contacts: NC = Normally closed, NO = Normally open
Contact material: Au-Ag = Gold-Silver, Ag-Cu = Hard silver, Ag-Pd = Silver-Palladium
Terminals: ST = Screw terminal, D-PT 6.3 = Double plug-in terminal 6.3 mm, PT 6.3 = Plug-in terminal 6.3 mm
Technical drawing from page 91, Circuit drawing from page 110

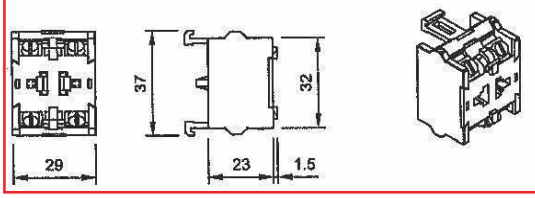
Switching element for ring cable shoe

	Switching system	Contacts	Contact material	Terminals	Typ-Nr.	Technical drawing	Circuit drawing	g
Switching element for ring cable shoe	SM	1 NC	Au-Ag	ST	**704.911.2B**	28	7	0.021
			Ag-Cu	ST	**704.910.2B**	28	7	0.021
		1 NC + 1 NO	Au-Ag	ST	**704.911.5B**	28	48	0.028
			Ag-Cu	ST	**704.910.5B**	28	48	0.028
		1 NO	Au-Ag	ST	**704.911.1B**	28	8	0.021
			Ag-Cu	ST	**704.910.1B**	28	8	0.021
		2 NC	Au-Ag	ST	**704.911.4B**	28	50	0.028
			Ag-Cu	ST	**704.910.4B**	28	50	0.028
		2 NO	Au-Ag	ST	**704.911.3B**	28	49	0.028
			Ag-Cu	ST	**704.910.3B**	28	49	0.028
	SA	1 NC	Ag-Cu	ST	**704.900.2B**	28	7	0.021
		1 NC + 1 NO	Ag-Cu	ST	**704.900.5B**	28	48	0.028
		1 NO	Ag-Cu	ST	**704.900.1B**	28	8	0.021
		2 NC	Ag-Cu	ST	**704.900.4B**	28	50	0.028
		2 NO	Ag-Cu	ST	**704.900.3B**	28	49	0.028

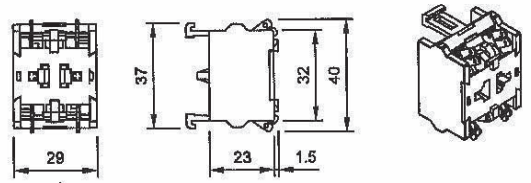
Switching system: SM = Slow-make switching element, SA = Snap-action switching element
Contacts: NC = Normally closed, NO = Normally open
Contact material: Au-Ag = Gold-Silver, Ag-Cu = Hard silver
Terminals: ST = Screw terminal
Technical drawing from page 91, Circuit drawing from page 110

Drawings 04

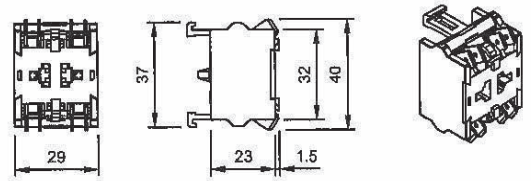
28 Switching element page 50 | **Switching element for ring cable shoe** page 51 | **Switching element for Emergency-stop pushbutton** page 52



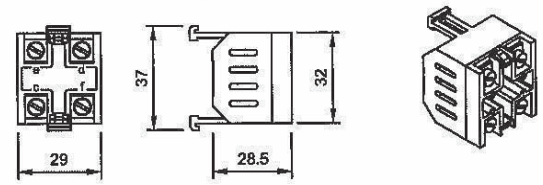
29 Switching element page 50 | **Switching element for Emergency-stop pushbutton** page 52



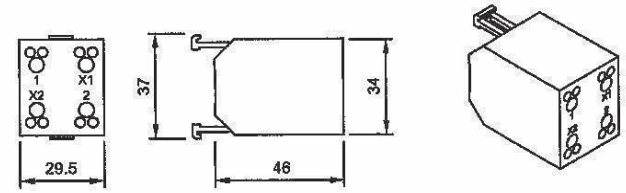
30 Switching element page 50 | **Switching element for Emergency-stop pushbutton** page 52



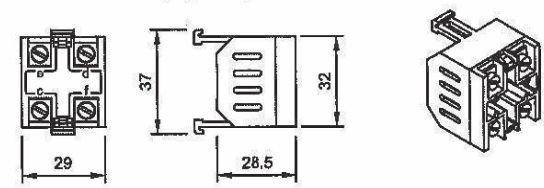
31 Flasher element page 49



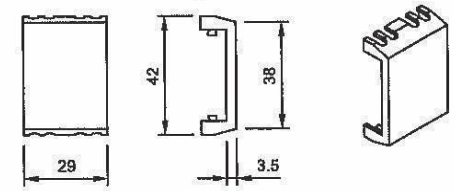
32 Lamp transformer page 57



33 Diode block page 56 | **Resistor block** page 57 | **Resistor-diode block** page 57



34 Terminal cover page 54



Technical Data 04

Snap-action switching element

Switching system

The double-break, snap-action switching element is equipped with one or two independent contact systems, acting as normally open or normally closed contact. The snap-action switching element is fitted with self-cleaning contacts.
Up to 3 switching elements can be snapped to each actuator.
Snap-action switching elements are not permissible for emergency-stop pushbuttons !

Material

Material of contact
Hard Silver, Gold-Silver, Silver-Palladium (for aggressive atmospheres)

Switch housing
Polycarbonate (PC)

Mechanical characteristics

Terminals
Screw terminals
Plug-in terminals 6.3 x 0.8 mm
max. wire cross-section 2 x 2.5 mm²
max. wire cross-section of stranded cable 2 x 1.5 mm²
For switches with plug-in terminals it is necessary to provide insulation sleeves and to maintain a spacing of 65 mm between rows (mounting dimensions)

Tightening torque
Screws at the mounting flange max. 25 Ncm
Screws at switching element max. 50 Ncm

Actuating force
1 Normally closed 1.9 N
1 Normally open 2 N

Actuating travel
5.8 mm ± 0.2 mm

Rebound time
≤3 ms

Mechanical lifetime
(with 1 switching element)

Pushbutton maintained action	1.5 million	Cycles of operation
Pushbutton momentary action	3 million	Cycles of operation
Selector switch maintained action	1.25 million	Cycles of operation
Selector switch momentary action	2.5 million	Cycles of operation
Keylock switch maintained action	25 000	Cycles of operation
Keylock switch momentary action	50 000	Cycles of operation

Electrical characteristics

Standards
The switches comply with the "Standards for low-voltage switching devices" EN IEC 60947-5-1

Rated Insulation Voltage U_i
500 VAC/600 VDC, as per EN IEC 60947-5-1

Contact resistance
New state ≤50 mΩ as per DIN IEC 60512-2-4

Conventional free air thermal current I_{th}
10 A, as per EN IEC 60947-5-1
the maximum current in continuous operation and at ambient temperature must not exceed the quoted maximum values.

Isolation resistance
≥10 MΩ between open contacts at 500 VDC, as per DIN IEC 60512-2-10

Switch rating
At switch rating AC for Gold-Silver, Silver-Palladium and Hard Silver contacts, service category AC-15, as per EN IEC 60947-5-1 (cosϕ 0.3)

Voltage	230 VAC	400 VAC	500 VAC
Current	6 A	4 A	2.5 A

At switch rating DC for Gold-, Silver- and Hard Silver contacts service category DC-13, as per EN IEC 60947-5-1

Voltage	24 VDC	60 VDC	110 VDC
Current	10 A	3 A	1 A

Recommended minimum operational data
Gold-Silver contacts :

Voltage	5 VDC	24 VDC	110 VDC
Current	15 mA	5 mA	2 mA

Hard Silver contacts :

Voltage	24 VDC	110 VDC
Current	50 mA	10 mA

Protection class
Indicators and switches, fit for mounting into devices with protection class II

Environmental conditions

Storage temperature
-40 °C ... +85 °C

Operating temperature
-40 °C ... +55 °C

Shock resistance
(single impacts, semi-sinusoidal)
300 m/s²puls width 11 ms, as per EN IEC 60068-2-27

Vibration resistance
(sinusoidal)
100 m/s² at 10 Hz ... 500 Hz, amplitude 0,75 mm, as per EN IEC 60068-2-6

Approvals

Approbations
CB (IEC 60947)
CCC
CSA
Germanischer Lloyd
GOST
SEV
UL

Declaration of conformity
CE

MTR CORPORATION LIMITED

CONTRACT C6014-14E

PROCUREMENT OF NEW TRAINS

Particular Specification

Volume 2b of 4

August 2015

MTR CORPORATION LIMITED

CONTRACT C6014-14E

PROCUREMENT OF NEW TRAINS

PARTICULAR SPECIFICATION

WORKING DOCUMENT

VOLUME 2b OF 4

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CONTRACT C6014-14E
PROCUREMENT OF NEW TRAINS
PARTICULAR SPECIFICATION
WORKING DOCUMENT

CONTENTS

[VOLUME 1 OF 4]

Section 1: Introduction

Section 2: Definitions and Abbreviations

Section 3: Scope of the Works

Section 4: System Description and Performance Requirements

Section 5: Infrastructure Constraints

Section 6: Car Body Structure and Exterior

Section 7: Interior of Car Body

Section 8: Cab Facilities and Layout

Section 9: Operation and Control

Section 10: Train Management System

Section 11: Traction and Braking Equipment

Section 12: Bogies and Suspensions

Section 13: Pneumatics and Air Distribution Systems

Section 14: Gangways and Couplers

Section 15: Air Conditioning and Ventilation

Section 16: Doors

Section 17: Auxiliary Electrical Supply

Section 18: Communications

[VOLUME 2a OF 4]

Section 19: Not Used

Section 20: Materials and Workmanship Requirements

Section 21: Design Requirements

Section 22: Testing Requirements

Section 23: Training Requirements

Section 24: Spare Parts, Special Tools and Test Equipment

Section 25: System Assurance

Section 26: Maintenance Requirements

Section 27: Quality Management

Section 28: Environmental Requirements

Section 29: Programme

Section 30: Site Arrangements

Section 31: Interface Arrangements

Section 32: Attendance

[VOLUME 2a OF 4 (Cont'd)]

APPENDICES

Appendix A: Schedules of Drawings

Appendix B: Codes and Standards

Appendix C: Schedule of Tests

Appendix D: Not Used

Appendix E: Schedule of Delivery

Appendix F: Engineer's Preliminary Programme, Project Calendar, Schedule of Critical Dates and Schedule of Key Dates

Appendix G: Site Layout and Works Areas

Appendix H: Rules and Procedures for Working Within or Adjacent to the Railway

- Annex 1 P-Licensing System - Caring and Coaching System for New Contractor Workers
- Annex 2 Contractor Fitness for Duty Management

Appendix I: Designated Contracts and Interfacing Systems

- Annex 1 P-way Interface (Track Data)
- Annex 2 Overhead Line/ Traction Power Supply System Interfaces
- Annex 3 ATC Interfaces

[VOLUME 2b OF 4]

Appendix I: Designated Contracts and Interfacing Systems

Annex 3 ATC Interfaces (Cont'd)
Annex 4 Communications Interfaces
Annex 5 Platform Screen Door Interfaces
Annex 6 Depot Interfaces
Annex 7 Electric Vehicle Interfaces
Annex 8 Not Used
Annex 9 Dynamic Route Map Interfaces
Annex 10 Cab Simulator System Coordination

Appendix J: Not Used

Appendix K: Not Used

Appendix L: Interior Styling Schedule

Appendix M: Life Cycle Cost

Appendix N: Design Data

Appendix O: Delivery of Equipment

Appendix P: Configuration Control Programme

Appendix Q: List of Named Suppliers

[VOLUME 3 OF 4]

ROLLING STOCK STANDARDS

RS/C6014/01: Data Transmission and Management

RS/C6014/02: Constructional and Workmanship Requirements

RS/C6014/03: Electrical and Design Requirements

RS/C6014/04: Electromagnetic Compatibility

RS/C6014/05: Software

RS/C6014/06: Cables

RS/C6014/07: Pneumatic Equipment

RS/C6014/08: Fire Performance

RS/C6014/09: Wheelsets

RS/C6014/10: Pantograph

RS/C6014/11: Battery

RS/C6014/12: Operation and Maintenance Manual

RS/C6014/13: Noise Performance and Measurement

RS/C6014/14: Operability Design Guidelines

RS/C6014/15: Keys and Locks

RS/C6014/16: LED Lighting Standard

[VOLUME 4 OF 4]

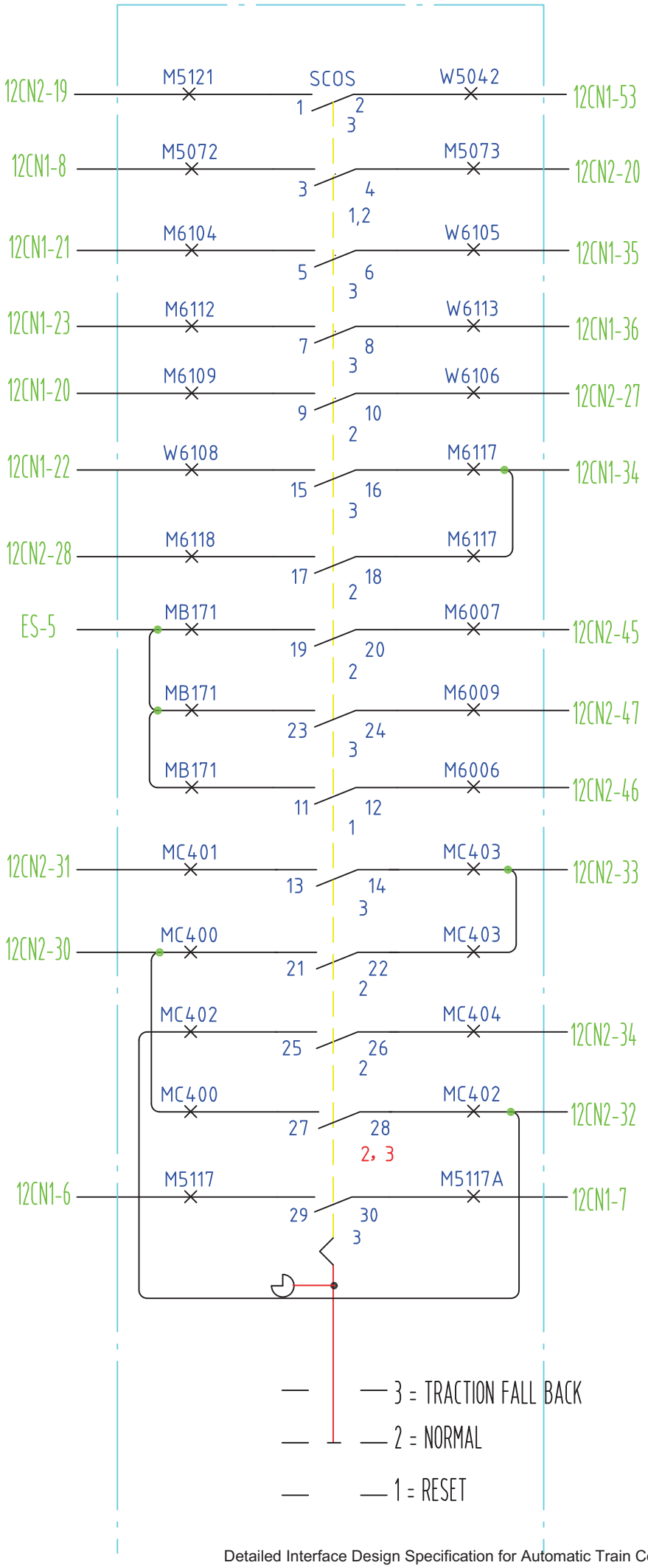
Drawings

DETAILED INTERFACE SPECIFICATION

ANNEX C8
SCOS CHARACTERISTICS

XD9031-8(SCOS)New

Contact	1	2	3
	-90	0	90
1-2			X
3-4	X	X	
5-6			X
7-8			X
9-10		X	
11-12	X		
13-14			X
15-16			X
17-18		X	
19-20		X	
21-22		X	
23-24			X
25-26		X	
27-28		X	X
29-30			X
31-32			


12CN2-19
M5121
SCOS
W5042
12CN1-53
12CN1-8
M5072
M5073
12CN2-20
12CN1-21
M6104
W6105
12CN1-35
12CN1-23
M6112
W6113
12CN1-36
12CN1-20
M6109
W6106
12CN2-27
12CN1-22
W6108
M6117
12CN1-34
12CN2-28
M6118
M6117
ES-5
MB171
M6007
12CN2-45
MB171
M6009
12CN2-47
MB171
M6006
12CN2-46
12CN2-31
MC401
MC403
12CN2-33
12CN2-30
MC400
MC403
MC402
MC404
12CN2-34
MC400
MC402
12CN2-32
12CN1-6
M5117
M5117A
12CN1-7
1,2
2, 3
3 = TRACTION FALL BACK
2 = NORMAL
1 = RESET

Kraus & Naimer

BLUE LINE switchgear

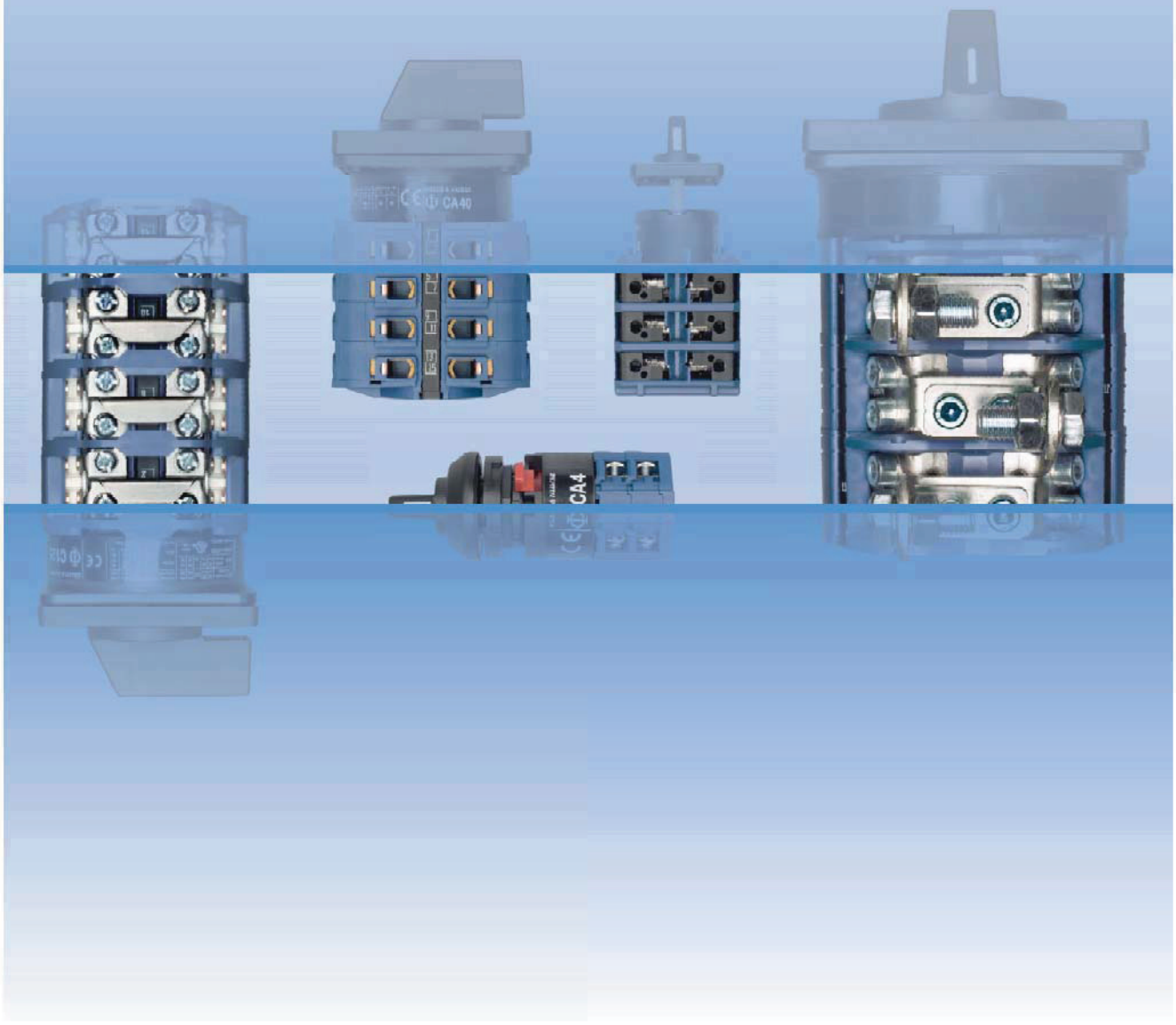
since 1907

Catalog 100

11/2008

Control and Load Switches for higher Capacities

CL type up to 20 A
CAD, CA and C type up to 315 A
L type up to 2400 A



Disconnectors and Main Switches acc. to IEC 60947-3 see Catalog 500

Contents

	Page
Construction Data	2
Dimensions and Nominal Ratings	3
How to order	4, 5
Switch Function and Configuration	
CL Switches 10 A-20 A C, CA and CAD Switches 10 A-315 A	
ON/OFF Switches	6, 7
Double-throw Switches	8-10
General Application Switches	10
Coding Switches	11
Multi-step Switches	12-14
Voltmeter Switches	15-17
Ammeter Switches	17-19
Volt-ammeter Switches	19
Control Switches	19, 20
Motor Switches	21-23
L Switches 350 A-2400 A	
ON/OFF Switches	24-26
Double-throw Switches	26, 27
Multi-step Switches	27, 28
Types of Mounting	
Panel Mounting	29-33
Base Mounting	34
Wall Mounting	35
Escutcheon Plates	36, 37
Handles	38
International Standards and Approvals	39
Technical Data	40-43
Dimensions	
Panel Mounting	44-48
Base Mounting	48, 49
Wall Mounting	50
Overall Switch Lengths	50, 51
Blue Line Switchgear: Summary	52

Construction Data

The load switches of the C, CA, CAD and CL-series offer a solution for most cam switch applications. Different contact designs, contact materials and terminals allow for their use as control switches, instrumentation switches and motor control switches, as well as in electronic circuitry and in aggressive environments according to IEC 60947-3 and VDE 0660 part 107.

The stage is the basis for all switches and can be supplied with a maximum of 2 contacts. The terminals are accessible from the side. CA and CAD switches are supplied with open terminals to facilitate wiring and are protected against accidental finger contact according to EN 50274, VDE 0660 part 514 and BGV A3. Switches up to type CA25B are supplied with captive screws with clamping plates. The switch types CA40-CA63 are supplied with box terminals. Captive plus-minus terminal screws and integrated screwdriver guides facilitate wiring.

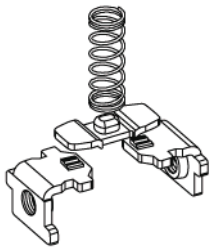
The switches of the new CL-series are supplied with rust-free and acid-resisting IDC terminals (**I**nsulation **D**isplacement **C**onnection) instead of screw type terminals. The stripping or preparation of the insulation is no longer required. Eliminate errors due to i.e., stripped end of the conductor too long or too short, incorrect sleeves used, sleeves crimped incorrectly or wrong crimping tool is used, terminal screws not tightened properly etc. The CL switches reduce installation time by 60 %-70 % compared to the screw type terminals. This translates to significant cost savings. For connecting 2 conductors to a terminal an additional screw terminal with plus-minus screw is available.

If a positive manual operation or a higher DC rating is required, many of these switches can be fitted with a snap action latching mechanism - suffix „S“ - to the switch type.

The cam-operated switches of the L-series are continuous current rated for off-load switching. They may be used to switch resistive or low inductive loads.

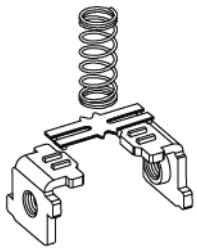
Special Contact Systems

CA4/CA4-1



High contact reliability by multiple cross-point contacts, electronic compatible, CA4 with 1 μ and CA4-1 with 35 μ gold plating.

CAD11/CAD12



H-bridge with „cross-wire“ contact system, high contact reliability also at lower voltages. CAD11 with gold-plated contacts, CAD12 with silver contact.

Type	Size	Possible Switching Angles	Max. No. of Stages
CA4, CA4-1	S00	30°, 45°, 60°, 90°	9
CL4	S00	30°, 45°, 60°, 90°	8
CA10-CA25	S0	30°, 45°, 60°, 90°	12
CA10S-CA25S	S0	60°	on request
CAD11, CAD12	S0	30°, 45°, 60°, 90°	12
CL10	S0	30°, 45°, 60°, 90°	10
CA10B-CA25B	S1	30°, 45°, 60°, 90°	12
CA40, CA50, CA63	S1	30°, 45°, 60°, 90°	12
C80, C125	S2	20°, 30°, 45°, 60°, 90°	12
C315	S3	20°, 30°, 45°, 60°, 90°	12
L350/51, L630/31, L1000/01, L1250/51	S2	30°, 45°, 60°, 90°	12
L400, L600, L800, L1200, L1600, L2000	S3	30°, 45°, 60°, 90°	12

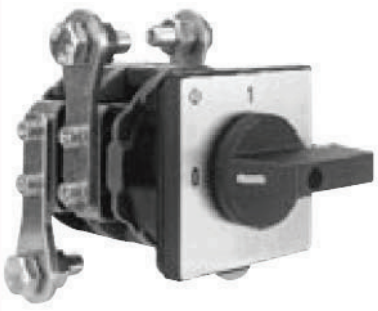
CL Switches

CA and CAD Switches (CA4-CA25B)

CA Switches (CA40-CA63)

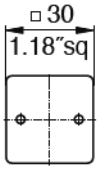
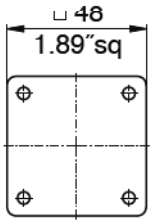
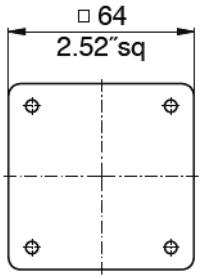
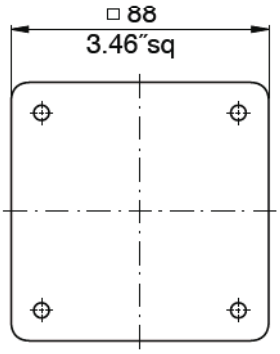
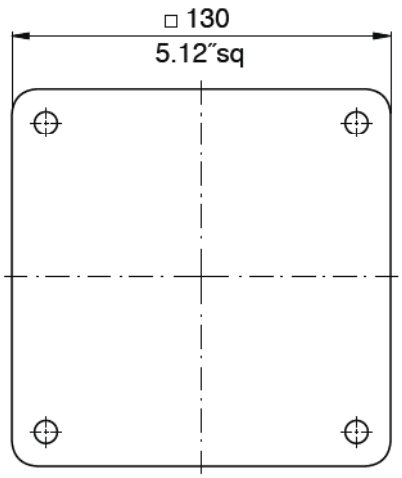
C Switches

L Switches



Above illustrates the standard terminal positions.

Nominal Ratings

Switch Size		Type	According to IEC 60947-3/VDE 0660 part 107			
			Insulation Voltage[1] U_i V	Thermal Current I_u/I_{th} A	Motor Rating 3 x 380 V-440 V AC-23 kW	AC-3 kW
S00		**CA4**	440	10	3	2,2
		CA4-1	440	10	3	2,2
		CL4	440	10	3	2,2
S0		**CA10**	690	20	7,5	5,5
		CA11	690	20	7,5	5,5
		CA20	690	25	11	7,5
		CA25	690	32	15	11
		CAD11	600	6	-	-
		CAD12	600	6	-	-
		CL10	690	20	7,5	5,5
S1		**CA10B**	690	20	7,5	5,5
		CA11B	690	20	7,5	5,5
		CA20B	690	25	11	7,5
		CA25B	690	32	15	11
		CA40	690	40	18,5	15
		CA50	690	50	22	18,5
		CA63	690	63	30	18,5
S2		**C80**	690	115	45	30
		C125	690	150	75	37
		L350	690	350	90	37
		L351	690	350	90	37
		L630	690	630[2]	90	37
		L631	690	630[2]	90	37
		L1000	690	1000[2]	90	37
		L1001	690	1000[2]	90	37
		L1250	690	1250[2]	90	37
		L1251	690	1250[2]	90	37
S3		**C315**	690	315	132	55
		C315[3]	1000	315	132	55
		L400	690	500	132	55
		L600	690	800[2]	132	55
		L800	690	1100[2]	132	55
		L1200	690	1450[2]	132	55
		L1600	690	1900[2]	132	55
		L2000	690	2400[2]	132	55

For further technical details, refer to pages 40-43.
To furnish with gold contacts and quick connects see page 4.

[1]Valid for lines with grounded common neutral termination, overvoltage category III, pollution degree 3. Values for other supply systems on request. [2]Ambient temperature 35 °C max. [3]Additional switch functions on request.

DETAILED INTERFACE SPECIFICATION

ANNEX C9
ZVR1, ZVR2, EBR1, EBR2 RELAYS SPECIFICATIONS
QN10 RELAYS P/N: B18559/1
TRAIN MOUNTING BASE P/N: C17806/7

Glossary of Terms

This glossary is divided into two parts; Part A - Relay Types and Part B – Relay terms and characteristics.

PART A – RELAY TYPES

A.C. Immune
A d.c. relay which will not operate if an a.c. voltage up to a stated value is applied to the relay coil.

Biased
A d.c. relay which will only operate with one particular polarity of supply. It will not operate if supply polarity is reversed.

Double Wound Coils
A neutral d.c. relay with two equal independent windings on the coil. Each winding will operate the relay so that relay can be operated from either of two independent sources.

Lamp Proving Relays
A neutral d.c. relay designed to operate from the current supplied to signal lamps and to release when lamp or lamps burn out. Some relays incorporate a bridge rectifier to operate from a.c. lamp currents.

Magnetically Latched
A d.c. relay which will only operate with one particular polarity of supply and remains operated when supply is removed. A second winding of the relay coil must be energised with the correct polarity supply to release the relay.

Neutral
A d.c. relay which will operate with either polarity of supply to the coil.

Sensitive Relay
Generally a neutral relay with high coil resistance and low power consumption.

Slow Acting Relays
A neutral d.c. relay with a built in copper slug to delay the operation or release action (time delay range 0-500 ms). Units incorporating various timing methods such as thermal, capacitor/resistor, electronic or synchronous motor (time delay 0-4 minutes).

Track Relay
Generally a neutral relay with low coil resistance and low power consumption.

Train Carried Relays
These relays are basically a standard design Q type relay with special relay bases to enable them to fit on anti-vibration resilient mountings.

Twin Relays
A unit having two independent relays, with up to 8 contacts each, all in a standard ‘Q’ type case. Both relays are of the same standard of construction and safety as the single ‘Q’ relays.

PART B – RELAY TERMS AND CHARACTERISTICS

Back Contact
A contact made when the relay is de-energised.

Front Contact
A contact made when the relay is energised.

Full Operate
The condition the relay assumes when its armature has complete full travel and maximum contact pressure is obtained.

Heavy Duty Front Contacts
These contacts are Sig/Sil contacts fitted with magnetic blowouts to extend the life of the contacts when switching high current loads.

Interruption Time
The time interval the supply to the relay can be interrupted without the relay releasing.

Metal to Metal Contacts
These are 'Non-Safety' contacts. Both elements are of the same material that can be silver, silver cadmium oxide or 60/40 silver palladium. The silver cadmium oxide is 'Weld Resistant' but not 'Non-Weld'.

MTBF
Mean time between failures.

MTBWSF
Mean time between wrong side failures.

Operate *(also known as Pick-Up or P.U.)*
The condition of the relay when all front contacts are just made.

Operate Time
The time interval measured between switching on the supply and the last front contact making.

Operate Transit Time
The time interval measured between the first back contact breaking and the last front contact making.

Percentage Release
The ratio of the actual release value : operate value, multiplied by 100.

Release *(also known as Drop Away or D.A.)*
The condition of the relay when all front contacts have opened.

Release Time
The time interval measured between the first front contact breaking and the last back contact making.

Vital (Safe)
Defines circuits and components that comply with stringent requirements of reliability and intrinsic safety.

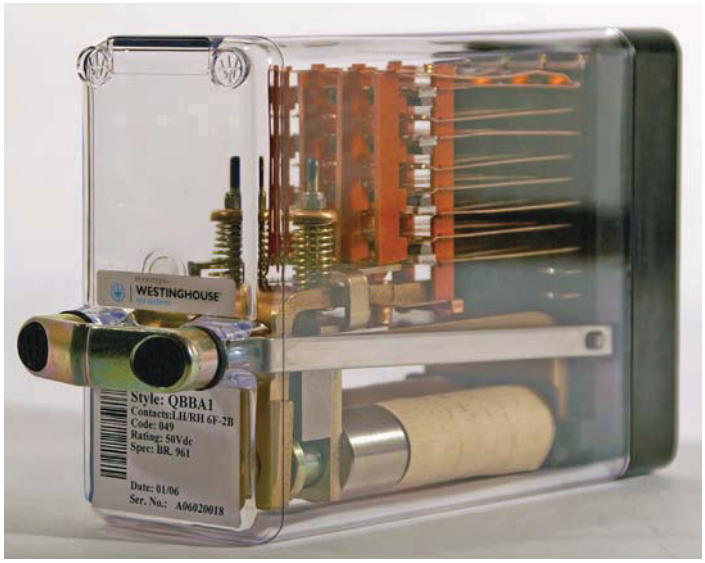
SIG/SIL Contacts
These are 'Non-weld' safety contacts. One contact is of 'silver impregnated graphite' and the other silver.

For further technical information, please contact Customer Services Dept TEL: +44(0) 1249 441420

Westinghouse Rail Systems Limited, PO Box 79, Pew Hill, Chippenham, Wiltshire, SN15 1JD UK
Tel: +44(0) 1249 441441 Email: marketing@wrsl.com
Fax: +44(0) 1249 652322 Website: www.wrsl.com

Q Series Relays

Westinghouse Rail Systems Limited Style Q-Relays are based on a series of designs for "miniature" plug in relays developed during the late 1950's



BR930 Series relays offer considerable size and cost savings when compared with the previous large plug-in and shelf type designs. Careful attention to detail design culminated in the production of a safe dependable and efficient relay, within a standardised minimum space envelope.

A method of safety interlocking was evolved such that only those units compatible with the plugboard could be mounted.

British Rail (now Network Rail) subsequently approved IRSE (Institute of Railway Signalling Engineers) designs for the relay and published them as a series of B.R specifications, starting with B.R.930.

This specified the requirements for a basic D.C, neutral, tractive-armature relay.

Style Q-Relays comply with the relevant emission requirements of EN 55014. It is considered that these relays have inherent immunity to in-service electro-magnetic disturbance

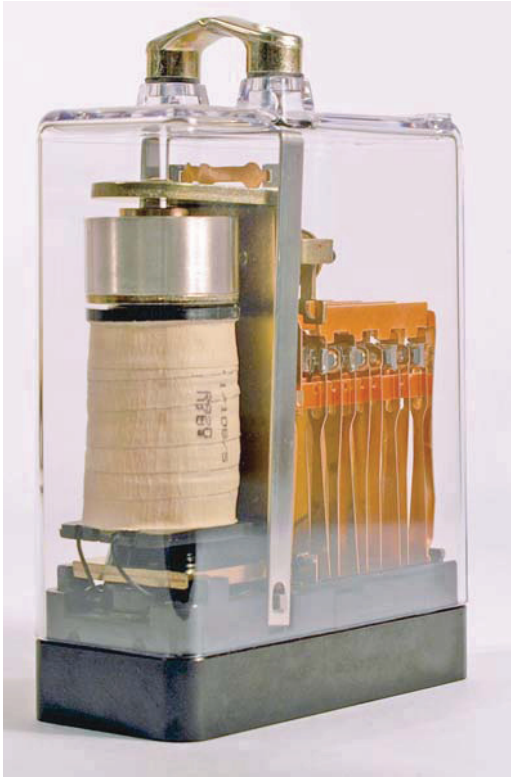
Relay Types

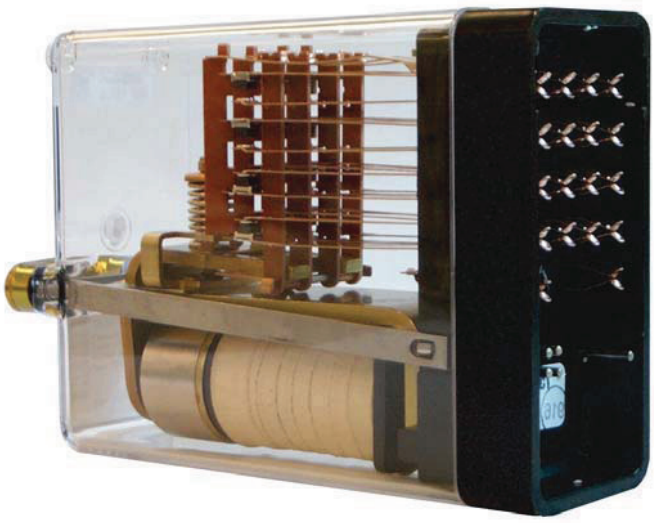
Style Q relays comprise three main categories:

- Single Relays (Most Common)
- Twin Relays (Identical to singles in size but offer cost and space advantages when less contacts required)
- Miscellaneous Relay Units (Used in conjunction with relays in signalling circuits)

Features

- Over 400 different relay variants
- Safety Interlocking system for insertion into plugboards
- Insect proofing for tropical countries
- Polycarbonate cover held in place by internal support strap
- Various Contact arrangements available
- Heavy duty contacts suitable for high current
- Weld resistant contact pairs fitted as standard





Temperature Range

Temperature Range: -20 deg C to 60 deg C

Reliability

Mean Time Between Failures: 2.56 x 10^6 hrs

Contact Ratings

Standard (Sig-Sil) contacts

Continuous Current: 4 Adc
Switching Current 12 Vdc 24W lamp load or 3 x BR930 relays rated at 3 W each.

Heavy Duty (Sig-Sil) Contacts

Continuous Rating: 7 A carrying
Switching Current: 2 A @ 110Vdc Inductive

Elkonite Weld Resistant Contacts

Continuous Rating: 6 A Adc
Switching Current 4 x 24 Vdc

Every effort has been made to ensure that the information contained in this document was correct at the time of going to press. However, the company retains the right to change any specification without notice.

For more details contact:

Westinghouse Rail Systems Limited
PO Box 79, Pew Hill, Chippenham,
Wiltshire SN15 1JD

Tel: +44 (0) 1249 441 441
Fax: +44 (0) 1249 441 442
Email: marketing@wrsl.com

www.wrsl.com

Registered Office: Portland House, Bressenden Place, London SW1E 5BF
Registered in England and Wales No. 1641421

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WESTINGHOUSE®
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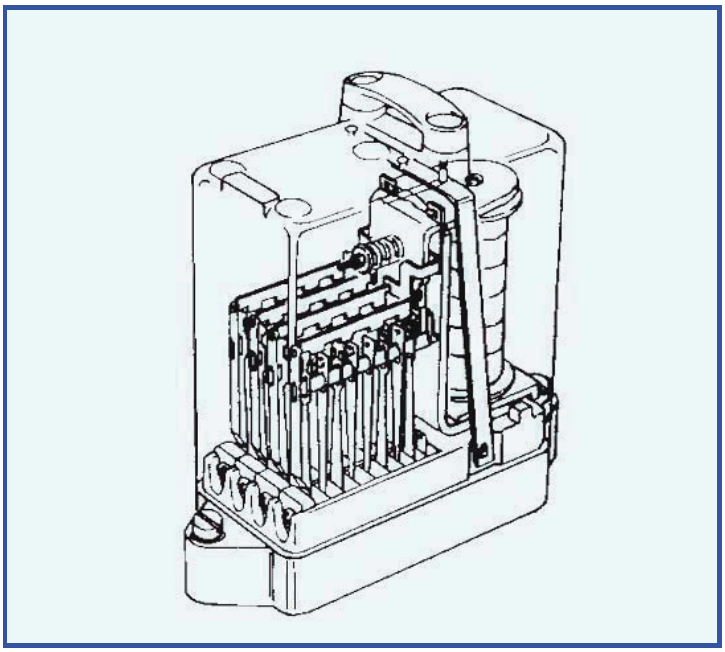
Data Sheet Part 7-2-41

Issue 3
April 2009

QN10



DESCRIPTION

A d.c. neutral, tractive armature relay designed for trainborne service.

In place of the standard securing clip the relay is attached to special anti-vibration brackets. The coil is impregnated to resist the effects of vibration to the windings.

NOTE: *This relay must not be energised from a traction control supply without surge suppression.*

GENERAL DATA

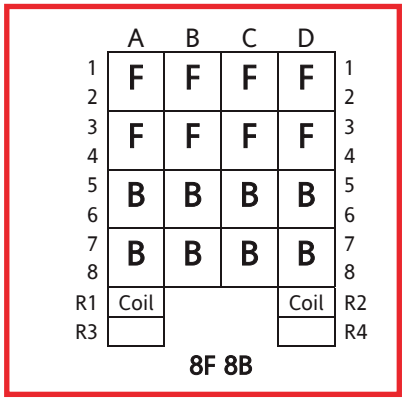
Nominal Rated Voltage:	24, 36, 40, 50, 72 and 110 V d.c.
Contact Arrangements:	8F 8B, 10F 6B
Approximate Weight:	1.2 kg

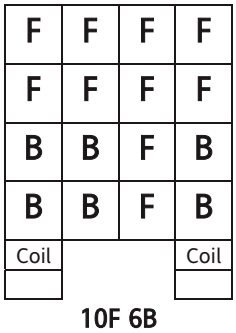
Note: *Refer to Data Sheet Part 7-1-1 for general information and contact ratings.*

Refer overleaf for specific data.

CONTACT LAYOUTS

Viewed from rear





Document Ref: X342/55/000060

TECHNICAL DATA

WSL PART NUMBER	CONTACTS	RATED VOLTS d.c.	PIN CODE	COIL RES (ohms)	WDG SPEC 1/108/-	MAX FULL OP. (Vd.c.)	MIN REL (Vd.c.)	PLUGBOARD E7218/1 DRILLED TO (SEE NOTE)	REQD NO. OF CONNECTORS J4137/3	REMARKS
B18559/1	8F 8B	50	XCEFJ	1490	117	35 MIN OP 21.5	15 MAX REL 20	J4138/315	34	
B18559/2	8F 8B	40	XCEFK	1050	129	26	5	J4138/316	34	
B18559/3	8F 8B	24	XEGHK	350	155	19.2	3.6	J4138/358	34	
B18559/4	10F 6B	36	ABCDS	600	158	20.5	7.0	J4138/367	34	
B18559/5	8F 8B	110	BDEKS	5200	178	60	20	J4138/439	34	
B18559/6	8F 8B	72	BDFHS	3500	227	45 MAX OP 20 MIN OP	10	J4138/481	34	

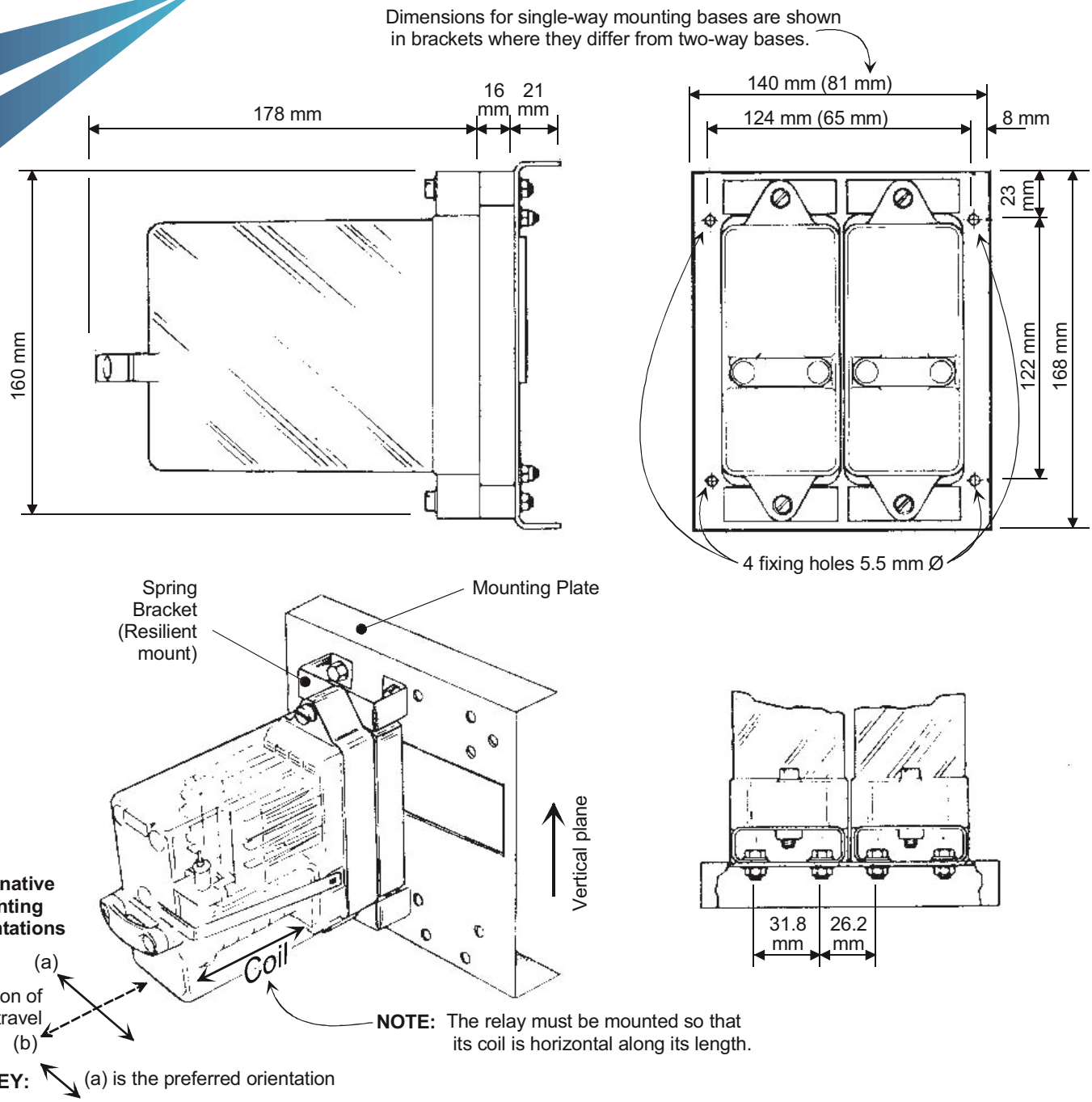
Note: *Plugboards included for reference only as they are included in special train carried mounting base, Data Sheet Part 8-1.*

For further technical information, please contact Customer Services Dept TEL: +44(0) 1249 441420

Westinghouse Rail Systems Limited, PO Box 79, Pew Hill, Chippenham, Wiltshire, SN15 1JD UK
Tel: +44(0) 1249 441441 **Email: marketing@wrsl.com**
Fax: +44(0) 1249 652322 **Website: www.wrsl.com**

Mounting Bases for Train Carried Relays

Data Sheet 8-1
Issue 4
April 2009



DESCRIPTION

The relay is screwed to two resilient mounting brackets which are screwed to the mounting plate. The mating relay plugboard is also fastened to the mounting plate but with limited movement. With the relay engaged with the plugboard both can move on the resilient mountings to a limited degree.

NOTE: *The Mounting Bases are supplied assembled and include Plugboard(s), Spring Brackets and Mounting Plate. Retaining Clips J4136/1 are not required. The 4 off 5.5 mm Ø clearance holes can be used to fix the Mounting Plate Assembly to the customer's panel using stand offs supplied by the customer.*

TECHNICAL DATA

MOUNTING BASE ASSEMBLY FOR 2-OFF TRAIN CARRIED RELAYS		
WRSL PARTNUMBER	**TO FIT RELAYS**	**MOUNTING PLATE FINISH**
C17806/1	2–Off QNC10 B18556/1	Tropical (Zinc plated and painted white)
C17806/2	2–Off QNC11 B18558/1	Tropical (Zinc plated and painted white)
C17806/3	2–Off QNC10 B18556/2	Yellow fire resistant paint to suit LUL
C17806/4	2–Off QNC10 B18556/5	Yellow fire resistant paint to suit LUL
C17806/5	1–Off QNC10 B18556/5 and 1–Off QNC11 B18558/4	Yellow fire resistant paint to suit LUL
C17806/6	1–Off QNC10 B18556/2 and 1–Off QNC11 B18558/5	Yellow fire resistant paint to suit LUL
C17806/7	2–Off QN10 B18559/1	Yellow fire resistant paint to suit LUL
C17806/8	2–Off QN10 B18559/3	Yellow fire resistant paint to suit LUL
C17806/9	2–Off QNN10 B18560/4	Yellow fire resistant paint to suit LUL
C17806/10	1–Off QNC10 B18556/2 and 1–Off QN10 B185559/5	Yellow fire resistant paint to suit LUL
C17806/11	2–Off QNC11 B18558/5	Tropical (Zinc plated and painted white)
C17806/12	2–Off QNC10 B18556/3	Tropical (Zinc plated and painted white)

MOUNTING BASE ASSEMBLY FOR 1-OFF TRAIN CARRIED RELAYS		
WRSL PARTNUMBER	**TO FIT RELAYS**	**MOUNTING PLATE FINISH**
C17821/1	1–Off QNC10 B18556/1	Tropical (Zinc plated and painted white)
C17821/2	1–Off QN10 B18559/4	Tropical (Zinc plated and painted white)
C17821/3	1–Off QNC10 B18556/2	Tropical (Zinc plated and painted white)
C17821/4	1–Off QNC11 B18558/1	Tropical (Zinc plated and painted white)
C17821/5	1–Off QN10 B18559/5	Tropical (Zinc plated and painted white)
C17821/6	1–Off QN10 B18559/6	Tropical (Zinc plated and painted white)

NOTE: *If the desired mounting base configuration is not shown in the table, consult Westinghouse Rail Systems Limited. The above mounting bases are supplied without crimp connectors J4137/3 except for C17806/7 and /8 (which are supplied with 68 connectors J4137/3) andC17806/12 (which is supplied with 44 connectors J4137/3). For bases other than C17806/7, /8 and 12, the crimp connectors must be ordered separately. For quantity of connectors required per relay see appropriate data sheet.*

Westinghouse Rail Systems Limited,
PO Box 79
Pew Hill
Chippenham,
Wiltshire SN15 1JD, UK

T +44 (0) 1249 441 441
F +44 (0) 1249 652 322
E marketing@wrsl.com
www.wrsl.com

DETAILED INTERFACE SPECIFICATION

ANNEX C10
MDR, BDR, SHR, DTSDR, MDRR, BDRR, AFRR, SHRR & DLIRR RELAYS SPECIFICATIONS

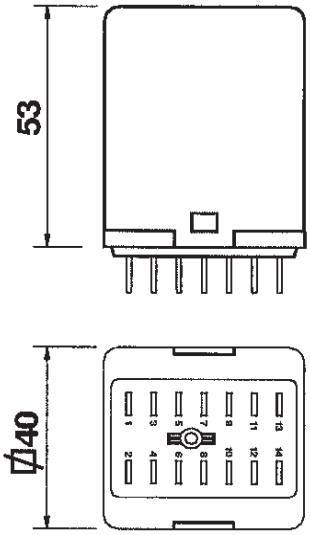
Relays: MDR, BDR, SHR & DTSDR

INSTANTANEOUS RELAY

Product D-U200 series
4 pole relay

Country of Origin: The Netherlands

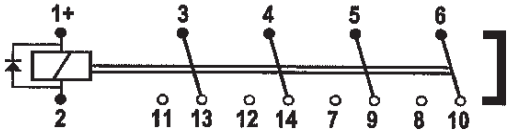
Dimensions



Company

P.O. Box 7023
3502 KA Utrecht
The Netherlands
T +31 (0)30-288 13 11
F +31 (0)30-289 88 16
E sales@nieaf-smitt.nl
I www.nieaf-smitt.nl/railway

Connection diagram



Description

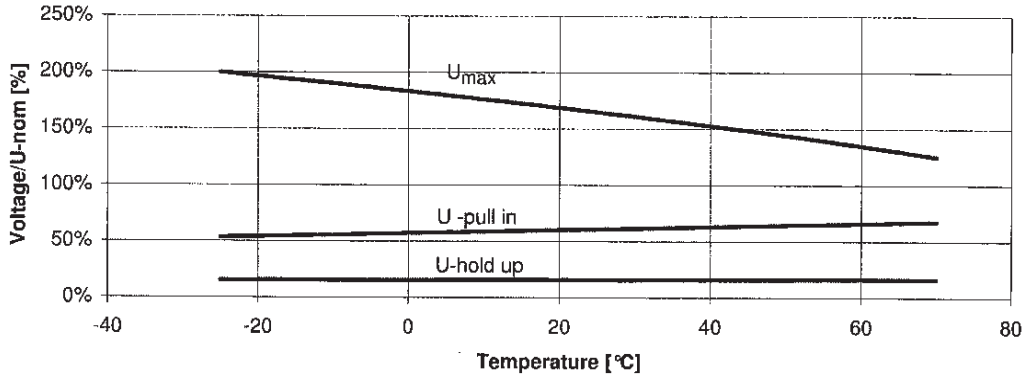
Plug-in railway relay with four change-over contacts.
Equipped with back EMF protection and magnetic arc blow out.

Coil data

Type	U_{nom}	U_{min}	U_{max}	$U_{hold-up}$	R_{coil}	$I_{coil-nom}$
D-U201	24 VDC	16.8 VDC	30 VDC	2.5 VDC	280 Ω	85.7 mA
D-U202	48 VDC	33.6 VDC	60 VDC	4.8 VDC	1110 Ω	43.2 mA
D-U203	72 VDC	50.4 VDC	90 VDC	13 VDC	2495 Ω	28.8 mA
D-U204	110 VDC	77 VDC	137.5 VDC	11 VDC	5830 Ω	18.9 mA
D-U205	96 VDC	67 VDC	120 VDC	9.5 VDC	4300 Ω	22.3 mA
D-U206	12 VDC	8.4 VDC	15 VDC	1.2 VDC	66 Ω	181 mA
D-U207	36 VDC	25.2 VDC	45 VDC	3.5 VDC	580 Ω	62 mA

Nom. Consumption	2.22 W	Inductance L/R at U_{nom} =	Energized	11 ms
			Released	8 ms
Pull-in time	20 ms	Release time		18 ms
Bounce time NO contacts	4 ms	Bounce time NC contacts		8 ms

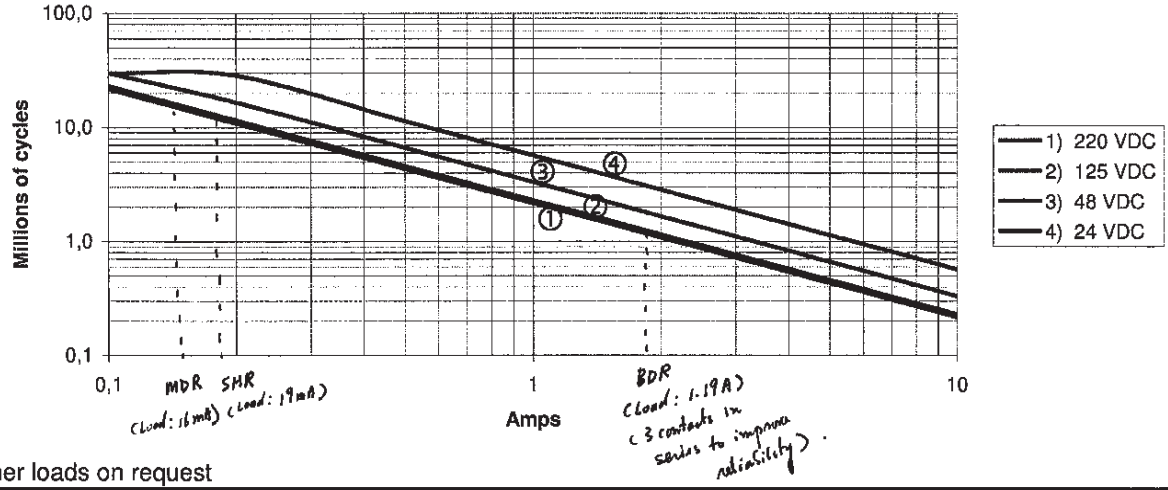
Operating range at various temperatures



Relays: MDR, BDR, SHR & DTSDR

Contact data			
Max. make current	16 A (200 A, 10 ms)	Material	silver
Max. cont. current	10 A (AC1 ; IEC 60947)	Contactgap	0.7 mm
Max. switching voltage	250 VDC, 440 VAC	Insulation between	2.5 kV; 50 Hz;
Min. switching voltage	12 V, 10mA	open contacts	1 min
Max. contact resistance	15 milli Ohm	Contactforce	> 200 mN
Max. breaking capacity			
DC	110 V, 10A (L/R<=15ms)		
AC	230 V, 10A (cos phi>=0.7)		

DC resistive current breaking capacity [D-U200-series relays]



Other loads on request

General Data		
Dielectric strength	EN 50155	
Pole-Pole	IEC 60255-5/	4 kV, 50 Hz, 1 min
Cont-Coil	IEC 60077	2.5 kV, 50 Hz, 1 min
Insulation class	IEC 60255-5	serie C 380 V 50Hz/450 VDC
Pulse withstanding	IEC 60255-5	5 kV (1.2/50 µs)
Vibration	IEC 60077	5 g at 50 Hz
	IEC 60571-1	2 g, 10-150 Hz
	EN 50155	
Shock	IEC 60077	5 g at 50 Hz
Mechanical life		$30*10^6$ ops
Max. switching frequency		1200 ops/h
Weight		125 g
Temperature	$T_{amb,max}$	+70 °C
	$T_{amb,min}$	-25 °C
Humidity		90%, temporary permitted condensation
Protection		IP 40
Materials		Makrolon
		Melamine Polyester
Electronic components		Back EMF protection diode BYW56

Options D – U200 – options according to table

C	-40 ºC, contactcurrent max 8A	Q	Double zenerdiode
E	Gold plated contacts	T	Push to test button
K	Special dust protection	X2	Coil for both DC and AC
L	LED indication on the coil	Y	Double make/ double break
N	No magnetic arc blow-out	Z	No diode

Relays: MDRR, BDRR, AFRR, SHRR & DLIRR

贝斯达系列
输出¡ 输入继电器

E25M (普通型)

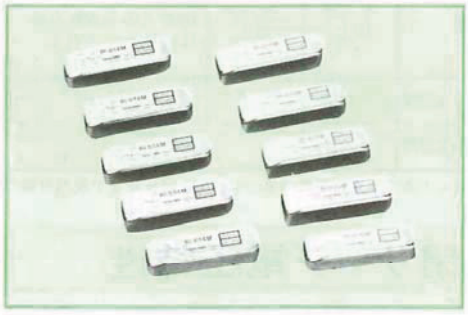
大容量型: RI - B□M、-C□M (普通型)

RI - B□MH、-C□MH (高绝缘型)

非常适合于 PC、单片机控制系统的高可靠性接口继电器

优　点

1 不但可以用于微弱电流回路，在 AC¡ DC100V 以上的回路中也能保证其出众的可靠性。
2 可以统一输出继电器。从 TTL 水准到大型电磁接触器、甚至直流电磁阀都可直接控制。
3 不需要输出继电器盘。
4 动作迅速 (5ms 以下)
5 绝缘性能好。
线圈绕组和触点间的可承受电压为 AC2000V 以上 (中容量型 AC1500V 以上)
6 可以自动焊接、自动洗净。
7 驱动功率小 (中容量型：0.4W、大容量型：0.6W)



主要用途

- 工业用编程控制器的输出¡ 输入继电器
- 微电脑应用装置的输出¡ 输入继电器
- 断路器的切断继电器
- 电力用记录传送继电器
- NC、MC 控制盘的输出¡ 输入继电器

产品规格

型号	种类	中容量型			大容量型			
	普通型	RI-D24M	RI-D25M	RI-E25M	RI-B14M	RI-B15M	RI-C14M	RI-C15M
	高绝缘型	—	—	—	RI-B14MH	RI-B15MH	RI-C14MH	RI-C15MH
触点结构		1a		1b	1a		1b	
内置贝斯达系列产品		R24	R25		R14	R15	R14	R15
额定使用电流 (感应负载)	AC	220V 0.5A			220V 1A			
	DC	110V 0.3A			220V 0.2A 、110V 0.5A			
最小使用电压¡ 电流		5V 1mA	24V 1mA *3		1V 1mA	24V 1mA *3	1V 1mA	24V 1mA *3
耐震动		98m/s² {10G} 以上 (20～1000Hz)			98m/s² {10G} 以上 (20～1000Hz)			
耐冲击	误动作	147m/s² {15G}			147m/s² {15G}			
	损坏	980m/s² {100G} 以上			980m/s² {100G} 以上			
耐电压		输出¡ 输入之间 AC1500V 1 分钟(触点之间 AC500V)			输出¡ 输入之间 AC2000V 1 分钟 (触点之间 AC800V)			
环境温度	使用时	－40～＋60℃			－40～＋60℃			
	保管时	－40～＋80℃			－40～＋80℃			
重　量		15g		20g	35g		40g	

注) 1. 关于触点规格、寿命、特性等详细内容请参照 4～7 页的贝斯达元件。
2. 大容量型也可以用于 DC110V 0.5A 以上。
详细内容请向生产厂家或代理商咨询。
*3. 光耦合器点灯回路时，可达到 5V 10mA。

Relays: MDRR, BDRR, AFRR, SHRR & DLIRR

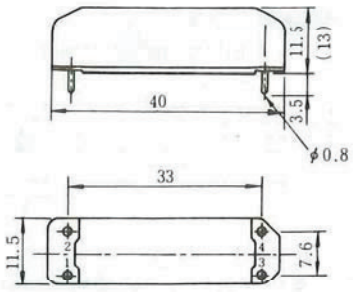
线圈绕组规格（有极性）

种 类	中 容 量 型						大 容 量 型					
型 号	RI－D			RI－E			RI－B			RI－C		
额定电压(E)	12V	24V	48V	12V	24V	48V	12V	24V	48V	12V	24V	48V
绕组电阻(Ω)	405	1520	5530	295	1160	4060	250	1020	3980	285	1080	3640
额定消费电力	0.4W		0.5W	0.5W		0.6W	0.6W			0.6W		0.7W
最大允许外加电压	170%E 约 1.2W			150%E 约 1.1W			220%E 约 3W			150%E 约 1.3W		
工作电压	75%E 以下			75%E 以下			75%E 以下			75%E 以下		
复位电压	8.5%E 以上			8.5%E 以上			8.5%E 以上			8.5%E 以上		

注) 1. 上表所记线圈绕组规格是在环境温度 20℃时的数值。
2. 线圈绕组的电阻值有¡ 10％的偏差。
3. RI－E 型以及 RI－C 型在超过最大容许电压(即使是短时间)时会发生误动作。

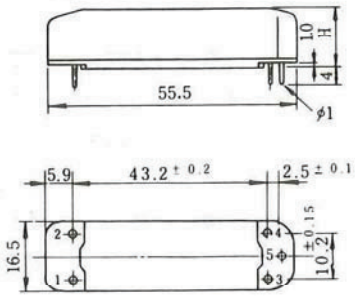
外形图 尺寸单位:mm

¡ 中容量型



注) 上图( )内的数值是 RI－E25M 型的尺寸

¡ 大容量型



尺寸 \ 型号	RI-B	RI-C
H	14.5	17

注) 只有 RI－□□M 有 5 号端子
(请参照下一页的接线图)

故障率(λ)是指¡

产品持续工作到某一时间为止所发生的故障次数与时间的比例。

(JIS Z 8115：可靠性用语)

$$故障率(\lambda)= \frac{故障次数}{使用个数¡\ 使用时间\ 10^{-9}}\ [Fit]$$

* 一般认为可靠性高的水银继电器的故障率是 50～60Fit。
而贝斯达系列继电器是它的 1/10，是半导体继电器的 1/20。

● 已经取得以下日本铁道(JR)型号

RL2606 型继电器：本厂 RI－B15MH / D24 的 JR 规格

TRL604 型继电器：本厂 RI－B15MH / D48 的 JR 规格

RL2607 型继电器：本厂 RI－C15MH / D24 的 JR 规格

TRL605 型继电器：本厂 RI－D25M 的 JR 规格

TRL606 型继电器：本厂 RI－E25M 的 JR 规格

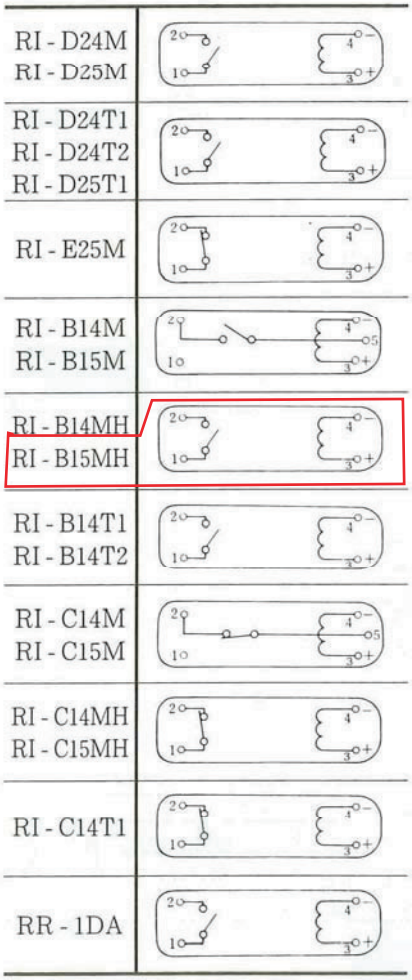
Relays: MDRR, BDRR, AFRR, SHRR, DLIRR

使用上的注意事项

(1) 关于接线

线圈绕组是有极性的、请按照下图进行接线。

请参照(2)确认接线端子的极性



*BOTTOM VIEW

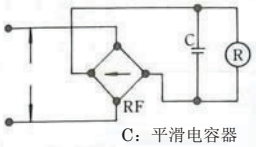
(2) 关于直流负载

使用直流负载时请按照下表进行连接。

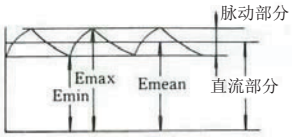
型 号	接线端子号码		
	2	5	1
RI - D24M, D25M	+		—
RI - D24T1, D24T2, D25T1	+		—
RI - E25M	+		—
RI - B14M, B15M	+	—	
RI - B14MH, B15MH	+		—
RI - B14T1, B14T2	+		—
RI - C14M, C15M	+	—	
RI - C14MH, C15MH	+		—
RI - C14T1	+		—
RR - 1DA	+		—

(3) 关于绕组的驱动电源

用于绕组的驱动电源必须是和蓄电池一样完全直流电源或者是像三相全波整流电流一样脉动率在 5%以下的电源。使用单相全波整流电源时，需要用滤波电容器将脉动率调至 5%以下。



C：平滑电容器
R：继电器绕组



$$\text{脉动率} = \frac{Emax - Emin}{Emean} \times 100\%$$

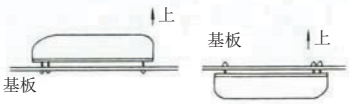
Emax：脉动部分的最大值
Emin：脉动部分的最小值
Emean：直流平均值

(4) 关于安装方向

标准的安装方向如图(a)。上下没有方向性。

如图(b)所示，将继电器的实际安装基板水平安装使用时，和标准的安装方向相比，工作电压¡ 复位电压最大有 5%左右的变化。

(a)安装基板垂直设置(标准)



(b) 安装基板水平设置

(5) 关于使用的注意事项

由于贝斯达元件是玻封式开关，需要注意以下几点。

(a) 为了维持正常性能，不得和物体强力碰撞或者落地撞击。

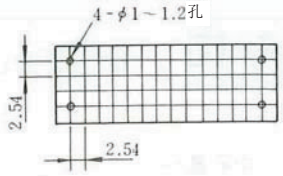
(b) 不可在继电器接线端子上施加过度的拉力（拉力 29.4N｛3kg｝以上)。

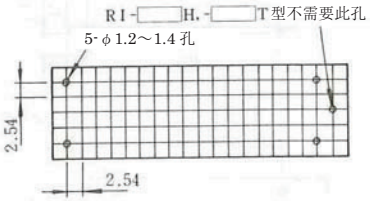
(6) 关于外部磁场

因为 RI 继电器是磁屏蔽式的，所以继电器之间可以进行密集安装。但是如果在强磁场中使用时，动作可能会发生很大的变化。

(7) 关于印刷电路基板

使用 2.54mm(0.1 英寸）导程孔的标准印刷电路基板比较方便。





(8) 关于基板安装以外的使用情况

在印刷电路基板以外的场合使用，请在安装以及接线时不要施加外力于继电器的接线端子上。

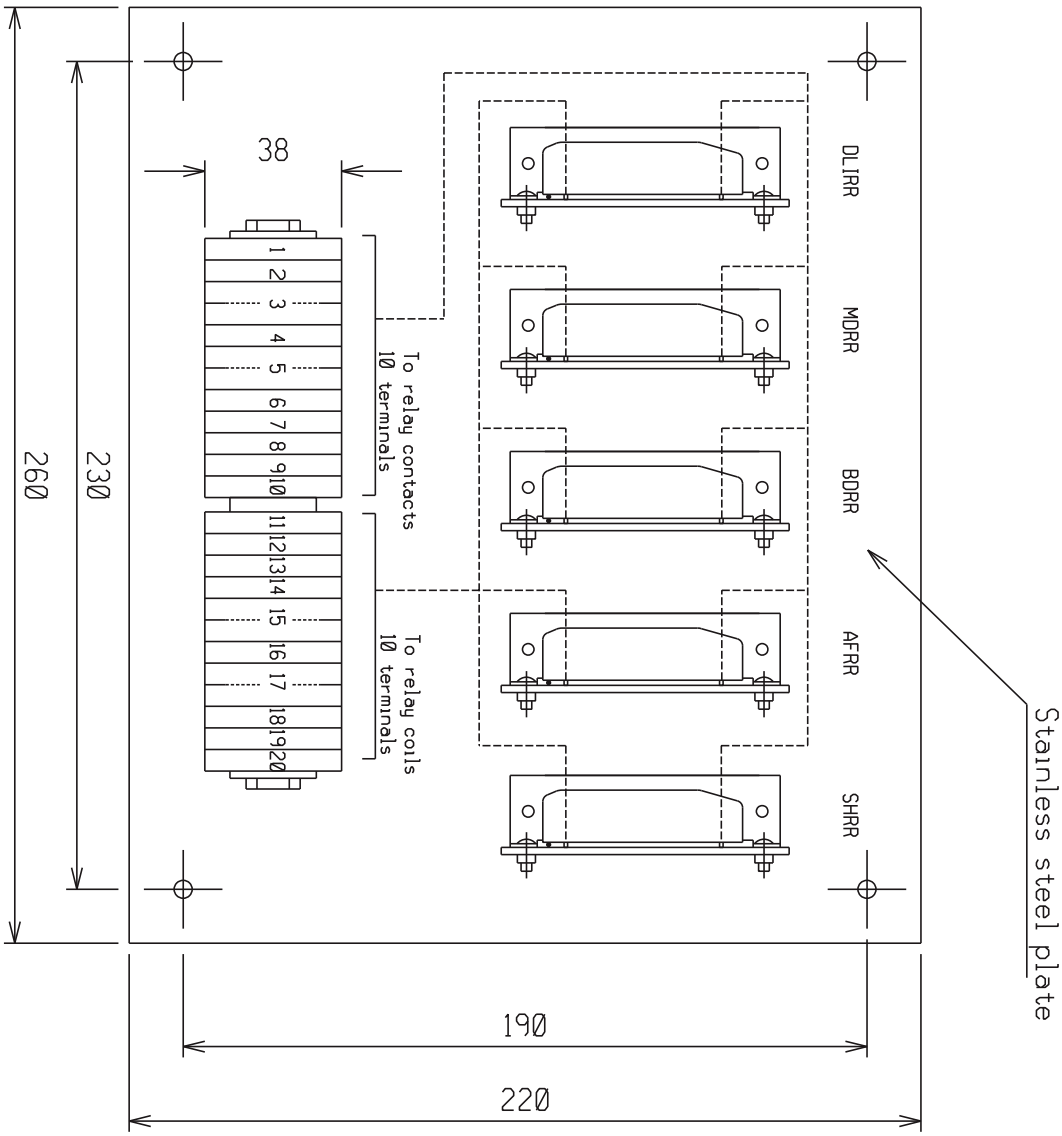
另外,要避免将接线端子根部折弯后使用。

(9) 开闭额定值

电流超过最大接入电流时，会发生触点烧结、玻壳破裂的危险。超过最大断路电流进行断路时，会发生触点烧结、触点熔断、玻壳破裂等的危险。所以请在额定开闭电压、电流以下使用。

DETAILED INTERFACE SPECIFICATION

ANNEX C11
REED RELAY PANEL

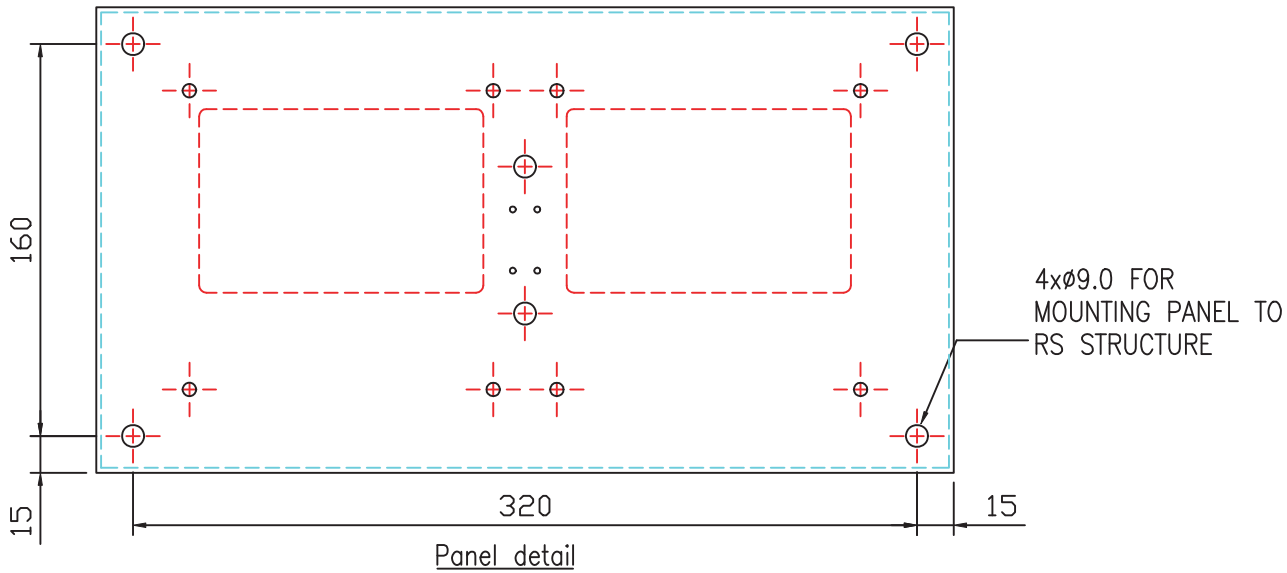


REED RELAY PANEL - Max weight 2 kg

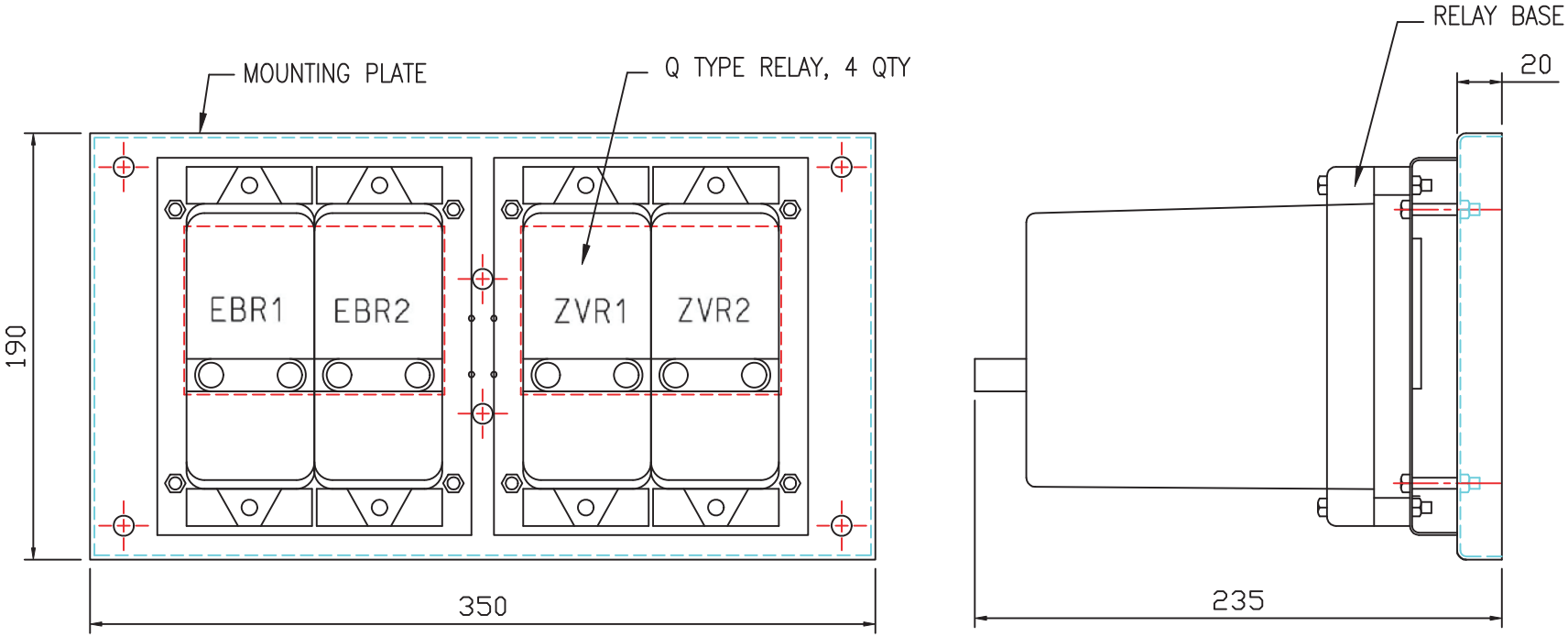
Note:
1. Self-Locking nuts are used on all screw of size M3 or above.
2. For M2 screws thread lock is used (Loctite 243).

DETAILED INTERFACE SPECIFICATION

ANNEX C12
QN10 RELAY PANEL



Panel detail



Front View
Max. weight: 10kg

Side View

GENERAL ARRAGEMENT FOR Q-TYPE RELAY PANEL

ANNEX C13
ATC CONNECOTRS & TAIL CABLES SPECIFICATIONS
REV.7

Appendix 3 Detailed Interface Specification Ver.2.5

ATC Connectors & Tail Cables Specifications

		T1 - T78	T1 - T2	T3 - T78
Item	Description	Supplied By	Installed By	
A	Speedometer	Signalling Contractor	RS Contractor	Signalling Contractor
B	QN10 Relay Panel + 4 x QN10 Bases + Terminals	Signalling Contractor	RS Contractor	Signalling Contractor
	4 X QN10 Relays + Assistance on Wire Terminations	Signalling Contractor	RS Contractor	Signalling Contractor
C	Reed Relay Panel	Signalling Contractor	RS Contractor	Signalling Contractor
D	ATC Cubicle	Signalling Contractor	RS Contractor	Signalling Contractor
E	DT Rack + Electronic Boards	Signalling Contractor	RS Contractor	Signalling Contractor
F	PAV Rack + Electronic Boards	Signalling Contractor	RS Contractor	Signalling Contractor
G	PCE Rack + Electronic Boards	Signalling Contractor	RS Contractor	Signalling Contractor
H	4 x DU204 Relays with V29 relay bases for MDR, BDR, SHR and DTSDR	Signalling Contractor	RS Contractor	Signalling Contractor
CA2, CA3, CA4, CA5	Train Interface Wires, Shielded Cable, etc. Refer to ATC1 A CAR and ATC2 A CAR drawings for detail.	RS Contractor	RS Contractor	RS Contractor
CA6, CA7, CA8, CA9, CA10	Shielded Twisted Cables and metallic cable conduits (CA6, CA7, CA8 and CA10) and PMA conduit (CA9). Refer to ATC1 A CAR and ATC2 A CAR drawings for detail.	RS Contractor	RS Contractor	RS Contractor
CA11	Coaxial Cable Maximum 6m long & Metallic & PMA cable conduit.	Coaxial Cable & PMA Cable Conduit - Signalling Contractor Metallic Cable Conduit - RS Contractor	RS Contractor	Coaxial Cable & PMA Cable Conduit - Signalling Contractor Metallic Cable Conduit - RS Contractor
CRP1-CA14-CRP2, CLP1-CA15-CLP2	CT Cords with plugs	Signalling Contractor	RS Contractor	Signalling Contractor
CA16, CA17, CA18, CA19, CA20, CA21, CA1	ATC Interface Wires, Shielded Cable, etc.	Signalling Contractor	RS Contractor	Signalling Contractor
HN/1, HN/2, LT/1, LT/2, J2, J3, BN, VRP1	ATC Connectors	Signalling Contractor	RS Contractor	Signalling Contractor
J1A, J1B, J3A, J4B	Junction Boxes	RS Contractor	RS Contractor	RS Contractor
CLC1, CRC1, 3AC1, 4BC1	Sockets	Signalling Contractor	RS Contractor	Signalling Contractor
VRP2	Plug	Signalling Contractor	RS Contractor	Signalling Contractor
BSP1	Plug + PMA adaptor	Signalling Contractor	RS Contractor	Signalling Contractor
4BP1, CA12, Odometer 4B	Integrated Coded Odometer 4B Assembly	Signalling Contractor	RS Contractor	Signalling Contractor
3AP1, CA13, Odometer 3A	Integrated Odometer Tacho 3A Assembly	Signalling Contractor	RS Contractor	Signalling Contractor
VRC2-RC Antenna	RC Antenna	Signalling Contractor	RS Contractor	Signalling Contractor
CRC2-CT Sensor 1B, CRC2-CT Sensor 1A	CT Sensors	Signalling Contractor	RS Contractor	Signalling Contractor
TB1	Terminal Block	RS Contractor	RS Contractor	RS Contractor

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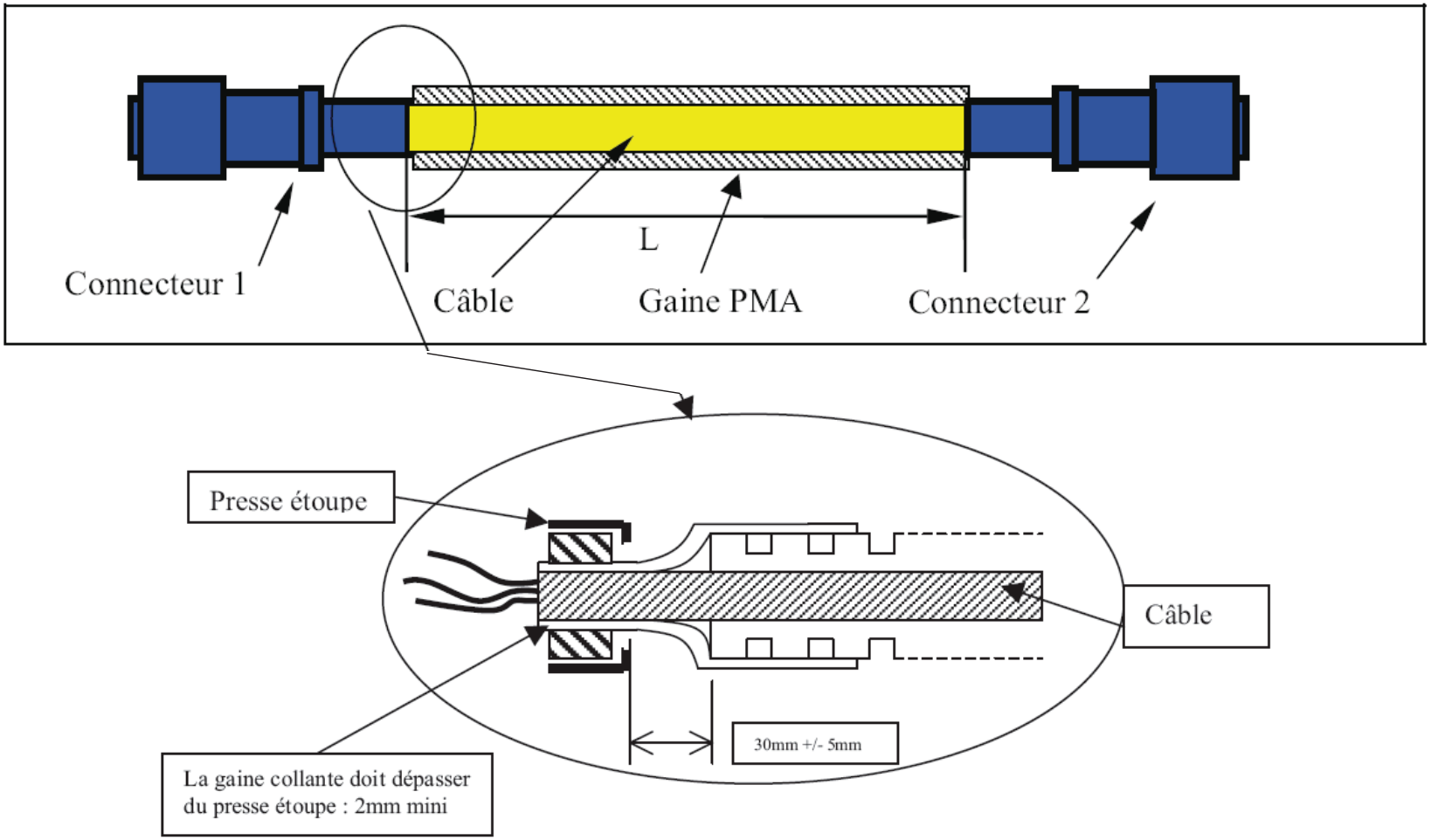
ATC Connectors & Tail Cables Specifications

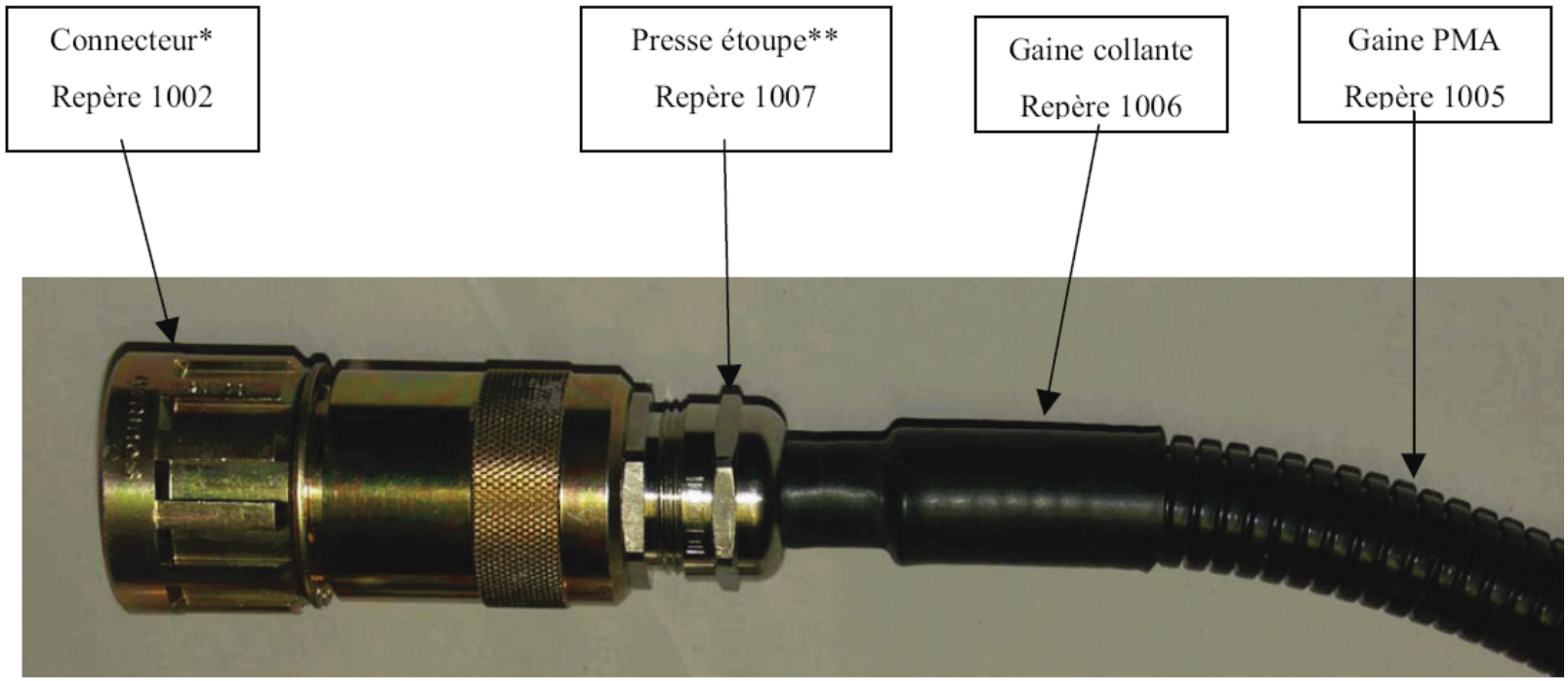
Item: CRP1-CA14-CRP2 & CLP1-CA15-CLP2 (CT Cords with plugs)

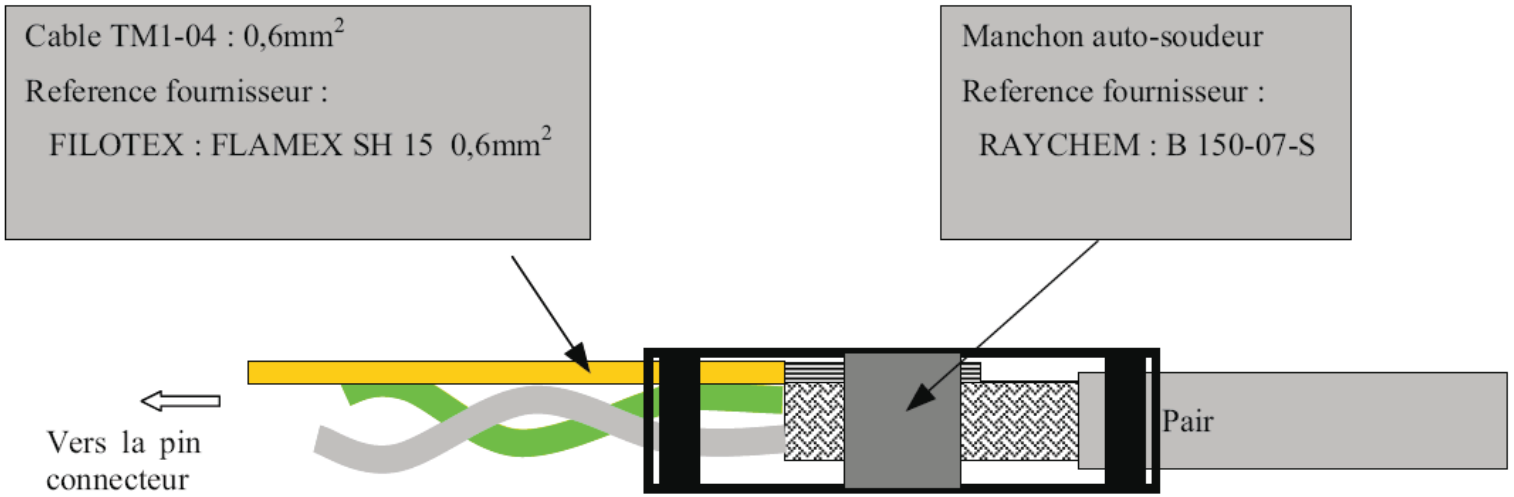


CA14 and CA15 are in the same length which is usually 2.2 metres (L).

ATC Connectors & Tail Cables Specifications

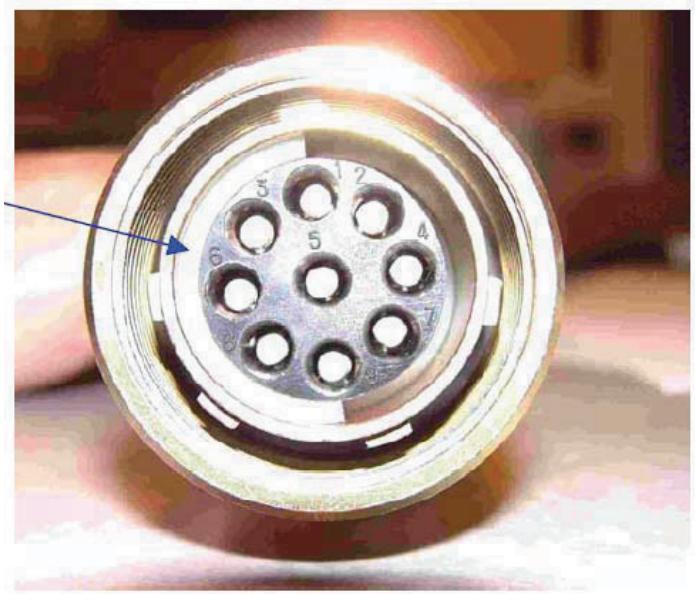
Item: CRP1-CA14-CRP2 & CLP1-CA15-CLP2 (CT Cords with plugs) (Cont.)





ATC Connectors & Tail Cables Specifications

Item: CRP1-CA14-CRP2 & CLP1-CA15-CLP2 (CT Cords with plugs) (Cont.)



Number of Pin	Number of cables	Signal	Comments
1	Lead 2 Pair 3	--	Connected but not used
2	Lead 2 Pair 1	12V	+Power Supply
3	Shield Pair 1	BL	Power supply shield
4	Lead 1 Pair 2	SL	Sensor Output
5	Lead 2 Pair 2	0V	0V ref loop sensor
6	Shield Pair 2	BL	Loop sensor signal shielding
7	Lead 1 Pair 3	--	Connected but not used
8	Shield Pair 3	--	Connected but not used
9	Lead 1 Pair 1	0V	0V Power supply

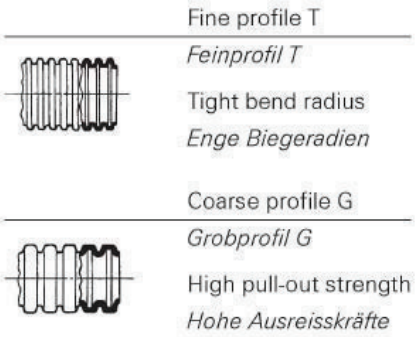
ATC Connectors & Tail Cables Specifications

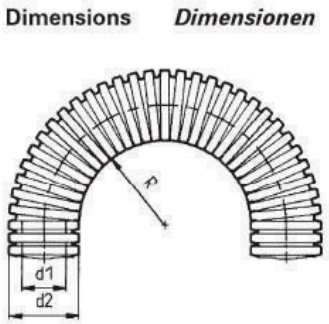
Item: CRP1-CA14-CRP2 & CLP1-CA15-CLP2 (CT Cords with plugs) (Cont.)

Câble 4 paires blindées plus 2 conducteurs avec blindage général : Ref. ALSTOM 24419.

Cord Static Bending radius	Cord Dynamic Bending Radius	Cord External diameter
35 mm	85 mm	21.2 mm

Order No	Conduit Size		Fits to threads		Dimensions in mm (nom.)				weight	Packing unit
(BLACK)	NW	metr.	metric	PG	D1	D2 (External Diameter)	Static Bending Radius	Dynamic Bending Radius	Kg/100 m	PU/m
PCSG-17B	17	20	M20 X 1.5	16	15.2	21.2	35	85	7.5	50



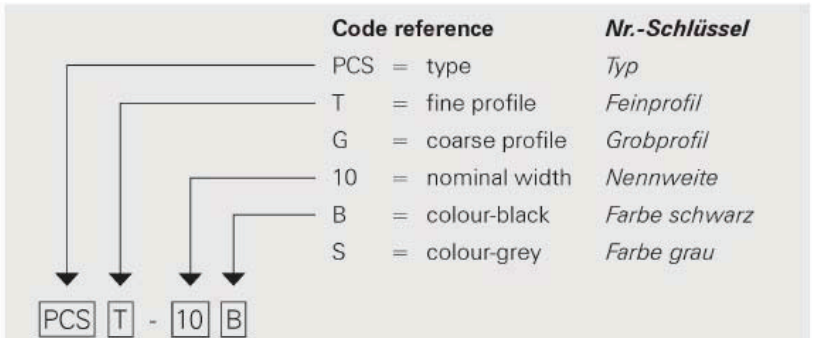


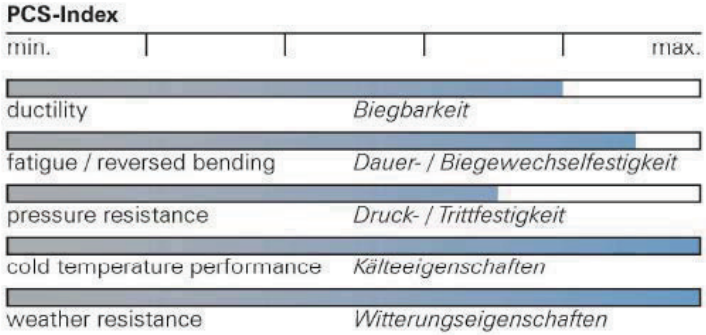
stat. R. = lowest recommended bending radius for static (fixed) installation

kleinster empfohlener Biegeradius für statische (feste) Verlegung

dyn. R. = lowest recommended bending radius for dynamic (flexible) installation

kleinster empfohlener Biegeradius für dynamische (flexible) Verlegung



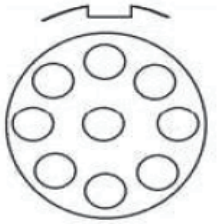


ATC Connectors & Tail Cables Specifications

Item: CLC1 & CRC1 (CT Underframe socket)

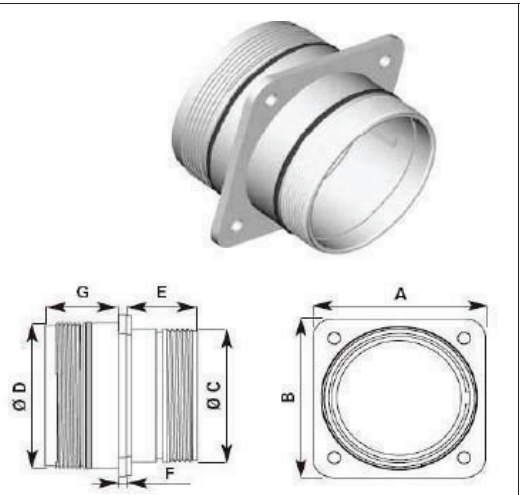
Item	ALSTOM ref	Manufacturer ref	Manuf.
Socket underframe	24182	8380E1E091BM0B	FCI

Shell Size E	Type M Receptacle without backshell	Panel cutout

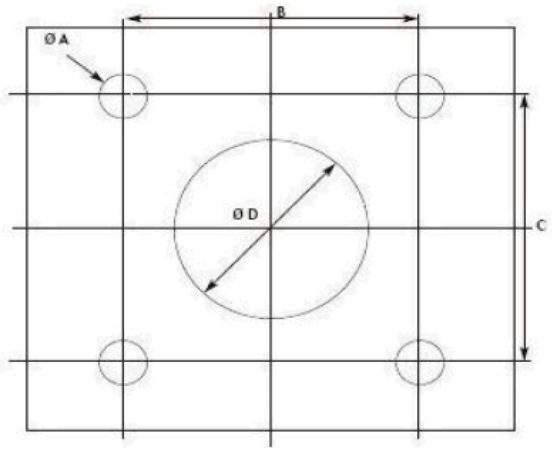


9 contacts ø 2 mm type B
09

Size	E (mm)
A	42
B	42
øC	35
øD	38
E	25
F	4
G	27
Indice	0



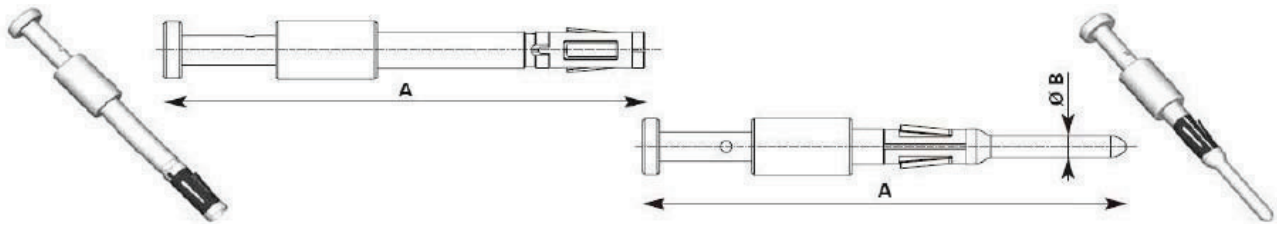
Size	E (mm)
øA	4.3
B	34
C	34
øD	36.5
øD*	40



*** Receptacle fixed behind the panel.**

Pin

Active part Ø Ø B (mm)	Contact type	Male or Female	Dimensions A	Part number	Protection Plating	Cable size	
						mini (mm^2)	maxi (mm^2)
Ø 2	B	F	41	8380-725	Passivated silver	0.6	1.5
Contact Ø 2 mm / Ø 3 mm							



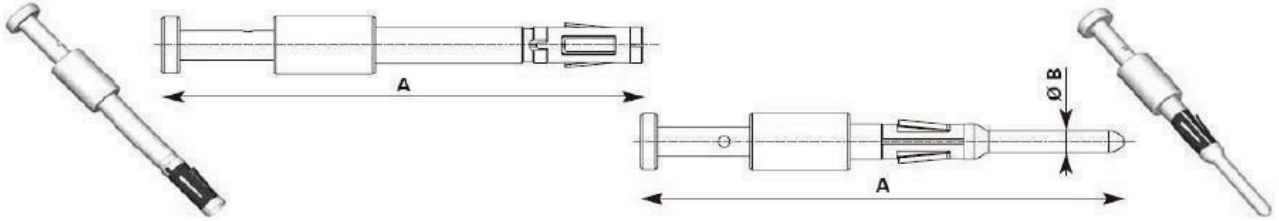
ATC Connectors & Tail Cables Specifications

Item: CA9 (Shielded Twisted Cables)

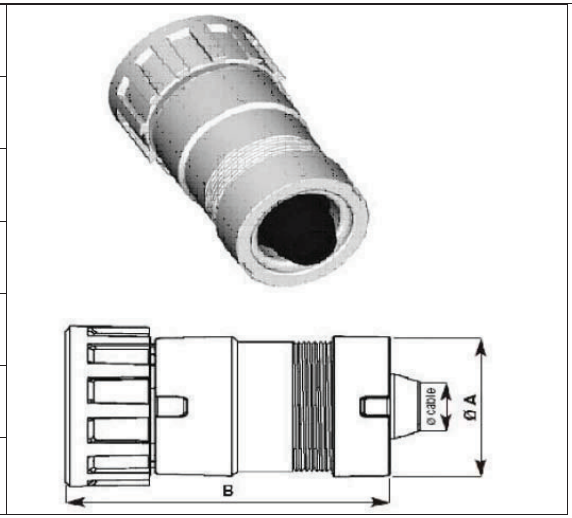
Description	Nominal section area mm^2	Conductor stranding-Nominal diam. mm	Cable Nominal external diameter in mm
3 shielded Twisted Pairs Cable each pair individually shielded	3 x 2 x 1.34	19 x 0.3-1.47	13

ATC Connectors & Tail Cables Specifications

Item: BSP1 (Plug)

Active part Ø Ø B (mm)	Contact type	Male or Female	Dimensions A	Part number	Protection Plating	Cable size	
						mini (mm^2)	maxi (mm^2)
Ø 2	B	M	42	8380-722	Passivated silver	0.6	1.5
Contact Ø 2 mm / Ø 3 mm							
							
Item		**ALSTOM ref**		**Manufacturer ref**		**Manufacturer**	
Plugs		11442		838 0 F 1 E 09 5 B W 0 A		SOURIAU	
Type W (Plug straight backshell with sealing gland and cable clamp)							

Size	**E**	
Ø A	39	
B	118	
Indice	**Ø Cable**	
	mini	**maxi**
0	14.5	17
1	10.1	13.3



ATC Connectors & Tail Cables Specifications

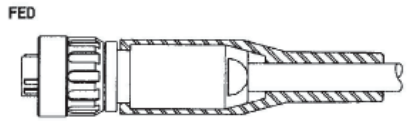
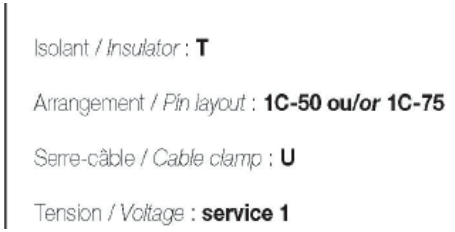
Item: CA11 (Coaxial Cable Maximum 6m long)

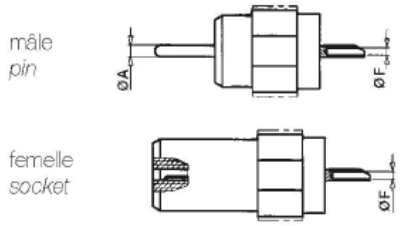
Cable Type	Static Bending radius	Dynamic Bending Radius	External diameter
COAXIAL KX 4 50 OHMS	100 mm	200 mm	10.3 mm

ATC Connectors & Tail Cables Specifications

Item: VPR1 & VPR2 (Plugs)

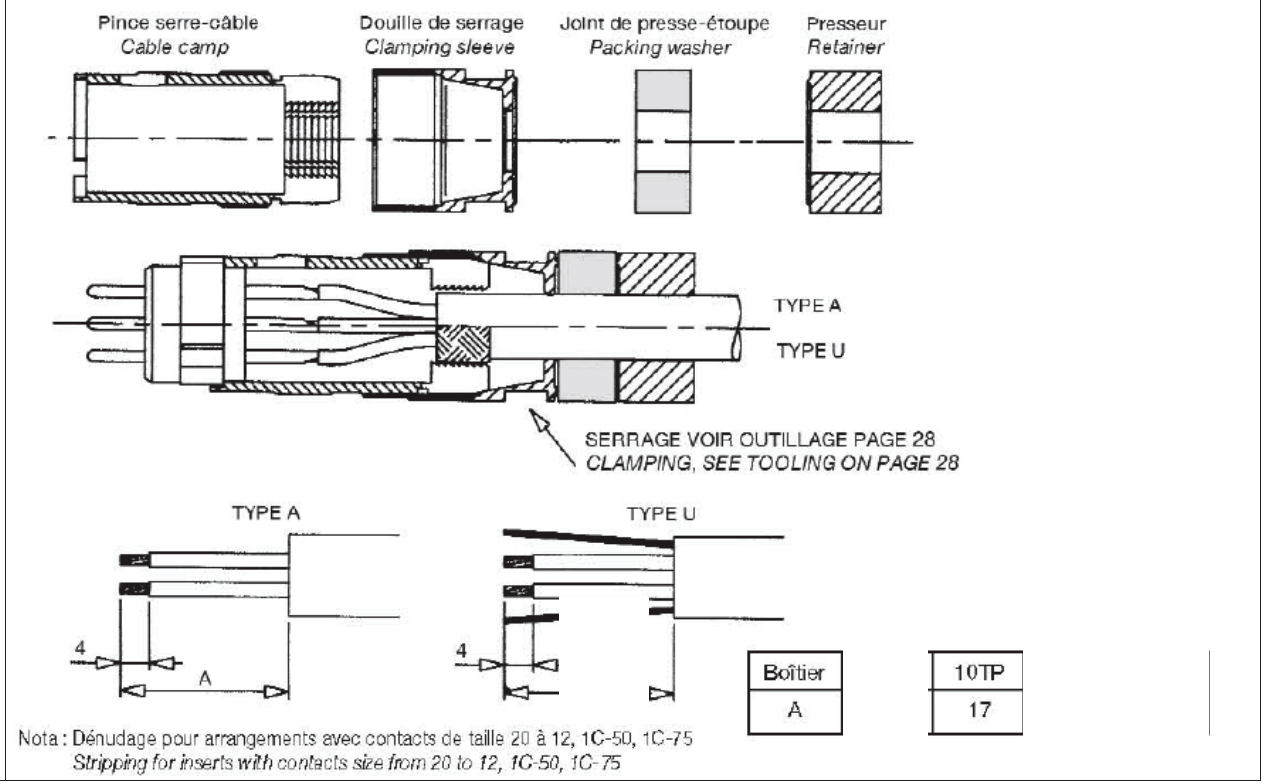
Plug Name	Type of Plug	Coaxial Connectors
VPR2	**Female Plug**	FED F 10 TP T 1C-50 H 103
VPR1	**Male Plug**	FED M 10 TP T 1C-50 H 103

FED	M / F	10TP	T	1C-50	H	103
FED: Straight plug 	Type of contacts: M: male F: female	Shell size	Insulating material T: Teflon (PTEE) 1 coax. 50Ω ou/or 75Ω 	Pin layouts	Cable clamp accessory U: Cable Clamp Ground braid linked to shell Max. diameter acceptable with grounding braid: with braid diameter turned down cable external sheath: **Ø 5 to Ø 11**	Max. diameter of the cable's cable external sheath (in 0.1mm) or cable code for coaxials, triaxials and high voltage

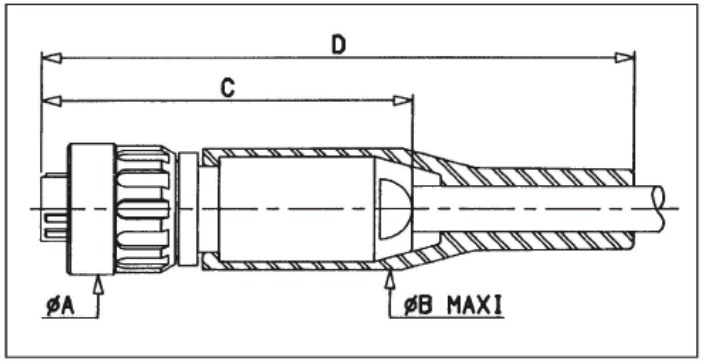
Shell Size	Size of contact	Ø A (mm) Front of contact	Ø F (mm) Inside the solder bucket	Acceptable cable and specifications	Removable contact	Definition
10TP	Coaxial 50Ω	1,93	2,4	KX4 – KX15 – NFC 93550 RG213U – RG58 CU – NIL C 17F	No	

ATC Connectors & Tail Cables Specifications

Item: VPR1 & VPR2 (Plugs) (cont.)

Shell Size	**10 TP**
Accessory U	

Shell Size	10TP
Ø A	25
Ø B maxi	23
C	72
D	110
Reference – P/N	FEDΔ10TP▲□□-□□■ooo



Δ = M (Male) for 01-HT and 04-HT pin layouts

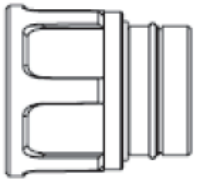
ATC Connectors & Tail Cables Specifications

Item: CA13

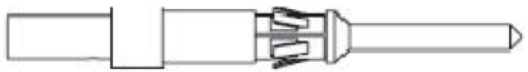
Cord static bending radius	Cord dynamic bending radius	Cord external diameter
50 mm	100 mm	20.5 mm

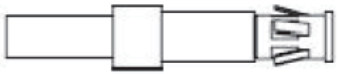
ATC Connectors & Tail Cables Specifications

Item: 3AP1 (Plug)

KHEOPS CMC36RD07-13SNM		
36  **Fiche à visser sans cliquet** *Screw plug without clicker*	**RD** **Raccord droit étanche** *Environmental straight backshell*	**13** 13 contacts Ø 1,6 mm Contact avancé / ***Advanced contact*** **Tension de service** / *Service voltage* - NF C 20-040 cat. B ..... 380 V eff. - NF F 61-030 ..... 72 V **Tension de tenue** / *Withstanding voltage* **> 1500 V eff.**

CRIMP Contacts			WIRE		SEALING PLUG	CRIMPING TOOL		EXTRACTING TOOL	INSERTION TOOL
Contact diam.	**Type**	**Part number**	**Cross section**	**AWG wire**	**Part number**	**Part number**	**Locator**	**Part number**	**Part number**
Ø1,6 mm	P S	DMC S24150-00B3 DMC S24151-00B3	0,6 to 1,82 mm^2	20 to 15	-	FT8 or M2 2520/1-01	- TP1012	OUTS1675-0003	OUT31748-000A2

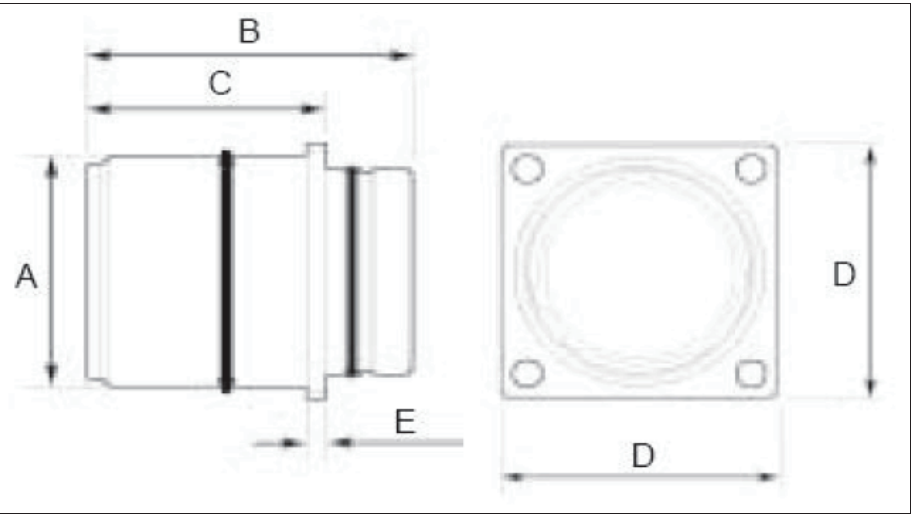
P  Mâle / *Male*

S  Femelle / *Female*

ATC Connectors & Tail Cables Specifications

Item: 3AC1 (Socket)

Size	07
A	37,9 (1.49)
B	48,7 (1.92)
C	36 (1.42)
D	42 (1.65)
E	3 (0.12)

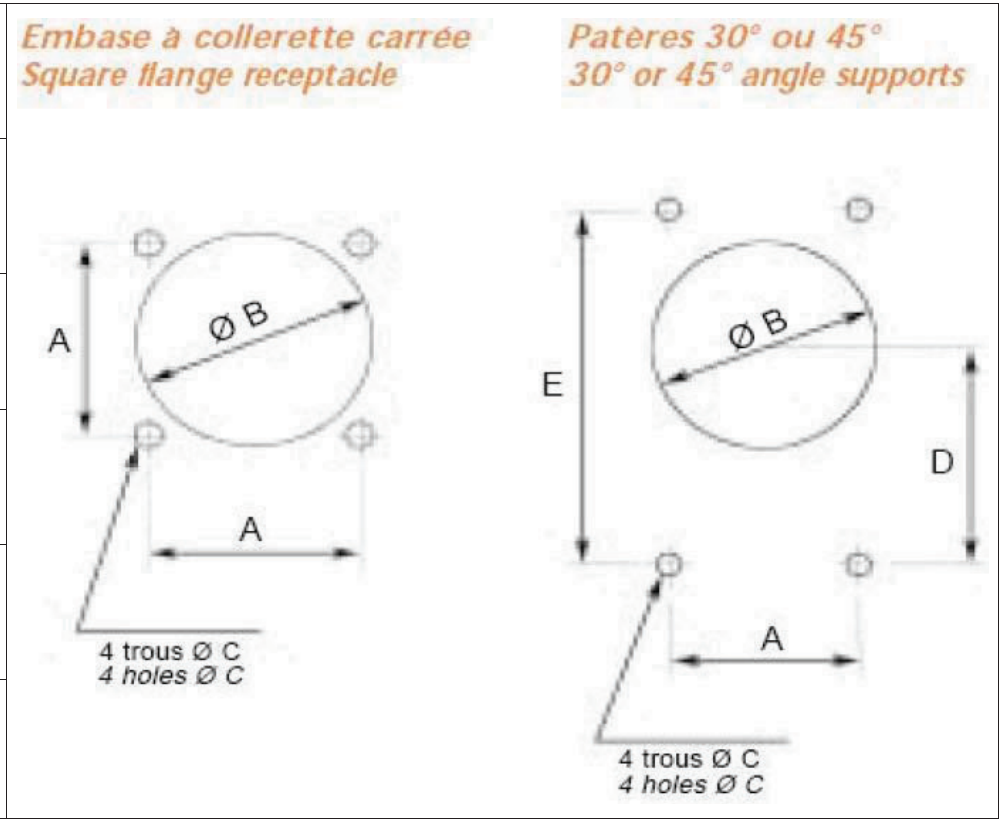


mm / (inches)

ATC Connectors & Tail Cables Specifications

Item: 3AC1 (Socket) (Cont.)

Size	07
A	34 (1.34)
B	39,5 (1.55)
C	4,5 (0.18)
D	45 (1.77)
E	72 (2.83)



mm / (inches)

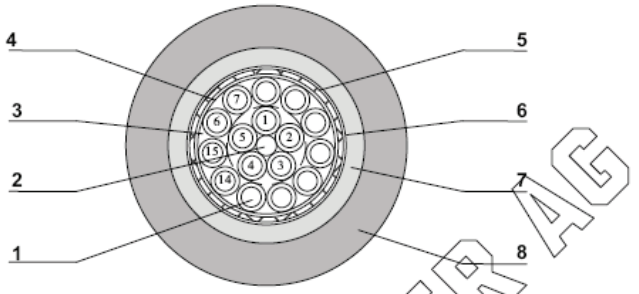
Note: Front mounted

ATC Connectors & Tail Cables Specifications

Item: CA12

Cable Type	Cord static bending radius	Cord dynamic bending radius	Cord external diameter
24264: CABLE DIVERS GKW-TM ZERO HALOGEN POLYESTER 15c NOIR 0,5mm^2 19 X 0.18	50 mm	150 mm	13 mm

System cable screened
15x0.5 mm² / MA12 / Radox Elastomer S FH



1.	15 cores 0.5 mm² type MA12–A1–0.5	Conductor : stranded tin plated copper Insulation : Polyester based insulation Colours : white–numbered	19 x 0.18 Ø : 1.3	mmØ mm
2.	Filler	Radox		
3.	Identification thread	H + S		
4.	Wrapping	Plastic tape		
5.	EMC – Screen optimised	Tin plated copper braid	Ø : 6.8	mm
6.	Wrapping	Plastic tape		
7.	Inner–Sheath	Radox Elastomer S FH, black		
8.	Outer–Sheath	Radox Elastomer S FH, black	**Ø : 13.0** +0.2/–0.3 mm	

Sheath–Marking: HUBER+SUHNER SWITZERLAND 12551839–XXXXXX / SECHERON 5.8604.220
Order number
Part number

HUBER+SUHNER AG

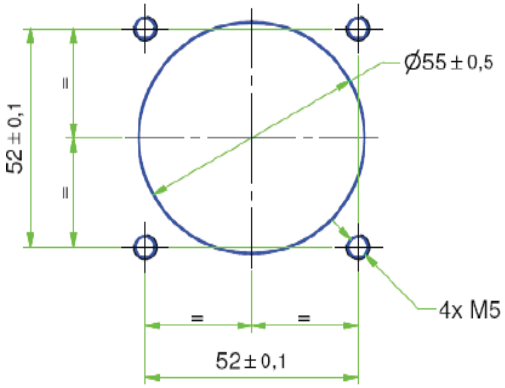
Size of cable between 0.5 mm^2 to 1.5 mm^2

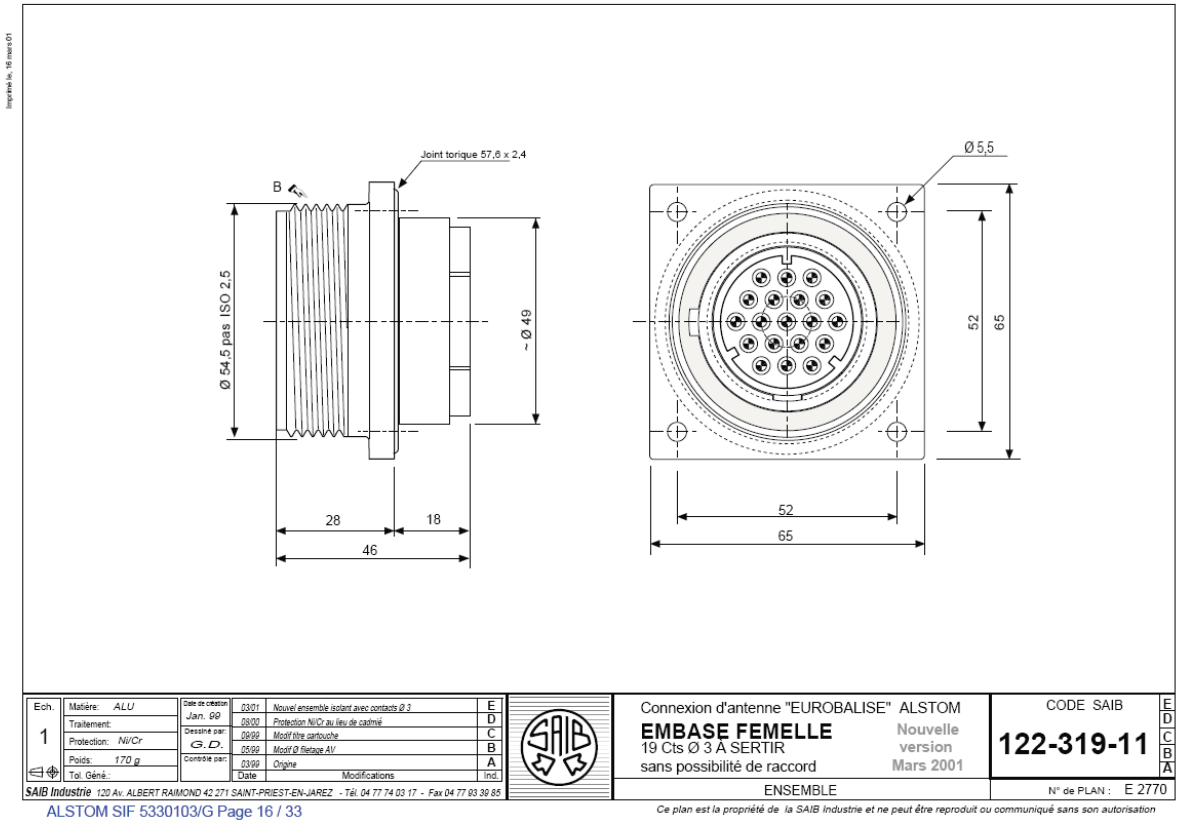
ATC Connectors & Tail Cables Specifications

Item: 4BC1 (Socket)

22278: CONNECTEUR CYLINDRIQUE; EMBASE FEMELLE; 19pts; A SERTIR; SANS REPRISE MASSE

Contact	Code	Code ALSTOM	
Ø 3 long. 33,5	13-11-01	24513	





838 series
8038 series (Fiber optics)
Intercoach Connectors

Qualified according to NFF 61030

SOURIAU
Connection Technology

838/8038 Series

SOURIAU

Connectors and interconnected systems for severe environments

The company designs, manufactures and markets high performance interconnected solutions for severe environments from industrial broadline and universal ranges to complex system with integrated functions :

filtering, high data transmission, hermicity, separation mechanism, remote handling, underwater mating,...

Industrial broadline

Circular and rectangular ranges

Umbilical system

The dedicated and markets for SOURIAU's products are aerospace, defense-space and industrial.

Railway
Geophysics
Manufacturing environment
Instrumentation
Automation & Process

Cilvil & Military aircraft
Helicopter
Weapon delivery system
Avionics

Military marine
Communication
Satellites
Launcher & Missile

SOURIAU was established in 1917 and has been created by successive acquisitions of the industrial, aeronautical, defense, and space activities of SOURIAU, JUPITER and BURNDY.

The Group's products are engineered and manufactured in the USA and Dominican Republic, Europe and Marocco, Japan and India, and sold by a worldwide sales and marketing organization, and in addition to SOURIAU's offices, a large network of licensed distributors and agents.

SOURIAU complies with most of national and international Quality Assurance standards, production unit with ISO 14001.

AFAQ ISO 9001 VERSION 2000

RN 23 F-72470 CHAMPAGNE
ZI des Ajeux F-72400 LA FERTE-BERNARD

a été évalué et jugé conforme aux exigences de la norme :
has been assessed and found to conform to the requirements of the standard :

ISO 14001 (1996)

Le certificat correspondant a été délivré dans les conditions fixées par AFAQ, le :
The corresponding certificate has been delivered under AFAQ application rules, on :

2004-03-18

Il est valable jusqu'au"
It is valid until"

2007-01-29

QUALITY ASSURED FIRM EN 9001 SGS

838 Series

Série 838 / *838 series*

Page 4 à/*to* page 24

Série 8038 / *8038 series*

Page 26 à/*to* page 42

838 Series

Sommaire

	page
• Caractéristiques techniques	6
• Synoptique	7
• Référencement	8
• Synoptique embase + raccord et fiche + raccord	9
• Arrangements	10
• Détrompage	11
• Dimensions	12
• Accessoires	19
• Contacts	20
• Outillage	22
• Perçage cloison	24

Présentation

Le connecteur 838 assure les connexions électriques sous moyenne et basse tension en ambiance industrielle sévère, où les astreintes mécaniques et climatiques sont particulièrement contraignantes.

Il équipe le matériel roulant ferroviaire (lignes de trains, liaisons sous caisses, raccordements d'appareillages) ainsi que les équipements de réseau et de signalisation (en accord avec la norme NFF 61030).

Le connecteur 838 dispose d'un boîtier en alliage d'aluminium protection sans Cadmium assurant un bon compromis poids/robustesse.

Le verrouillage à vis à filets carrés assure une haute tenue mécanique. Un système de détrompage amovible à 12 positions permet à l'opérateur d'effectuer la polarisation lors du câblage.

Le connecteur 838 est équipé d'isolants en matériau thermoplastique qui se caractérisent par :

- un haut niveau de performances mécaniques et électriques,
- une mise en œuvre simplifiée, rapide et efficace,
- une sécurité d'emploi garantie par :
  - un guidage constant et un alignement précis des contacts mâles et femelles dans leurs logements,
  - une rétention mécanique éprouvée et endurante des contacts dans leurs alvéoles,
- un respect des exigences de tenue feu-fumée définies dans les standards NFF 16101 et NFF 16102,
- la protection des mécaniques est sans cadmium répondant ainsi aux nouvelles réglementations.

Content

	page
• *Technical features*	*6*
• *Synoptic*	*7*
• *Ordering information*	*8*
• *Synoptic receptacle + backshell and plug + backshell*	*9*
• *Layouts*	*10*
• *Keying system*	*11*
• *Dimensions*	*12*
• *Accessories*	*19*
• *Contacts*	*20*
• *Tools*	*22*
• *Panel cutout*	*24*

Presentation

The 838 connector series is used for LV and MV electrical connections in harsh environmen, with especially very strong mechanical and climatic constraints.

The typical applications of 838 connector series include rolling stock (intercoach connections, undercoach connections, equipment connections) as well as signalling and fixed electrical equipments (complying with NFF 61030 standard).

The 838 connectors are designed in aluminium alloy to enable a good compromise weight / robustness.

The square threads screw coupling withstand very strong mechanical endurance. A removable coding system allows the operator to choose between 12 positions for the cabling.

The 838 connector series is equipped with thermoplastic insulators enabling:

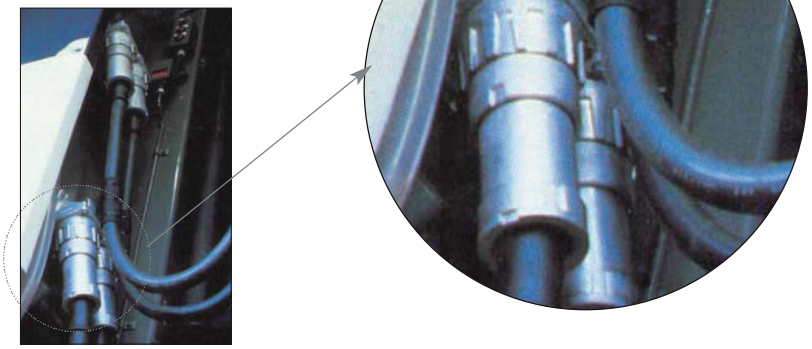
- *a high mechanical and electric performance level,*
- *user friendly installation,*
- *a safe application guaranteed by:*
  - *constant guiding and accurate alignment of male and female contacts in their cavities,*
  - *a proven and robust mechanical retention of contacts in their cavities,*
- *respect of the fire and fumes demands conform to the NFF 16101 and NFF 16102 standards,*
- *shell plating is cadmium free therefore complying with environmental rules.*

838 Series

Technical features & benefits

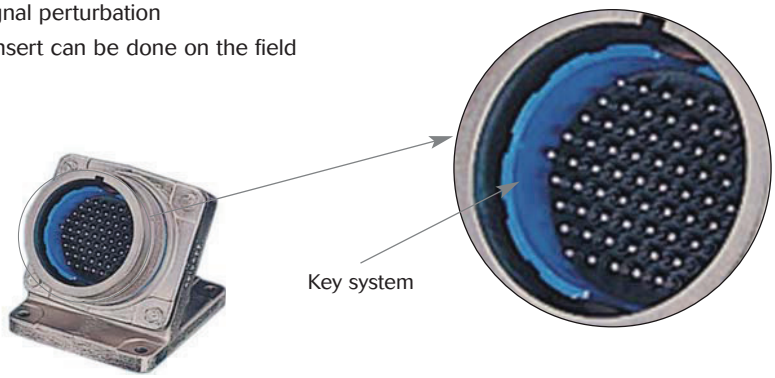
Ruggedized circular connector to matching intercoach environment

- Enabling 500 mating-unmating without wear out
- Screw coupling with thin square thread for secure mating under vibration
- Traction force withstanding
- 30° panel mounting



Versatile series

- Versatile insert with reverse gender
- 360° shell shielding permit to reduce signal perturbation
- Polarization system enabling: keying of insert can be done on the field



RoHS compliancy

- Shells plating are cadmium free: Alodine 1200
- Inserts are halogen free: PBB & PBDE

838 Series

Caractéristiques / *Technical features*

Mécaniques

- **Boîtier :**
  alliage d'aluminium
- **Protection :**
  conversion chimique sans cadmium
- **Système de verrouillage :**
  - à vis sans cliquet (boîtiers B, J, C et E)
  - à vis avec cliquet (boîtiers C et E).
- **Isolant :**
  thermoplastique renforcé fibre de verre conforme aux spécifications feu-fumée NFF 16101-16102 (exigence 3), classé V0 suivant la norme UL94.
- **Joint interfacial :**
  élastomère
- **Système de codage amovible** offrant 12 possibilités différentes de détrompage (livré en position 1).
- **Les isolants mâles et femelles** peuvent équiper indifféremment les fiches ou les embases.
- **Contacts :**
  - alliage cuivreux, argenté ou doré
  - à sertir, muni de clips et démontable de la face avant de l'isolant.
- **Endurance mécanique :**
  500 manœuvres (verrouillage + déverrouillage).

Mechanical

- ***Shell:***
  aluminium alloy
- ***Plating:***
  chemical conversion cadmium free
- ***Locking system:***
  - *screw without clicker (shell sizes B, J, C and E)*
  - *screw with clicker (shell sizes C and E).*
- ***Insulator:***
  thermoplastic: polyamide I2-F3 in accordance with NFF 16101-16102 (exigence 3) (fire and smoke emissions) for installations on equipments category A1 UL94-V0.
- ***Interfacial seal:***
  elastomeric
- ***Removable coding system** enables the operator to choose between 12 different key orientations (delivered in position 1).*
- ***Both male and female insulators** can fit in either the plugs or the receptacles.*
- ***Contacts:***
  - *copper alloy, silver or gold plating*
  - *crimp type, with clips removable from the front of the insulator.*
- ***Endurance:***
  500 mating-unmating cycles.

Climatiques

- **Température d'utilisation :**
  - thermoplastique : -40°C à +100°C
- **Etanchéité :**
  - IP66 et IP67 (avec raccord adapté)
- **Chaleur humide :**
  21 jours à +40°C ; 90% d'humidité relative (NFC 20703)
- **Brouillard salin :**
  96 heures (NFC 20711)
  (Pour d'autres exigences, nous consulter).

Environmental

- ***Temperature range:***
  - thermoplastic: -40°C to +100°C
- ***Sealing:***
  - IP66 and IP67 (with adapted backshell)
- ***Damp heat:***
  21 days to +40°C ; 90% relative humidity (NFC 20703)
- ***Salt spray:***
  96 hours (NFC 20711)
  (For other requirements, consult us)

Electriques

- **Tension de tenue :**
  - 3250 Veff
- **Résistance d'isolement :**
  ≥ 5000 MΩ sous 500 Vcc
- **Résistance de contact :**
  ≤ 2 mΩ
- **Tension de service par arrangement :**
  380 Veff
- **Intensité admissible par contact :**

Ø 1.6 mm (Trim-Trio)	13 A
Ø 2 mm	15 A
Ø 3 mm	30 A
Ø 5 mm	40 A
Ø 12 mm	180 A

Electrical

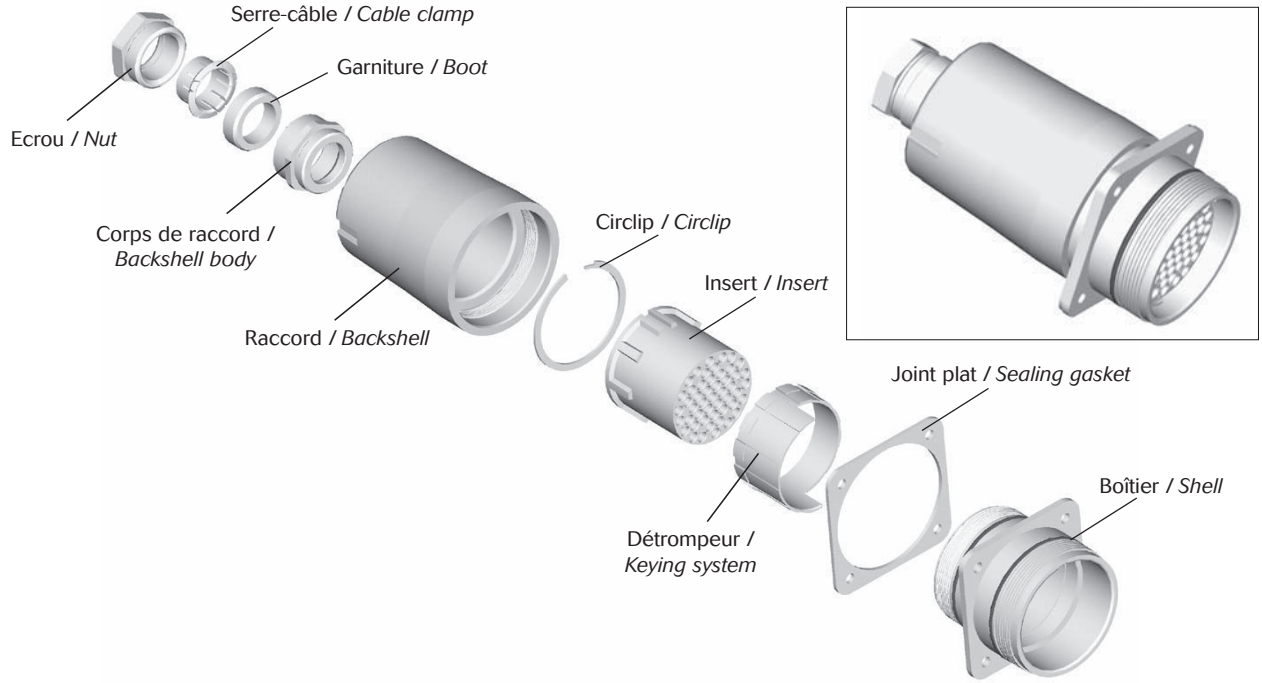
- ***Test voltage:***
  - 3250 Vrms
- ***Insulation resistance:***
  ≥ 5000 MΩ under 500 Vdc
- ***Contact resistance:***
  ≤ 2 mΩ
- ***Maximum voltage per layout:***
  380 Vrms
- ***Maximum rating per contact:***

Ø 1.6 mm (Trim-Trio)	*13 A*
Ø 2 mm	*15 A*
Ø 3 mm	*30 A*
Ø 5 mm	*40 A*
Ø 12 mm	*180 A*

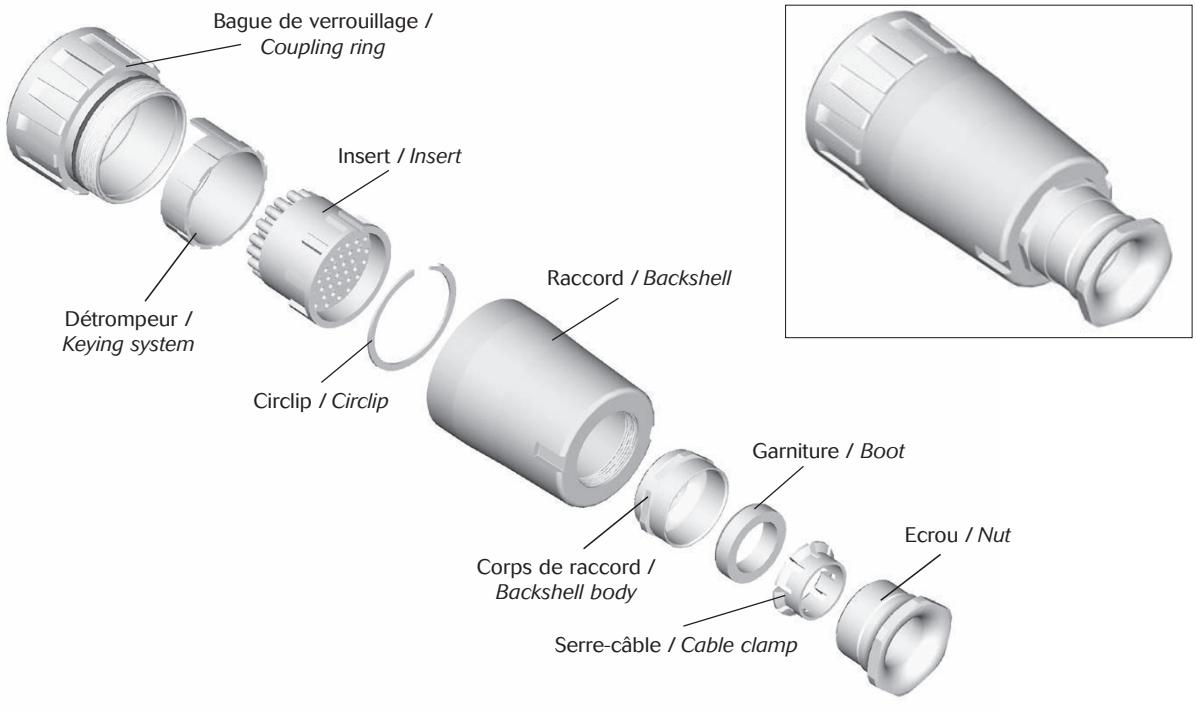
838 Series

Synoptique / *Synoptic*

Embase / *Receptacle*



Fiche / *Plug*



838 Series

Référencement / *Ordering information*

Racine / *Basic series*	**838**	**0**	**E**	**1**	**C**	**19**	**5**	**B**	**N**	**0**	**A**

0 verrouillage à vis avec possibilité de détrompage
screw coupling with coding option
2 verrouillage à vis sans possibilité de détrompage (boîtier B seulement)
screw coupling without coding option (shell size B only)

E embase / *receptacle*
F fiche / *plug*

0 embase à collerette carrée sans joint d'étanchéité
square flange receptacle without seal
1 embase à collerette carrée avec joint d'étanchéité
square flange receptacle with seal
0 fiche sans verrouillage à cliquet
plug without clicker locking
1 fiche avec verrouillage à cliquet (boîtiers E et C seulement)
plug with clicker locking (shell sizes E and C only)

taille de boîtier / *shell size*
B - J - C - E

arrangements de contacts / *contacts layouts*
(voir pages 10 et 11 / *see pages 10 and 11*)

1 contact mâle à sertir / *male crimp contact*
5 contact femelle à sertir / *female crimp contact*

L connecteur livré sans contact / *connector supplied without contact*
B à/*to* U type de contact (voir pages 20 à 21) / *contact type (see pages 20 and 21)*

G raccord droit pour gaine annelée PMA (boîtiers C et E)
straight backshell for PMA flexible tube (shell sizes C and E)
M sans raccord, sans accessoire */ without backshell or accessory*
N coiffe (boîtiers C et E) */ boot (shell sizes C and E)*
R raccord avec orientation 30° */ receptacle assembled on 30°*
S raccord droit avec presse-étoupe et raccord pour gaine annelée PMA (boîtier B seulement)
straight backshell with sealing gland and backshell for PMA flexible tube (shell size B only)
V raccord droit à presse-étoupe (boîtiers C et E) / *straight backshell with sealing gland (shell sizes C and E)*
W raccord droit avec serre-câble et presse-étoupe / *straight backshell with cable clamp and sealing gland*
T raccord à presse-étoupe et serre-câble à faible encombrement / *backshell with low profile sealing gland*
U raccord type T avec reprise de tresse / *backshell T type with shielding termination*
Z raccord pour reprise de tresse / *backshell for shielding termination*

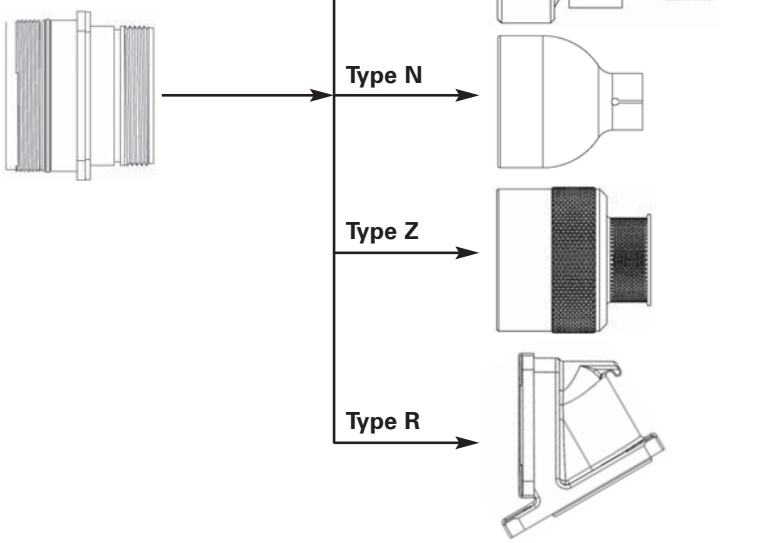
indice / *index*
0 à/*to* 16 obligatoire, voir tableau pages 12 à 19 / *mandatory, see table pages 12 to 19*

A thermoplastique / *thermoplastic*

B thermoplastique et boîtier 500 heures (nous consulter) / *thermoplastic and shell 500 hrs salt spray (consult us)*

838 Series

Embase / *Receptacle*



V : Raccord droit avec presse-étoupe
Straight backshell with sealing gland

W : Raccord droit avec presse-étoupe et serre-câble
Straight backshell with sealing gland and cable clamp

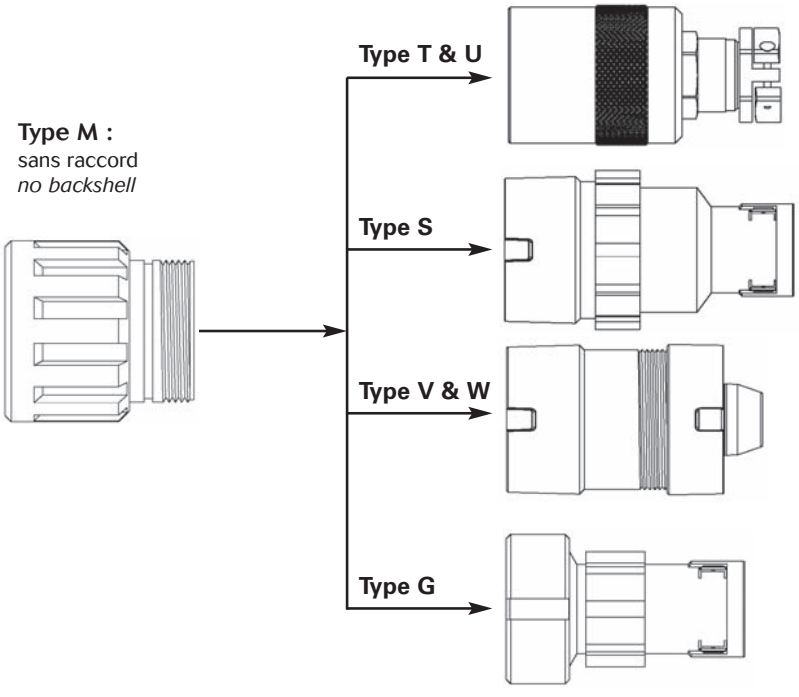
G : Raccord droit pour tube PMA
Straight backshell for PMA

N : Coiffe
Boot

Z : Raccord pour reprise de tresse
Backshell for shielding termination

R : Raccord avec orientation de 30°
Receptacle assembled on 30°

Fiche / *Plug*



T : Serre-câble avec presse-étoupe de faible encombrement
Cable clamp with low profile sealing gland

U : Type T avec reprise de tresse
Type T with shielding termination

S : Raccord droit pour tube PMA avec presse-étoupe
Straight backshell with sealing gland + backshell for PMA

V : Raccord droit avec presse-étoupe
Straight backshell with sealing gland

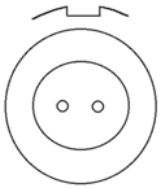
W : Raccord droit avec presse-étoupe et serre-câble
Straight backshell with sealing gland and cable clamp

G : Raccord droit pour tube PMA
Straight backshell for PMA

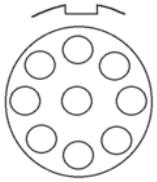
838 Series

Arrangements / *Layouts*

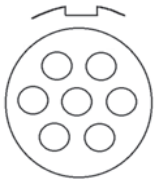
Boîtier E / *Shell size E*



1 twinax contact 120 Ω
01

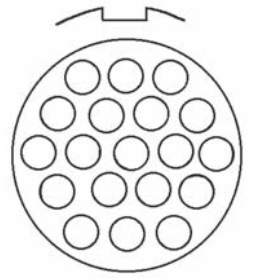


9 contacts Ø 2 mm type B ou/*or* H
09

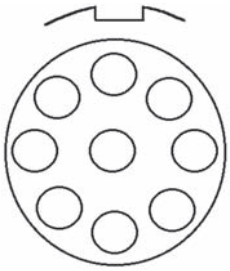


7 contacts Ø 2 mm type B ou/*or* H
07

Boîtier C / *Shell size C*

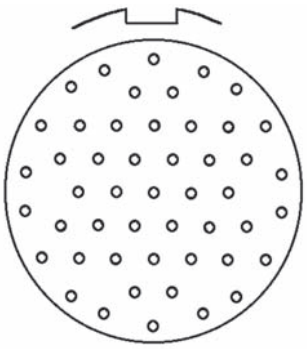


19 contacts Ø 2 mm type B ou/*or* H
19

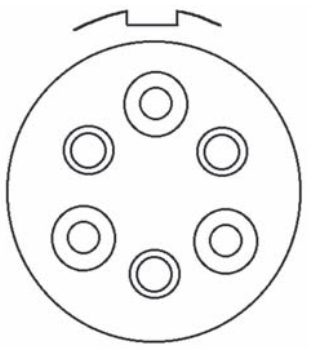


9 contacts Ø 3 mm type E ou/*or* F
09

Boîtier J / *Shell size J*



49 contacts Ø 1,6 mm Trim-Trio
49

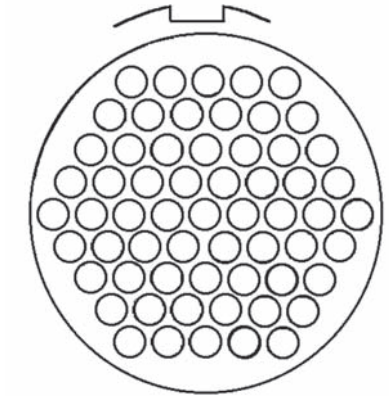


3 contacts Ø 3 mm type F ou/*or* E
3 contacts Ø 5 mm type G
06

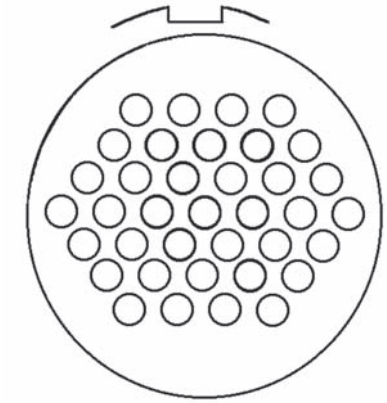
838 Series

Arrangements / *Layouts*

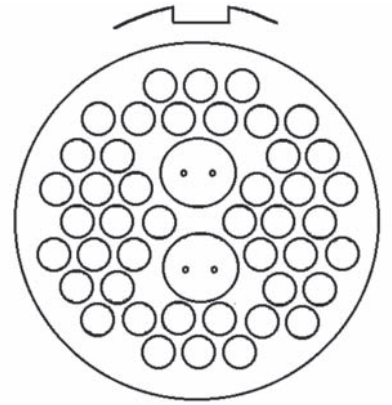
Boîtier B / *Shell size B*



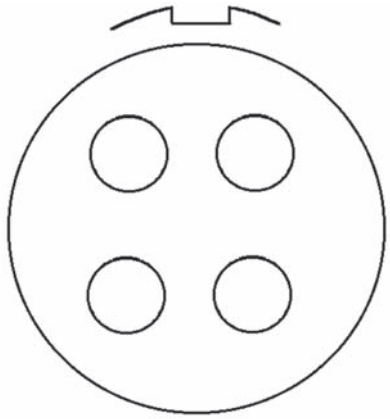
61 contacts Ø 2 mm type B ou/*or* H
61



37 contacts Ø 3 mm type E ou/*or* F
37

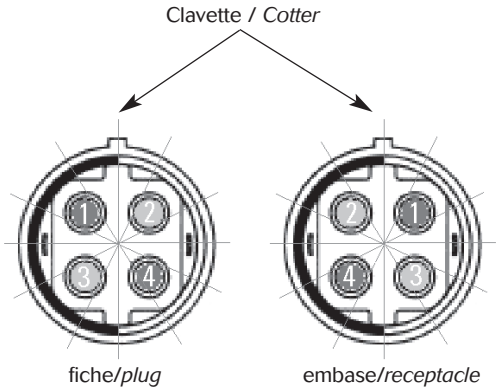


44 contacts Ø 2 mm type B ou/*or* H
+ 2 twinax 105 Ω
45

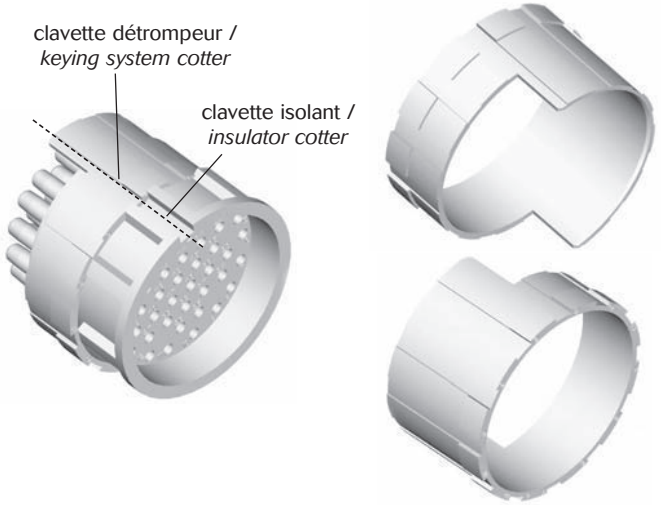


4 contacts Ø 12 mm
04

Détrompage / *Keying system*



Exemple de détrompage pour
un arrangement 4 contacts
Keying system 4 contacts layouts

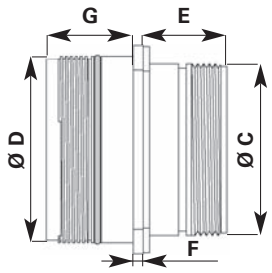


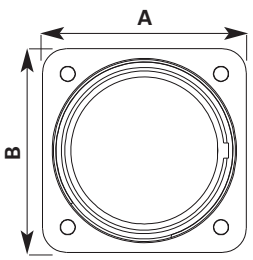
838 Series

Dimensions fiche et embase / *Plug and receptacle dimensions*

Type M
Embase sans raccord / *Receptacle without backshell*

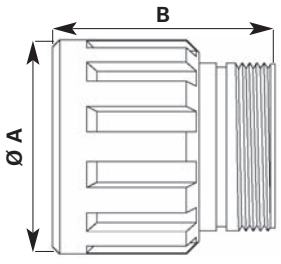
Taille/*Size*	E	C	J	B
A	42	70	85	121
B	42	70	85	110
Ø C	35	52	70	86
Ø D	38	58	76	96
E	25	24	34	21
F	4	4	4	11
G	27	28	35,5	52
Indice	0			





Type M
Fiche sans raccord / *Plug without backshell*

Taille/*Size*	E	C	J	B
Ø A	45	68	85	111
B	59	57	64	94
Indice	0			



Note : Ces dimensions ne sont pas contractuelles et peuvent être modifiées / Ces dimensions sont en millimètres.
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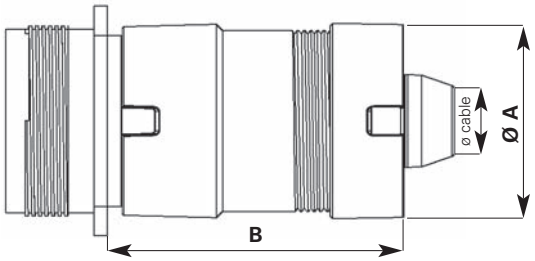
838 Series

Dimensions raccords presse-étoupe / *Sealing gland backshells dimensions*

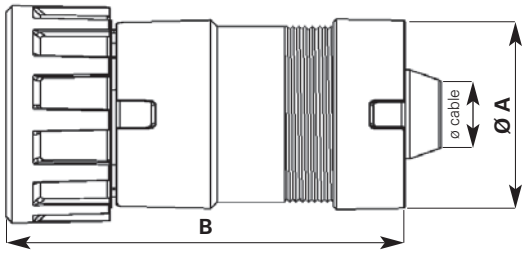
Type V
Raccord droit presse-étoupe pour embase / *Receptacle straight backshell with sealing gland*

Taille / *Size*	E		C		J		B	
Ø A	39		60		-		-	
B	84		98		-		-	
Indice	Ø cable							
	mini	maxi	mini	maxi	mini	maxi	mini	maxi
0	-	-	17	23	-	-	-	-
1	-	-	23	30	-	-	-	-
4	14,5	17	-	-	-	-	-	-



Type V
Raccord droit presse-étoupe pour fiche / *Plug straight backshell with sealing gland*

Taille/*Size*	E		C		J		B	
Ø A	39		60		-		-	
B	118		131		-		-	
Indice	Ø cable							
	mini	maxi	mini	maxi	mini	maxi	mini	maxi
0	-	-	17	23	-	-	-	-
1	-	-	23	30	-	-	-	-
4	14,5	17	-	-	-	-	-	-



Note : Ces dimensions ne sont pas contractuelles et peuvent être modifiées / Ces dimensions sont en millimètres.
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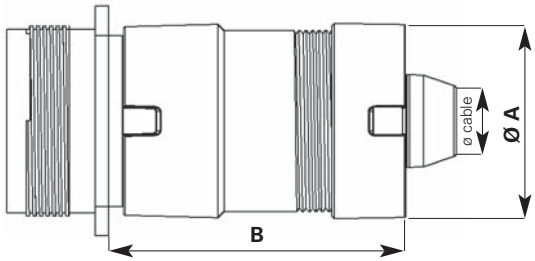
838 Series

Dimensions raccords presse-étoupe / *Sealing gland backshells dimensions*

Type W

Raccord droit presse-étoupe pour embase avec serre-câble / *Receptacle straight backshell with sealing gland and cable clamp*

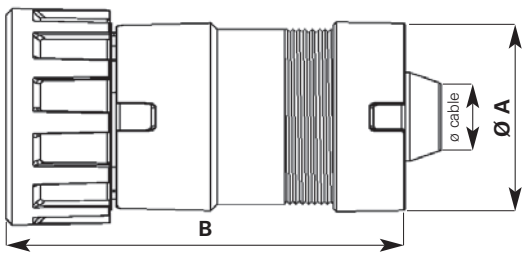
Taille/*Size*	E		C		J		B	
Ø A	39		60		-		-	
B	84		98		-		-	
Indice			Ø cable					
	mini	maxi	mini	maxi	mini	maxi	mini	maxi
0	14,5	17	14,5	17	-	-	-	-
1	10,1	13,3	10,1	13,3	-	-	-	-
2	8	11	8	11	-	-	-	-
3	6	9	6	9	-	-	-	-



Type W

Raccord droit presse-étoupe pour fiche avec serre-câble / *Plug straight backshell with sealing gland and cable clamp*

Taille/*Size*	E		C		J		B	
Ø A	39		60		-		91	
B	118		131		-		240	
Indice			Ø cable					
	mini	maxi	mini	maxi	mini	maxi	mini	maxi
0	14,5	17	14,5	17	-	-	36,6	44,8
1	10,1	13,3	10,1	13,3	-	-	32	38
2	8	11	8	11	-	-	44,8	48,5
3	6	9	6	9	-	-	28	32



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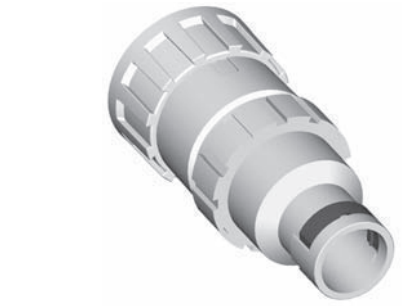
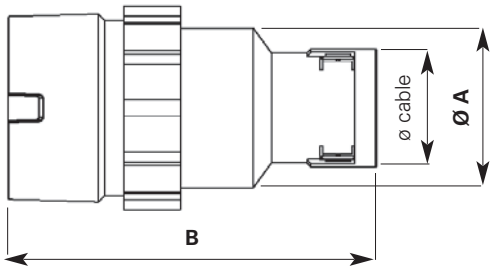
838 Series

Dimensions raccords pour gaine PMA / *PMA tube backshells dimensions*

Type S
Raccord droit presse-étoupe PMA pour fiche / *Plug straight backshell with sealing gland for PMA*

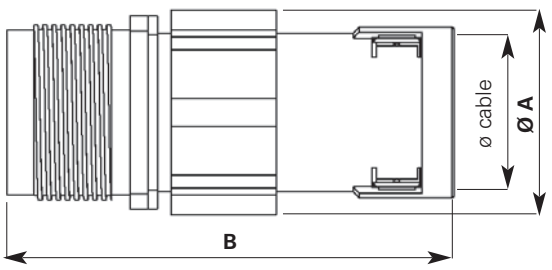
Taille/*Size*	Gaine **PMA**	**E**		**C**		**J**		**B**	
Ø A		39		-		-		106	
B	NW12	55		-		-		-	
	NW17	111		-		-		-	
	NW19	64		-		-		-	
	NW23	67		-		-		-	
Indice	Gaine PMA	Ø cable							
		mini	maxi	mini	maxi	mini	maxi	mini	maxi
2	NW12								
3	NW17	12,5	20						
7	NW19								
9	NW23								





Type G
Raccord droit PMA pour embase / *Receptacle straight backshell for PMA*

Taille/*Size*	Gaine **PMA**	**E**		C_3	C_9 *	**J**		**B**	
Ø A		45		45	62	-		-	
B	NW12	55		-	-	-		-	
	NW17	62		87**	-	-		-	
	NW23	67		-	-	-		-	
	NW29	-		-	64	-		-	
Indice	Gaine PMA	Ø cable							
		mini	maxi	mini	maxi	mini	maxi	mini	maxi
2	NW12	-	12	-	-	-	-	-	-
3	NW23	-	22	-	22	-	-	-	-
7	NW17	-	16	-	-	-	-	-	-
9	NW29	-	-	-	29	-	-	-	-



* 3 et 9 sont les indices / *3 and 9 are the index.*

** Pour le boîtier C, l'indice 3 correspond à la référence NW17
For C shell index 3 is for NW17 reference

Note : Ces dimensions ne sont pas contractuelles et peuvent être modifiées / Ces dimensions sont en millimètres.
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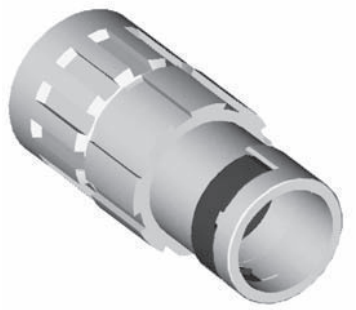
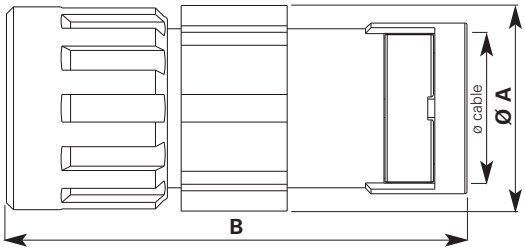
Dimensions raccords pour gaine PMA / *PMA tube backshells dimensions*

Type G
Raccord droit PMA pour fiche / *Plug straight backshell for PMA*

Taille/*Size*	Gaine **PMA**	**E**		C_7	C_9 *	**J**		**B**	
Ø A		45		45	62	-		-	
B	NW12	89		-	-	-		-	
	NW17	96		122	-	-		-	
	NW23	111		-	-	-		-	
	NW29	98		98	-	-		-	
Indice	Gaine PMA	Ø cable							
		mini	maxi	mini	maxi	mini	maxi	mini	maxi
2	NW12	-	12	-	-	-	-	-	-
3	NW23	-	22	-	-	-	-	-	-
7	NW17	-	16	-	16	-	-	-	-
9	NW29	-	28	-	28	-	-	-	-

* 7 et 9 sont les indices / *7 and 9 are the index*





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838 Series

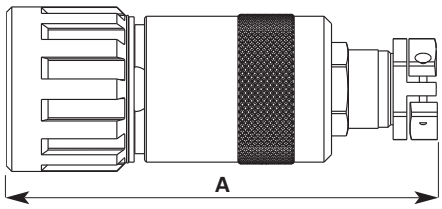
Dimensions raccords type T&U presse-étoupe avec serre-câble
Type T sealing gland with cable clamp backshells dimensions

Type T_{0-6}
Presse-étoupe avec serre-câble type ZA SIB-ADR
Sealing gland with ZA SIB-ADR cable clamp

Type U_{0-6}
Presse-étoupe avec serre-câble type ZA SIB-ADR et reprise de tresse
Sealing gland with ZA SIB-ADR cable clamp and shielding

Taille/*Size*		E	C	J	B
A	PG13	111	-	-	-
	PG16	-	-	-	-
	PG21	124	-	-	-
	PG29	-	-	-	-
	PG36	-	-	-	230
	PG42	-	-	-	-
	PG48	-	-	-	244

Indice		Ø cable							
		mini	maxi	mini	maxi	mini	maxi	mini	maxi
0	PG13	8,5	12	-	-	-	-	-	-
1	PG16	-	-	-	-	-	-	-	-
2	PG21	8	19	-	-	-	-	-	-
3	PG29	-	-	-	-	-	-	-	-
4	PG36	-	-	-	-	-	-	22	33
5	PG42	-	-	-	-	-	-	-	-
6	PG48	-	-	-	-	-	-	30	45

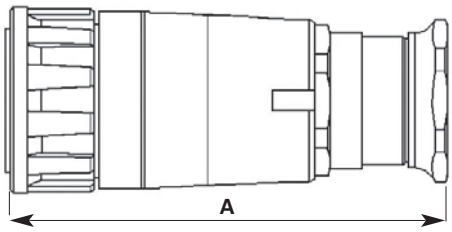


Type T_{10-16}
Presse-étoupe avec griffe type EEXe SIB-ADR
Sealing gland with EEXe SIB-ADR "claw"

Type U_{10-16}
Presse-étoupe avec griffe type EEXe SIB-ADR et reprise de tresse
Sealing gland with EEXe SIB-ADR "claw" and shielding

Taille/*Size*		E	C	J	B
A	PG13	-	-	-	-
	PG16	-	-	-	-
	PG21	-	-	-	-
	PG29	-	-	-	-
	PG36	-	-	213	-
	PG42	-	-	-	-
	PG48	-	-	223	-

Indice		Ø cable							
		mini	maxi	mini	maxi	mini	maxi	mini	maxi
10	PG13	-	-	-	-	-	-	-	-
11	PG16	-	-	-	-	-	-	-	-
12	PG21	-	-	-	-	-	-	-	-
13	PG29	-	-	-	-	-	-	-	-
14	PG36	-	-	-	-	22	30	-	-
15	PG42	-	-	-	-	-	-	-	-
16	PG48	-	-	-	-	32	40	-	-



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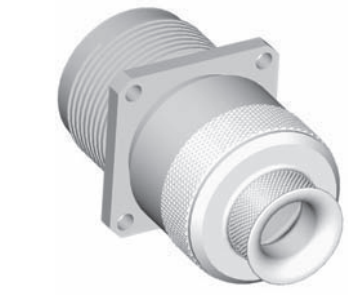
838 Series

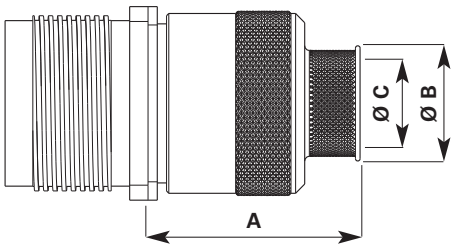
Dimensions de raccords spécifiques / *Specifics backshells dimensions*

Type Z

Raccord droit avec reprise de tresse pour embase / *Receptacle straight backshell for shielding termination*

Taille/*Size*	E	C	J	B
A	46	-	34	-
Ø B	25	-	74	-
Ø C		-		-
Indice	**0**			

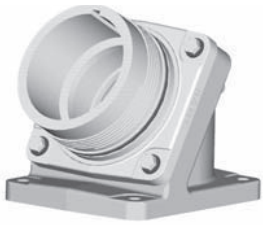


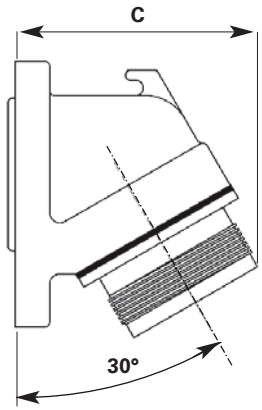


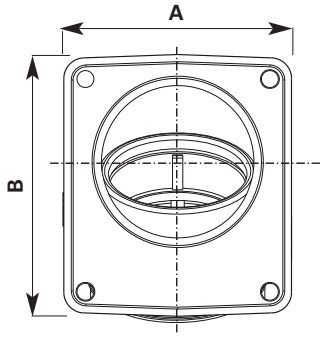
Type R

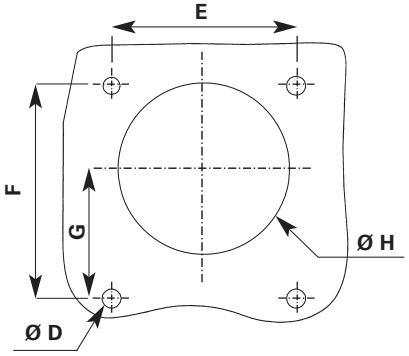
Raccord coudé / *Elbow backshell*

Taille/*Size*	E	C	J	B
A	53	71	-	98
B	95	109	-	108
C	77	95	-	138
Ø D	4,3	4,3	-	9
E	34	52	-	98
F	72	87	-	113
G	45	51	-	69
Ø H	39,5	54,5	-	94
Indice	**0**			









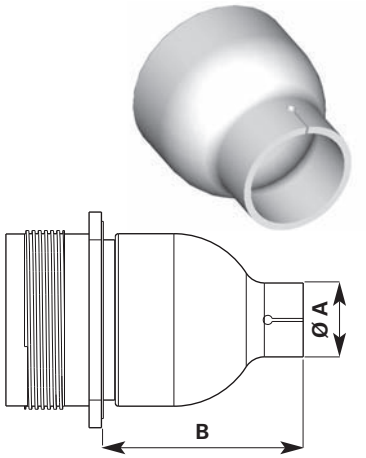
Note : Ces dimensions ne sont pas contractuelles et peuvent être modifiées / Ces dimensions sont en millimètres.
Dimensions are not contractual and may be subject to change / Dimensions are in millimeters.

838 Series

Dimensions accessoires / *Accessories dimensions*

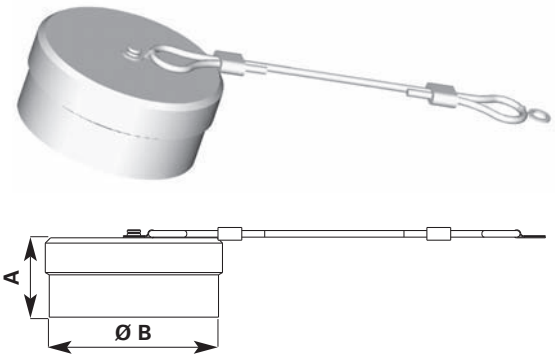
Type N
Coiffe / *Boot shell*

Taille/*Size*	E	C	J	B
Ø A	22	24	-	-
B	70	70	-	-
Indice	**0**			



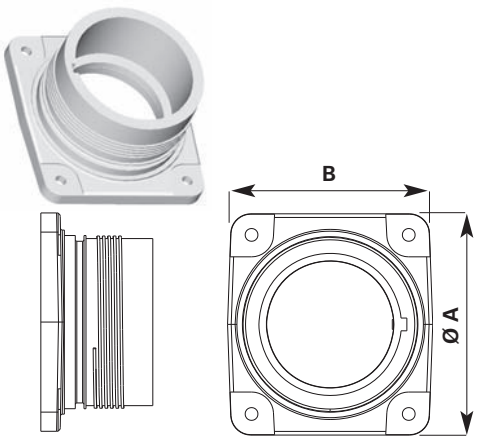
Bouchon d'embase / *Cap for receptacle*

Taille/*Size*	E	C	J	B
A	35	33	-	53
Ø B	45	68	-	110
Reference	**8038-0141A**	**8038-0140**	**-**	**8380-777**



Embase de repos / *Dummy receptacle*

Taille/*Size*	E	C	J	B
A	42	70	-	121
B	42	70	-	110
Reference	**8038-0133**	**8038-0131**	**-**	**8380-983**

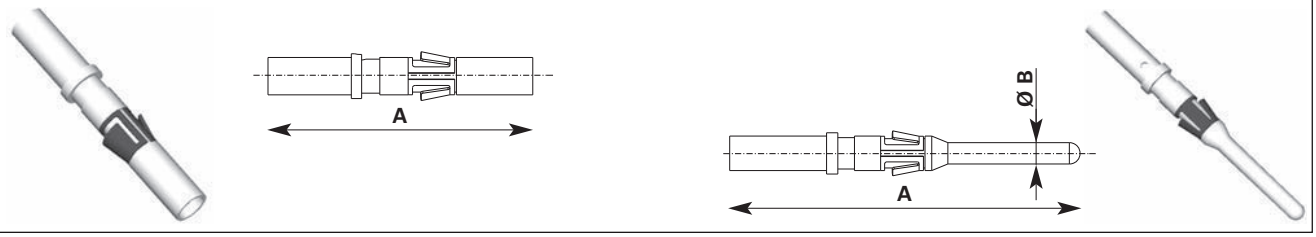


Note : Ces dimensions ne sont pas contractuelles et peuvent être modifiées / Ces dimensions sont en millimètres.
Dimensions are not contractual and may be subject to change / Dimensions are in millimeters.

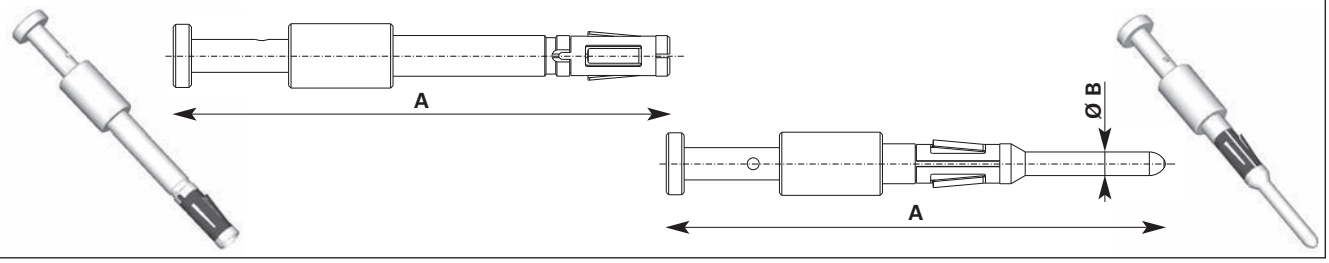
838 Series

Contacts / *Contacts*

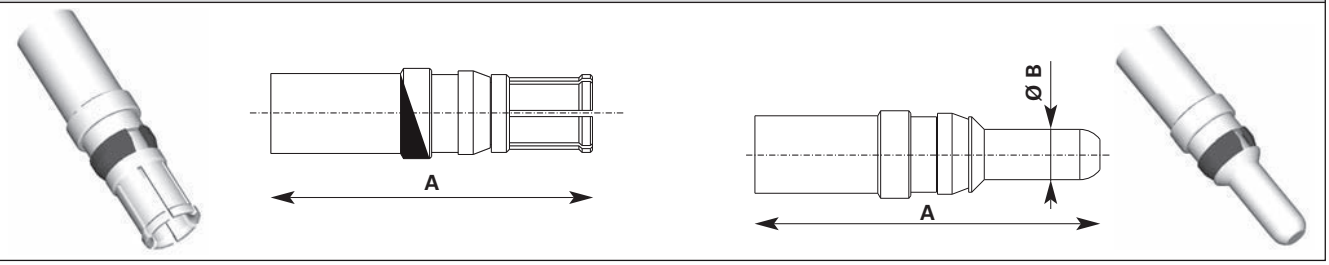
Contact Trim-Trio # 16



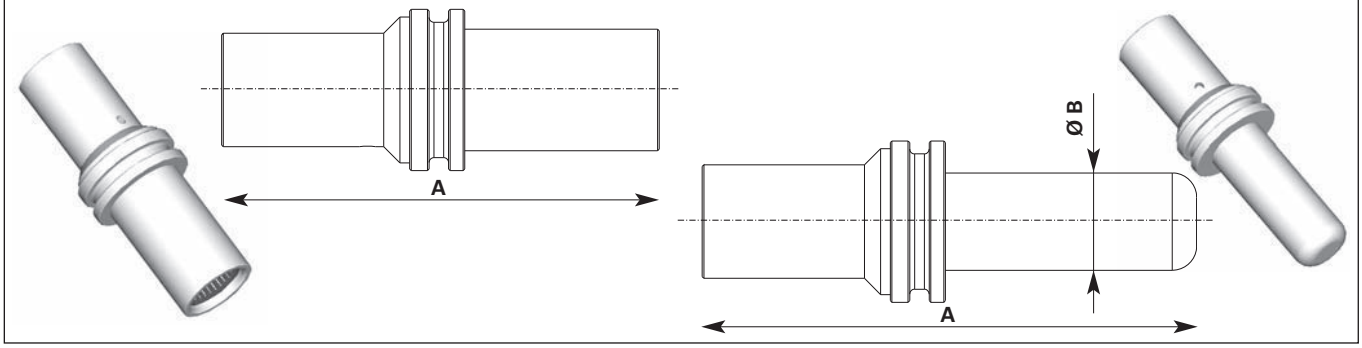
Contact Ø 2 mm / Ø 3 mm



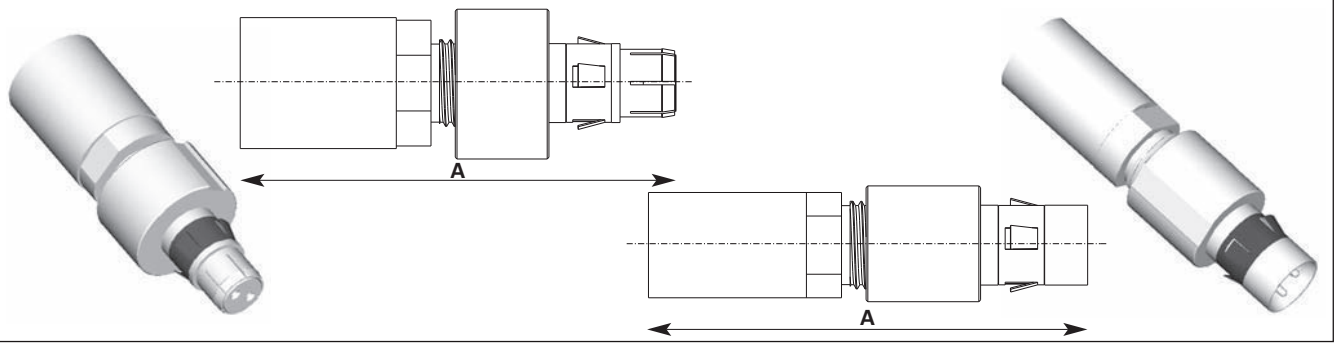
Contact Ø 5 mm



Contact Ø 12 mm



Twinax



838 Series

Contacts / *Contacts*

Ø partie active *Active part Ø* Ø B (mm)	Type de contact *Contact type*	Mâle ou femelle *Male or female*	Dimensions A	Référence *Part number*	Protection *Plating*	Section de câble *Cable size* mini (mm²)	Section de câble *Cable size* maxi (mm²)
Ø 1,6	T (Trim-Trio)	M	26,2	RM16M23K	doré *gold*	0,52	1,5
		F	18,2	RC16M23K			
Ø 2	B	M	42	8380-722	argenté passivé *passivated silver*	0,6	1,5
		F	41	8380-725			
Ø 2	B	M	42	8380-726	doré *gold*	0,6	1,5
		F	41	8380-727			
Ø 2	H	M	42	8380-970	argenté passivé *passivated silver*	1,34	2,61
		F	41	8380-973			
Ø 3	F	M	45	8380-716	argenté passivé *passivated silver*	1,34	2,61
		F	41	8380-719			
Ø 3	F	M	45	8380-717	doré *gold*	1,34	2,61
		F	41	8380-723			
Ø 3	E	M	45	8380-1365	argenté passivé *passivated silver*	4	4,78
		F	41	8380-1366			
Ø 3	E	M	45	8380-730	doré *gold*	4	4,78
		F	41	8380-731			
Ø 5	G	M	34,5	8380-728	argenté passivé *passivated silver*	10	10
		F	31	8380-729			
Ø 12	J	M	61	8380-1020A	argenté passivé *passivated silver*	50	50
		F	54	8380-1021A			
Twinax 105 Ω cable Arrangement / *Layout* 45	-	M	-	8380-951	doré / argenté *gold / passivated silver*	0,2 (250BLG)	0,6
		F	-	8380-950			
Twinax 120 Ω cable Arrangement / *Layout* 45	U	M	50	8380-994	doré / argenté *gold / passivated silver*	0,2 ROCKBEST05 2/C AWG20	0,6
		F	50	8380-995			
Twinax 120 Ω cable Arrangement / *Layout* 01	S	M	50	8380-1009	contact doré / corps argenté *gold contact / passivated silver body*	0,2	0,6
		F	50	8380-1010 8380-1012			

Note : Notice de câblage du Twinax disponible sur demande : ref. BT105 et NC132 / *Twinax wiring instructions are available upon request: ref BT105 and NC132.*

838 Series

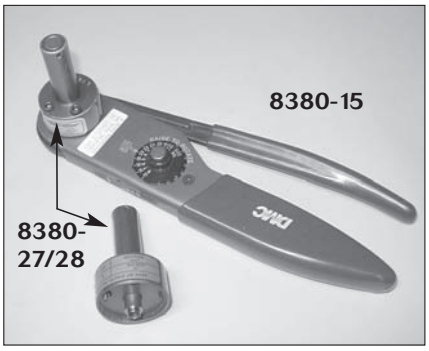
Outillage / *Tooling*

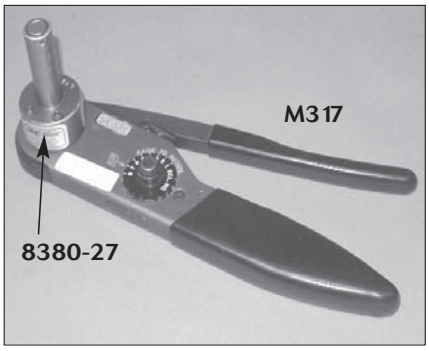
Ø partie active (mm) *Active part Ø* (mm)	Type de contact *Contact type*	Mâle ou femelle *Male or female*	Référence *Part number*	Pince de sertissage *Crimping tool*	Positionneur *Locator*	Outil d'extraction de la cavité *Extraction tool*
Ø 1,6	T (Trim-Trio)	M	RM16M23K	MH860 (M22520/7-01)	MH86164G	RX2025GE1
		F	RC16M23K			
Ø 2	B	M	8380-722	8380-15	8380-28	8380-740
		F	8380-725			
Ø 2	B	M	8380-726	8380-15	8380-28	8380-740
		F	8380-727			
Ø 2	H	M	8380-970	8380-15	8380-28	8380-740
		F	8380-973			
Ø 3	F	M	8380-716	8380-15	8380-27	8380-741
		F	8380-719			
Ø 3	F	M	8380-717	8380-15	8380-27	8380-741
		F	8380-723			
Ø 3	E	M	8380-1365	M317	8380-27	8380-741
		F	8380-1366			
Ø 3	E	M	8380-730	M317	8380-27	8380-741
		F	8380-731			
Ø 5	G	M	8380-728	MECATRACTION PMM1	D5HCU10-50	5106.021.09.50
		F	8380-729		D5HCU10-50	5106.021.06.50
Ø 12	J	M	8380-1020A	MECATRACTION TR461R	MECATRACTION TN50-460	
		F	8380-1021A			
Twinax 105 Ω cable Arrangement / *Layout* 45	-	M	8380-951	pour contact *for contact* M22520/2.01	M22520/2.08	8532-01
		F	8380-950	pour ferrule *for ferrule* M22520/5.01	Y116	
Twinax 120 Ω cable Arrangement / *Layout* 45	U	M	8380-994	pour contact *for contact* M22520/2.01	M22520/2.08	8532-01
		F	8380-995	pour ferrule *for ferrule* M22520/5.01	Y116	
Twinax 120 Ω cable Arrangement / *Layout* 01	S	M	8380-1009	pour contact *for contact* M22520/2.01	M22520/2.08	8532-01
		F	8380-1000 8380-1012	pour ferrule *for ferrule* M22520/5.01	Y116	

838 Series

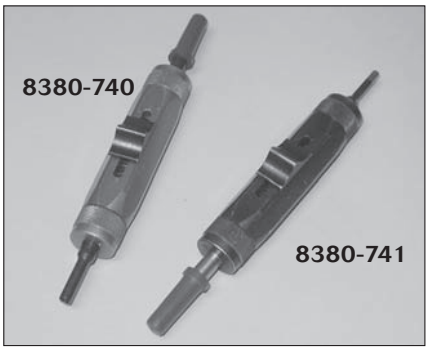
Photographies outillages / *Tools photographies*

Pinces de sertissages avec positionneur / *Crimping tools with locator*



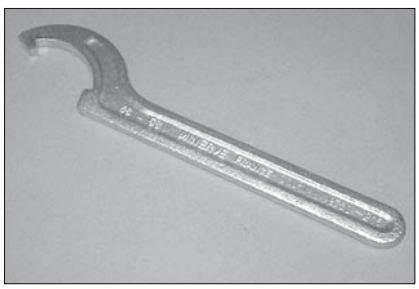


Outils d'extractions / *Extraction tools*



- L'insertion des contacts dans leur cavité ne nécessite aucun outil
  No tool needed for contact insertion.
- L'insertion de l'outil se fait par l'avant et l'extraction du contact par l'arrière de l'insert
  Front remove, rear release.

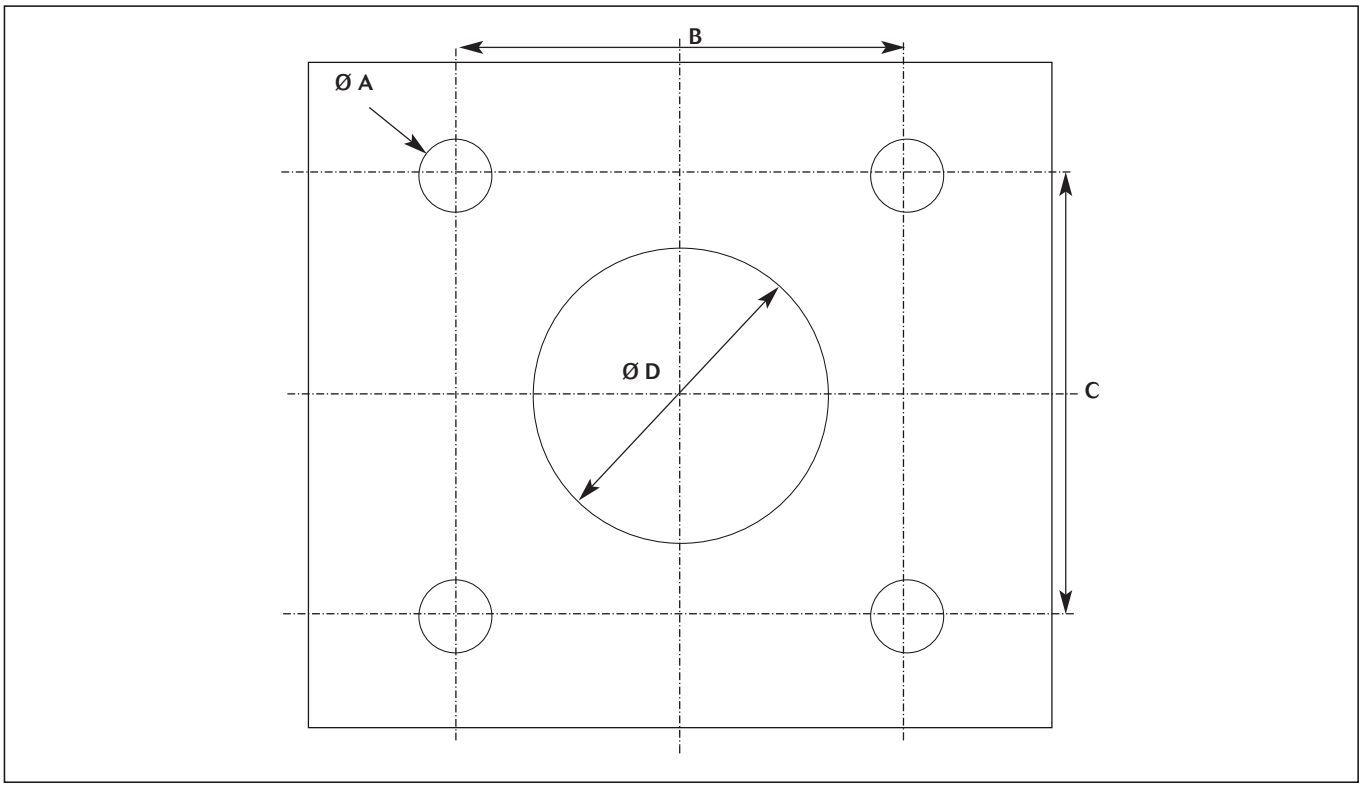
Clé à ergot / *Pin wrench*



Boîtier *Shell*	Clé à ergot *Pin wrench*	Couple de serrage / *Coupling torque* (daN.m)	
		mini	maxi
E	8380-216	0,4	1
C	8380-216	0,6	1,5
J	8380-216	0,6	1,5
B	8380-213	0,7	2

838 Series

Perçage de cloison / *Panel cutout*



Taille / *Size*	E	C	J	B
Ø A	4,3	4,3	6,5	7
B	34	52	64	98
C	34	52	64	86
Ø D	38,5	54	77	88
Ø D*	44,5	60	77	88

* Fixation de l'embase par l'avant de la cloison
Receptacle fixed from front of the panel.

Ces dimensions sont en millimètres.
Dimensions are in millimeters.

838 Series

Notes

8038 Series

Sommaire

	page
• Caractéristiques techniques	28
• Synoptique	29
• Référencement	30
• Arrangement et détrompage	31
• Séries 8011 : contacts et connecteur	32
• Disponibilité 8011	33
• Bretelle optique	34
• Dimensionnement	35
• Contacts	39
• Outillage	40
• Perçage cloison	40
• Mise en œuvre	41
• Famille optique	42
• Index gamme ferroviaire	43

Content

	page
• *Technical features*	*28*
• *Synoptic*	*29*
• *Ordering information*	*30*
• *Layouts and Keying system*	*31*
• *8011 series : contacts and connector*	*32*
• *8011 Availability*	*33*
• *Patchcords*	*34*
• *Dimensioning*	*35*
• *Contacts*	*39*
• *Tools*	*40*
• *Panel cutout*	*40*
• *Fiber termination*	*41*
• *Optical family*	*42*
• *Railways sheet*	*43*

Présentation

Les apports de la fibre optique sont considérables en milieu dit « perturbé » :

- insensibilité aux perturbations électriques des liaisons,
- accroissement du débit des informations transmises,

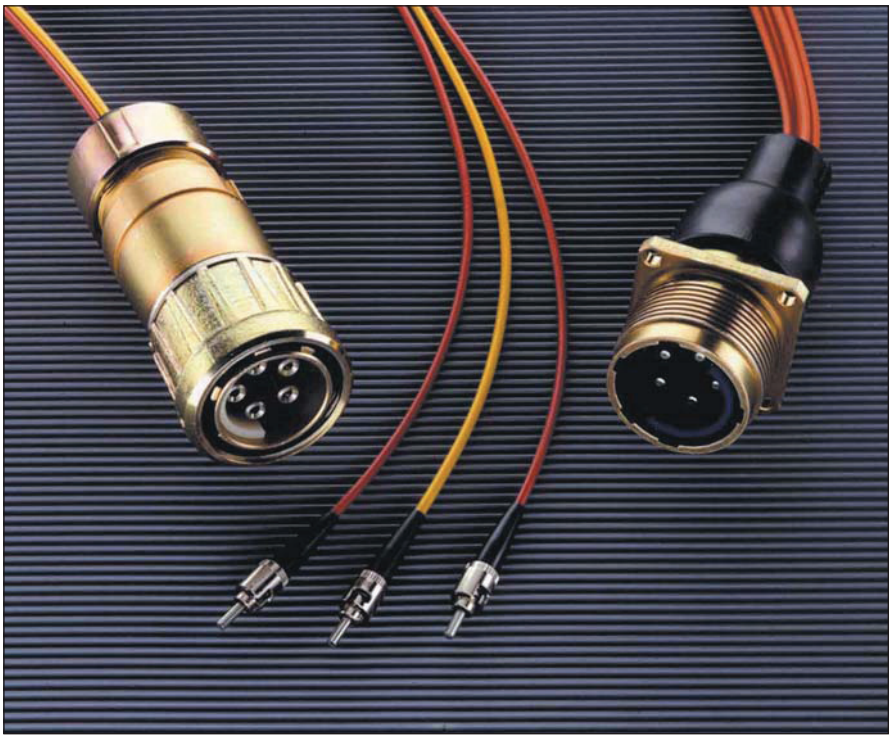
c'est pourquoi la division fibre optique a développé à partir du connecteur 838, un connecteur optique 8038, homologué par ABB (Asea Brown Boveri) en accord avec la norme allemande BN 411 012 et les normes IEC 77 et 571.

Presentation

The optical fiber optics has lot of advantages in disturbe areas:

- *insensitivity to the electric disturbances,*
- *increase in transmitted information flow,*

this is why, fiber optics division has developed the optical connector 8038, based on the 838 series connector, approved by ABB (Asea Brown Boveri) according to the German standard BN 411 012 and the IEC 77 and 571 standards.

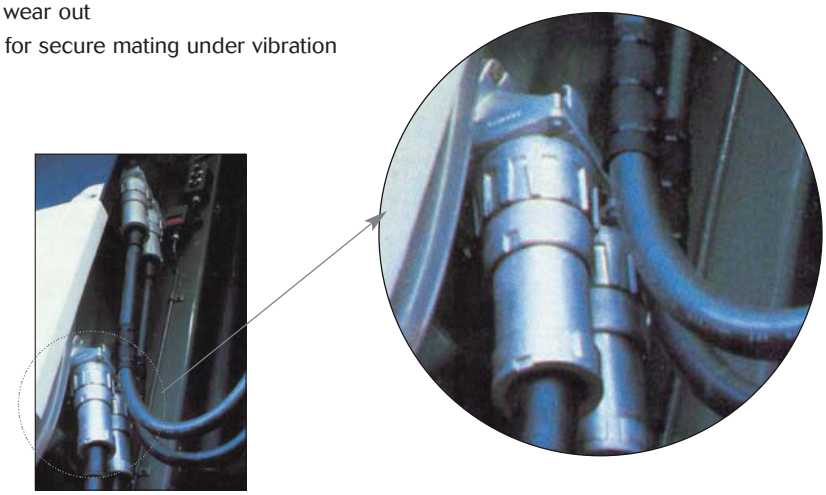


8038 Series

Technical features & benefits

Ruggedized circular connector to matching intercoach environment

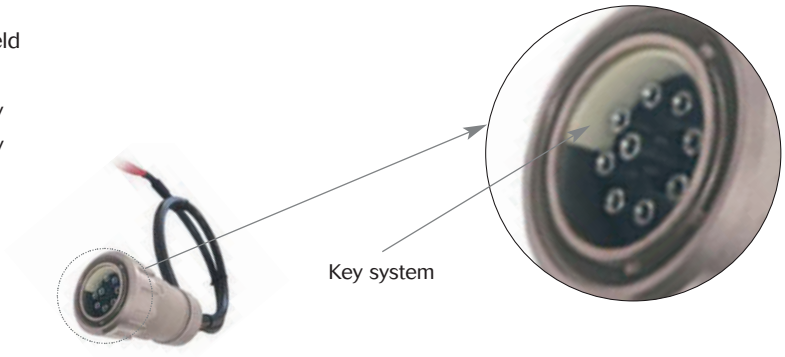
- Enabling 500 mating-unmating without wear out
- Screw coupling with thin square thread for secure mating under vibration
- Traction force withstanding
- 30° panel mounting



Versatile series

- Versatile insert with reverse gender
- Polarization system enabling
- Keying of insert can be done on the field
- Optical contact :

- Electro Magnetic Interference immunity
- Radio Frequency Interference immunity



RoHS compliancy

- Shells plating are cadmium free: Alodine 1200
- Insert are halogen free: PBB & PBDE

8038 Series

Caractéristiques / *Technical features*

Mécaniques

- **Boîtier :** alliage d'aluminium
- **Protection :** alodine (1200)
- **Système de verrouillage :** à vis avec cliquet
- **Isolant :** thermoplastique : polyamide I2-F3 conforme aux spécifications feu-fumée NFF 16101-16102 (exigence 3) pour installations sur matériel catégorie A1 et conforme à UL94-V0
- **Système de codage amovible** offrant 12 possibilités différentes de détrompage à l'opérateur (livré en position 5 pour le boîtier E et 9 pour le boîtier C)
- **Endurance mécanique :** 500 manœuvres (verrouillage + déverrouillage).

Mechanical

- ***Shell:*** *aluminium alloy*
- ***Plating:*** *alodine (1200)*
- ***Locking system:*** *screw with clicker*
- ***Insulator:*** *thermoplastic: polyamide I2-F3 in accordance with NFF 16101-16102 (exigence 3) (fire and smoke emissions) for installations on equipments category A1 UL94-V0*
- ***Removable coding system*** *enable 12 different key orientations to be selected by the operator (delivered in position 5 for the shell and 9 for the shell).*
- ***Endurance:*** *500 mating-unmating cycles.*

Climatiques et environnementales

- **Température d'utilisation :** - thermoplastique : -40°C à +85°C
- **Etanchéité :**
  - A la lance (NFC 20010)
  - IP67
- **Chaleur humide :** 21 jours à +40°C ; 90% d'humidité relative (NFC 20703, sévérité 5)
- **Brouillard salin :** 96 heures (NFC 20711)
- **Chocs :** +/-3g selon IEC 68-2-27
- **Test de vibration :**
  - A = 25/f - 1 Hz < f < 10 Hz
  - A = 250/f - 10 Hz < f < 100 Hz

(Pour d'autres exigences, nous consulter).

Climatic and environmental

- ***Temperature range:*** *- thermoplastic: -40°C to +85°C*
- ***Sealing:***
  - *Jet proof (NFC 20010)*
  - *IP 67*
- ***Damp heat:*** *21 days to +40°C ; 90% relative humidity (NFC 20703, severity 5)*
- ***Salt spray:*** *96 hours (NFC 93422)*
- ***Chocks:*** **:** +/-3g IEC 68-2-27
- ***Vibration test :***
  - *A=25/f - 1 Hz < f < 10 Hz*
  - *A=250/f - 10 Hz < f < 100 Hz*

(For other requirements, consult us)

Electriques

- **Tension de tenue :** 3250 Veff
- **Résistance d'isolement :** ≥ 5000 MΩ sous 500 Vcc
- **Résistance de contact :** ≤ 2 mΩ
- **Tension de service par arrangement :** 380 Veff
- **Intensité admissible par contact :** 30 A pour Ø 3 mm

Electrical

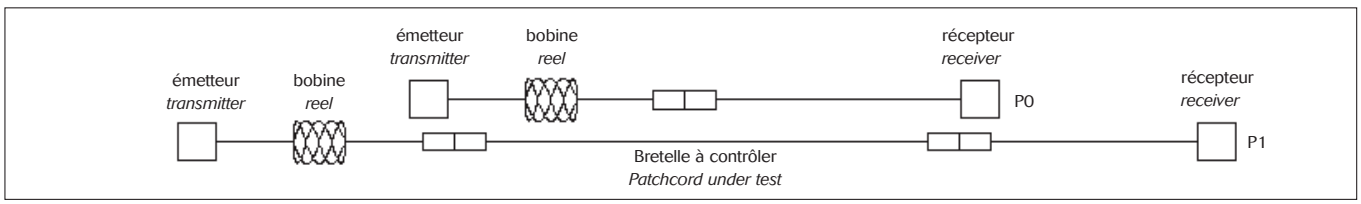
- ***Test voltage:*** *3250 Vrms*
- ***Insulation resistance:*** *≥ 5000 MΩ under 500 Vdc*
- ***Contact resistance:*** *≤ 2 mΩ*
- ***Maximum voltage per layouts:*** *380 Vrms*
- ***Maximum rating per contact:*** *30 A for Ø 3 mm*

Optiques

La 8038 utilise des contacts optiques de type 8011.

Optical

8038 use 8011 optical contacts



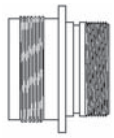
- **Atténuation :** méthode normalisée (IEC 874.1 § 27,1 méthode 6) =10 log (P1/P0).
- **Pertes d'insertion :**
  - 0,4 dB par voie avec fibre HCS 62,5 /125 et l = 820 nm
  - 0,7 dB par voie avec fibre HCS 200 /230 et l = 820 nm
  - 1,2 dB par voie avec fibre plastique 1 mm et l = 670 nm

- ***Attenuation :*** *standard test method (IEC 874.1 § 27,1 method 6) = 10 log (P1/P0).*
- ***Insertion lost :***
  - *< 0,4 dB / way with fiber 62,5 /125 HCS and l = 820 nm*
  - *< 0,7 dB / way with fiber 200 /230 HCS and l = 820 nm*
  - *< 1,2 dB / way with plastic fiber 1 mm and l = 670 nm.*

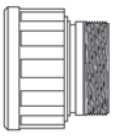
8038 Series

Boîtier E / *Shell E*

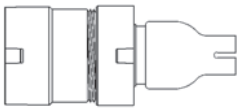
Type A :
embase sans raccord
receptacle without backshell



Type B :
fiche sans raccord
plug without backshell

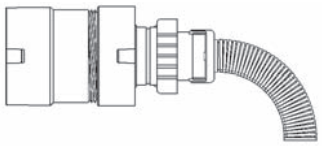


Type C



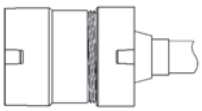
Raccord sortie libre
Backshell for single outlet

Type D



Raccord avec PMA
Backshell with PMA

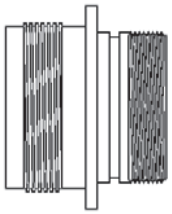
Type E



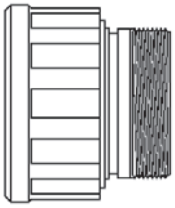
Raccord câble constitué
Backshell for multiway cable assembly

Boîtier C / *Shell C*

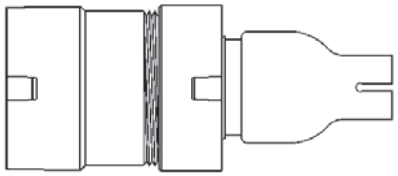
Type A :
embase sans raccord
receptacle without backshell



Type B :
fiche sans raccord
plug without backshell

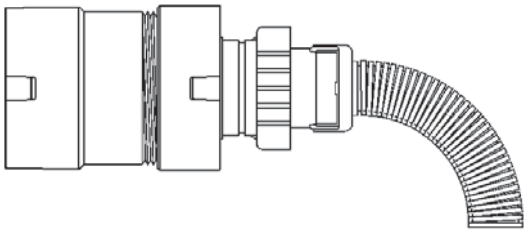


Type C



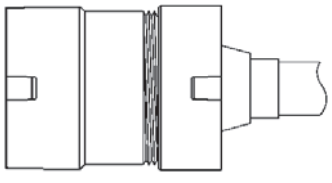
Raccord sortie libre
Backshell for single outlet

Type D



Raccord avec PMA
Backshell with PMA

Type E



Raccord câble constitué
Backshell for multiway cable assembly

8038 Series

Système de référence / *Cross-reference list*

Boîtier E / *Shell size E*	
Désignation / *Designation*	**SOURIAU**
Embase avec tétine / *Plug with boot*	8038-0006
Fiche avec raccord de sortie libre / *Plug with single cable outlet backshell*	8038-0005
Fiche avec raccord pou tube PMA / *Plug with PMA backshell*	8038-0015
Fiche avec raccord pour câble constitué / *Plug with multiway cable assembly backshell*	8038-0018
Embase de repos / *Dummy stowage receptacle*	8038-0133
Raccord coudé 30° / *30° angle support*	8038-0146
Bouchon d'embase / *Protective cap for receptacle*	8038-0141A

Boîtier C / *Shell size C*	
Désignation / *Designation*	**SOURIAU**
Embase avec tétine / *Plug with boot*	8038-0002
Fiche avec raccord de sortie libre / *Plug with single cable outlet backshell*	8038-0003
Fiche avec raccord pou tube / *PMA Plug with PMA backshell*	8038-0019
Fiche avec raccord pour câble constitué / *Plug with multiway cable assembly backshell*	8038-0017
Embase de repos / *Dummy stowage receptacle*	8038-0131
Raccord coudé 30° / *30° angle support*	8038-0145
Bouchon d'embase / *Protective cap for receptacle*	8038-0140

Système d'obturation / *Sealing system*	
Désignation / *Designation*	**SOURIAU**
Sous-ensemble - Obturateur de fiche / *Filler plug for 8038 plug* - **1**	8038-0127
Sous-ensemble - Obturateur d'embase / *Filler plug for 8038 receptacle* - **2**	8038-0126
Obturateur de raccord - Arrière boîtier C / *Filler plug for C backshell* - **3**	8380-2960LM
Obturateur de raccord - Arrière boîtier E / *Filler plug for E backshell* - **4**	8038-0161NZ

Obturateur de fiche **- 1**
Filler receptacle

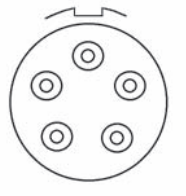
Obturateur d'embase **- 2**
Filler plug

Obturateur de raccord **- 3/4**
Filler backshell

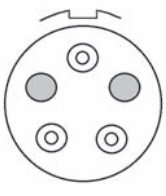
8038 Series

Arrangements / *Layouts*

Boîtier E / *Shell size E*

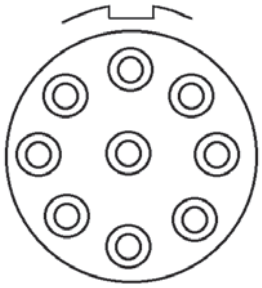


5 contacts optiques
5 optical contacts



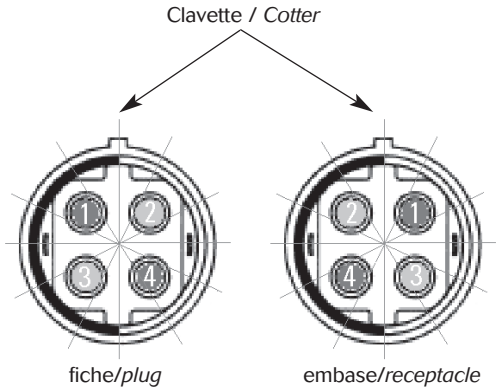
3 contacts optiques + 2 électriques
3 optical contacts + 2 electrical

Boîtier C / *Shell size C*

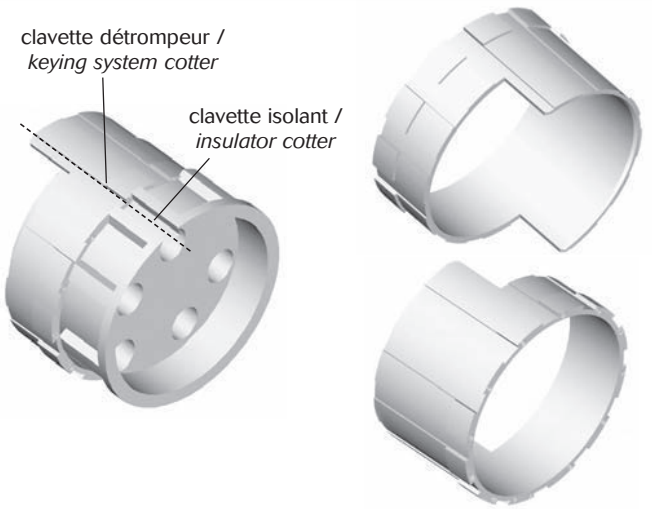


9 contacts optiques
9 optical contacts

Détrompage / *Keying system*



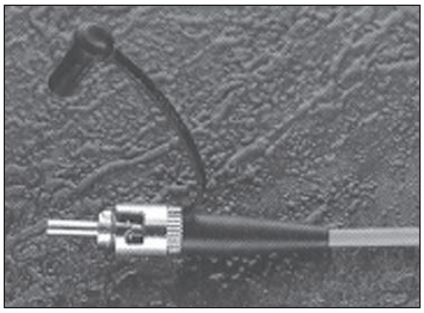
Exemple de détrompage
Keying system



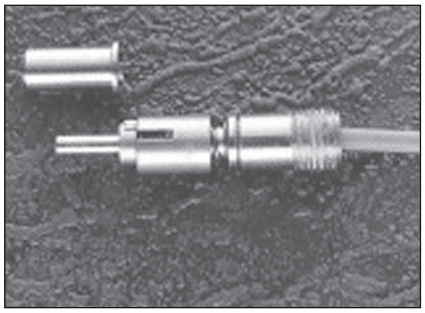
8038 Series

Séries 8011 : contacts et connecteurs / *8011 series : contacts and connectors*

Connecteur optique 8011 compatible ST
Optical connector 8011 (ST compatible)



Connecteur optique 8011 de fiche
Optical connector 8011 for plug



Connecteur optique 8011 d'embase
Optical connector 8011 for receptacle

Système de référence : contact et connecteur 8011
Ordering system : 8011 contacts and connector

Famille / *Basic series*	**8011**	**xx**	**x**	**x**	**xx**
15 Connecteur / *Plug*					
55 Contact d'embase / *Contact for receptacle*					
56 Contact de fiche / *Contact for plug*					
Fibre / *Fiber*					
R 200 / 230 µm					
G 50 / 125 µm - 62,5 / 125 µm					
H 100 / 140 µm					
I 500 µm fibre plastique / *Plastic fiber*					
J 1000 µm fibre plastique / *Plastic fiber*					
Autres fibres, nous consulter / *Other fibers, on request*					
Code de modification / *Modification index*					
0 Version sertissage - fracture pour réparation sur site *Crimping - cleaving version for field repair*					
1 Version standard collage - polissage *Glueing - polishing standard version*					
27 Câble / *cable* Ø 2,8 mm					
63 Câble / *cable* Ø 2,6 mm					
62 Câble / *cable* Ø 2,2 mm					
52 Câble / *cable* Ø 1 mm					

8038 Series

Références disponibles / *Available part numbers*

Designation / *Designation*		Références complètes / *Complete part numbers*										
		8011 12G163D	8011 12G180D	8011 72G163D	8011 15H163D	8011 15R063D	8011 15R163D	8011 75R163D	8011 15J062D	8011 22Z01D	8011 22Z01C	8011 0076
Fiche ***Plug***	ST	●	●		●	●	●		●			
	ST II			●				●				
Fibre ***Fiber***	50/125 µm + 62,5/125 µm	●	●	●								
	100/140 µm				●							
	200/230 µm					●	●	●				
	Plastique 1 mm *Plastic 1 mm*								●			
Raccordement ***Termination***	Sertissage / clivage *Crimping / cleaving*					●						
	Sertissage / polissage *Crimping / polishing*								●			
	Collage / polissage *Gluing / polishing*	●	●	●	●		●	●				
Câble ***Cable***	Câble 2,2 mm *Cable 2,2 mm*								●			
	Câble 2,4 à 3 mm *Cable 2,4 to 3 mm*	●		●	●	●	●	●				
Accessoires ***Accessories***	Bouchon de protection *Protection cap*											●
	Réducteur câble 1,1 mm *Hole adaptor cable 1,1 mm*		●									
	Réducteur câble 1,6 mm *Hole adaptor cable 1,6 mm*		●									
Matériaux ***Material***	Embout métallique *Metallic ferule*				●	●	●	●	●			
	Embout céramique *Ceramic ferule*	●	●	●								
	Centreur métallique *Metallic sleeve*									●	●	
Raccord ***Adaptor***	Raccord *Thru-bulkhead adaptator*									●	●	
Emballage ***Packaging***	Emballage par 10 *10 pieces packaging*	●	●	●	●	●	●	●	●	●		●
	Emballage par 100 *100 pieces packaging*										●	

Ferrule de rétention / *Retention ferule :* **8038-0124NZ**

8038 Series

Bretelles optiques

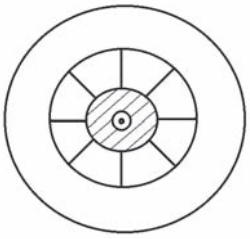
SOURIAU fournit des cordons équipés de connecteurs ou contacts optiques 8011 répondant aux spécifications de l'utilisateur.

Patchcords

SOURIAU provides jumpers and patchcords equipped with 8011 series connectors and optical contacts. Production acc. to customer specification on request.

Structure des câbles optiques

Cable optical structure



Fibre / Fiber HCS 200/230/500 - Ø 100/140/500 µm

Kevlar 491580 Dtex Ø 1,20 mm

Gaine Zéro halogène, faible émission de fumée Ø 2,6 mm
Halogenfree jacket, Ø 2,6 mm

Système de référence : Bretelles optiques
• Réf ABB câble monovoie : HESN 454 384 XXXX
• Réf ABB câble duplex : HESN 454 392 XXXX

***Ordering system** : Patchcords*
• P/N ABB jumper : HESN 454 384 XXXX
• P/N ABB duplex jumper : HESN 454 392 XXXX

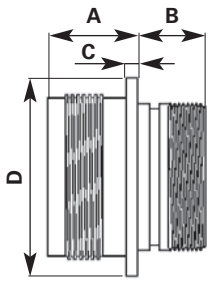
Famille / *Basic series*	8011	90	R	2	XX	X
90 bretelle monovoie / *jumper* **91** bemi-bretelle monovoie / *pigtail* **92** bretelle duplex / *duplex jumper* **93** bemi-bretelle duplex / *duplex pigtail*						
Fibre / *Fiber* **G** 50 / 125 µm - 62,5 / 125 µm **H** 100 / 140 µm **J** 1000 µm fibre plastique / *Plastic fiber* **R** 200 / 230 µm HCS Autres fibres, nous consulter / *Other fibers, on request*						
2 bretelle équipée de 8011-15-R-163 / *jumper with two plugs* **5** bretelle d'embase 8038-8011-5-R-163 / *jumper with optical contact for 8038* **6** bretelle de fiche 8038-8011-5-R-163 / *jumper with optical contact for 8038 plug*						
Longueur bretelle nous consulter / *Jumper length on request*						
Câble / *Cable* **A** Orange H & S / *jumper length : on request* **S** Orange Métallurgie Bresciance zéro halogène / *Métallurgie Bresciance cable-halogen free jacket* **D** Orange Duplex (jaune et orange) H & S / *H & S Orange Duplex cable (yellow and orange)* Autres câbles, nous consulter / *Other cables, on request*						

8038 Series

Dimensions / *Dimensions*

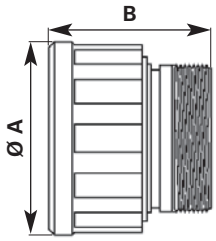
Type A
Embase sans raccord / *Receptacle without backshell*

Taille/*Size*	E	C
A	31	31
B	25	24
C	4	4
D	42	70



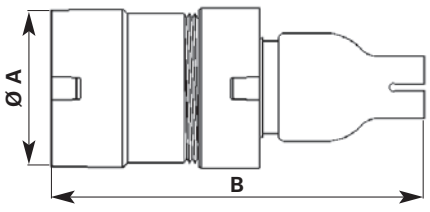
Type B
Fiche sans raccord / *Plug without backshell*

Taille/*Size*	E	C
Ø A	43	68
B	58	57



Type C
Raccord sortie libre / *Backshell for single cable outlet*

Taille/*Size*	E	C
Ø A	40	59
B	82	148



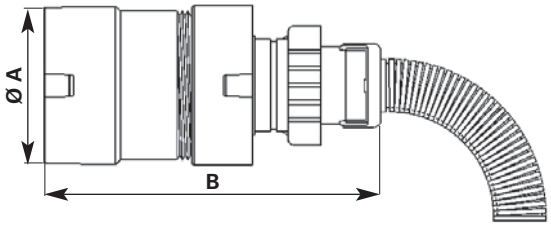
Note : Ces dimensions ne sont pas contractuelles et peuvent être modifiées / Ces dimensions sont en millimètres.
Dimensions are not contractual and may be subject to change / Dimensions are in millimeters.

8038 Series

Dimensions / *Dimensions*

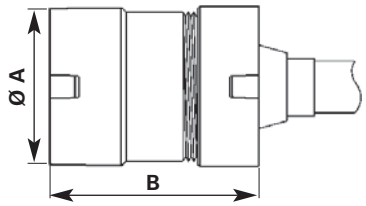
Type D
Raccord avec PMA / *Backshell with PMA*

Taille/*Size*	E	C
Ø A	40	59
B	124	126



Type E
Raccord pour câble constitué / *Backshell for multiway cable assembly*

Taille/*Size*	E	C
Ø A	40	59
B	82	89



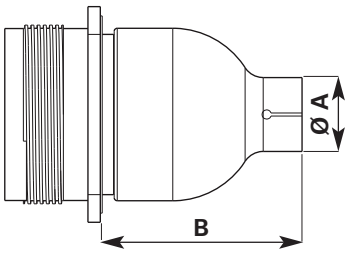
Note : Ces dimensions ne sont pas contractuelles et peuvent être modifiées / Ces dimensions sont en millimètres.
Dimensions are not contractual and may be subject to change / Dimensions are in millimeters.

8038 Series

Dimensions / *Dimensions*

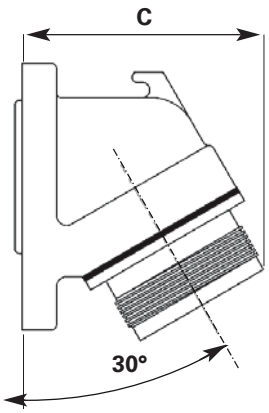
Coiffe / *Boot shell*

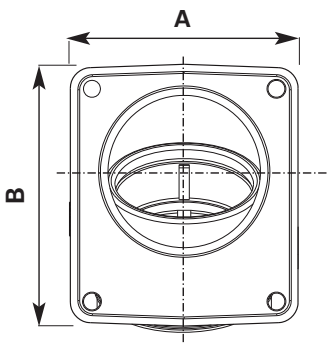
Taille/*Size*	E	C
Ø A	21,3	24
B	62	62

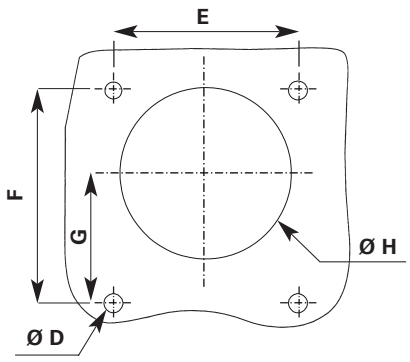


Raccord coudé / *Elbow backshell*

Taille/*Size*	E	C
A	53	71
B	95	109
C	77	95
Ø D	4,3	4,3
E	34	52
F	72	87
G	45	51
Ø H	39,5	54,5







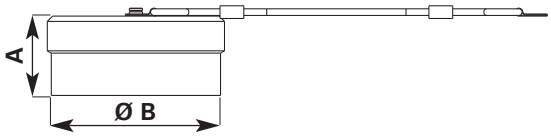
Note : Ces dimensions ne sont pas contractuelles et peuvent être modifiées / Ces dimensions sont en millimètres.
Dimensions are not contractual and may be subject to change / Dimensions are in millimeters.

8038 Series

Dimensions accessoires / *Accessories dimensions*

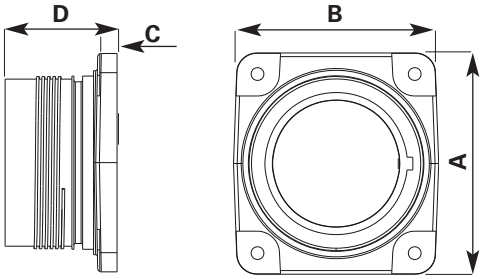
Bouchon d'embase / *Cap for receptacle*

Taille/*Size*	E	C
A	35	33
Ø B	45	68
Reference	**8038-0141A**	**8038-0140**



Embase de repos / *Dummy receptacle*

Taille/*Size*	E	C
A	42	70
B	42	70
C	4	4
D	31	31



Note : Ces dimensions ne sont pas contractuelles et peuvent être modifiées / Ces dimensions sont en millimètres.
Dimensions are not contractual and may be subject to change / Dimensions are in millimeters.

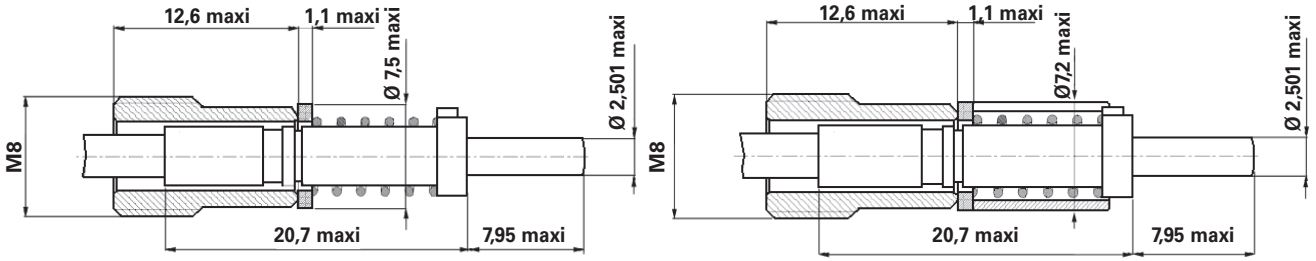
8038 Series

Contacts / *Contacts*

Contact électrique / *Electrical contact*

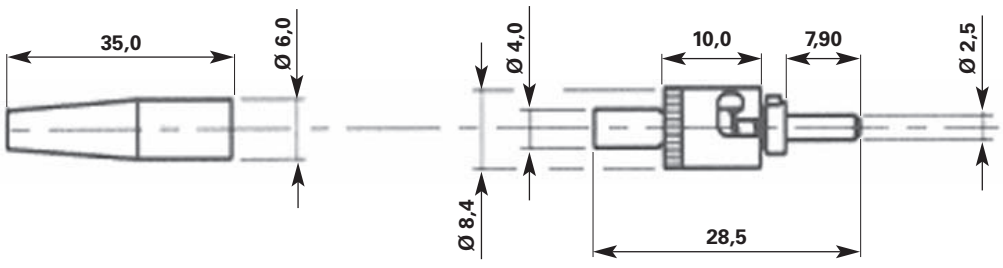
Ø partie active *Active part Ø* (mm)	Type de contact *Contact type*	Mâle ou femelle *Female or male*	Référence unitaire *Unit reference*	Protection *Plating*	Section de câble / *Cable size*	
					mini (mm²)	maxi (mm²)
Ø 3	F	M	8380-716	argenté passivé *passivated silver*	1,34	2,61
		F	8380-719			
Ø 3	F	M	8380-717	doré *gold*	1,34	2,61
		F	8380-723			
Ø 3	E	M	8380-1365	argenté passivé *passivated silver*	4	4,78
		F	8380-1366			
Ø 3	E	M	8380-730	doré / *gold*	4	4,78
		F	8380-731			

Contact optique / *Optical contact*



Connecteur / *Connector*

8011 ST

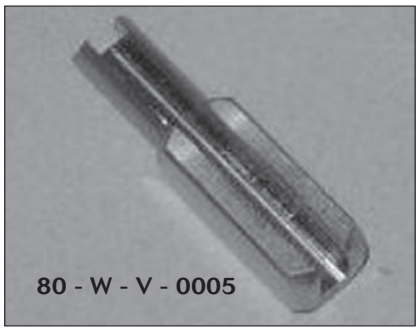


Dimensions en millimètres - *Dimensions are millimeters*

8038 Series

Outillage spécifique / *Specific tools*

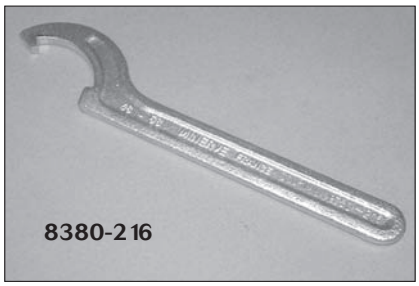
Outils de serrage des contacts 8011 / *Screw driver for 8011 contacts*



Nous nous réservons le droit d'apporter à nos matériels toutes modifications que nous jugerions utiles dans un but d'amélioration. Les cotes portées dans nos catalogues sont donc susceptibles de subir de légères variations. Nous donnerons sur demande toutes cotes de détail nécessaires.

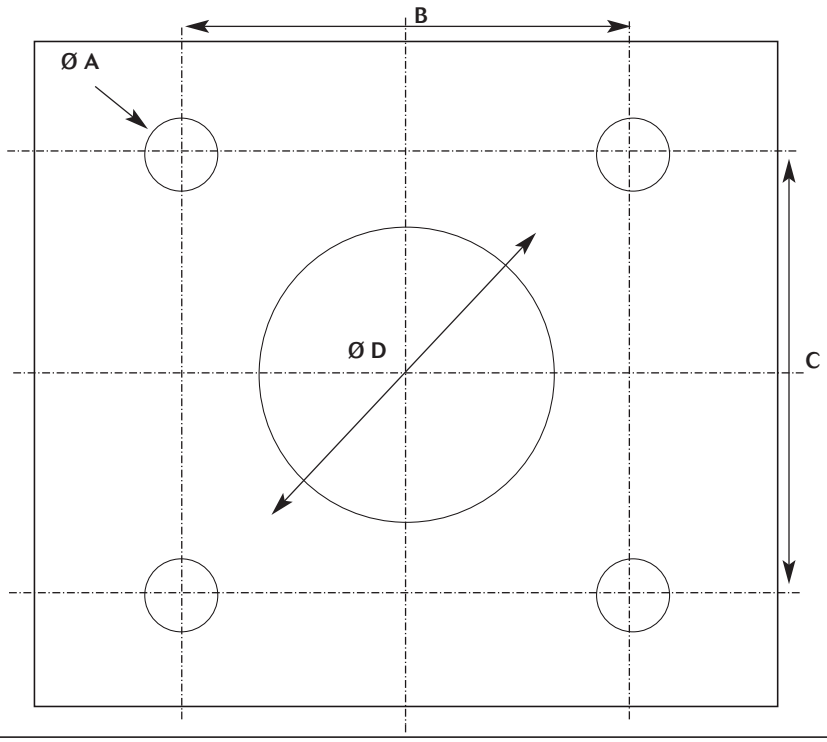
Souriau reserves the right to make any engineering refinements, alterations or improvements deemed necessary on its products. The dimensions appearing in this catalogue are thus subject to change without notice. When dimensions are critical detailed drawings should be requested.

Clé à ergot / *Pin wrench*



Boîtier *Shell*	Clé à ergot *Pin wrench*	Couple de serrage / *Coupling torque* (daN.m)	
		mini	maxi
E	8380-216	0,4	1
C	8380-216	0,6	1,5
B	8380-213	0,7	2

Perçage de cloison / *Panel cutout*



Taille / *Size*	E	C
Ø A	4,3	4,3
B	34	52
C	34	52
Ø D	38,5	54
Ø D*	44,5	60

* Fixation de l'embase par l'avant de la cloison
Receptacle fixed from front of the panel

Dimensions en millimètres - *Dimensions are millimeters*

8038 Series

Mise en œuvre

• **Technologie :**
- collage / polissage pour fibre de type G, H, R
- sertissage / clivage pour fibre type R (field cabling).

• **Valise de mise en œuvre : P/N: 80-MG0011**
Cette valise comprend les outillages nécessaire à la mise en œuvre des fiches de type ST* pour la technique de collage / polissage (pince à sertir ou à dénuder, …).

• **Valise de mise en œuvre : P/N: 80-MF0002**
Cette valise comprend les outillages nécessaire à la mise en œuvre des fiches de type ST* pour la technique de sertissage / clivage, surtout utilisé sur le terrain.

• **Valise de mise en œuvre : P/N: 80-MS0003**
Cette valise comprend les outillages nécessaire à la mise en œuvre des fiches de type ST* avec fibres plastiques, tel que:
- pince à dénuder,
- pince à sertir,
- outil de polissage.

• **Certaines options sont disponibles séparément pour les valise de mise en œuvre 80-MG0011 et 80-MS0003**
- microscope / haut grossissement
  - (*200) P/N : 80-WL0007
  - (*400) P/N : 80-WL0001

- adaptateur pour microscope : P/N: 80-WL0002

• **Kit des consommables : P/N: 80-KG0009**
Le kit de consommables comprend tout le matériel nécessaire pour la mise en œuvre des fiches :
- disques à polir
- colle
- seringues + aiguilles
- éthanol
- bombe à air sec.

• **Kit de nettoyage: P/N: 80-KN0002**
Le kit de nettoyage comprend tout le matériel nécessaire au nettoyage des fiches, coupleurs, l'emballage extérieur, tel que :
- spray nettoyant écologique
- bombe à air sec
- éthanol
- pointe papier
- papier Joseph.

Fiber termination

• ***Technology*:**
- *gluing / polishing for fiber type G, H, R*
- *crimping / cleaving for fiber type R (field cabling).*

• ***Tool kit: P/N: 80-MG0011***
The tool kit contains all necessary tools to terminates ST plugs in gluing / polishing technic (stripping tools for cable and fiber, crimping tool, …).*

• ***Tool kit: P/N: 80-MF0002***
The tool kit contains all necessary tools required to terminate ST plug in crimping / cleaving technic, particularly used in case of field cabling.*

• ***Tool kit: P/N: 80-MS0003***
The tool kit contains all necessary tools to terminates ST plugs in plastic fiber, such as:*
- *stripping plier*
- *crimping tool*
- *polishing tool.*

• ***Option can be ordered separately for tool kits 80-MG0011 and 80-MS0003***
- *microscope / high magnification*
  - *(*200) P/N: 80-WL0007*
  - *(*400) P/N: 80-WL0001*

- *ST* adaptor for microscope : P/N: 80-WL0002*

• ***Consumable: P/N: 80-KG0009***
The consumable kit contains all necessary materials to terminate about so plugs such as:
- *polishing disks*
- *glue*
- *syringes and needles*
- *ethanol*
- *dry air canned.*

• ***Cleaning kit: P/N: 80-KN0002***
The cleaning kit contains all necessary items to clean either plugs, couplers or device housings, such as:
- *ecological cleaning spray*
- *dry air canned*
- *ethanol*
- *paper sticks*
- *cleaning paper.*

8038 Series

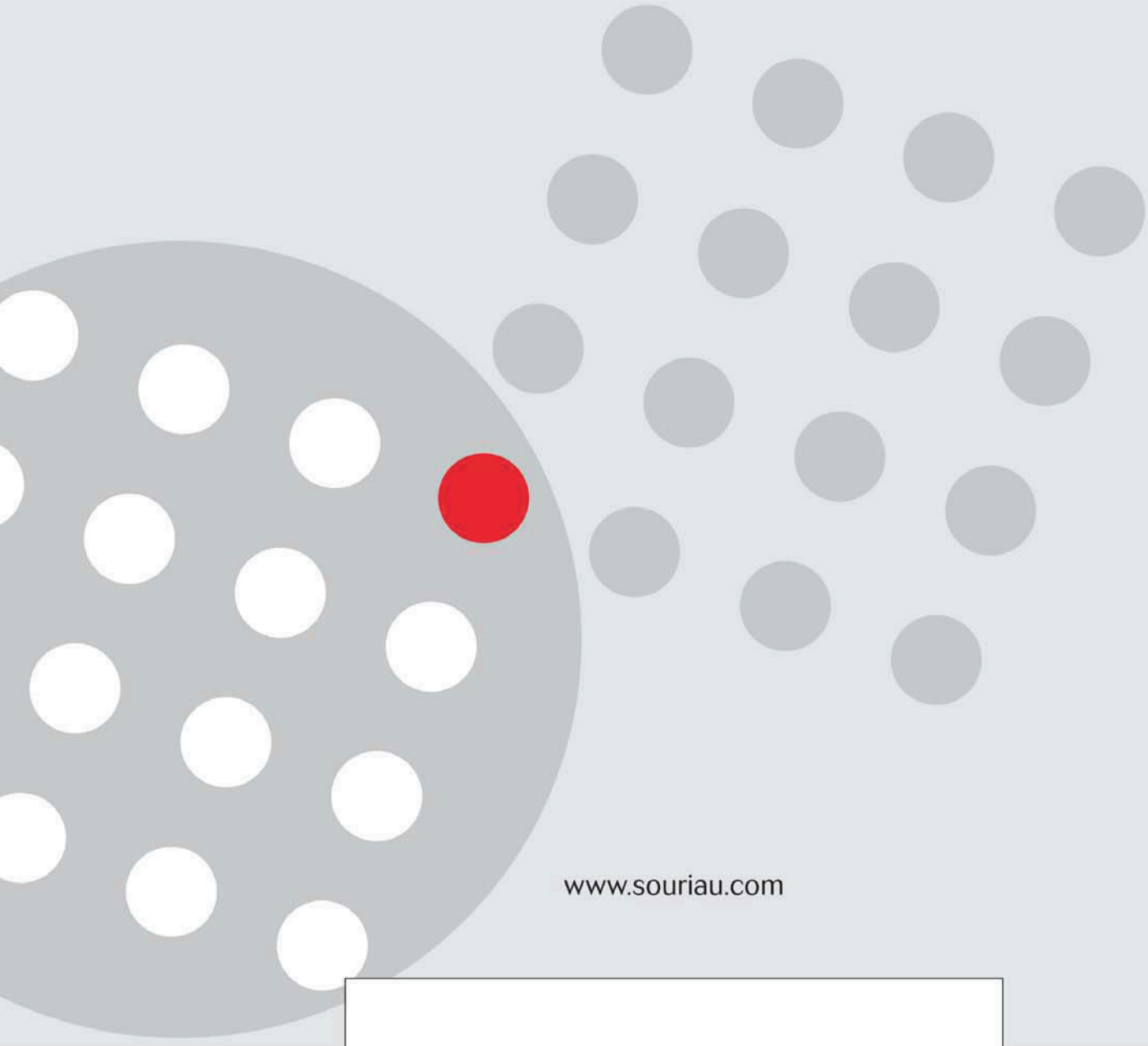
Famille optique
Optical family

Produits standards optiques / ***Optic standard products***	**Désignation** ***Designation***
Séries PER 1 ***PER 1 series***	Connecteur 6 voies compatible ST II, utilisations intérieures *6 ways connector compatible with ST II for interior applications*
Séries 8038 ***8038 series***	Connecteur 5 ou 9 voies, utilisations ferroviaires *5 or 9 ways connector for railways applications*
Série HYB 1 ***HYB 1 series***	Connecteur mixte, utilisations extérieures *Mixed connector for exterior applications*
Série GEO 1 ***GEO 1 series***	Connecteur 2 voies à faisceaux expansés, environnements sévères *2 ways connector with expanded beams for harsh environments*
Série 8005 SMA ***8005 SMA series***	Environnement industriel, applications militaires, aéronautiques *Industrial environment, applications aeronautical, military*
Séries 8011 ***8011 series***	Compatible ST et ST II, environnement industriel *Compatible ST and ST I, industial environment*
Série 8012 SUB-D ***8012 series SUB-D***	Connecteur de carte multi voies, utilisation dans alvéoles coaxiales *Multiways rackable connector, to be fit in coaxial cavities*
Série 8012 DIN 41612 ***8012 series DIN 41612***	Connecteur de carte, utilisation dans alvéoles coaxiales *Rackable connector, to be fit in coaxial cavities*
Série 8012 38999 ***8012 38999 series***	Contacts pour connecteur multi voies 38999 *Contacts for 38999 multiways connector*
Série 8012 TRIM-TRIO ***8012 TRIM-TRIO series***	Contacts pour connecteur multi voies TRIM-TRIO *Contacts for TRIM-TRIO multiways connector*
Série 8012 embases actives et pig tails ***8012 series active and pig tailled receptacle***	Compatible DIN 42612, SUB-D,SMA et ST II pour composants boîtier TO 18 *Compatible DIN 42612, SUB-D,SMA and ST II for shell components TO 18*
Kit fibre optique ***Optical fiber kit***	Outils de câblage *Tool kit*
Series ELIO ***ELIO series***	Contact fibre optique dernière génération *Fiber optic contact last generation*

838/8038 Series

Autres gammes pour les applications ferroviaires
Other product lines for the railways market

	Matériel roulant / *Rolling Stock Equipments*			Signalisation *Signaling*	Systèmes d'information des passagers *Passenger information systems*
	Inter-caisse *Intercoach*	Sous-caisse *Undercoach*	Equipements *On board equipments*		
DSub series			X	X	X
Elio® Fiber optics			X	X	X
FY series		X	X		
Junction connectors				X	
Metro series	X	X			
MSH / MPH	X	X			
SN 2581 series	X	X			
TP series	X	X			
Trim-Trio (circular)			X	X	X
Trim-Trio (MSM, SMS)			X	X	X
Trim-Trio (MSG, MB52)			X	X	X
Trim-Trio specials fitered/shielding			X		
VGE1 series (5015 derivated)		X	X		
8ST / 8D (MIL-DTL-38999)		X	X		
8038 series	X	X			
8525 (MIL-DTL-26482 SII)		X	X		
838 series	X	X			



www.souriau.com

SOURIAU
Connection Technology

FSOURIAU838/80380305FE

Americas
Tel. : 1 (717) 767 67 05

Europe
Tel. : 33 1 30 84 77 99

Japon
Tel. : (81) 442 101 147

Asia/Pacific
Tel. : 33 1 30 84 77 99

COMPAGNIE DEUTSCH®

Division Connecteurs Industriels

Gammes / Series CMC-CMB-CPP

- Verrouillage à vis ou à baïonnette / *Screw or bayonet locking*
- Connecteur de signal ou de puissance / *Signal or power connector*
- Continuité de blindage / *Shielding EMI - RFI*
- Environnement sévère / *Severe environment*

Présentation
Presentation

Les gammes CMC/CMB/CPP sont appréciées par un grand nombre d'utilisateurs en milieux ferroviaire et industriel sévères. La sécurité d'accouplement et de verrouillage, la fiabilité des contacts, la bonne tenue aux vibrations et à la corrosion, l'exigence feu-fumée, le faible entretien, la longévité sont les performances atteintes et maîtrisées par ces connecteurs.

Ces familles de produits ont été conçues pour différentes applications :

- Les applications standard
  CMC de signal en aluminium (96 h BS)
- Les applications spécifiques
  Fibre optique, cellules coax/twinax, reprise et continuité de blindage
- Les applications de puissance
  Produits CPP intégrant des blocs isolants et contacts de puissance
- Les environnements extrêmes
  Produits CMB bronze - 500 h BS et au-delà

Les séries bronze CMB acceptent tous les arrangements des isolants et contacts des CMC/CPP, et respectent les mêmes encombrements.

Chaque ligne de produits propose un verrouillage à vis ou à baïonnette.

The CMC/CMB/CPP series are recognised by many users as suitable for severe railway and industrial environments. With secure coupling and locking, the reliability of contacts. Meeting vibration, corrosion resistance and low smoke specifications, along with low maintenance and durability, these performances are all achieved by these connectors.

The series has been developed for use in :

- *Standard applications*
  Signal aluminium CMC (96 hours salt spray)
- *Specific applications*
  Fiber optic, coax/twinax contacts, shielding continuity maintained
- *Power applications*
  CPP products use the CMC shell for power contacts and inserts
- *Extreme environments*
  CMB bronze products - 500 hours salt spray and over

The CMB bronze series can be adapted to every CMC/CPP insert and contact configuration and uses the same dimensions.

Each product lines permits a screw or bayonet locking.

CMC twinax

CMC à visser / *Screw CMC*

CMC à baïonnette / *Bayonet CMC*

CPP

Sommaire
Table of contents

Sommaire

Présentation

CMC - Standard 96 h BS
Vue isométrique 4
Caractéristiques 5
Système de référence 6
Synoptique 7
Arrangements 8-9
Contacts 10
Optique 11

CMC - Coax & Twinax 96 h BS
Système de référence 12
Synoptique 12
Arrangements 13
Cellules 13

CMC - Continuité de blindage 96 h BS
Système de référence 14
Synoptique 14
Principe de reprise de blindage 15

CMB 500 h BS et au-delà
Système de référence 16
Synoptique 17

CPP
Système de référence & arrangements 18
Contacts et outillages 19

CMC/CMB/CPP
Encombrements 20-21
Perçage 22
Passage de câble 23
Accessoires 24-25

Table of contents

Presentation

CMC *- Standard* *96 h BS*
Scheme 4
Characteristics 5
Part numbering system 6
Styles 7
Configurations 8-9
Contacts 10
Optical contacts 11

CMC *- Coax & Twinax* *96 h BS*
Part numbering system 12
Styles 12
Configurations 13
Coax or Twinax contacts 13

CMC *- Shielding* *96 h BS*
Part numbering system 14
Styles 14
Shield attachment 15

CMB *500 h BS and over*
Part numbering system 16
Styles 17

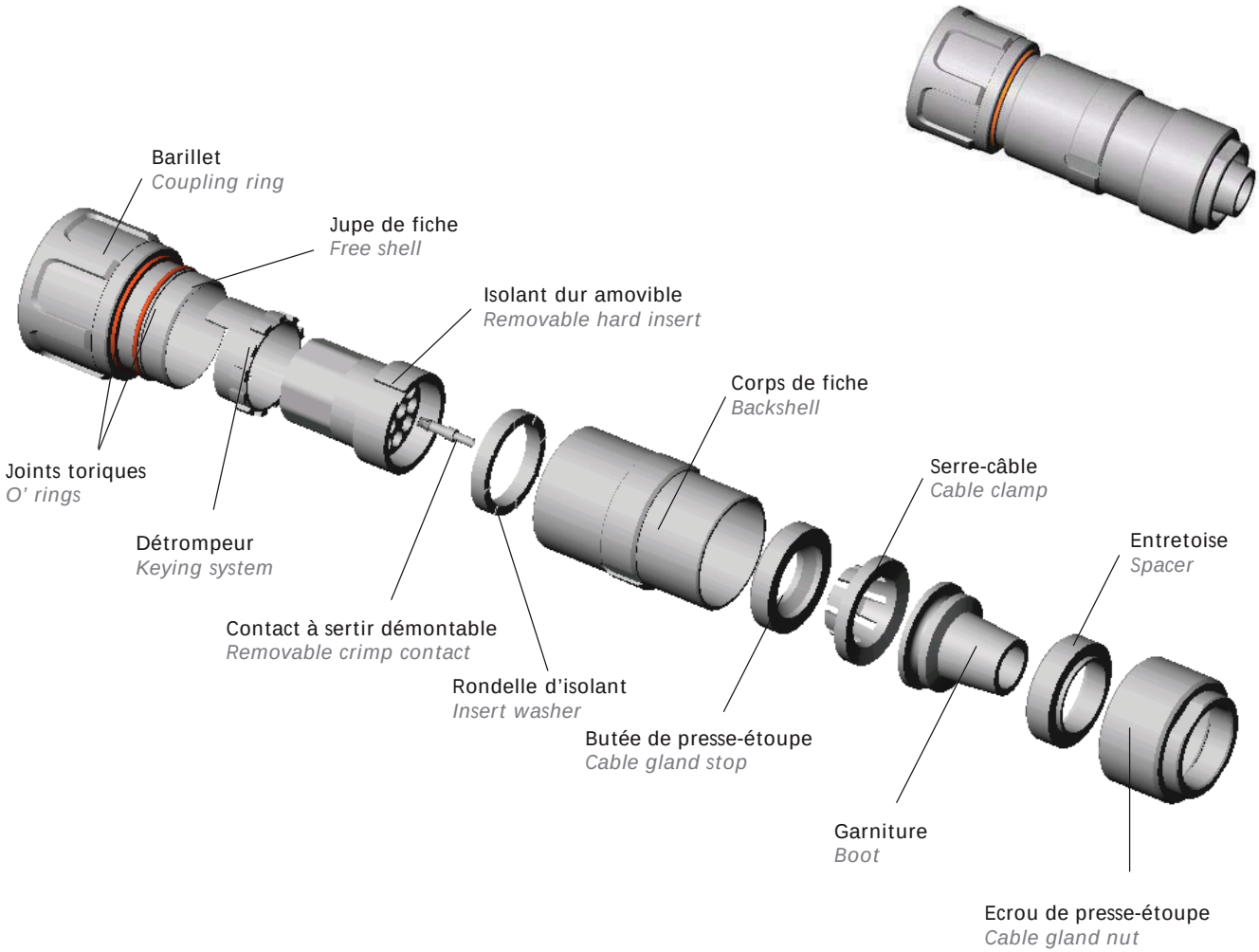
CPP
Part numbering system & config. 18
Contacts and tools 19

CMC/CMB/CPP
Dimensions 20-21
Cut out 22
Cable dimensions 23
Accessories 24-25

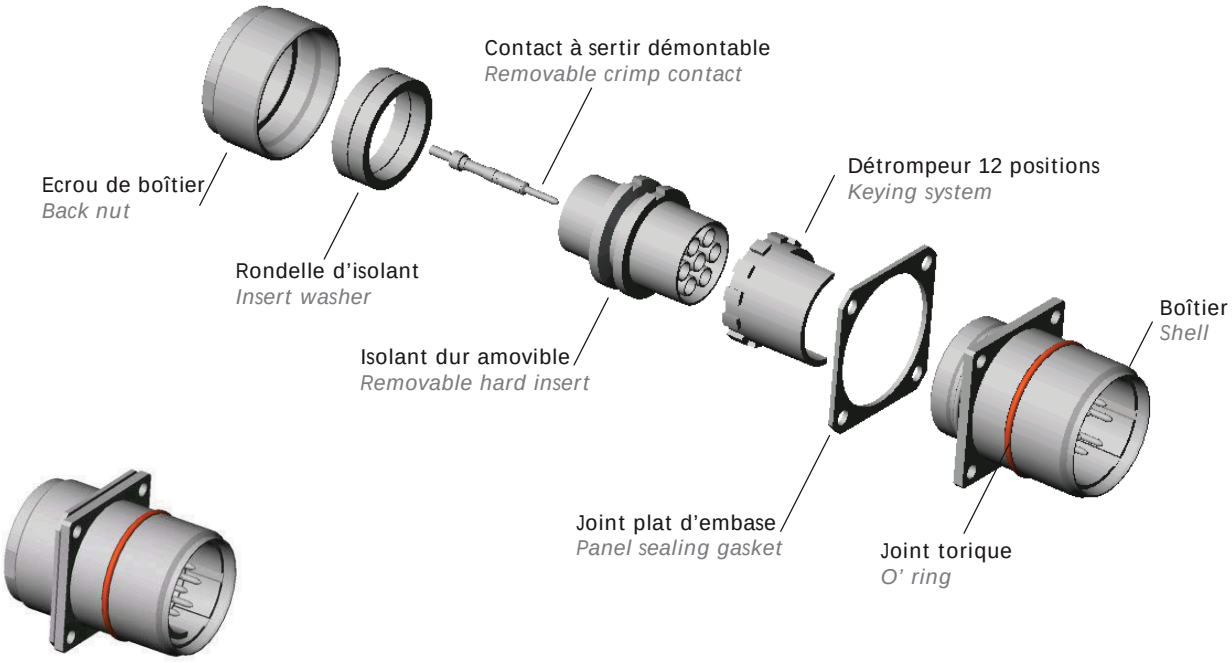
Standard
96 h brouillard salin / *96 h salt spray*

CMC

Fiche avec raccord droit étanche / *Plug with environmental straight backshell*



Embase semi-encastrée avec écrou arrière / *Semi-recessed receptacle with back nut*



CMC

Standard
96 h brouillard salin / 96 h salt spray

Caractéristiques mécaniques
Mechanical characteristics

Boîtier / *Shell*

Matière : alliage d'aluminium
Material : aluminium alloy

Protection : oxydation chimique
Plating : chemical oxydation

Contact / *Contact*

Raccordement : à sertir
Connection : crimp type

Matière : laiton argenté
Material : silver plated brass

Isolant / *Insulator*

Matière : polyamide
Material : polyamid

Conforme aux spécifications feu fumée :
In accordance with fire and smoke specifications :

NF F 16-102 exigence 2
UL94 5V

Endurance / *Durability*

500 manoeuvres
500 mating cycles

Vibration, tenue aux chocs
Vibration, shock resistance

Conforme aux normes / *In accordance with :*

NF F 60-002 sévérité 2 (CEI 68-2-6 Sept. 1985)
NF C 20-706

Résistance aux fluides / *Fluid resistance*

Tenue aux huiles minérales, aux acides et aux bases suivant NF F 61-030.
Withstands mineral oil, acids in accordance with NF F 61-030.

Caractéristiques électriques
Electrical characteristics

Intensité admissible sur contact standard
Max. rating per standard contact

Calibre *Caliber*	Intensité de service permanent *Continious service current**	Section de câble admissible (mm^2) *Cable cross section*	
		mini.	maxi.
Ø 1 mm	10 A	0,22	0,93
Ø 1,6 mm	16 A	0,6	1,82
Ø 2 mm	20 A	0,6	1,82
Ø 3 mm	35 A	1,34	6
Ø 5 mm	80 A	6	6
Ø 7 mm	150 A	35	35
Ø 7,9 mm	200 A	50	50
Ø12 mm	260 A	50	95

* Ces valeurs sont données pour les utilisations avec sections maxi
Current values are for the max. cable cross section

Tension de service par arrangement
Service voltage per configuration

Voir tableau pages 8 et 9 / *See table pages 8 and 9*

Résistance de contact / *Contact resistance*

< 2 mΩ

Résistance d'isolement / *Insulation resistance*

> 5000 MΩ

Caractéristiques climatiques
Climatic characteristics

Température d'utilisation / *Temperature range*

-40 °C, +120 °C

Indice de protection / *Protection index*

EN 60529 (CEI 529 - NF C 20-010) - Oct. 1992

IP 67
Boîtier équipé d'un raccord droit étanche
Shell fitted with environmental straight backshell

IP 43
Boîtier équipé d'un raccord PG + serre-câble à bride
Shell fitted with PG backshell with cable clamp

Brouillard salin / *Salt spray*

96 heures / *96 hours*

Standard
96 h brouillard salin / *96 h salt spray*

CMC

Système de référence / *Part numbering system*

CMC 36 RD 07 - 13 S N A ***

GAMME / *SERIES*

TYPES DE BOITIERS
SHELL TYPES

32 Embase carrée à visser
Screw square receptacle

52 Embase carré à baïonnette (sauf taille 61)
Square receptacle with bayonet (except size 61)

35 Fiche à visser avec cliquet (nous consulter)
Screw plug with clicker (consult us)

36 Fiche à visser sans cliquet
Screw plug without clicker

56 Fiche à baïonnette (sauf taille 61)
Plug with bayonet (except size 61)

TYPES DE RACCORDS
BACKSHELL TYPES

EA Ecrou arrière
Back nut

PG Raccord sortie filetée PG suivant NF C 68-312 et DIN 40430
Backshell for PG outlet

RD Raccord droit étanche
Environmental straight backshell

TAILLES DE BOITIERS
SHELL SIZES

02 - 04 - 07 - 19 - 27 - 61

ARRANGEMENTS
CONFIGURATIONS

Défini par le nombre d'alvéoles de l'isolant
Defined by the insert number of cavity
Pages 8-9

TYPES DE CONTACTS
CONTACT TYPES

P Mâle / *Male*
S Femelle / *Female*

MODIFICATIONS SPÉCIALES
SPECIAL MODIFICATIONS

****
Connecteur équipé de contacts standard
Connector equipped with standard contacts

090
Connecteur sans contact
Connector without contact

Les contacts "non standard" sont à commander séparément
"Non standard" contacts have to be ordered separately

Pages 10-11

Note : pour d'autres modifications, nous consulter
for other modifications, consult us

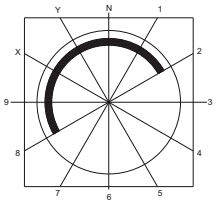
CODES CABLES
CABLE INDEXES

Voir tableaux passage de câble
See accepted cable characteristics
Page 23

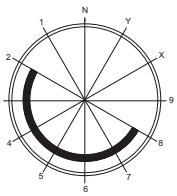
Vues de face
Front views

DÉTROMPAGES
KEYING SYSTEMS

Tailles / *Sizes* 02 - 04 - 07 - 19 - 27
N - 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - X - Y



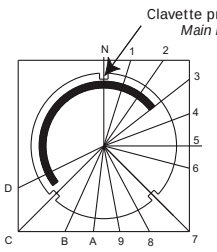
Embase / *Receptacle*



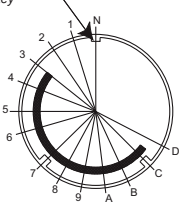
Fiche / *Plug*

Taille 02 : intégré à l'isolant
Size 02 : integrated to insert

Taille / *Size* 61
N - 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - A - B - C - D



Embase / *Receptacle*



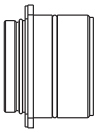
Fiche / *Plug*

CMC

Standard
96 h brouillard salin / *96 h salt spray*

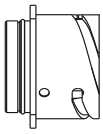
Synoptique des boîtiers et des raccords / *Shell and backshell styles*

32



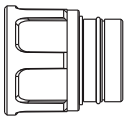
Embase carrée à visser
Screw square receptacle

52



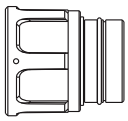
Embase carrée à baïonnette
Square receptacle with bayonet
(sauf taille 61 / *except size 61*)

36



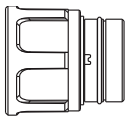
Fiche à visser sans cliquet
Screw plug without clicker

56



Fiche à baïonnette
Plug with bayonet
(sauf taille 61 / *except size 61*)

35



Fiche à visser avec cliquet
Screw plug with clicker
(nous consulter / *consult us*)

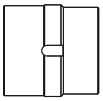
EA

Ecrou arrière
Back nut

RD

Raccord droit étanche
Environmental straight backshell

PG



Raccord pour PG
Backshell for PG outlet

Standard
96 h brouillard salin / *96 h salt spray*

CMC

Arrangements / *Configuration*

Taille / *Size* 02

04 4 contacts Ø 1,6 mm
Contact avancé / *Advanced contact*

Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 380 V eff.
- NF F 61-030 ..... 72 V

Tension de tenue / *Withstanding voltage*
> 2550 V eff.

07 7 contacts Ø 1 mm
Contact avancé / *Advanced contact*

Nous consulter
Consult us

Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 250 V eff.
- NF F 61-030 ..... 72 V

Tension de tenue / *Withstanding voltage*
> 1250 V eff.

Taille / *Size* 04

04 4 contacts Ø 2 mm
Contact avancé / *Advanced contact*

Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 500 V eff.
- NF F 61-030 ..... 380 V eff.

Tension de tenue / *Withstanding voltage*
> 3250 V eff.

07 7 contacts Ø 1,6 mm
Contact avancé / *Advanced contact*

Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 380 V eff.
- NF F 61-030 ..... 72 V

Tension de tenue / *Withstanding voltage*
> 2550 V eff.

Taille / *Size* 07

05 5 contacts Ø 3 mm
Contact avancé / *Advanced contact*

Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 500 V eff.
- NF F 61-030 ..... 380 V eff.

Tension de tenue / *Withstanding voltage*
> 3250 V eff.

07 7 contacts Ø 2 mm

Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 500 V eff.
- NF F 61-030 ..... 380 V eff.

Tension de tenue / *Withstanding voltage*
> 3250 V eff.

09 9 contacts Ø 2 mm
Contact avancé / *Advanced contact*

Nous consulter
Consult us

Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 750 V eff.
- NF F 61-030 ..... 380 V eff.

Tension de tenue / *Withstanding voltage*
> 3250 V eff.

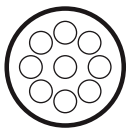
13 13 contacts Ø 1,6 mm
Contact avancé / *Advanced contact*

Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 380 V eff.
- NF F 61-030 ..... 72 V

Tension de tenue / *Withstanding voltage*
> 1500 V eff.

Taille / *Size* 19

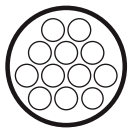
09 9 contacts Ø 3 mm



Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 500 V eff.
- NF F 61-030 ..... 380 V eff.

Tension de tenue / *Withstanding voltage*
> 3250 V eff.

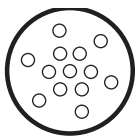
12 12 contacts Ø 3 mm
Contact avancé / *Advanced contact*



Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 500 V eff.
- NF F 61-030 ..... 380 V eff.

Tension de tenue / *Withstanding voltage*
> 3250 V eff.

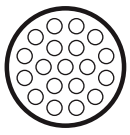
13 13 contacts Ø 2 mm



Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 500 V eff.
- NF F 61-030 ..... 380 V eff.

Tension de tenue / *Withstanding voltage*
> 3250 V eff.

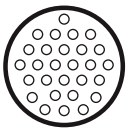
19 19 contacts Ø 2 mm



Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 500 V eff.
- NF F 61-030 ..... 380 V eff.

Tension de tenue / *Withstanding voltage*
> 3250 V eff.

28 28 contacts Ø 1,6 mm
Contact avancé / *Advanced contact*

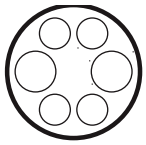
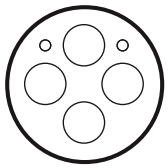
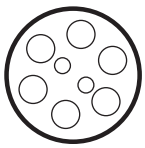
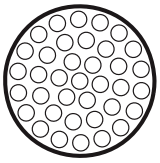
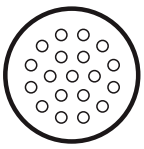
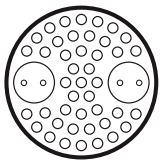
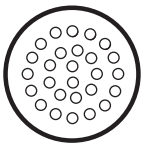
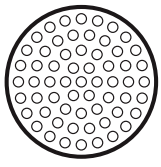
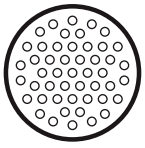
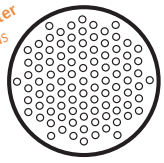


Tension de service / *Service voltage*
- NF C 20-040 cat. B ..... 380 V eff.
- NF F 61-030 ..... 72 V

Tension de tenue / *Withstanding voltage*
> 2550 V eff.

CMC

Standard
96 h brouillard salin / *96 h salt spray*

Taille / *Size* 27	Taille / *Size* 61
06 — 4 contacts Ø 5 mm + 2 contacts Ø 7,9 mm	06 — 4 contacts Ø 12 mm + 2 contacts Ø 3 mm
	
Tension de service / *Service voltage* - NF C 20-040 cat. B ..... 500 V eff. - NF F 61-030 ..... 380 V eff. **Tension de tenue** / *Withstanding voltage* **> 3250 V eff.**	**Tension de service** / *Service voltage* - NF C 20-040 cat. B ..... 1000 V eff. - NF F 61-030 ..... >380 V eff. **Tension de tenue** / *Withstanding voltage* **> 3250 V eff.**
08 — 6 contacts Ø 7 mm + 2 contacts Ø 3^{-B} mm	37 — 37 contacts Ø 3^{-A} mm
	
Tension de service / *Service voltage* - NF C 20-040 cat. B ..... 500 V eff. - NF F 61-030 ..... 380 V eff. **Tension de tenue** / *Withstanding voltage* **> 3250 V eff.**	**Tension de service** / *Service voltage* - NF C 20-040 cat. B ..... 500 V eff. - NF F 61-030 ..... 380 V eff. **Tension de tenue** / *Withstanding voltage* **> 3250 V eff.**
19 — 19 contacts Ø 3 mm	45 — 43 contacts Ø 2 mm + 2 coax ou twinax
	
Tension de service / *Service voltage* - NF C 20-040 cat. B ..... 500 V eff. - NF F 61-030 ..... 380 V eff. **Tension de tenue** / *Withstanding voltage* **> 2500 V eff.**	**Tension de service** / *Service voltage* - NF C 20-040 cat. B ..... 500 V eff. - NF F 61-030 ..... 380 V eff. **Tension de tenue** / *Withstanding voltage* **> 3250 V eff.**
27 — 27 contacts Ø 2 mm	61 — 61 contacts Ø 2 mm
	
Tension de service / *Service voltage* - NF C 20-040 cat. B ..... 500 V eff. - NF F 61-030 ..... 110 V **Tension de tenue** / *Withstanding voltage* **> 3250 V eff.**	**Tension de service** / *Service voltage* - NF C 20-040 cat. B ..... 500 V eff. - NF F 61-030 ..... 380 V eff. **Tension de tenue** / *Withstanding voltage* **> 3250 V eff.**
49 — 49 contacts Ø 1,6 mm	97 — 97 contacts Ø 1,6 mm
	Nous consulter / *Consult us* 
Tension de service / *Service voltage* - NF C 20-040 cat. B ..... 380 V eff. - NF F 61-030 ..... 72 V **Tension de tenue** / *Withstanding voltage* **> 2550 V eff.**	**Tension de service** / *Service voltage* - NF C 20-040 cat. B ..... 380 V eff. - NF F 61-030 ..... 72 V **Tension de tenue** / *Withstanding voltage* **> 2550 V eff.**

Les contacts et les cellules sont à commander séparément. Arrangement à prévoir dans la référence avec le code **090**. Voir page 13.
Contacts have to be ordered separately. Use code 090 in the part number to indicate this. See page 13.

Possibilité d'intégrer le contact optique / *Possibility to integrate the optical contact*

Diamètre maxi. des conducteurs dans l'arrière d'isolant
Maxi diameter of conductors in the rear insert

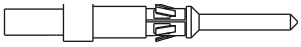
Arrangement d'isolant *Insert configuration*		Ø maxi. dans l'alvéole *Ø maxi. in cavity*
02	**04**	4,5 / *(0.177)*
	07	Nous consulter *Consult us*
04	**04**	5,7 / *(0.224)*
	07	4,5 / *(0.177)*
07	**05**	7,85 / *(0.309)*
	07 - 09	5,7 / *(0.224)*
	13	4,5 / *(0.177)*
19	**09**	7 / *(0.275)*
	12	7,85 / *(0.309)*
	13 - 19	5,7 / *(0.224)*
	28	4,5 / *(0.177)*
27	**06**	16,3 / *(0.64)* - 8,6 / *(0.34)*
	08	13,5 / *(0.53)* - 5,1 / *(0.20)*
	19	7,85 / *(0.309)*
	27	5,7 / *(0.224)*
	49	4,5 / *(0.177)*
61	**06**	21,5 / *(0.84)* - 6,4 / *(0.25)*
	37	6 / *(0.236)*
	45 - 61	5,7 / *(0.224)*
	97	Nous consulter *Consult us*

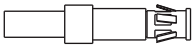
mm / *(inches)*

Standard
96 h brouillard salin / *96 h salt spray*

CMC

Contacts

P  Mâle / *Male*

S  Femelle / *Female*

CONTACTS A SERTIR *CRIMP CONTACTS*			CABLE *WIRE*		OBTURATEUR *SEALING PLUG*	PINCE A SERTIR *CRIMPING TOOL*		OUTIL DE DÉMONTAGE *EXTRACTING TOOL*	OUTIL DE MONTAGE *INSERTION TOOL*
Calibre *Contact diam.*	Type	Référence *Part number*	Section *Cross section*	Gauge *AWG wire*	Référence *Part number*	Référence *Part number*	Positionneur *Locator*	Référence *Part number*	Référence *Part number*
Ø1 mm	P S	DCI CCI000A0 M000 DCI CCI000A0 F000	0,22 à/*to* 0,93 mm²	24 à/*to* 18	-	FT8 ou/*or* M22520/1-01	- M22520/1-04	OUTCCIEXTA0000	-
Ø1,6 mm	P S	DMC S24150-00B3 DMC S24151-00B3	0,6 à/*to* 1,82 mm²	20 à/*to* 15	-	FT8 ou/*or* M22520/1-01	- TP1012	OUTS1675-0003	OUT31748-000A2
Ø2 mm	P S	DMC S1545-0008-B DMC S1545-0009-B	0,4 à/*to* 0,6 mm²	22 à/*to* 20	STD 0391-0104A3	FT8 ou/*or* M22520/1-01	- TP900-1	OUTS1545-0023	OUTS1545-0002
Ø2 mm	P S	DMC S1545-0007-B DMC S1545-0005-B	0,6 à/*to* 1,82 mm²	20 à/*to* 15	STD 0391-0104A3	FT8 ou/*or* M22520/1-01	- TP900-1	OUTS1545-0023	OUTS1545-0002
Ø2 mm	P S	DMC S1545-0006-B DMC S1545-0004-B	1,5 à/*to* 2,61 mm²	15 à/*to* 14	STD 0391-0104A3	FT8 ou/*or* M22520/1-01	- TP900-1	OUTS1545-0023	OUTS1545-0002
Ø3 mm	P S	DMC S24578-0003 DMC S24577-0003	1,34 à/*to* 2,61 mm²	16 à/*to* 14	-	M317	OUT S24823-0003	OUTCCIEXT-C0000	OUT18990-0004
Ø3 mm	P S	DMC S19554-0004 DMC S19555-0004	2,07 à/*to* 4 mm²	14 à/*to* 12	-	M317	OUT S24823-0003	OUTCCIEXT-C0000	OUT18990-0004
Ø3 mm	P S	DMC S24750-0003 DMC S24747-0003	3,8 à/*to* 6 mm²	12 à/*to* 10	-	M317	OUT S24823-0003	OUTCCIEXT-C0000	OUT18990-0004
Ø3-A mm	P S	DAM S0692-0130 DMC S1239-0007	1,34 à/*to* 2,61 mm²	16 à/*to* 13	-	M317	TP1065	-	-
Ø3-B mm	P S	DLN S18970-0004 DLN S18971-0004	2,07 à/*to* 4 mm²	14 à/*to* 12	-	MS 3191-1	Jaune/*Yellow* 12A	OUTCCIEXT-C0000	OUT18990-0004
Ø5 mm	P S	DLN S24149-0003 DLN S24146-0003	6 mm²	-	-	PMM1CF	H1 35-6	OUTCCIEXT-D0200	-
Ø5 mm	P S	DMS S18879-0004 DMS S18880-0004	13,4 mm²	6	-	PMM1CF	H1 6AWG	OUTCCIEXT-D0200	-
Ø5 mm	P S	DMS S24482-0004 DMS S24481-0004	16 mm²	-	-	PMM1CF	H1 16-50F	OUTCCIEXT-D0200	-
Ø7 mm	P S	DMS S18889-0004 DMS S18890-0004	35 mm²	2	-	PMM1CF	H1 10-35F	OUTCCIEXT-G0100	-
Ø7 mm	P S	DMS S18891-0004 DMS S18892-0004	50 mm²	0	-	PMM1CF	H1 16-50F	OUTCCIEXT-G0100	-
Ø7,9 mm	P S	DLN S24817-0003 DLN S24164-0003	50 mm²	0	-	PMM1CF	H1 16-50F	OUTCCIEXT-H0100	-
Ø7,9 mm	P S	DLN S24163-0003 DLN S24818-0003	70 mm²	00	-	PMM1CF	H1 25-70F	OUTCCIEXT-H0100	-
Ø12 mm	P S	DMC S25463-0003 DMC S25464-0003	50 mm²	0	19947-0004 19948-0004	PMM1CF	H1 16-50F	-	-
Ø12 mm	P S	DMC S25461-0003 DMC S25462-0003	70 mm²	00	19947-0004 19948-0004	PMM1CF	H1 25-70F	-	-
Ø 12 mm	P S	DMC S25564-0003 DMC S25565-0003	95 mm²	000	19947-0004 19948-0004	PMM1CF	H1 95F	-	-

Nota : Utilisation possible d'outillages hydrauliques / *Possibility of hydraulic tools*

Contacts standard livrés avec le connecteur
Standard contacts supplied with connector

CMC

Standard
96 h brouillard salin / *96 h salt spray*

Contacts optiques / *Optic contacts*

Ces contacts optiques ont été étudiés pour s'intégrer dans les alvéoles Ø 3 mm des isolants standard CMC (pages 8 et 9). Arrangements : 07-15, 19-09, 19-12, 27-19.
These optical contacts have been designed to fit in the Ø 3 mm cavities of standard CMC inserts (pages 8 and 9). Configurations : 07-15, 19-09, 19-12, 27-19.

Caractéristiques / *Characteristics*

Technologie Fibre à Fibre / *Fiber to Fiber technology*

Perte d'insertion / *Insertion loss* : à 850 nm < 0,7 dB

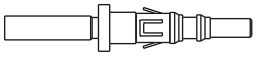
Température de fonctionnement / *Temperature* : - 55°C, + 125°C

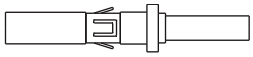
Vibrations / *Vibrations* : 20 à/*to* 2000 Hz - 20 g

Endurance / *Durability* : 1000 h à/*to* 125°C

Rétention du câble / *Cable retention* : 6 daN

Durée de mise en oeuvre / *Installation time* : 10 min.

P  Mâle / *Male*

S  Femelle / *Female*

Cellule ou contact *Contact*	Type	Référence *Part number*	Montage *Mounting*	Pince à sertir Positionneur *Crimping tool Locator*	Outil de démontage *Extracting tool*	Fibre *Fiber*
OPTIQUE	P S	DWS 75P 78.** DWS 75S 78-**	Se monte en lieu et place du contact Ø 3 mm *Use this contact instead of contact Ø 3 mm*	Nous consulter *Consult us*	OUT S1545-0024	200 / 230

** Référence suivant spécification du câble / *Part number following the cable specification*

Les contacts sont à commander séparément du connecteur.
The contacts have to be ordered separately in addition to the connector.

Bretelles optiques / ***Patchcords***

La réalisation de cordons équipés de connecteurs ou contacts optiques est possible sur demande et en respectant les spécifications de l'utilisateur. Veuillez nous consulter.
Patchcords using connectors with optical contacts can be made on request. Please, consult us.

COAX & TWINAX
96 h brouillard salin / *96 h salt spray*

CMC

Système de référence / *Part numbering system*

CMC 36 RD 07 - T2 S N E 090

GAMME / *SERIES*

TYPES DE BOITIERS
SHELL TYPES

32 - 52 - 36 - 56

Excepté pour la taille 61 / *Excepted for the size 61*

TYPES DE RACCORDS
BACKSHELL TYPES

EA - PG - RD

TAILLES DE BOITIERS
SHELL SIZES

07 - 61

ARRANGEMENTS
CONFIGURATIONS

C1 Coax : 50 Ω
C2 Coax : 75 Ω

T1 Twinax : 105 Ω
T2 Twinax : 120 Ω

45 Coax/twinax : 43 contacts Ø 2 mm
+ 2 cellules/*contacts* 50, 75, 105 ou/*or* 120 Ω

MODIFICATIONS SPÉCIALES
SPECIAL MODIFICATIONS

090
Ce code est à indiquer impérativement
Use as part of main code

Les carcasses sont gérées sans les cellules.
Les cellules mâles et femelles
sont à commander séparément.

Coax, twinax contacts are not includes
with shells codification
Male and female contacts
have to be ordered separately.

Page 13

CODES CABLES
CABLE INDEXES

Voir tableaux de passage de câble
See tables for accepted cable characteristics
Page 23

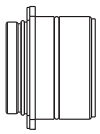
DÉTROMPAGES
KEYING SYSTEMS

Page 6

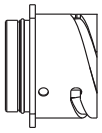
TYPES DE CONTACTS
CONTACT TYPES

P Mâle / *Male* - S Femelle / *Female*

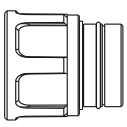
Synoptique des boîtiers et des raccords / *Shells and backshells styles*

32 

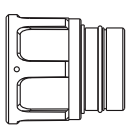
Embase carrée à visser
Screw square receptacle

52 

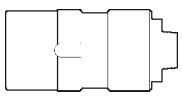
Embase carrée à baïonnette
Square receptacle with bayonet
(Sauf taille 61 / *Except size 61*)

36 

Fiche à visser sans cliquet
Screw plug without clicker

56 

Fiche à baïonnette
Plug with bayonet
(Sauf taille 61 / *Except size 61*)

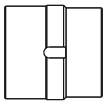
RD 

Raccord droit étanche
Environmental straight backshell

Pour taille 61 uniquement
Only for size 61

EA

Ecrou arrière
Back nut

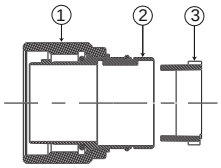
PG 

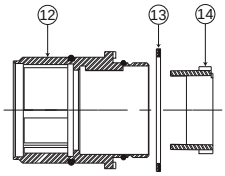
Raccord pour PG
Backshell for PG outlet

CMC

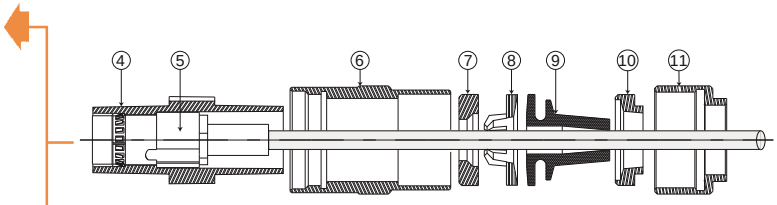
COAX & TWINAX
96 h brouillard salin / *96 h salt spray*

Fiche avec raccord RD
Plug with RD backshell



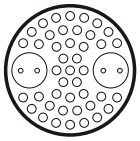


Embase avec raccord RD
Receptacle with RD backshell



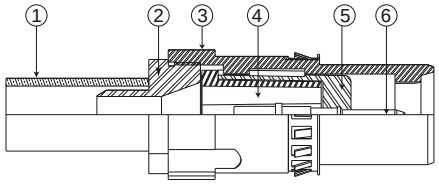
1 Barillet / *Coupling ring*
2 Jupe de fiche / *Shell*
3 Détrompeur / *Keying system*
4 Isolant de cellule / *Insert*
5 Cellule/*Contact* coax ou/*or* twinax
6 Corps arrière / *Backshell*
7 Butée de presse-étoupe *Cable gland stop*
8 Serre-câble / *Cable clamp*
9 Garniture / *Boot*
10 Entretoise / *Spacer*
11 Ecrou arrière / *Back nut*
12 Embase / *Receptacle*
13 Joint d'embase / *Sealing gasket*
14 Détrompeur / *Keying system*

Arrangements / *Configurations*

Taille / *Size* 07				Taille / *Size* 61	
C1	Impédance 50 Ω	T1	Impédance 105 Ω	45	43 contacts Ø 2 mm + + 2 cellules 50, 75, 105 ou/*or* 120 Ω
C2	Impédance 75 Ω	T2	Impédance 120 Ω		
Cellule / *Contact* COAX		Cellule / *Contact* TWINAX		 Cellule / *Contact* COAX-TWINAX	

IMPORTANT
Les contacts et les cellules sont à commander séparément.
Contacts and coax,twinax contacts have to be ordered separately.

Cellules / *Coax, twinax contact arrangement*



1 Ferrule / *Ferrule*
2 Ecrou de tresse / *Braid nut*
3 Corps d'isolant / *Insert shell*
4 Isolant mixte / *Mixed insert*
5 Isolant / *Insert*
6 Contact / *Contact*

Cellule ou contact *Contact*	Type	Référence *Part number*	Référence du câble *Wire part number*	Outil de sertissage *Crimping tool*	Positionneur *Locator*	Outil de démontage *Extracting tool*
COAX **50** Ω	P S	DMC 1698-0003-A0001 DMC 1698-0004-A0001	RG 214 14 à/*to* 12	Contact → FT8 Ferrule → PMM1	→ M22520/1-05 → H1 16-50	OUT S1677-0003
COAX **75** Ω	P S	DAMS 1681-0130-00000 DAMS 1681-0131-00000	KX8 RSS	Contact → FT8 Ferrule → PMM1	→ M22520/1-05 → H1 25-70F	OUTS1677-0003
TWINAX **105** Ω	P S	DMC 1637-0002-B0001 DMC 1637-0001-B0001	DTRF150 002	Contact → FT8 Ferrule → PMM1	→ M22520/1-05 → H1 16-50	OUT S1677-0003
TWINAX **120** Ω	P S	DMC 1713-0100-A0001 DMC 1713-0101-A0001	DTRF 150 046 DTRF 150 047	Contact → FT8 Ferrule → PMM1	→ M22520/1-05 → H1 16-50	OUT S1677-0003
TWINAX **120** Ω	P S	DMC 1713-0104-00000 DMC 1713-0105-00000	DDF 2630-80-121	Contact → FT8 Ferrule → PMM1	→ M22520/1-05 → H1 35-50	OUT S1677-0003

Nota
Possibilité d'adapter la cellule avec d'autres types de câble, à partir de la fiche technique du câble. Nous consulter.
Following the technical data sheet, cell adaptation is possible with other type of cables. Consult us.

Continuité de blindage / *RFI Shielding*
96 h brouillard salin / *96 h salt spray*

CMC

Système de référence / *Part numbering system*

CMC 36 RD 07 - 13 P N A ***

GAMME / *SERIES*

TYPES DE BOITIERS / *SHELL TYPES*

32 - 52 Standard
33 - 53 - 38 - 58 Reprise de blindage / *RFI*

TYPES DE RACCORDS / *BACKSHELL TYPES*

EA - RD - PG

TAILLES DE BOITIERS / *SHELL SIZES*

04 - 07 - 19 - 27

ARRANGEMENTS / *CONFIGURATIONS*

Défini par le nombre d'alvéoles de l'isolant
Defined by the insert number of cavity
Pages 8-9

TYPES DE CONTACTS / *CONTACT TYPES*

P Mâle / *Male* - S Femelle / *Female*

MODIFICATIONS SPÉCIALES
SPECIAL MODIFICATIONS

***
Connecteur équipé de contacts standard
Connector equipped with standard contacts

090
Connecteur sans contact
Connector without contact

Les contacts "non standard"
sont à commander séparément
"Non standard" contacts
have to be ordered separately

Pages 10-11

Note : pour d'autres modifications, nous consulter
for other modifications, consult us

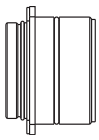
CODES CABLES / *CABLE INDEXES*

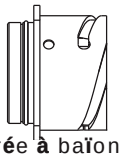
Voir tableaux de passage de câble
See accepted cable characteristics
Page 23

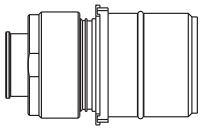
DÉTROMPAGES / *KEYING SYSTEMS*

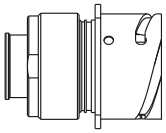
Page 6

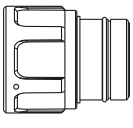
Synoptique des boîtiers et des raccords / *Shells and backshells styles*

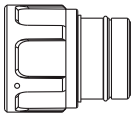
32

Embase carrée à visser
Screw square flange receptacle

52

Embase carrée à baïonnette
Square flange receptacle with bayonet

33

Embase à visser carrée
avec reprise de tresse
Screw square receptacle with shielding

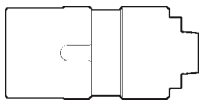
53

Embase carrée à baïonnette
avec reprise de tresse
Square bayonet receptacle with shielding

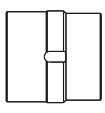
38

Fiche à visser sans cliquet
avec reprise de tresse
Screw plug without clicker with shielding

58

Fiche à baïonnette
avec reprise de tresse
Bayonet plug with shielding

EA

Ecrou arrière
Back nut

RD

Raccord droit étanche
Environmental straight backshell

PG

Raccord pour PG
Backshell for PG outlet

CMC

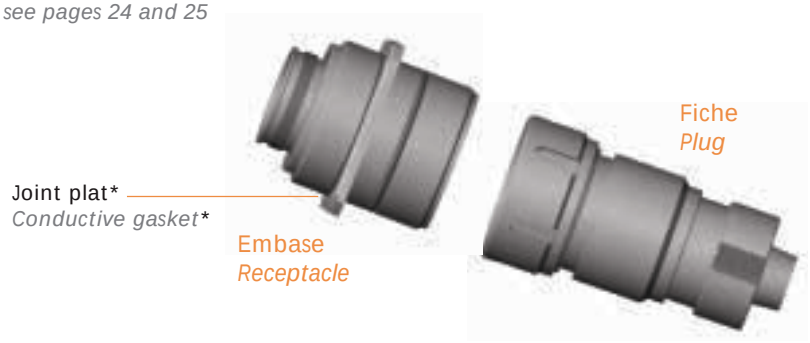
Reprise de blindage / *RFI Shielding*
96 h brouillard salin / *96 h salt spray*

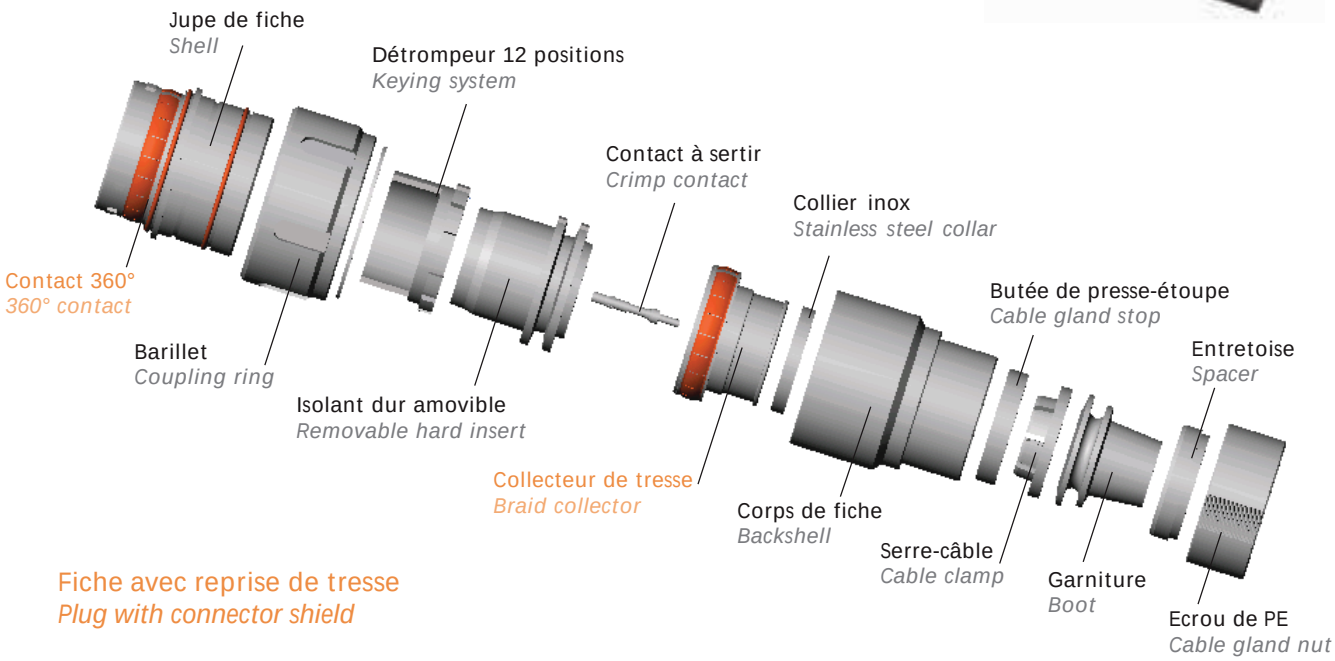
La reprise de blindage s'effectue sur 360° à l'aide d'un collecteur multi-tresses intégré sur la jupe de fiche (et/ou sur l'arrière de l'embase) constituant de ce fait une parfaite cage de Faraday.
La continuité de blindage fiche/embase est réalisée par contact électrique périphérique à 360° sur la tête de fiche. L'embase semi-encastrée peut être équipée d'un joint plat conducteur.

360° shielding is achieved using the braid collector within the connector making a complete Faraday cage. The plug/receptacle shielding is realized by 360° circular electrical contact on the plug head. The semi-recessed receptacle can be equiped with a conductive gasket.

Reprise de blindage / *Shield attachment*

* Le joint plat conducteur est à commander séparément, voir pages 24 et 25
Conductive gaskets are ordered separately, see pages 24 and 25





Fiche avec reprise de tresse
Plug with connector shield

Collier de tresse / *Braid collar*

Fourni avec le collecteur de tresse
Included with the connector shield

Standard
500 h brouillard salin / *500 h salt spray*

CMB

Système de référence / *Part numbering system*

CMB 36 PG 07 - 13 P N A ***

GAMME / *SERIES*

TYPES DE BOITIERS
SHELL TYPES

32 Embase carrée à visser
Screw square receptacle

33 Embase carrée à visser avec rep. de tresse
Screw square receptacle with shielding

52 Embase carrée à baïonnette
Screw square receptacle with bayonet

53 Embase carrée à baïonnette avec reprise de tresse
Square bayonet receptacle with shielding

36 Fiche à visser sans cliquet
Screw plug without clicker

38 Fiche à visser sans cliquet avec reprise de tresse
Screw plug without clicker with shielding

56 Fiche à baïonnette
Plug with bayonet

58 Fiche à baïonnette avec reprise de tresse
Plug with bayonet with shielding

Excepté pour la taille 61 / *Excepted for the size 61*

TYPES DE RACCORDS
BACKSHELL TYPES

EA Ecrou arrière
Back nut

PG Raccord sortie filetée PG suivant NF C 68-312 et DIN 40430
Backshell for PG outlet

RD Raccord droit étanche
Environmental straight backshell

TAILLES DE BOITIERS
SHELL SIZES

02 - 04 - 07 - 19 - 27 - 61

ARRANGEMENTS
CONFIGURATIONS

Défini par le nombre d'alvéoles de l'isolant
Defined by the insert number of cavity
Pages 8- 9

TYPES DE CONTACTS
CONTACT TYPES

P Mâle / *Male*

S Femelle / *Female*

MODIFICATIONS SPÉCIALES
SPECIAL MODIFICATIONS

***
Connecteur équipé de contacts standard
Connector equipped with standard contacts

090
Connecteur sans contact
Connector without contact

Les contacts "non standard" sont à commander séparément
"Non standard" contacts have to be ordered separately

Pages 10-11

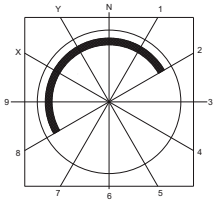
Note : pour d'autres modifications, nous consulter
for other modifications, consult us

CODES CABLES
CABLE INDEXES

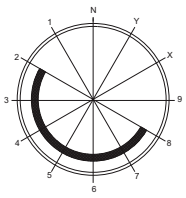
Voir tableaux «passage de câble»
See cable dimensions
Page 23

DÉTROMPAGES
KEYING SYSTEMS

Taille / *Sizes* 02 - 04 - 07 - 19 - 27
N - 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - X - Y



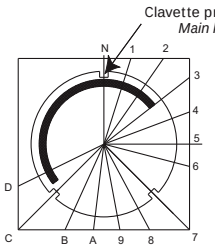
Embase / *Receptacle*



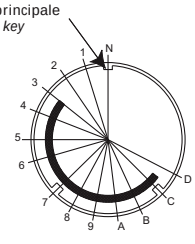
Fiche / *Plug*

Taille 02 : intégré à l'isolant
Size 02 : integrated to insert

Taille / *Size* 61
N - 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - A - B - C - D



Embase / *Receptacle*



Fiche / *Plug*

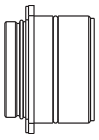
CMB

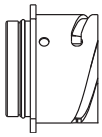
Standard
500 h brouillard salin / *500 h salt spray*

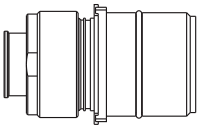
Caractéristiques / *Characteristics*

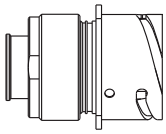
Boîtier / *Shell* : Pièces d'accouplement en bronze / *Bronze mating pieces*
Contacts / *Contacts* : Laiton argenté, à sertir / *Silver plated brass, crimp*
Isolants / *Inserts* : Polyamide / *Polyamid*
Tenue feu-fumée / *Fire and smoke withstand* : NF F 16-102 exigence 2 & UL95 5V
Endurance / *Durability* : > 500 manoeuvres/*matings*
Température d'utilisation / *Temperature* : - 40°C + 120°C
Indice de protection / *Protection index* : IP67 avec raccord droit étanche
IP67 with environmental straight backshell
IP43 avec raccord PG + presse-étoupe
IP43 with backshell with PG outlet + cable gland
Brouillard salin / *Salt spray* : 500 h
Etude spécifique pour les environnements extrêmes > 500 h brouillard salin, nous consulter.
More 500 hours salt spray, specifical assessment for the severe environments, consult us.
Reprise de blindage / *RFI shielding* : Page 15

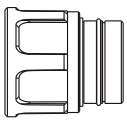
Synoptique des boîtiers et des raccords / *Shells and backshells styles*

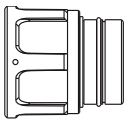
32

Embase carrée à visser
Screw square receptacle

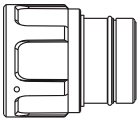
52

Embase carrée à baïonnette
Square bayonet receptacle

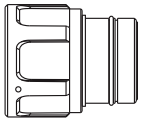
33

Embase carrée à visser
avec reprise de tresse
Screw square receptacle with shielding

53

Embase carrée à baïonnette
avec reprise de tresse
Square bayonet receptacle with shielding

36

Fiche à visser sans cliquet
Screw plug without clicker

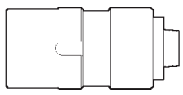
56

Fiche à baïonnette
Bayonet plug

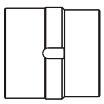
38

Fiche à visser sans cliquet
avec reprise de tresse
Screw plug without clicker with shielding

58

Fiche à baïonnette
avec reprise de tresse
Bayonet plug with shielding

EA

Ecrou arrière
Back nut

RD

Raccord droit étanche
Environmental straight backshell

PG

Raccord pour PG
Backshell for PG outlet

Standard CPP

Les connecteurs CPP proposent des arrangements pour des applications de puissance.

Cette gamme est directement dérivée de la CMC 96 h BS. Elle reprend les mêmes boîtiers, raccords et accessoires. Seuls les blocs isolants et les contacts sont spécifiques.

Un code de modification spécifique sera attribué pour une configuration supérieure à 96 h BS.

The CPP connectors have been designed for power applications.

The metal shells and coupling are the same for CMC and CPP ranges. Only contacts and inserts are specific.

A specific modification code will be given for a salt spray withstand more than 96 hours .

Système de référence / *Part numbering system*

CPP 36 RD 19 - 4A P N A ***

GAMME / *SERIES*

TYPES DE BOITIERS *SHELL TYPES* (p. 6)

TYPES DE RACCORDS *BACKSHELL TYPES* (p. 6)

TAILLES DE BOITIERS *SHELL SIZES*
19 - 61

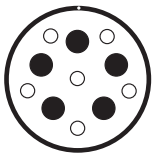
(p. 6) MODIFICATIONS SPÉCIALES *SPECIAL MODIFICATIONS*

(p. 23) CODES CABLES *CABLE INDEXES*

(p. 6) DÉTROMPAGES *KEYING SYSTEMS*

(p. 6) TYPES DE CONTACTS *CONTACT TYPES*

ARRANGEMENTS / *CONFIGURATIONS*

Taille 19						Taille 61	
4A	2 contacts Ø6 + 2 pilotes Ø3	5A	3 contacts Ø5 + 2 pilotes Ø3	7A	5 contacts Ø5 + 2 pilotes Ø3	11	4 contacts Ø9 + Terre + 6 contacts Ø4
4B	2 contacts Ø7 + 2 pilotes Ø3	5B	3 contacts Ø6 + 2 pilotes Ø3	7B	5 contacts Ø6 + 2 pilotes Ø3		
4C	2 contacts Ø8 + 2 pilotes Ø3	5C	3 contacts Ø7 + 2 pilotes Ø3				
Un 500 V - In 80 à/*to* 100 A		Un 500 V - In 80 à/*to* 100 A		Un 500 V - In 80 à/*to* 100 A		 Un 500 V - In 200 A	
		6A	4 contacts Ø5 + 2 pilotes Ø3				
		6B	4 contacts Ø6 + 2 pilotes Ø3				
		Un 500 V - In 80 à/*to* 100 A					

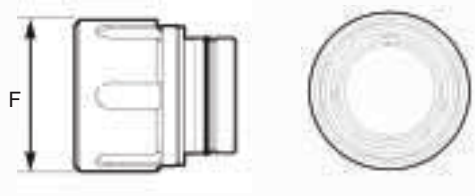
CPP Standard

Arrangements MULTIPOLAIRES / *MULTIPOLE configurations*

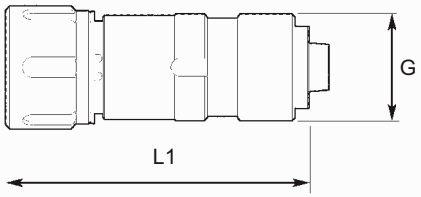
CONTACTS		CABLE		CONTACT		OUTILLAGE / *TOOLS*		
Calibre *Diameter* (mm)	Ampérage *Rating*	Section *Cross section* (mm^2)	Gauge *AWG*	Type	Référence *Part number*	Pince ou vérin *Crimping tool or actuator*	Tourelle ou matrice *Positionner or die*	Outil d'extraction *Extraction tool*
Ø 3	-	0.6	20	P	S18877-0004	Pince / *Crimping tool* Océta M22520/1-01	Tourelle / *Positionner* E18994-0004	CCIEXT-C0000
				S	S18878-0004			
Ø 3	-	2.5	-	P	S24480-0004	Pince / *Crimping tool* Océta M22520/1-01	Tourelle / *Positionner* E18994-0004	CCIEXT-C0000
				S	S24479-0004			
Ø 4	-	6	-	P	18260-000A4	Pince / *Crimping tool* Sertilec PN4E	Nous consulter *Consult us*	CCIEXT-V0100 CCIEXT-D0100
				S	S18325-0004			
Ø 5	80 A	13.4	# 6	P	S18879-0004	Pince / *Crimping tool* Océta D31	Matrice / *Die* Océta 02607	CCIEXT-D0100
				S	S18880-0004			
Ø 5	80 A	16	-	P	S24482-0004	Pince / *Crimping tool* Océta D31	Matrice / *Die* Océta 02607	CCIEXT-D0100
				S	S24481-0004			
Ø 6	80 A	13.4	# 6	P	S19069-0004	Pince / *Crimping tool* Océta D31	Matrice / *Die* Océta 02607	CCIEXT-D0100
				S	S19070-0004			
Ø 6	70 A	16	-	S	S25467-0003	Pince / *Crimping tool* Océta D31	Matrice / *Die* MP2RH16	CCIEXT-F0100
Ø 6	100 A	21.4	# 4	P	S18887-0004	Pince Océta D31 ou/*or* Vérin Mécatraction	Matrice 19243-000A4 Matrice 19004-000A4	CCIEXT-F0100
				S	S18888-0004			
Ø 6	100 A	25	-	P	S23547-00B3	Pince Océta D31 ou/*or* Vérin Mécatraction	Matrice 19243-000A4 Matrice 19004-000A4	CCIEXT-F0100
Ø 7	120 A	33.6	# 2	P	S18889-0004	Pince / *Crimping tool* Mécatraction PMM1	Matrice / *Die* H1 10-35F	CCIEXT-G0100
				S	S18890-0004			
Ø 7	180 A	53.5	# 0	P	S18891-0004	Pince / *Crimping tool* Mécatraction PMM1	Matrice / *Die* H1 16-50F	CCIEXT-G0100
				S	S18892-0004			
Ø 8	200 A	67.2	# 00	P	S18895-0004	Vérin Mécatraction	Matrice / *Die* TN 70-20	CCIEXT-H0100
				S	S18896-0004			
Ø 9	200 A	50	-	P	18260-000A4	Pince / *Crimping tool* Mécatraction TN	Nous consulter *Consult us*	Nous consulter *Consult us*
				S	S18264-0004			

Contacts standard livrés avec le connecteur/ *Standard contacts supplied with connector*

Encombrement de la fiche / *Plug dimensions*



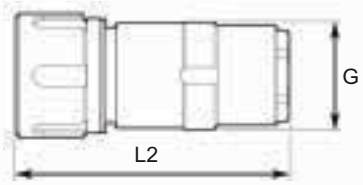
avec raccord droit étanche
with environmental straight backshell



Taille *Size*	02	04	07	19	27	61
F	28 *(1.10)*	36 *(1.42)*	45 *(1.77)*	63 *(2.48)*	81 *(3.19)*	106 *(4.17)*
G	24 *(0.94)*	32 *(1.26)*	39 *(1.53)*	56 *(2.20)*	74 *(2.91)*	94 *(3.70)*
L1	83 *(3.27)*	87 *(3.42)*	110 *(4.33)*	110 *(4.33)*	137 *(5.39)*	255 *(10.04)*
L1 blindé *shielded*	-	93 *(3.66)*	115 *(4.53)*	115 *(4.53)*	140 *(5.51)*	-
L2	69 *(2.78)*	78 *(3.07)*	95 *(3.74)*	95 *(3.74)*	107 *(4.21)*	173 *(6.81)*
L2 blindé *shielded*	-	84 *(3.30)*	100 *(3.94)*	100 *(3.94)*	110 *(4.33)*	-

mm / *(inches)*

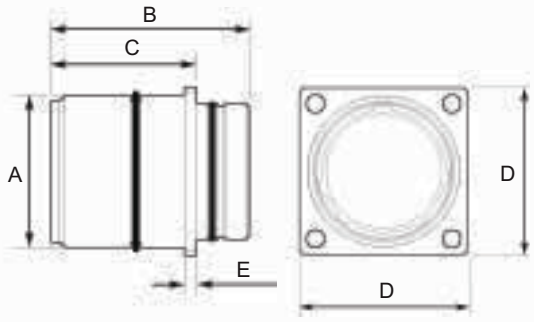
avec raccord sortie filetée PG
with backshell for PG outlet



Encombrement de l'embase à collerette carrée / *Square flange receptacle dimensions*

Taille *Size*	02	04	07	19	27	61
A	24 *(0.94)*	32 *(1.26)*	37,9 *(1.49)*	56 *(2.20)*	74 *(2.91)*	96 *(3.78)*
B	44 *(1.73)*	46 *(1.81)*	48,7 *(1.92)*	48,7 *(1.92)*	56,4 *(2.22)*	85 *(3.34)*
C	31 *(1.22)*	35 *(1.38)*	36 *(1.42)*	36 *(1.42)*	36 *(1.42)*	56 *(2.20)*
D	25 *(0.98)*	35 *(1.38)*	42 *(1.65)*	67 *(2.64)*	79 *(3.11)*	112 *(4.41)*
E	3 *(0.12)*	3 *(0.12)*	3 *(0.12)*	3 *(0.12)*	5 *(0.20)*	9 *(0.35)*

mm /*(inches)*

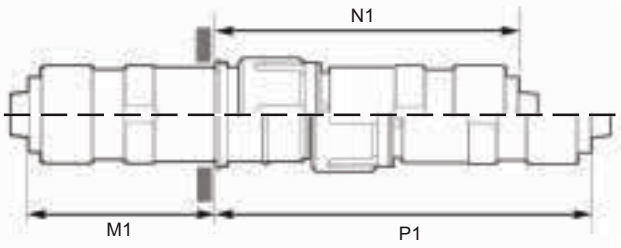


Encombrement à l'accouplement / *Mating dimensions*

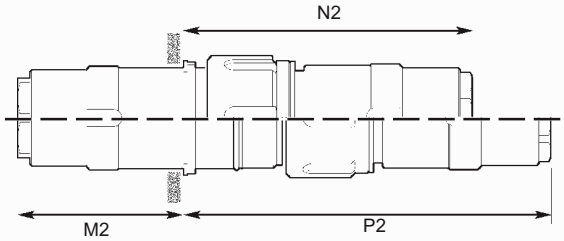
Taille *Size*	02	04	07	19	27	61
M1 max.	55 *(2.16)*	55 *(2.16)*	70 *(2.75)*	70 *(2.75)*	103 *(4.05)*	215 *(8.46)*
M1 max. blindé *shielded*	-	61 *(2.40)*	75 *(2.95)*	75 *(2.95)*	106 *(4.17)*	-
M2 max.	40 *(1.57)*	46 *(1.81)*	57 *(2.24)*	57 *(2.24)*	73 *(2.87)*	133 *(5.24)*
M2 max. blindé *shielded*	-	52 *(2.04)*	62 *(2.44)*	62 *(2.44)*	76 *(2.99)*	-
N1 max.	92 *(3.62)*	98 *(3.86)*	123,5 *(4.86)*	123,5 *(4.86)*	153 *(6.02)*	275 *(10.83)*
N1 max. blindé *shielded*	-	104 *(4.09)*	128,5 *(5.06)*	128,5 *(5.06)*	156 *(6.14)*	-
N2 max.	78 *(3.07)*	89 *(3.50)*	108,5 *(4.27)*	108,5 *(4.27)*	123 *(4.84)*	193 *(7.06)*
N2 max. blindé *shielded*	-	95 *(3.74)*	113,5 *(4.46)*	113,5 *(4.46)*	126 *(4.96)*	-
P1 max.	114 *(4.49)*	122 *(4.80)*	146 *(5.75)*	146 *(5.75)*	175 *(6.89)*	311 *(12.24)*
P1 max. blindé *shielded*	-	128 *(5.04)*	151 *(5.94)*	151 *(5.94)*	178 *(7.00)*	-
P2 max.	100 *(3.94)*	113 *(4.45)*	131 *(5.16)*	131 *(5.16)*	148 *(5.83)*	229 *(9.02)*
P2 max. blindé *shielded*	-	119 *(4.68)*	136 *(5.35)*	136 *(5.35)*	151 *(5.94)*	-

mm / *(inches)*

avec raccord droit étanche
with environmental straight backshell



avec raccord sortie filetée pour PG
with backshell for PG outlet



Couple de blocage des connecteurs / *Coupling torque*

Taille Size	02	04	07	19	27	61
N.m (0/-10%)	10	15	20	50	70	100

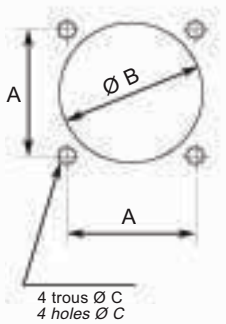
Standard CMC-CMB-CPP

Perçage cloison / *Panel cut out*

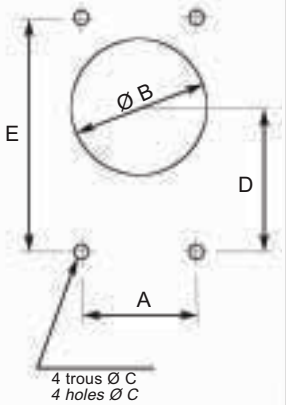
Taille *Size*	02	04	07	19	27	61
A	19,8 *(0.78)*	27 *(1.06)*	34 *(1.34)*	52 *(2.04)*	64 *(2.52)*	88 *(3.46)*
B	24,5 *(0.96)*	31,5 *(1.24)*	39,5 *(1.55)*	56,5 *(2.22)*	75 *(2.95)*	96 *(3.78)*
C	2,6 *(0.10)*	3,5 *(0.14)*	4,5 *(0.18)*	4,5 *(0.18)*	7 *(0.27)*	9,5 *(0.37)*
D	30 *(1.18)*	35 *(1.38)*	45 *(1.77)*	41,5 *(1.63)*	-	69 *(2.72)*
E	48 *(1.89)*	55 *(2.16)*	72 *(2.83)*	70 *(2.75)*	-	113 *(4.45)*

mm / *(inches)*

Embase à collerette carrée
Square flange receptacle



Patères 30° ou 45°
30° or 45° angle supports

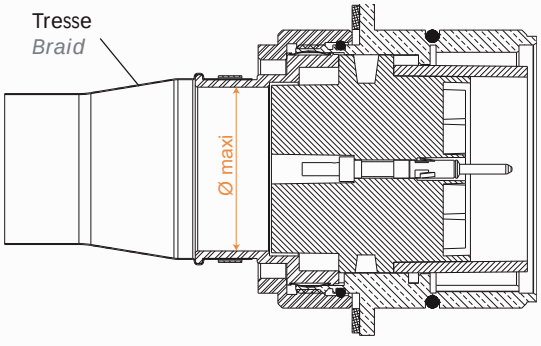


Note : Montage par l'avant / *Front mounted*

Entrée de faisceau de câbles dans le collecteur de tresse blindée
Cable bundle entry for shielded connectors

Taille *Size*	Ø maxi
04	13 *(0.51)*
07	18,50 *(0.73)*
19	31 *(1.22)*
27	46,5 *(1.83)*

mm / *(inches)*

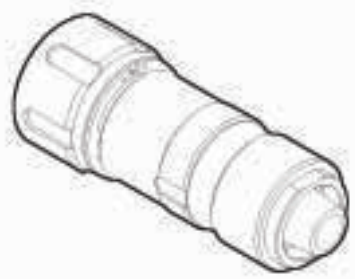


CMC-CMB-CPP Standard

Code de référence - Sortie des raccords droits étanches
Part number code - Environmental straight backshells outlet

CABLE Ø ext. sur gaine (mm) *INSULATION O.D.*		TAILLE DE BOITIER *Shell size*					
min.	max.	02	04	07	19	27	61
4	6	Nous consulter *Consult us*					
5.5	8			D			
7.5	10			E			
9.5	11.5			F			
12	13			H			
13.5	15.5						
13.5	17			L			
16	21			M			
16.5	20				N		
19.5	23.5				P		
22	28				Q		
30	36					W	W
31	33				T		
36	40						X
42	46						Z
44	48						Y

CODE CABLE / *CABLE INDEX* RD
Raccords droits étanches
Environmental straight backshells

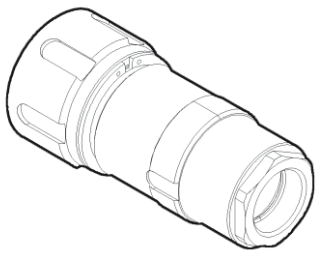


Fiche équipée d'un raccord droit étanche
Plug with environmental straight backshell

Code de référence - Sortie des raccords PG
Part number code - PG outlet backshells

PAS ELECTRIQUE P.G.	TAILLE DE BOITIER *SHELL SIZE*					
	02	04	07	19	27	61
9	D	D				
16		G	G			
21			H			
29				K	K	
36				L		
42					M	
48 DIN					N	N
48					P	P

Raccord sortie filetée
pas électrique PG PG
Backshell for PG outlet



Fiche équipée d'un raccord pour PG
Plug with backshell for PG outlet

Accessoires
Accessories

CMC-CPP-CMB

Système de référence des accessoires CMC-CPP / *CMC-CPP accessories part number*

CPP PT30 61 ***

GAMMES / *SERIES*

CMC - CPP

TYPES D'ACCESSOIRES
ACCESSORIE TYPES

PT30	Patère 30° / *30° angle support*
PT45	Patère 45° / *45° angle support*
PT90	Patère 90° / *90° angle support*
SD	Socle droit à 2 entrées *Wall mounting base with 2 entries*
BE	Bouchon pour embase à visser *Cover for receptacle*
BEB	Bouchon pour embase à baïonnette *Cover for receptacle with bayonet*
BF	Bouchon de fiche à visser *Cover for screw plug*
BFB	Bouchon de fiche à baïonnette *Cover for plug with bayonet*
BR	Boîte de repos / *Dummy socket*
BRB	Boîte de repos à baïonnette / *Bayonet dummy socket*
T	Tétine / *Hood*
JPC	Joint plat conducteur / *Conductive gasket*

MODIFICATIONS SPÉCIALES
SPECIAL MODIFICATIONS

***
Accessoires standard
Standard accessories

Note : Pour toutes modifications, nous consulter
For all modifications, consult us
Exemple : bouchons en polyamide
Example : Cover in polyamid

TAILLES DE BOITIERS
SHELL SIZES

02 - 04 - 07 - 19 - 27 - 61

Système de référence des accessoires CMB / *CMB accessories part number*

CMB BE 19 ***

GAMME / *SERIES*

CMB

TYPES D'ACCESSOIRES
ACCESSORIE TYPES

BE	Bouchon pour embase à visser *Cover for screw receptacle*
BEB	Bouchon pour embase à baïonnette *Cover for bayonet receptacle*
BF	Bouchon de fiche à visser *Cover for screw plug*
BFB	Bouchon de fiche baïonnette *Cover for bayonet plug*
BR	Boîte de repos / *Dummy socket*
BRB	Boîte de repos baïonnette / *Bayonet dummy socket*

MODIFICATIONS SPÉCIALES
SPECIAL MODIFICATIONS

***
Accessoires standard
Standard accessories

Note : Pour toutes modifications, nous consulter
For all modifications, consult us

TAILLES DE BOITIERS
SHELL SIZES

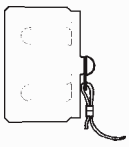
02 - 04 - 07 - 19 - 27 - 61

CMC-CMB-CPP

Accessoires
Accessories

Accessoires / *Accessories*

BE

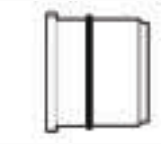


Bouchon pour embase
visser
Cover for receptacle

BEB

Bouchon pour embase
ba onnette
Cover for bayonet receptacle

BR



Bo te de repos
Dummy socket

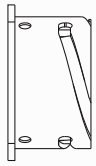
BF

Bouchon pour fiche
visser
Cover for plug

BFB

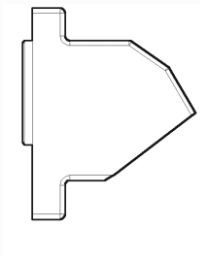
Bouchon pour fiche
ba onnette
Cover for bayonet plug

BRB



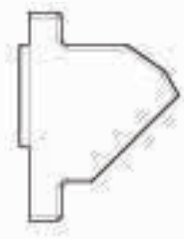
Bo te de repos
pour ba onnette
Bayonet dummy socket

PT30



Pat re 30
30° angle support

PT45



Pat re 45
45° angle support

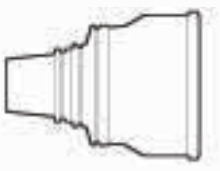
PT90

Patère 90°
90° angle support

JPC

Joint plat conducteur
Conductive gasket

T



T tine
Hood

Autre accessoire possible
Other accessories possible

SD

Socle droit 2 entr es
oppos es verticalement
Wall mounting base
with 2 entries

Carrier Kheops Bac

Boulevard Pierre Lefaucheux - ZI Sud - 72027 LE MANS CEDEX 2 (FRANCE)
Tél : +33 (0)2 43 61 45 45 - Fax : +33 (0)2 43 61 45 00

E-mail : ckb@compagnie-deutsch.com - Web : www.compagnie-deutsch.com

Edition Janvier 2000

Photo JM2 - Impression Renard, Le Mans

DETAILED INTERFACE SPECIFICATION

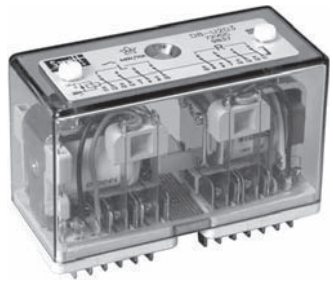
ANNEX C14
DZVR RELAY SPECIFICATION

DZVR Relay

MORS SMITT RELAIS
INSTANTANEOUS RELAYS - D8-U200

FEATURES:

- Conforms with IEC 571, IEC 77, EN 50155.
- Ultra compact space saving package size.
- Plug-in design with SNAPLOCK (built-in space saving locking feature so no retaining clip is needed) for maximum ease of maintenance - i. e. - no wires need to be disconnected or other hardware removed for relay inspection or replacement.
- Resistance to impact and vibration conform to standards in force for Railway Transported Equipment.
- Positive mechanical keying of relay to socket is accomplished by an integrated locking pin.
- Terminal identifications are clearly marked on the relay cover.
- Equipped with magnetic arc blow out for inductive loads
- Equipped with surge protection diode.



INSULATION MATERIALS

COVER	Polycarbonate
BASE	Polyester

Note: These materials have been tested for fire propagation and smoke emission .

GENERAL SPECIFICATIONS - ELECTRICAL

DESCRIPTION	Relay has 8 changeover contacts (Form C).
ACTION	Nominal load current: 10 Amps Instantaneous contact changeover with contact wiping action in both positions and magnetic arc blow-out.
CONTACT MATERIAL	Silver .
CONTACT RESISTANCE	Initial: 15 milliohms max. at 10 milliAmps.
DIELECTRIC STRENGTH	4000 VAC / 50 Hz for 1 minute between contacts. 2500 VAC / 50 Hz for 1 minute between contacts and coil.
INSULATION RESISTANCE	≥ 1000 Megohms at 500 VDC
COIL OVERVOLTAGE PROTECTION	Equipped with surge protection diode (standard).

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS
INSTANTANEOUS RELAYS - D8-U200

GENERAL SPECIFICATIONS - - MECHANICAL & ENVIRONMENTAL

OPERATING TEMPERATURE RANGE — -25°C TO 70°C.

OPERATING POSITION — May be mounted in any attitude.

CONTACT LIFE (MECHANICAL) — 30 million cycles.

WEIGHT — Relay: 330 grams (11.63 ounces).

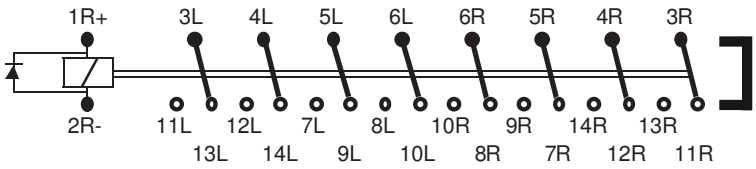
VIBRATION — Sine wave:
Frequency range 1-100 Hz, 2g, 2 hours in X,Y and Z direction
Random:
Frequency range 10-150 Hz, ASD level 0.005g²/Hz
(0.84 g RMS), 30 hours in X,Y and Z direction.

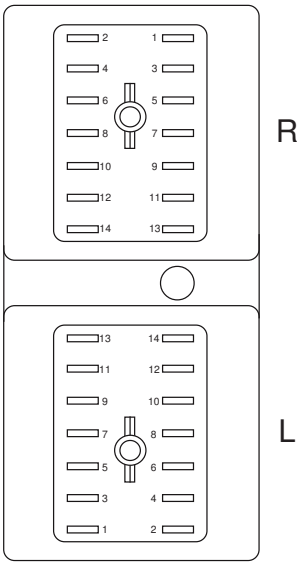
SHOCK — 3 shocks half sine wave 5g, 30ms, X,Y and Z direction.
(upwards and downwards)

SALT MIST — 5% NaCl, 35°C for 4 days (IEC68, test Ka).

HUMIDITY — 90%

SCHEMATIC AND RELAY PIN CORRESPONDANCE





Relay pin correspondence
(rear view of relay shown)

MECHANICAL OUTLINE & MOUNTING HOLE LAYOUTS — REFERENCE "LD8-U"

DYNAMIC RELAY SELECTION CURVES — REFERENCE "CD-U"

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS
INSTANTANEOUS RELAYS - D8-U200

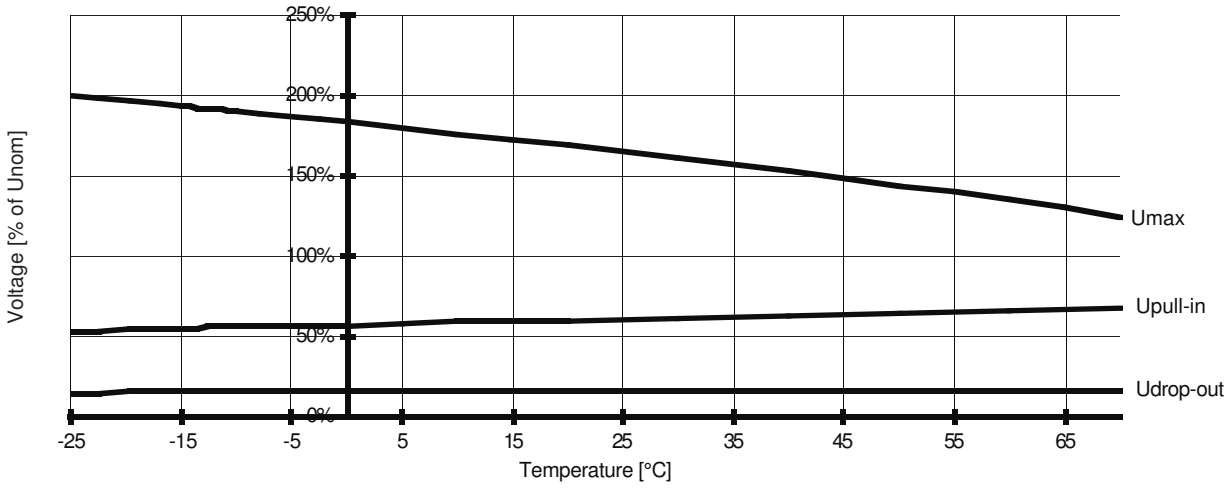
STANDARD MODELS WITH COIL DATA & CONTACT DATA

	TYPE	D8-U201	D8-U202	D8-U203	D8-U204	D8-U205	D8-U206	D8-U207
COIL DATA	NOMINAL VOLTAGE‡	24 VDC	48 VDC	72 VDC	110 VDC	96 VDC	12 VDC	36 VDC
	VOLTAGE RANGE	16.8 - 30	33.6 - 60	50.4 - 90	77 - 137.5	67.2 - 120	8.4 - 15	25.2 - 45
	NOMINAL POWER	2.8 Watts						
	PULL IN & DROP OUT VOLTAGES	SEE DIAGRAM "COIL VOLTAGE VS ENVIRONMENTAL TEMPERATURE DIAGRAM"						
	RESISTANCE (OHMS)	222	680	1500	3790	3790	100	500
	TIME CONSTANT (L/R)	8 ms						
CONTACT DATA	NOMINAL CURRENT	10 Amps AC Resistive, according to IEC 947 (AC1)						
	SPECIFIED BREAKING CAPACITY & LIFE	1 Amp @24VDC	L/R = 0 ms	Electrical life: 5.5 million ops				
		0.5 Amp @ 110VDC	L/R = 40 ms	Electrical life: 1 million ops				
		1 Amp @ 220V, 50Hz	PF = 1	Electrical life: 3.5 million ops				
	PULL-IN TIME	20 ms						
	RELEASE TIME	12 ms						
	MINIMUM CONTACT CONTINUITY	12 V, 10 mA						
	NO. OF CONTACTS	8 changeover contacts (Form C)						
	CONTACT MATERIAL	Silver						

‡ - other voltages on request

COIL VOLTAGE VS ENVIRONMENTAL TEMPERATURE DIAGRAM

Use this curve to assess voltage range limits in function of environmental temperature.

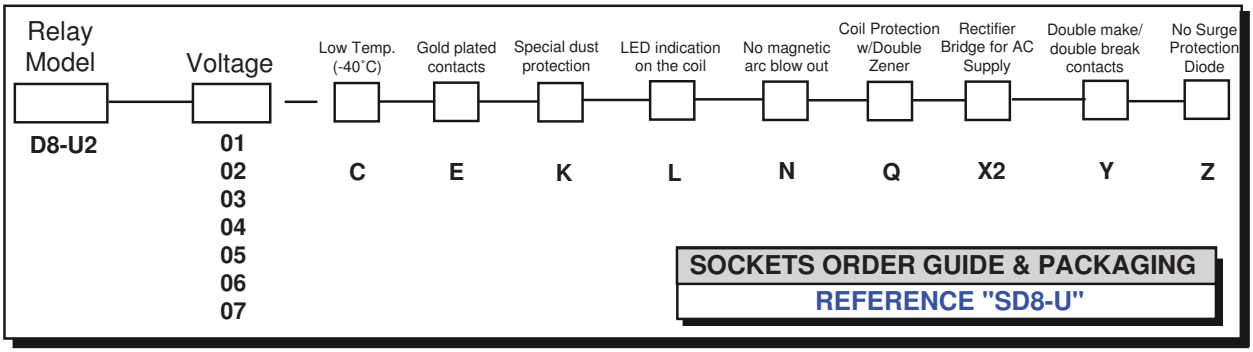


SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS
INSTANTANEOUS RELAYS - D8-U200

MODEL D8-U200 - RELAY ORDER GUIDE

To specify a relay, a complete part number must first be determined.
The boxes below have brief descriptions of the options above and the allowable option suffixes beneath.
Complete descriptions of the options are listed below.
Simply fill in all boxes with selected option suffixes for the complete part number.



SOCKETS ORDER GUIDE & PACKAGING
REFERENCE "SD8-U"

- Relay Model:	**D8-U2**		Specify for all part numbers.
- Voltage:	**01**	=	**24 VDC**
	02	=	**48 VDC**
	03	=	**72 VDC**
	04	=	**110 VDC**
	05	=	**96 VDC**
	06	=	**12 VDC**
	07	=	**36 VDC**
			(Select one from above and specify)
- Low Temperature (-40˚C):			option not selected
	C		option selected
			(Select one from above and specify)
- Gold plated contacts:			option not selected
	E		option selected
			(Select one from above and specify)
- Special dust protection:			option not selected
(unremovable cover)	**K**		option selected
			(Select one from above and specify)
- LED indication on the coil:			option not selected
	L		option selected
			(Select one from above and specify)
- No magnetic arc blow out:			option not selected
	N		option selected
			(Select one from above and specify)
- Coil Protection with Double Zener:			option not selected
	Q		option selected
			(Select one from above and specify)
- Rectifier Bridge for AC Supply:			option not selected
	X2		option selected
			(Select one from above and specify)
- Double make/double break:			option not selected
(only 4z contact will remain)	**Y**		option selected
			(Select one from above and specify)
- No Surge Protection Diode:			option not selected
	Z		option selected
			(Select one from above and specify)

Examples of complete relay part numbers:
D8-U201-CE
D8-203-LY

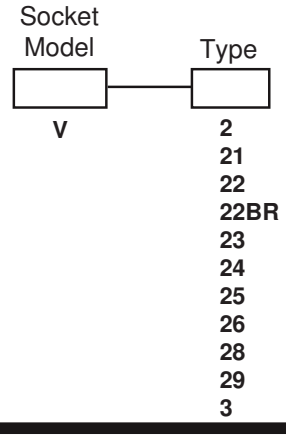
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS

SOCKET ORDER GUIDE AND PACKAGING - SD-U

SOCKET ORDER GUIDE

To specify a socket, a complete part number must first be determined.
The boxes below have brief descriptions of the options above and the allowable option suffixes beneath.
Complete descriptions of the options are listed below.
Simply fill in all boxes with selected option suffixes for the complete part number.



- Socket Model:	**V**	Specify for all part numbers.
- Type :	**2**	Front mount - for bare wire or pin terminals or one wire 2.5 mm²
	21	DIN-rail mount - for bare wire or pin terminals or one wire 2.5 mm²
	22	Front mount - for ring or fork terminals 7.5 mm or two wires 2.5 mm²
	22BR	Front mount - for ring or fork terminals 9 mm or two wires 2.5 mm²
	23	DIN-rail mount - for ring or fork terminals 7.5 mm or two wires 2.5 mm²
	24	Front mount - for faston 6.3 mm or 2 fastons 2.8 mm
	25	DIN-rail mount - for faston 6.3 mm or 2 fastons 2.8 mm
	26	Panel mount - with direct crimp-on contacts A260
	28	Front mount - cage clamp connection for 2 wires up to 2.5 mm²
	29	DIN-rail mount - cage clamp connection for 2 wires up to 2.5 mm²
	3	Panel mount / PCB mount - with solder contacts (Select one from above and specify)

Examples of complete socket part numbers:
V21
V22BR

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS

SOCKET ORDER GUIDE AND PACKAGING - SD-U

PACKAGING & MISCELLANEOUS

All relays are packaged in batches of 5 in a transparent plastic container.

V2/V21 socket	Shrink wrap in package of 5
V22/V23 socket	Shrink wrap in package of 5
V22BR socket	Bulk
V24/V25 socket	Shrink wrap in package of 5
V28/V29 socket	Shrink wrap in package of 5
V3 socket	Bulk
V26 socket	Bulk
A260 contact	Bulk in bag of 100 pieces

V2 SOCKET
(PA 66, 6% GF)

V21 SOCKET
(PA 66, 6% GF)

V22 SOCKET
(PA 66, 30% GF)

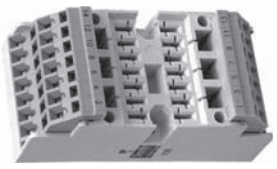
V22BR SOCKET
(PPS)

V23 SOCKET
(PA 66, 30% GF)

V24 SOCKET
(PA 66, 30% GF)

V25 SOCKET
(PA 66, 30% GF)

V26 SOCKET
(PA 66, 30% GF)



V28 SOCKET
(PA 66, 35% GF, class 2 according to NFF16102)

V29 SOCKET
(PA 66, 35% GF, class 2 according to NFF16102)

V3 SOCKET
(MF)

A260 CONTACTS

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

DETAILED INTERFACE SPECIFICATION

ANNEX C15
SIR RELAY SPECIFICATION

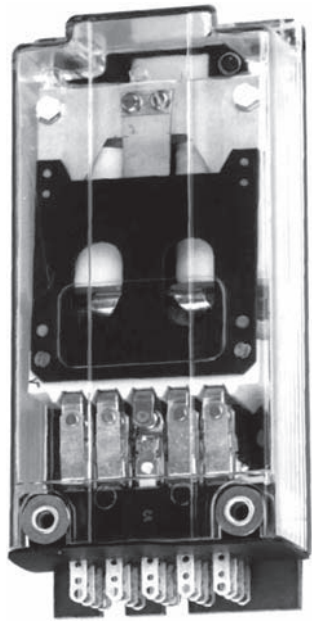
SIR Relay

MORS SMITT RELAIS

INSTANTANEOUS RELAYS - C

FEATURES:

- Conforms with French Railway Standard CF 62 - 002.
- Ultra-compact space saving package size.
- Plug-in design with secure locking feature for maximum ease of maintenance - i. e. - no wires need to be disconnected or hardware removed for relay inspection or replacement.
- Resistance to impact and vibration conform to standards in force for Railway Transported Equipment.
- Positive mechanical keying of relay to socket.
- For safe installation or replacement, key combination is different according to voltage or function (instantaneous, latching, timer...).
- Terminal identifications are clearly marked on identification plate that is permanently attached to the relay.
- Weld no transfer safety contacts are standard.



INSULATION MATERIALS

COVER	Polycarbonate Resin
BASE	Phenalic Compound

Note: These materials have been tested for fire propagation and smoke emission according to Standards NFF16101 and NFF16102 and have been approved to go on the English/French Train Channel Shuttle.

GENERAL SPECIFICATIONS - ELECTRICAL

DESCRIPTION	Relay has 9 double break contacts (Forms X & Y - per customers specification) in all NO and NC combinations.
ACTION	Nominal load current: 8 Amps. (according to CF 62-002) Instantaneous contacts with contact wiping action in both positions.
CONTACT MATERIAL	Hard silver overlay laminated to copper.
CONTACT RESISTANCE	Initial: 10 milliohms max. at 8 Amps. End of life: 40 milliohms max. at 8 Amps.
DIELECTRIC STRENGTH	2200 VAC for 1 minute between contacts. 2600 VAC for 1 minute between contacts, coil and frame.
INSULATION RESISTANCE	≥ 1000 Megohms at 500 VDC.
CONTACT OVERLOAD WITHSTAND	At 24 VDC contacts will withstand 160 Amps at L/R = 0 for 10 ms duration for 10 operations at the rate of 1 operation per minute.
COIL OVERVOLTAGE PROTECTION	To reduce or eliminate spurious EMI interference, an optional double zener diode (Transil) can be supplied connected to the coil.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS
INSTANTANEOUS RELAYS - C

GENERAL SPECIFICATIONS - - MECHANICAL & ENVIRONMENTAL

OPERATING TEMPERATURE RANGE — -40°C TO 80°C.

OPERATING POSITION — May be mounted in any attitude, however, we recommend the following: If relay is mounted vertically,the direction of contact closure should be oriented transverse to the direction of forward motion. If relay is mounted horizontally, it should be oriented so that gravity will cause the contacts to revert to their de-energized position.

CONTACT LIFE (MECHANICAL) — 100 million cycles.

WEIGHT — Relay: 400 grams (14.1 ounces).

VIBRATION — Tests are conducted in the X, Y & Z planes at resonant frequency between 5 & 50 cycles at 1 g, or if indeterminate at 10 HZ (sinusoidal).

SHOCK — Tests are applied in both directions in the X, Y & Z planes. Three successive shocks are administered consisting of the positive component of sinusoidal with a value of 30 g, 11 milliseconds.

HUMIDITY — 93% RH, 40° C for 4 days.

SALT MIST — 5% NaCl, 35° C for 4 days.

MECHANICAL OUTLINE & MOUNTING HOLE LAYOUTS — REFERENCE "LC"

DYNAMIC RELAY SELECTION CURVES — REFERENCE "CC"

COIL DATA & CONTACT DATA

COIL DATA	NOMINAL VOLTAGE	24 VDC	36 VDC	48 VDC	72 VDC	110 VDC	220 VAC
	OP. VOLTAGE RANGE	16/33	25/45	33./60	48/90	77/138	176/242
	NOMINAL POWER	4.8 Watts	4.8 Watts	4.6 Watts	5.2 Watts	5 Watts	4 VA
	HOLD SPECIFIED	13.5 VDC	21 VDC	28.5 VDC	40.5 VDC	60 VDC	129 VDC
	DROPOUT SPECIFIED	2.5 VDC	3.5 VDC	4.5 VDC	6.5 VDC	11.5 VDC	21 VDC
	RESISTANCE (OHMS)†	120	270	500	1000	2400	12000
	TIME CONSTANT (L/R)‡	25 ms	25 ms	25 ms	25 ms	25 ms	25 ms

CONTACT DATA	NOMINAL CURRENT	8 Amps (Resistive)		
	SPECIFIED BREAKING CAPACITY & LIFE	2.4 Amps at 72 VDC	Time constant: 0 ms	Electrical life: 5,000,000 operations
		0.8 Amps at 72 VDC	Time constant: 30 ms	Electrical life: 2,000,000 operations
		2.4 Amps at 220 VAC, 50 Hz.	Power factor=1	Electrical life: 2,500,000 operations
		Lamp filament circuit: 160 watts at 72 VDC		Electrical life: 500,000 operations

	Pick-up	Drop-out*
CONTACT CLOSURE TIME	NO: less than 45 ms.	NC: less than 35 ms
CONTACT OPENING TIME	NC: less than 30 ms	NO: less than 8 ms

MINIMUM CONTACT CONTINUITY	20 milliamps at 24 VDC
NO. OF CONTACTS	9 double break contacts (Form X & Y)
CONTACT MATERIAL	Hard silver overlay laminated to copper

* = with P option less than 70 ms † = Coil resistance tol.: ± 8% at 20° C ‡ = valid for closed relay

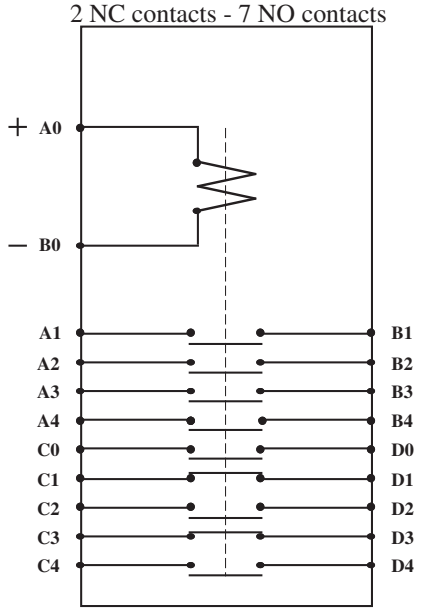
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS

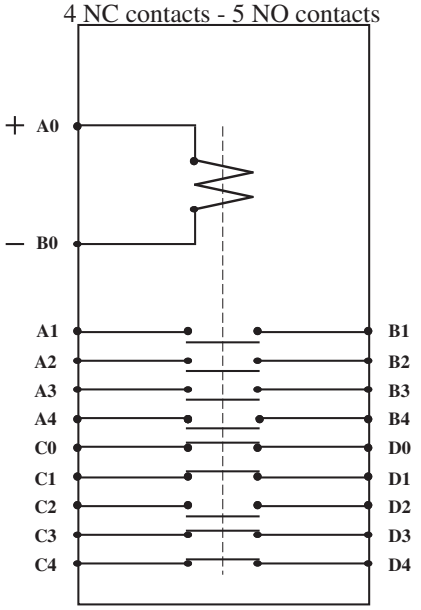
INSTANTANEOUS RELAYS - C

SCHEMATICS AND RELAY PIN CORRESPONDENCE

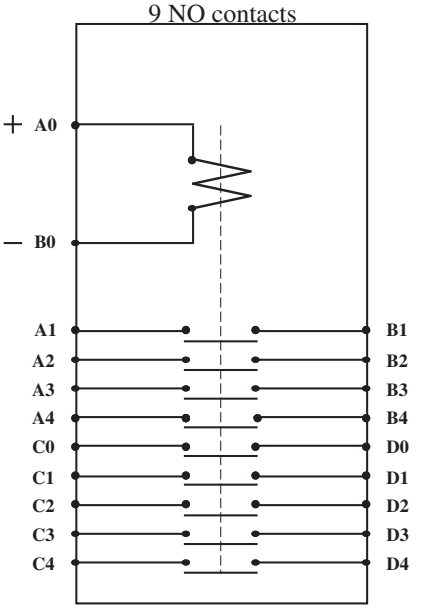
Schematic #1
2 NC contacts - 7 NO contacts



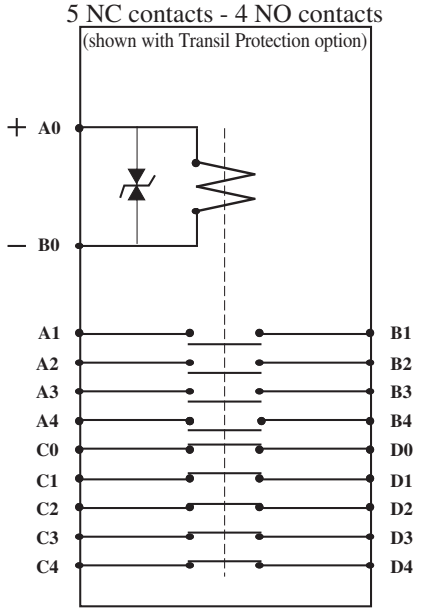
Schematic #2
4 NC contacts - 5 NO contacts



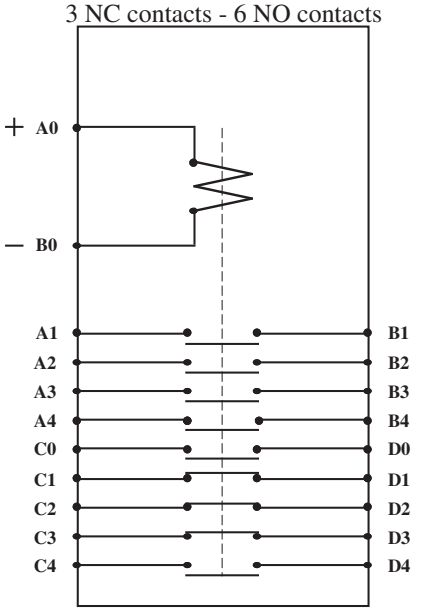
Schematic #3
9 NO contacts



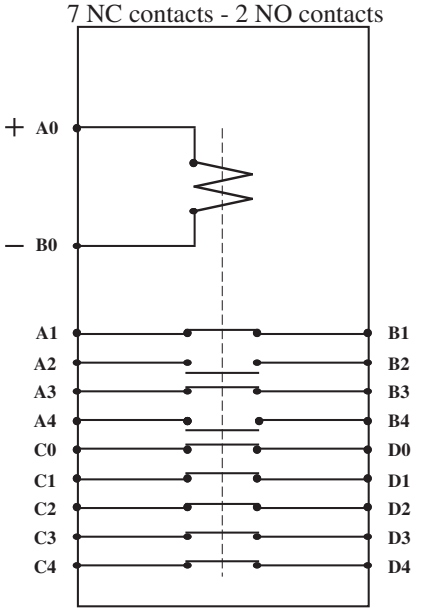
Schematic #4
5 NC contacts - 4 NO contacts
(shown with Transil Protection option)



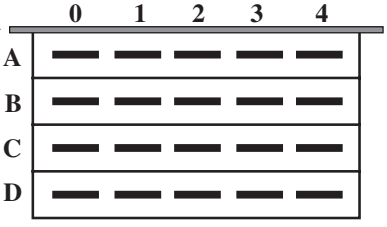
Schematic #5
3 NC contacts - 6 NO contacts



Schematic #6
7 NC contacts - 2 NO contacts



Keying Plate



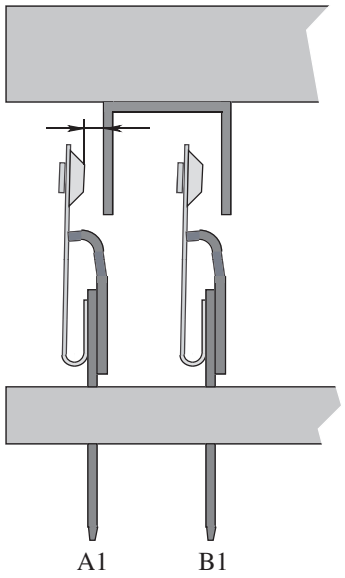
Relay pin correspondence
(rear view of relay shown)

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS
INSTANTANEOUS RELAYS - C

DOUBLE BREAK CONTACTS DESIGN

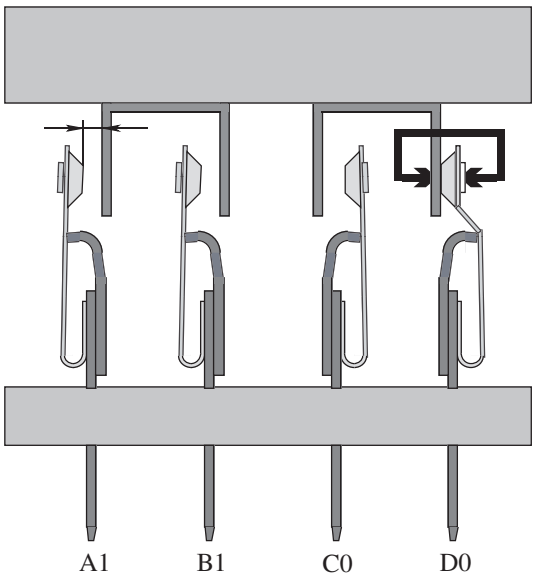
Double break contacts extend the contact life on highly inductive DC currents.



WELD NO TRANSFER CONTACTS DESIGN

WELD NO TRANSFER FUNCTION:

If one NO contact welds, no NC contact can close (and visa versa) and cause an overlapping of functions. All relays are factory tested to insure they meet this important safety requirement. 150% of max. operating voltage is applied to the relay while holding 1 NC contact closed by mechanical means. Under these conditions, it is verified that no NO contact makes.

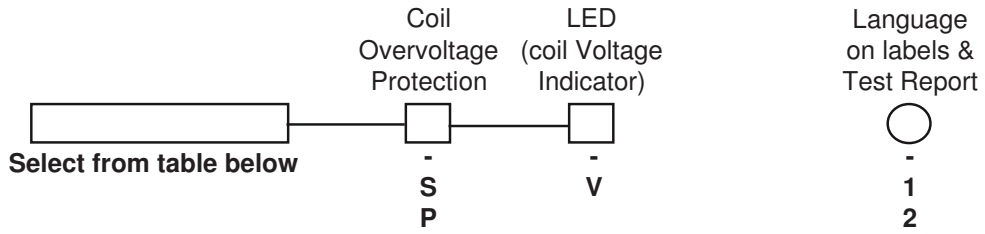


SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS
INSTANTANEOUS RELAYS - C

MODEL C - RELAY ORDER GUIDE

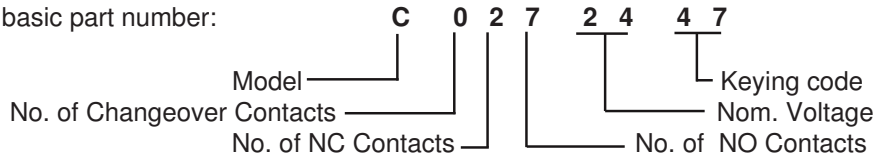
To specify a relay, a complete part number must first be determined.
The boxes below have brief descriptions of the options above and allowable option suffixes beneath.
Complete descriptions of the options are listed below.
Simply fill in all boxes with selected option suffixes for the complete part number.



Relay basic part number: Note - table shows standard part no's. - others available on request.

Nom. Voltage	Schematic #1	Schematic #2	Schematic #3	Schematic #4	Schematic #5	Schematic #6
24 VDC	**C 027 24 47**	**C 045 24 45**	**C 009 24 3D**	**C 054 24 49**	**C 036 24 811**	**C 072 24 68**
36 VDC	**C 027 36 16**	**C 045 36 35**	**C 009 36 46**	**C 054 36 48**	**----**	**C 072 36 511**
48 VDC	**C 027 48 89**	**C 045 48 19**	**C 009 48 6C**	**C 054 48 711**	**C 036 48 410**	----
72 VDC	**C 027 72 11B**	**C 045 72 69**	**C 009 72 15**	**C 054 72 8D**	**C 036 72 2E**	**C 072 72 1F**
110 VDC	**C 027 110 4F**	**C 045 110 38**	**C 009 110 1J**	**C 054 110 14**	**----**	**C 072 110 7F**
220 VAC	**C 027 220 1011**	**C 045 220 4C**	**C 009 220 5C**	**C 054 220 611**	**C 036 220 4E**	**----**

Explanation of relay basic part number:



Coil Overvoltage protection:
- **-** Indicates no coil protection.
- **S** Indicates Transil coil protection.
- **P** Indicates controlled avalanche diode coil protection.

(Select one from above)

LED (coil voltage indicator)
- **-** Indicates without LED.
- **V** Indicates with LED.

(Select one from above)

Language used on labels Parameters Test Report
- **-** French
- **1** English
- **2** Spanish

(Select one from above)

Example of complete relay part number: C 027 24 47 S V - 1

SOCKETS ORDER GUIDE & PACKAGING
REFERENCE "SC"

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Notes...

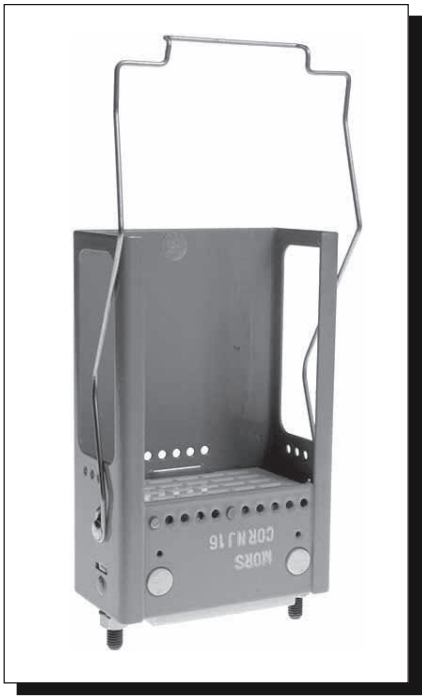
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS

SOCKET ORDER GUIDE AND PACKAGING - SC

SOCKET AND LOCKING MECHANISM ORDER GUIDE

- Base, socket & frame assembly with locking spring:



SOCKET
(Alkyde Compound)

For Model C Relay:
Part Number: 153879 TYPE COR NJ ☐
(indicate keying code from (relay) table) ⌐T
For Model C 1019 Relay:
Part Number: 153879 TYPE COR NJ5F or COR NJ311
For Model CM Relay:
Part Number: 926913 TYPE COR NJ37
For Model C 1020 B Relay:
Part Number: 153879 TYPE COR NJ11B
For Model C 1022 B Relay:
Part Number: 153879 TYPE COR NJ47

PACKAGING & MISCELLANEOUS

Each relay is packaged in an individual sealed bag with Parameters Test Report for shipment. Prior to packaging, each relay is keyed by the factory with orientation codes for the keys.

Each socket (153879 TYPE COR NJ and 926913 TYPE COR NJ) is packaged in a box. Prior to packaging, each socket is keyed by the factory with orientation codes for the keys.

Panel mounting hardware for the M5 threaded studs, which are part of the socket, consists of 2 each nuts and lockwashers and are hand tightened to the studs prior to bagging for shipment. The recommended installation torque is 1.7 Nm (1.25 ft-lbs.).

Note that exact quantity of hardware is provided. Additional spare parts kits are available and may be ordered separately.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS

SOCKET ORDER GUIDE AND PACKAGING - SC

Notes...

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MORS SMITT RELAIS

SOCKET ORDER GUIDE AND PACKAGING - S300

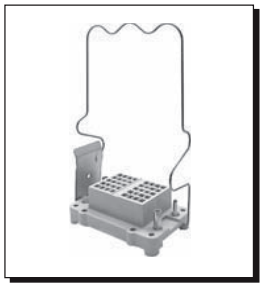
SOCKET AND LOCKING MECHANISM ORDER GUIDE

Sockets with locking spring:

153913 TYPE COR NK 58D ☐ _____ Indicates socket without guide.

(Polyester Melamine)

(Indicate keying code from relay table)



907983 TYPE COR PA 58D ☐ _____ Indicates socket with guide.

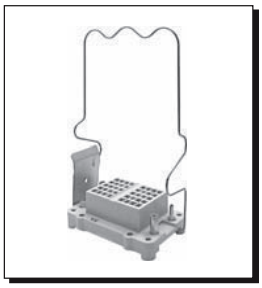
(Polyester Melamine)

(Indicate keying code from relay table)

To use with standard 303 Relays

160967 TYPE COR SA _____ Indicates socket without guide.

(Polyester Melamine)



To use with Relay 303S

(Select one from above and specify)

PACKAGING & MISCELLANEOUS

Each Model serie 300 relay is tested and individually packaged in a sealed bag. Prior to packaging, each relay is keyed by the factory. A Test Report for each lot of relays is provided with shipment.

Each COR NK, COR PA and COR SA socket with Spring Lock assembled is packaged in a box. Prior to packaging, each socket is keyed by the factory.

All sockets include 4 holes for M5 Threaded mounting bolts. Mounting hardware is not supplied.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

DETAILED INTERFACE SPECIFICATION

ANNEX C16
ATC-TMS COMMUNICATION PROTOCOLS REV.F

81-7271-1A

MITSUBISHI ELECTRIC CORPORATION

TITLE: INTERFACE BETWEEN TMS AND ATC

CUSTOMER: **MTR CORPORATION LIMITED**

PROJECT:

MODEL NO. :**TRAIN MANAGEMENT SYSTEM (TMS)**

ORDER NO.:

FR. NO.OF	R.DATE	DWG.SEC	2 SYM.	K.	S.	PRINT	DUP.DIST
SKIP	DUP	8 3 2	7 C		4		

CHANGE [DATE]											
	A	28 Jun. 2008	F	01 Feb. 2010							
	B	31 Aug.2009									
	C	24 Sep. 2009									
	D	26 Oct. 2009									
	E	13 Nov. 2009									

release of drawing	MITSUBISHI ELECTRIC CORPORATION., JAPAN			
	DRAWN	CHECKED	APPROVED	DOCUMENT NO.
	H.Kusaka Apr., 21, 2008	Y. Fujimoto	Y. Fujimoto	JHAV431

81-7271-3

CHANGED

REV.	CONTENTS	DRAWN DATE	CHECKED	APPROVED
A	All pages were reviewed and modified.	H. Kusaka 27 Jun. 08	E. Fushimi	E. Fushimi
B	- According to PS Annex 3 Attachment, AF15-AF0 were added to detect the ATC failures. (p. 9, 10-1, 10-2) - According to MTRC's information, Destination code list and Station code list were updated. (p. 12, 13)	H. Kusaka 31 Aug. 09	Y. Fujimoto	Y. Fujimoto
C	- According to MTRC's information(e-mail on 24 Sep. 2009), fault name of AF4 and AF5 were changed.(p. 10-2)	H. Kusaka 24 Sep. 09	Y. Fujimoto	Y. Fujimoto
D	- According to MTRC's information(e-mail on 19 Oct. 2009), ATC failure code table were changed.(p. 10-2)	Y. Tanaka 26.Oct. 09	H. Kusaka	M. Takeyama
E	- According to MTRC's information(e-mail on 9 Nov. 2009), fault name of AF0 and AF1 were changed.(p. 10-2)	M. Iida 13.Nov. 09	H. Kusaka	Y. Fujimoto
F	- According to MTRC's information(e-mail on 26 Jan. 2010), fault name of AF3 was changed.(p. 10-2E) - The error in writing of station name was corrected from "TKS" to "LHP".(p. 13)	M. Iida 13.Nov. 09	H. Kusaka	M. Fujimoto

MITSUBISHI ELECTRIC CORPORATION., JAPAN

CHANGE								DOCUMENT NO.	
A	27 Jun. 08	C	24 Sep. 09	E	13 Nov. 09			JHAV431	2 /
B	31 Aug. 09	D	26 Oct. 09	F	01 Feb. 10				

81-7271-4

CONTENTS

NO.	TITLE	PAGE
1	Application	4
2	Configuration	4
3	Transmission Specification	5
	3.1 Physical Interface	5
	3.2 Package format	5
4	Data Explanation	7
	4.1 From TMS to ATC	7
	4.2 From ATC to TMS	9
5	Communication Procedure	14

1. Application

This document details the interface specification between TMS(Train Management System) and ATC(Automatic Train Control) system.

2. Configuration

The interface configuration is shown as follows.

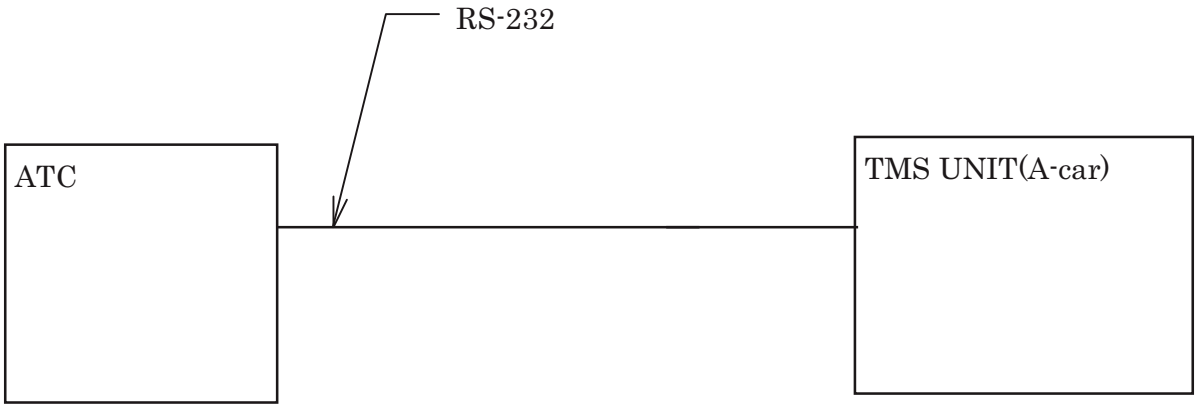


Fig. 2 Interface configuration between TMS and ATC

3. Transmission Specification

3.1 Physical Interface

(1) Wire	Shielded twisted cable (3 signals Tx, Rx and GND)
(2) Network topology	Point-to-point connection
(3) Transmission method	Asynchronous
(4) Protocol	Compliant with NF F 72010 standard
(5) Baud rate	9600 bps
(6) Transmission signal	RS-232C(full-duplex)
(7) Character format	Start bit : 1 bit Data bit : 7 bit Parity bit : 1 bit(Even parity) Stop bit : 1 bit

(8) The bits are sent from the LSB to the MSB

3.2 Package Format

(1) Message Structure

STX	Message Number	Repeat number	Useful Characters	LP	Number of Char 1	Number of Char 2	CR
Characters of service				Characters of service			

- STX : Start of message [STX = 02H]
- Message Number:
  ASCII Character from " 0" to " 3" means 30H, 31H, 32H or 33H.
  The first message starts at " 0".
  For a new message the value is increased by 1 modulo 4.
  The message is not increased when the message is repeated.
  The message is repeated when the ACK character is not replied within the acknowledge delay ΘA (maximum delay).
- Repeat Number:
  ASCII Character from " 1" to " 3" means 31H, 32H or 33H.
  The first message starts at " 1".
  For a repeated message the value is increased by 1 up to " 3".
  If the ACK message is not received the message is transmitted again with an increased repeat number.
  Maximum repeat number is 3.

The repetition delay is ΘA (maximum delay).

- Useful characters:
  DATA size (N) : from TMS to ATC : 7 useful characters
  : from ATC to TMS : 17 useful characters

- LP (Longitudinal parity):
  The longitudinal parity is a XOR of bytes of the message excluding STX, Parity (LP), the number of characters (Nb char) and CR.
  Bit 7 is set to 1.
  The XOR is applied to Message Number, Repeat number and the useful characters.

- Number of characters 1 & 2:
  The number of characters include all the characters from STX to LP.
  from TMS to ATC : 7+4 (0BH)
  Nb 1: 30H (“ 0”)
  Nb 2: 42H (“ B”)

  from ATC to TMS : 17+4 (15H)
  Nb 1: 31H (“ 1”)
  Nb 2: 35H (“ 5”)

- CR: End of message character: CR=0DH

The time delay STX to CR is within 200ms.

- ACK: Acknowledge character: ACK=06H
  The time delay from CR reception to ACK send is within 1 sec.

4. Data Explanation

4.1 From TMS to ATC

a) Data Structure (unoccupied cab)

Char.	Description	Bit number						
		7	6	5	4	3	2	1
1	Equipment failures	1	1	1	FC9	FC8	FC7	FC6
2		1	1	1	FC5	FC4	FC3	FC2
3		1	1	1	FC1	FC0	CT1	CT0
4		1	1	1	FN8	FN7	FN6	FN5
5		1	1	1	FN4	FN3	FN2	FN1
6		1	1	1	FN0	FS	FR	0
7	Fault identification	1	1	1	1	0	1	0

b) Code explanation

(1) Equipment failures

Equipment failures consists of the Fault car number, Fault car type, Fault number and Fault Set/Reset status.

- Fault car number(FC9 - FC0)

  This is 10 bit number with range of (0 to 1023) indicating car number the fault/event detected by the TMS.

- Fault car type(CT1 - CT0)

  This is a 2 bit number with range 0f (0 to 3) indicating the car type the fault/event detected by the TMS.

A-car : 0

B/B1-car : 1

C/C1-car: 2

- Fault number(FN8 to FN0)

This is a 9 bit number with range of (0 to 511) indicating fault number the fault/event detected by the TMS.

- Fault set/reset status(FS and FR)

This is a 2 bit data indicating the set/reset status of a fault.

A fault/event is detected : FS=1, FR=0

A fault/event is cleared : FS=0, FR=1

(4) Fault identification

The fault identification with fixed value(7AH) is set by the TMS.

4.2 From ATC to TMS

a) Data format (occupied cab)

Char.	Description		Bit number						
			7	6	5	4	3	2	1
1	Train Run Number	Destination code	1	1	1	D7	D6	D5	D4
2			1	1	1	D3	D2	D1	D0
3		Time table code	1	1	1	TT7	TT6	TT5	TT4
4			1	1	1	TT3	TT2	TT1	TT0
5		Train number	1	1	1	TN15	TN14	TN13	TN12
6			1	1	1	TN11	TN10	TN9	TN8
7			1	1	1	TN7	TN6	TN5	TN4
8			1	1	1	TN3	TN2	TN1	TN0
9	Station identification		1	1	1	L2	L1	L0	S4
10			1	1	1	S3	S2	S1	S0
11	Station characteristic		1	1	1	PS1	PS0	0	PT
12	System identification		1	1	1	NR3	NR2	NR1	NR0
13	Special message code		1	1	1	MC3	MC2	MC1	MC0
14	On board ATC		1	1	1	AF15 B ~~0~~	AF14	AF13	AF12
15	equipment failures		1	1	1	AF11	AF10	AF9	AF8
16			1	1	1	AF7	AF6	AF5	AF4
17			1	1	1	AF3	AF2	AF1	AF0

b) Code explanation

(1) Destination code(D7 to D0)

This is an alphabetical character in ASCII format. The meaning of the code are shown in Table 4.2.1.

(2) Time table code(TT7 to TT0)

Time table code is not used by TMS.

(3) Train number(TN15 to TN0)

This is a 16 bit code which consist of two numerical code in ASCII format.
TN0 to TN7 is the unit digit and TN8 to TN15 is tens digit.
The range of train number are shown in Table 4.2.1.

(4) Station identification

The station identification consists of the Station number and Line number .

- Station number(S4 - S0)

This is a 5 bit code indicating the next station to which the train travel or is traveling.
The station code is updated once the train depart from the station.
The meaning of the station number are shown in Table 4.2.2.

- Line number(L2 to L0)

This is a 3 bit code indicating the line the train is currently running.

Island line - up track : 1
Island line - down track : 2
Kwun Tong Line - up track : 3
Kwun Tong Line - down track : 4
Tsuen Wan Line - up track : 5
Tsuen Wan Line - down track : 6
Tseung Kwan O Line - up track : 7
Tseung Kwan O Line - down track : 0

(5) Station characteristics

The station characteristics consists of the Platform side and Platform screen door.
These data is set to "0" once the train start from station, and is set to correct status before the train enter the next station.

- Platform side(PS1 and PS0)

This is a 2 bit code indicating the platform side in the next station.

Undefined : PS1=0, PS0=0
Left side : PS1=1, PS0=0
Right side : PS1=0, PS0=1
Both left and right : PS1=1, PS0=1

- Platform screen door(PT)

Platform screen door is not used by the TMS.

(6) System Identification (NR3, NR2, NR1, NR0)

The 4 bits are used in conjunction with line number (5 bits) to represent expansion possibilities.

(7) Special message code (MC0,MC1,MC2,MC3)

The Special message code is used for change operation and driverless turnaround operation.
TMS transmits this code to DVAS.

(8) On board ATC equipment failures

TMS is B ~~not~~ required to store and display these fault codes.

[Remark]

For sending DTO message,
Char.1 to 12 = [70H]
Char.13 = [71H]

For sending other PA message,
Char.1 to 12 = [contents as demanded]
Char.13 = [70H]

B This page added.

Table 4.20 ATC failure code table

CODE	Failure abbreviation	Failure meaning	Level	Remarks
AF0	AF0	ATC is halt ~~ATC PCE Failure~~	1 ~~3~~	SACEM COMPUTER LOCKED UP E ~~PCE_FAILURE~~
AF1	AF1	ATC is delocalized ~~ATC PS Failure~~	1 ~~3~~	SACEM DELOCALIZED E ~~PAV_PS_FAILURE~~
AF2	AF2	PSD Failed to Open ~~ATC Fallback Failure~~	1 ~~3~~	PSD FAILED TO OPEN ~~PAV_FB_FAILURE~~
AF3	AF3	PSD Closed F ~~PSD Opened~~ ~~ATC RC Failure~~	3	PSD CLOSED F ~~PSD OPENED~~ D ~~PAV_RC_FAILURE~~
AF4	AF4	~~ATC Odometer 4A Failure~~	~~3~~	~~ODO_3A C 4A_FAILURE~~
AF5	AF5	~~ATC Odometer 3B Failure~~	~~3~~	~~ODO_4B C 3B_FAILURE~~
AF6	AF6	~~ATC CT Sensors Failure~~	~~3~~	~~CT_SENSOR_FAILURE~~
AF7	AF7	~~ATC Antenna Failure~~	~~3~~	~~ANTENNA_FAILURE~~
AF8	AF8	~~Speedometer Failure~~	~~3~~	~~SPEEDO_FAILURE~~
AF9	AF9	~~ATC Indicator Failure~~	~~3~~	~~LAMP_FAILURE~~
AF10	AF10	~~SACEM Localisation Fault~~	~~3~~	~~SACEM_LOC_FAULT~~
AF11	AF11	~~ATC EB Fault~~	~~3~~	~~EB_FAULT~~
AF12	AF12	~~PSD Fault~~	~~3~~	~~PSD_FAULT~~
AF13	AF13	~~DTO Fault~~	~~3~~	~~DTO_FAULT~~
AF14		(Speed signal for DVAS only)	N.A.	COMPLETE_STOP
AF15		(Spare)		D

Table 4.2.1 Train number / Destination code table

LINE	TRAIN No. RANGE	TRACK	DESTINATION CODE		
			MEANING	CHAR.	CODE
Kwun Tong Line (KTL)	01 - 39	Up track	Choi Hung reversing	E	45H
			Choi Hung for Depot	K	4BH
			Kwun Tong Centre Siding	Y	59H
			QUB Reversing	Q	51H
			Kwun Tong Reversing	F	46H
			Shek Kip Mei Revering	M	4DH
			North Point reversing	V	56H
			Tiu Keng Leng reversing	G	47H
		Down track	KBD South End	H	48H
			CHH for Depot	J	4AH
			Shek Kip Mei Reversing	L	4CH
			Yau Ma Tei Reversing	N	4EH
			Yau Ma Tei Siding	O	4FH
			Kwun Tong for South End	X	58H
Tsuen Wan Line (TWL)	31 - 79	Up track	Tsim Sha Tsui Reversing	D	44H
			Tsuen Wan Reversing	R	52H
			Tsuen Wan for Depot	S	53H
			Kwai Hing Reversing	T	54H
			Lai King Reversing	U	55H
			Mei Foo for Siding	W	57H
		Down track	Central Reversing	A	41H
			Admiralty or Siding	B	42H
			Tsim Sha Tsui Reversing	C	43H
			Kwai Hing Reversing	G	47H
			Lai King Reversing	P	50H
			Yau Ma Tei Reversing	N	4EH
			Yau Ma Tei for lower level Siding	O	4FH
Island line (ISL)	11 - 49	Up track	Admiralty for Siding	Q	51H
			Causeway Bay Reversing	O	4FH
			Tai Koo Reversing	M	4DH
			Shau Kei Wan for Depot	E	45H
			Heng Fa Chuen Reversing	G	47H
			Chai Wan Reversing	H	48H
		Down track	Depot East End	R	52H
			Tai Koo for Siding	A	41H
			Causeway Bay Reversing	F	46H
			Admiralty for Siding	B	42H
			Sheung Wan Reversing	J	4AH
			Heng Fa Chuen for Depot	K	4BH
			Wan Chai Reversing	P	50H

Table 4.2.1 Train number / Destination code table

LINE	TRAIN No. RANGE	TRACK	DESTINATION CODE		
			MEANING	CHAR.	CODE
Tseung Kwan O line (TKL)		Up track	Yau Tong reversing	I	49H
			Tseung Kwan O reversing	C	43H
			Lohas Park (LHP) reversing B ~~Tseung Kwan O south reversing~~	P	50H
			Po Lam reversing	J	4AH
			Tseung Kwan O Depot	D	44H
			B Po Lam for Depot	A	41H
			B Lohas Park (LHP) for Depot	B	42H
		Down track	Tseung Kwan O reversing	W	57H
			Tiu Keng Leng reversing	Z	5AH
			North Point reversing	V	56H
			Tseung Kwan O Depot via shunt neck	S	53H
Special/ Engineer's Train	80 - 96	-	-	-	-

Table 4.2.2 Station number table

No.	Station number	Line - Track							
		ISL Up	ISL down	KTL up	KTL Down	TWL Up	TWL Down	TKL Up	TKL down
1	01	CEN	HFC	MOK	LAT	ADM	TWH	NOP	~~TKS~~ F LHP
2	02	ADM	SKW	PRE	KWT	ADM_PLT	KWH	QUB	POA
3	03	ADM_PLT	SWH	SKM	NTK	TST	KWF	YAT	HAH
4	04	WAC	TAK	KOT	KOB	JOR	LAK	TIK	HAH_PLT
5	05	CAB	QUB	LOF	CHH	YMT	MEF	TKO	TKO
6	06	TIH	NOP	WTS	DIH	MOK	LCK	HAH	TIK
7	07	FOH	FOH	DIH	WTS	PRE	CSW	HAH_PLT	YAT
8	08	NOP	TIH	CHH	LOF	SSP	SSP	POA	QUB
9	09	QUB	CAB	KOB	KOT	CSW	PRE	POA_PLT	NOP
10	0A	TAK	WAC	NTK	SKM	LCK	MOK	~~TKS~~ F LHP	NOP_PLT
11	0B	SWH	ADM	KWT	PRE	MEF	YMT	LHP_PLT F ~~TKS_PLT~~	NOP_SDG
12	0C	SKW	ADM_PLT	LAT	MOK	LAK	JOR	BHT_SDG	BHT_SDG
13	0D	HFC	CEN	QUB	YMT	KWF	TST	YAT_PLT	TKO rev
14	0E	CHW	SHW	QUB_PLT	YMT_PLT	KWH	ADM	TKO rev	TIK rev
15	0F	CHW_PLT	SHW_PLT	YMT	QUB	TWH	ADM_PLT	TIK rev	POA_SDG
16	10	SHW	CHW	KOT rev	PRE rev	TSW	CEN	NOP rev	DEP_DN
17	11	ADM rev	WAC rev	CHH rev	-	TSW_PLT	CEN_PLT	NOP_SDG	LHP rev F ~~TKS rev~~
18	12	CAB rev	HFC rev	KWT rev	CHH rev	CEN	TSW	DEP_UP	TIK_PLT
19	13	TAK rev	QUB rev	LAT rev	CHH cen	JOR rev	KWH rev	DEP_SN	
20	14	CHW rev		CHH cen	YMT rev	LAK rev	MEF rev	TKO_PLT tks	
21	15			TTT	TTT	MEF rev	TST rev	TKO_PLT hah	
22	16			SKM rev	NOP		CEN rev	LHP rev F ~~TKS rev~~	
23	17			NOP	NOP_rev		TSW rev	TKO tks	
24	18			NOP_PLT	TIK		LAK rev	DVAS	
25	19			YAT	YAT				
26	1A			TIK	YAT_PLT				
27	1B			TIK_SDG	NOP_SDG				
28	1C			NOP_SDG					
29	1D			TIK_PLT					
30	1E								
31	1F								

B

5. Communication Procedure

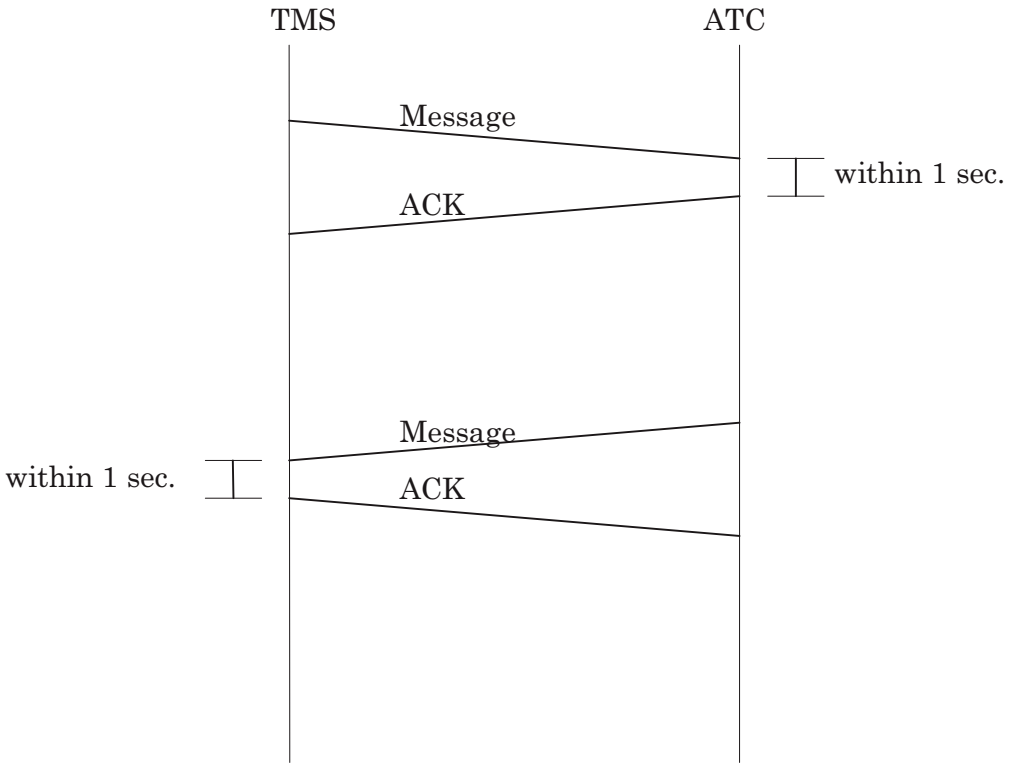


Fig. 5.1 Transmission timing(normal case)

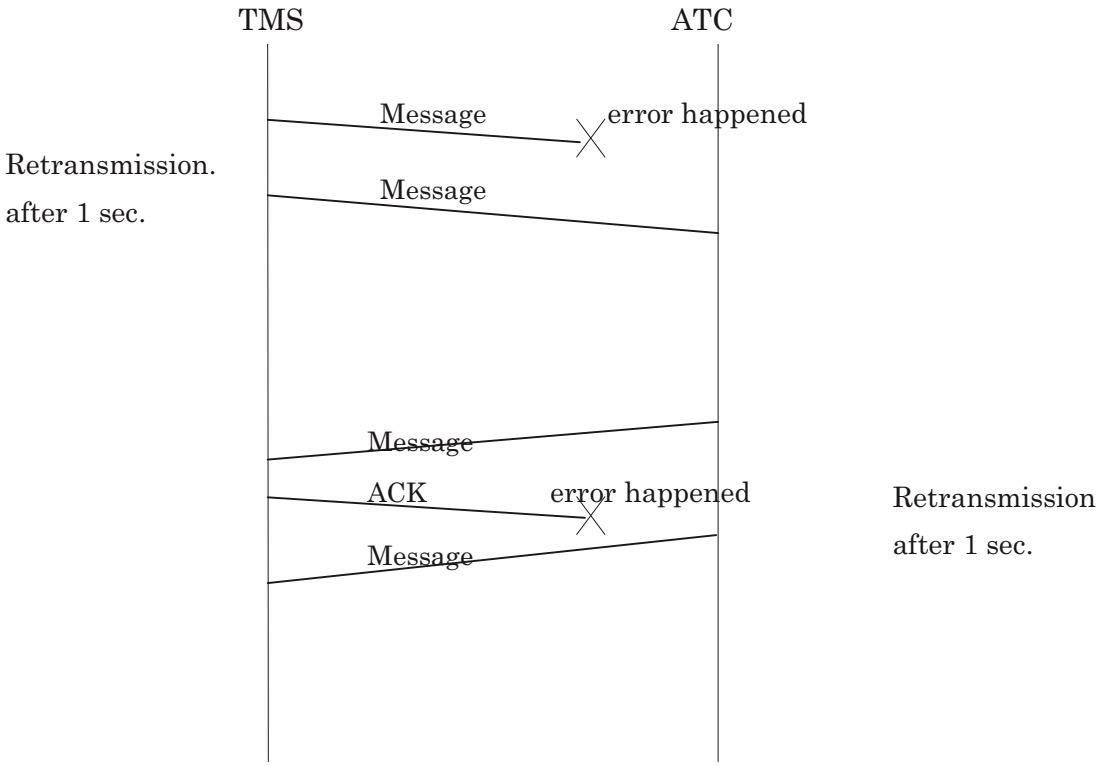


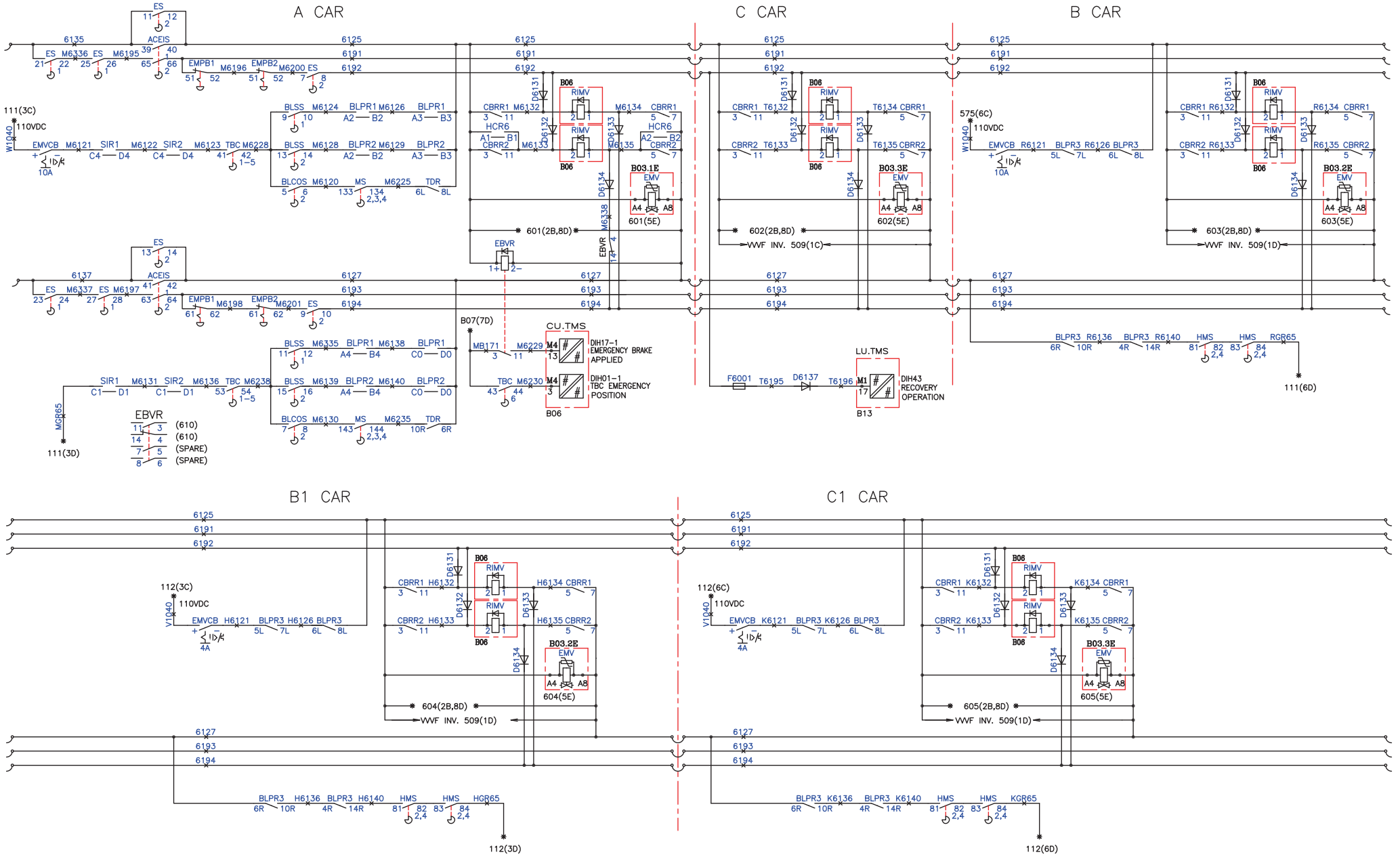
Fig. 5.2 Transmission timing(error case)

MITSUBISHI ELECTRIC CORPORATION., JAPAN

CHANGE	DOCUMENT NO.	
	JHAV431	15 / 15

DETAILED INTERFACE SPECIFICATION

ANNEX C17
EMERGENCY BRAKE CIRCUIT



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

DESIGNED	ZhouYong	2010-04-15	STANDARD	Zhang	2010-05-10	TITLE
CHECK	LIEnlong	2010-04-25				EMERGENCY VALVE A,C,B,B1,C1 CAR
			CHIEF ENGINEER	MaYanbo	2010-05-16	
DIRECTOR	ZhouYong	2010-04-30				
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28	

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-610	A

DETAILED INTERFACE SPECIFICATION

ANNEX C18
SAFETY INTERLOCK CIRCUIT

DRAWING NO. DKZ28-00-00-000DY-615 VERSION B

A CAR C CAR

111(3C)
110VDC
W1040 EMPB1 31 32 M6102 EMPB2 31 32 M6103 BSR 5 7 B M6104 SCOS 5 6 3 W6105
DSD B
ATC EBR2 A1 A2 C14 M6125 EBR2 A3 A4 M6109 SCOS 9 10 2
ATC DTO_SR 09JX3-24 C14 09JX3-23
MS 113 114 2,4,5,6 M6107 SIR1 A3 B3 W6108 SIR2 A0 B0
W6106
MS 12a 12b 2,4 M6110 TBC 83 84 6 M6111
B36 BCPS 3 4 1 1 2 2 M6112 SCOS 7 8 3 W6113
CU. TMS B M5 12 # # SET SIR B06
W6108
ATC DTO_MSS 09JX3-41 09JX3-42 C14
ATC ZVR2 A1 A2 C14 M6123 ZVR2 A3 A4 SCOS 15 16 3
CU. TMS M5 14 SAFETY INTERLOCK RELAY 2 B06
SIR1 A4 B4 M6114 SIR2 A4 B4 M6116
ATC ZVR1 A1 A2 C14 M6922 ZVR1 A3 A4
6 4 1 4 5 2 P 2bar 1bar 601(4E)
ATC EBR1 A1 A2 C14 M6124 EBR1 A3 A4 M6119 SIR2 A3 B3 M6118 SCOS 17 18 2 M6117 SIR1 A0 B0 MGR64
CU. TMS M5 13 SAFETY INTERLOCK RELAY 1 B06
W1040 TBC 63 64 5,6 M6921 B BSR A1 A2
111(3D)

VVVF INVERTER
W6105 6105 TOSR
W6106 6106
W6113 6113 TZVR
W6108 6108
509

B07
CU. TMS
MB171 SCOS 11 12 1 M6006 M4 40 # # SAFETY CUTOUT (RESET)
M6007 19 20 2 M4 41 # # SAFETY CUTOUT (NORMAL)
M6009 23 24 3 M4 43 # # SAFETY CUTOUT (TRACTION FALL BACK)
EMPB1 43 44
EMPB2 43 44 M6115 M5 2 # # EMERGENCY PUSHBUTTON
B07

SIR1
A1 B1 (401)
A2 B2 (501)
A3 B3 (615)
A4 B4 (615)
C0 D0 (106) B
C1 D1 (610)
C2 D2 (C14)
C3 D3 (508)
C4 D4 (610) B

SIR2
A1 B1 (401)
A2 B2 (501)
A3 B3 (615)
A4 B4 (615)
C0 D0 (106) B
C1 D1 (610)
C2 D2 (C14)
C3 D3 (508)
C4 D4 (610) B

BSR
11 3 (807)
12 4 (808)
7 5 (615)
8 6 (SPARE)

SCOS
1=RESET
2=NORMAL
3=TRACTION FALL BACK

MS
1=SHUT DOWN
2=REVERSE
3=STANBY
4=FORWARD
5=CODED MANUAL
6=AUTO

TBC
1=FULL MOTORING
2=LIMITED MOTORING
3=COASTING
4=MINIMUM BRAKING
5=FULL SERVICE BRAKING
6=EMERGENCY

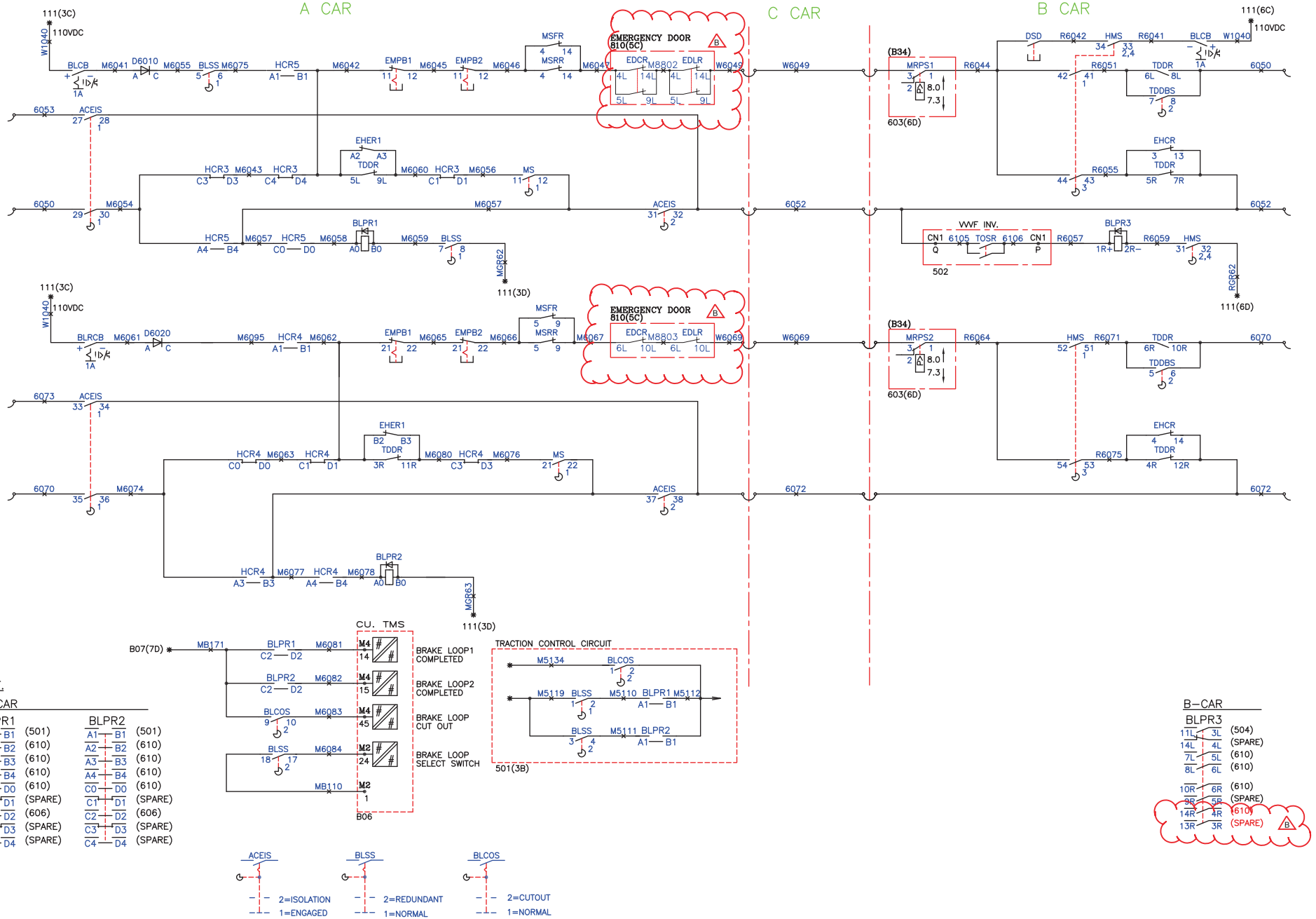
REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Remove DSD Time Delay Function	ZHOUYONG 2010-09-05	LIENLONG 2010-09-07	MAYANBO 2010-09-09

DESIGNED	ZhouYong	2010-04-20	STANDARD	Zhang	2010-05-10	TITLE
CHECK	LIEnlong	2010-04-25				SAFETY PROVING A, C CAR
			CHIEF ENGINEER	MaYanbo	2010-05-16	
DIRECTOR	ZhouYong	2010-04-30				
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28	

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-615	B

DETAILED INTERFACE SPECIFICATION

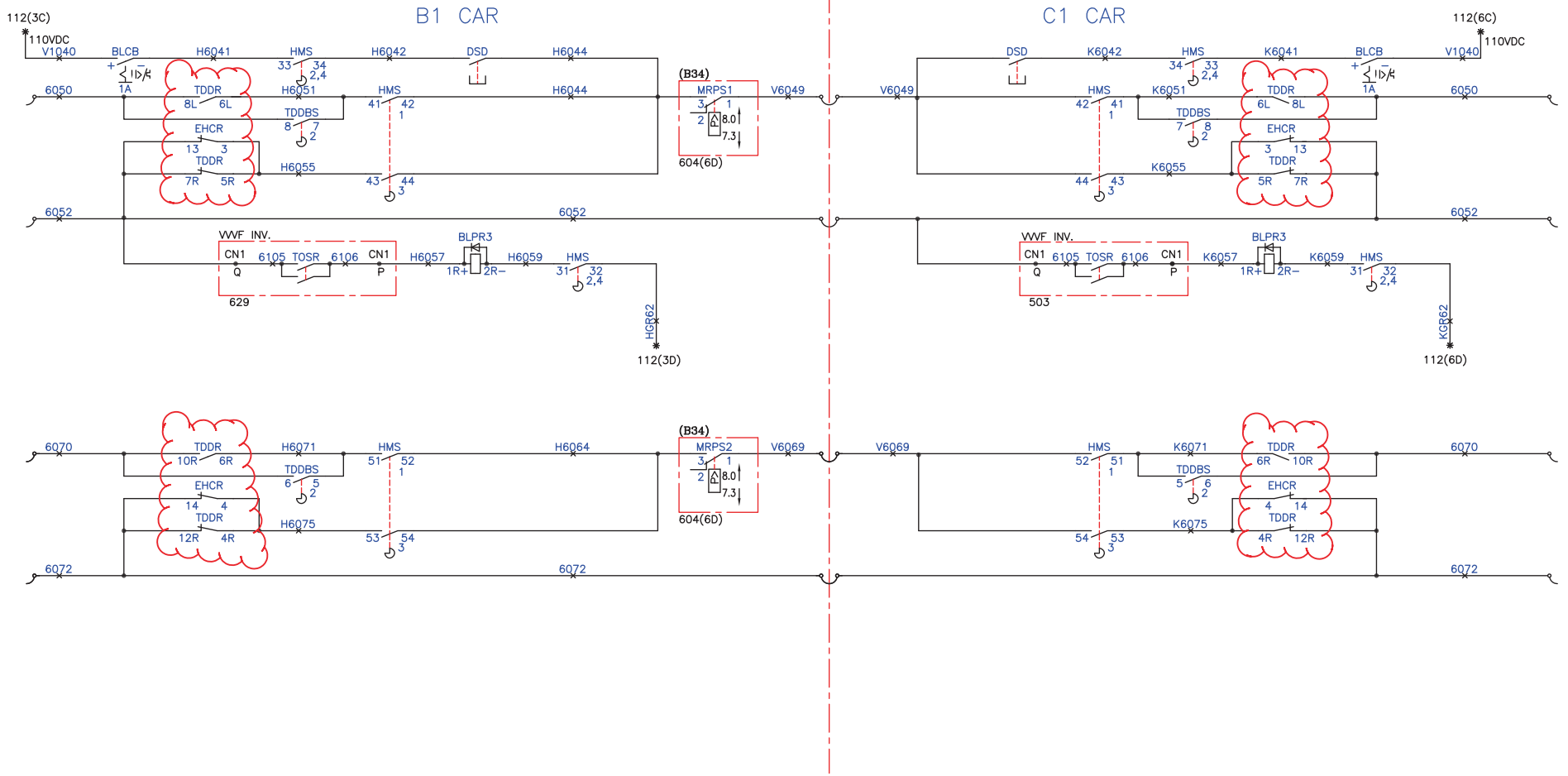
ANNEX C19
BRAKE CIRCUIT



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Revise emergency door contacts	ZHOUYONG 2010-07-13	YINHANG 2010-07-14	MAYANBO 2010-07-15

DESIGNED	ZhouYong	2010-04-15	STANDARD	Zhang	2010-05-10	TITLE
CHECK	LIEnlong	2010-04-25				BRAKE LOOP A,C,B CAR
			CHIEF ENGINEER	MaYanbo	2010-05-16	
DIRECTOR	ZhouYong	2010-04-30				
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28	

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-606	B



REF.

B1—CAR

BLPR3

11L	3L	(504)
14L	4L	(SPARE)
7L	5L	(610)
8L	6L	(610)
10R	6R	(610)
9R	5R	(SPARE)
12R	4R	(610)
13R	3R	(SPARE)

C1—CAR

BLPR3

11L	3L	(505)
14L	4L	(SPARE)
7L	5L	(610)
8L	6L	(610)
10R	6R	(610)
9R	5R	(SPARE)
14R	4R	(610)
13R	3R	(SPARE)

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

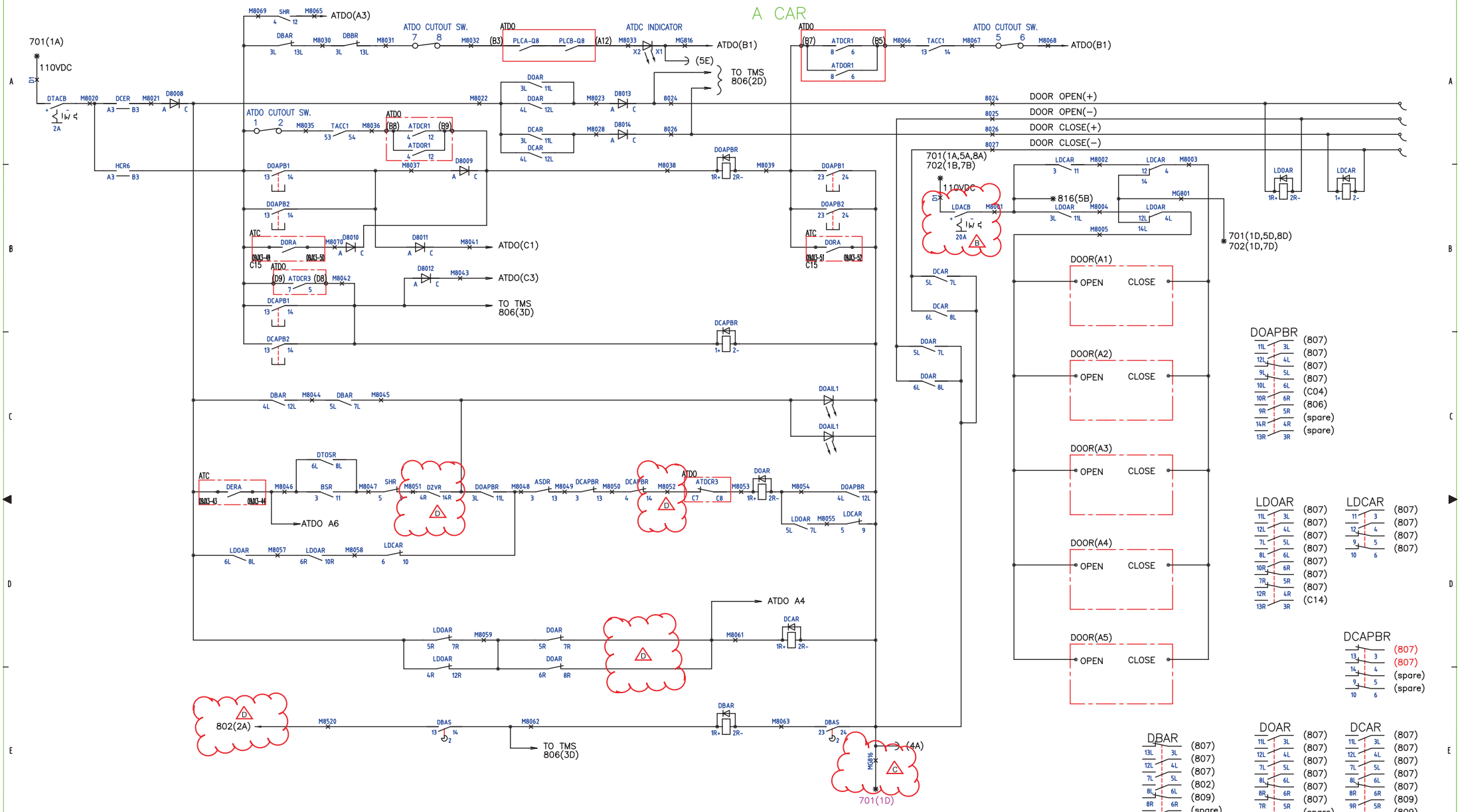
REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

DESIGNED	ZhouYong	2010-04-15	STANDARD	Zhang	2010-05-10	TITLE
CHECK	LIEnlong	2010-04-25				BRAKE LOOP B1,C1 CAR
			CHIEF ENGINEER	MaYanbo	2010-05-16	
DIRECTOR	ZhouYong	2010-04-30				
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28	

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-607	A

DETAILED INTERFACE SPECIFICATION

ANNEX C20
DOOR CONTROL CIRCUIT



NOTES:

1. WIRING NUMBER SHOWN AS "ATDO(A1)" DENOTES THE WIRING CONNECTED TO THE CONTACT PIN OF ATDO BOX.
2. STATUS OF ATDO CUTOUT SWITCH SHOWN AT "NORMAL" POSITION

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Change LDACB from 16A to 20A	ZHOUYONG 2010-07-13	YIMIANG 2010-07-14	MAYANBO 2010-07-15
C	Change Wiring No. MGR80 to MG816	ZHOUYONG 2010-11-05	YIMIANG 2010-11-06	MAYANBO 2010-11-08
D	Remove DOAPBR Contacts:5L&9L,6L&10L			
	Remove DCAR contacts:6R&8R.Add DZVR contact:4R&14R	ZHOUYONG 2011-02-02	YIMIANG 2011-02-02	MAYANBO 2011-02-03

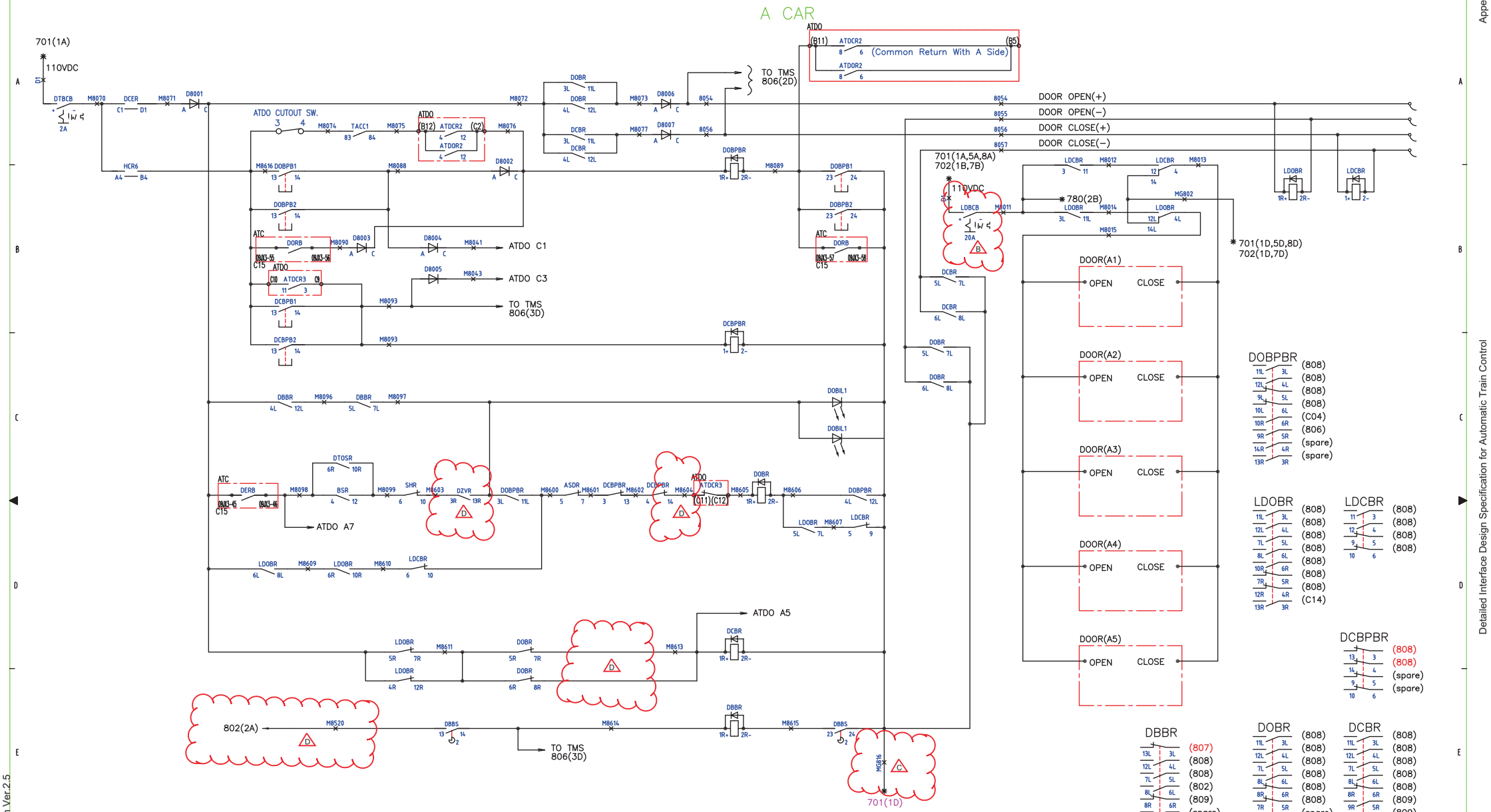
DESIGNED	ZhouYong	2010-04-21	STANDARD	Zhang	2010-05-10	
CHECK	LIEnlong	2010-04-25				
			CHIEF ENGINEER	MaYanbo	2010-05-16	
DIRECTOR	ZhouYong	2010-04-30				
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28	

TITLE: DOOR OPERATION A SIDE A CAR

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-807	D

Appendix 3 Detailed Interface Specification Ver.2.5

Appendix 3 Detailed Interface Design Specification for Automatic Train Control



NOTES:

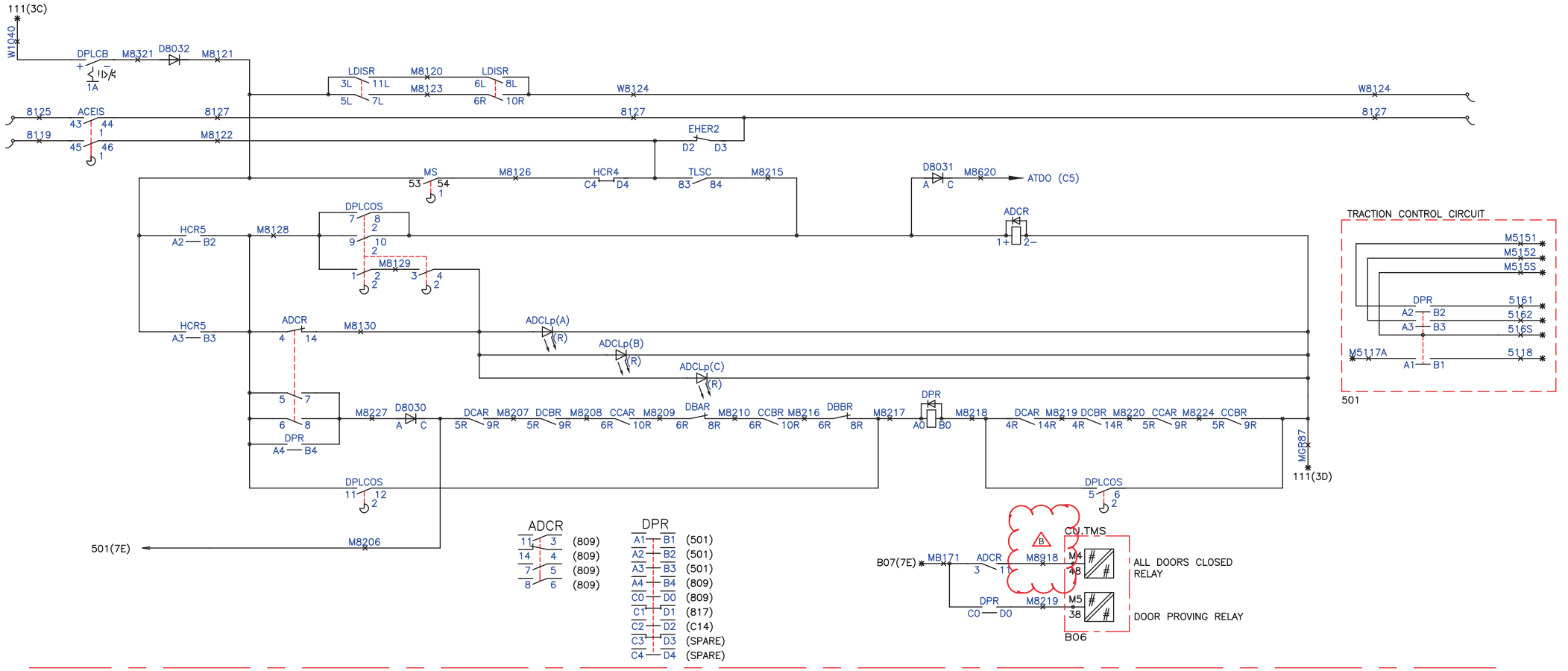
WIRING NUMBER SHOWN AS "ATDO(A1)" DENOTES THE WIRING CONNECTED TO THE CONTACT PIN OF ATDO BOX.

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Change LDACB from 16A to 20A	ZHOUYONG 2010-07-13	YINHANG 2010-07-14	MAYANBO 2010-07-15
C	Change Wiring No. MGR81 to MG816	ZHOUYONG 2010-11-05	YINHANG 2010-11-06	MAYANBO 2010-11-08
D	Remove DOBPBR Contacts:5L&9L,6L&10L			
	Remove DCBR contacts:6R&8R.Add DZVR contact:3R&13R	ZHOUYONG 2011-02-02	YINHANG 2011-02-02	MAYANBO 2011-02-03

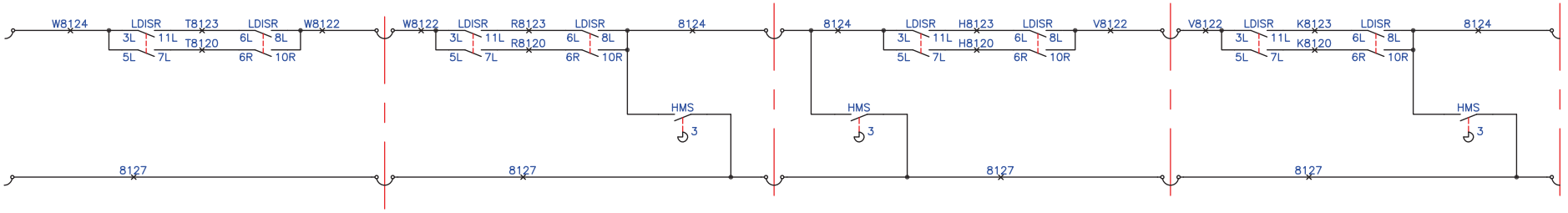
DESIGNED	ZhouYong	2010-04-21	STANDARD	Zhang	2010-05-10	TITLE
CHECK	LIEnlong	2010-04-25				DOOR OPERATION B SIDE A CAR
			CHIEF ENGINEER	MaYanbo	2010-05-16	
DIRECTOR	ZhouYong	2010-04-30				
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28	

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-808	D

A CAR



C CAR



B CAR

B1 CAR

C1 CAR

NOTES:
1. WIRE NUMBER SHOWN AS "ATDO(A1)" DENOTES THE WIRING CONNECTED TO THE CONTACT PIN OF ATDO BOX.

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Change wiring No. 8218 TO 8918	ZHOUYONG 2010-07-13	YINHANG 2010-07-14	MAYANBO 2010-07-15

DESIGNED	ZhouYong	2010-04-15	STANDARD	Zhang	2010-05-10	TITLE: DOOR LOOP A,C,B,B1,C1 CAR
CHECK	LIEnlong	2010-04-25				
			CHIEF ENGINEER	MaYanbo	2010-05-16	
DIRECTOR	ZhouYong	2010-04-30				
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28	

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-809	B

DRAWING NO. DKZ28-00-00-000DY-817 VERSION B

A CAR

C/B/B1/C1 CAR

701(1A)
110VDC
D1
ZVCCB
1A
M8350
DCER
A2 B2
M8351
D8044
A C

DPR C1 D1 M8362 DZVR 3L 11L DZVR MG816 A1 A2 701(1D)

ZVR1 M8361 B1 B2 ZVR1 M8361A B3 B4 ZVR2 M8361B B1 B2 ZVR2 M8363 B3 B4

M8352 DZVR 5L 7L M8353 DZVR 6L 8L

DBAR 4R 14R M8354 DBAR 3R 13R W8175 502(2C)

DBBR 4R 14R M8355 DBBR 3R 13R

DCER C3 D3

816(2B) Y8011 ZVR 12 4 14 YG802 Y8016

816(5B) Y8001 ZVR 11 3 13 YG801 Y8006

8174

8175

ZERO SPEED SIGNAL ZVR 1 2

B-CAR ONLY 502(5C)

DOOR(B1) DOOR(B2) DOOR(B3) DOOR(B4) DOOR(B5)

DOOR(A1) DOOR(A2) DOOR(A3) DOOR(A4) DOOR(A5)

MG816

701(1D)

ZVR
11 3 (817)
12 4 (817)
7 5 (817) B
8 6 (SPARE)

DZVR
11L 3L (817)
12L 4L (SPARE)
7L 5L (817)
8L 6L (817)
10R 6R (SPARE)
9R 5R (SPARE)
14R 4R (807) B
13R 3R (808)

Cu. TMS
M8360
ZVR 5 7
MB110
M2 38
M2 1
N24-1
B07
DOOR ZERO VELOCITY TRAINLINE

ZVR
11 3 (817)
12 4 (817)
7 5 (SPARE)
8 6 (SPARE)

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Change DZVR spare contacts:3R&13R(807) and 4R&14R(808)	ZHOUYONG 2011-02-02	LIENLONG 2011-02-02	MAYANBO 2011-02-03

DESIGNED	ZhouYong	2010-04-15	STANDARD	Zhang	2010-05-10
CHECK	LIEnlong	2010-04-25			
			CHIEF ENGINEER	MaYanbo	2010-05-16
DIRECTOR	ZhouYong	2010-04-30			
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28

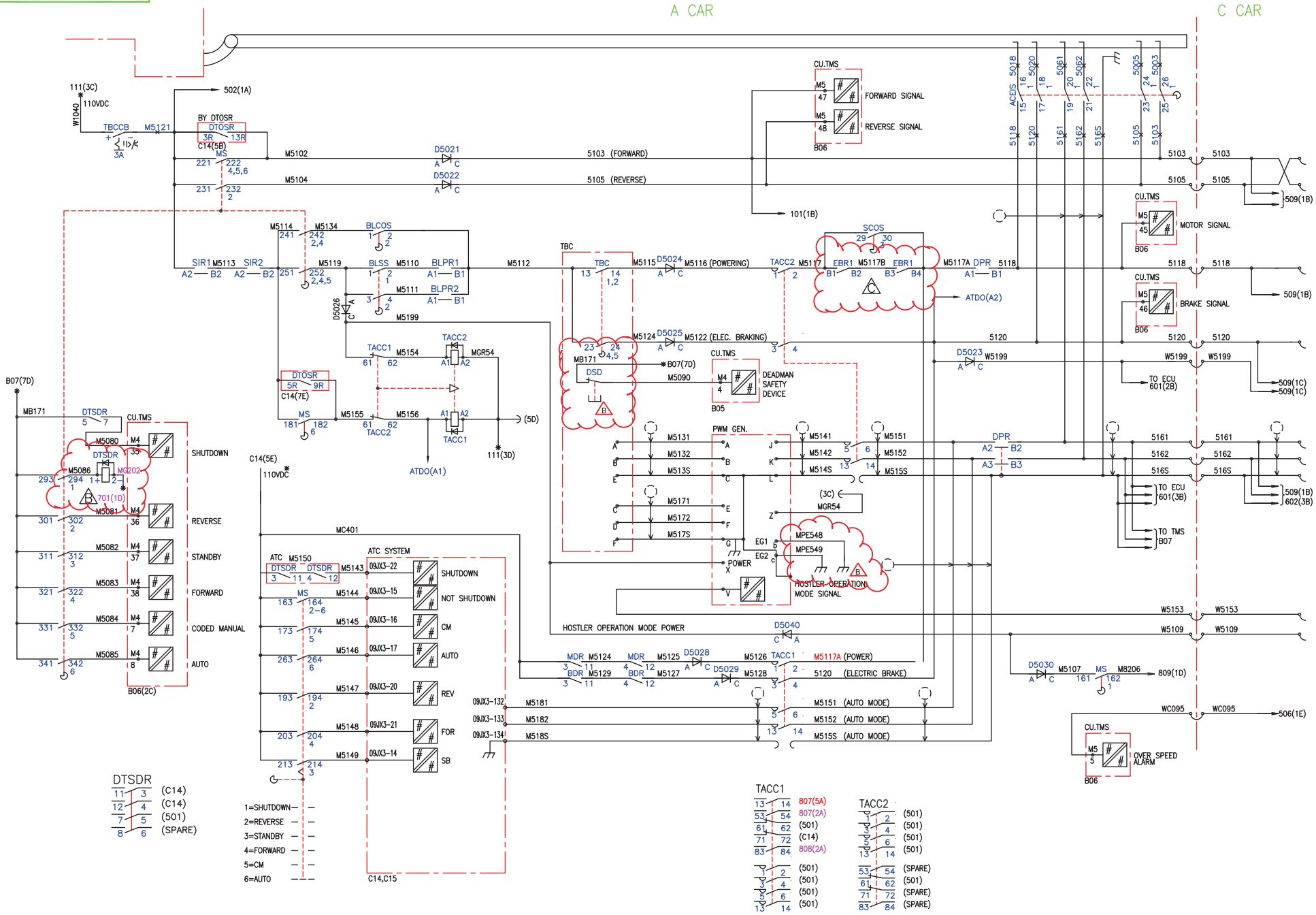
TITLE

ZERO SPEED SIGNAL A,C,B,B1,C1 CAR

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-817	B

DETAILED INTERFACE SPECIFICATION

ANNEX C21
CAB CONTROL CIRCUIT



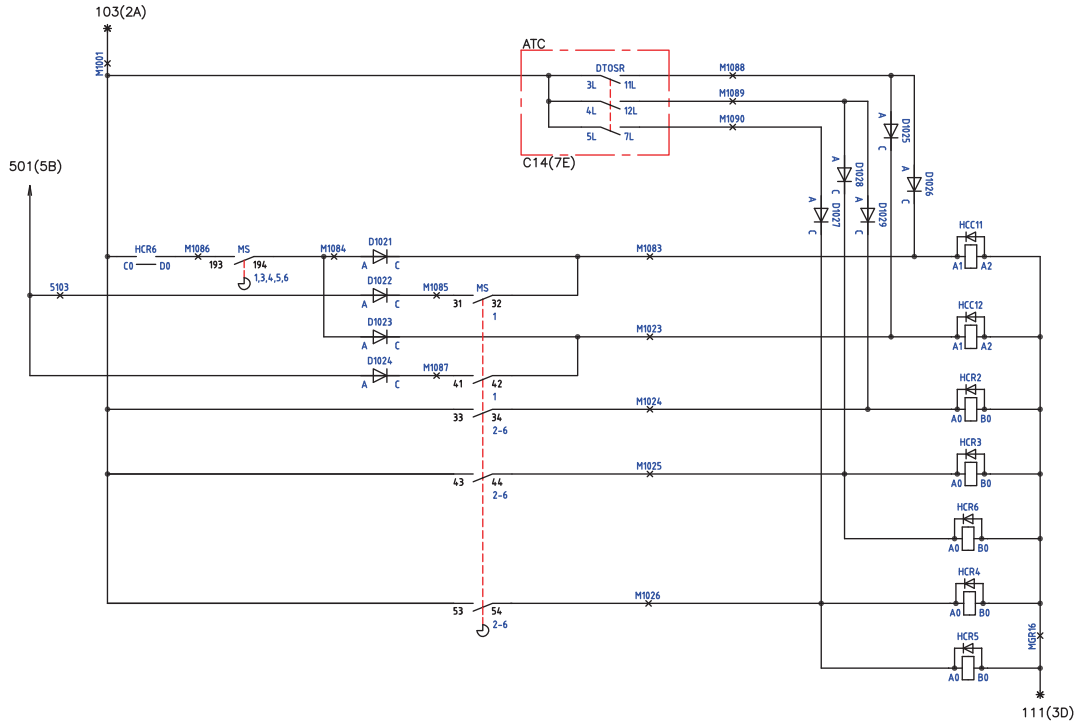
REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Change DTSDR Earthing	ZHOUYONG 2010-11-05	YINHANG 2010-11-06	MAYANBO 2010-11-08
C	Add EBR1 B1&B2 contact	ZHOUYONG 2011-02-16	LIENLONG 2011-02-16	MAYANBO 2011-02-17

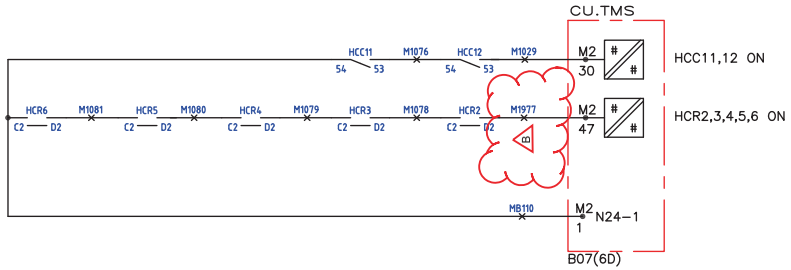
DESIGNED	ZhouYong	2010-03-17	STANDARD	Zhang	2010-05-10
CHECK	LIEnlong	2010-04-25			
			CHIEF ENGINEER	MaYanbo	2010-05-16
DIRECTOR	ZhouYong	2010-04-30			
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28

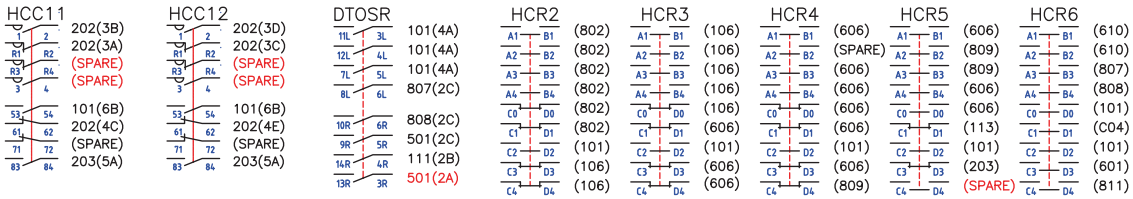
TITLE: DRIVING CAB OPERATION A,C CAR

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-501	C

A CAR







REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Change Wiring No. M1077 to M1977	ZHOUYONG 2010-07-13	YINHANG 2010-07-14	MAYANBO 2010-07-15

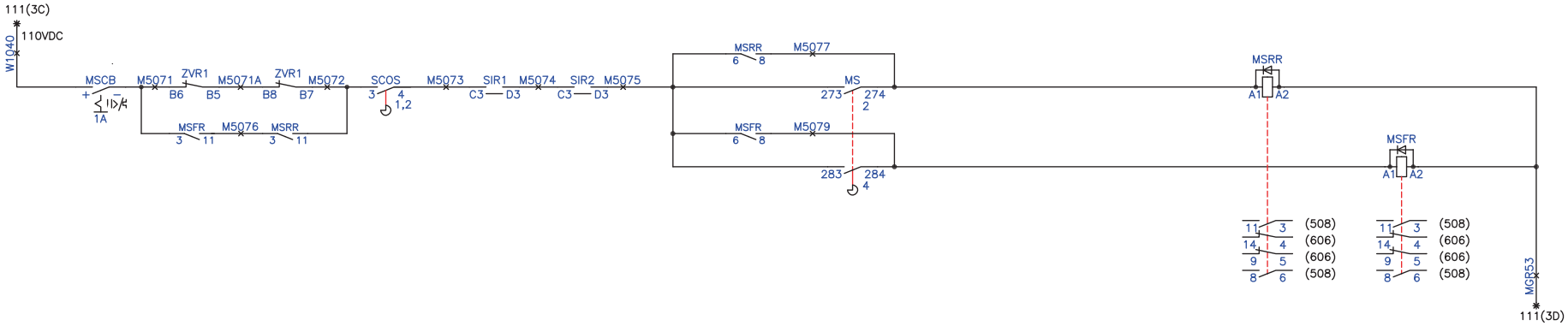
DESIGNED	ZhouYong	2010-04-18	STANDARD	Zhang	2010-05-10
CHECK	LIEnlong	2010-04-25			
			CHIEF ENGINEER	MaYanbo	2010-05-16
DIRECTOR	ZhouYong	2010-04-30			
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28

TITLE: CAB ACTIVATION(A CAR)

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-101	B

DRAWING NO. DKZ28-00-00-000DY-508 VERSION A

A CAR



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

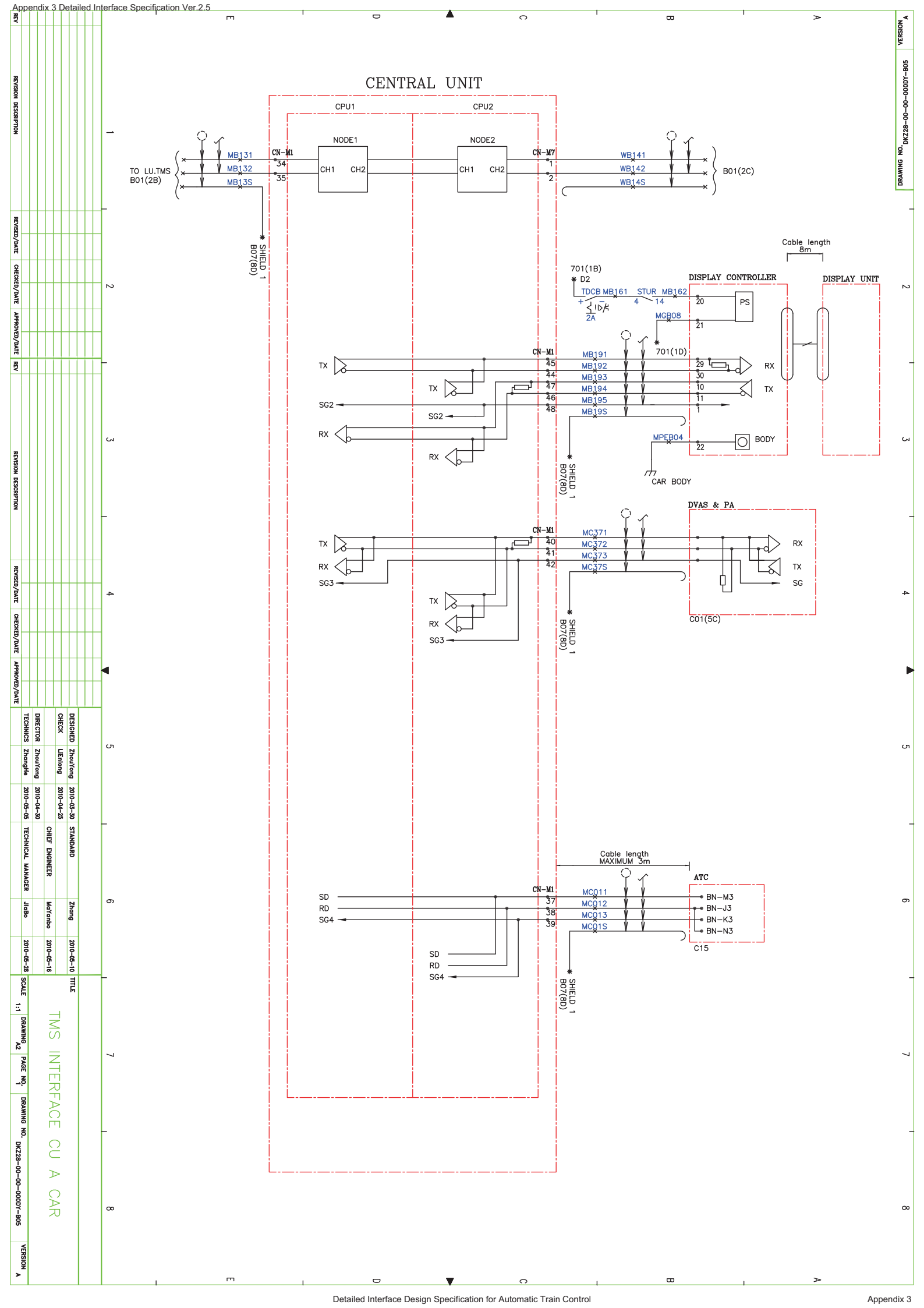
REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

DESIGNED	ZhouYong	2010-04-20	STANDARD	Zhang	2010-05-10	TITLE
CHECK	LIEnlong	2010-04-25				MODE CHANGE AT SPEED A CAR
			CHIEF ENGINEER	MaYanbo	2010-05-16	
DIRECTOR	ZhouYong	2010-04-30				
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28	

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-508	A

DETAILED INTERFACE SPECIFICATION

ANNEX C22
TMS CIRCUIT



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

DESIGNED	ZhouYong	2010-03-30	STANDARD	
CHECK	LiHong	2010-04-23		
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo
DIRECTOR	ZhouYong	2010-04-30	CHIEF ENGINEER	MaYanbo
				Zhang
		2010-05-16		2010-05-10

SCALE	1:1	TITLE	TMS INTERFACE CU A CAR	
DRAWING	A2			
PAGE NO.	1			
DRAWING NO.	DKZ28-00-00-0000Y-B05			
VERSION	A			

REV.	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Change wiring No. 8218 to 8918	ZHOUYONG 2010-04-15	LIEHONG 2010-04-14	ZHONG 2010-05-15

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

DESIGNED	ZhouYong	2010-04-15	STANDARD
CHECK	LiEnlong	2010-04-23	
TECHNICS	ZhongHe	2010-04-30	
DIRECTOR	ZhouYong	2010-05-05	CHIEF ENGINEER
TECHNICAL MANAGER	JiaBo	2010-05-28	MaYanbo 2010-05-16
			Zhong 2010-05-10

TITLE	TMS INTERFACE CU A CAR
SCALE	1:1
DRAWING	A2
PAGE NO.	1
DRAWING NO.	DKZ28-00-00-0000Y-B06
VERSION	B

VERSION	DRAWING NO.
B	DKZ28-00-00-0000Y-B06

DETAILED INTERFACE SPECIFICATION

ANNEX C23
CAB DOOR OPERATION A CAR

A CAR

701(1A)
110VDC
D1
CDCB
6A
M8520

807(2E)
808(2E)
803(5B)
803(5D)

CAB DOOR(A)
M8520 DC110V
M8531 OPEN
ZERO VELOCITY
M8532 CLOSE
MPE801 EARTHING
MG805
803(2B)

CCAPB M8524 COAPB
M8525 HCR2 M8526 CCAR M8527 CCAPB
HCR2
CDCATR
TTPOR
CCAR
CDCATR
HCR2 M8528
ON DELAY(10SEC)

LU.TMS
M1 23 B09
A-SIDE CAB DOOR CLOSE
M8546
LU.TMS
M1 39 B09
A-SIDE CAB DOOR OPEN
M8545

CU.TMS
M2 41 A-SIDE CAB DOOR CLOSE RELAY
M2 5 B-SIDE CAB DOOR CLOSE RELAY
M2 1
B07
CCAR M8398
CCBR M8399
MB110

DBBR
DBAR
ZVR1 M8550 ZVR1
STUR
M8551
D8050
COAPB M8521 CCAR M8522 COAR M8523 COAPB
COAR
COBPB M8533 CCBR M8534 COBR M8535 COBPB
COBR

CCBPB M8536 COBPB M8537 HCR2 M8538 CCBR M8539 CCBPB
HCR2
CDCBTR
TTPOR
CCBR
CDCBTR
HCR2 M8540
ON DELAY(10SEC)
MG805

LU.TMS
M1 41 B09
B-SIDE CAB DOOR CLOSE
M8548
LU.TMS
M1 24 B09
B-SIDE CAB DOOR OPEN
M8547

CAB DOOR(B)
M8520 DC110V
M8542 OPEN
ZERO VELOCITY
M8543 CLOSE
MPE802 EARTHING
MG805
803(2D)

0VDC
701(1D)
0VDC
701(1D)

COAR (802) (802) (802) (802)
COBR (802) (802) (802) (802)
CCAR (802) (802) (802) (809) (809) (802) (802)
CCBR (802) (802) (802) (809) (809) (802) (802)
CDCATR (802) (802) (802) (802)
CDCBTR (802) (802) (802) (802)

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Add Wiring No. 8550 between Two ZVR1 Contacts	ZHOUYONG 2010-12-15	LIENLONG 2010-12-17	MAYANBO 2010-12-18
C	Move Door Open Circuit in Series with ZVR1			
	Add CDCATR&CDCBTR,CCAR&CCBR Contacts in Parallel with HCR	ZHOUYONG 2011-01-06	LIENLONG 2011-01-09	MAYANBO 2011-01-10
D	Add M8520 to 807(2E) and 808(2E)	ZHOUYONG 2011-02-02	LIENLONG 2011-02-02	MAYANBO 2011-02-03

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

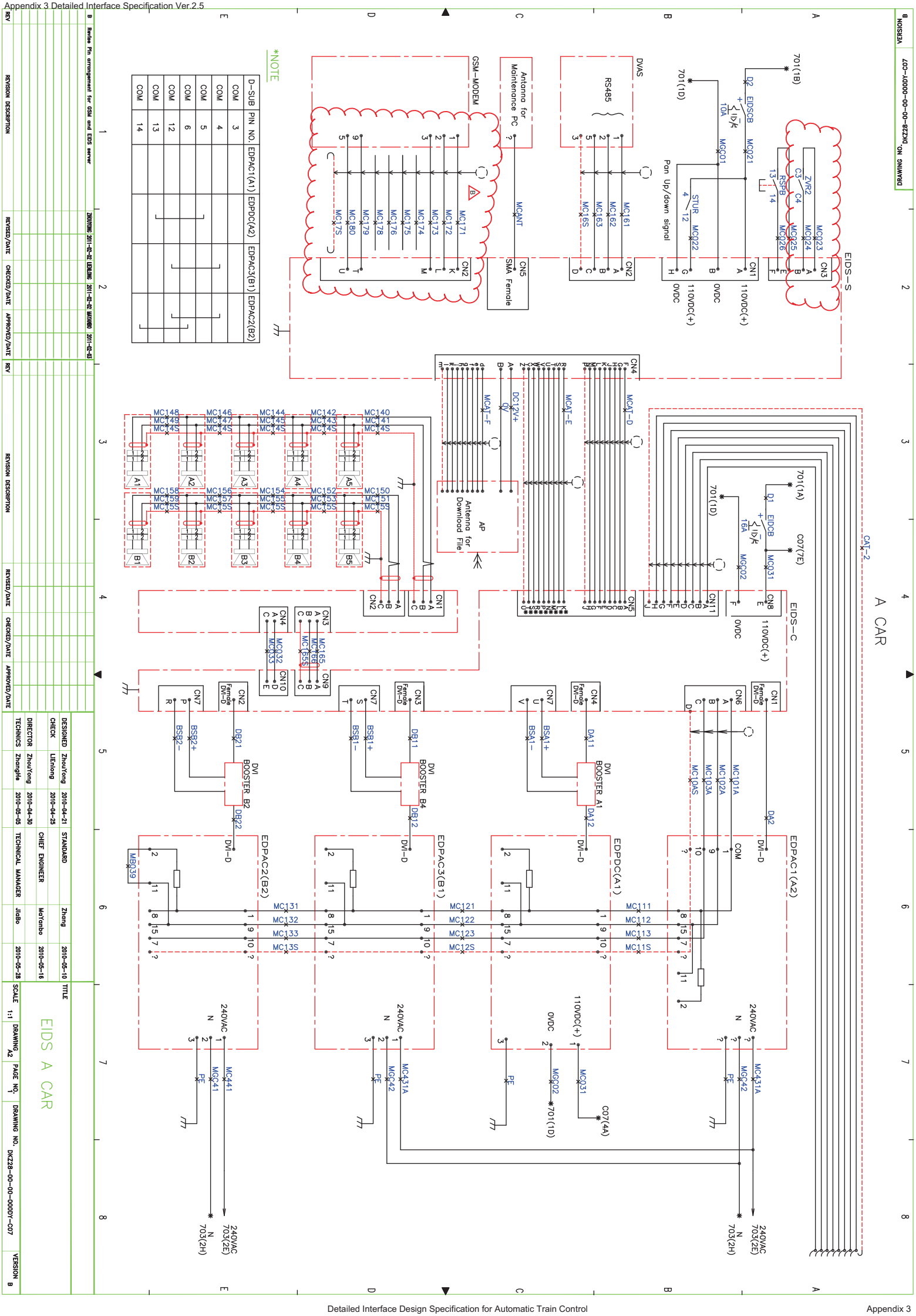
DESIGNED	ZhouYong	2010-04-15	STANDARD	Zhang	2010-05-10
CHECK	LIEnlong	2010-04-25			
			CHIEF ENGINEER	MaYanbo	2010-05-16
DIRECTOR	ZhouYong	2010-04-30			
TECHNICS	ZhangHe	2010-05-05	TECHNICAL MANAGER	JiaBo	2010-05-28

TITLE: CAB DOOR OPERATION A CAR

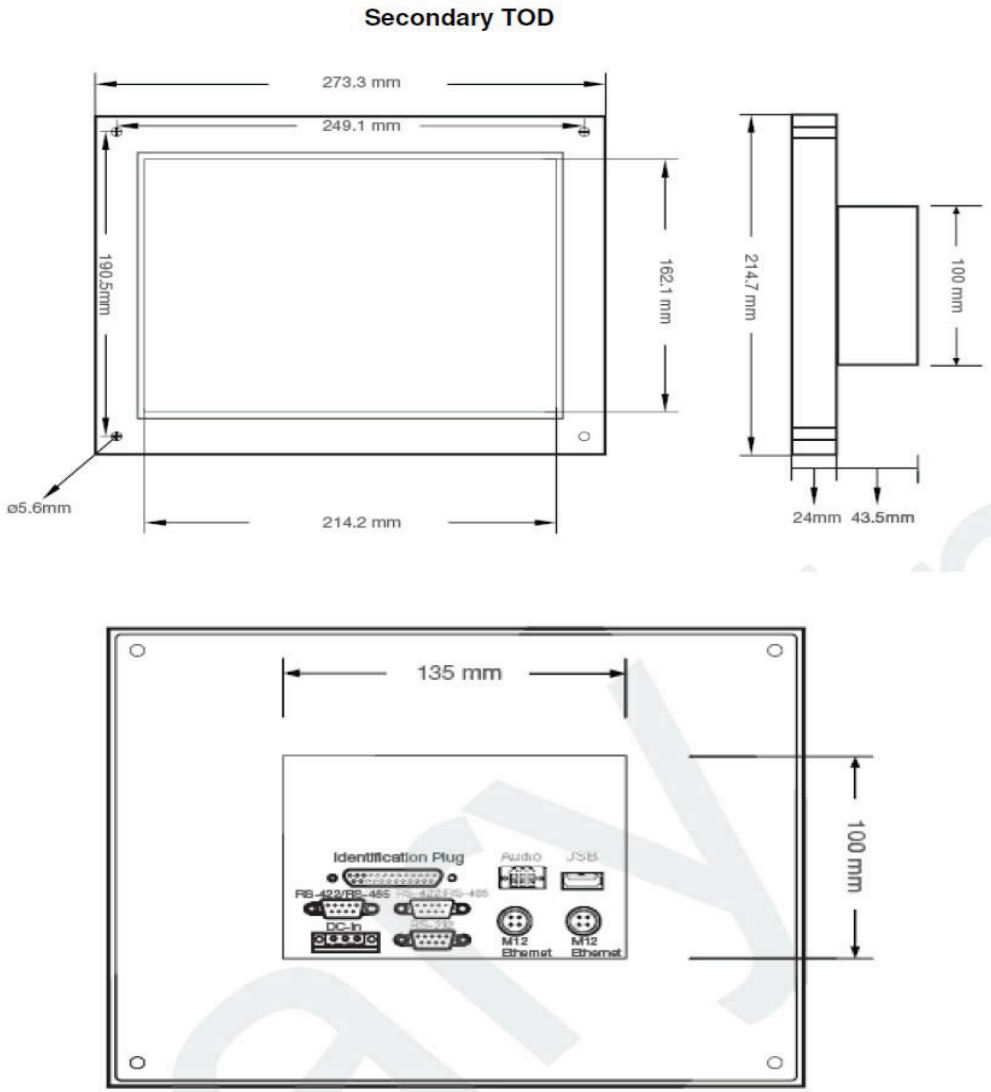
SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1	DKZ28-00-00-000DY-802	D

DETAILED INTERFACE SPECIFICATION

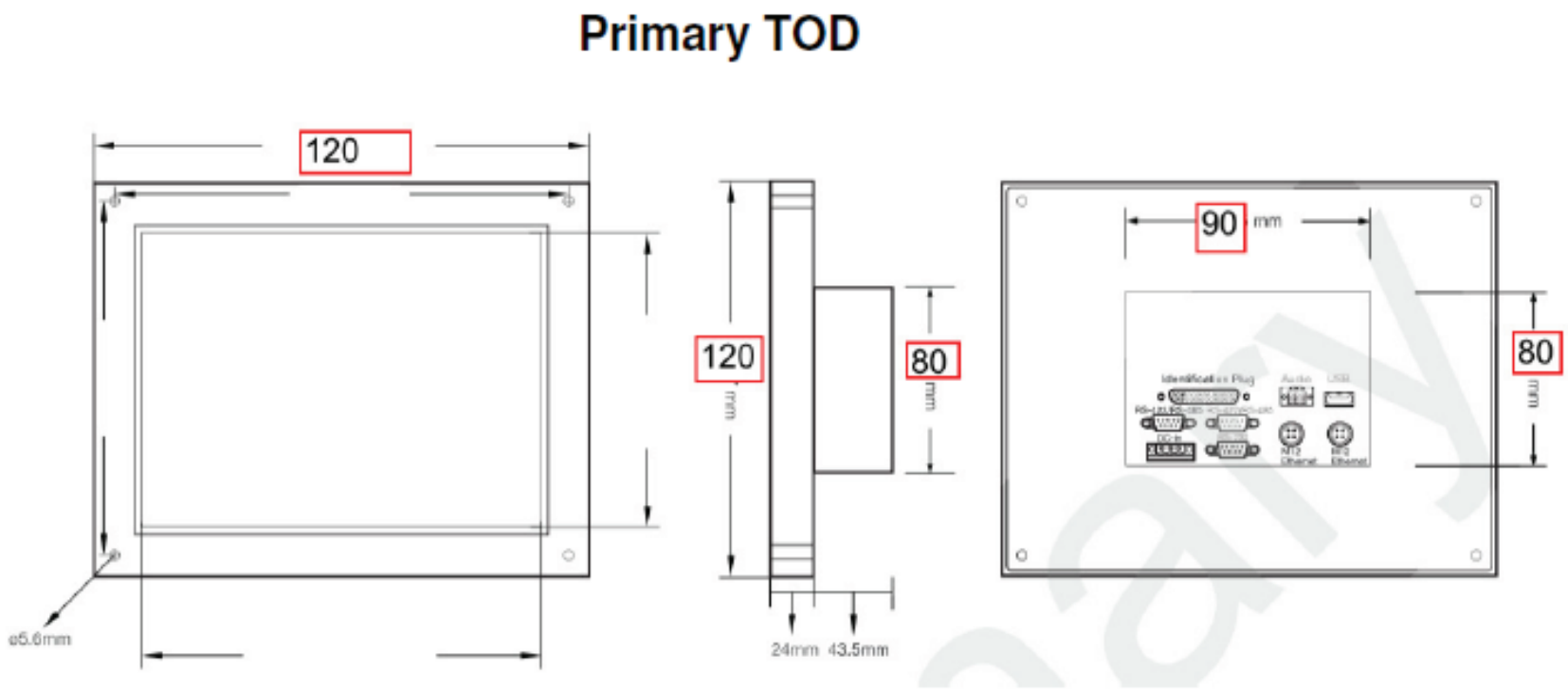
ANNEX C24
EIDS CIRCUIT


EIDS-S
EIDS-C
A CAR
EDPAC1(A2)
EDPDC(A1)
EDPAC3(B1)
EDPAC2(B2)
701(1B)
701(1D)
701(1A)
C07(7E)
C07(4A)
110VDC(+)
0VDC
240VAC
Pan Up/down signal
RS485
DVAS
GSM-MODEM
Antanna for Maintenance PC
SMA Female
Antenna for Download File
AP
DVI BOOSTER A1
DVI BOOSTER B2
DVI BOOSTER B4
703(2E)
703(2H)
*NOTE
D-SUB
PIN NO.
EDPAC1(A1)
EDPDC(A2)
EDPAC3(B1)
EDPAC2(B2)
COM
TITLE
EIDS A CAR
SCALE
1:1
DRAWING A2
PAGE NO. 1
DRAWING NO. DKZ28-00-00-0000Y-C07
VERSION B

Attachment H – Secondary TOD



Attachment I – Primary TOD



APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 4 COMMUNICATIONS INTERFACES

1 Introduction

2 Trainborne Radio

3 In-Cab CCTV

4 Electronic Information Display System (EIDS)

5 Door Chime System (DCS)

6 Trainborne Video Display

7 In-Saloon CCTV

8 RFID Tags

9 RFID Axle Box Temperature Detection System

Attachment App-I-Annex-4 Detailed Interface Specification for Communications

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 4 COMMUNICATIONS INTERFACES

1 Introduction

1.1 This document defines the interface requirements for all the trainborne communications equipment and the train system.

1.2 Each car with driving cab will be equipped with all the trainborne communications equipment as defined in PS 18.1.2.

1.3 The Contractor shall install all the communications equipment as stipulated in PS 18. All the required connectors, interfacing plugs and sockets, earthing connections and all associated mounting materials shall be provided by the Contractor.

1.4 The Contractor shall provide accommodation including mountings, equipment cabinets and cable access for the installation of all the communications equipment as stipulated in PS 18.

1.5 The Contractor shall provide the appropriate power supply, including the power supply interface and the protection device to all the communications equipment as stipulated in RS/C6014/02.

1.6 The Contractor shall provide all required EMI protective measures, such as special EMC cubicle, to protect the communications equipment in order to fulfil the EMC requirements as stipulated in RS/C6014/04.

1.7 The Contractor shall incorporate appropriate interfaces, power supply, delivery schedule, installation, testing and setting to work. The Contractor shall ensure that the equipment can be easily operated, removed and replaced.

1.8 The Contractor shall be responsible for the test and commissioning of all communications equipment that are supplied by the Contractor and those purchased from the Named Suppliers.

1.9 EMC Consideration and Constraints

1.9.1 The Contractor shall ensure that all train equipment is designed and constructed in accordance with RS/C6014/04 or equivalent, to ensure proper functioning of all the communications equipment.

1.9.2 The Contractor shall interface with all the Named Suppliers to ensure that EMC is achieved between all the communications equipment and train

systems. Special consideration shall be given on the positioning and protection of the Trainborne Radio antenna, In-Cab CCTV receivers, real time data receivers and trainborne transceivers for EIDS in order to ensure that each communication equipment shall be fully functional without suffering interference from any other communications equipment.

1.9.3 The Contractor shall, through this interface, develop a Communication Compatibility Specification which shall identify the possible interference sources and define the levels of susceptibility and emissivity for all the trainborne communications equipment that will guarantee compatibility in SEMP Stage 2. A Communication Compatibility Study shall be developed in SEMP Stage 3 to document the steps taken to ensure that the defined level of susceptibility and emissivity is achieved for all communications equipment and train systems.

1.9.4 Train systems and equipment shall be EMC tested in SEMP Stage 4 in accordance with RS/C6014/04 to demonstrate compliance with the PS. An appropriate technical construction file shall be developed in accordance with the EC EMC Directives and be certified by an appropriate Competent Body for the compliance of the EMC Directives.

2 Trainborne Radio

2.1 The Named Supplier of Trainborne Radio shall be in accordance with Appendix Q. The Contractor shall purchase from the Named Supplier all trainborne radio equipment as stipulated in clause 2.3 below.

2.2 Mobile unit consists of a train mobile radio unit (transceiver), a Train Control Interface Unit, a radio control head, a handset with PTT and volume control function, a loudspeaker, a power supply unit together with all associated cables to be installed in the train cab.

Trainborne Radio Set consists of a Mobile Unit, a trainborne antenna and all associated cables together with all associated interface with other trainborne systems.

2.3 Each driving cab shall be fitted with the following trainborne radio set:

(a) a mobile unit as stipulated in clause 2.2;
(b) a trainborne antenna; and
(c) all interconnection cables together with all associated interface.

2.4 All interconnection cables including the RF feeder cable shall be provided and installed by the Contractor in accordance with RS/C6014/02.

2.5 The system block diagram of the Trainborne Radio Set is shown in Figure 1. The Contractor shall liaise with the Named Supplier to define the detailed interconnections between various equipment.

2.6 Performance Requirements of the Trainborne Radio Set and Train System Interfaces

2.6.1 Mobile Unit

(a) The Mobile Units to be provided by the Named Supplier shall be TETRA compliant equipment and shall comply with the requirements stated in below table.

Item	Description	Requirement
1	Frequency Band (TMO)	Receive (Rx) 851 – 866 MHz Transmit (Tx) 806 – 821 MHz
2	Frequency Band (DMO)	806 to 821 MHz and 851 to 866 MHz
3	Duplex Spacing	45 MHz
4	RF Channel Bandwidth	25 kHz
5	Operation/Switching Bandwidth	At least 19 MHz
6	Transmitted Power	3 W, Power Class 3 as defined in the latest revision of ETSI EN 300 392-2.
7	Transmitted Power Control	4 or 5 steps of 5 dB
8	Receiver Sensitivity	-112 dBm static at 4% BER -103 dBm dynamic at 4% BER
9	Receiver Class	A according to EN300 392-2
10	Control Head LCD Display	- Provide illumination for operation in dark environment
11	Display and Input Languages	English and Traditional Chinese
12	Audio output power	3 W (5% THD maximum)
13	User Control	- Talk-group Selector, - Volume Control, - PTT Key, - Power On/Off Key, - Soft Keys, Menu Key and up-down-left-right Navigation Keys - *-#-0-to-9 Alphanumeric keypad, - Emergency Key with red/orange colour, - User Definable Short-cut Keys - Keypad tone can be enabled or disabled by the Employer's engineering users.

Item	Description	Requirement
14	Talk-groups	- Trunked Mode Operation (TMO): support a maximum of 1300 groups and 200 folders - Direct Mode Operation (DMO): support a maximum of 180 groups
15	Dynamic Group Number Assignment (DGNA)	- Support a maximum of 24 DGNA groups - Accept DGNA assignment with attachment
16	Scanning	- Support a maximum of 10 scan lists with 10 groups per list - Support background scanning - Scan group attachment signalling - Provide a scan on/off status
17	Address Book	- Support at least 255 persons (name entries). - Support at least 10 digits (0 – 9, * and #) per entry.
18	Short Data Service (SDS)	- Allow SDS messages to be sent/received to/from an individual / a talk-group - Support up to 140 bytes per SDS message. - Store up to 100 SDS messages and, when enabled, allow re-cycling overwriting upon memory full
19	Status Message	- Allow Status messages to be sent/received to/from an individual / a talk-group - Support 100 status lists
20	Data Interface	External Interface for RS232 Data via Short Data Service and Packet Data
21	Half Duplex / Full Duplex	Support both half duplex and full duplex operation
22	Security features	- Support Air Interface Encryption of TEA1, TEA2 and TEA3. TEA1 shall be used in the Delivered System if Option 2 is exercised. - Support keying with Security Class 1 (Clear), Class 2 (SCK) and Class 3 (DCK and CCK) - Support Authentication initiated by infrastructure and made mutual by terminal

Item	Description	Requirement
23	Security – End-to-end Encryption	The Mobile Units shall allow equipage of end-to-end encryption (between dispatcher and terminal, and between terminals) by adding a SIM card and/or software/firmware upgrade in a workshop in Hong Kong.
24	Other Features	- Ambient Listening - Emergency Hot Mic. - DTMF Over-dial - Late Entry - Talking Party Identification - Busy User Pre-emption (Pre-emption Priority Call) - Keypad lock - Supporting JAVA or WAP
25	Hand Over	- undeclared cell reselection - unannounced cell reselection - announced type 3 cell reselection
26	Real Time Clock	The real time clock shall be available for the user to set to show or hide from the hand-portable radio display. The clock time shall be synchronized to the Employer's system clock.
27	Dimensions (H x W x D)	Transceiver Unit not larger than 60 x 190 x 170 mm (H x W x D) Control Head not larger than 80 x 190 x 130 mm (H x W x D)
28	Weight	The weight of a Control Head together with a Transceiver unit shall not be more than 1800 g.
29	Operating Temperature	-10 to +55°C continuous
30	Humidity	5 to 95% RH, non-condensing, ETS 300 019-1-7 class 7.3E.
31	Enclosure	IEC 60529 IP55
32	Durability	- Polycarbonate and hard-coated display window. - Protected against drop, high shock and vibration according to MIL-Standard 810 D/E/F

(b) On switching on, the registration and Air interface encryption using TEA1 of a Mobile Unit with the active Call and Switching Centre shall be completed within 5 seconds if radio coverage of the MTR Radio System is available and the Mobile Unit shall be ready to make and receive calls.

(c) The Mobile Unit de-registration time, starting from an operator switching off the Mobile Unit to the moment the system finished updating all relevant databases, shall not be more than 3 seconds.

(d) The Trainborne Radio Set shall be able to store at least 100 most recent messages. When the Trainborne Radio Set runs out of memory, the earliest message received shall be discarded once a new message arrives.

(e) During the event of changing of status of the “Cab Occupied”, the changing of status of the signal to the completion of updating of information by the Central Equipment of the MTR Radio System shall be completed within 5 seconds.

(f) The radio control head of the Mobile Unit shall have backlights for the screen and keys for working in situations where ambient lighting is not sufficient.

(g) The screen of the radio control head of each Mobile Unit shall be able to display at least 2 lines of text, with 14 English/7 Traditional Chinese characters per line. Message scrolling function (both up and down) shall be provided for the users to read the whole message in case the message cannot be fitted on one screen.

(h) The loudspeaker shall produce an adjustable sound pressure level of 75-95 dBA when measured at a height of 1.65 meters above the floor level of the train cab while the handset shall enable audible communications under a background noise of 90 dBA.

2.6.2 Trainborne Antenna

(a) The trainborne antennae should be installed on the roof of train. All opening and the gap between the trainborne antenna and the car body shall be sealed properly using sealants approved by the Engineer to prevent leakage of water into train compartment.

(b) The trainborne antennae shall support the following frequency range:

Uplink (Mobile Unit Tx) : 806MHz – 821MHz
Downlink (Mobile Unit Rx) : 851MHz – 866MHz

The VSWR of the trainborne antennae shall be less than 1.5 and with a gain of 0 dBi within the frequency bands above.

(c) The trainborne antennae of the Delivered System shall comply with all the environmental requirements in below table and maintain its performance under such conditions. Moreover, the trainborne antennae shall be designed for operation under prolonged exposure to direct sunlight and with an operating life of not less than 15 years.

Environmental factor	**Range/Requirement**
Temperature	0 to 50°C without air circulation
Humidity (Relative)	5 to 99%
shock and vibration	RIA 20 (Category 1 for equipment mounted on a vehicle body)
Immunity to Environmental	shall not be degraded by sunlight, dust, dirt, grease, heavy rainfall, water droplets, vapour disposition and the above operating conditions.
Wind speed	Up to 117km/h and gust speed of up to 216km/h blowing in the opposite direction of train movement.

(d) The trainborne antenna shall be able to withstand corrosive environment, including the use of commercial acidic wash plant for train exterior cleaning.

(e) The trainborne antenna shall be properly grounded and protected against lightning and high tension lines. Attention shall be drawn to the 1500V DC high voltage traction current supplied by the overhead line system of the Employer. The material of the radome of the antennae shall not breakdown under these operating conditions.

2.7 Design Constraints

2.7.1 Power Supply Requirement for the Trainborne Radio Equipment

A power supply shall be provided to supply the trainborne radio equipment with the following output:

Output voltage: 110 v d.c.
Output current rating: 5.0 A continuous

2.7.2 Accommodation of the Trainborne Radio Equipment

The Contractor shall liaise with the Named Supplier to define the mechanical requirements (location and dimensions) to accommodate the

Trainborne Radio Equipment. Typical mechanical envelops and locations of the Trainborne Radio Equipment are summarised as follows:

Equipment to be purchased from the Named Supplier	Typical mechanical envelops H x W x D in mm	Typical location	Reference Drawing No.
Mobile unit comprising of radio transceiver, train control interface unit and dc-dc converter mounted in an equipment enclosure	Height : 100mm Width : 400mm Depth : 300mm (a further 30 mm allowed to the front to provide access for cable connections)	inside the cab back cubicle	TBA
Control Head	Height : 80mm Width : 190mm Depth : 130mm (including mounting bracket and screws)	on the driving console (refer to PS 8)	TBA
Loudspeaker	Ceiling speaker: 100mm diameter x 37mm (L) And Speaker near console: Height : 80mm Width : 140mm Depth : 50mm	One speaker mount on the ceiling and one mount on the driving console near the handset (refer to PS 8)	TBA
Handset	Height : 82mm Width : 218mm Depth : 62mm	on the driving console (refer to PS 8)	TBA
Antenna	Length : 300mm Width : 300mm Height : 80mm	mounted on the roof of the train	TBA

2.8 Interface with Trainborne PA Equipment

2.8.1 Each set of Trainborne Radio Set shall interface with the Trainborne PA System of the respective train cab to support the making of CPA calls from designated OCC operators.

2.8.2 The Trainborne Radio Set shall provide an interface of

- 0 +/- 10dBm 600Ω 2-wire audio
- 24V dry contact

to the Trainborne PA System. During ordinary radio calls, the audio of the Trainborne Radio Set shall not be routed to the Trainborne PA System. For CPA calls, the Trainborne Radio Set shall pull the dry contact to 24V to indicate the incoming of a CPA call and the audio shall be sent to the Trainborne Radio Set through the 2-wire audio. The dry contact shall be sent prior to the audio to ensure no truncation of the incoming audio messages. The audio output level to trainborne PA equipment shall be adjustable through 10-turns trimmer in the Train Control Interface box.

2.8.3 On establishment of a CPA call, the audio output of the Trainborne Radio Set shall automatically be routed to the Trainborne PA System as well as to the loudspeaker but not to handsets of the Mobile Unit.

2.9 Interface with future Passenger Call equipment

2.9.1 The Contractor shall provide an interface on each Trainborne Radio Set for interfacing with the future passenger call equipment as shown in Figure 1 and detailed below.

2.9.2 The passenger call interface shall provide the following connections:

- a 2-wire audio input;
- an RS422 port (one of the 3 RS422 ports described in PS Clause 18.2.23); and
- a PTT input for relay contact connection.

2.9.3 The audio input in PS Appendix I_Annex 4_Clause 2.9.2 shall have the following characteristics:

- 2-wire input connection with 600 ohm input impendence;
- an input sensitivity of -10dbm, adjustable for +/-10dB;

and this audio input shall work with the audio output for the Trainborne PA interface (described in PS Appendix I Annex 4 Clause 2.8) to form a 4-wire

audio interface, such that the return audio will go through the Trainborne PA system to the passenger.

2.9.4 The Contractor shall propose a protocol to enable normal call requests and emergency call requests to the Traffic Controllers of the associated line of the train to be made via the above RS422 port. The protocol shall handle the complete call process to enable the call to be answered and cleared by the associated Traffic Controller. Both half-duplex calls and full-duplex calls shall be supported by this protocol.

2.9.5 Upon a passenger call request is answered by a Traffic Controller, the call shall also be connected to the loudspeaker of the Trainborne Radio Set in the front train cab for monitoring.

2.10 Confirmation of Design Information

2.10.1 Any change in the design constraints (including power supply, accommodation and interconnection cables wiring arrangement) as stipulated in clause 2.7 above shall be submitted for Approval in accordance with the Configuration Control Program (refer to Appendix P) before the end of SEMP Stage 3.

2.10.2 The Contractor shall ensure that the Trainborne Radio shall be programmed in an identical manner of other Trainborne Radio Equipment currently in use by the Employer.

3 In-Cab CCTV

3.1 The Named Supplier of the In-Cab CCTV shall be in accordance with Appendix Q. The Contractor shall purchase from the Named Supplier all the In-Cab CCTV equipment, except the trainborne video display unit, as stipulated in clause 3.2 below.

3.2 Each driving cab shall be fitted with the following In-Cab CCTV equipment:

(a) Wireless video receiver integrated with video demodulator and picture auto on/off control;
(b) Two flat antennas;
(c) Connections of video output (which shall interface with the trainborne video display unit and TMS);
(d) Isolation transformer box; and
(e) All interconnection cables in accordance with RS/C6014/06.

3.3 The system block diagram of the In-Cab CCTV is shown in Drg. No. C6014-14E/TSEG/667/008 which indicates the interconnection between the various units of the trainborne In-Cab CCTV system.

3.4 Performance Requirements of the In-Cab CCTV and Train System Interfaces

3.4.1 General

The design of the train system shall ensure that the main objectives of the In-Cab CCTV summarised as below can be achieved:

(a) To show clearly the alighting, boarding and waiting passengers at the platform and the passenger loading and unloading conditions when the train enters the signal coverage area as detailed in PS 18.3.4(b).

(b) Fallback control for bypassing the picture auto on/off control to display the received pictures in case of malfunction of the picture auto on/off equipment via TMS on-screen commands.

3.4.2 Detailed Functions

(a) The pictures of the platform shall be displayed on the integrated trainborne video display (split screen for straight platform and quadrant screen for curved platform) automatically when the train enters the signal coverage area.

(b) Fallback control for bypassing the picture auto on/off control shall be provided by TMS on-screen commands such that the display of pictures can be manually controlled by the train operator.

3.5 Design Constraints

3.5.1 Power Supply Requirement for the In-Cab CCTV Equipment

The maximum power consumption of all trainborne In-Cab CCTV equipment will be less than 150 W and the total current less than 0.6 A. The power supply for the In-Cab CCTV shall be taken from the DC output of the Auxiliary Converter system (refer to PS 17.4). The power supply to the In-Cab CCTV shall be available when either one of the Auxiliary Converter is running.

3.5.2 Accommodation of the Trainborne In-Cab CCTV Equipment

The Contractor shall liaise with the Named Supplier to accommodate the In-Cab CCTV equipment. Typical dimensions and location of the InCab CCTV equipment are summarised as follows:

Equipment to be purchased from the Named Supplier	Typical dimensions H x W x D in mm	Typical location	Reference Drawing No.
Wireless video receiver with video demodulator	112 x 333 x 97	inside driving cab ceiling and facing the normal running direction	C6014-14E/TSEG/667/008 (refer to clause 3.5.3 below)
Not used	Not used	Not used	Not used
Equipment to be purchased from the Named Supplier	Typical dimensions H x W x D in mm	Typical location	Reference Drawing No.
Power supply unit	130 x 220 x 65	equipment cubicle within a space envelope of 350 x 350 x 150 mm (H x W x D)	NA
Not used	Not used	Not used	Not used

3.5.3 Control Interfaces with TMS

TMS shall be able to send the following control commands to the In-cab CCTV equipment and display the corresponding control status for Mode and Channel on the TMS screen (refer to PS 10.3.3). The In-Cab CCTV equipment will respond to the commands and perform the operations respectively as below:

Control Group	Operation Selection	Operation Method	Remarks

Mode	Auto / Manual	Press once	Toggle the operation mode between Auto / Manual
Channel	Ch 1 / Ch 2	Press once	Toggle the channel selection between Channel 1 and 2 by a single strobe activation

3.5.4 Status Interfaces with TMS

TMS shall be able to receive the following reply from the In-cab CCTV equipment and display the status respectively.

Indication Group	Operation Selected	On-screen Indication
Microwave Reception (Rx)	Fail	Red
	Healthy	Grey

3.5.5 Physical Interfaces from the In-cab CCTV equipment

Connector	To	Description	Data Carried
Video Output	Trainborne video display	BNC connector type 22 BNC75-0-1	1Vp-p composite video, PAL, 625 lines, 50Hz, 75Ω impedance
Control Data I/O	TMS	10 way chassis mounted Amphenol Pattern 105 bayonet plug type 62GB 12E 12-10 P (760)	4 RS422 Digital Levels: • Output: Display On / Off • Output: Mode Selection Auto / Manual • Input: Rx status Healthy / Fail • Output: Channel Selection Ch1 / Ch2

3.6 Confirmation of Design Information

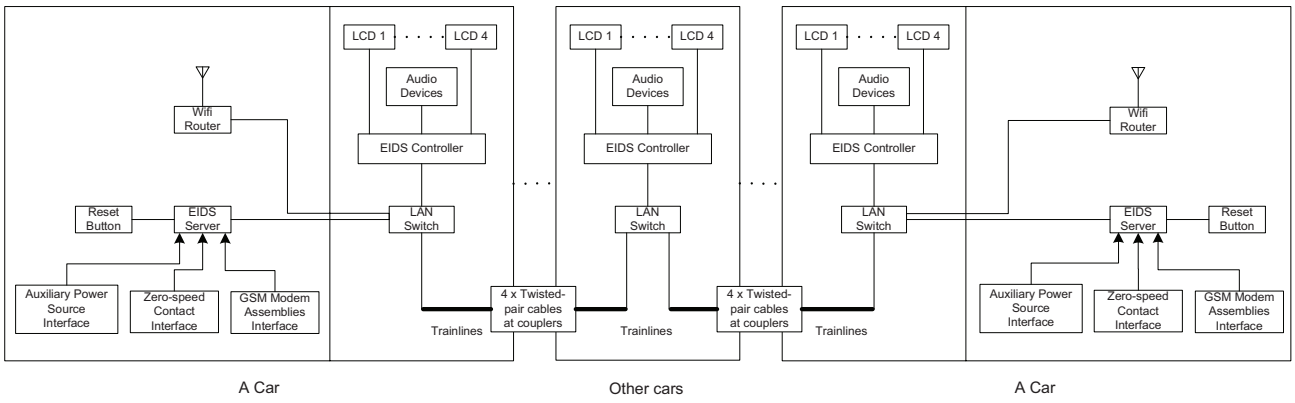
Any change in the design constraints (including power supply, accommodation and interconnection cables wiring arrangement) as stipulated in clause 3.5 above shall be submitted for Approval in accordance with the Configuration Control Program (refer to Appendix P) before the end of SEMP Stage 3.

4 Electronic Information Display System

4.1 The Employer will free-issue the EIDS equipment, including Bulk Data Transmission Facilities (the WiFi Access Point and WiFi Router), EIDS Server, LAN Switch, EIDS Controller and Audio equipment, reset button, except the GSM Modem Assemblies Interface and EID panels, to the Contractor for installation.

4.2 The Contractor shall provide and install the EID panels for the information display.

4.3 All interconnection cables between cars shall be supplied and installed by the Contractor in accordance with RS/C6014/06. System Schematic Diagram as follows:



4.4 Performance Requirements of the EIDS Equipment and Train System Interfaces

4.4.1 General

The design of the train system shall ensure that the main objectives of the EIDS equipment summarised as below can be achieved:

(a) The Bulk Data Transmission Facilities will provide a secure communication link to allow EIDS server to receive scheduling list, advertising messages and other information on certain strategic locations in the Urban Lines.

(b) The GSM Modem Assemblies Interface shall allow EIDS Server to receive a dry contact signal via the public GSM network in the Urban Lines for blanking the screen or display pre-loaded images/video files on the EID panels in the event of broadcasting emergency messages.

(c) The EIDS controller will control the EID panels and audio equipment to display and broadcast messages and advertisements in accordance with

the scheduling list, message priority and audio levels that are compensated from the ambient conditions.

(d) The Zero-speed Contact Interface shall allow EIDS Server to obtain a voltage free relay contact for indicating whether the speed of the train is zero or not and achieve audio output level adjustment with respect to whether the train is moving or stationary.

(e) The Auxiliary Power Source Interface shall allow EIDS Server to monitor its power of the train for achieving the required delay shutdown function.

4.4.2 Use of Attachment App-I-Annex-4

The Contractor shall refer to Attachment App-I-Annex-4 “Detailed Interface Design Specification for Communications”. The Contractor shall ensure the trains are fully adapted to the EIDS equipment.

Attachment App-I-Annex-4 shall be read in conjunction with other Clauses in the PS Appendix I Annex 4. To the extent that any provision of Attachment App-I-Annex-4 is inconsistent with any provision of other Clauses in PS Appendix I Annex 4, the provisions of the other Clauses in PS Appendix I Annex 4 shall prevail.

4.5 Design Constraints

4.5.1 Bulk Data Transmission Facilities

(a) Power Supply and Electrical Requirement

(i) The power of WiFi Router shall be supplied by DC110V and the power consumption will be less than 200W; and

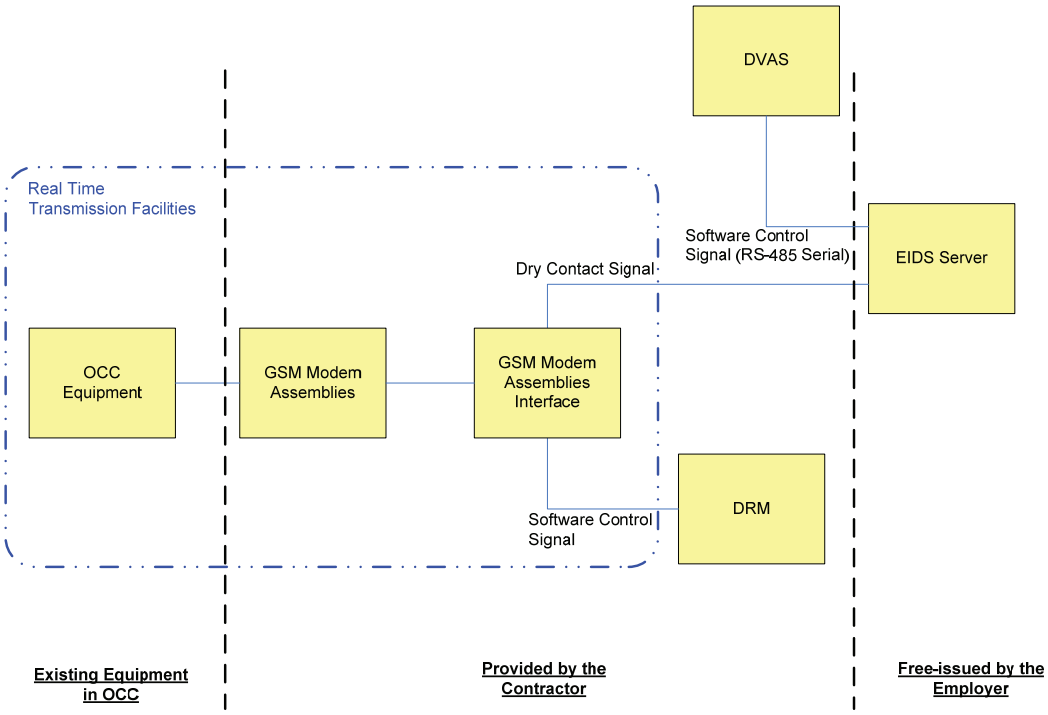
(ii) The power of WiFi Access Point will be supplied by the WiFi Router via a feeder cable.

(b) Accommodation Requirement

The Contractor shall install the Bulk Data Transmission Facilities according to the mechanical requirements (location and dimensions), installation requirements (the maximum allowable separation between the antenna and the WiFi Router) as stipulated in the Attachment App-I-Annex-4.

4.5.2 Real Time Transmission Facilities

The interface between the GSM Modem Assemblies Interface and EIDS Server shall be a dry contact signal and satisfy the interface requirement which shall be submitted for Approval during the detailed design. The interface demarcation diagram is shown as follows:



(a) Power Supply and Electrical Requirement

(i) The power of the real time data receivers (GSM Modem Assemblies) shall fulfil the requirement as stipulated in Appendix I Annex 9 Clause 2.2.2.

(ii) Not used.

(b) Accommodation Requirement

(i) The size, exact location, mounting method and arrangement of the real time data receiver, with all associated antenna, necessary cases and enclosures shall fulfil the requirement as stipulated in Appendix I Annex 9 Clause 2.2.2.

(ii) The total weight of the trainborne real time data receiver shall fulfil the requirement as stipulated in Appendix I Annex 9 Clause 2.2.2.

(iii) The Contractor shall liaise with the Employer to define the mechanical requirements (location and dimensions) and installation requirements to accommodate the GSM Modem Assemblies Interface.

4.5.3 Zero-speed Contact

The interface between the Zero-speed Contact and the EIDS Server shall be a voltage free relay contact and satisfy the interface requirement and submit for Approval during the detailed design.

(a) Accommodation Requirement

(i) The Contractor shall liaise with the Employer to define the mechanical requirements (location and dimensions) and installation requirements to accommodate the Zero-speed Contact Interface.

4.5.4 Auxiliary Power Source

The interface between the Auxiliary Power Source and the EIDS Server shall be a voltage supplied by the Auxiliary Power Source and satisfy the interface requirement and submit for Approval during the detailed design.

(a) Power Supply and Electrical Requirement

(i) The power supplied by the Auxiliary Power Source shall be in the form of 110V DC.

(b) Accommodation Requirement

(i) The Contractor shall liaise with the Employer to define the mechanical requirements (location and dimensions) and installation requirements to accommodate the Auxiliary Power Source Interface.

4.5.5 EIDS Server and LAN Switch

(a) Power Supply and Electrical Requirement

The power of the EIDS Server and LAN Switch shall be supplied from DC 110V and the maximum power consumptions will be less than 600 W.

(b) Accommodation Requirement

The EIDS Server and LAN Switch shall be installed in saloon electric equipment cabinet of each A car respectively. The Contractor shall install the EIDS Server and LAN Switch according to the mechanical requirements (location and dimensions) and installation requirements as stipulated in the Attachment App-I-Annex-4.

4.5.6 EIDS Controller

(a) Power Supply and Electrical Requirement

The power of the EIDS Controller and audio equipment shall be supplied from DC 110V and the maximum power consumption will be less than 200 W.

(b) Accommodation Requirement

The EIDS Controller and audio equipment shall be installed in saloon electric equipment cabinet of in each car respectively. The Contractor shall install the EIDS Controller and audio equipment according to the mechanical requirements (location and dimensions) and installation requirements as stipulated in the Attachment App-I-Annex-4.

4.5.7 Inter-car connections

(a) Electrical Requirement

The performance of connection cables shall meet the data rate of Cat.5e standard.

(b) Accommodation Requirement

The Contractor shall provide the connection interfaces with the LAN cables at the electrical connection boxes of the couplers.

4.5.8 Reset button

(a) Accommodation Requirement

The reset button shall be installed in cab of each A car respectively. The Contractor shall install the reset button according to the layout Zone C2 as stipulated in the Drg No. C6014-14E/TSEG/110/004.

4.6 Confirmation of Design Information

Any change in the design constraints (including power supply, accommodation and interface arrangement) as stipulated in clause 4.5 above shall be submitted for Approval in accordance with the Configuration Control Program (refer to Appendix P) before the end of SEMP Stage 3.

5 Door Chime System (DCS)

5.1 The DCS equipment per cab which will be free issued by the Employer are as follow:

(i) Train-borne Unit (TU)
(ii) DCS antenna
(iii) DCS antenna cable with connectors (for connection between TU and DCS antenna)
(iv) DCS external loudspeaker
(v) DCS external loudspeaker cable with connectors (for connection between TU and DCS external loudspeaker)

5.2 The DCS consists mainly of a Train-borne Unit (TU) for the coordinated and simultaneous operation onboard a train and on the platform where the train stops at.

5.3 The TU shall be installed inside each driving cab and it shall interface with train-borne Vehicle Control Circuit (VCC) and the train PA system for automatic broadcast of audible alerts on board the train and send commands to the platform via Radio Frequency (RF) link for triggering of broadcast of the same audible alerts at the platform through the station PA system. The RF link working in the Industrial, Science, and Medical (ISM) band at 2.4GHz, IEEE802.15.4, maximum transmission power at 2W is used for the communication between the TU and the platform.

5.4 Performance Requirements of the Door Chime System and Train System Interfaces

5.4.1 General

The design of the train system shall ensure that the main objectives of the Door Chime System summarized as below can be achieved:

(a) The DCS shall synchronize the platform announcement system to broadcast the unified chime/audible announcement on platform to alert passengers when train doors, platform screen doors (PSD) and automatic platform gates (APG) are opening, about to close, and closing.

(b) When a train stops at a platform and its doors begin to open, a "Door Opening" chime shall be broadcast through the Train Public Address (PA) System. When the train is about to leave and before the train doors begin to close, a “door-about-to-close” PA message (DPA) shall be announced. And when the train doors begin to close, a “Door Closing” chime shall be played until the moment the doors close completely.

(c) The broadcast of the chimes and the DPA shall also take place on the platform simultaneously with that on the train. This shall be achieved by relaying the broadcast commands from the train via wireless link to the platform where the commands will be sent through hardwire to the station PA system to initiate the appropriate broadcast.

(d) The DCS shall be programmed to broadcast the chime/audible announcement, and to ensure that they are broadcast at the right times under the various scenarios of door open/close activities.

5.5 Design Constraints

5.5.1 Power Supply Requirement for the Door Chime System Equipment

(a) The Contractor shall provide power supply at 24Vd.c. ±10% (min. 300mA) to DCS equipment in driving cab. The circuit protection device, i.e. Miniature Circuit Breaker shall be provided for the DCS equipment.

(b) The power supply for DCS equipment shall always be available when the train is switched on and D1 supply is energized.

5.5.2 Installation Requirement

(a) The TU shall be located in driving cab. DCS antenna and DCS external loudspeaker shall be installed on auxiliary console where appropriate. The design details and any alternative locations shall be proposed subject to Engineer’s Approval.

(b) The dimension of TU will not be larger than 150(W) x 200(H) x 100(D) mm. The dimension of DCS external loudspeaker and DCS antenna are provided in Clause 5.5.5

(c) The distance between a DCS antenna (in a driving cab) and a platform RF receiver (at platform headwall/tailwall) to establish the communication is less than 10 meters. A metal free zone for installation of DCS antenna shall be provided in light of this coverage requirement.

5.5.3 Interface with train-borne Vehicle Control Circuit (VCC)

5.5.3.1 The Contractor shall provide the following VCC interface to TU:

(a) A-side Door (open/close) Command;
(b) B-side Door (open/close) Command;
(c) Door Public Announcement (DPA) Command;
(d) Cab Occupied Status (for indication of leading cab) for enabling/disabling of the TU;
(e) Emergency Brake Status.

5.5.3.2 The electrical characteristic and signal interpretation of individual command are tabulated as follows:

<table>
<tr><th rowspan="2">Signal Name</th><th colspan="3">Electrical Characteristic</th><th rowspan="2">Interpretation of Signal</th></tr>
<tr><th>VCC</th><th colspan="2">TU</th></tr>
<tr><td>A-side Door Command</td><td rowspan="5">Dry Contact

Contact Capacity: 350Vdc 8A max.

Min. Voltage: 12Vdc

Wetting Current: 10mA</td><td rowspan="5">Input</td><td rowspan="5">Voltage Sink (Input) 24Vdc</td><td>Contact Open -> Door Closed
Contact Closed -> Door Open</td></tr>
<tr><td>B-side Door Command</td><td>Contact Open -> Door Close
Contact Closed -> Door Open</td></tr>
<tr><td>DPA Command</td><td>Contact Open -> Released
Contact Closed -> Pressed</td></tr>
<tr><td>Cab Occupied Status</td><td>Contact Open -> Not Occupied
Contact Closed -> Occupied</td></tr>
<tr><td>Emergency Brake Status</td><td>Contact Open -> Emergency Brake Applied
Contact Closed -> Emergency Brake Released</td></tr>
</table>

Table App-I-Annex-4-1

5.5.3.3 The system timing diagrams are provided in Clause 5.5.7

5.5.4 Interface with Train PA System

5.5.4.1 The outputs of PA microphone audio and Press-To-Talk (PTT) circuit shall be connected to TU. The following signals will therefore be received by TU and then relayed to train PA system when any PA microphone is engaged for live manual PA:

(a) Audio output signal from the PA microphones;
(b) PTT (contact) signals from the PA microphones.

5.5.4.2 The TU will emulate as a microphone (when triggered by the VCC) and send the following signals to the train PA system for “automatic” broadcast:

(a) Audio signal to PA microphone input;
(b) PTT (contact) signal to PA microphone PTT input;
(c) DPA signal (24Vdc discrete signal) to DPA input.

5.5.4.3 The audio output signal of the TU will be interrupted immediately and discontinued if the PA microphone's PTT is pressed. This is to ensure that live manual PA (through the PA microphone) will have the highest priority at any time.

5.5.4.4 The microphone of train PA system will remain operational regardless of whether the TU is powered on or off.

5.5.4.5 When the TU is in the idle state, i.e. with no signals received from the VCC, all audio and PTT signals from the PA microphone will be relayed (or "repeated") to the train PA system allowing live manual PA operation be made in a normal way.

5.5.4.6 The electrical characteristic and interpretation of the signals are detailed as follows:

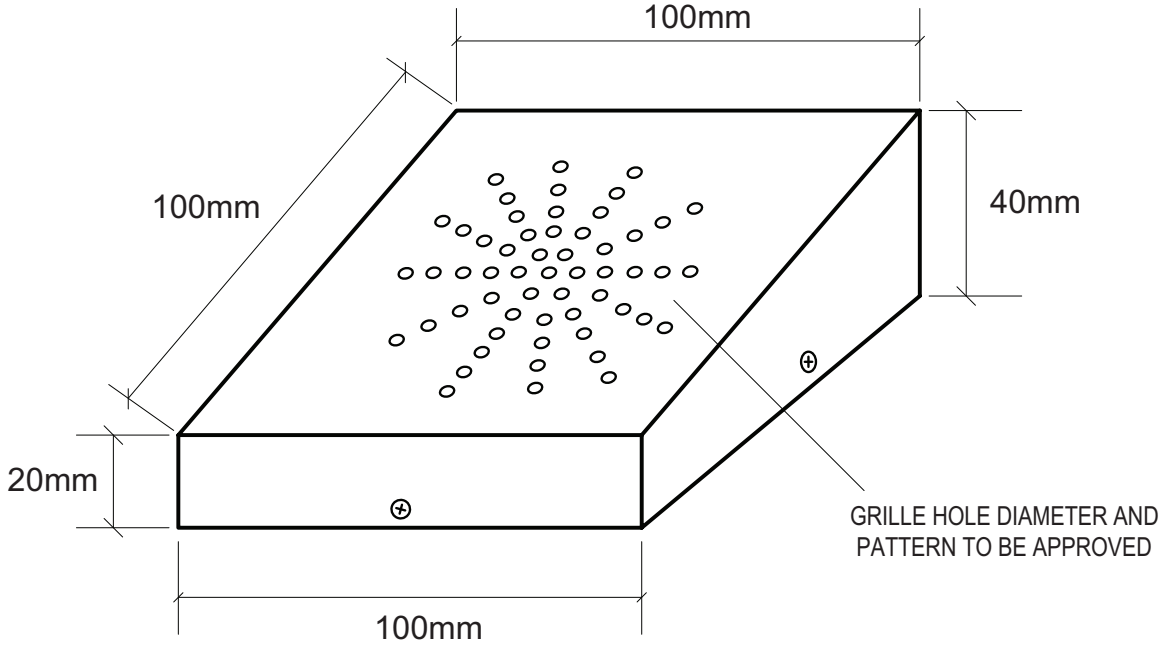
Signal Name	Electrical Characteristic			Interpretation of Signal
	Train PA System	TU		
Audio output from PA microphone	AC Voltage	Input	Load	Audio signal at approximate 1V from PA microphone output
PTT (contact) from PA microphone	Dry Contact or 24Vdc Voltage	Input	Voltage Sink (Input) 24Vdc, ≦20mA (This input point shall be software configurable to read 24Vdc discrete signal from the Train PA instead of dry contact)	Contact open -> PTT released Contact closed -> PTT pressed or 0Vdc -> PTT released 24Vdc -> PTT pressed
PTT (contact) from PA microphone	Dry Contact	Input	Voltage Sink (Input) 24Vdc, ≦20mA	Contact open -> PTT released Contact closed -> PTT pressed
Audio output from digital announcer of TU	Load	Output	AC Voltage	Audio signal at approximate 1V to train PA system

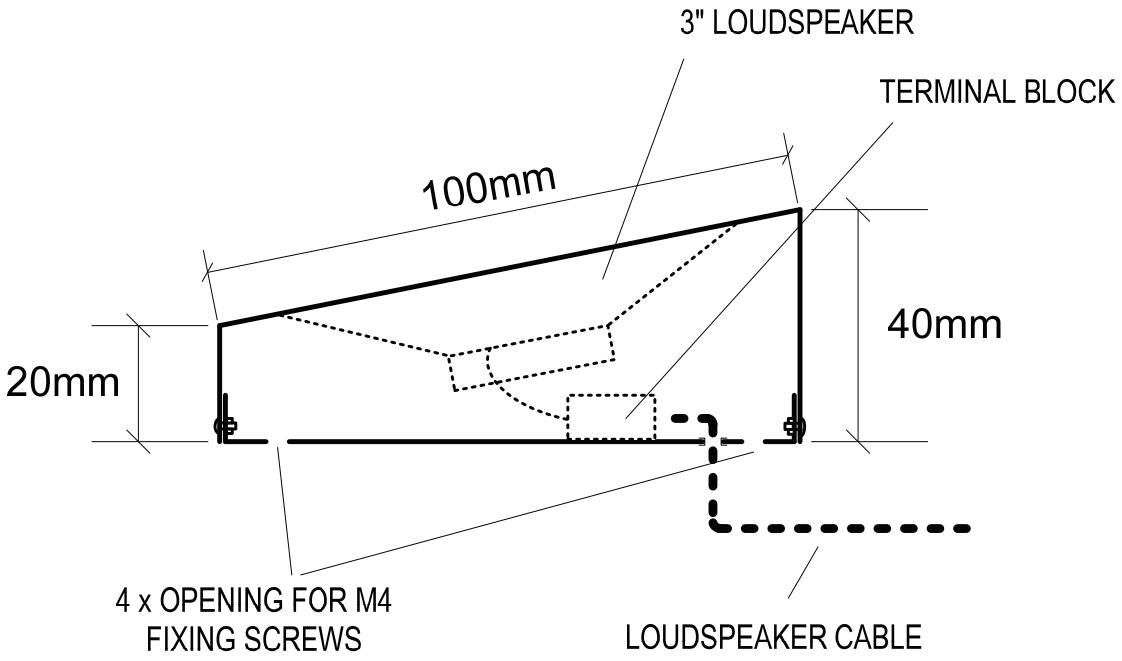
Signal Name	Electrical Characteristic			Interpretation of Signal
	Train PA System	TU		
PTT (contact) from TU	DC Voltage or Load	Output	Dry Contact (This output point shall be software configurable to send 24Vdc voltage to the Train PA instead of dry contact)	Contact open -> PTT released Contact closed -> PTT pressed or 0Vdc -> PTT released 24Vdc -> PTT pressed
DPA signal from TU	DC Voltage	Output	24Vdc discrete signal	0Vdc -> all DPA pushbuttons released 24Vdc -> any DPA pushbutton pressed

Table App-I-Annex-4-2

5.5.5 Dimensions of Door Chime System Equipment

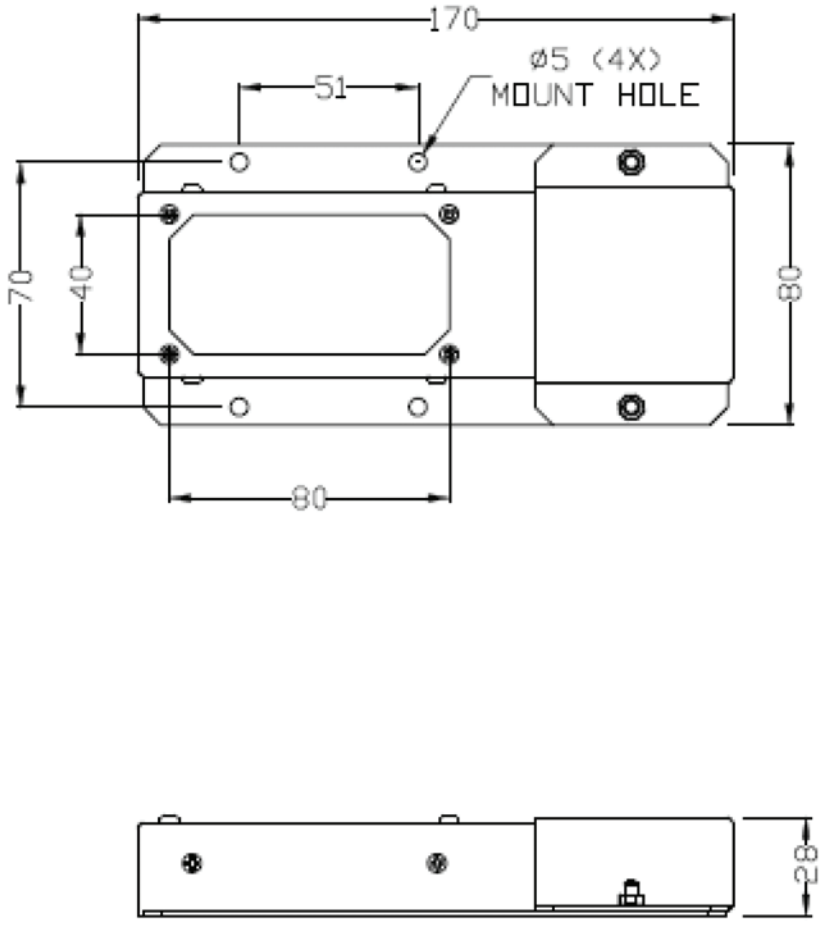
DCS External Loudspeaker



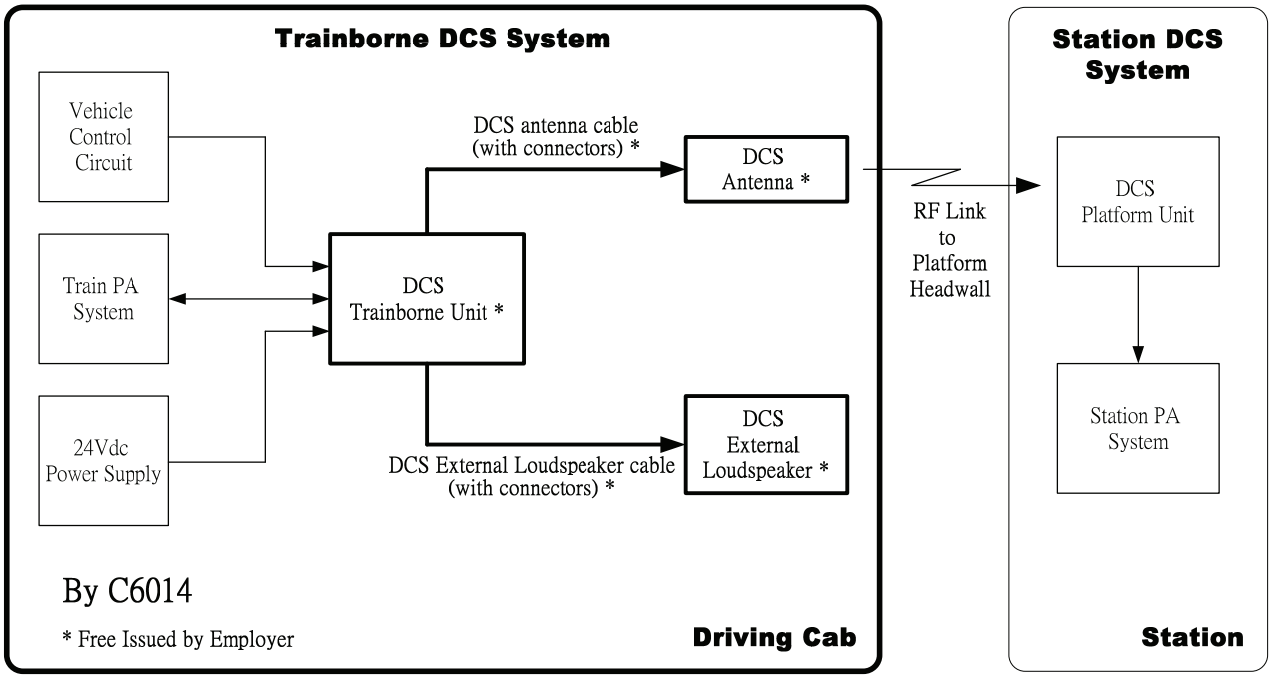


CROSS-SECTIONAL VIEW

Dimension of DCS Antenna

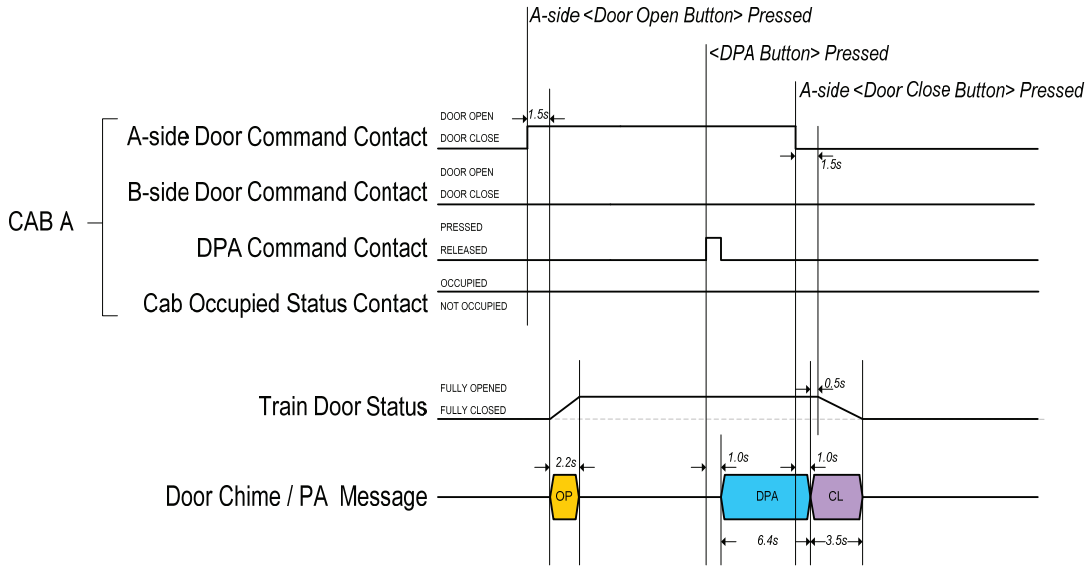


5.5.6 Interface Demarcation Diagram

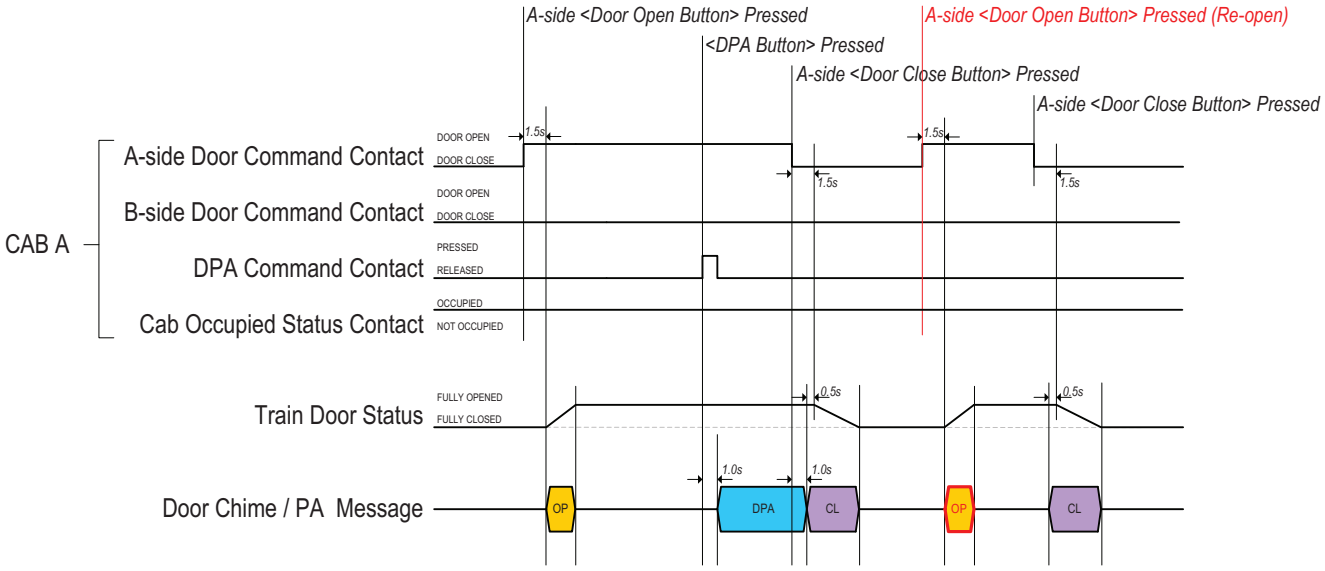


5.5.7 System Timing Diagram

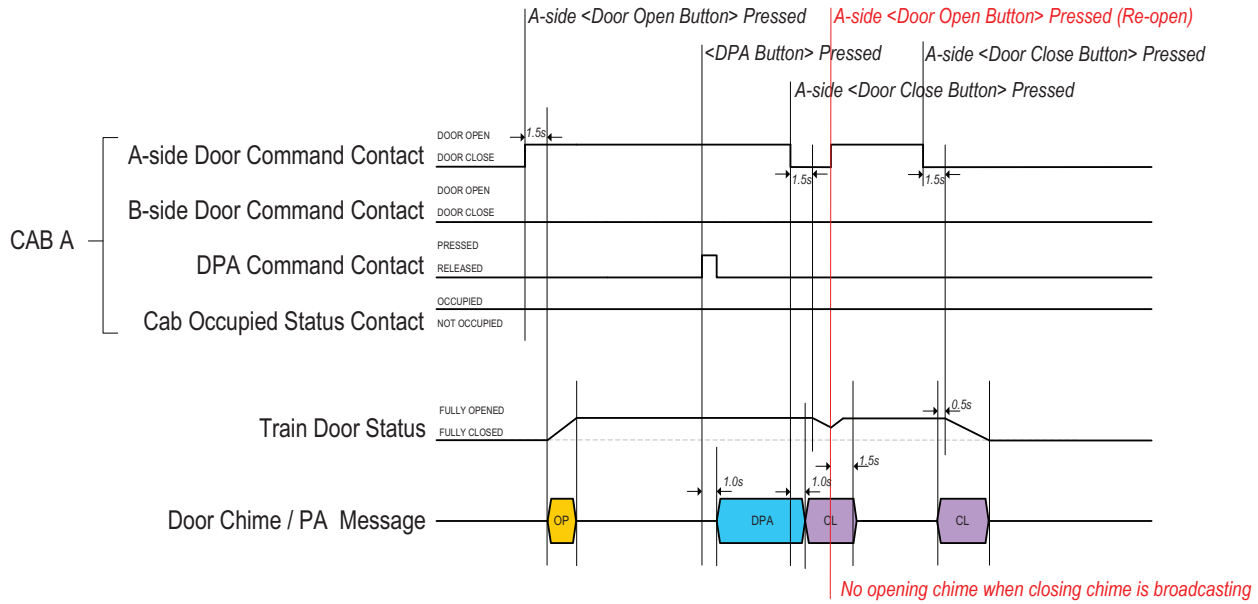
Scenario 1 - Normal Door Open and Close



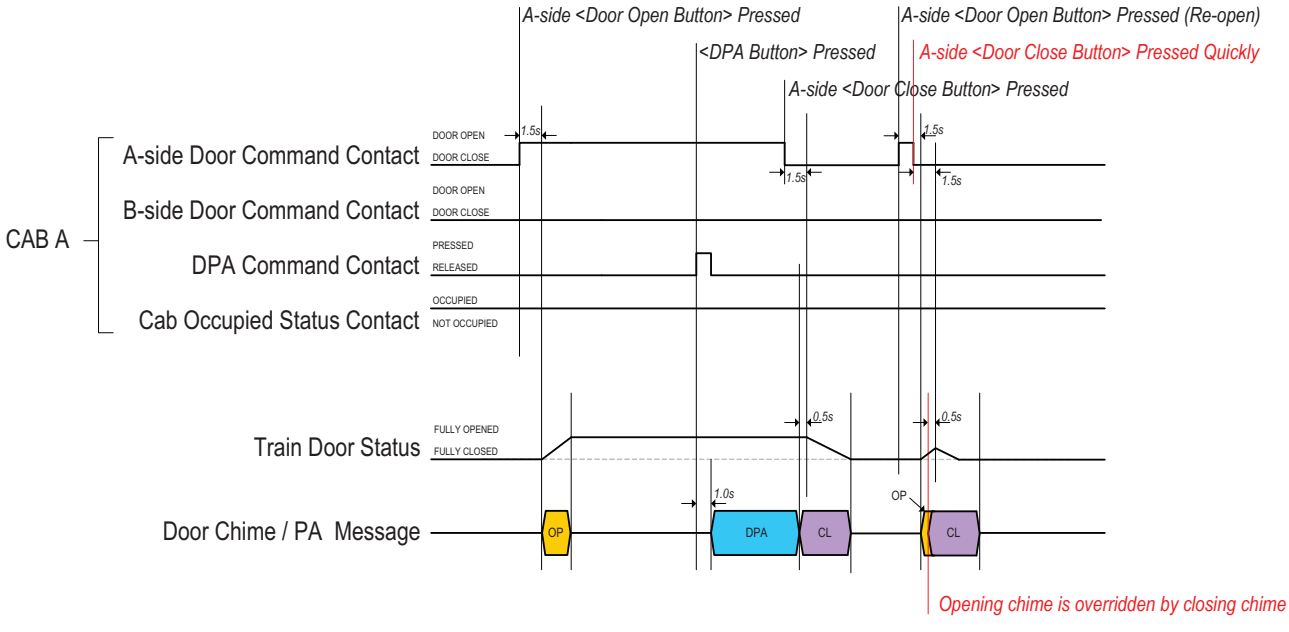
Scenario 2 - Door Re-Open



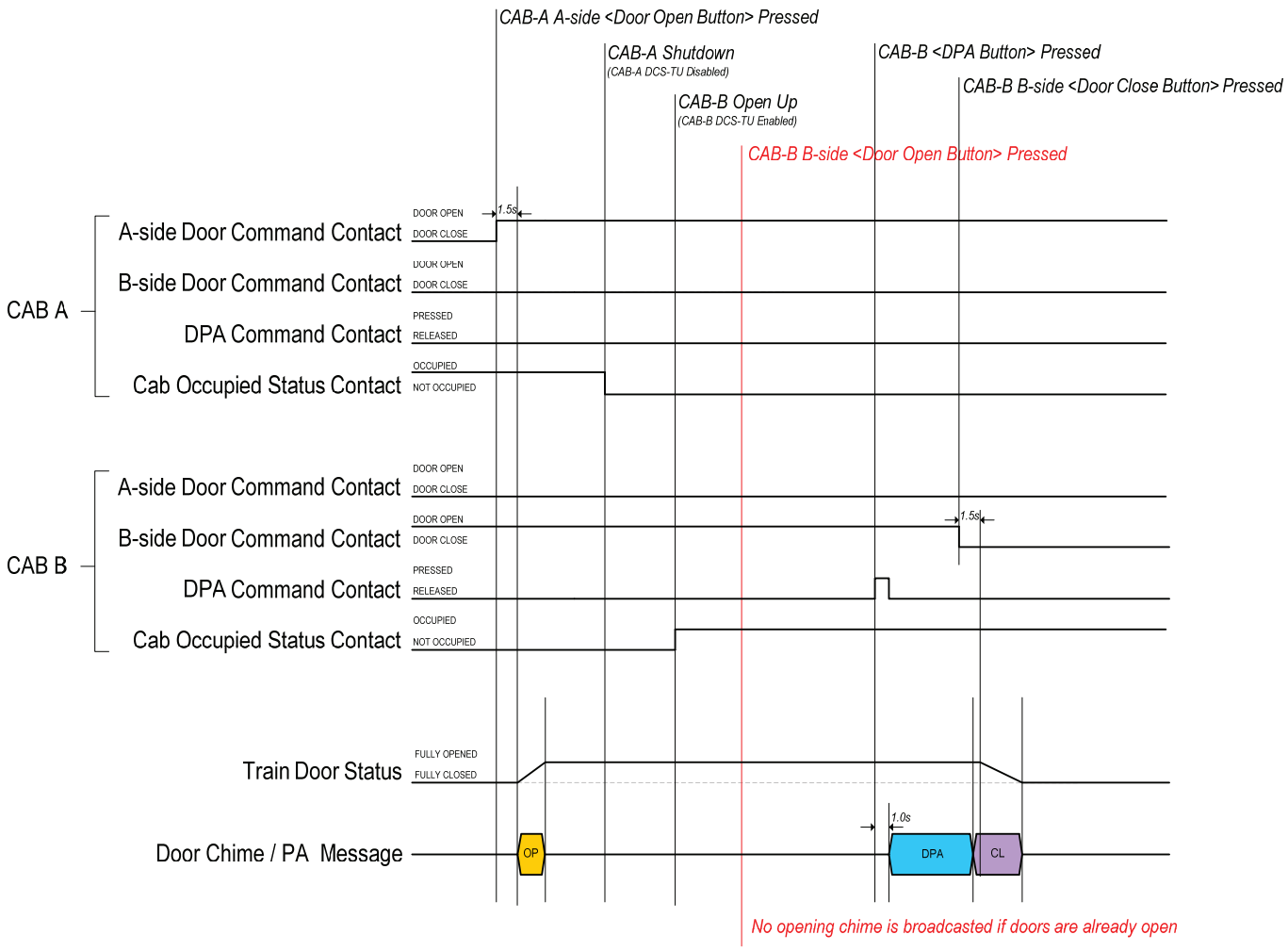
Scenario 3 - Door Re-Open (During Door Closing)



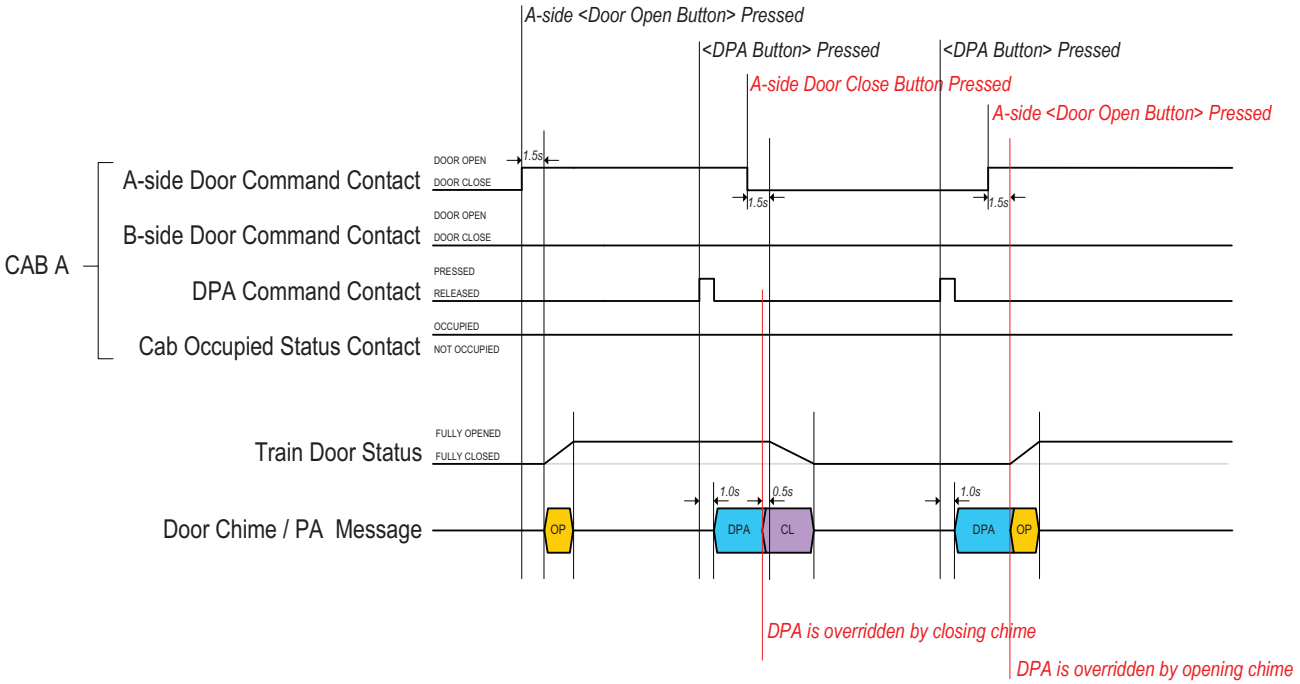
Scenario 4 - Door Close (During Door Opening)



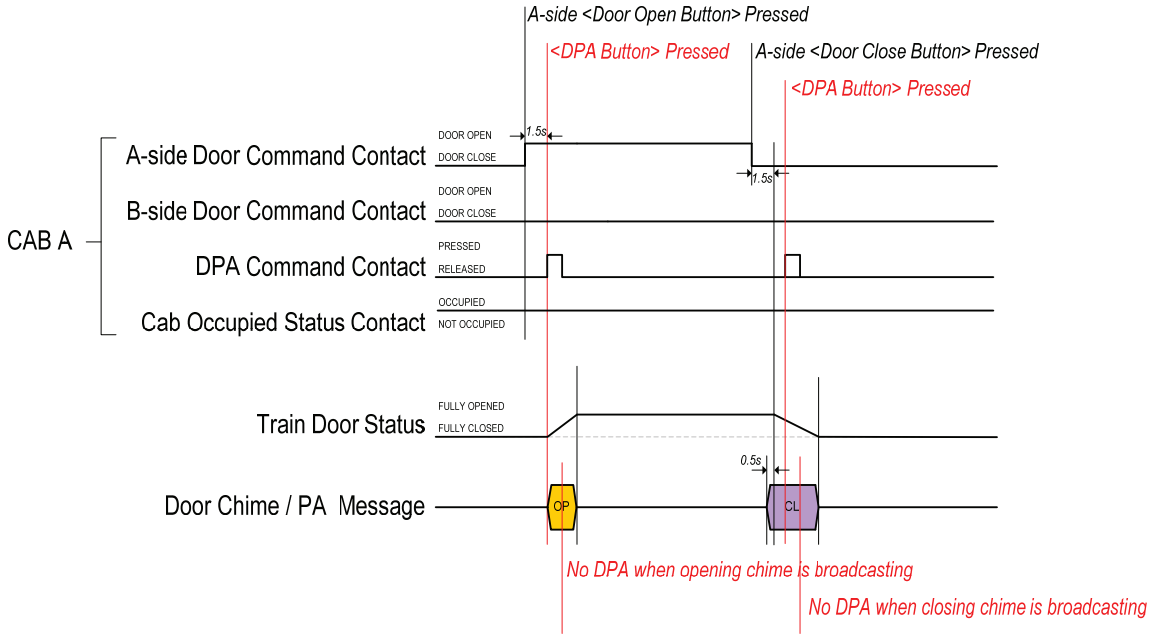
Scenario 5 - Change End Operation



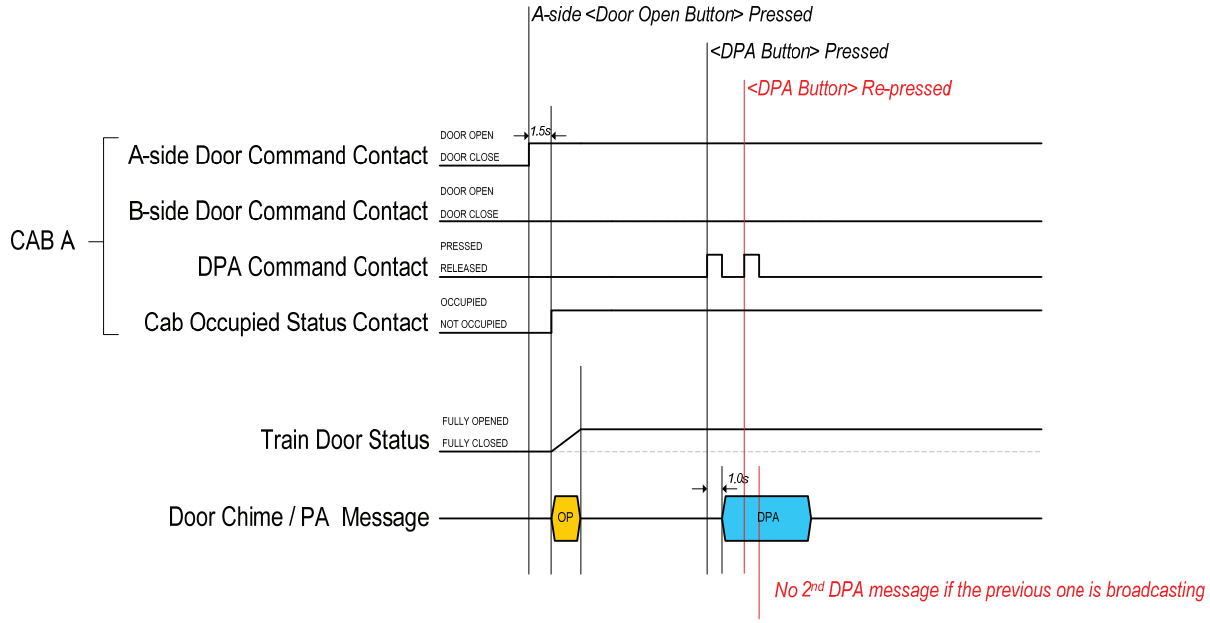
Scenario 6 - Door Open/Close (During DPA broadcasting)



Scenario 7 - Door Open/Close (During DPA broadcasting)



Scenario 8 - DPA Button pressed for the 2nd time (During previous DPA broadcasting)



5.6 Confirmation of Design Information

Any change in the design constraints (including power supply, accommodation and interconnection cables wiring arrangement) as stipulated in clause 5.5 above shall be submitted for Approval in accordance with the Configuration Control Program (refer to Appendix P) before the end of SEMP Stage 3.

6 Trainborne Video Display

6.1 The Contractor shall provide an integrated trainborne video display for the images of the In-Cab CCTV system and the In-Saloon CCTV system.

6.2 Control Interfaces with TMS

TMS shall be able to send the following control commands to the trainborne video display. The trainborne video display will respond to the commands and perform the operations respectively as below:

Control Group	Operation Selection	Operation Method	Remarks

Mode	Auto / Manual	Press once	Toggle the operation mode between Auto / Manual
Display	ON / OFF	Press once	Toggle the display between ON / OFF by a single strobe activation
ALC	Active / Inactive	Press once	Toggle the automatic light control between Active / Inactive by a single strobe activation
Brightness	+ / -	Press once or continuous	Increment or decrement the brightness level step by step or continuously at 5 steps/sec
Contrast	+ / -	Press once or continuous	Increment or decrement the contrast level step by step or continuously at 5 steps/sec
Colour Saturation	+ / -	Press once or continuous	Increment or decrement the colour saturation level step by step or continuously at 5 steps/sec

6.3 Video Input Interfaces to the Trainborne Video Display

Interfaces	**From**	**Description**	**Data Carried**
Video Input	In-Cab CCTV	BNC connector type 22 BNC-75-0-1	1Vp-p composite video, PAL, 625 lines, 50Hz, 75Ω impedance
	In-Saloon CCTV	RGB connector or VGA connector	1Vp-p composite video, PAL, 625 lines, 50Hz, 75Ω impedance or VGA/SVGA/XGA multi scan mode

7 In-Saloon CCTV

TMS shall be able to send the following control commands to the In-Saloon CCTV :

(a) Mode selection - to choose between single, split and quad screen modes for displaying the camera images from the saloons (refer to PS 18.7.9(f)(vi));

(b) Source selection - to select the camera or groups of camera to be viewed (refer to PS 18.7.9(f)(vii));

(c) "cab-occupied" control command via a serial link to active the trainborne video display. The In-Saloon CCTV System shall automatically start to display the real time images on the screen on receiving such "caboccupied" control; and

(d) TMS shall report fault on receiving fault information of video storage failure from In-Saloon CCTV (refer to PS 18.7.10(h)).

8 RFID Tags

8.1 The Named Supplier of RFID tags shall be in accordance with Appendix Q. The Contractor shall purchase from the Named Supplier RFID tags as stipulated in clause 8.2 below.

8.2 Each driving cab shall be fitted with the following equipment:

(a) Four (4) RFID tags
(b) Four (4) mounting brackets for RFID tags

8.3 Performance Requirements of the RFID Tags and Train System Interfaces

8.3.1 General

The design of the train system shall ensure that the main objectives of the RFID tags summarized as below can be achieved:

RFID tags information at each train's driving cab could be successfully read by RFID readers as a means to track specific operating scenarios of trains including entering or leaving depots and crossing the railway lines.

8.4 Design Constraints

8.4.1 RFID Tags

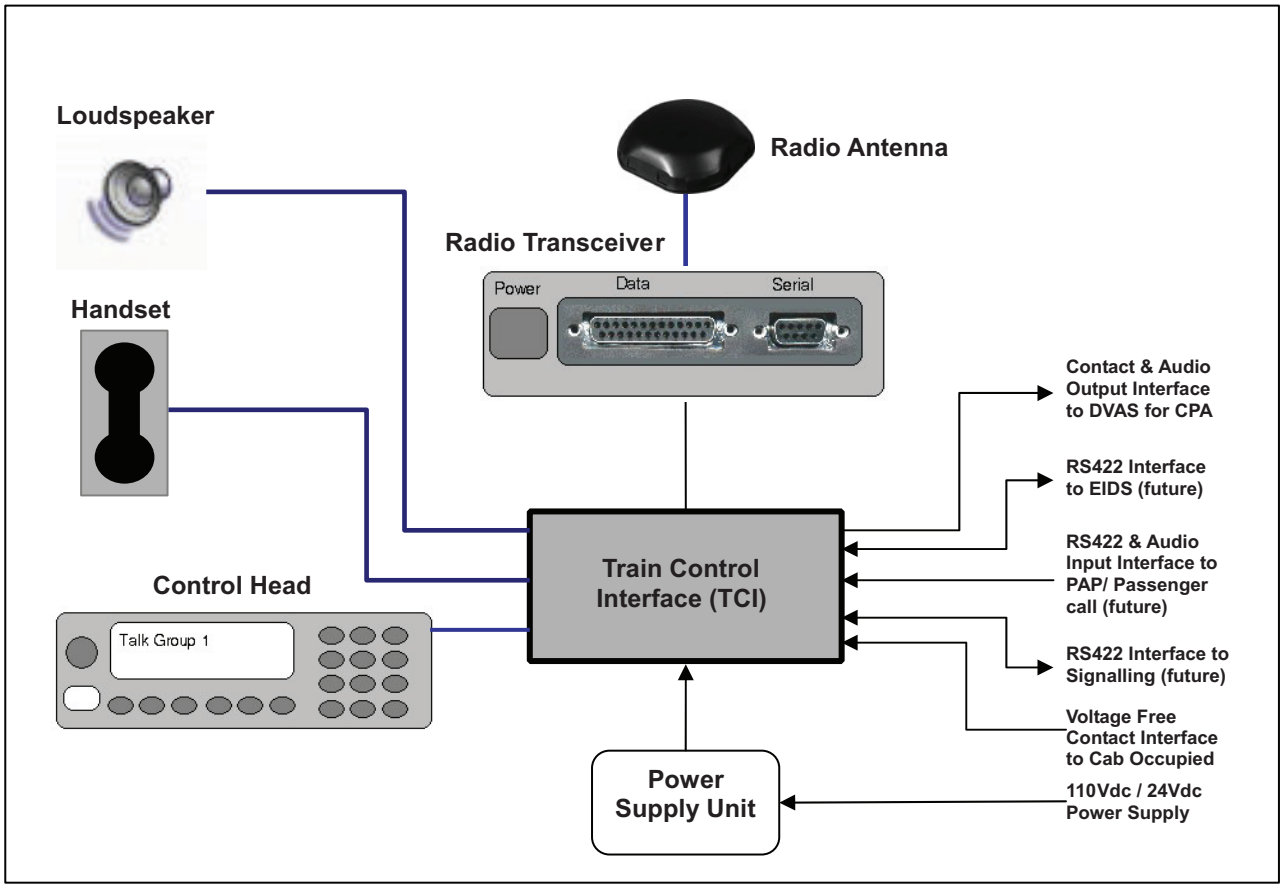
(a) Power Supply and Electrical Requirement

The RFID tags shall not rely on any power supply source or battery,including internal battery, to support their operation.

(b) Accommodation Requirement

The size of a RFID tag is approximately 13.4 cm (L) x 6 cm (H) x 1 cm (D). The mounting bracket shall be provided to mount the RFID tags at the level 600 mm above the rail in each corners of the driving cab.

Figure 1 System Block Diagram of Trainborne Radio Set



9 RFID Axle Box Temperature Detection System

9.1 The Named Supplier of trainborne RFID Axle Box Temperature Detection System is specified in Appendix Q.

9.2 The RFID tags shall be properly enclosed and installed on every bogie. Each RFID tag shall connect with a temperature sensor which shall be installed on an axle box.

9.3 The information transmitted by each RFID tag shall include but not limited to the following:

(a) Preset high temperature indication
(b) High temperature sensor fault
(c) Tag healthy signal
(d) Unique RFID serial number
(e) Time and date of the transmission

9.4 The RFID tags shall operate in 2.4GHz ISM frequency for communication with trackside receivers.

9.5 The RFID tags shall transmit tag and temperature data in a fixed time interval automatically. No acknowledgement is required from trackside receiver unit.

9.6 The data received by the receiver will be transmitted via the Corporate Data network (CDN) to their respective Depot Monitoring Servers and Monitoring Servers in MMC. The respective lines and depots are shown as follow:

(a) Kwun Tong Line – Kowloon Bay Depot
(b) Tseung Kwan O Line – Tseung Kwan O Depot
(c) Tsuen Wan Line – Tsuen Wan Depot
(d) Island Line – Chai Wan Depot

9.7 Performance Requirements of the Trainborne RFID Axle Box Temperature Detection System Interfaces

9.7.1 The operation of the trainborne RFID Axle Box Temperature Detection System shall not interfere with the normal operation of the EMU and Signalling System. The operation of the trainborne RFID Axle Box Temperature Detection System shall not cause interference to other RFID and electronic equipment currently in use on the railway systems.

9.7.2 The trainborne RFID Axle Box Temperature Detection System shall be able to uniquely recognise and detect the current temperature and highest temperature in past two hours from each axle box.

9.7.3 The RFID tags and temperature sensors shall be able to real-time monitor the axle box temperature and transmitted the data to track-side receiver at pre-defined location. Interval for data transmission of not more than 30 seconds for each cycle.

9.7.4 The measured temperature of the trainborne RFID Axle Box Temperature Detection System shall be within ±2°C from the true temperature from the axle box mounting bolt. The range of temperature measurement shall be from 0°C up to 200°C.

9.7.5 The RFID tag must display a negative temperature or fault notification when the temperature sensor disconnected from the RFID tag body.

9.7.6 The axle box temperature sensing RFID system shall cater for future expansion of the Employer fleet size.

9.8 Design Constraints

9.8.1 Power Supply and Electrical Requirements

The RFID tags shall be powered by internal battery to support its operation. External power source is not required.

9.8.2 Reliability Requirement

The axle box temperature sensing RFID tag shall achieve a reliability figure of 99.98% of all radio transmitted.

9.8.3 Maintainability Requirements

(a) The RFID tag shall achieve a minimum service life of 4 years. One battery replacement is allowed during its service life and no major replacement shall be required during the 4 years period.

(b) The RFID tags shall be designed and installed to maximise its availability, to minimise the amount of maintenance required and to ensure that maintenance can be safely easily and quickly carried out.

(c) The Contractor shall provide easy access for components which require regular inspection, adjustment and replacement.

(d) All equipment, including the mechanical mountings and cabling of the RFID tag, shall be designed to facilitate prompt removal and replacement.

(e) The Contractor shall provide all the special equipment necessary for the installation and removal of modules from the trainborne RFID Axle Box Temperature Detection System.

9.8.4 System Life Time

(a) The RFID tag shall be designed that it can achieve a minimum service life of 4 years. One battery replacement is allowed during its service life and no major replacement shall be required during the 4 years period.

(b) The Contractor shall declare the expected life and the maintenance requirement of the equipment to achieve the design life time.

9.9 Functional Requirement

9.9.1 The RFID tags and temperature sensors shall be able to real-time monitor the axle box temperature and transmitted the data to track-side receiver at pre-defined location.

9.9.2 The axle box temperature sensing RFID system shall be able to update and forward the last detected temperature and continuous detected maximum temperature in the past 2 hours at the last detected point from individual tag with its unique information, from temperature sensing area with date and time to monitoring system for processing.

9.9.3 The axle box temperature sensing RFID system shall be able to evaluate the temperature detected from the axle box mounting point (target zone) on the axle box and translate the information into 'Normal' and different temperature alarm levels. The axle box temperature sensing RFID system shall provide at least the following preset temperature alarms in accordance to BS EN 15437-1:

(a) Critical temperature alarm;
(b) Warning temperature alarm; and
(c) Attention temperature alarm.

9.9.4 The Contractor shall provide preset temperature alarm levels customised for the Employer's EMU and running conditions in HKSAR. The temperature reading shall be made available on the monitoring station. The threshold or range of each level shall be made editable with preferential access.

9.10 Design Requirement

9.10.1 RFID Tag and Temperature Sensor

9.10.1.1 The temperature sensor and RFID tag-on-PCB and related accessories for EMU installation shall include.

(a) RFID tag-on-PCB;
(b) IP66 rated box housing to install RFID tag-on-PCB according to BS EN 60529: 1992;
(c) Battery to power the RFID tag-on-PCB and must be last longer than 3 years;
(d) Temperature probe extended from the RFID tag-on-PCB and the cable extension, the cable must have sufficient length to connect from the housing mounting position onto the axle box cover;
(e) The cable between RFID tag-on PCB and temperature probe must be protected and approved by the Engineer. All other current

operation and maintenance operation on Rolling Stock shall not cause damage to temperature sensor cable;

(f) Fixing assembly for housing mounting position, which are provided in the form of completed assembly of RFID tags and mounting bracket;

(g) The RFID brackets are preferably being mounted by bolt and nut.

9.10.1.2 The RFID tag and temperature sensor shall comply with:

(a) Battery life with at least 3 years for continuous operation;

(b) OFTA approved general public communication frequency;

(c) Interval for data transmission of not more than 10 seconds for each cycle

(d) Temperature variation not more than ±2 °C;

(e) Temperature memory on highest temperature detected in the past 2 hours at last data transmission cycle;

(f) Disconnection on temperature sensor from RFID tag-on PCB must display a fault temperature lower than zero degree Celsius.

9.10.1.3 The Contractor shall comply with international Rolling Stock standard which cover EMC, Vibration & Shock and Water & Dust Ingress for all equipment installed.

9.10.1.4 The RFID tag must be self-powered and must not be connected to power source from the train.

9.10.1.5 Following design standard must be observed for PCB and temperature sensors with associated mounting bracket:

(a) The RFID tags to be installed onto the EMU shall comply with the shock and vibration test requirements per BS EN 61373:2010. The test category shall depend on the position on EMU where the tags are installed. The Contractor shall submit a test plan to the Engineer for Approval prior to carrying out the shock and vibration test. All non-metallic materials to be installed on the EMU shall also compile with BS6853:1999 or EN 45545-2:2013 and shall be submitted to the Engineer for Approval;

(b) The temperature sensor shall comply with shock and vibration test requirement per BS EN 61373 category 3 for axle mounted equipment;

(c) The RFID equipment shall comply with emission and immunity requirement of BS EN 50121-3-2 and BS EN 50121-4;

(d) The temperature senor and RFID tag shall be weather proof to IP66 or above per BS EN 60529: 1992;

(e) Bolts, nuts and studs shall be of Grade 8.8 or above to BS EN ISO 898-1;

(f) Plastic materials shall be flame retardant, acid-based cleaner resistant and UV resistant to appropriate standards including RoHS;

(g) The tag and mounting assembly must subject to static stress / fatigue analysis / random vibration simulation under the maximum bending moment. The mounting bracket shall demonstrate life of more than 2.5 times of prescribed service life, 20 years;

(h) For avoidance of the doubt, the standard of the extreme load cases depending on its mounting position as follows without permanent deformation:

(i) Carbody mounted equipment – The equipment shall be designed to survive the load cases stipulated in PS 6.4.4;
(ii) Bogie mounted equipment – The equipment shall be designed to survive the load cases stipulated in PS12.9.3; or
(iii) Axle mounted equipment – The equipment shall be designed to survive the load cases stipulated in Clause D.2.3 in Annex D of EN 13749:2011.

9.10.2 RFID Axle Box Temperature Monitoring System automatic association

9.10.2.1 The Contractor shall propose a fully automatic system to associate both RFID tag at individual axle box on New Trains.

9.10.2.2 The Contractor shall confirm the method of association for the Engineer's Approval.

9.10.2.3 The Contractor shall note to keep the human intervention on automatic association to minimum. For avoidance of the doubt, the MMI shall be automatic recognise association after RFID tag has been changed on individual axle box.

9.10.2.4 Mobile RFID Reader and association mechanism shall be provided as part of automatic association. The association result

shall be uploaded onto MMI software via any means of transfer protocol. Double check mechanism shall be provided on both MMI software and Mobile RFID reader.

9.10.2.5 The Contractor shall provide permanent labelling on both New trains and RFID tag with associated printing tool to allow Employer to reproduce label. The Contractor shall supply the supplier and model of label for the Engineer's Approval.

9.10.3 The Contractor shall provide necessary amendment on the software or install new MMI software used in the URL RFID Axle Box Temperature Monitoring System to ensure the information of New Trains can also be monitored in URL depots and MMC.

9.10.4 Environment Considerations

9.10.4.1 The outdoor ambient air temperature and relative humidity in HKSAR ranges from 0 °C to 40 °C and 0 % to 100 % non-condensing, respectively.

9.10.4.2 The RFID Temperature Monitoring System shall have built in mechanism to compensate the ambient temperature for true Axle Box Temperature display.

9.11 Material and Workmanship Requirement

9.11.1 Unless otherwise specified, the material and workmanship of the RFID Axle Box Temperature Monitoring System shall comply with the requirement specified in RS/C6014/02.

9.11.2 The Contractor shall carry out the insulation resistance test and dielectric withstanding voltage test on all wiring with the following sequence:

(a) Conduct 1st insulation resistance test at 1,000 VDC to the wiring with respect to earth. The result insulation resistance of each cable shall be no less than 100 MΩ;
(b) Conduct dielectric withstanding voltage test with voltage at 2,500 VAC for 1 minute. The leakage current shall be no more than 100 mA; and
(c) Conduct 2nd insulation resistance test at 1,000 VDC to the wiring with respect to earth. The result insulation resistance of each cable shall be no less than 100 MΩ.

9.11.3 All conduits and fittings shall be of hot dip galvanized steel to BS 4568 -1, BS EN 61386 -1 and BS EN 61386 -21 with Class 4 protection. Flexible

conduit shall be flame-retardant, flexible, of heavy duty nylon types made of polyamide PA66, of UL94 Class V-0 and halogen free.

9.11.4 Labelling

9.11.4.1 All electrical components such as controllers, motors, fuses, relays, contactors, timers, solenoids, limit switches, cables and sensors shall be labelled according to their identity in the respective schematic diagrams for easy maintenance.

9.11.4.2 Cable marker shall be provided at both sides of each cable. The identification numbers of the cable markers shall be the same as shown in the electrical circuit diagrams.

9.12 Testing and Commissioning

9.12.1 The RFID Axle Box Temperature Detection System shall be tested and commissioned in accordance with PS Appendix C.

9.12.2 Calibration and Test certificates applicable to the equipment shall be submitted to the Engineer for Approval before the acceptance of the axle box temperature sensing RFID System.

Attachment App-I-Annex-4
Detailed Interface Specification for Communications

Detailed Interface Design Specification for Communications

Contents

1 Introduction 4
1.1 Abbreviations and Acronyms 4
2 Scope of Supply 5
2.1 EIDS Interfacing Contractor Provision 6
2.2 C6014-14E Provision 6
2.2.1 Relevant Communication Equipment 6
2.2.2 Cable and connector interface arrangement 7
3 Mechanical Interface 7
3.1 EIDS Equipment 7
3.1.1 EIDS Sever 7
3.1.1.1 EIDS Sever Mounting Position 7
3.1.1.2 EIDS Server Mounting Details 7
3.1.2 EIDS Controller 7
3.1.2.1 EIDS Controller Mounting Position 7
3.1.2.2 EIDS Controller Mounting Dimension 8
3.1.3 WiFi Router & Antenna 8
3.1.3.1 WiFi Router equipment 8
3.1.3.2 Antenna Mounting Requirement 8
3.1.3.3 Antenna Mounting Details 8
3.1.4 EIDS Loudspeaker 9
3.1.5 EID DVI Booster 9
3.1.6 Audio amplifier 9
3.2 Interfaced Train Systems 9
3.2.1 EIDS Panel 9
3.3 Cable Connections 10
3.3.1 EIDS Server to DVAU Cables 10
3.3.2 EIDS Controller to EID Panel Cables 10
3.4 Cable containment 10
4 Electrical Interface 10
4.1 Interface Between EIDS Sever and DVAU 11
4.2 Interface Between EIDS Controller and EID panel 11
4.3 Zero-speed Dry Contact 12
4.4 Earthing 12
5 Functional Interface 12
5.1 Interface Between EIDS Sever and DVAU 12
5.2 Interface Between EIDS Controller and EID panel 13
6 EMC 14

7 Testing 14
Appendix 15

1 Introduction

This document describes the detailed interface between the trainborne communications equipment and the train system, i.e. the interface for Electronic Information Display System (EIDS) which is free-supplied by MTR and the train system.

- MTR shall free-issue the EIDS equipment, including Bulk Data Transmission Facilities (the WiFi Access Point and WIFi Router), EIDS Server, LAN Switch, EIDS Controller and Audio equipment;
- The Contractor shall provide the real time data receivers (GSM Modem Assemblies Interface), EID panels and all interconnection cables (including 4x twisted pair cable) between cars;

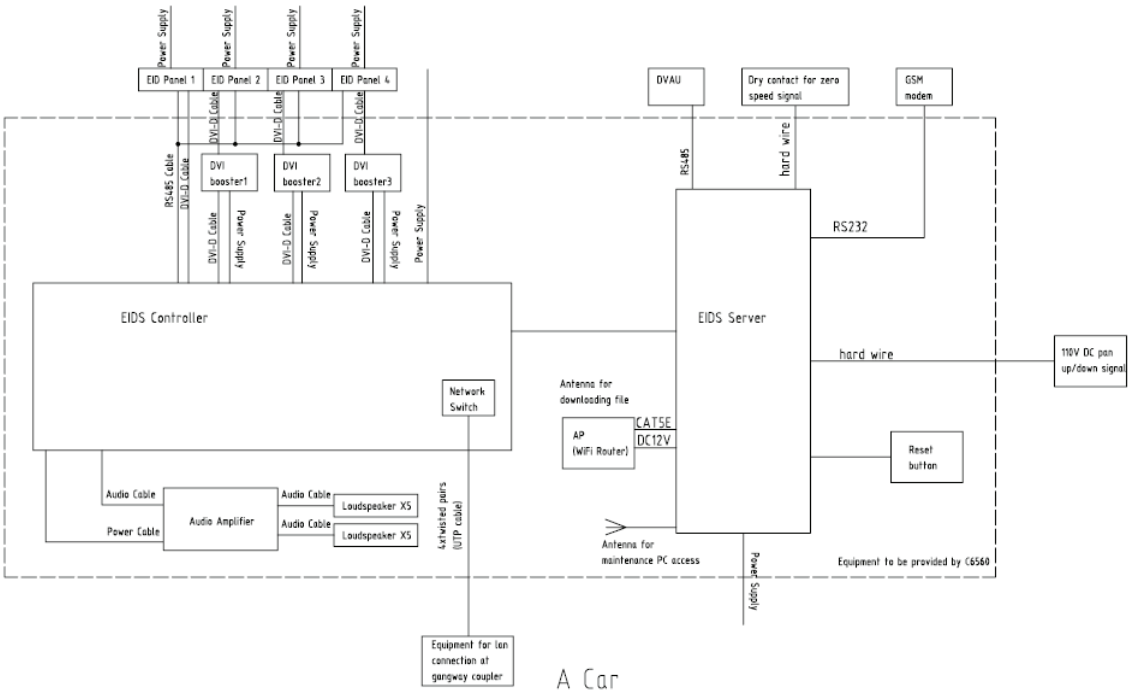
The purpose of this document is to ensure complete compatibility between EIDS and train system.

1.1 Abbreviations and Acronyms

DDS	Detailed Design Specification
DID	Detail Interface Document (including the Interface Design Specification)
DVAS	Digital Voice Announcement System
DVAU	Digital Voice Announcement Unit
EIDS	Electronic Information Display System
EMC	Electromagnetic Compatibility
IMP	Interface Management Plan
IR	Interface Register
GS	General Specification
MoM	Minutes of Meeting
MTR	Mass Transit Railway
PA	Public Address
PDS	Preliminary Design Specification
PS	Particular Specification
RAM	Reliability Availability and Maintainability
SEMP	System Engineering Management Plan
TMS	Train Management System
TRDR	Trainborne Real-time Data Receivers

2 Scope of Supply

The EIDS equipment (except EID panels and inter-car connections) free-supplied by MTR will be required to operate together with communication equipments and system (supplied from the Contractor under MTR contract C6014-14E). The detailed interfaces are shown in the following figure.



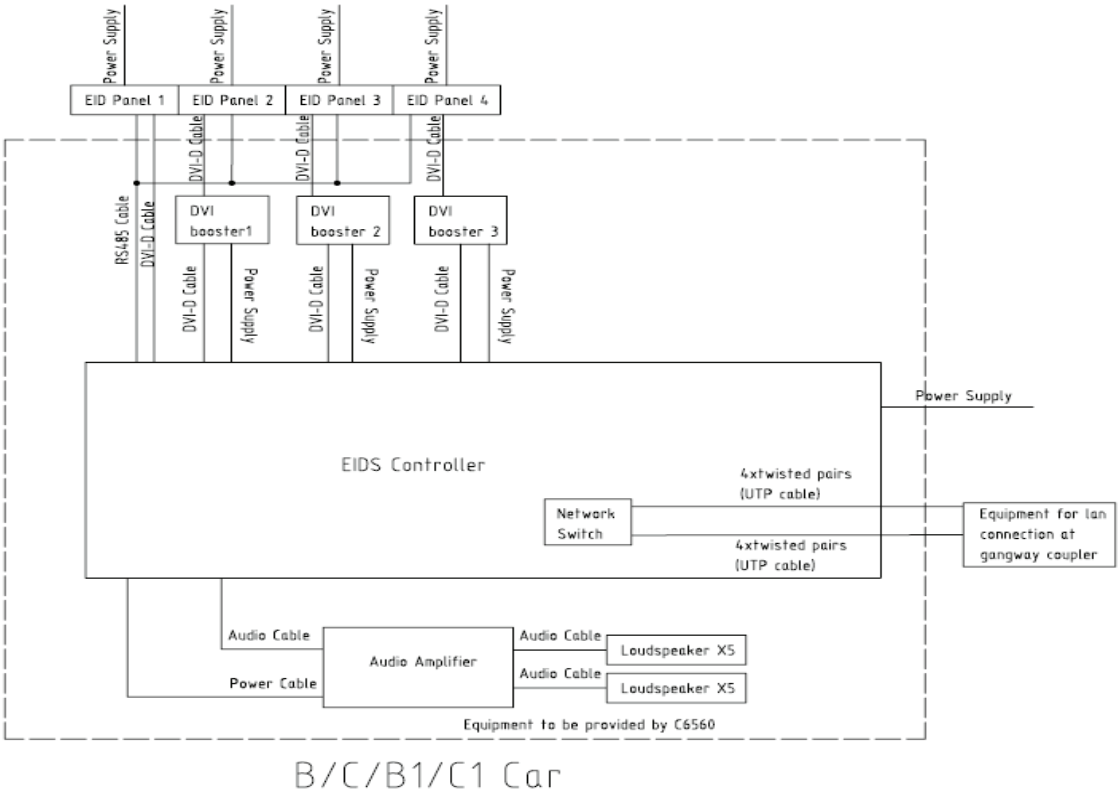


Figure 3-1: Signal Interface between EIDS Interfacing Contractor and C6014-14E

2.1 EIDS Interfacing Contractor Provision

1. EIDS Server
2. EIDS Controller
3. WiFi Router
4. LCD Loudspeaker
5. LAN switch for EIDS
6. EID DVI booster
7. Antenna for maintenance PC access
8. Antenna for download file
9. EIDS reset button
10. Audio Amplifier

2.2 C6014-14E Provision

2.2.1 Relevant Communication Equipment

1. DVAU
2. EID Panel

3. GSM Modem Assemblies
4. Dry contact for zero speed signal in the cab cubicle
5. 110V DC power supply and 110VDC Pan Up / Down signal
6. The equipment for jumper cable of Cat5e for connecting the LAN cables at the gangway couplers

2.2.2 Cable and connector interface arrangement

The cable and connector interface arrangement refers to Appendix 4 Annex 4.6.

3 Mechanical Interface

3.1 EIDS Equipment

The dimensions and mounting arrangements of EIDS Equipment are described as follows.

The minimum bending radius of DVI cable is 150mm, the minimum bending radius of UTG cable is 100mm and minimum bending radius of SMA cable is 50mm. The design is according to this requirement.

3.1.1 EIDS Sever

3.1.1.1 EIDS Sever Mounting Position

There are two EIDS severs in one 8-car train, and the EIDS servers are installed in saloon electric equipment cabinet of A car respectively. The power of EIDS server is supplied by DC110V. EIDS Server is located in end 2 B side of A car. The detailed layout is given in annex 3.1. The connection which is in the front of the equipment and the cable will be connected to the connector. The cables are bundled along the fixed pole to terminal board.

3.1.1.2 EIDS Server Mounting Details

The EIDS server including mounting dimension is 340x435x480.5mm. The details of the EIDS server mounting drawing including connectors is shown in annex 4.1.

3.1.2 EIDS Controller

3.1.2.1 EIDS Controller Mounting Position

There is an EIDS controller in each car, and the EIDS controller is installed in saloon electric equipment cabinet. The power of EIDS controller is supplied by DC110V. The detailed layout of EIDS controller

including audio amplifier is given in annex 3.1. The dimension which is marked on the drawings is in annex 4.2.

The connection which is in the front of the equipment and the cable will be connected to the connector. The cables are bundled along the fixed pole to terminal board.

The detail distance information between cubicle frame and EIDS Controller (or audio amplifier) is shown in annex 3.2.

3.1.2.2 EIDS Controller Mounting Dimension

The EIDS controller including mounting dimension is 340x240x480mm. The details of the EIDS controller mounting drawing including connector is shown in annex 4.2.

3.1.3 WiFi Router & Antenna

3.1.3.1 WiFi Router equipment

There are two different types of antenna, one is only an antenna which is installed in A car saloon cabinet, and another is the antenna which is installed in driving cab.

3.1.3.2 Antenna Mounting Requirement

The position of the antenna on the cab roof is critical for efficient operation, and there must be clear of any metal obstructions which may shadow the antenna. The space restriction is shown is Appendix 4 Annex 4.3. In the current design, the space restriction is that in the front of antenna, there must not be 50mm width metal panel.

3.1.3.3 Antenna Mounting Details

The space restriction for antenna for downloading file is 240mmx260mmx137mm. Detailed equipment layout of the antenna shall refer to Annex 4.4.

The maintenance antenna is connected to EIDS Server CN5 port directly for communication.

The detailed layout of the antenna for downloading file is shown in the annex 3.14.

3.1.4 EIDS Loudspeaker

There are 10 loudspeakers for EIDS in each car and they are arranged in the saloon ceiling. And the arrangement of loudspeaker is shown in annex 3.15. The audio cable schedule including cable length is shown in annex 3.12.

The EIDS loudspeaker provided by EIDS Interfacing Contractor shall be referred to Annex 4.5.

3.1.5 EID DVI Booster

There are 3 EID DVI boosters in each car, only the nearest EID panel need not EID DVI booster to magnify signal. EID DVI booster is mounted on the carbody structure. The detailed mounting drawing is shown in annex 3.13. The minimum cable bending radius is 150mm, so the cable should be straight for 150mm-300mm at the connector side to meet the 150mm bending radius requirement. The sketch is shown in annex 3.18.

3.1.6 Audio amplifier

There is an audio amplifier in each car, and the audio amplifier is connected to EIDS controller and EID loudspeakers.

The mounting position details are shown in annex 3.2.

3.2 Interfaced Train Systems

3.2.1 EIDS Panel

The EIDS is designed for 8-car train with the following configuration:

Equipment name	Quantity								Remark
	A	C	B	B1	C1	B	C	A	
EID panels	3	3	3	3	3	3	3	3	240V AC Input
	1	1	1	1	1	1	1	1	110V DC Input

32 EID Panels (4 panels per car) for electronic information display, and the EIDS system architecture for 8-car train as shown in Annex 3.3.

The layout of EID panel is shown in annex 3.5.

3.3 Cable Connections

3.3.1 EIDS Server to DVAU Cables

EIDS Interfacing Contractor will provide all the RS 485 cables and connector except the connector at the DVAU equipment side (supplied by C6014).
Detailed information of cable and connector is described in annex 4.6.

3.3.2 EIDS Controller to EID Panel Cables

(1) DVI cables

EIDS Interfacing Contractor will supply the DVI-D cables (including connector at both sides of the cable).The length of the DVI cable shall not be longer than 10m for transmitting signal within acceptable signal level, so three EID panels need booster. The booster mounting drawing is shown in annex 4.7, and the booster layout is shown in annex 3.9. The length of DVI cable is shown in annex 3.10.

EIDS Interfacing Contractor will supply connector of EIDS controller side and C6014 will provide connector of EID panel side.

(2) RS 485 cables

EIDS Interfacing Contractor will provide connector at RS 485 cable of EIDS Controller side and RS 485 connector of EIDS controller side.

C6014 will supply the RS 485 cables (including RS 485 connector of EID panel side and RS 485 cable of panel side).

3.4 Cable containment

For the cables used for EIDS system, RS485 cables and DVI cables will be through the RS 485 duct. The audio cable is through audio duct. And power supply cables and 110VDC control / signal cables will be through the DC duct. The detailed cable containment drawing is shown in annex 3.16.

4 Electrical Interface

EIDS server and EIDS controller will be powered from 110V DC power source. The control schematic diagram is described in annex 4.8, and the pin assignment is shown in annex 3.11. And the electrical interface relation is shown in the following figure.

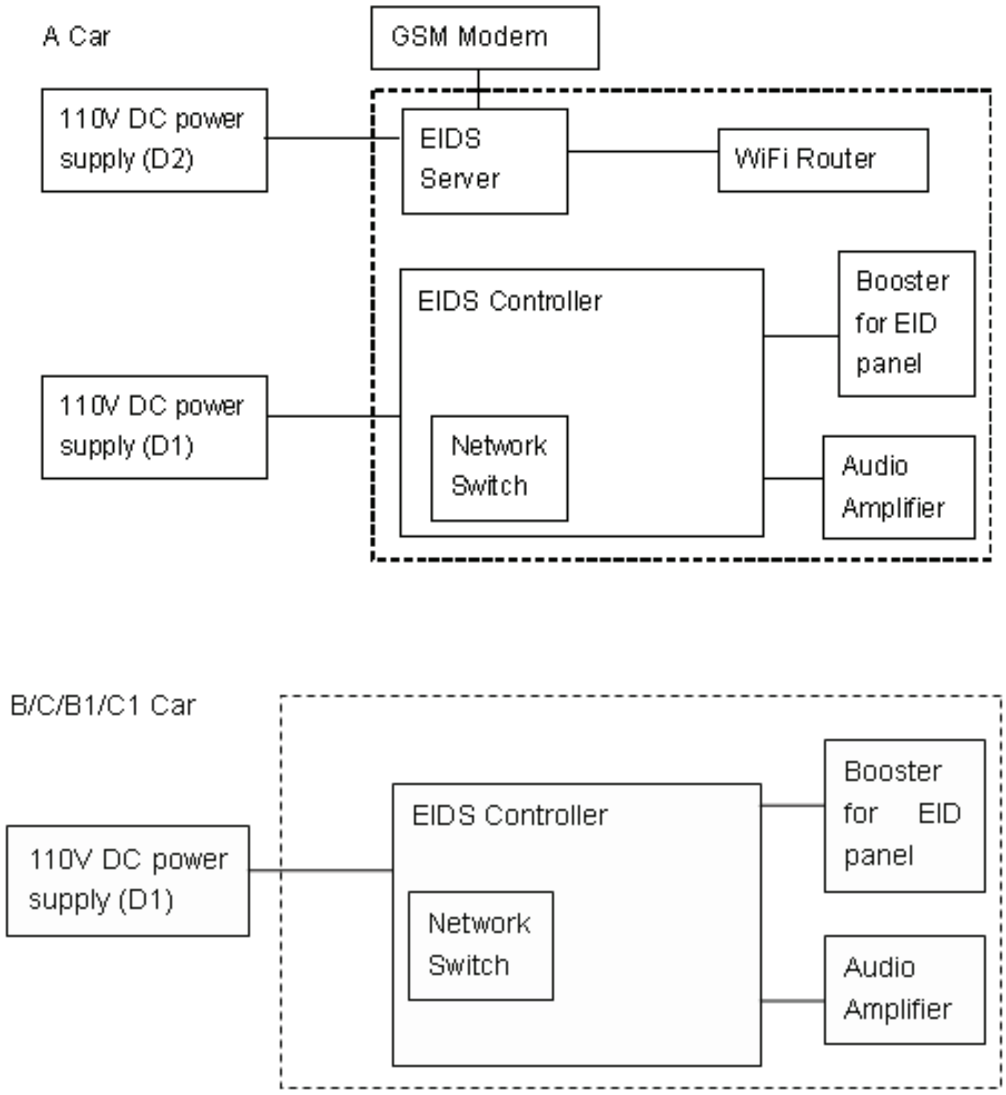


Figure 5-1 Power supply arrangement between EIDS Interfacing Contractor and C6014-14E

4.1 Interface Between EIDS Sever and DVAU

The schematic of the interface between the EIDS Server and DVAU is provided in annex 3.11.

4.2 Interface Between EIDS Controller and EID panel

The booster is for the signal transmission from EIDS controller to EID panel, the power for the booster is DC 5V. And the power is from EIDS controller.

There are 4 EID panels per car. Three units are operating at 240V AC power input, while the other one is operating at 110V DC power input. In

current design, the EID panel which is mounted in Side A and near to the End 1 is supplied by 110V DC, and the rest are supplied by 240V AC.

When there is a loss of AC power on the train, only the panel supplied by DC shall be in service. Normal messages shall not be displayed and only those priority messages shall be displayed in order to save the emergency DC power from the battery.

4.3 Zero-speed Dry Contact

A voltage free relay contact will be provided to EIDS Server for indicating whether the speed of the train is zero or not. The EIDS Server shall monitor this relay contact to achieve the required audio output level adjustment with respect to whether the train is moving or stationary.
The nominal rating used by the EIDS Server to detect the zero speed signals is 100mA at 5VDC.

4.4 Earthing

On the each cabinet, there is an earthing connection bolt, the electronic equipment will be used the cable to connect to it to ensure earthing requirement. For A car, the EID Controller and EID Server will be connected together to earth, and for other cars, the controller will be directly earthed. The washer inner diameter is 4mm or 5mm will be used to earth bonding, and the outer diameter is 12mm or 15mm. So EIDS equipment relevant position paint should be removed.
For the earthing of EID panel, there are equipment earthing point and carbody earthing point, and a cable is used to connect two points to ensure well earthing.

5 Functional Interface

5.1 Interface Between EIDS Sever and DVAU

EIDS Server interfaces with the DVAS and PA to obtain information of door status, next station, pre-recorded DVAS and PA message codes.

Two EIDS Servers are for information updates, controls of network equipment, GSM modem interface and DVAS/PA interface.

According to discussion with C6014 and EIDS Interfacing Contractor, communication mode is confirmed. There are three cases for communication.

Case 1: Both DVAS Sever and EIDS Server are active in the same end. Active DVAS sends all information to the active EIDS Server, and the active EIDS Server performs all necessary actions.

Case 2: The DVAS Server is active in one end while the EIDS Server is active in the other end. And the standby EIDS Server is in service.
At first, the active DVAS Server sends all information to the standby EIDS Server. Then the standby EIDS Server sends all information to the active EIDS Server. At last, the active EIDS Server performs all necessary actions.

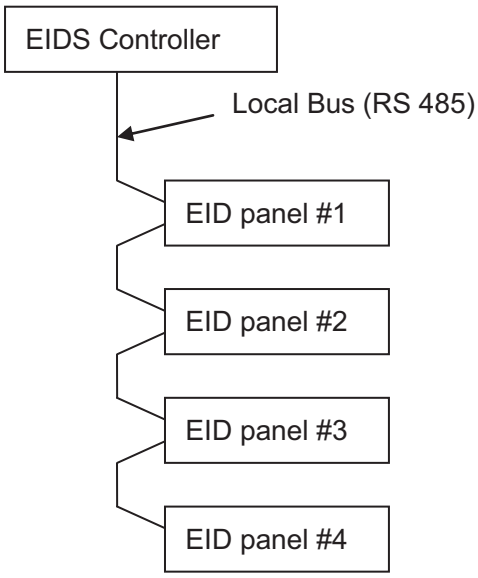
Case 3: The DVAS Server is active in one end while the EIDS Server is active in the other end. In addition, the EIDS Server in the standby mode is out of service.

The active DVAS polls the standby EIDS Server, and active DVAS fails to communicate with the standby EIDS Server. Then the active DVAS sends all information to the standby DVAS (with a delay of no more than 10s). The standby DVAS sends all information to the active EIDS Server and the active EIDS Server performs all necessary actions. The detailed information is shown in annex 4.9.

EIDS Server will transmit some information to DVAU, and DVAU will send the information to TMS for monitor. The detailed interface information which is between DVAU and EIDS Sever is shown in annex 3.20.

5.2 Interface Between EIDS Controller and EID panel

There are 4 EID panels in one car and these EID panels are connected by the multi-drop method. The overall configuration is shown as follows:



There is only one “COMM” port at the EID Panel for the RS485 cables. Connection details shall refer to the latest and approved Detailed Design Specification for EIDS There is only on “COMM” port for RS485 cable, but there is a connector for one “COMM” port. Using the connecter, the RS485 cable will be connected to next EID Panel.

The detailed interface between EIDS controller and EID panel is shown in annex 3.19.

EIDS Panel will transmit error information (no signal input) to EIDS Controller, and when controller can not monitor EID Panel during a period of time, it will determine connection overtime with EID Panel automatically.

6 EMC

To ensure that there is no electro-magnetic interference to the communication equipments supplied by C6014 and communication equipments and systems supplied by MTR, the EMC analysis and testing will be carried out in accordance with PS RS/C6014/04.

7 Testing

The interface test shall be jointly conducted by C6014 and EIDS Interfacing Contractor, and interface test specification will be developed. C6014 and EIDS Interfacing Contractor shall support the testing by

attending the tests and to provide technical advice with regard to the design and operation of the equipment as and when necessary.

Both contractors will ensure that their respective equipment is fully tested.

Detailed test procedure will be provided from the Contractor in the future.

Appendix

Appendix 1 Not used.

Appendix 2 Not used.

Appendix 3 Interface Information and Drawings provided by C6014-14E

annex 3.1 EIDS Server and EIDS Controller layout

annex 3.2 Distance for partition door&EIDS controller front panel

annex 3.3 EIDS Panel architecture for 8-car Train

annex 3.4 Not used.

annex 3.5 Layout of EID panel

annex 3.6 Not used.

annex 3.7 Not used.

annex 3.8 Not used.

annex 3.9 Booster Layout

annex 3.10 length of DVI cable

annex 3.11 Schematic of EIDS system

annex 3.12 Audio cable schedule including cable length

annex 3.13 EID DVI Booster mounting drawing

annex 3.14 Detailed layout of antenna in cab

annex 3.15 EIDS Loudspeaker installation

annex 3.16 Cable containment drawing.

annex 3.17 Not used.

annex 3.18 DVI cable layout sketch

annex 3.19 Interface Control Document Between EIDS Panel & Controller ver F

annex 3.20 Interface Control Document Between DVAS&EIDS Rev G

annex 3.21 Not used.

Appendix 4 Interface Information and Drawings provided by EIDS Interfacing Contractor

Annex 4.1 Details of the EIDS server mounting drawing (including connector)

Annex 4.2 Details of the EIDS controller mounting drawing (including connector)

Annex 4.3 Non-metal space restriction for WiFi Router in cab

Annex 4.4 Agreed mounting drawing of the antenna on the driving cab

Annex 4.5 EIDS Interfacing Contractor speaker drawing

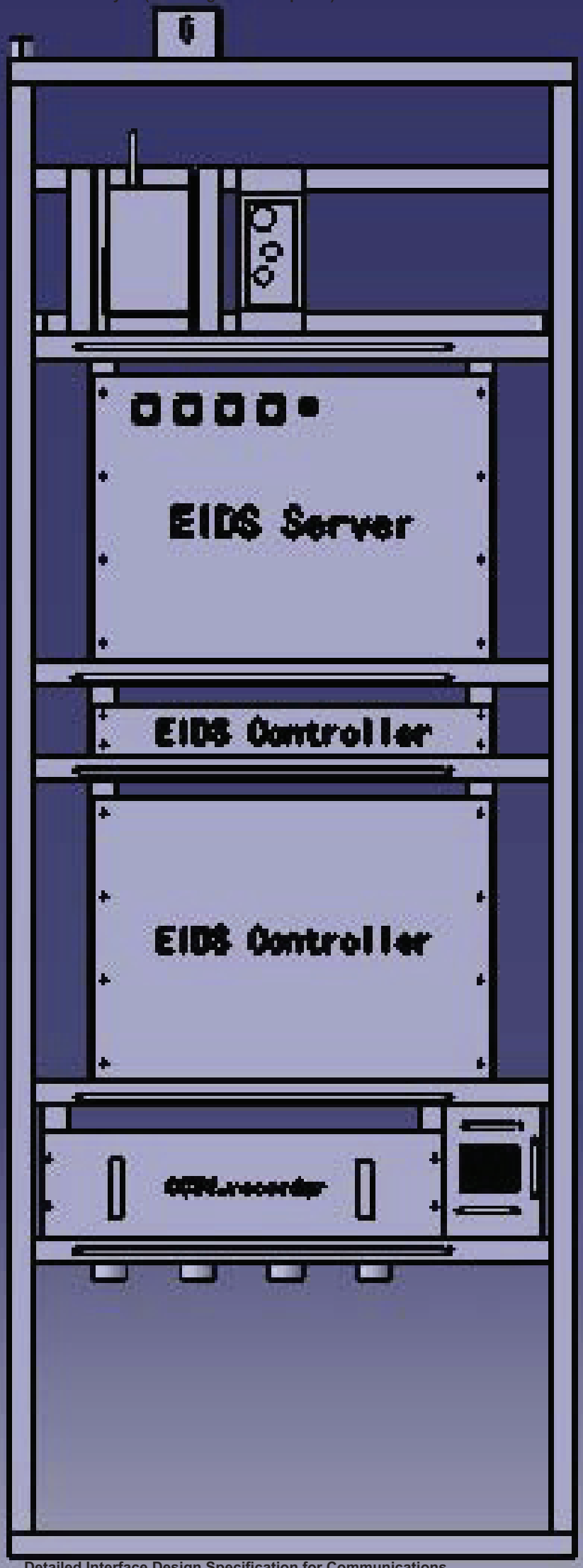
Annex 4.6 Detailed cable and connector information

Annex 4.7 Booster mounting drawing

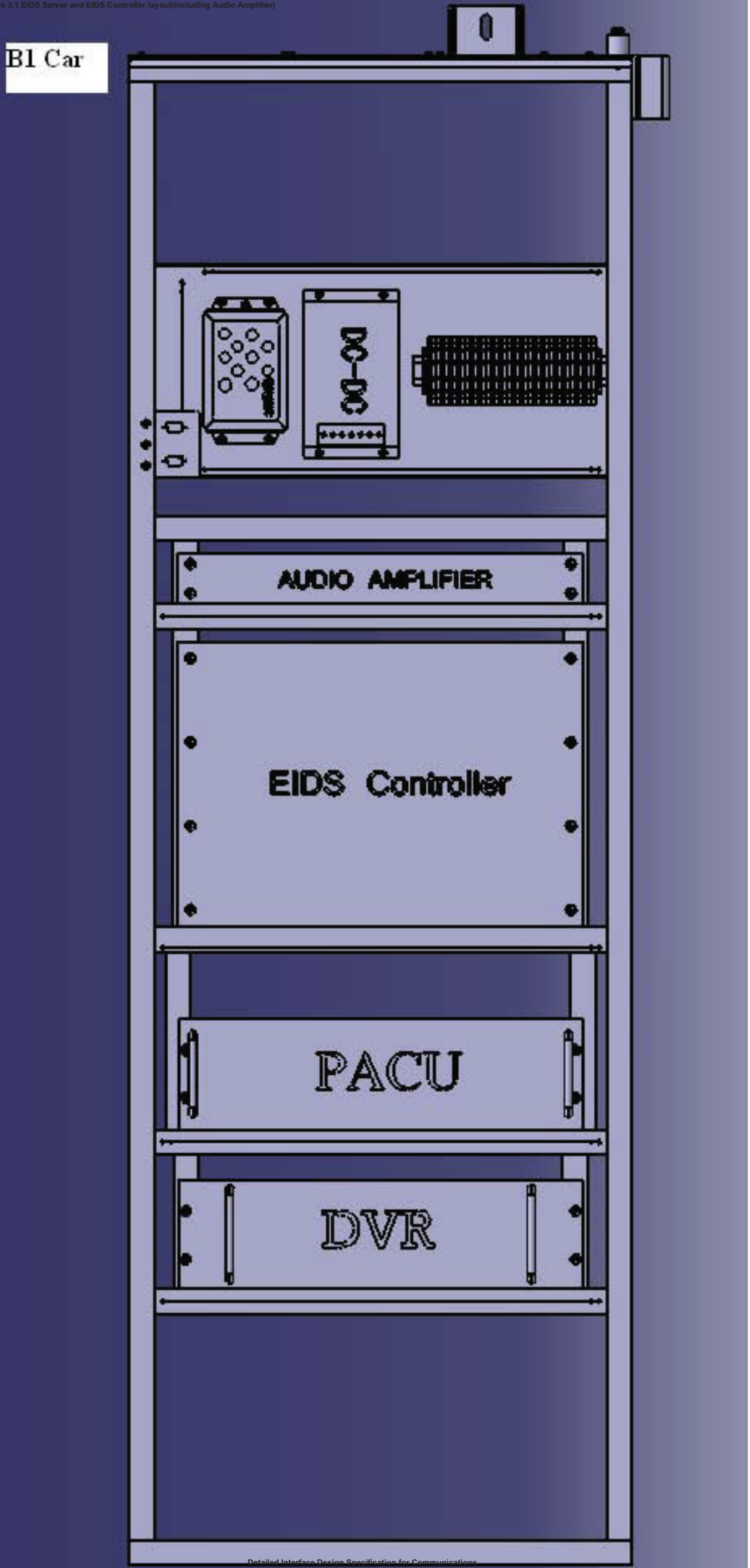
Annex 4.8 Control schematic diagram

Annex 4.9 Communication mode between DVAU and EIDS Server

A Car



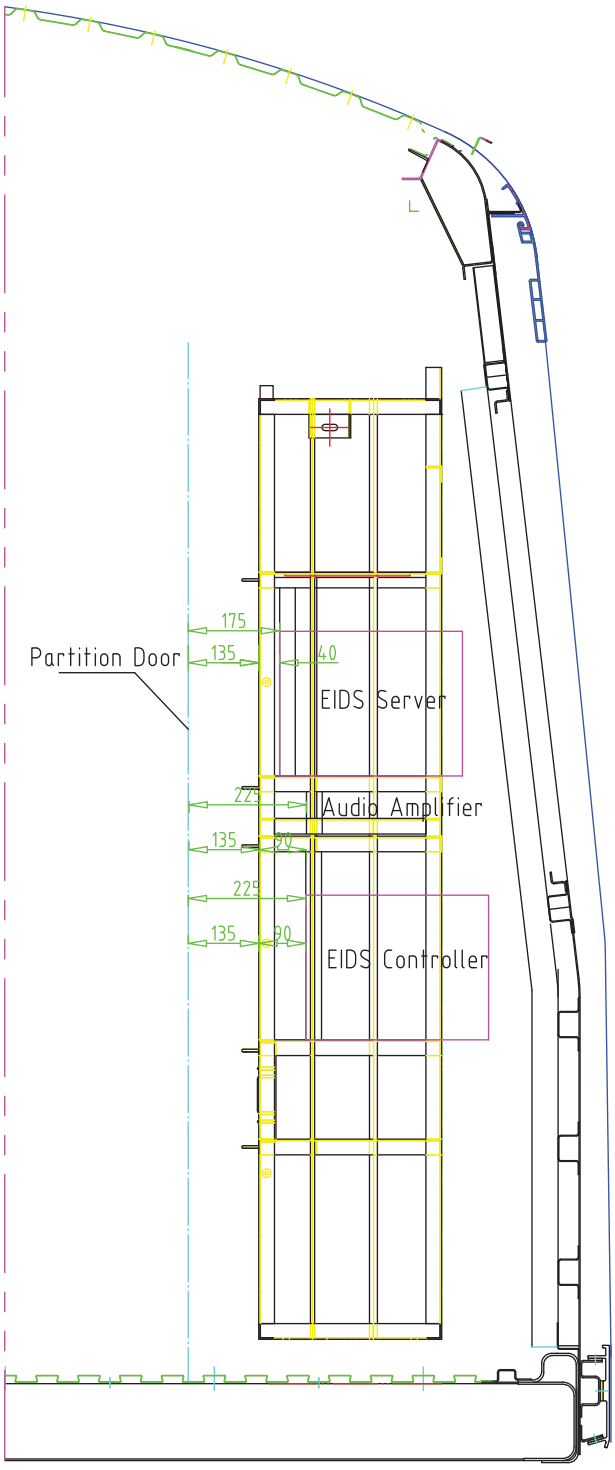
B Car
0
DC-DC
AUDIO AMPLIFIER
EIDS Controller
PACU


B1 Car
AUDIO AMPLIFIER
EIDS Controller
PACU
DVR

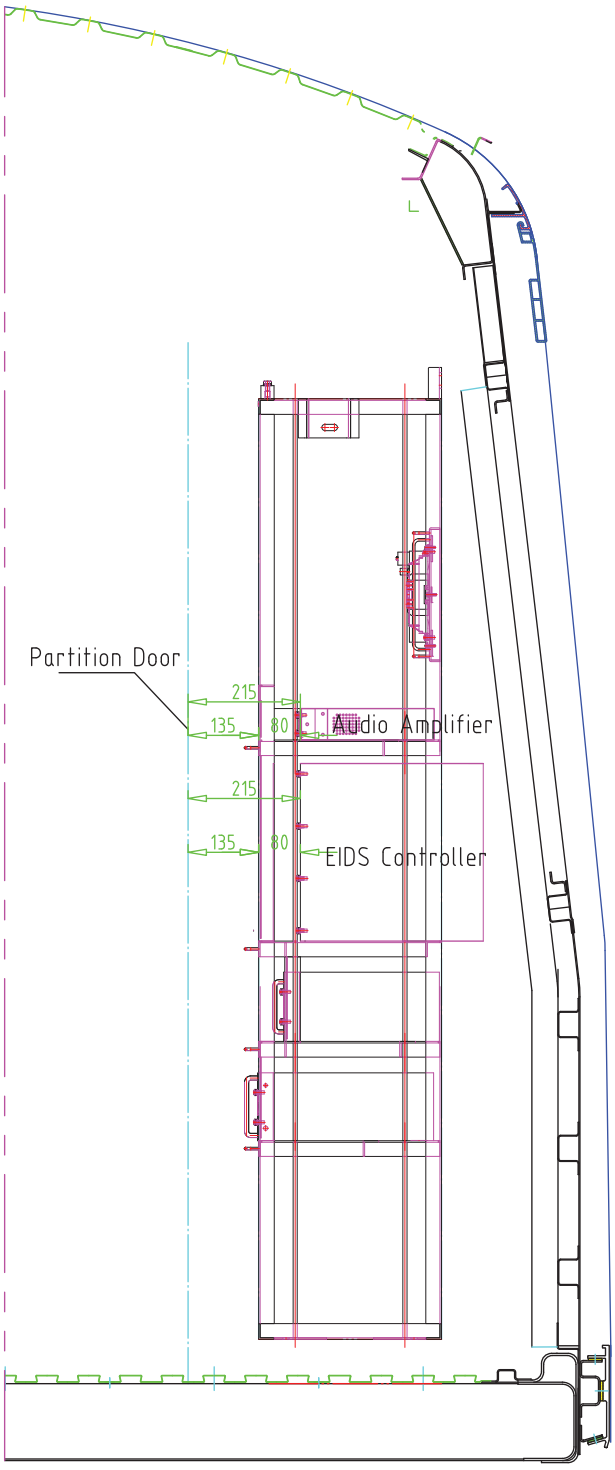
C Car
AUDIO AMPLIFIER
EIDS Controller
PACU

C1 Car

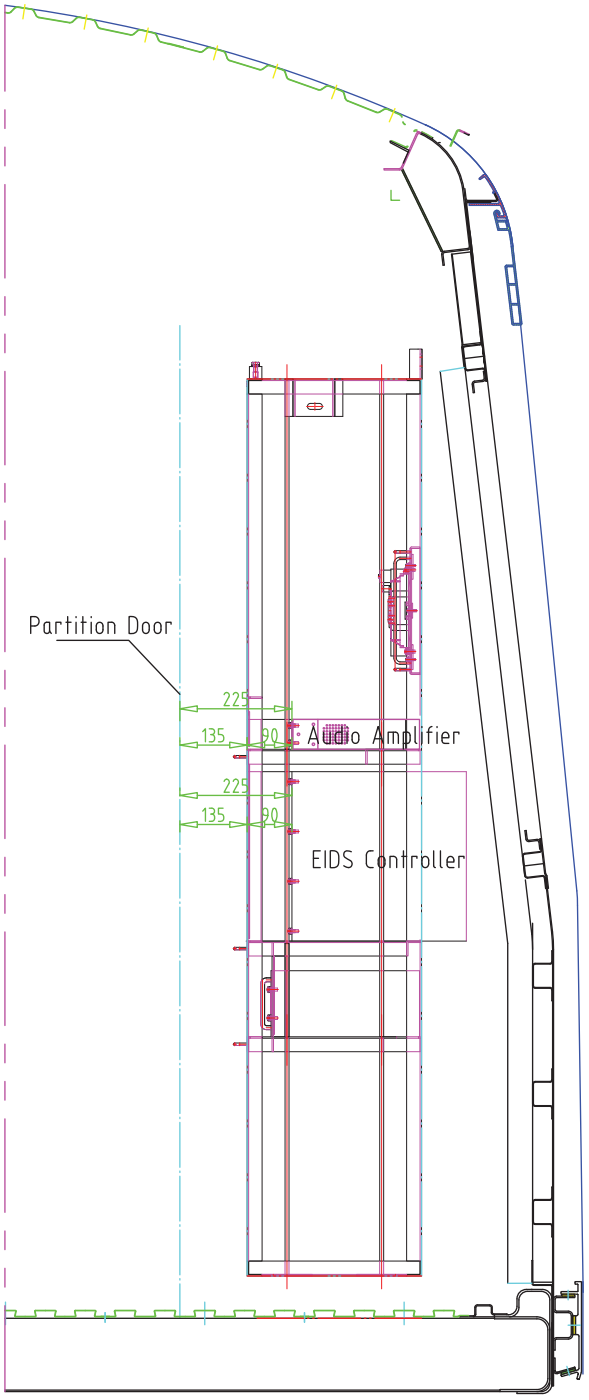
A CAR


Partition Door
175
135
40
EIDS Server
225
Audio Amplifier
135
80
225
135
80
EIDS Controller

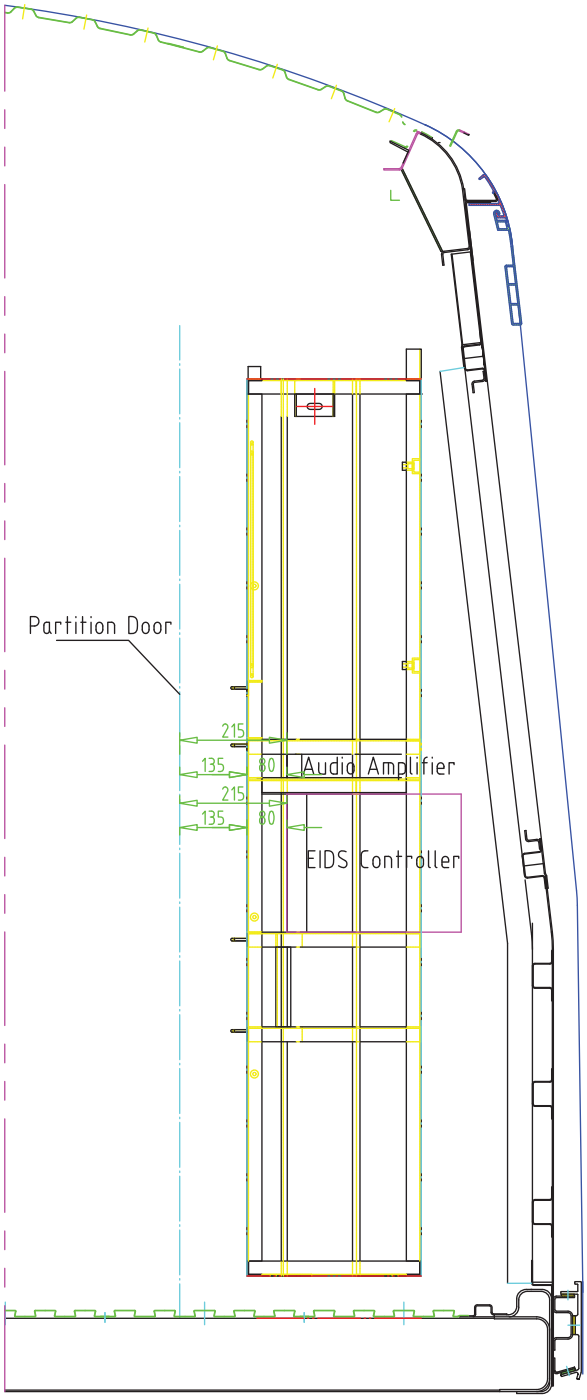
B1 CAR

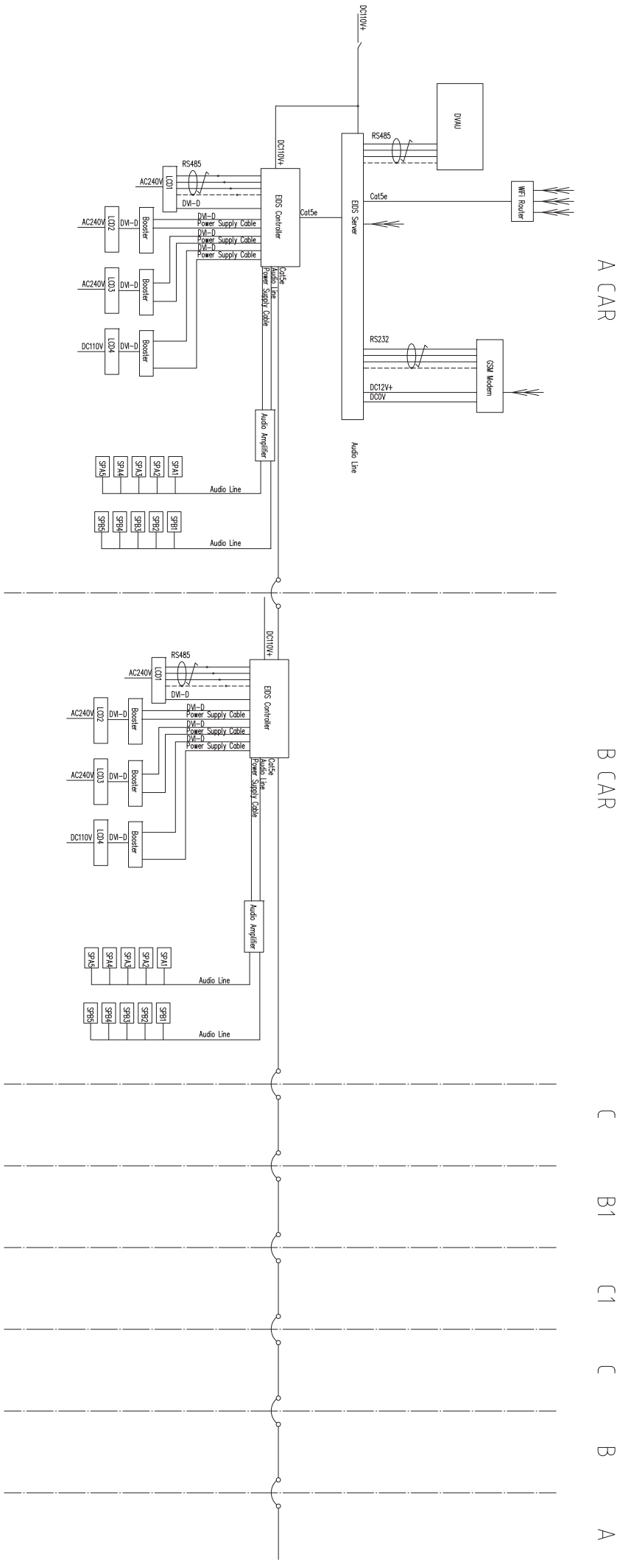

Partition Door
215
135
80
Audio Amplifier
215
135
80
EIDS Controller

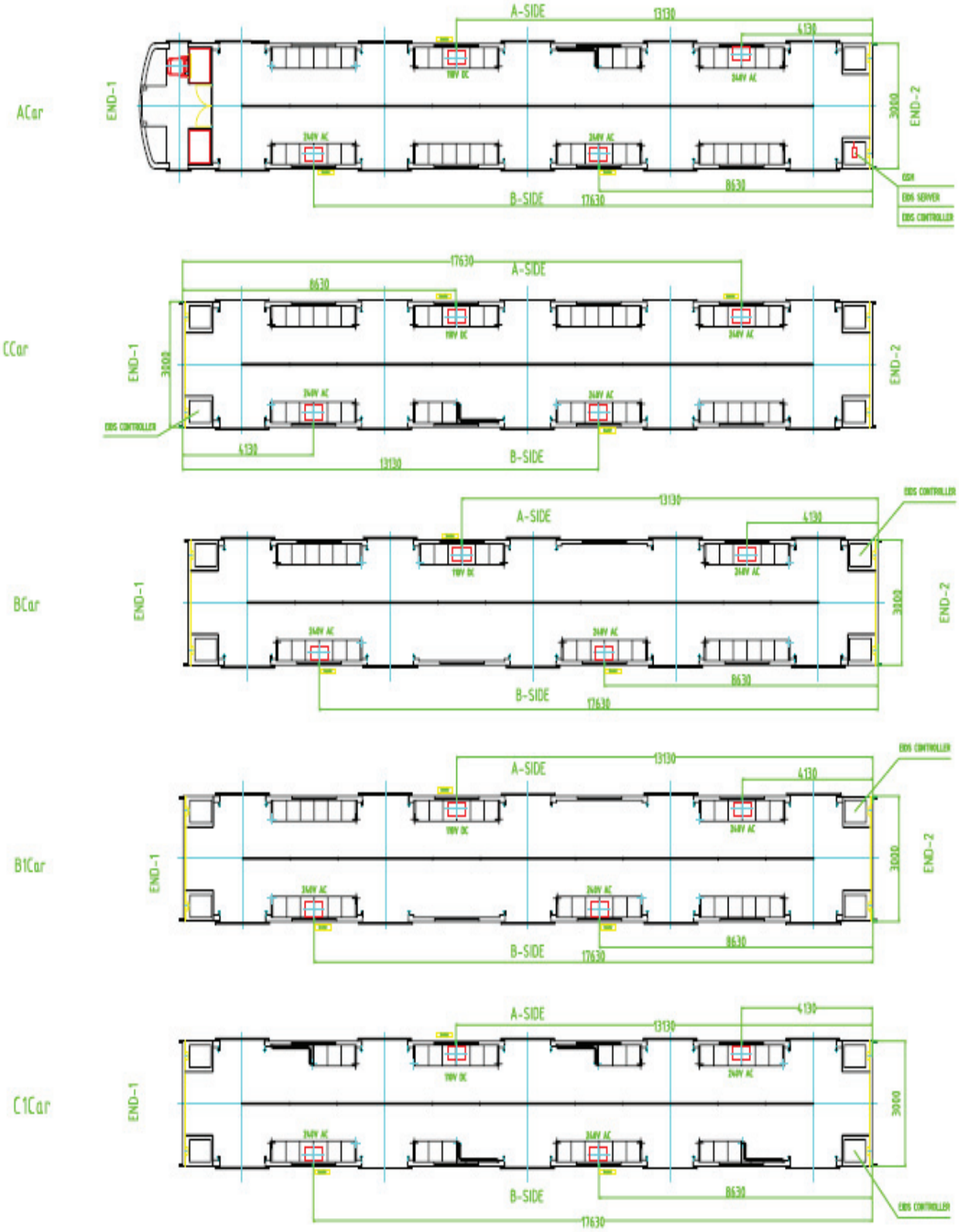
B/C CAR

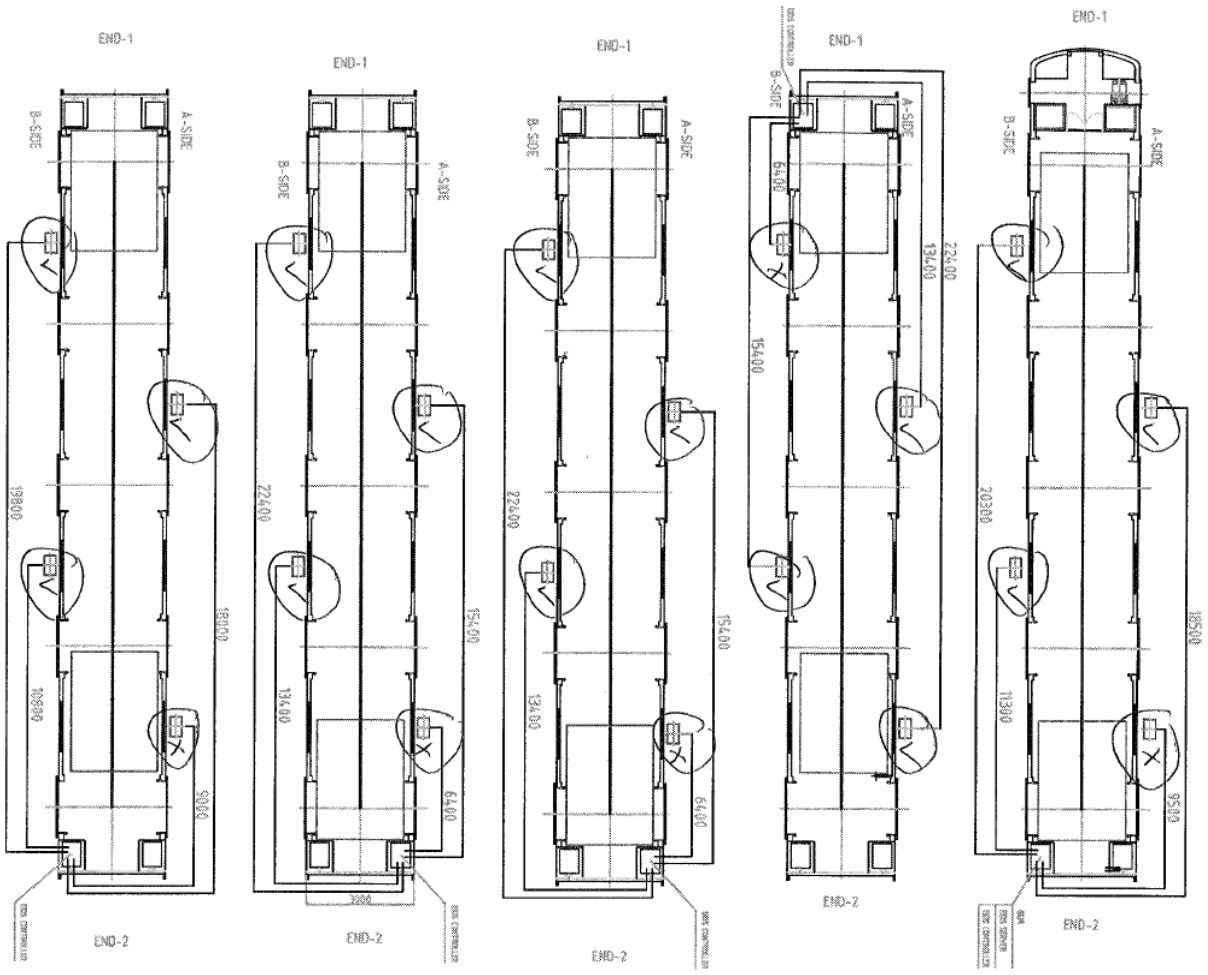

Partition Door
225
135
90
Audio Amplifier
225
135
90
EIDS Controller

C1 CAR


Partition Door
215
135
80
Audio Amplifier
215
135
80
EIDS Controller


DC110V+
DVAU
RS485
EIDS Server
Cat5e
WiFi Router
RS232
GSM Modem
DC12V+
DC0V
Audio Line
A CAR
B CAR
C
B1
C1
C
B
A
EIDS Controller
LCD1
LCD2
LCD3
LCD4
AC240V
DC110V
DVI-D
Booster
Power Supply Cable
Audio Amplifier
SPA1
SPA2
SPA3
SPA4
SPA5
SPB1
SPB2
SPB3
SPB4
SPB5


ACar
A-SIDE
13130
4130
END-1
END-2
3000
B-SIDE
17630
8630
EDS SERVER
EDS CONTROLLER
CCar
EDS CONTROLLER
BCar
B1Car
C1Car

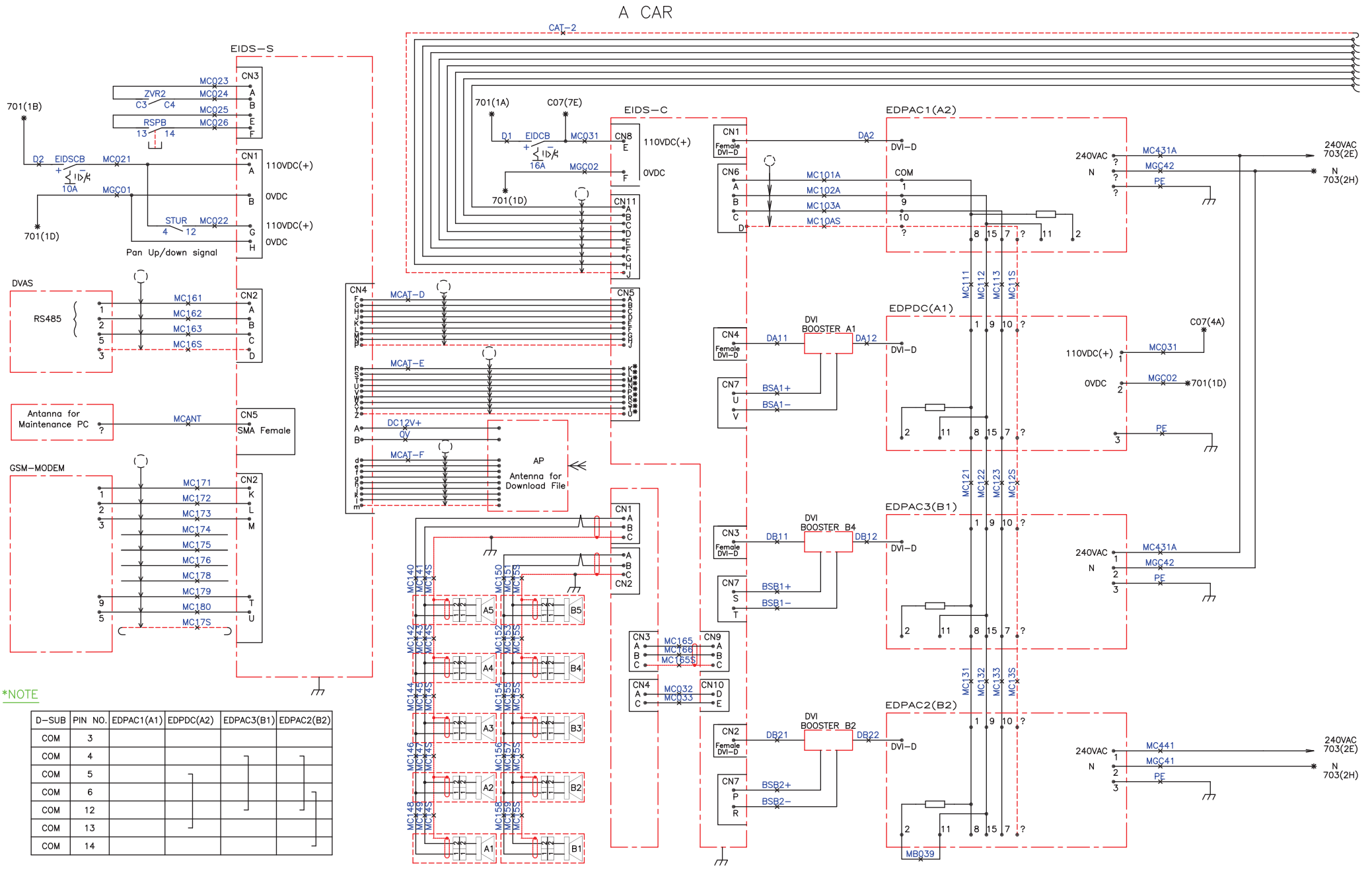


Legend：The “Tick” is the EID panel need EID booster

The “Cross” is the EID panel need not EID booster

DVI Cable(预制)

					From		To		
Car Type	Cable type	Cable No	Core No (C6554)	Core No (C6560)	location	Plug/Socket	location	Plug/Socket	Length(mm)
Odd A car	DVI-D	M314917	DA11	80101	EIDS Controller	DVI-D(M)	booster A1	DVI-D(M)	19000
Odd A car	DVI-D	M304919	DA12	?	booster A1	DVI-D(M)	EIDS Panel A1	DVI-D(M)	1500
Odd A car	DVI-D	M314916	DA2	80102	EIDS Controller	DVI-D(M)	EIDS Panel A2	DVI-D(M)	11000
Odd A car	DVI-D	M314914	DB11	80103	EIDS Controller	DVI-D(M)	booster B1	DVI-D(M)	20500
Odd A car	DVI-D	M304919	DB12	?	booster B1	DVI-D(M)	EIDS Panel B1	DVI-D(M)	1500
Odd A car	DVI-D	M314915	DB21	80104	EIDS Controller	DVI-D(M)	booster B2	DVI-D(M)	11500
Odd A car	DVI-D	M304919	DB22	?	booster B2	DVI-D(M)	EIDS Panel B2	DVI-D(M)	1500
Odd C car	DVI-D	T314915	DA11	80101	EIDS Controller	DVI-D(M)	booster A1	DVI-D(M)	11500
Odd C car	DVI-D	T304919	DA12	?	booster A1	DVI-D(M)	EIDS Panel A1	DVI-D(M)	1500
Odd C car	DVI-D	T314914	DA21	80102	EIDS Controller	DVI-D(M)	booster A2	DVI-D(M)	20500
Odd C car	DVI-D	T304919	DA12	?	booster A2	DVI-D(M)	EIDS Panel A2	DVI-D(M)	1500
Odd C car	DVI-D	T314916	DB1	80103	EIDS Controller	DVI-D(M)	EIDS Panel B1	DVI-D(M)	11000
Odd C car	DVI-D	T314917	DB21	80104	EIDS Controller	DVI-D(M)	booster B1	DVI-D(M)	19000
Odd C car	DVI-D	T304919	DB22	?	booster B1	DVI-D(M)	EIDS Panel B2	DVI-D(M)	1500
Odd B car	DVI-D	R314913	DA11	80101	EIDS Controller	DVI-D(M)	booster A1	DVI-D(M)	16000
Odd B car	DVI-D	R304919	DA12	?	booster A1	DVI-D(M)	EIDS Panel A1	DVI-D(M)	1500
Odd B car	DVI-D	R314912	DA2	80102	EIDS Controller	DVI-D(M)	EIDS Panel A2	DVI-D(M)	8000
Odd B car	DVI-D	R314910	DB31	80103	EIDS Controller	DVI-D(M)	booster B1	DVI-D(M)	23500
Odd B car	DVI-D	R304919	DB32	?	booster B1	DVI-D(M)	EIDS Panel B1	DVI-D(M)	1500
Odd B car	DVI-D	R314911	DB21	80104	EIDS Controller	DVI-D(M)	booster B2	DVI-D(M)	14500
Odd B car	DVI-D	R304919	DB22	?	booster B2	DVI-D(M)	EIDS Panel B2	DVI-D(M)	1500
B1 car	DVI-D	H314913	DA11	80101	EIDS Controller	DVI-D(M)	booster A1	DVI-D(M)	16000
B1 car	DVI-D	H304919	DA12	?	booster A1	DVI-D(M)	EIDS Panel A1	DVI-D(M)	1500
B1 car	DVI-D	H314912	DA2	80102	EIDS Controller	DVI-D(M)	EIDS Panel A2	DVI-D(M)	8000
B1 car	DVI-D	H314910	DB31	80103	EIDS Controller	DVI-D(M)	booster B1	DVI-D(M)	23500
B1 car	DVI-D	H304919	DB32	?	booster B1	DVI-D(M)	EIDS Panel B1	DVI-D(M)	1500
B1 car	DVI-D	H314911	DB21	80104	EIDS Controller	DVI-D(M)	booster B2	DVI-D(M)	14500
B1 car	DVI-D	H304919	DB22	?	booster B2	DVI-D(M)	EIDS Panel B2	DVI-D(M)	1500
C1 car	DVI-D	K314917	DA11	80101	EIDS Controller	DVI-D(M)	booster A1	DVI-D(M)	19000
C1 car	DVI-D	K304919	DA12	?	booster A1	DVI-D(M)	EIDS Panel A1	DVI-D(M)	1500
C1 car	DVI-D	K314916	DA2	80102	EIDS Controller	DVI-D(M)	EIDS Panel A2	DVI-D(M)	11000
C1 car	DVI-D	K314914	DB31	80103	EIDS Controller	DVI-D(M)	booster B1	DVI-D(M)	20500
C1 car	DVI-D	K304919	DB32	?	booster B1	DVI-D(M)	EIDS Panel B1	DVI-D(M)	1500
C1 car	DVI-D	K314915	DB21	80104	EIDS Controller	DVI-D(M)	booster B2	DVI-D(M)	11500
C1 car	DVI-D	K304919	DB22	?	booster B2	DVI-D(M)	EIDS Panel B2	DVI-D(M)	1500
Even B car	DVI-D	R314913	DA11	80101	EIDS Controller	DVI-D(M)	booster A1	DVI-D(M)	16000
Even B car	DVI-D	R304919	DA12	?	booster A1	DVI-D(M)	EIDS Panel A1	DVI-D(M)	1500
Even B car	DVI-D	R314912	DA2	80102	EIDS Controller	DVI-D(M)	EIDS Panel A2	DVI-D(M)	8000
Even B car	DVI-D	R314910	DB31	80103	EIDS Controller	DVI-D(M)	booster B1	DVI-D(M)	23500
Even B car	DVI-D	R304919	DB32	?	booster B1	DVI-D(M)	EIDS Panel B1	DVI-D(M)	1500
Even B car	DVI-D	R314911	DB21	80104	EIDS Controller	DVI-D(M)	booster B2	DVI-D(M)	14500
Even B car	DVI-D	R304919	DB22	?	booster B2	DVI-D(M)	EIDS Panel B2	DVI-D(M)	1500
Even C car	DVI-D	T314915	DA11	80101	EIDS Controller	DVI-D(M)	booster A1	DVI-D(M)	11500
Even C car	DVI-D	T304919	DA12	?	booster A1	DVI-D(M)	EIDS Panel A1	DVI-D(M)	1500
Even C car	DVI-D	T314914	DA21	80102	EIDS Controller	DVI-D(M)	booster A2	DVI-D(M)	20500
Even C car	DVI-D	T304919	DA12	?	booster A2	DVI-D(M)	EIDS Panel A2	DVI-D(M)	1500
Even C car	DVI-D	T314916	DB1	80103	EIDS Controller	DVI-D(M)	EIDS Panel B1	DVI-D(M)	11000
Even C car	DVI-D	T314917	DB21	80104	EIDS Controller	DVI-D(M)	booster B1	DVI-D(M)	19000
Even C car	DVI-D	T304919	DB22	?	booster B1	DVI-D(M)	EIDS Panel B2	DVI-D(M)	1500
Even A car	DVI-D	M314917	DA11	80101	EIDS Controller	DVI-D(M)	booster A1	DVI-D(M)	19000
Even A car	DVI-D	M304919	DA12	?	booster A1	DVI-D(M)	EIDS Panel A1	DVI-D(M)	1500
Even A car	DVI-D	M314916	DA2	80102	EIDS Controller	DVI-D(M)	EIDS Panel A2	DVI-D(M)	11000
Even A car	DVI-D	M314914	DB11	80103	EIDS Controller	DVI-D(M)	booster B1	DVI-D(M)	20500
Even A car	DVI-D	M304919	DB12	?	booster B1	DVI-D(M)	EIDS Panel B1	DVI-D(M)	1500
Even A car	DVI-D	M314915	DB21	80104	EIDS Controller	DVI-D(M)	booster B2	DVI-D(M)	11500
Even A car	DVI-D	M304919	DB22	?	booster B2	DVI-D(M)	EIDS Panel B2	DVI-D(M)	1500



*NOTE

D-SUB	PIN NO.	EDPAC1(A1)	EDPDC(A2)	EDPAC3(B1)	EDPAC2(B2)
COM	3				
COM	4				
COM	5				
COM	6				
COM	12				
COM	13				
COM	14				

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

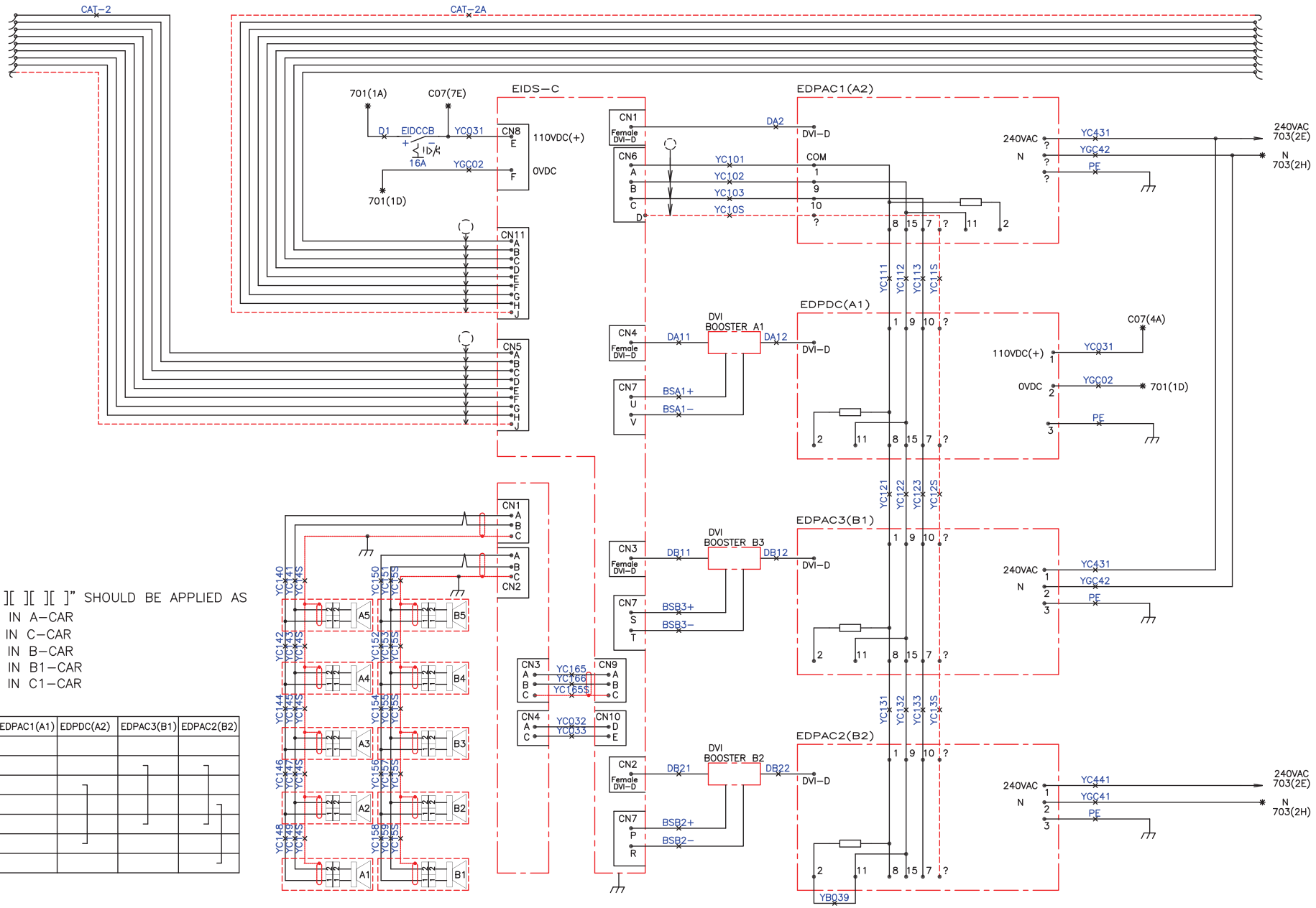
REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

TITLE: EIDS A CAR

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1		

DRAWING NO. | VERSION

B/B1/C1 CAR



*NOTE

1. WIRE NO. "Y[ ][ ][ ][ ]" SHOULD BE APPLIED AS
   "M[ ][ ][ ][ ]" IN A-CAR
   "T[ ][ ][ ][ ]" IN C-CAR
   "R[ ][ ][ ][ ]" IN B-CAR
   "H[ ][ ][ ][ ]" IN B1-CAR
   "K[ ][ ][ ][ ]" IN C1-CAR

D-SUB	PIN NO.	EDPAC1(A1)	EDPDC(A2)	EDPAC3(B1)	EDPAC2(B2)
COM	3				
COM	4				
COM	5				
COM	6				
COM	12				
COM	13				
COM	14				

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

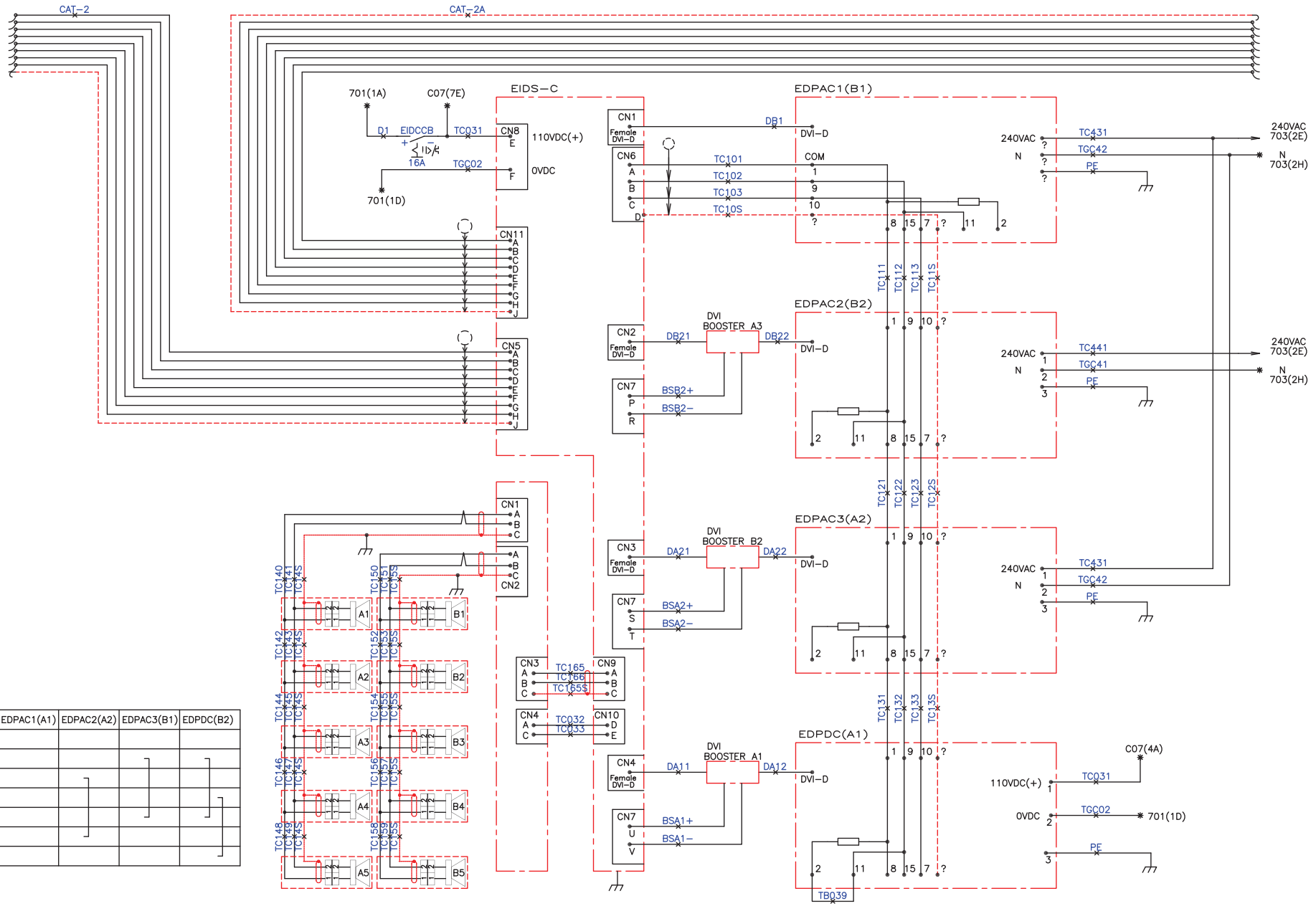
REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

TITLE: EIDS B,B1,C1 CAR

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1		

DRAWING NO. | VERSION

C CAR



*NOTE

D-SUB	PIN NO.	EDPAC1(A1)	EDPAC2(A2)	EDPAC3(B1)	EDPDC(B2)
COM	3				
COM	4				
COM	5				
COM	6				
COM	12				
COM	13				
COM	14				

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

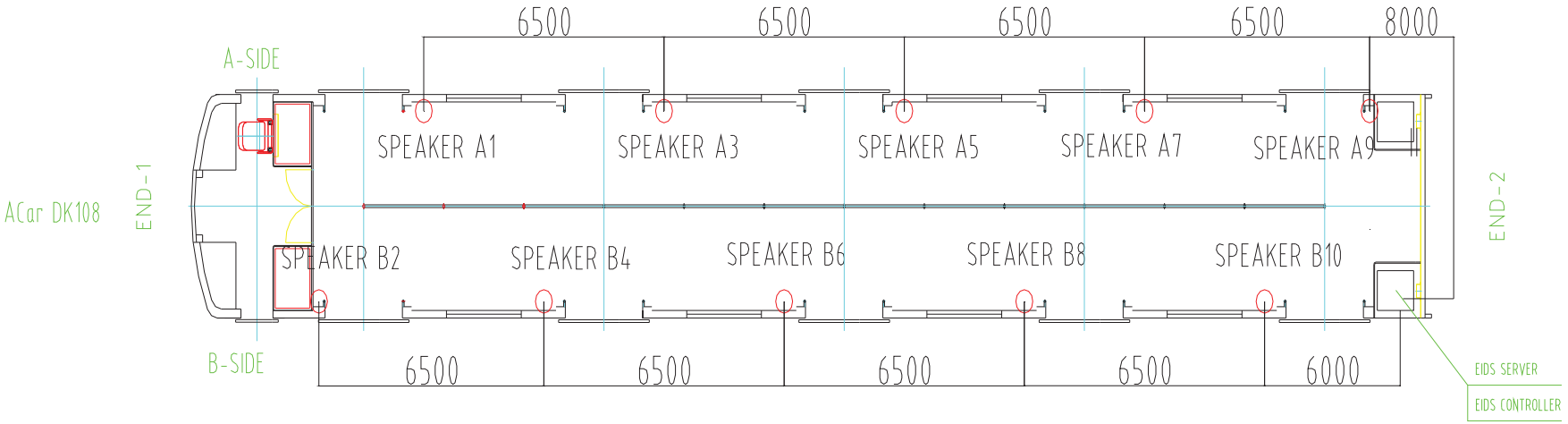
REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

TITLE: EIDS C CAR

SCALE	DRAWING	PAGE NO.	DRAWING NO.	VERSION
1:1	A2	1		

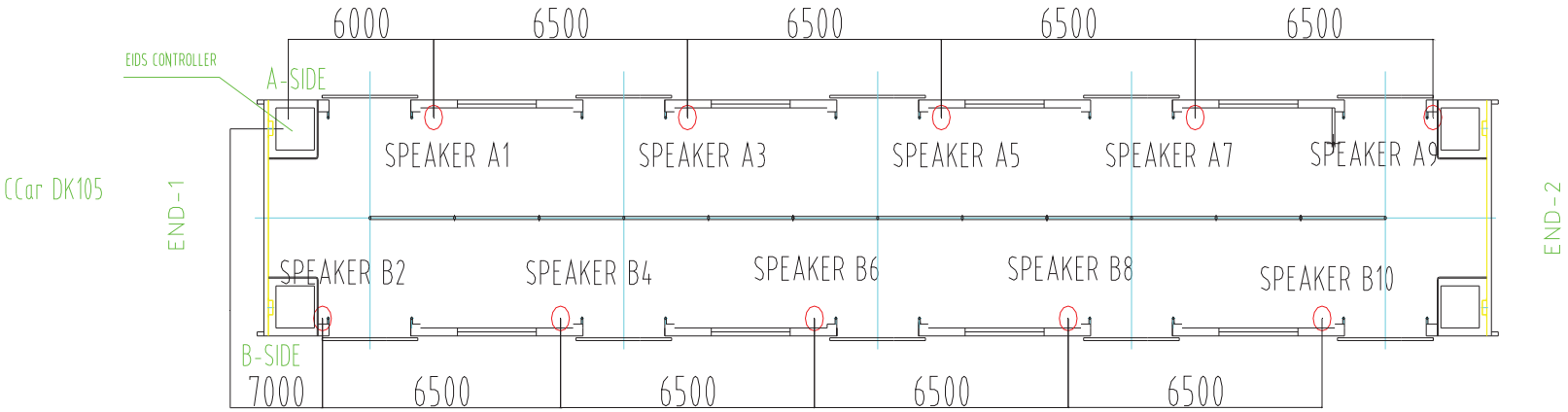
A CAR

Cable type	Cable No	From		To		Length(mm)
		location	Plug/Socket	location	Plug/Socket	
2 core twisted pair Screen cable (Audio cable)		Audio amplifier CN1	*UTG-6/14/12P (M)*	Louder speaker A9 S1	*Terminal block in Loudspeaker*	8000
2 core twisted pair Screen cable (Audio cable)		Louder speaker A9 S1	*Terminal block in Loudspeaker*	Louder speaker A7 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A7 S1	*Terminal block in Loudspeaker*	Louder speaker A5 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A5 S1	*Terminal block in Loudspeaker*	Louder speaker A3 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A3 S1	*Terminal block in Loudspeaker*	Louder speaker A1 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Audio amplifier CN2	*UTG-6/14/12P (M)*	Louder speaker B10 S1	*Terminal block in Loudspeaker*	6000
2 core twisted pair Screen cable (Audio cable)		Louder speaker B10 S1	*Terminal block in Loudspeaker*	Louder speaker B8 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B8 S1	*Terminal block in Loudspeaker*	Louder speaker B6 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B6 S1	*Terminal block in Loudspeaker*	Louder speaker B4 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B4 S1	*Terminal block in Loudspeaker*	Louder speaker B2 S1	*Terminal block in Loudspeaker*	6500


6500
6500
6500
6500
8000
A-SIDE
SPEAKER A1
SPEAKER A3
SPEAKER A5
SPEAKER A7
SPEAKER A9
ACar DK108
END-1
END-2
SPEAKER B2
SPEAKER B4
SPEAKER B6
SPEAKER B8
SPEAKER B10
B-SIDE
6500
6500
6500
6500
6000
EIDS SERVER
EIDS CONTROLLER

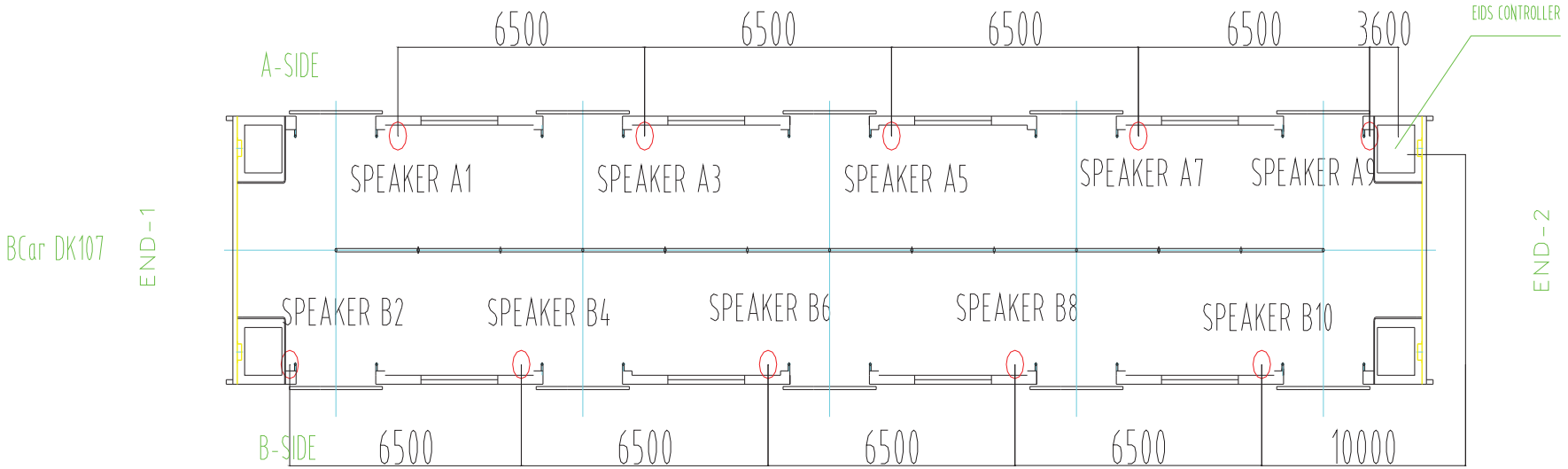
C CAR

Cable type	Cable No	From		To		Length(mm)
		location	Plug/Socket	location	Plug/Socket	
2 core twisted pair Screen cable (Audio cable)		Audio amplifier CN1	*UTG-6/12/BP (M)*	Louder speaker A1 S1	*Terminal block in Loudspeaker*	6000
2 core twisted pair Screen cable (Audio cable)		Louder speaker A1 S1	*Terminal block in Loudspeaker*	Louder speaker A3 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A3 S1	*Terminal block in Loudspeaker*	Louder speaker A5 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A5 S1	*Terminal block in Loudspeaker*	Louder speaker A7 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A7 S1	*Terminal block in Loudspeaker*	Louder speaker A9 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Audio amplifier CN2	*UTG-6/12/BP (M)*	Louder speaker B2 S1	*Terminal block in Loudspeaker*	7000
2 core twisted pair Screen cable (Audio cable)		Louder speaker B2 S1	*Terminal block in Loudspeaker*	Louder speaker B4 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B4 S1	*Terminal block in Loudspeaker*	Louder speaker B6 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B6 S1	*Terminal block in Loudspeaker*	Louder speaker B8 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B8 S1	*Terminal block in Loudspeaker*	Louder speaker B10 S1	*Terminal block in Loudspeaker*	6500


6000
6500
6500
6500
6500
EIDS CONTROLLER
A-SIDE
SPEAKER A1
SPEAKER A3
SPEAKER A5
SPEAKER A7
SPEAKER A9
CCar DK105
END-1
END-2
SPEAKER B2
SPEAKER B4
SPEAKER B6
SPEAKER B8
SPEAKER B10
B-SIDE
7000
6500
6500
6500
6500

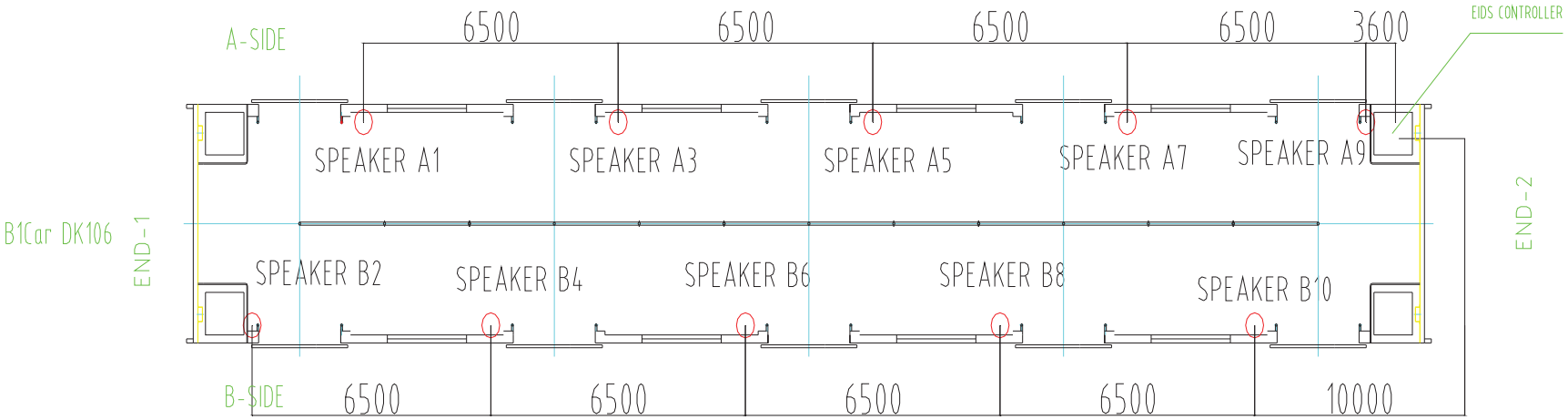
B CAR

Cable type	Cable No	From		To		Length(mm)
		location	Plug/Socket	location	Plug/Socket	
2 core twisted pair Screen cable (Audio cable)		Audio amplifier CN1	*UTG-6/12/8P (M)*	Louder speaker A9 S1	*Terminal block in Loudspeaker*	3600
2 core twisted pair Screen cable (Audio cable)		Louder speaker A9 S1	*Terminal block in Loudspeaker*	Louder speaker A7 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A7 S1	*Terminal block in Loudspeaker*	Louder speaker A5 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A5 S1	*Terminal block in Loudspeaker*	Louder speaker A3 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A3 S1	*Terminal block in Loudspeaker*	Louder speaker A1 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Audio amplifier CN2	*UTG-6/12/8P (M)*	Louder speaker B10 S1	*Terminal block in Loudspeaker*	10000
2 core twisted pair Screen cable (Audio cable)		Louder speaker B10 S1	*Terminal block in Loudspeaker*	Louder speaker B8 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B8 S1	*Terminal block in Loudspeaker*	Louder speaker B6 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B6 S1	*Terminal block in Loudspeaker*	Louder speaker B4 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B4 S1	*Terminal block in Loudspeaker*	Louder speaker B2 S1	*Terminal block in Loudspeaker*	6500


6500
6500
6500
6500
3600
EIDS CONTROLLER
A-SIDE
SPEAKER A1
SPEAKER A3
SPEAKER A5
SPEAKER A7
SPEAKER A9
BCar DK107
END-1
END-2
SPEAKER B2
SPEAKER B4
SPEAKER B6
SPEAKER B8
SPEAKER B10
B-SIDE
6500
6500
6500
6500
10000

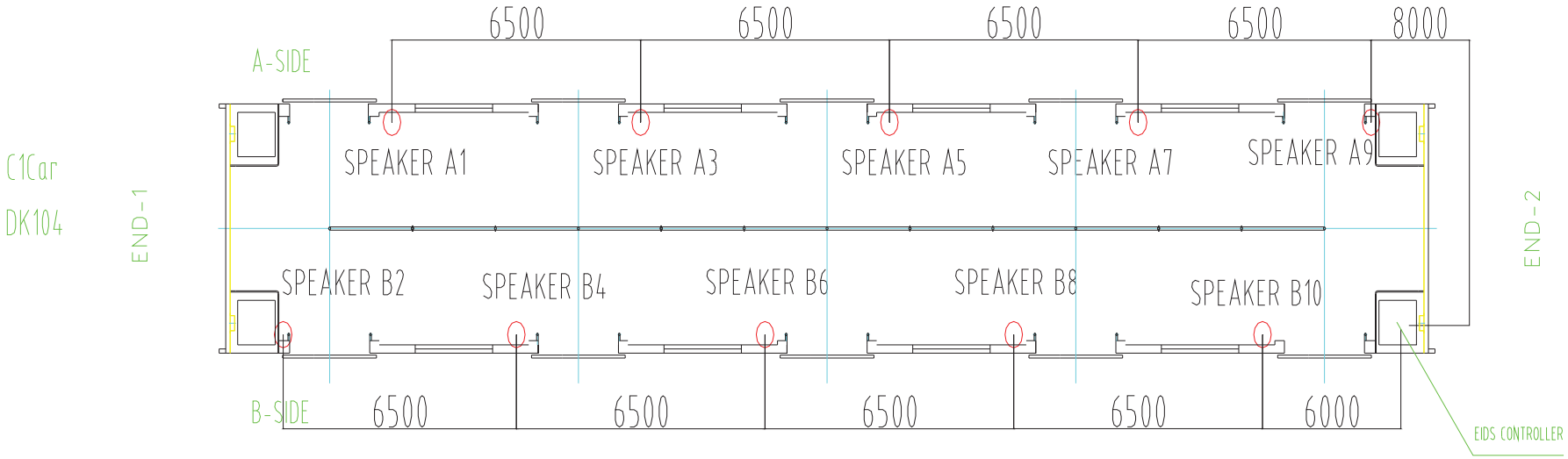
B1 CAR

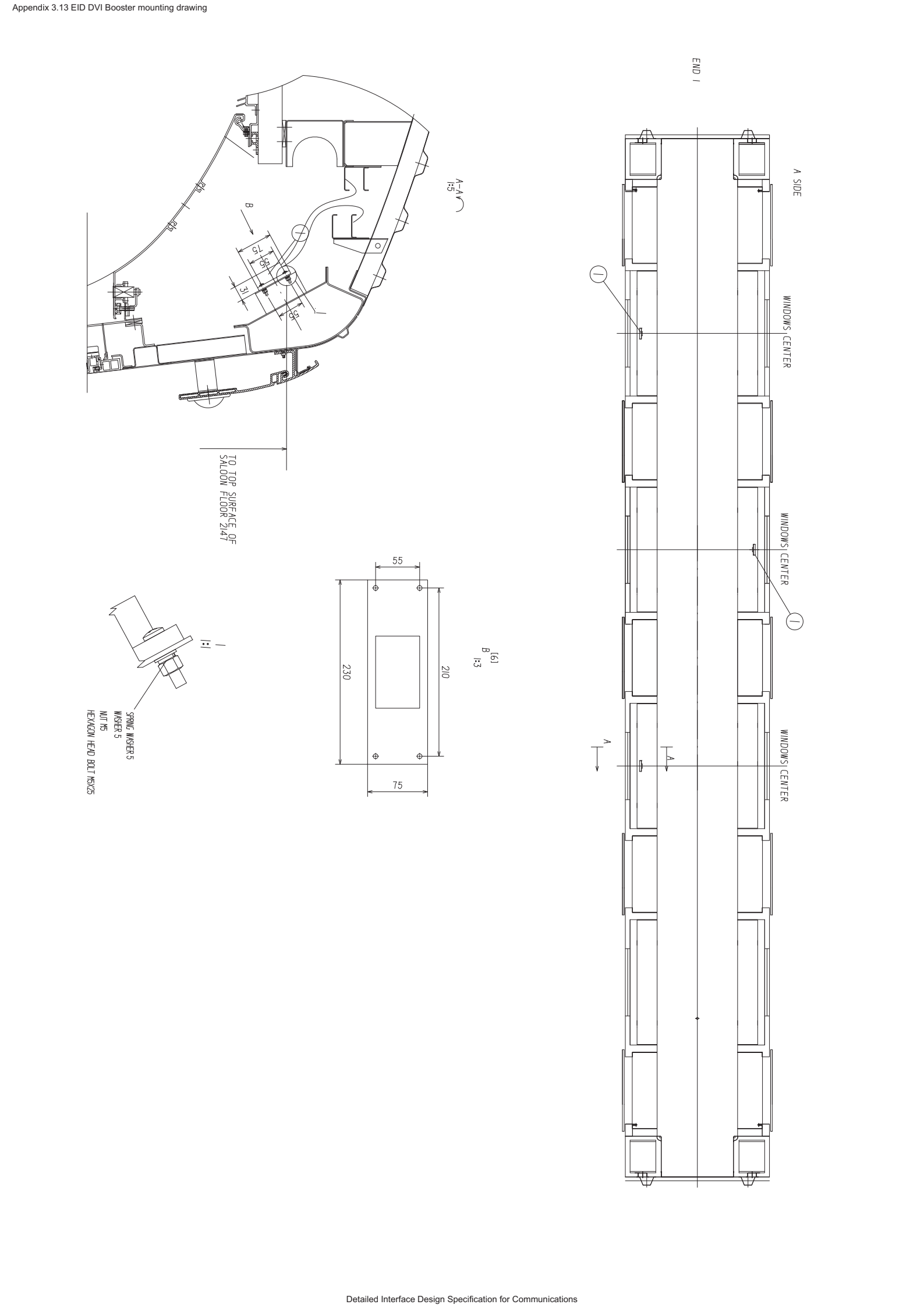
Cable type	Cable No	From		To		Length(mm)
		location	Plug/Socket	location	Plug/Socket	
2 core twisted pair Screen cable (Audio cable)		Audio amplifier CN1	*UTG-6/12/RP (M)*	Louder speaker A9 S1	*Terminal block in Loudspeaker*	3600
2 core twisted pair Screen cable (Audio cable)		Louder speaker A9 S1	*Terminal block in Loudspeaker*	Louder speaker A7 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A7 S1	*Terminal block in Loudspeaker*	Louder speaker A5 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A5 S1	*Terminal block in Loudspeaker*	Louder speaker A3 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A3 S1	*Terminal block in Loudspeaker*	Louder speaker A1 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Audio amplifier CN2	*UTG-6/12/RP (M)*	Louder speaker B10 S1	*Terminal block in Loudspeaker*	10000
2 core twisted pair Screen cable (Audio cable)		Louder speaker B10 S1	*Terminal block in Loudspeaker*	Louder speaker B8 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B8 S1	*Terminal block in Loudspeaker*	Louder speaker B6 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B6 S1	*Terminal block in Loudspeaker*	Louder speaker B4 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B4 S1	*Terminal block in Loudspeaker*	Louder speaker B2 S1	*Terminal block in Loudspeaker*	6500

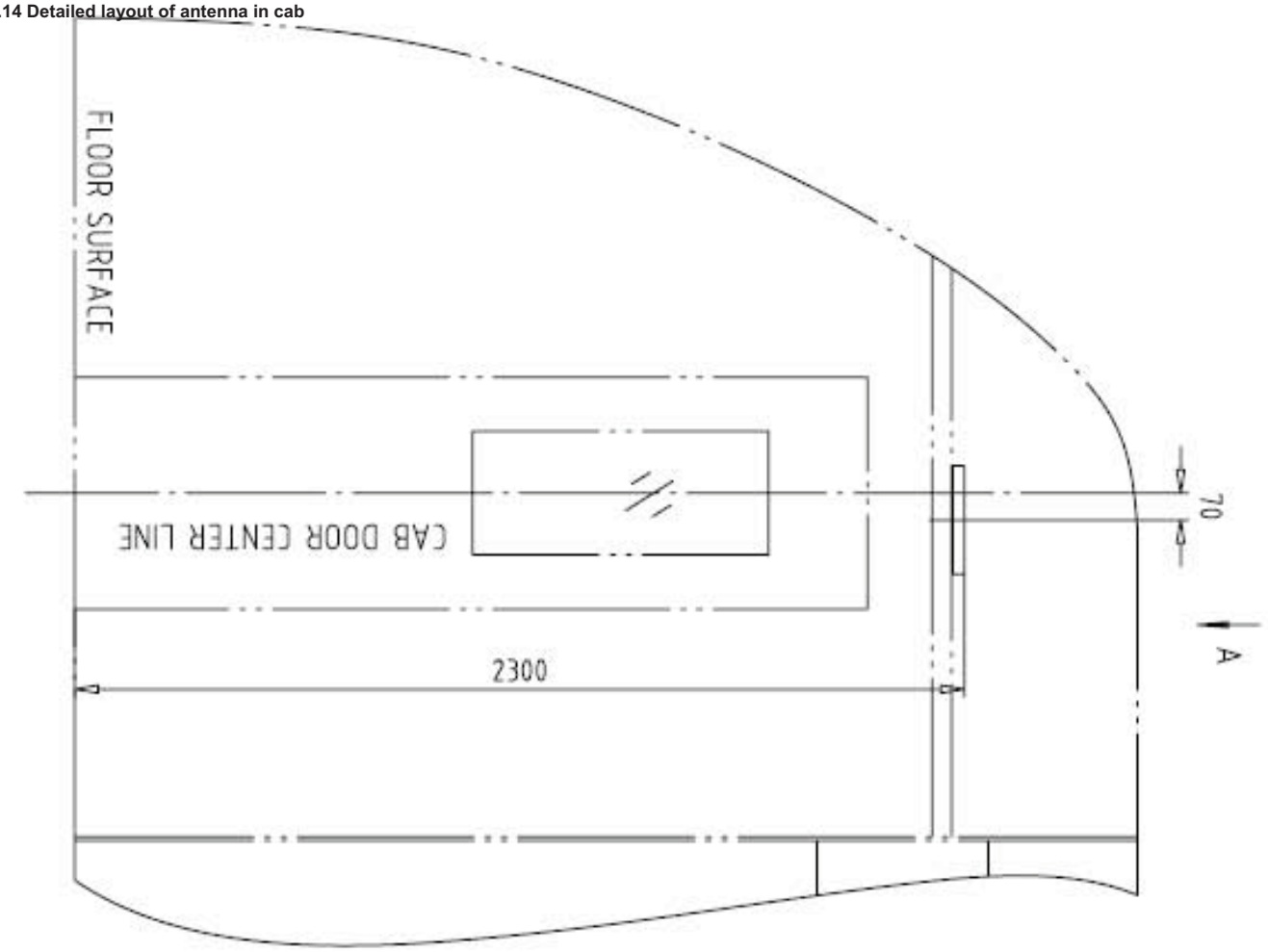

A-SIDE
6500
6500
6500
6500
3600
EIDS CONTROLLER
SPEAKER A1
SPEAKER A3
SPEAKER A5
SPEAKER A7
SPEAKER A9
B1Car DK106
END-1
END-2
SPEAKER B2
SPEAKER B4
SPEAKER B6
SPEAKER B8
SPEAKER B10
B-SIDE
6500
6500
6500
6500
10000

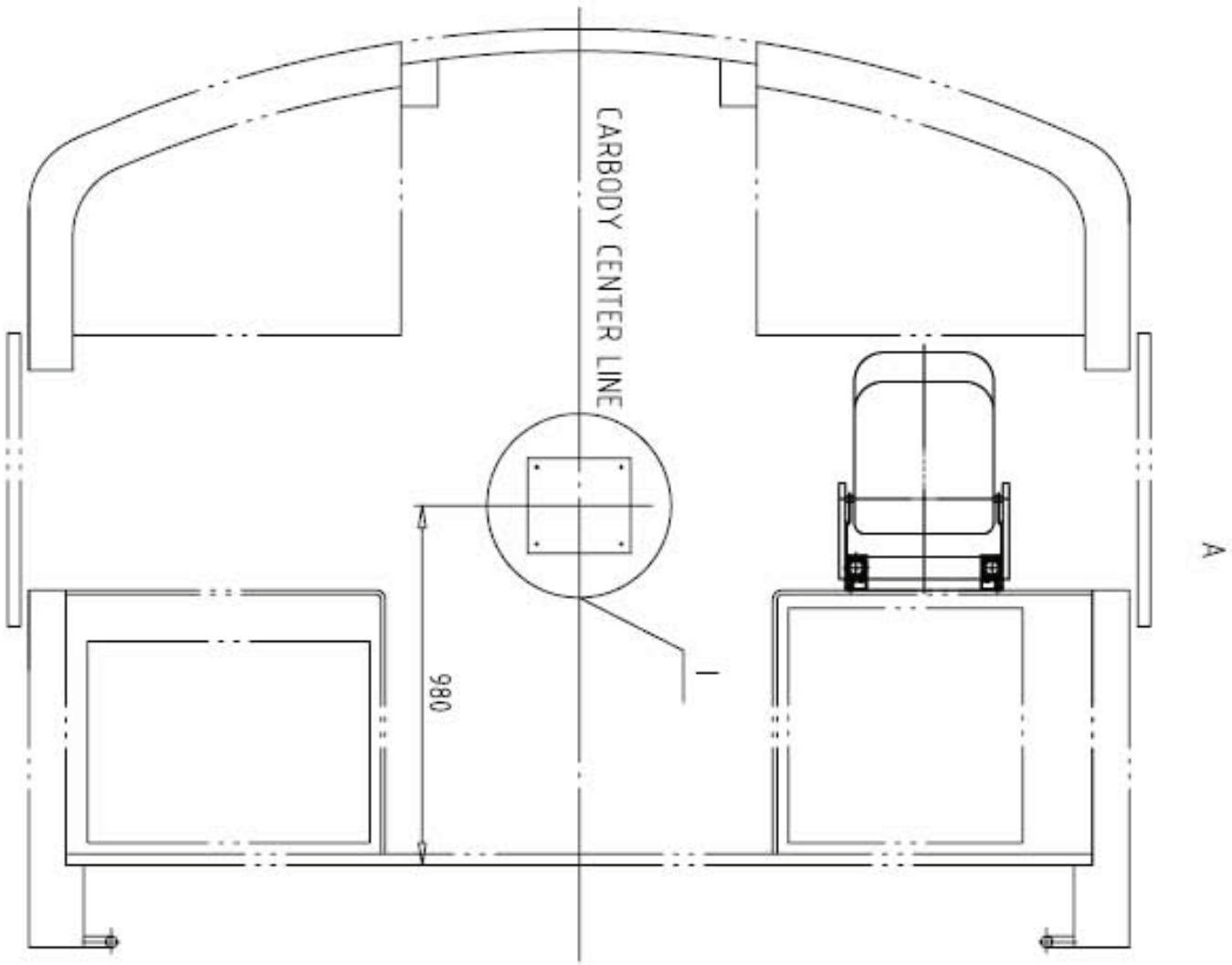
C1 CAR

Cable type	Cable No	From		To		Length(mm)
		location	Plug/Socket	location	Plug/Socket	
2 core twisted pair Screen cable (Audio cable)		Audio amplifier CN1	*UTG-6/12/RP (M)*	Louder speaker A9 S1	*Terminal block in Loudspeaker*	8000
2 core twisted pair Screen cable (Audio cable)		Louder speaker A9 S1	*Terminal block in Loudspeaker*	Louder speaker A7 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A7 S1	*Terminal block in Loudspeaker*	Louder speaker A5 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A5 S1	*Terminal block in Loudspeaker*	Louder speaker A3 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker A3 S1	*Terminal block in Loudspeaker*	Louder speaker A1 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Audio amplifier CN2	*UTG-6/12/RP (M)*	Louder speaker B10 S1	*Terminal block in Loudspeaker*	6000
2 core twisted pair Screen cable (Audio cable)		Louder speaker B10 S1	*Terminal block in Loudspeaker*	Louder speaker B8 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B8 S1	*Terminal block in Loudspeaker*	Louder speaker B6 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B6 S1	*Terminal block in Loudspeaker*	Louder speaker B4 S1	*Terminal block in Loudspeaker*	6500
2 core twisted pair Screen cable (Audio cable)		Louder speaker B4 S1	*Terminal block in Loudspeaker*	Louder speaker B2 S1	*Terminal block in Loudspeaker*	6500

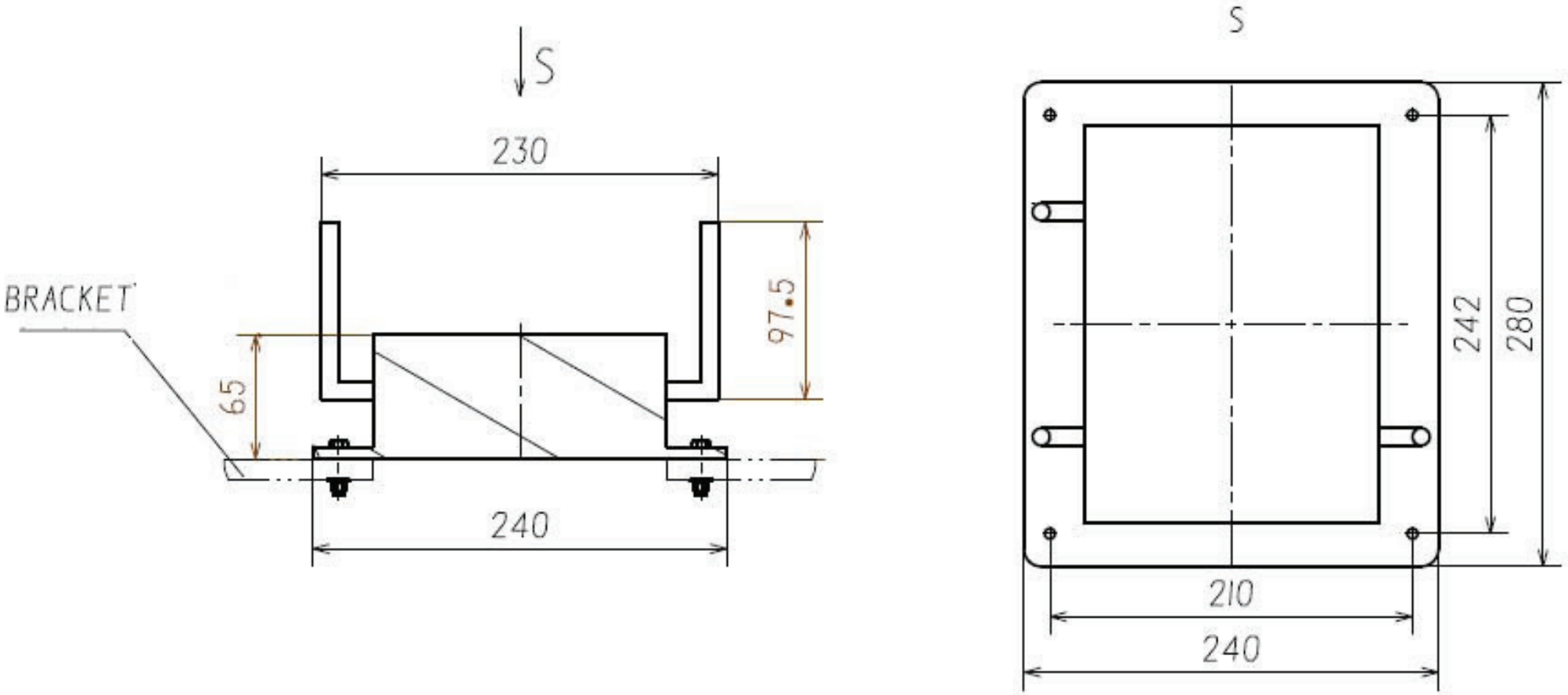

6500
6500
6500
6500
8000
A-SIDE
C1Car
DK104
END-1
END-2
SPEAKER A1
SPEAKER A3
SPEAKER A5
SPEAKER A7
SPEAKER A9
SPEAKER B2
SPEAKER B4
SPEAKER B6
SPEAKER B8
SPEAKER B10
B-SIDE
6500
6500
6500
6500
6000
EIDS CONTROLLER

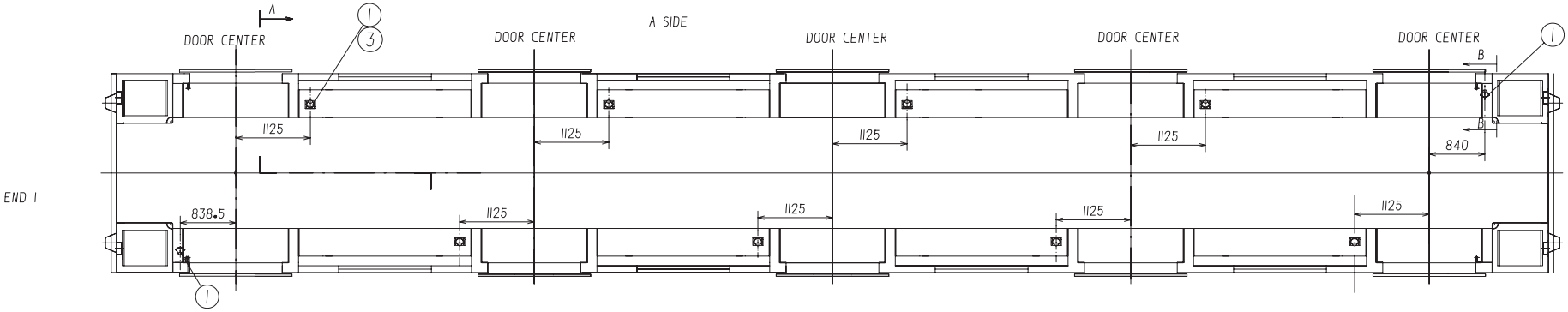

END I
A SIDE
WINDOWS CENTER
WINDOWS CENTER
WINDOWS CENTER
A
A
A–A
1:5
B
15
55
31
53
TO TOP SURFACE OF
SALOON FLOOR 247
55
230
210
75
B
[6]
1:3
I
1:1
SPRING WASHER 5
WASHER 5
NUT M5
HEXAGON HEAD BOLT M5X25

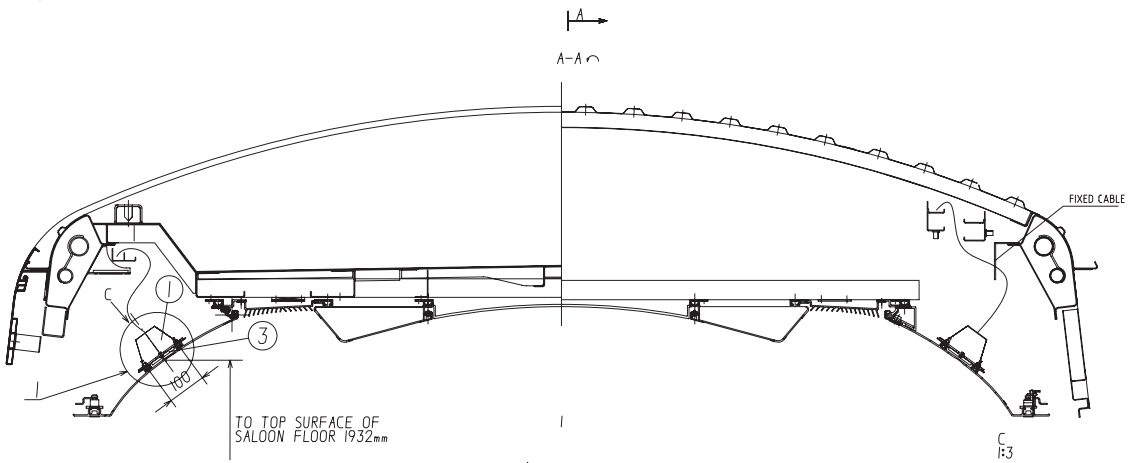

FLOOR SURFACE
CAB DOOR CENTER LINE
70
A
2300

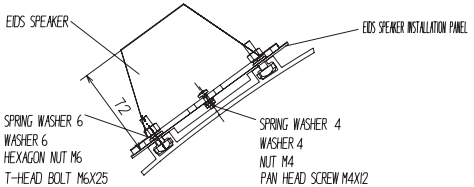

CARBODY CENTER LINE
980
A

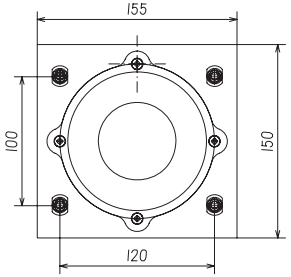
annex 3.14 Detailed layout of antenna in cab

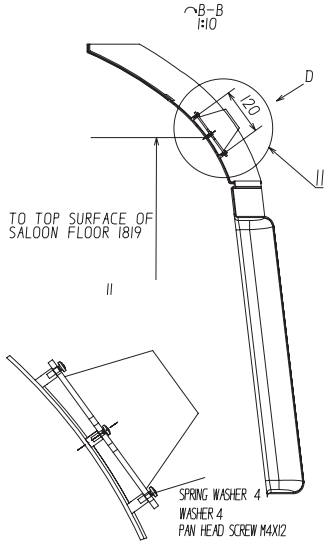


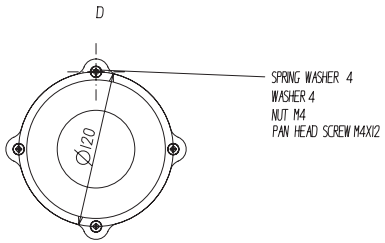

A
DOOR CENTER
DOOR CENTER
A SIDE
DOOR CENTER
DOOR CENTER
DOOR CENTER
B
B
END 1
1125
1125
1125
1125
840
838.5
1125
1125
1125
1125

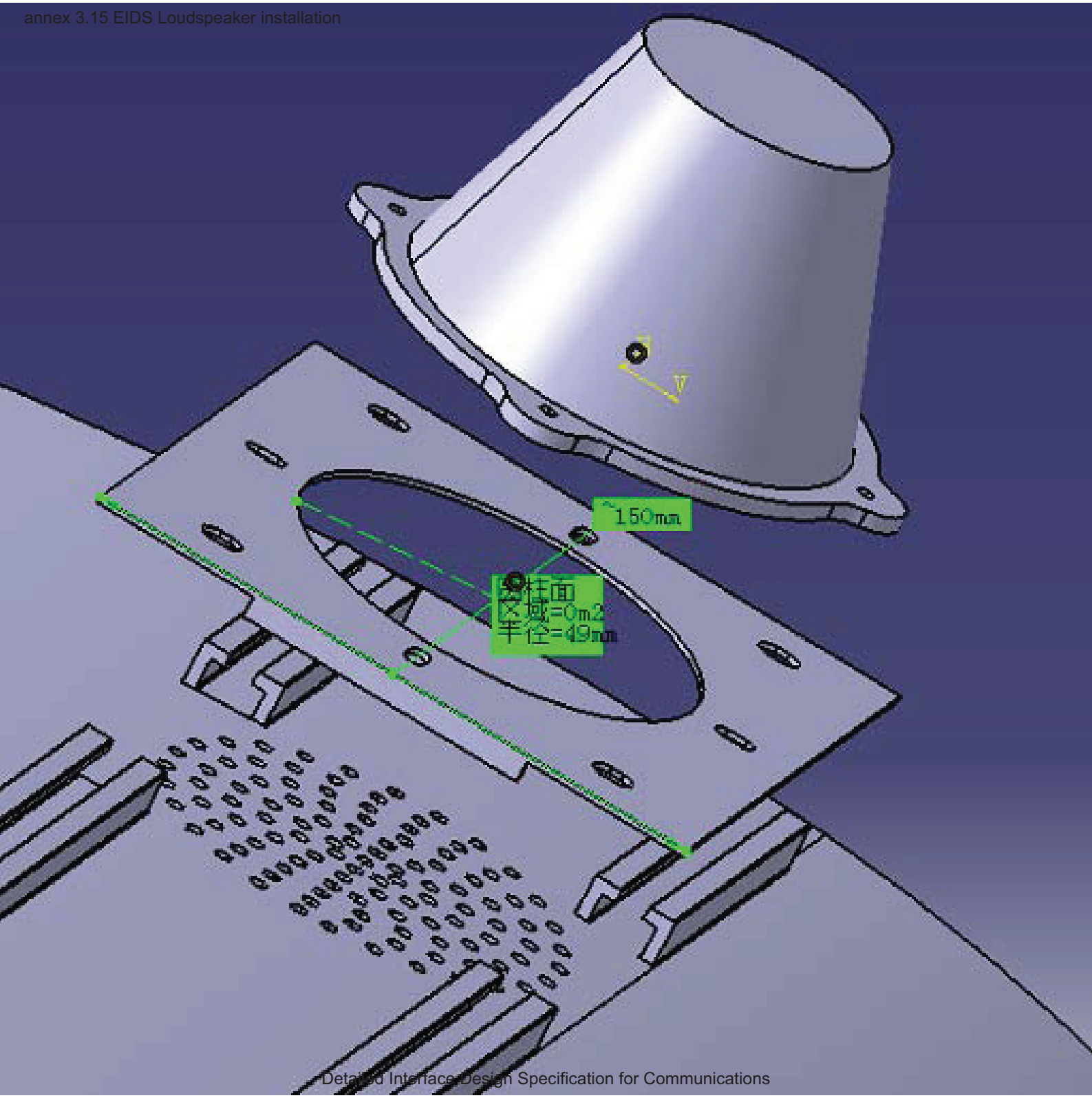

A
A-A
FIXED CABLE
C
100
TO TOP SURFACE OF
SALOON FLOOR 1932mm
C
1:3

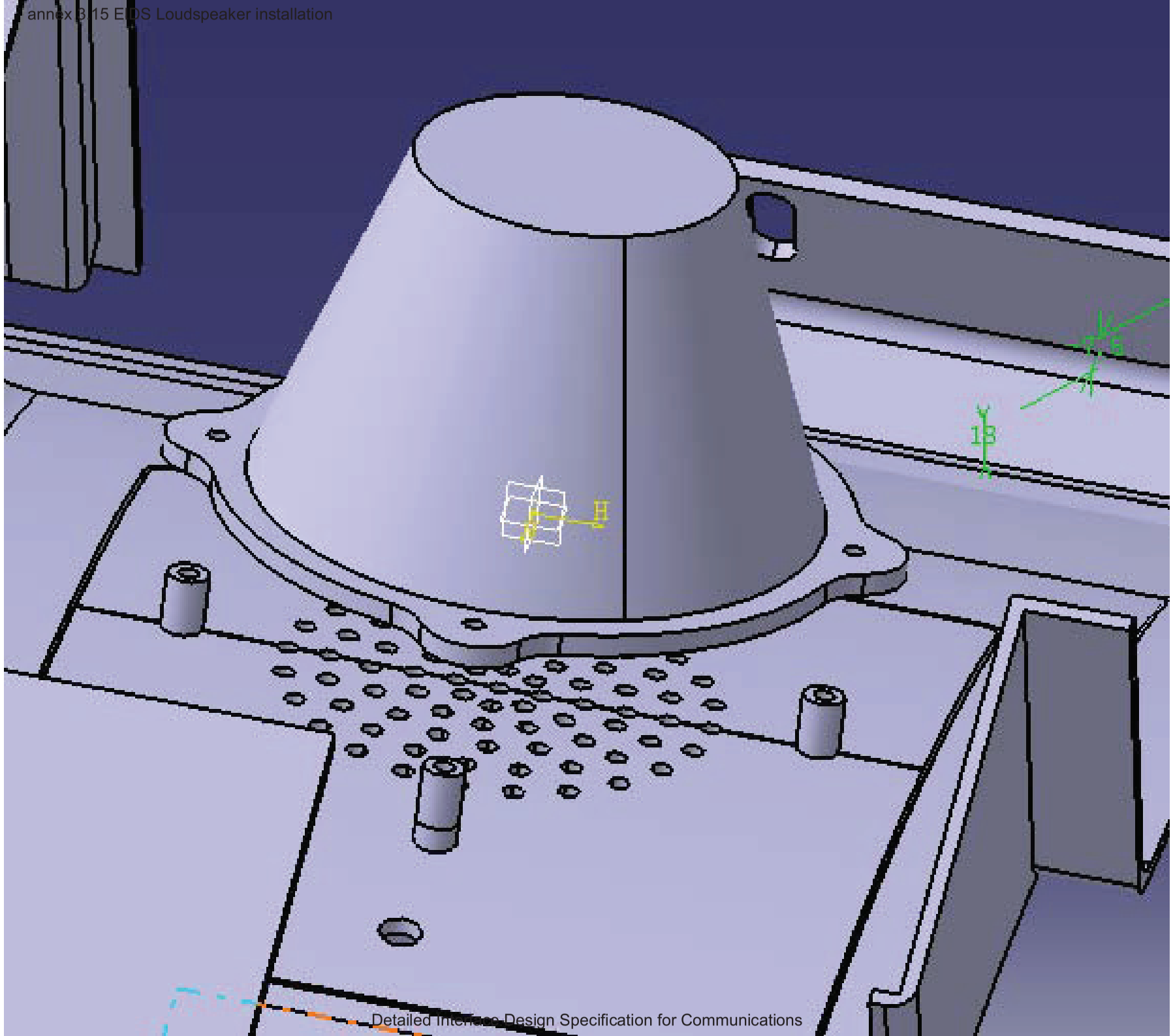

EIDS SPEAKER
EIDS SPEAKER INSTALLATION PANEL
72
SPRING WASHER 6
WASHER 6
HEXAGON NUT M6
T-HEAD BOLT M6X25
SPRING WASHER 4
WASHER 4
NUT M4
PAN HEAD SCREW M4X12

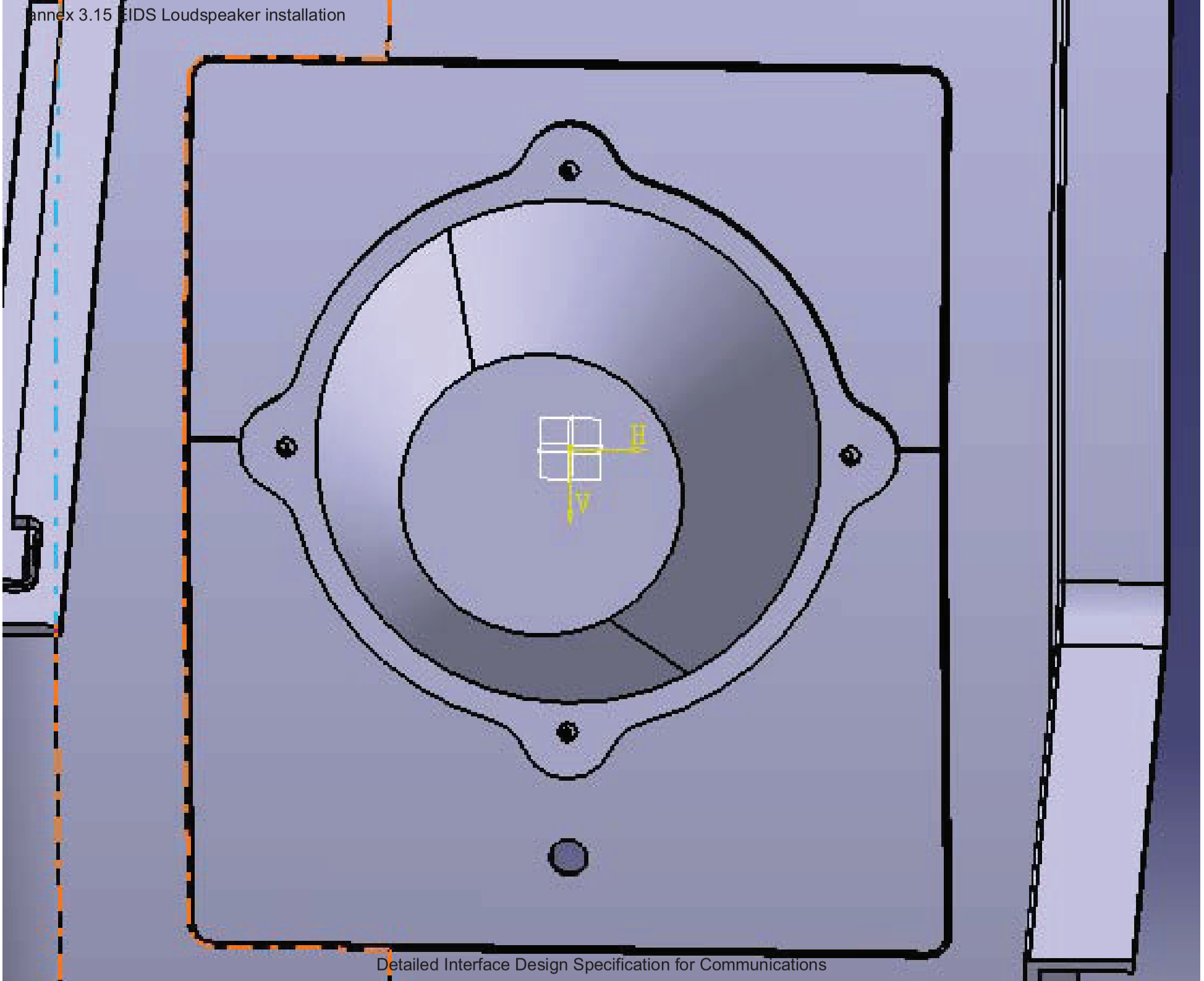

155
100
150
120

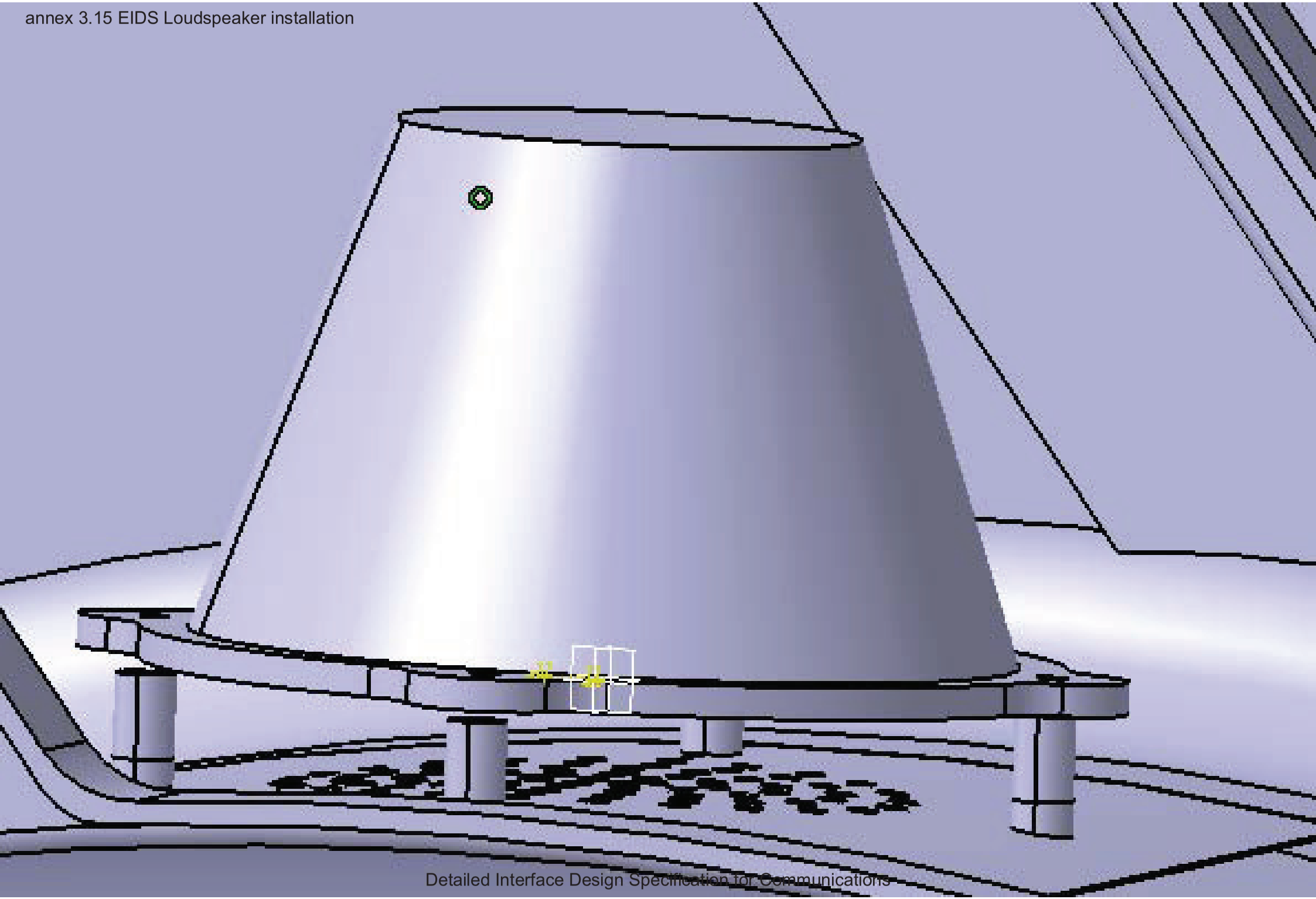

B-B
1:10
D
120
II
TO TOP SURFACE OF
SALOON FLOOR 1819
II
SPRING WASHER 4
WASHER 4
PAN HEAD SCREW M4X12

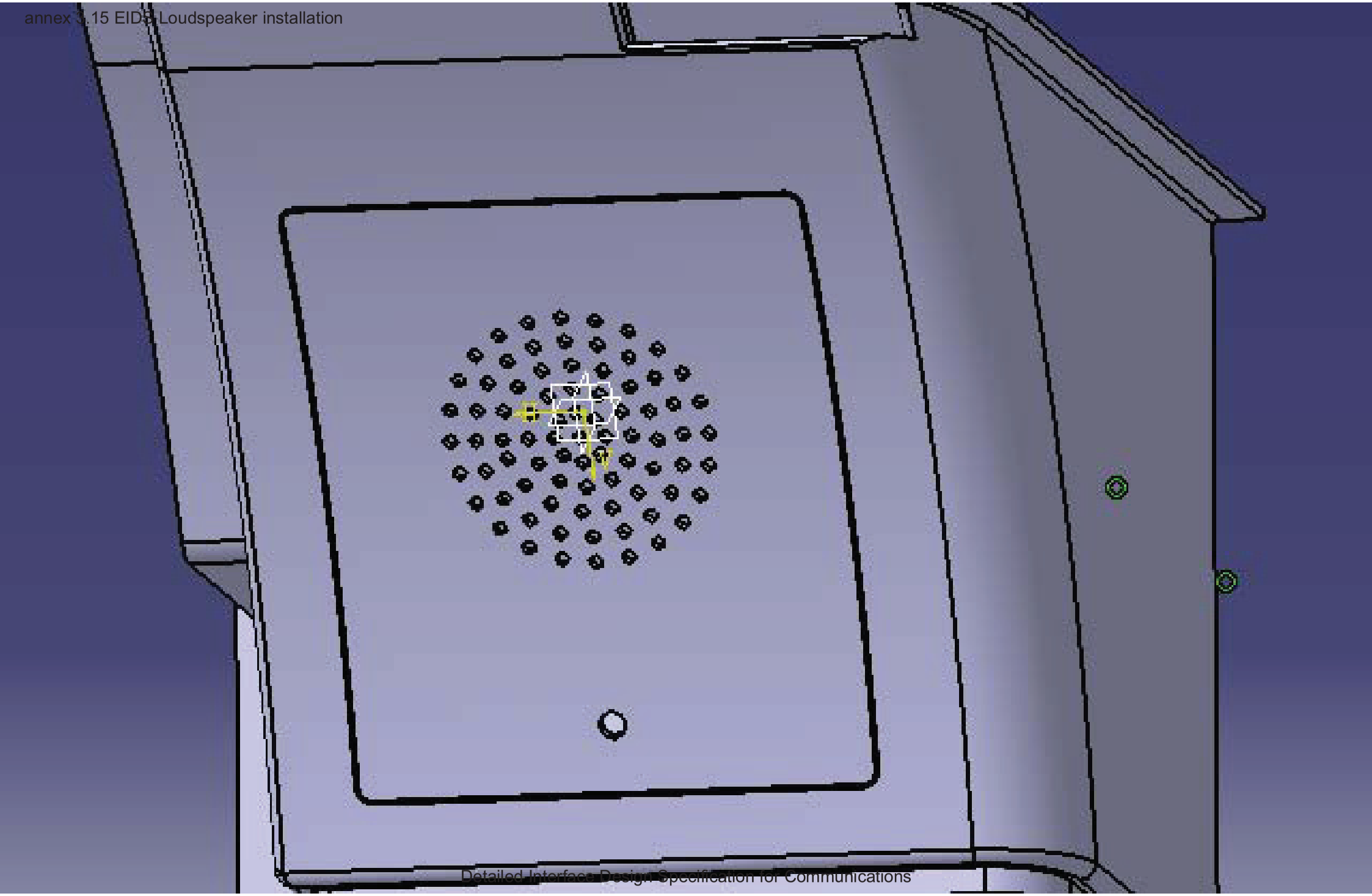

D
SPRING WASHER 4
WASHER 4
NUT M4
PAN HEAD SCREW M4X12
Ø120

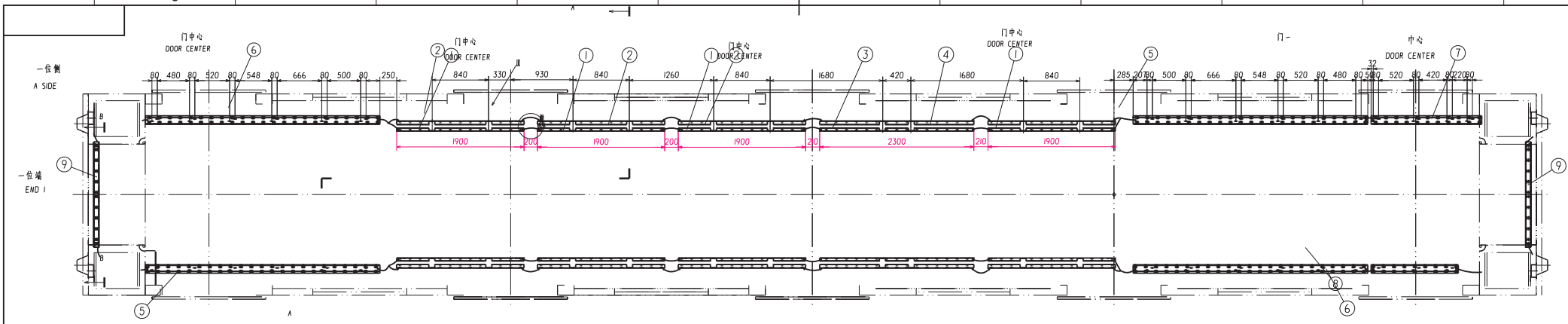

~150mm
面
域=0m2
半径=49mm

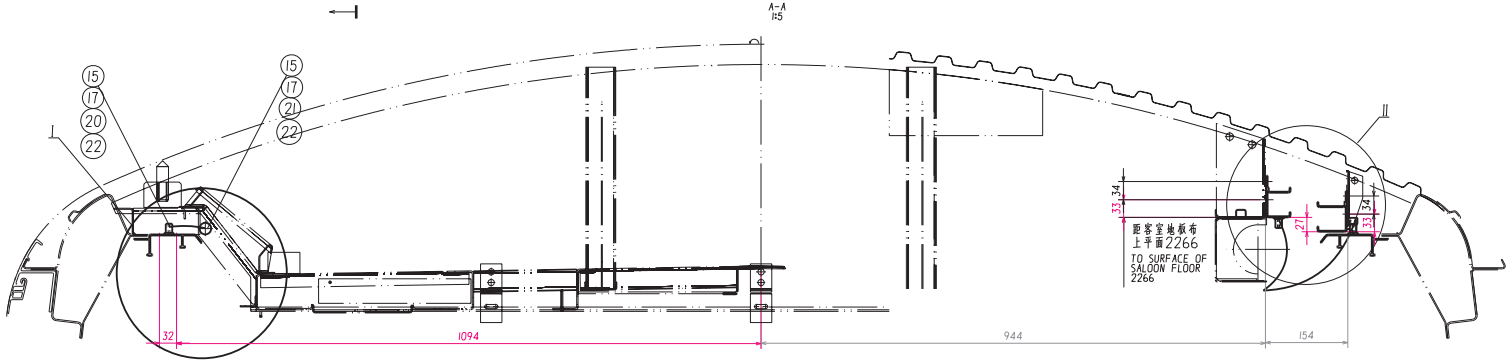

H
G
B

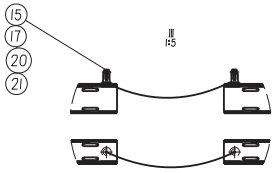

H
V

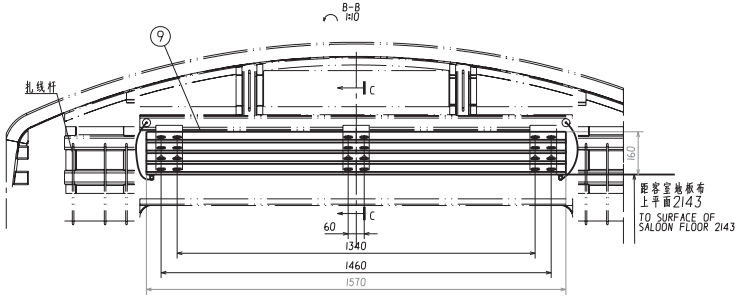


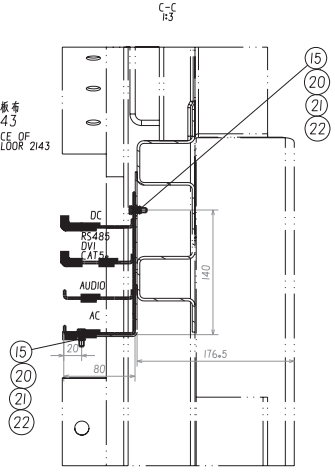


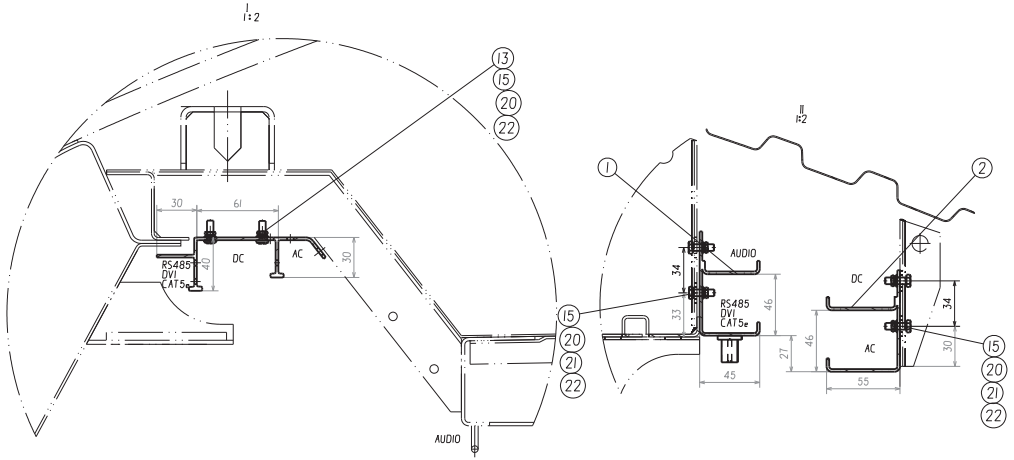












ACCORDING TO CABLE DIAGRAM.

-TRY

技术要求

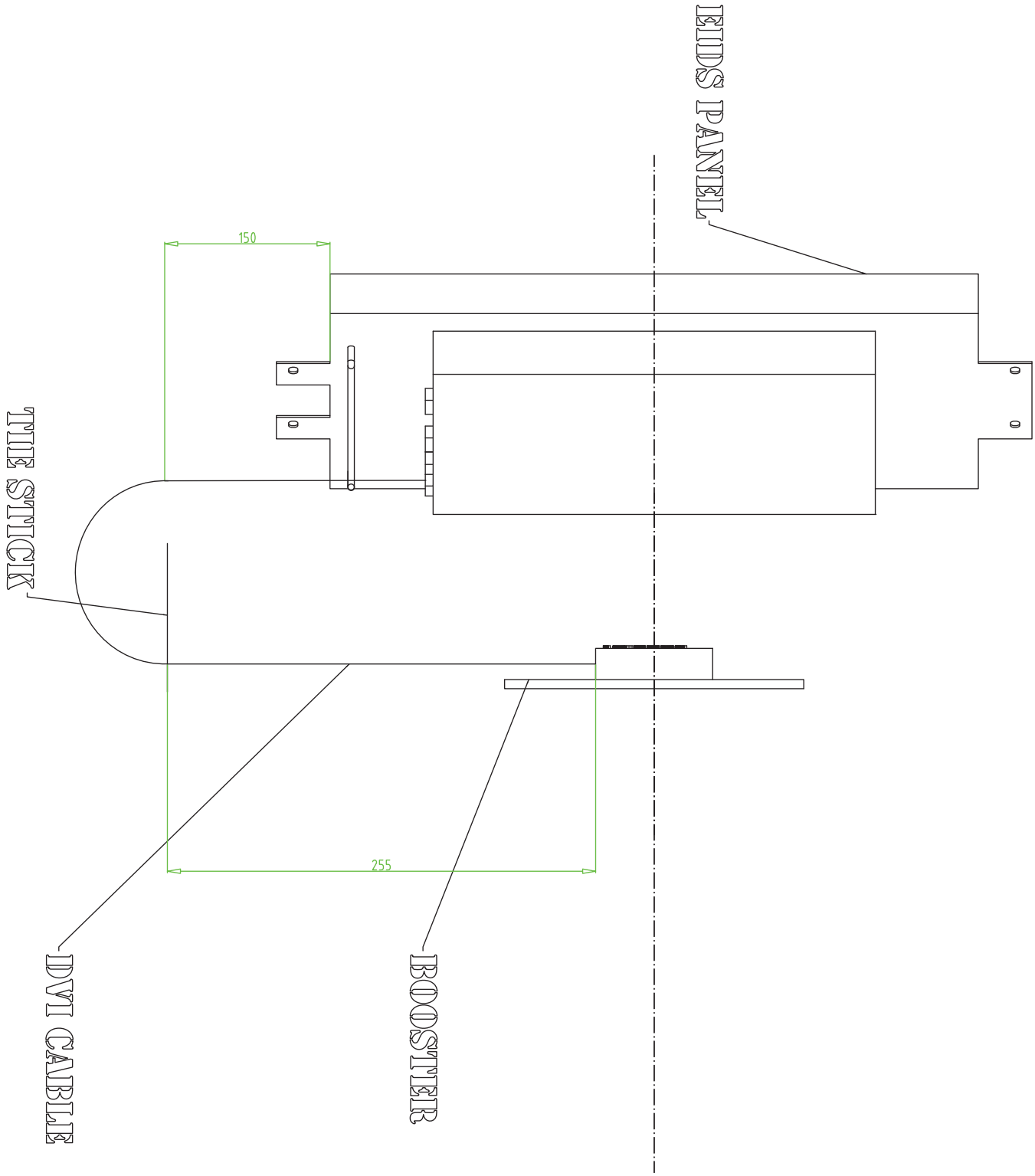
1 线槽安装沿着车体中心线一、二位侧镜像对称。

NOTES

1 CABLE DUCT WILL BE ARRANGED TO SYMME

总数	
服	
玻	
具	
试	
镀	
木	
械	
冲	
体一	
体二	
装一	
装二	
锻	
精	
钢	
铆	
协	
供	
单位 数量	
旧底图总号	
底图总号	
签字	
日期	

	版本	
		A1


EIDS PANEL
150
TILESTICK
255
DVI CABLE
BOOSTER

INTERFACE CONTROL DOCUMENT BETWEEN EIDS PANEL & EIDS CONTROLLER

Contents

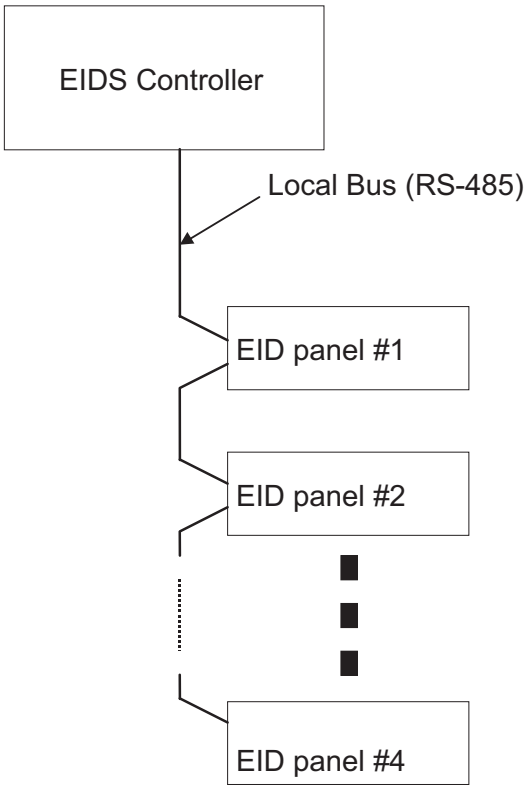
1 Introduction 3
1.1 Abbreviations 3
2 Interface Configuration 5
2.1 Interface Configuration between EIDS Panel and EIDS Controller 5
3 Interface Specifications 6
3.1 Transmission Specifications 6
3.2 Package Format 6
3.3 Calculation of CRC 8
4 Communication Procedure 9

1 Introduction

This document details the interface specification between the Electronics Information Display System (EIDS) and the Electronics Information Display (EID) panel.

The EIDS consists of the EIDS Server, the EIDS Controller and the EID panel. There are 4 EID panels in one car and these EID panels are connected by the multi-drop method. Hardware arrangement and physical connection applied to document for RS 485 Transmission.

The overall configuration is shown as follows:



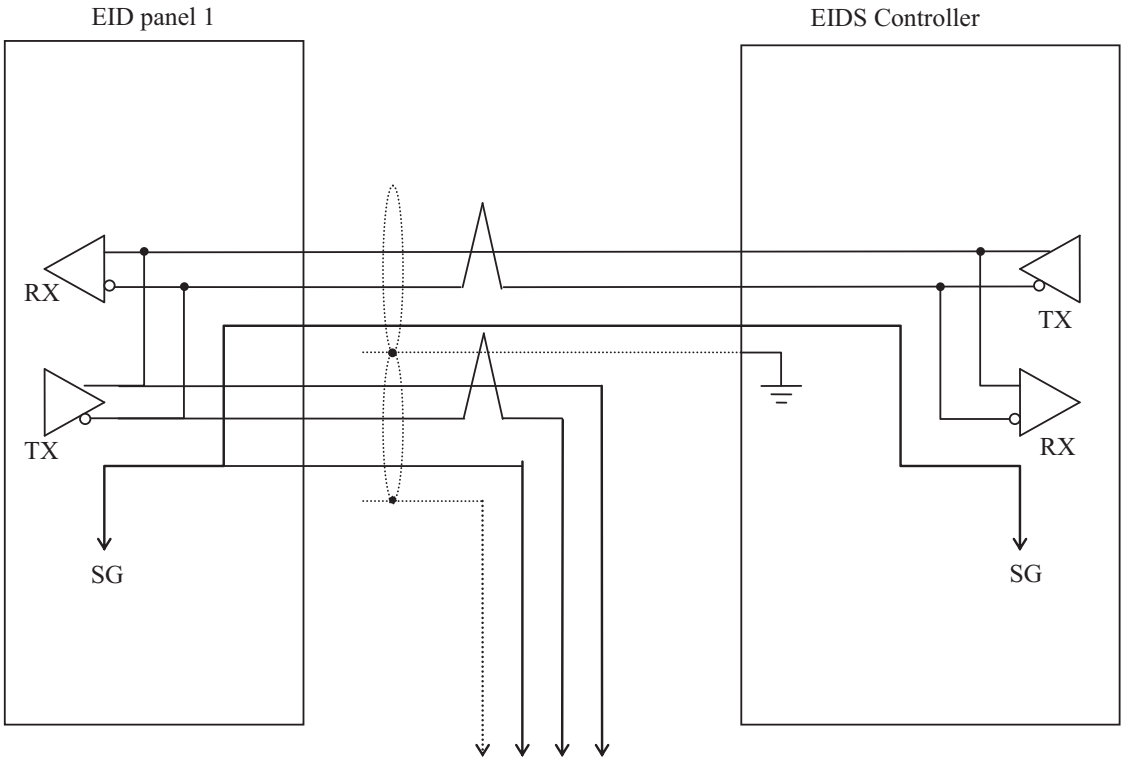
1.1 Abbreviations

ATC	Automatic Train Controller
CAB	Cabin
CPU	Central Processing Unit
DVAU	Digital Voice Announcement Unit

EDD	Electronic Destination Display
EID	Electronic Information Display
EMU	Electric Motion Unit
ETND	Electronic Train Number Display
FSM	Flashing System Map
GND	Ground
HMI	Human Machine Interface
I/O	Input/Output
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MTR	Mass Transit Railway
MTBF	Mean Time Between Failures
NA	Not Applicable
PCB	Printed Circuit Board
PCBA	Printed Circuit Board Assembled
PIS	Passenger Information System
PS	Particular Specification
PWR	Power
RX	Receive
RXD	Receive Data
SPK	Speaker
SRAM	Static Random Access Memory
SW	Switch
TBD	To Be Determined
TMS	Train Monitoring System
TX	Transmit
TXD	Transmit Data
V	Voltage
W	Watt

2 Interface Configuration

2.1 Interface Configuration between EIDS Panel and EIDS Controller



3 Interface Specifications

3.1 Transmission Specifications

The following local bus specification is applied to the interface.

(1) Wire: Shielded twisted cable
1 data pair and 1 data ground line
(2) Network topology: Multi-drop bus
(3) Transmission method: Asynchronous
(4) Protocol: Polling/selecting
(5) Baud rate: 9600 bps
(6) Transmission signal RS-485 (half-duplex)
Matching resistor = 120 ohm
(Matching resistor is installed in EIDS Controller and the terminal equipment.)
(7) Character format: Start bit: 1
Data bit: 8
Parity bit: none
Stop bit: 1
(8) Polling: Polling at every 1 second

3.2 Package Format

(1)Command Package (from EIDS Controller)

LENGTH 1 byte	TYPE 1 byte	CMD 1 Byte	Arrow 1 Byte	Reserve 1 Byte	Reserve 1 Byte	CRC 1 byte

The following is the example for the data package.

No.	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	
Example	0x07	0x51	0x32	0x00	0x00	0x00	0x76	
Define	Length	Address	StateCommand	Arrow	reserve	reserve	Check Sum	

Byte0：Length of package=0x07.
Byte1：Address of EID Panel.

（0x51，Panel A1；0x52，Panel A2；0x53，Panel B1；0x54，Panel B2）

Byte2：=0x32H, request the current state of EID Panel.
0x3fH, request the EID Panel to display emergency arrow.

Byte3：=0x00H, clear arrow or default.
0x01H, request the EID Panel to display the right oriental arrow.
0x02H, request the EID Panel to display the left oriental arrow.

Byte6：Checksum, please see Chapter 3.3 for the details.

(2) Reply Package (from EID panel)

Length 1 byte	STX 1byte	FIX 0x45	FIX 0x50	Status 1 byte	Reserved 0x00	Address 1 byte	Reserved 0x00	CRC 1 byte

The following is the example for the data package.

No	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Example	0x09	0x0D	0x45	0x50	0x57	0x00	0x51	0x00	AD
Define	Length	StartCode	E	P	Current state	0	Address	0	CheckSum

Byte0：Length of package=0x09.
Byte1：Define start code 0x0D.
Byte2：Always=0x45.
Byte3：Always=0x50.
Byte4：Current state of EID Panel.
（0x4E，Normal；0x57，No Signal）
Byte5：Always=0x00.
Byte6：Address of this EID Panel.
Byte7：Always=0x00.
Byte8：CheckSum, please see Chapter 3.3 for the details.

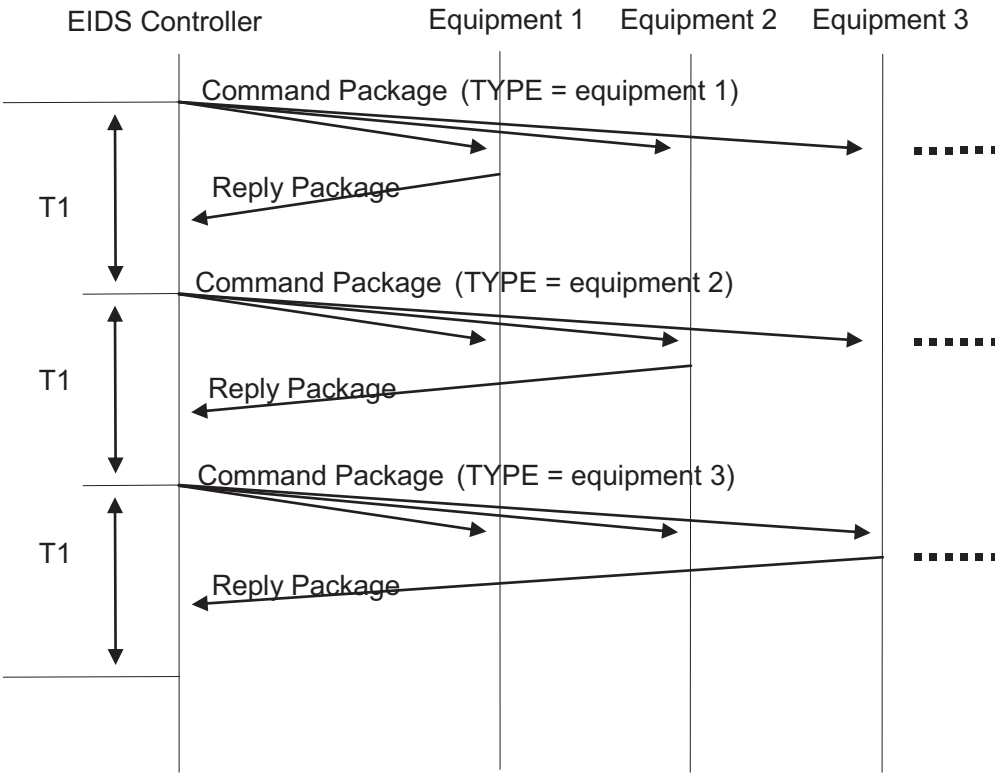
3.3 Calculation of CRC

A package is calculated from Byte 0 to Byte n (n =5, or 7).

```
Unsigned char CheckSum(unsigned char *pt,unsigned char len)
{
  Unsigned char i;
  Unsigned char z;
  Z=0;
  For(i=0;i<len;i++)
  {
    Z+=*pt;
    Pt++;
  }
z=~z+1;
  Return(z);
}
```

4 Communication Procedure

T1: for EIDS Panel is 1s.



INTERFACE CONTROL DOCUMENT BETWEEN DVAS & EIDS

Contents

Contents 2
1. Introduction 3
   1.1 Abbreviations 3
   1.2 Reference Documents 3
2. Functions 4
3. Transmission Data 4
   3.1 From DVAU to EIDS Server 4
   3.2 From EIDS Server to DVAU 4
4. Interface Specifications 5
   4.1 Transmission Specifications: 5
   4.2 Pin Configuration 5
   4.3 Packet Format 5
   4.4 Transmission Format 6
5. Transmission Data Format 6
   5.1 Data from DVAU 6
   5.2 Data from EIDS Server 13

1. Introduction

This document designates the required interface specifications between the Digital Voice Announcement and Public Address System (DVAS & PA) and Electronic Information Display System (EIDS).

The EIDS consists of the EIDS Server, the EIDS Controller and the EID panel. There are 4 EID panels and 1 EIDS controller in each saloon and 1 EIDS Server in each driver cab.

1.1 Abbreviations

DVAS	Digital Voice Announcement System
DVAU	Digital Voice Announcement Unit
EID	Electronic Information Display
EIDS	Electronic Information Display System
LSB	Least Significant bit
MSB	Most Significant bit
LDR	Load Data Request
SDR	Send Data Request

2. Functions

EIDS shall interface with the DVAS and PA to obtain information and status. The EIDS Server will respond to the DVAU and send the corresponding data.

3. Transmission Data

3.1 From DVAU to EIDS Server

1. Route code from DVAU.
2. Station code from DVAU.
3. Door Status from DVAU.
4. Detainment Signal
5. Request Self test

3.2 From EIDS Server to DVAU

1. EIDS Server response Active/Inactive status to DVAU.
2. EIDS Server response EID Panel, EIDS Server and EIDS Controller status to DVAU.
3. EIDS Server response Testing Validating status to DVAU.

4. Interface Specifications

4.1 Transmission Specifications:

The following local bus specification is applied to the interface.

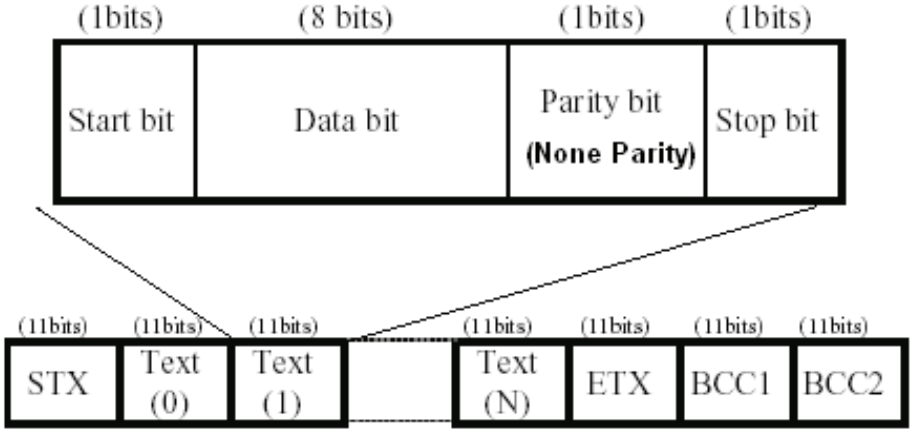
(1)	Wire:	Shielded twisted cable 1 data pair and 1 data ground line
(2)	Network topology:	point to point bus
(3)	Transmission method:	Asynchronous
(4)	Protocol:	Polling/selecting
(5)	Baud rate:	9600 bps
(6)	Transmission signal:	RS-485 (half-duplex) Matching resistor = 120 ohm (Matching resistor is installed in EIDS and DVAU.)
(7)	Character format:	Start bit: 1 Data bit: 8 Parity bit: None Stop bit: 1
(8)	Polling:	Polling at every 500ms

4.2 Pin Configuration

Pin	Signal	Cable Type
1	RS-485 Data (-)	1 x Twisted Triad
2	RS-485 Data (+)	
5	GND	

4.3 Packet Format

The proposed Command Package (from EIDS Server) is as follows:

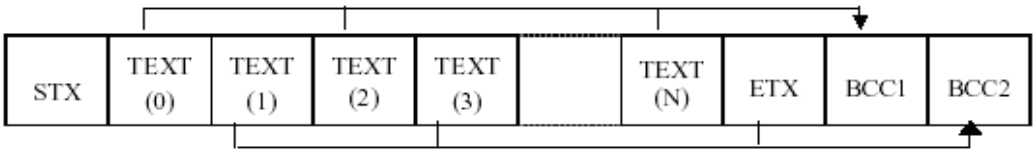


The bits are sent from the LSB to the MSB
STX: Start of Text [STX=02H]
TEXT: Contents of TEXT
ETX: END of TEXT (Message) [ETX=03H]
BCC: Block Checker Count

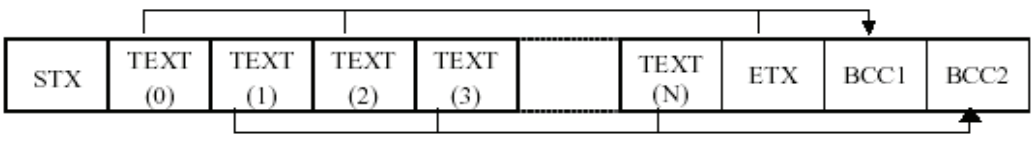
4.4 Transmission Format

To generate check sum:
The BCC is generated using XOR method.

N = (even number)



N = (odd number)



5. Transmission Data Format

5.1 Data from DVAU

Contents of Status Data Request (SDR)

TEXT No.	Bit No. 7	6	5	4	3	2	1	0	Contents	Note
0	Text code : 20H									
1	Self test								Binary	Test execution request
2	Line Number				Station Number					Refer to Note 8
3	Route Code								BCD code	Refer to Note 2
4	Station Code								BCD code	Refer to Note 1
5	Cab Occup -ied	PA Mode						Ann Status	Binary	Refer to Note 7
6	Event									Refer to Note 4
7	Spare									
8	Message Index									Refer to Note 6
9	Car No. (X00)				Car No. (0X0)				BCD Code	
10	Car No. (00X)				Detrainment Signal				BCD Code	Refer to Note 3
11	Car No. (X00)				Car No. (0X0)				BCD Code	
12	Car No. (00X)				Detrainment Signal				BCD Code	Refer to Note 3
	Spare									

[Note 1] Station Code (subject to changes with respect to TMS protocol)

CODE	STATION
00H	not valid
01 – 04H	not used
05 – 06H	spare
07H	KET
08H	HKU
09H	SYP
10H	SHW
11H	CEN
12H	ADM
13H	WAC
14H	CAB
15H	TIH
16H	FOH
17H	NOP
18H	QUB
19H	TAK
20H	SWH
21H	SKW
22H	HFC
23H	CHW
24 - 29H	spare
30H	TSW
31H	TWH
32H	KWH
33H	KWF
34H	LAK
35H	MEF
36H	LCK
37H	CSW
38H	SSP
39H	PRE
40H	MOK

CODE	STATION
41H	YMT
42H	JOR
43H	TST
44-45H	not used
46-49H	spare
50-51H	not used
52H	LAT
53H	KWT
54H	NTK
55H	KOB
56H	CHH
57H	DIH
58H	WTS
59H	LOF
60H	KOT
61H	SKM
62-64H	not used
65H	HMT
66H	WHA
67-69H	spare
70-79H	spare
80H	spare
81H	TKS
82H	POA
83H	HAH
84H	TKO
85H	TIK
86H	YAT
87-89H	spare
90-95H	not used
96-99H	spare

[Note 2] Route Code (subject to changes with respect to TMS protocol)

CODE	ROUTE
00H	not valid
01-0FH	spare
10H	ISL-up
11H	ISL-down
12H	KTL-up
13H	KTL-down
14H	TWL-up
15H	TWL-down
16-2FH	spare
30H	TKL1-up
31H	TKL1-down
32H	TKL2-up
33H	TKL2-down
34-4FH	Spare
50H	TWL-KTL-up
51H	KTL-TWL-down
52H	ISL-TWL up
53H	TWL-ISL-down
54H	KTL- TKL1-up
55H	TKL1-KTL-down
56H	KTL- TKL2-up
57H	TKL2-KTL-down
58H	ISL- TKL1-up
59H	TKL1-ISL-down
5AH	ISL- TKL2-up
5BH	TKL2-ISL-down
5C-6FH	Spare
70-FFH	Spare

CODE	ROUTE

[Note 3]
0- normal
1- detrainment

[Note 4]
01H- door opening message
02H- door closing message
03H- special message
04H- emergency message
05H- next station message (ATC code)
06H- Non ATC operational message

[Note 6]
The details of the message index will be provided by the Engineer after the award of the Contract.

[Note 7]

Bit No.							
7	6	5	4	3	2	1	0
Cab Occupied Status	PA Mode	–	–	–	–	–	Announcement Status

Cab Occupied Status:

‘0’-Not-Occupied
‘1’-Occupied

PA Mode:

‘0’- Automatic Mode
‘1’- Manual mode (ATC disabled)

Announcement Status:

‘0’- No announcement

'1'- On-going announcement

[Note 8]
Line Number/Station Number.

Bit No.							
7	6	5	4	3	2	1	0
Line Number			Station number				

The bit format for line/station number shall follow the Interface between TMS and DVAS & PA as shown below:

Line number:

Island line - up track : 1
Island line - down track : 2
Kwun Tong Line - up track : 3
Kwun Tong Line - down track : 4
Tsuen Wan Line - up track : 5
Tsuen Wan Line - down track : 6
Tseung Kwan O Line - up track : 7
Tseung Kwan O Line - down track: 0

	MTR Rolling Stock Project	

No.	Station number	Line - Track							
		ISL Up	ISL down	KTL up	KTL Down	TWL Up	TWL Down	TKL Up	TKL down
1	01	CEN	HFC	MOK	LAT	ADM	TWH	NOP	TKS
2	02	ADM	SKW	PRE	KWT	ADM_PLT	KWH	QUB	POA
3	03	ADM_PLT	SWH	SKM	NTK	TST	KWF	YAT	HAH
4	04	WAC	TAK	KOT	KOB	JOR	LAK	TIK	HAH_PLT
5	05	CAB	QUB	LOF	CHH	YMT	MEF	TKO	TKO
6	06	TIH	NOP	WTS	DIH	MOK	LCK	HAH	TIK
7	07	FOH	FOH	DIH	WTS	PRE	CSW	HAH_PLT	YAT
8	08	NOP	TIH	CHH	LOF	SSP	SSP	POA	QUB
9	09	QUB	CAB	KOB	KOT	CSW	PRE	POA_PLT	NOP
10	0A	TAK	WAC	NTK	SKM	LCK	MOK	TKS	NOP_PLT
11	0B	SWH	ADM	KWT	PRE	MEF	YMT	TKS_PLT	NOP_SDG
12	0C	SKW	ADM_PLT	LAT	MOK	LAK	JOR	BHT_SDG	BHT_SDG
13	0D	HFC	CEN	QUB	YMT	KWF	TST	YAT_PLT	TKO rev
14	0E	CHW	SHW	QUB_PLT	YMT_PLT	KWH	ADM	TKO rev	TIK rev
15	0F	CHW_PLT	SHW_PLT	YMT	QUB	TWH	ADM_PLT	TIK rev	POA_SDG
16	10	SHW	CHW	KOT rev	PRE rev	TSW	CEN	NOP rev	DEP_DN
17	11	ADM rev	WAC rev	CHH rev	-	TSW_PLT	CEN_PLT	NOP_SDG	TKS rev
18	12	CAB rev	HFC rev	KWT rev	CHH rev	CEN	TSW	DEP_UP	TIK_PLT
19	13	TAK rev	QUB rev	LAT rev	CHH cen	JOR rev	KWH rev	DEP_SN	
20	14	CHW rev		CHH cen	YMT rev	LAK rev	MEF rev	TKO_PLT tks	
21	15			TTT	TTT	MEF rev	TST rev	TKO_PLT hah	
22	16			SKM rev	NOP		CEN rev	TKS rev	
23	17			NOP	NOP_rev		TSW rev	TKO tks	
24	18			NOP_PLT	TIK		LAK rev	DVAS	
25	19			YAT	YAT				
26	1A			TIK	YAT_PLT				
27	1B			TIK_SDG	NOP_SDG				
28	1C			NOP_SDG					
29	1D			TIK_PLT					
30	1E								
31	1F								

5.2 Data from EIDS Server

DVAU shall poll from EIDS Server repeatedly for 3 times before declaring that the link between EIDS Server and DVAU is down to TMS.

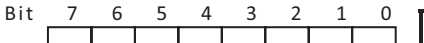
Contents of Status Data (SD)

TEXT NO.	bit No. 7	6	5	4	3	2	1	0	Contents	note
0	Text code : 22H									
1	LCD Fault Status EID 1 (110 v)								Binary	Refer to Note 8
2	LCD Fault Status EID 2 (240 v)								Binary	Refer to Note 8
3	LCD Fault Status EID 3 (240 v)								Binary	Refer to Note 8
4	LCD Fault Status EID 4 (240 v)								Binary	Refer to Note 8
5	Fault Status EID Controller								Binary	Refer to Note 8
6	Fault Status EIDS Server								Binary	Refer to Note 8
7	Message Code Error		Station Code Error			Route Code Error			Binary	Refer to Note 9
8	EIDS Status									Refer to Note 10
9	Spare									

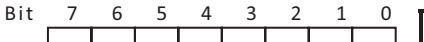
[Note 8] Illustrates the indication of the Status of the EIDS Server, EID Controller and EIDS Panel.

Bit	7	6	5	4	3	2	1	0
	Cab A	Cab C	Cab B	Cab B1	Cab C1	Cab B	Cab C	Cab A

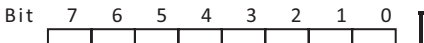
signal name	description
EID Panel 1 (110V)	“1”: error ; “0”: Working
EID Panel 1 (110V)	“1”: error ; “0”: Working
EID Panel 1 (110V)	“1”: error ; “0”: Working
EID Panel 1 (110V)	“1”: error ; “0”: Working
EID Panel 1 (110V)	“1”: error ; “0”: Working
EID Panel 1 (110V)	“1”: error ; “0”: Working
EID Panel 1 (110V)	“1”: error ; “0”: Working
EID Panel 1 (110V)	“1”: error ; “0”: Working



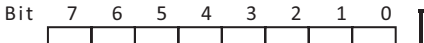
signal name	description
EID Panel 2 (240 V)	“1”: error ; “0”: Working
EID Panel 2 (240 V)	“1”: error ; “0”: Working
EID Panel 2 (240 V)	“1”: error ; “0”: Working
EID Panel 2 (240 V)	“1”: error ; “0”: Working
EID Panel 2 (240 V)	“1”: error ; “0”: Working
EID Panel 2 (240 V)	“1”: error ; “0”: Working
EID Panel 2 (240 V)	“1”: error ; “0”: Working
EID Panel 2 (240 V)	“1”: error ; “0”: Working



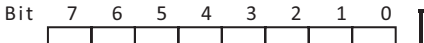
signal name	description
EID Panel 3 (240 V)	“1”: error ; “0”: Working
EID Panel 3 (240 V)	“1”: error ; “0”: Working
EID Panel 3 (240 V)	“1”: error ; “0”: Working
EID Panel 3 (240 V)	“1”: error ; “0”: Working
EID Panel 3 (240 V)	“1”: error ; “0”: Working
EID Panel 3 (240 V)	“1”: error ; “0”: Working
EID Panel 3 (240 V)	“1”: error ; “0”: Working
EID Panel 3 (240 V)	“1”: error ; “0”: Working



signal name	description
EID Panel 4 (240 V)	“1”: error ; “0”: Working
EID Panel 4 (240 V)	“1”: error ; “0”: Working
EID Panel 4 (240 V)	“1”: error ; “0”: Working
EID Panel 4 (240 V)	“1”: error ; “0”: Working
EID Panel 4 (240 V)	“1”: error ; “0”: Working
EID Panel 4 (240 V)	“1”: error ; “0”: Working
EID Panel 4 (240 V)	“1”: error ; “0”: Working
EID Panel 4 (240 V)	“1”: error ; “0”: Working



signal name	description
EID Controller	“1”: error ; “0”: Working
EID Controller	“1”: error ; “0”: Working
EID Controller	“1”: error ; “0”: Working
EID Controller	“1”: error ; “0”: Working
EID Controller	“1”: error ; “0”: Working
EID Controller	“1”: error ; “0”: Working
EID Controller	“1”: error ; “0”: Working
EID Controller	“1”: error ; “0”: Working



signal name	description
EIDS Server	“1”: error ; “0”: Working
EIDS Server	“1”: error ; “0”: Working

[Note 9]*

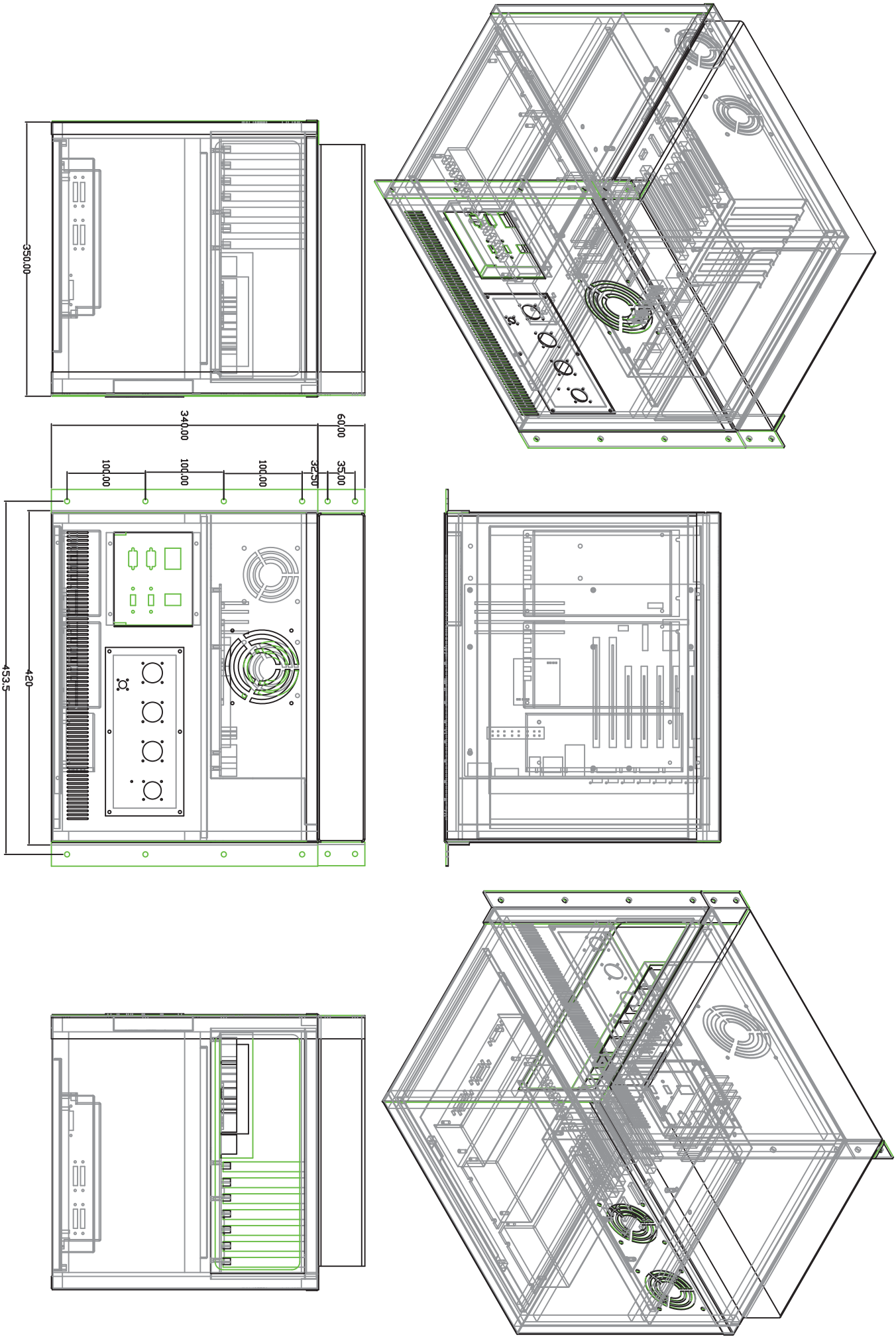
Bit 7	6	5	4	3	2	1	0
Spare	Spare	Spare	Spare	Spare	Message Code Error	Station Code Error	Route Code Error

0 – Normal
1 – Error

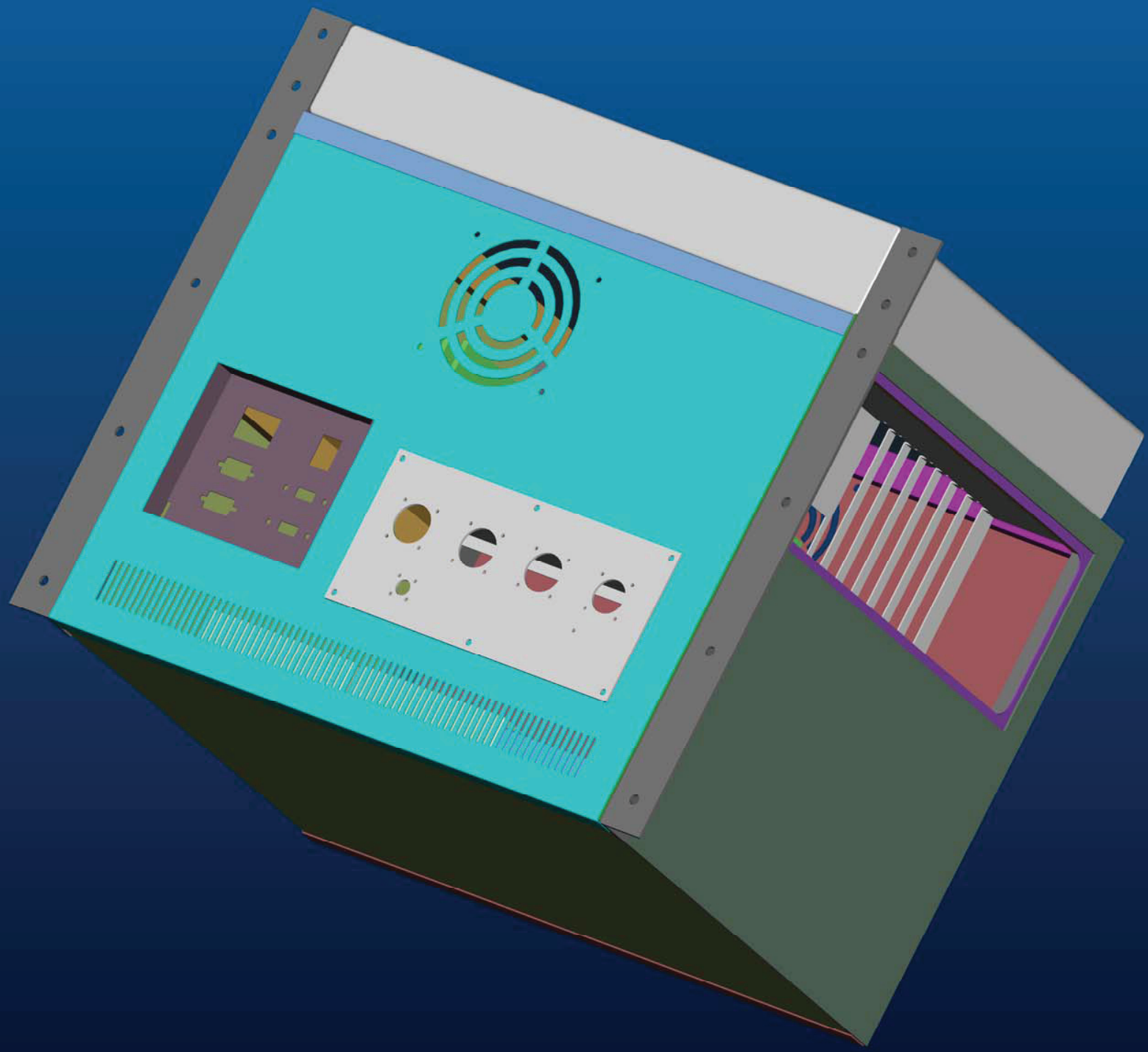
*Subject to TMS confirmation

[Note 10]

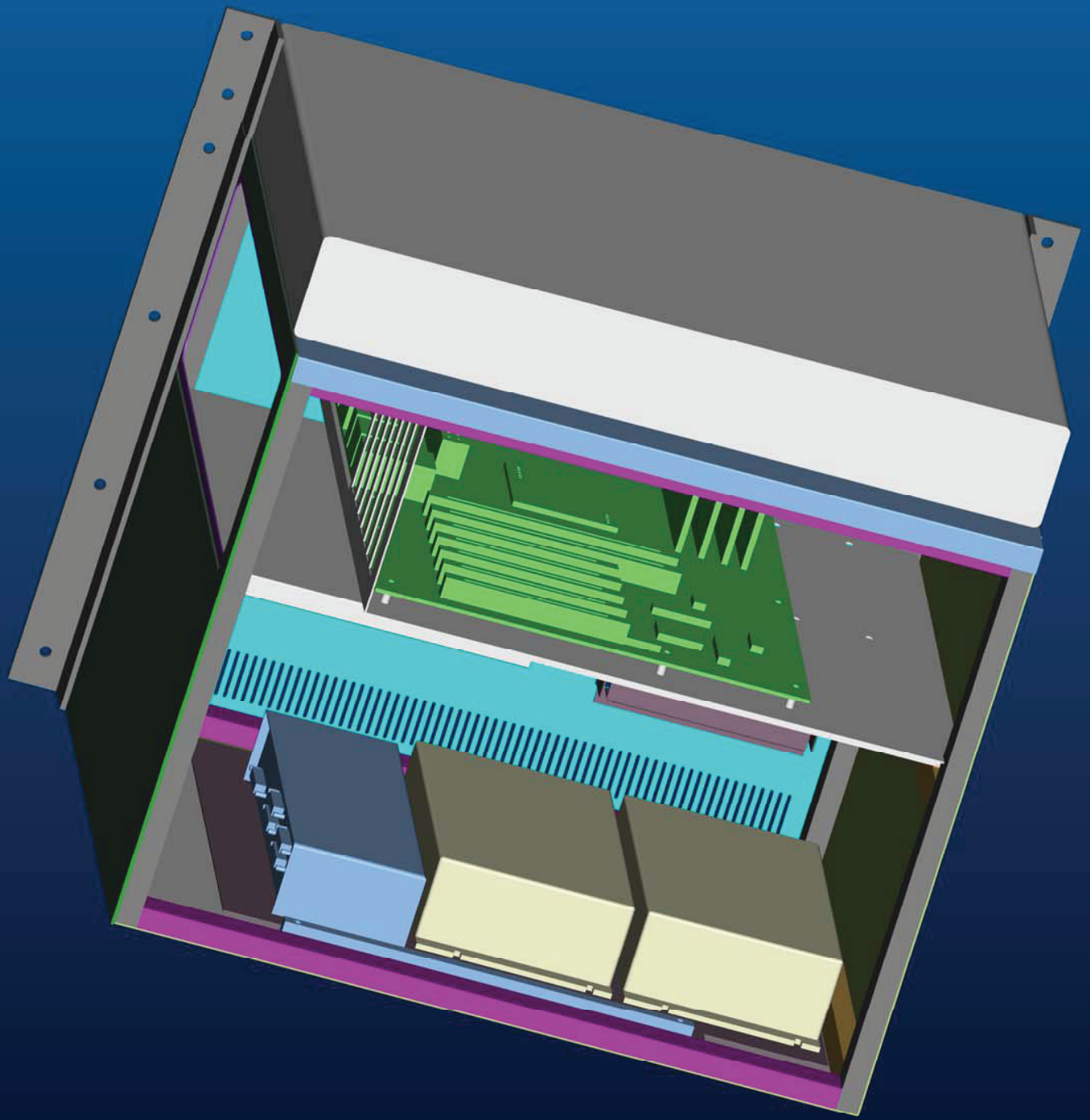
1- Active
2- Stand by

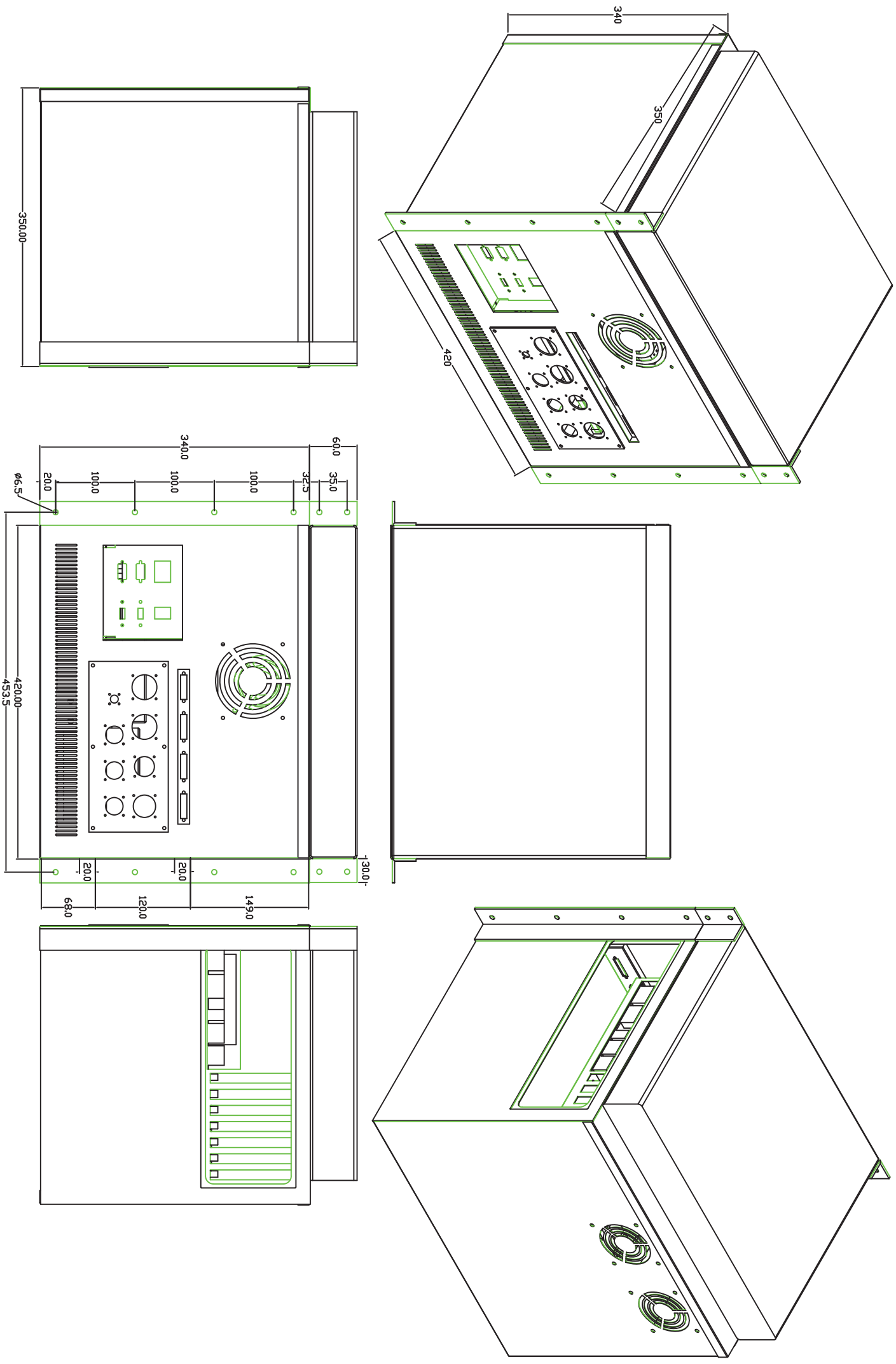

350.00
340.00
60.00
100.00
100.00
100.00
32.50
35.00
453.5
420

annex 4.1 Details of the EIDS server mounting drawing(including connector)

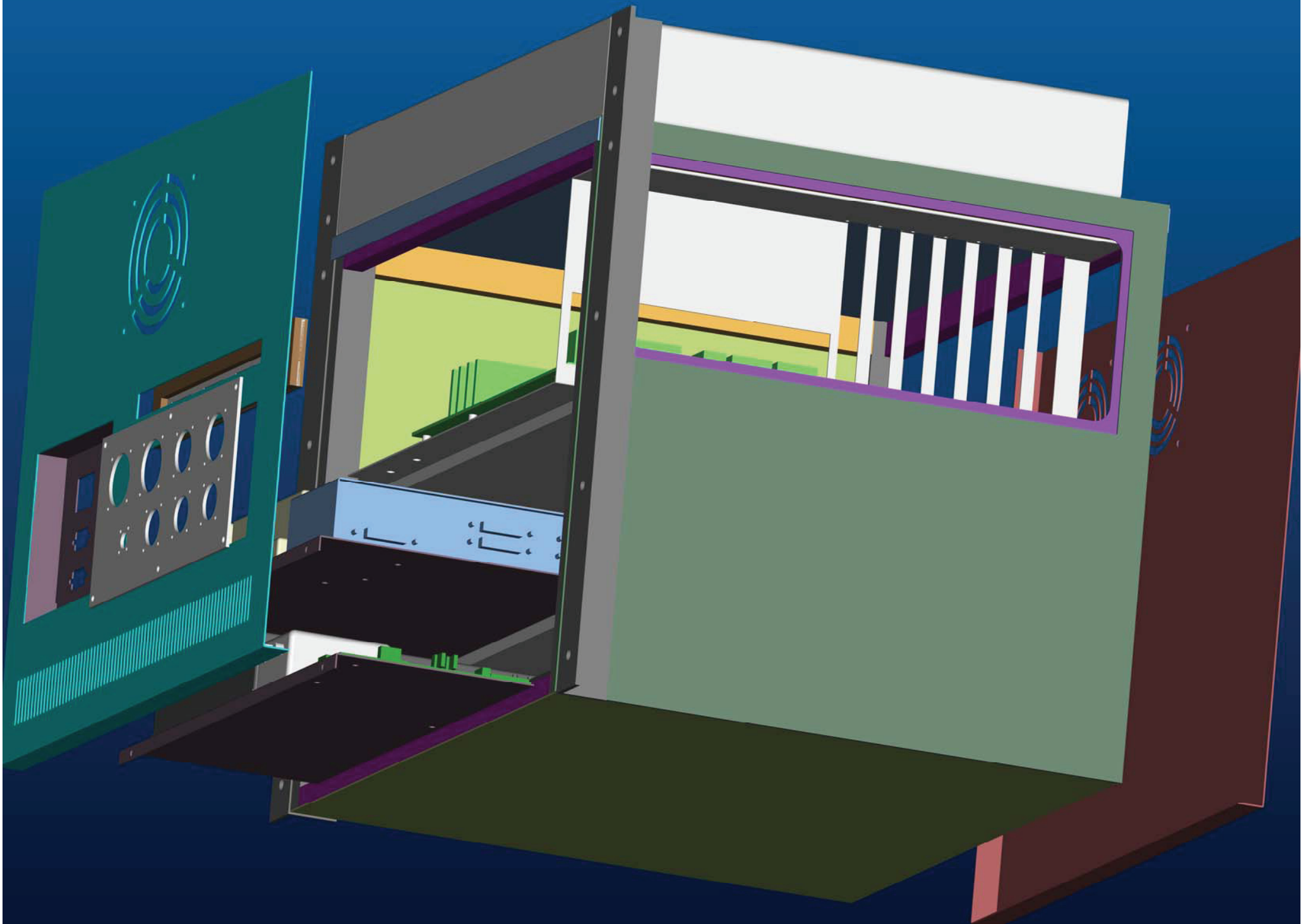


annex 4.1 Details of the EIDS server mounting drawing(including connector)

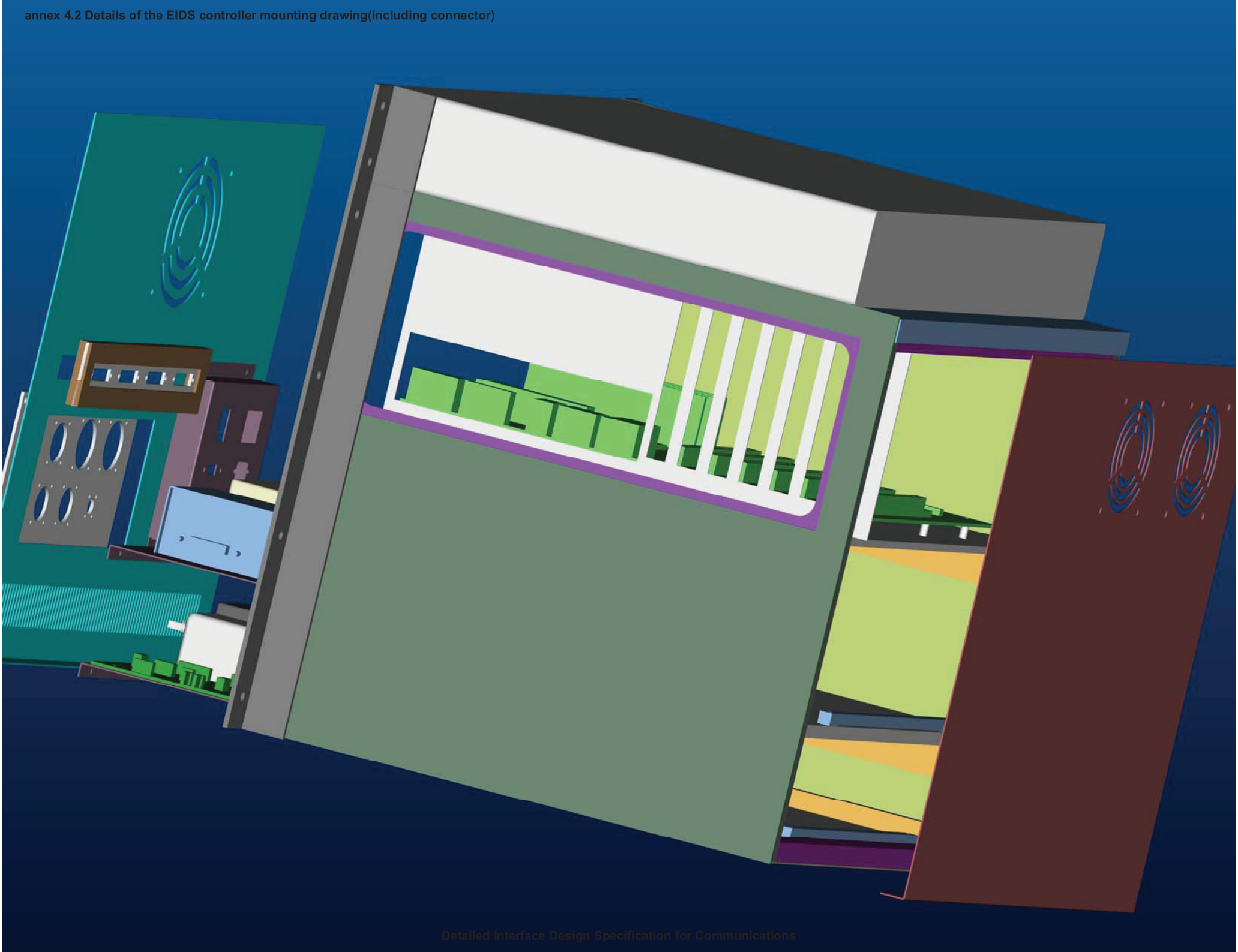



340
350
350.00
420
340.0
60.0
ø6.5
20.0
100.0
100.0
100.0
32.5
35.0
420.00
453.5
20.0
20.0
30.0
68.0
120.0
143.0

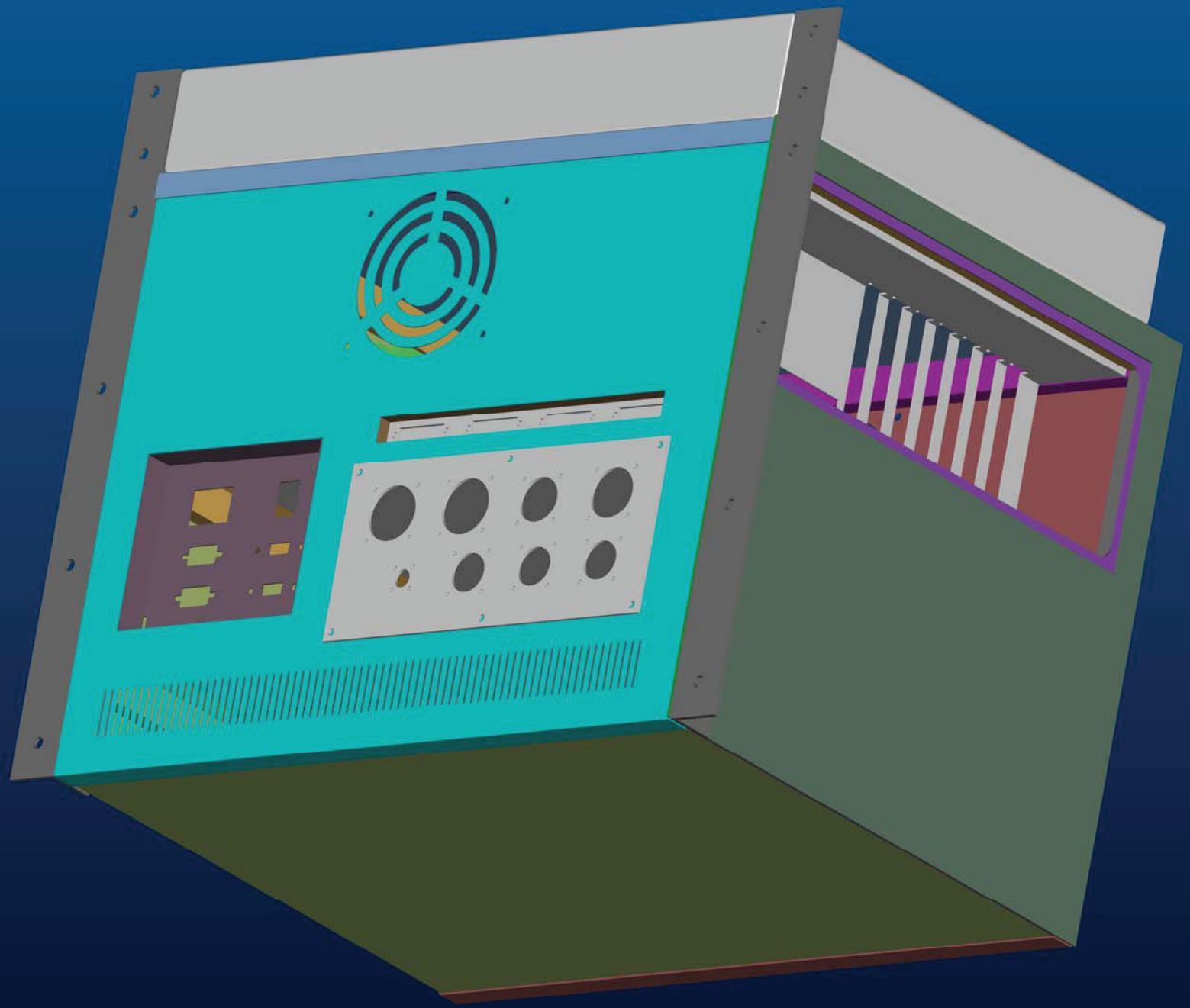
annex 4.2 Details of the EIDS controller mounting drawing(including connector)



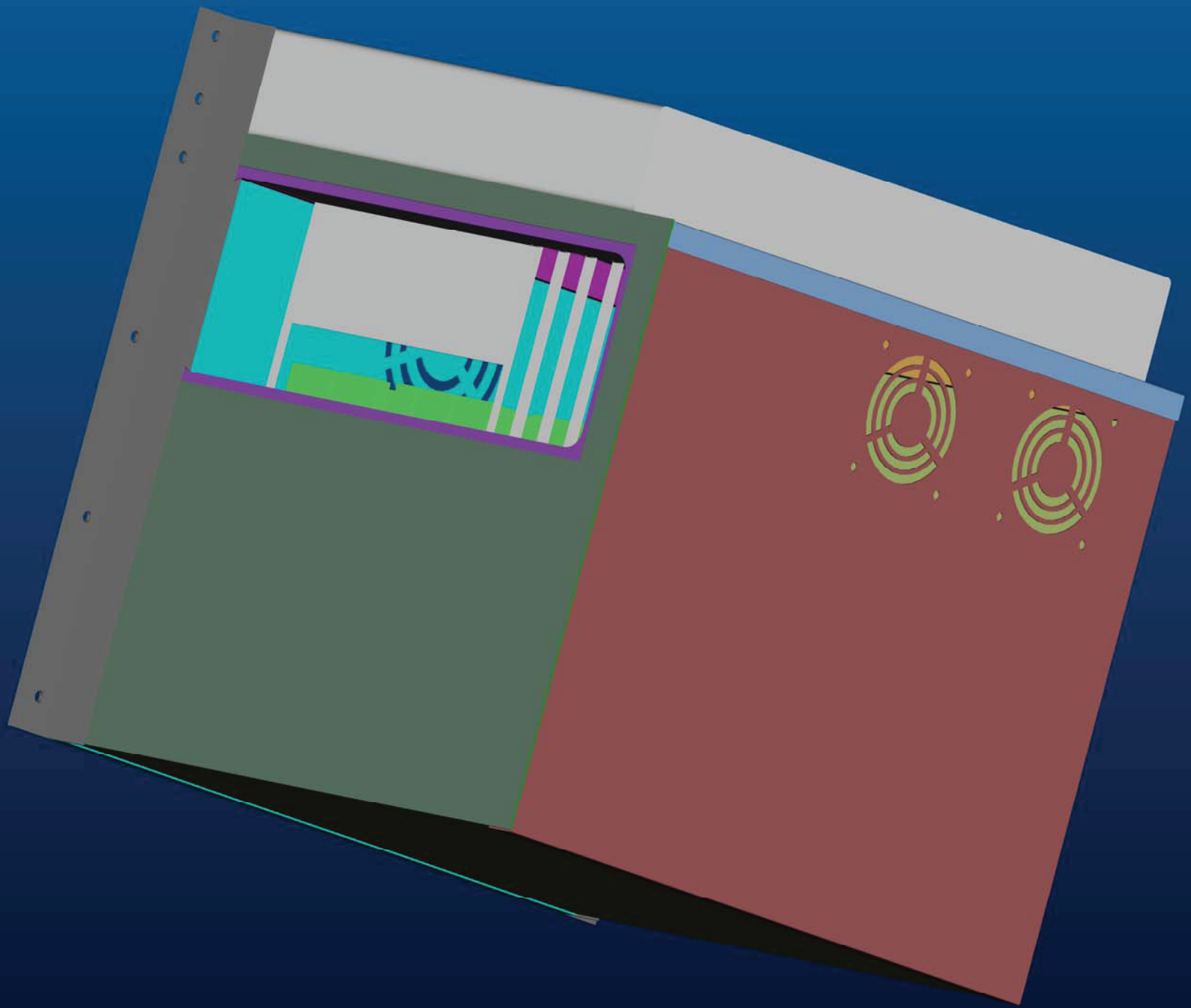
annex 4.2 Details of the EIDS controller mounting drawing(including connector)

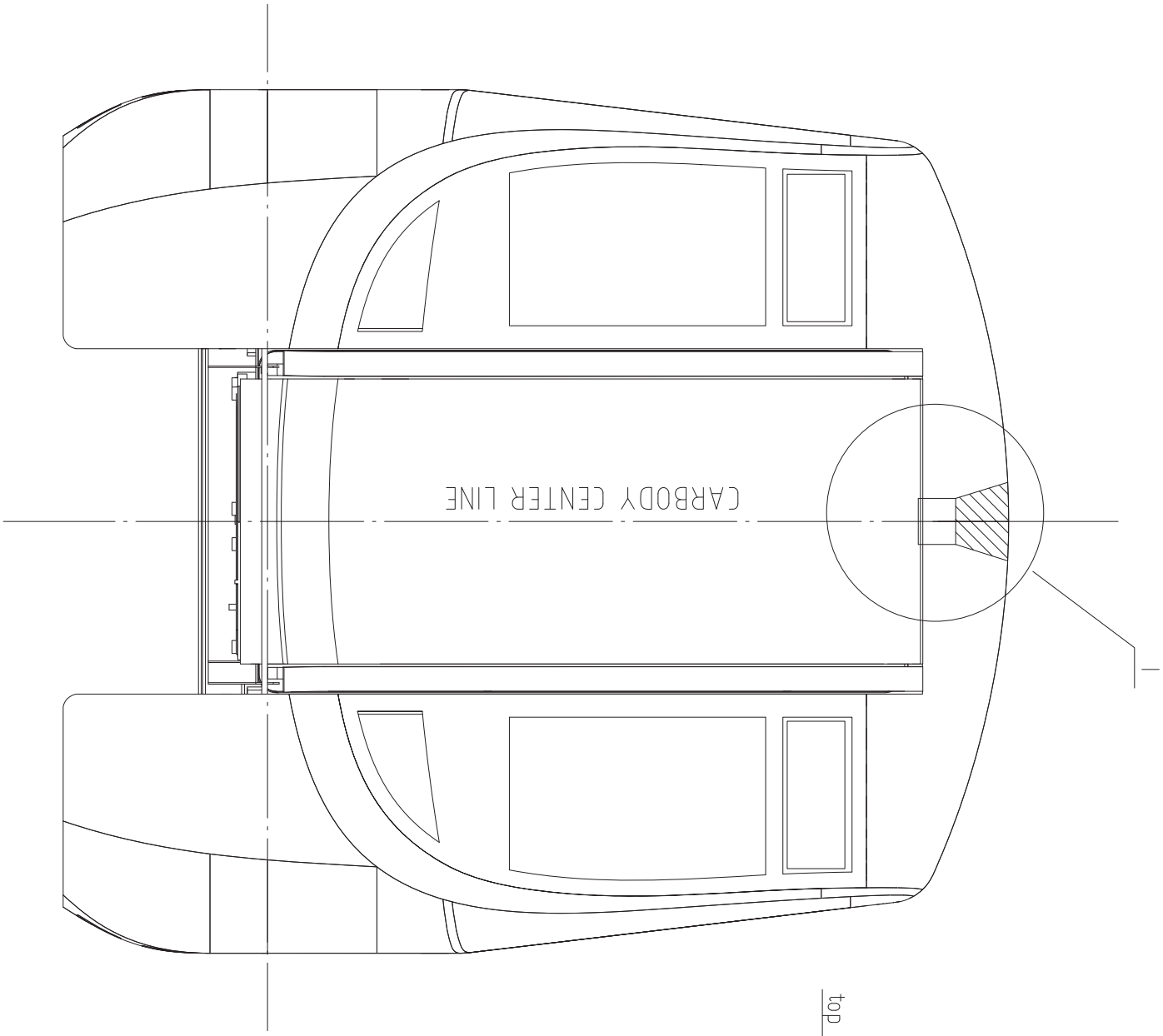


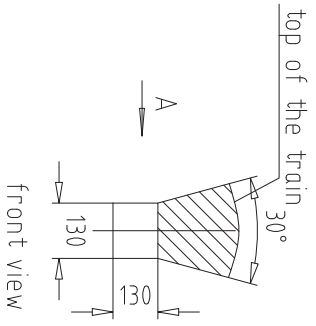
annex 4.2 Details of the EIDS controller mounting drawing(including connector)

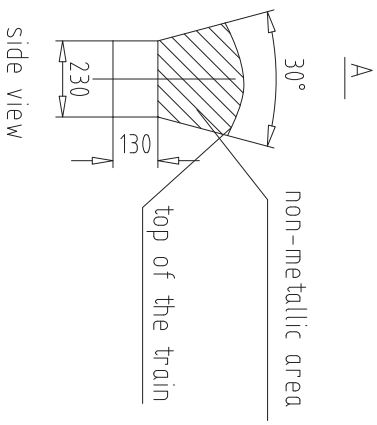


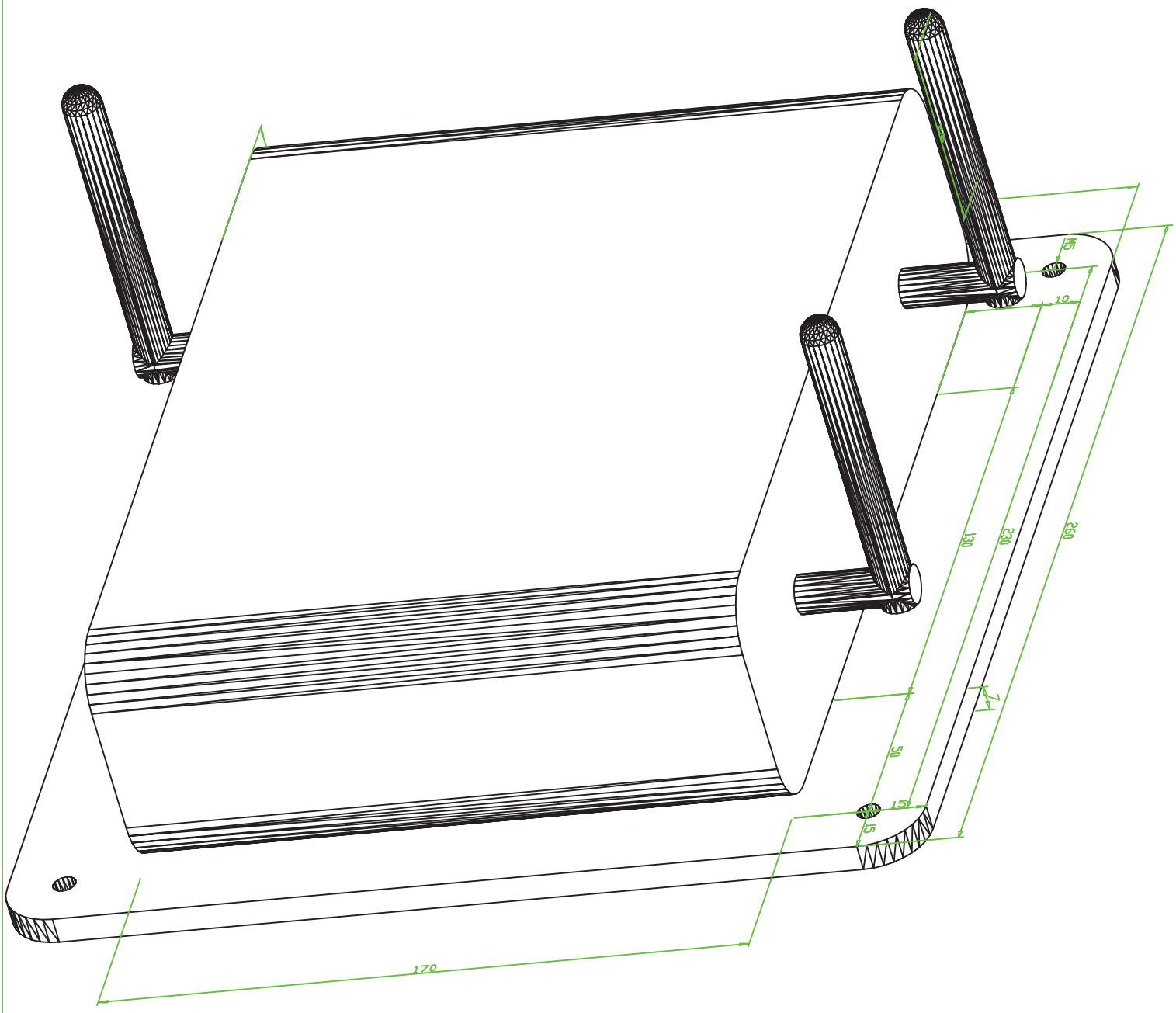
annex 4.2 Details of the EIDS controller mounting drawing(including connector)



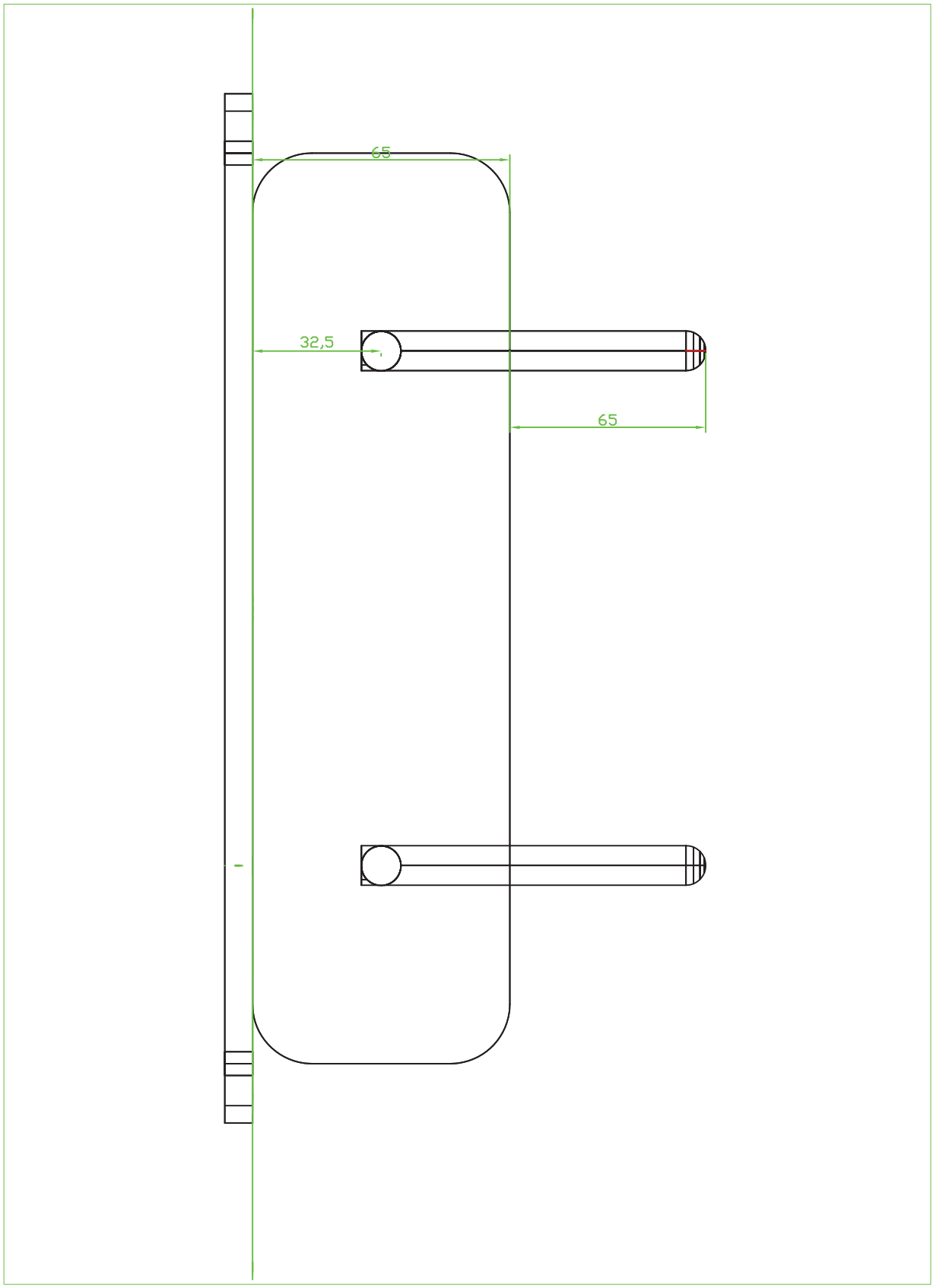

CARBODY CENTER LINE
I


top of the train
A
front view
130
130
30°
I

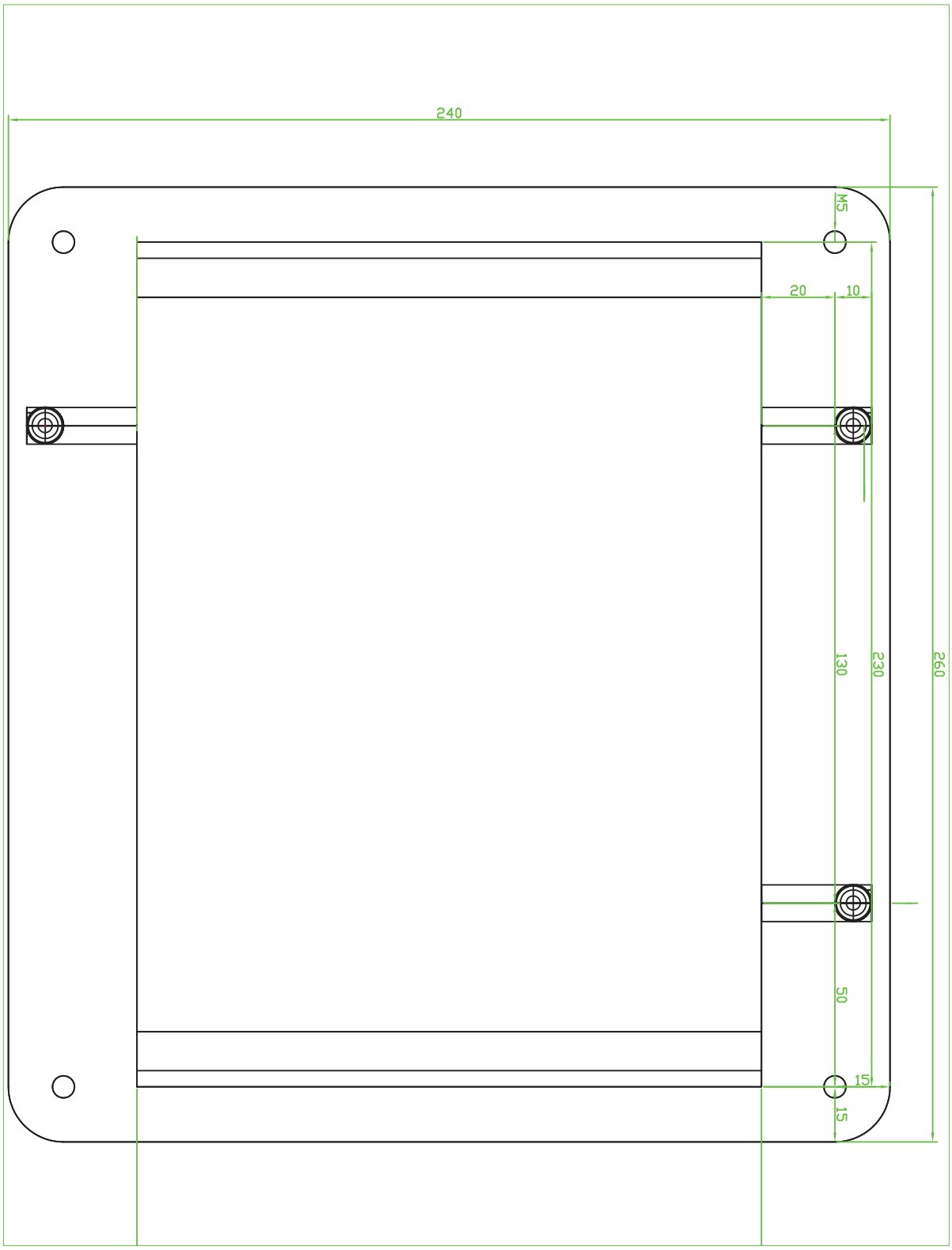

side view
230
130
30°
A
top of the train
non-metallic area

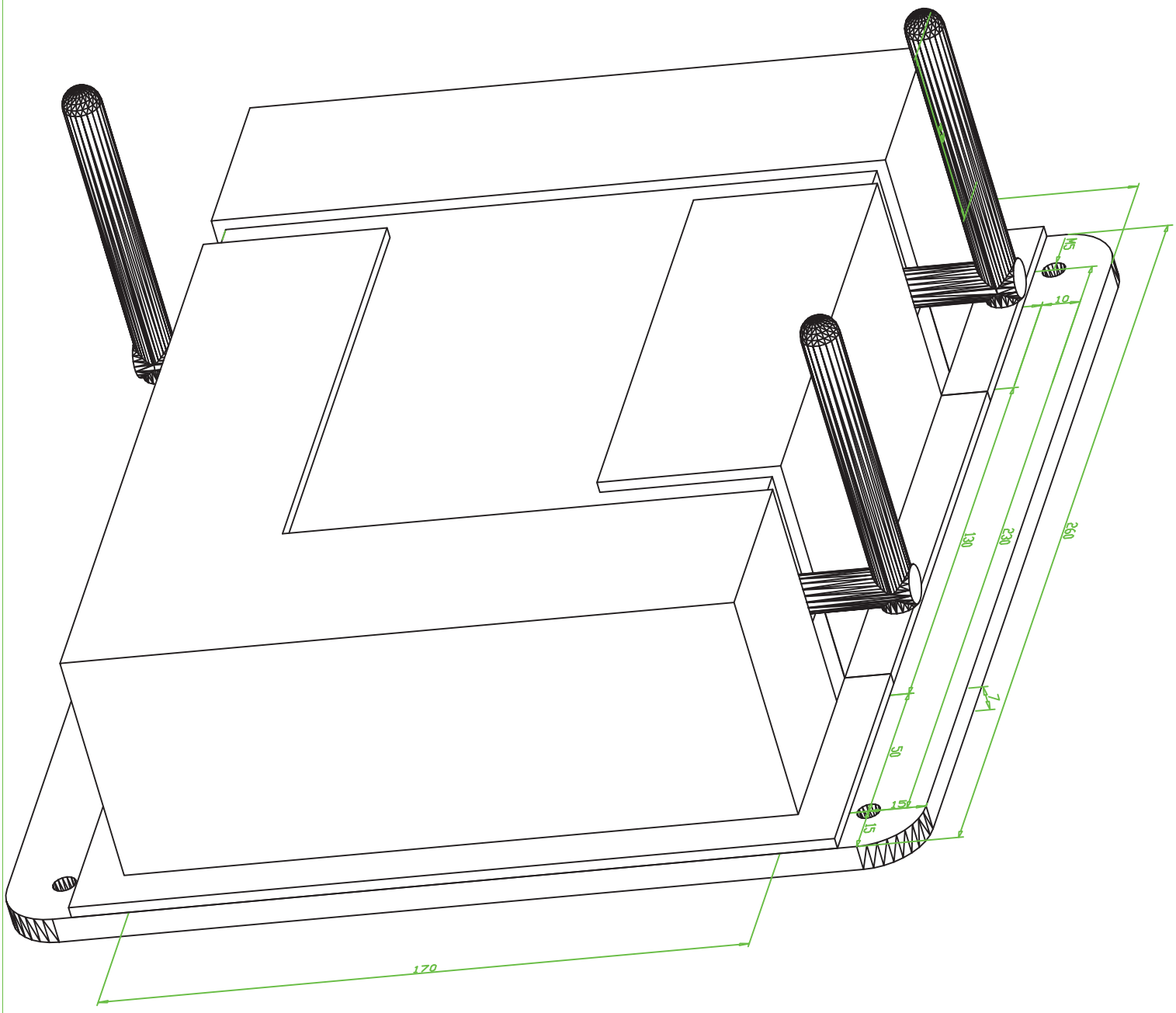

35
10
130
230
260
50
15
15
170

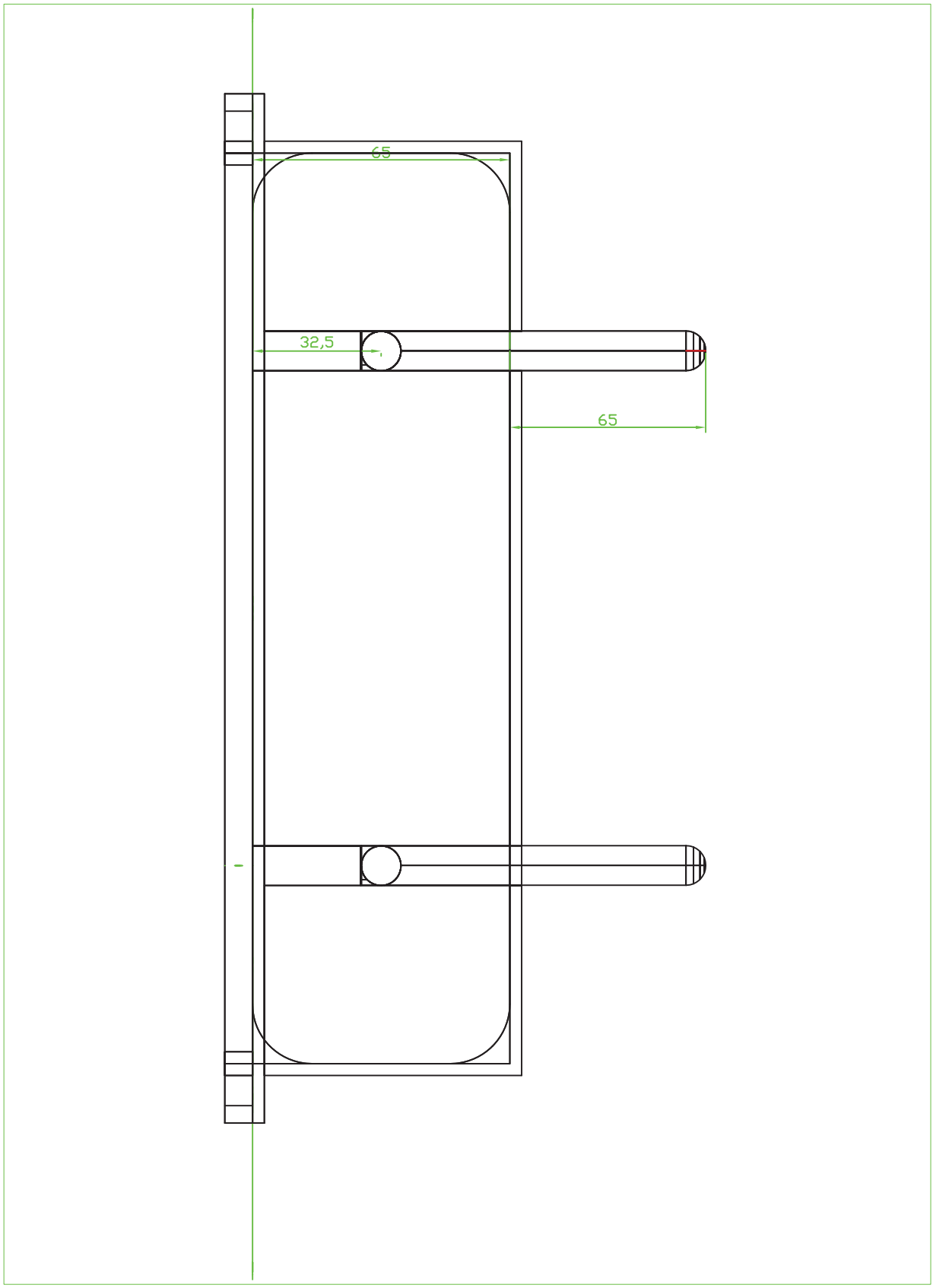
annex 4.4 Agreed mounting drawing of the antenna on the driving cab



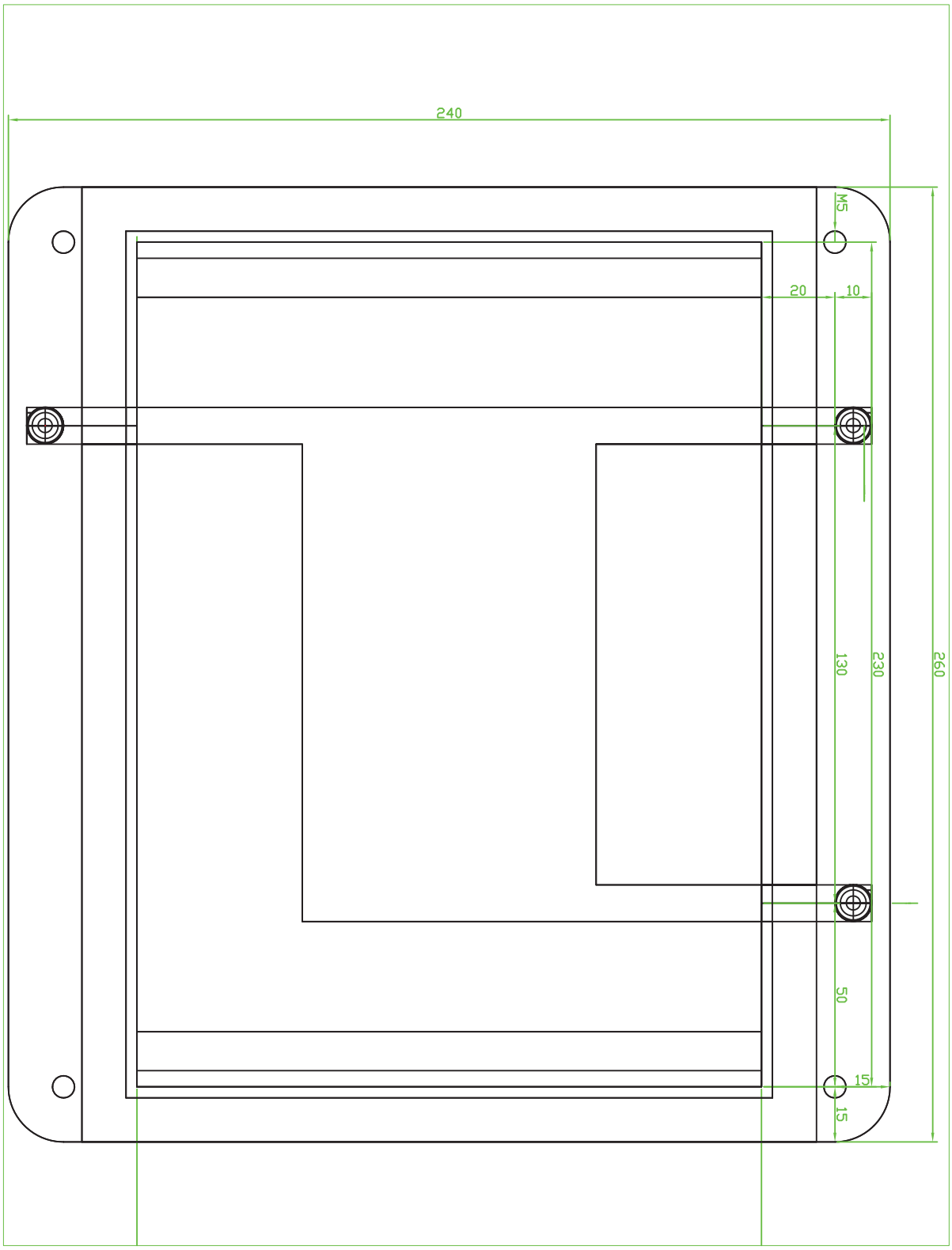
annex 4.4 Agreed mounting drawing of the antenna on the driving cab




35
10
130
230
260
7
50
15
15
170


65
32,5
65

annex 4.4 Agreed mounting drawing of the antenna on the driving cab



TOA

CEILING MOUNT SPEAKER PC-1869

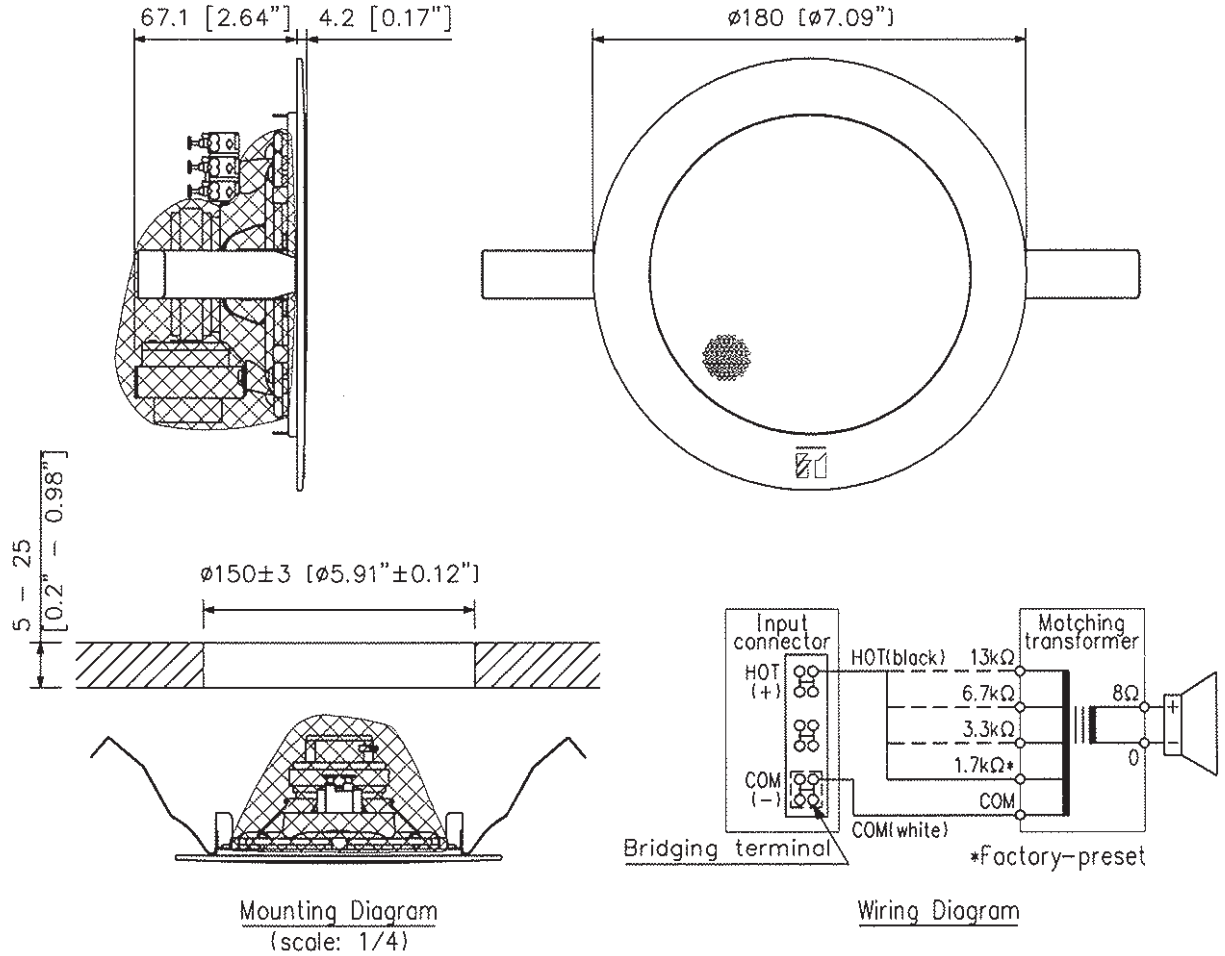
■DESCRIPTION

Integrated with a speaker unit and panel, the PC-1869 Ceiling Mount Speaker is of all metallic construction and ideal for use in a voice alarm system. It feature spring clamp mechanism for easy speaker mounting to the ceiling. The input impedance can be easily changed by changing the tap position of the transformer. The push-in type input terminal block makes cable connections easy and allows bridge wiring.

■SPECIFICATIONS

Rated Input	6 W (100 V line), 3 W (70 V line)
Rated Impedance	100 V line: 1.7 kΩ (6 W), 3.3 kΩ (3 W), 6.7 kΩ (1.5 W), 13 kΩ (0.8 W) 70 V line: 1.7 kΩ (3 W), 3.3 kΩ (1.5 W), 6.7 kΩ (0.8 W), 13 kΩ (0.4 W)
Sensitivity	90 dB (1 W, 1 m) (500 – 5,000 Hz, pink noise)
Frequency Response	55 – 18,000 Hz (peak –20 dB)
Speaker Component	12 cm (5") cone-type
Dimensions for Fixing Hole	Mounting hole: ø150±3 mm (ø5.91"±0.12") Ceiling thickness: 5 – 25 mm (0.2" – 0.98")
Speaker Mounting Method	Spring clamp
Applicable Cable	600 V vinyl-insulated cable (IV wire or HIV wire) Solid copper wire: ø0.8 – ø1.6 mm (equivalent to AWG 20 – 14) 7-core twisted copper wire: 0.75 – 1.25 mm² (equivalent to AWG 18 – 16)
Connection	Push-in connector (bridging terminal-2 branch type)
Finish	Baffle: Steel plate, off-white (RAL 9010 or equivalent color), paint Grille: Surface-treated steel plate net, off-white (RAL 9010 or equivalent color), paint
Dimensions	ø180 × 72 (D) mm (ø7.09" × 2.83")
Weight	620 g (1.37 lb)
Accessory	Paper pattern ···1

■APPEARANCE



Mounting Diagram (scale: 1/4)

Wiring Diagram

UNIT: mm SCALE: 1/3

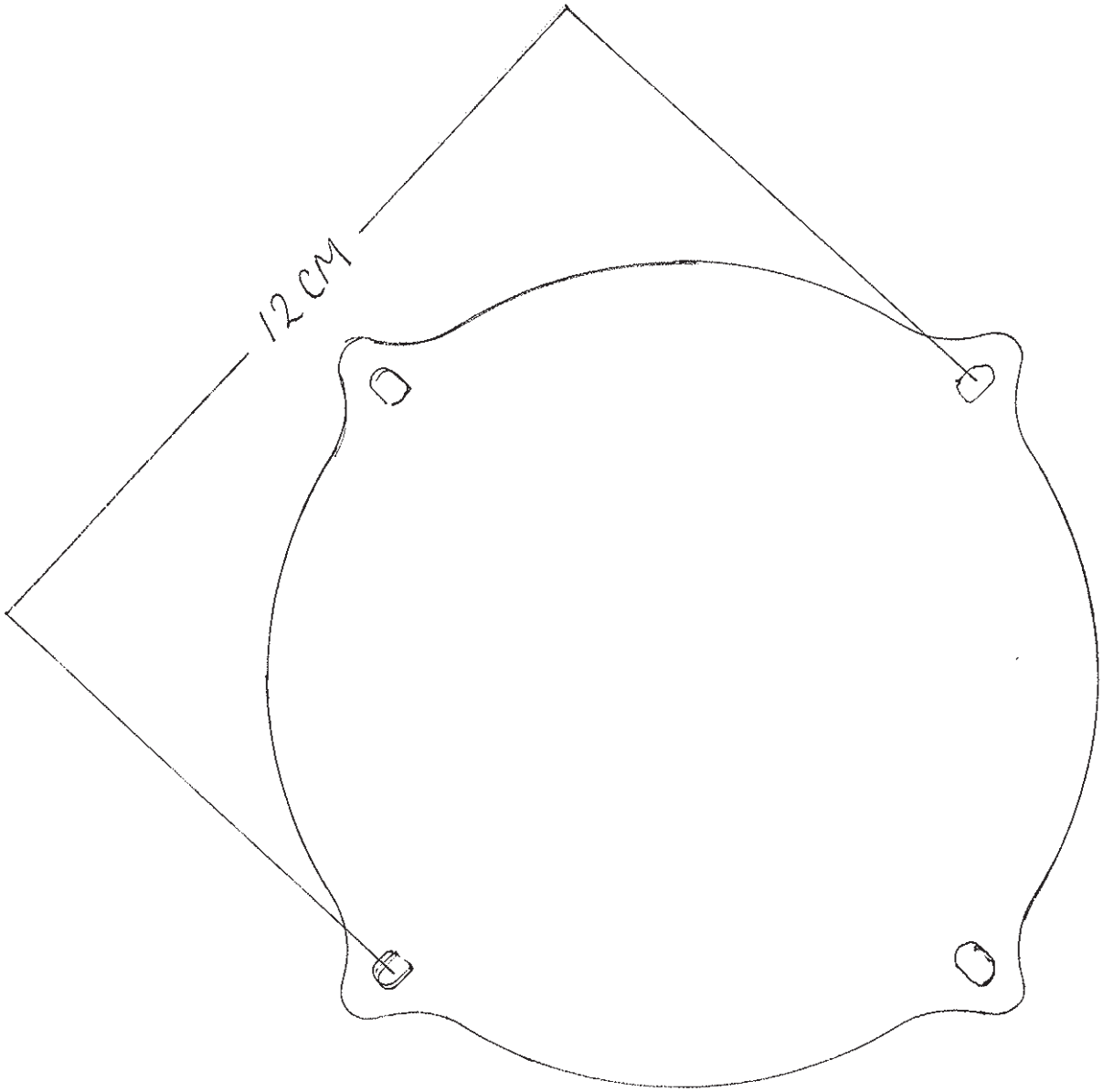
07D

TOA Corporation

DWG No: GPC02PA1

ELEPHANT HOLDINGS LIMITED

Exact Dimensions of PC-1869 Speaker Unit for your Information



C6014 and EIDS Interfacing Contractor Interface Agreement Table

System Provided by	DVAS input								110V DC Power Input			Reset button in driving cab			Zero Speed Dry Contact		
	C6014								C6014			EIDS Interfacing Contractor			C6014		
	DVAS interface in EIDS Server								Power Interface in EIDS Server			Reset Button Interface in EIDS Server			Zero Speed Interface in EIDS Server		
	EIDS Interfacing Contractor								EIDS Interfacing Contractor			EIDS Interfacing Contractor			EIDS Interfacing Contractor		
Cable ID	A								C			D			E		
Cable type	3 core twisted pair Screen cable								1 core cable x2 (One pair of power cable)			2 core Screen cable			2 core Screen cable		
Cable supplied by	EIDS Interfacing Contractor								EIDS Interfacing Contractor			EIDS Interfacing Contractor			EIDS Interfacing Contractor		
Cable specification	Provided by EIDS Interfacing Contractor								Provided by EIDS Interfacing Contractor			Provided by EIDS Interfacing Contractor			Provided by EIDS Interfacing Contractor		
Connector ID	*A1*	*A1'*	*CN2'*	*CN2*					*Circuit breaker*	*CN1'*	*CN1*	*Reset button*	*CN3'*	*CN3*	*Z*	*CN3'*	*CN3*
Connector type	*DB-9 (M)*	*DB-9 (F)*	*UTG-6/16/19P (M)*	*UTG0/16/19S (F)*					*Circuit breaker*	*UTG-6/14/12S (F)*	*UTG0/14/12P (M)*	*Reset button*	*UTG-6/16/19S (F)*	*UTG0/16/19P (M)*	*Provided by C6014*	*UTG-6/16/19S (F)*	*UTG0/16/19P (M)*
Connect or supplied by	C6014	EIDS Interfacing Contractor							C6014	EIDS Interfacing Contractor		EIDS Interfacing Contractor			C6014	EIDS Interfacing Contractor	

Connection for system provided by	**110V DC Pan/down Input**		
	C6014		
	110VDC Pan up/down interface in EIDS Server		
	EIDS Interfacing Contractor		
Cable ID	H		
Cable type	1 core cable x2 (One pair of power cable)		
Cable supplied by	EIDS Interfacing Contractor		
Cable specification	Provided by EIDS Interfacing Contractor		
Connector ID	*110V DC*	*CN1'*	*CN1*
Connector/Relay type	*Provided by C6014*	*UTG-6/14/12S (F)*	*UTG0/14/12P (M)*
Connect or supplied by	C6014	EIDS Interfacing Contractor	

EIDS Controller (EIDS Interfacing Contractor) and LCD Monitor (C6014) Interface Agreement Table

Connection for system provided by	**EIDS Controller LCD Display Interface**				**EIDS Controller LCD Display Interface**				**EIDS Controller LCD Power Interface**				**DVI Booster (D1, D2 & D3)**				**EIDS Controller LCD Signal Interface**			
	EIDS Interfacing Contractor				EIDS Interfacing Contractor				EIDS Interfacing Contractor				EIDS Interfacing Contractor				EIDS Interfacing Contractor			
	LCD Monitor 1				**DVI Booster (D1, D2 and D3)**				**DVI Booster (D1, D2 and D3)**				**LCD Monitor 2, 3 & 4**				**LCD Monitor 1, 2, 3 &4**			
	C6**014**				EIDS Interfacing Contractor				EIDS Interfacing Contractor				C6**014**				C6014			
Cable ID	I				I				K				I				J			
Cable type	DVI Cable				DVI Cable				1 core cable x6 (Three pairs of power cable)				DVI Cable				RS 485 Cable			
Cable supplied by	EIDS Interfacing Contractor				EIDS Interfacing Contractor				EIDS Interfacing Contractor				EIDS Interfacing Contractor				C6014			
Cable specification	Provided by EIDS Interfacing Contractor				Provided by EIDS Interfacing Contractor				Provided by EIDS Interfacing Contractor				Provided by C6014				Provided by C6014			
Connector ID	*CN1*	*CN1'*	*L1'*	*L1*	*CN2/ CN3/ CN4*	*CN2'/ CN3'/ CN4'*	*D1'/D2'/ D3'*	*D1/D2/ D3*	*CN7*	*CN7'*	*P1'/P2'/ P3'*	*P1/P2/ P3*	*O1/O2/ O3*	*O1'/O2' /O3'*	*L2'/L3'/ L4'*	*L2/L3/L 4*	*CN6*	*CN6'*	*R1'/R2' /R3'/R4 ,*	*R1/R2/ R3/R4*
Connector/Relay type	*DVI-D (F)*	*DVI-D (M)*	*DVI-D (M)*	*DVI-D (F)*	*DVI-D (F)*	*DVI-D (M)*	*DVI-D (M)*	*DVI-D (F)*	*UTG0/16/ 19S (F)*	*UTG-6/16/19P (M)*	**DC Power Jack (F)*	**DC Power Jack (M)*	*DVI-D (F)*	*DVI-D (M)*	*DVI-D (M)*	*DVI-D (F)*	*UTG0/ 18/23S (F)*	*UTG-6/18/23P (M)*	*Provided by C6014*	*Provided by C6014*
Connect or supplied by	EIDS Interfacing Contractor			C6014	EIDS Interfacing Contractor				EIDS Interfacing Contractor				EIDS Interfacing Contractor			C6014	EIDS Interfacing Contractor		C6014	

*Note: The DC power jack connector will be delivered with the cable to C6014 for installation.

EIDS Controller (EIDS Interfacing Contractor) and 110V DC Power (C6014) Interface Agreement Table

Connection for system provided by	**110V DC Power Input from D1**		
	C6014		
	Power Interface in EIDS Controller		
	EIDS Interfacing Contractor		
Cable ID	M		
Cable type	1 core cable x2 (One pair of power cable)		
Cable supplied by	EIDS Interfacing Contractor		
Cable specification	Provided by EIDS Interfacing Contractor		
Connector ID	*Circuit breaker*	*CN8'*	*CN8*
Connector type	*Circuit breaker*	*UTG-6/14/12S (F)*	*UTG0/14/12P (M)*
Connect or supplied by	C6014	EIDS Interfacing Contractor	

EIDS Interfacing Contractor Internal Cat5e Cables Interface Agreement Table For A-car:

Connection for system provided by	**EIDS Server UTP Interface**				**Wireless Router(AP) UTP Interface**				**EIDS Controller UTP Interface**				**Wireless Interface for b/g Maintenance PC download**	
	EIDS Server (EIDS Interfacing Contractor)				EIDS Interfacing Contractor				EIDS Server (EIDS Interfacing Contractor)				EIDS Server (EIDS Interfacing Contractor)	
	EIDS Controller UTP Interface				**EIDS Server UTP Interface**				**Next Car EIDS Controller UTP Interface (*by Gangway Copular LAN Interface) Note: Car to Car Lan connection to be provided by C6014**				**External Antenna**	
	EIDS Controller (EIDS Interfacing Contractor)				EIDS Server (EIDS Interfacing Contractor)				EIDS Controller (EIDS Interfacing Contractor)				EIDS Server (EIDS Interfacing Contractor)	
Cable ID	G				G				G				P	
Cable type	8 core twister pair screen cable (Cat5e cable)				8 core twister pair screen cable (Cat5e cable)				8 core twister pair screen cable (Cat5e cable)				Antenna Cable	
Cable supplied by	EIDS Interfacing Contractor				EIDS Interfacing Contractor				EIDS Interfacing Contractor				EIDS Interfacing Contractor	
Cable specification	Provided by EIDS Interfacing Contractor				Provided by EIDS Interfacing Contractor				Provided by EIDS Interfacing Contractor				Antenna Cable	
Connector ID	*CN4*	*CN4'*	*CN5'*	*CN5*	*P*	*P'*	*CN4'*	*CN4*	*CN11*	*CN11'*	*Provided by C6014*	*Provided by C6014*	*CN5'*	*CN5*
Connector/Relay type	*UTG0/22/35S (F)*	*UTG-6/22/35P (M)*	*UTG-6/20/28P (M)*	*UTG0/20/28S (F)*	*RJ-45 (F)*	*RJ-45 (M)*	*UTG-6/22/35P (M)*	*UTG0/22/35S (F)*	*UTG0/20/28P (M)*	*UTG-6/20/28S (F)*	*Provided by C6014*	*Provided by C6014*	*SMA (M)*	*SMA (F)*
Connect or supplied by	EIDS Server		EIDS Controller		Wireless AP		EIDS Server		C6560 (First Car EIDS Controller)		*C6014*		EIDS Interfacing Contractor (Antenna)	EIDS Server

For B/C Car

<table>
<tr><td rowspan="3">Connection for system provided by</td><td colspan="4">Previous Car EIDS Controller UTP
(from Gangway Copular LAN Interface)</td><td colspan="4">EIDS Controller UTP Interface</td></tr>
<tr><td colspan="4">*Gangway Coupler LAN Interface (C6014)
* Note: Car to Car Lan connection to be provided by C6014</td><td colspan="4">EIDS Controller (EIDS Interfacing Contractor)</td></tr>
<tr><td colspan="4">EIDS Controller UTP Interface</td><td colspan="4">Next Car EIDS Controller UTP Interface (*by Gangway Copular LAN Interface)
* Note: Car to Car Lan connection to be provided by C6014</td></tr>
<tr><td>Cable ID</td><td colspan="4">G</td><td colspan="4">G</td></tr>
<tr><td>Cable type</td><td colspan="4">8 core twister pair screen cable (Cat5e cable)</td><td colspan="4">8 core twister pair screen cable (Cat5e cable)</td></tr>
<tr><td>Cable supplied by</td><td colspan="4">EIDS Interfacing Contractor</td><td colspan="4">EIDS Interfacing Contractor</td></tr>
<tr><td>Cable specification</td><td colspan="4">Provided by EIDS Interfacing Contractor</td><td colspan="4">Provided by EIDS Interfacing Contractor</td></tr>
<tr><td>Connector ID</td><td>Provided by C6014</td><td>Provided by C6014</td><td>CN5’</td><td>CN5</td><td>CN11</td><td>CN11’</td><td>Provided by C6014</td><td>Provided by C6014</td></tr>
<tr><td>Connector/Relay type</td><td>Provided by C6014</td><td>Provided by C6014</td><td>UTG-6/20/28P (M)</td><td>UTG0/20/28S (F)</td><td>UTG0/20/28P (M)</td><td>UTG-6/20/28S (F)</td><td>Provided by C6014</td><td>Provided by C6014</td></tr>
<tr><td>Connect or supplied by</td><td colspan="2">C6014</td><td colspan="2">EIDS Controller</td><td colspan="2">EIDS Controller</td><td colspan="2">C6014</td></tr>
</table>

EIDS Controller (EIDS Interfacing Contractor) and Audio Amplifier (EIDS Interfacing Contractor) Interface Agreement Table

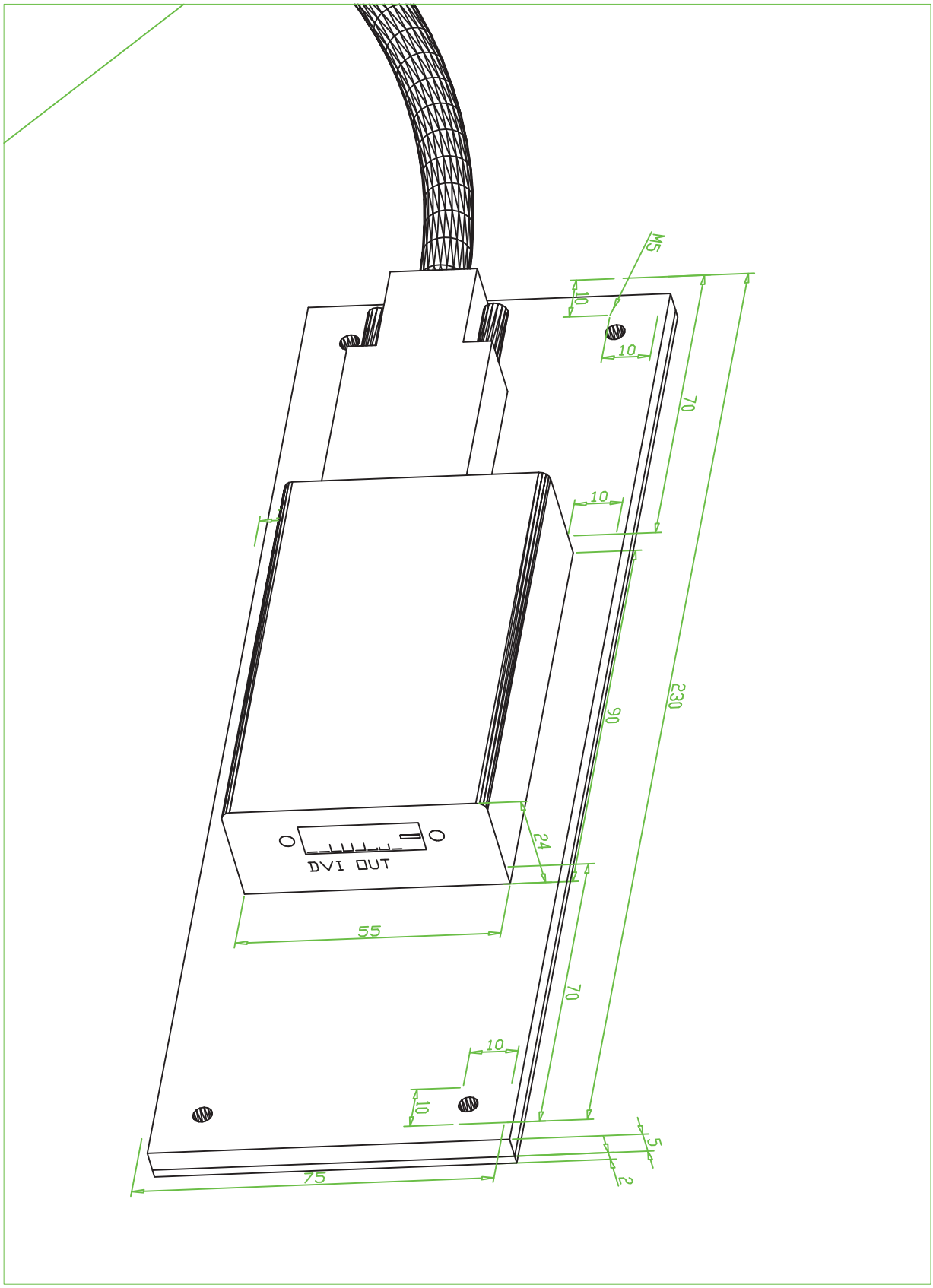
Connection for system provided by	**EIDS Controller Audio Amplifier Interface**				**EIDS Controller Loudspeaker Interface**			
	EIDS Interfacing Contractor				EIDS Interfacing Contractor			
	Audio Amplifier				**Audio Amplifier**			
	EIDS Interfacing Contractor				EIDS Interfacing Contractor			
Cable ID	M				L			
Cable type	1 core cable x2 (One pair of power cable)				2 core twisted pair Screen cable (Audio cable)			
Cable supplied by	EIDS Interfacing Contractor				EIDS Interfacing Contractor			
Cable specification	Provided by EIDS Interfacing Contractor				Provided by EIDS Interfacing Contractor			
Connector ID	*CN10*	*CN10'*	*CN4'*	*CN4*	*CN9*	*CN9'*	*CN3'*	*CN3*
Connector/terminal type	*UTG0/14/12S (F)*	*UTG-6/14/12P (M)*	*UTG6/12/8S (F)*	*UTG0/12/8P (M)*	*UTG0/14/12S (F)*	*UTG-6/14/12P (M)*	*UTG6/12/8P (M)*	*UTG0/12/8S (F)*
Connect or supplied by	EIDS Interfacing Contractor(EIDS Controller)		EIDS Interfacing Contractor (Audio Amplifier)		EIDS Interfacing Contractor(EIDS Controller)		EIDS Interfacing Contractor(Audio Amplifier)	

Driving Cab Wireless Access Point and EIDS Server 12V DC Power Interface Table

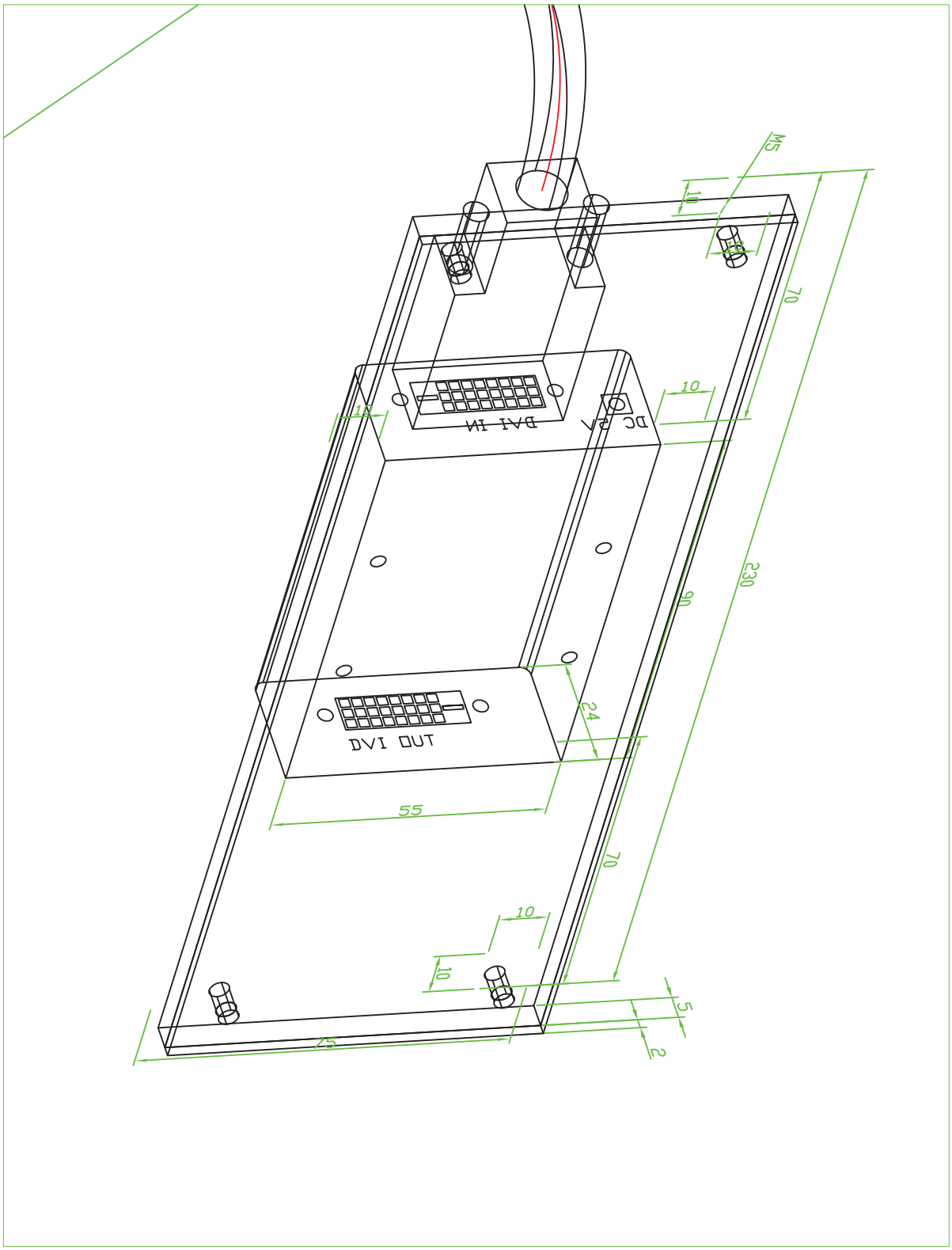
Connection for system provided by	**12V DC Power Output from EIDS Server**			
	EIDS Interfacing Contractor			
	Power Interface in Access Point			
	EIDS Interfacing Contractor			
Cable ID	F			
Cable type	One pair of power cable			
Cable supplied by	EIDS Interfacing Contractor			
Cable specification	Provided by EIDS Interfacing Contractor			
Connector ID	*CN4'*	*CN4*	*S'*	*S*
Connector type	*UTG-6/22/35P (M)*	*UTG0/22/35S (F)*	*Power Jack (F)*	*Power Jack (M)*
Connect or supplied by	EIDS Server		Wireless AP	

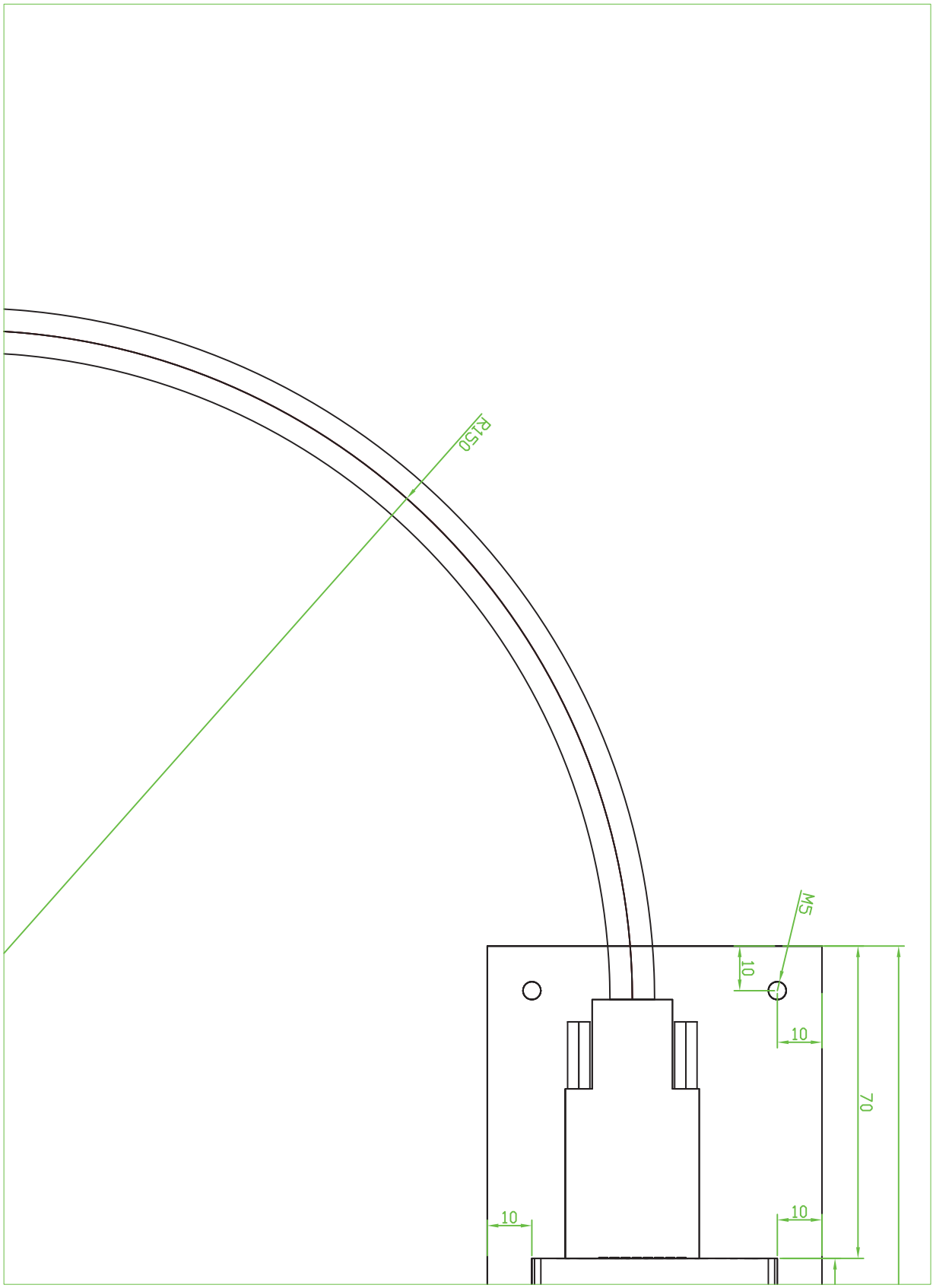
Audio Amplifier (EIDS Interfacing Contractor) and Loud Speaker (EIDS Interfacing Contractor) Interface Agreement Table

Connection for system provided by	**Audio Amplifier Loudspeaker Interface**			**Audio Amplifier Loudspeaker Interface**		
	EIDS Interfacing Contractor			EIDS Interfacing Contractor		
	Left Loudspeaker (x5)			**Right Loudspeaker (x5)**		
	EIDS Interfacing Contractor			EIDS Interfacing Contractor		
Cable ID	L			L		
Cable type	2 core twisted pair Screen cable (Audio cable)			2 core twisted pair Screen cable (Audio cable)		
Cable supplied by	EIDS Interfacing Contractor			EIDS Interfacing Contractor		
Cable specification	Provided by EIDS Interfacing Contractor			Provided by EIDS Interfacing Contractor		
Connector ID	*CN1*	*CN1'*	*S1*	*CN2*	*CN2'*	*S1*
Connector/terminal type	*UTG0/12/8S (F)*	*UTG-6/12/8P (M)*	*Terminal block in Loudspeaker*	*UTG0/12/8S (F)*	*UTG-6/12/8P (M)*	*Terminal block in Loudspeaker*
Connect or supplied by	EIDS Interfacing Contractor (Audio Amplifier)		EIDS Interfacing Contractor (loudspeaker)	EIDS Interfacing Contractor (Audio Amplifier)		EIDS Interfacing Contractor (Loudspeaker)

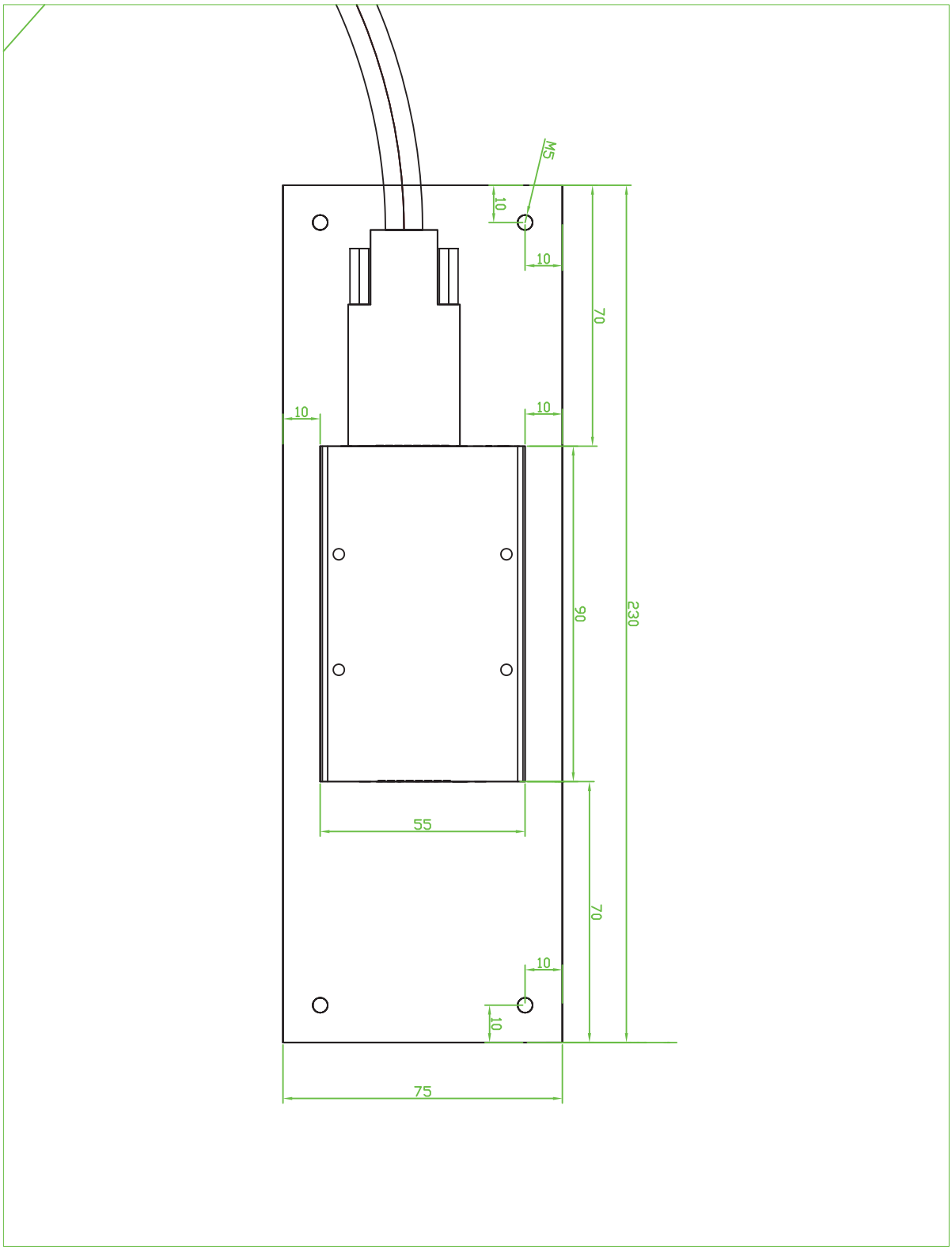

M5
10
10
70
10
230
90
24
DVI OUT
55
70
10
10
5
2
75

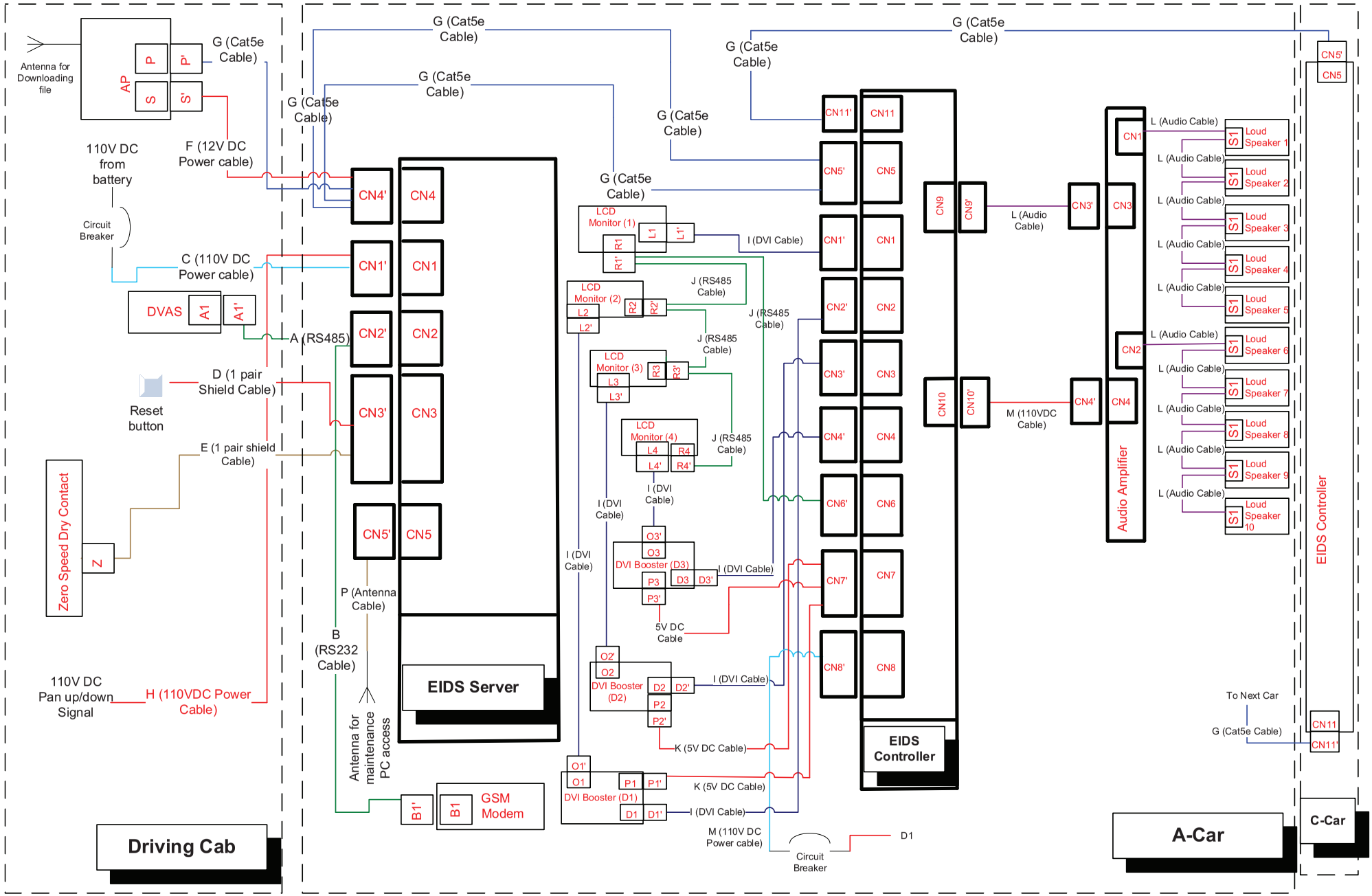
annex 4.7 Booster mounting drawing



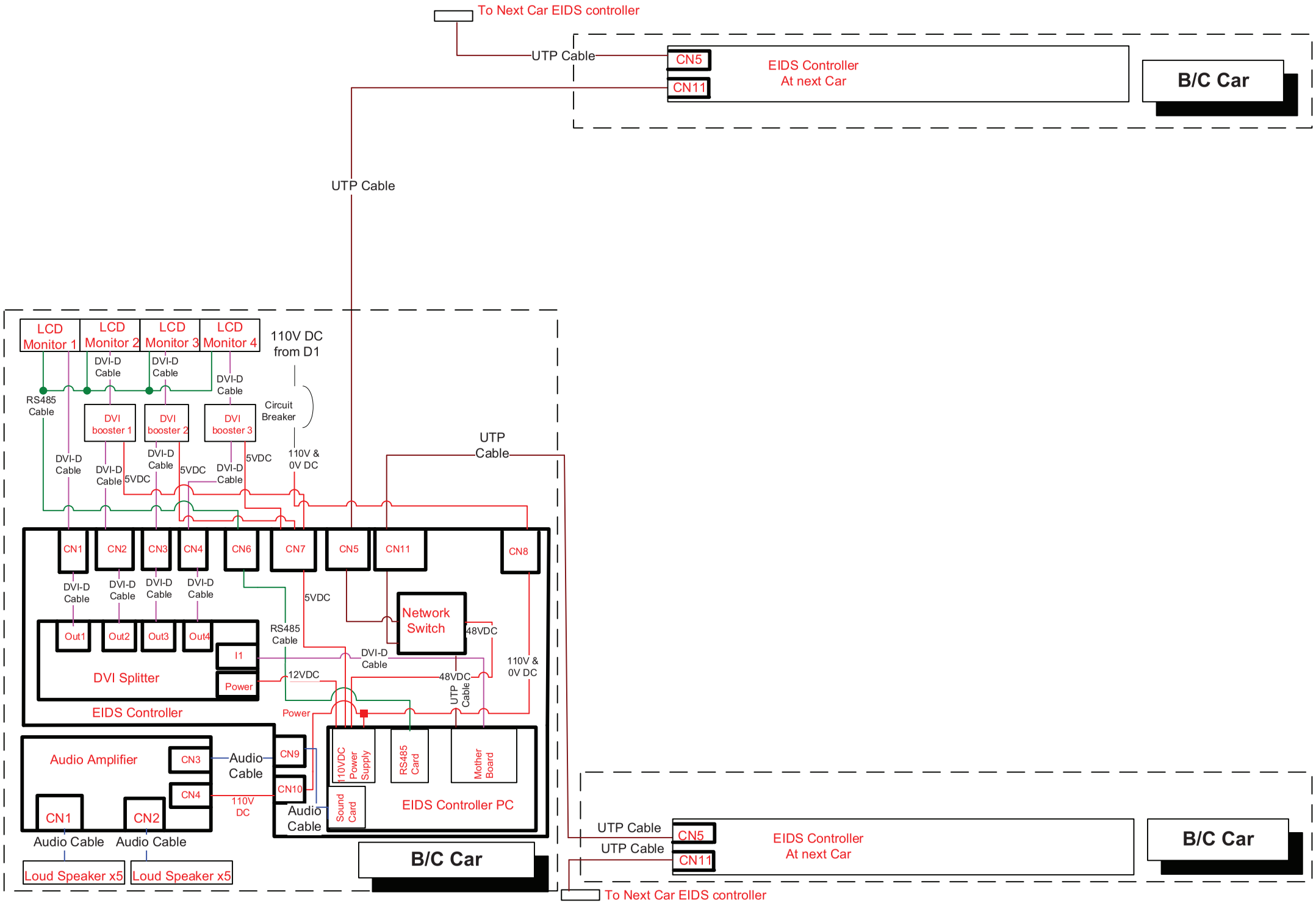

R150
M5
10
10
70
10
10

annex 4.7 Booster mounting drawing




Antenna for Downloading file
AP
P
P'
S
S'
G (Cat5e Cable)
F (12V DC Power cable)
110V DC from battery
Circuit Breaker
C (110V DC Power cable)
DVAS
A1
A1'
A (RS485)
D (1 pair Shield Cable)
Reset button
E (1 pair shield Cable)
Zero Speed Dry Contact
Z
110V DC Pan up/down Signal
H (110VDC Power Cable)
P (Antenna Cable)
B (RS232 Cable)
Antenna for maintenance PC access
B1'
B1
GSM Modem
CN4'
CN4
CN1'
CN1
CN2'
CN2
CN3'
CN3
CN5'
CN5
EIDS Server
Driving Cab
LCD Monitor (1)
LCD Monitor (2)
LCD Monitor (3)
LCD Monitor (4)
I (DVI Cable)
J (RS485 Cable)
DVI Booster (D3)
DVI Booster (D2)
DVI Booster (D1)
5V DC Cable
K (5V DC Cable)
M (110V DC Power cable)
Circuit Breaker
D1
CN11'
CN11
CN6'
CN6
CN7'
CN7
CN8'
CN8
EIDS Controller
CN9'
CN9
CN10'
CN10
L (Audio Cable)
M (110VDC Cable)
Audio Amplifier
Loud Speaker 1
Loud Speaker 2
Loud Speaker 3
Loud Speaker 4
Loud Speaker 5
Loud Speaker 6
Loud Speaker 7
Loud Speaker 8
Loud Speaker 9
Loud Speaker 10
EIDS Controller
To Next Car
G (Cat5e Cable)
A-Car
C-Car

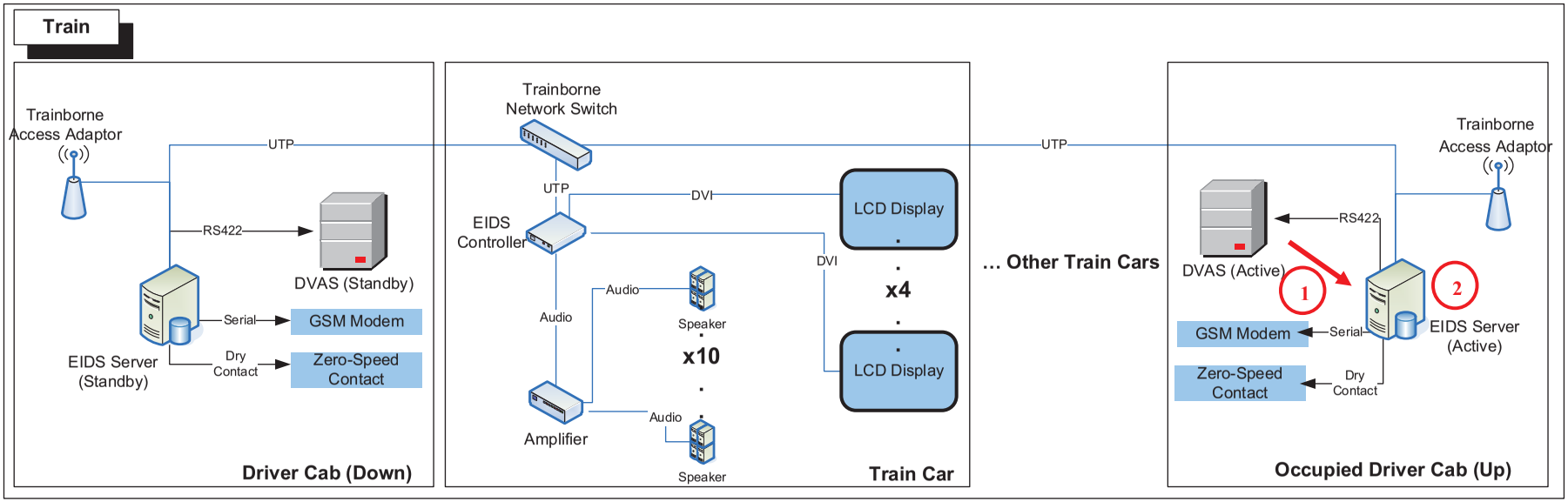
annex 4.8 Control schematic diagram



EIDS and DVAS Communication Methodology

Case 1

Description: Both DVAS Server and EIDS Server are active in the same end.



For all actions, please refer to the labels in the figure above in red.

Action:

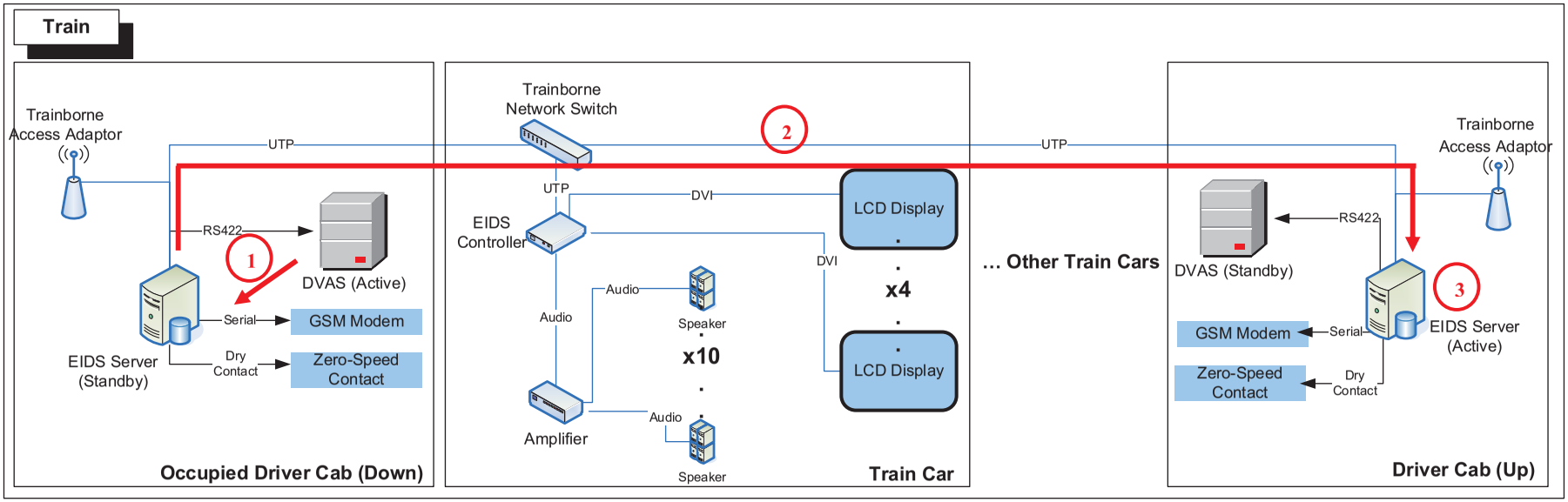
1. **DVAS (Active) sends all information to the EIDS Server (Active).**
2. **EIDS Server (Active) performs all necessary actions.**

Fault Messages:

1. **The DVAS (Active) shall be able to receive all fault messages from the EIDS Server (Active).**
2. **The DVAS (Active) shall pass all fault messages received from EIDS Server (Active) to TMS.**
3. **The EIDS fault messages from EIDS Server (Active) to the DVAS (Active) shall include both fault messages from EIDS Server (Active) and EIDS Server (Standby).**

Case 2

Description: The DVAS Server is active in one end while the EIDS Server is active in the other end.



For all actions, please refer to the labels in the figure above in red.

Action:

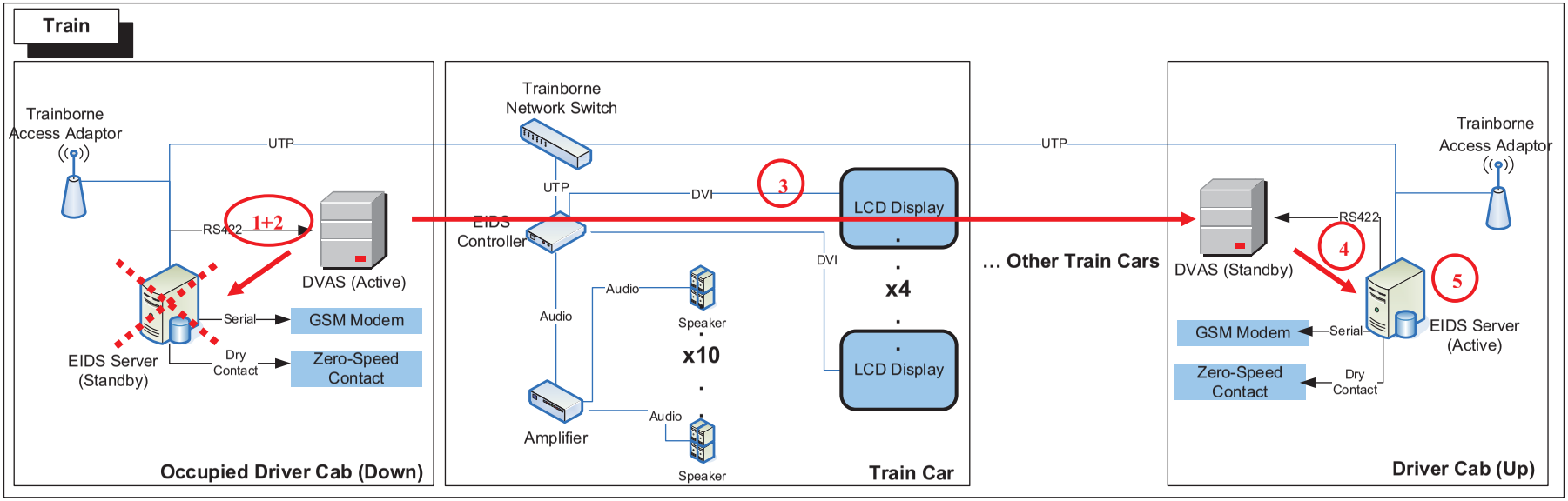
1. **DVAS (Active) sends all information to the EIDS Server (Standby).**
2. **EIDS Server (Standby) sends all information to the EIDS Server (Active).**
3. **EIDS Server (Active) performs all necessary actions.**

Fault Messages:

1. **The DVAS (Active) shall be able to receive all fault messages from the EIDS Server (Standby).**
2. **The DVAS (Active) shall pass all fault messages received from EIDS Server (Standby) to TMS.**
3. **The EIDS fault messages from EIDS Server (Standby) to the DVAS (Active) shall include both fault messages from EIDS Server (Active) and EIDS Server (Standby).**

Case 3

Description: The DVAS Server is active in one end while the EIDS Server is active in the other end. In addition, the EIDS Server in the Standby mode is out of service.



For all actions, please refer to the labels in the figure above in red.

Action:

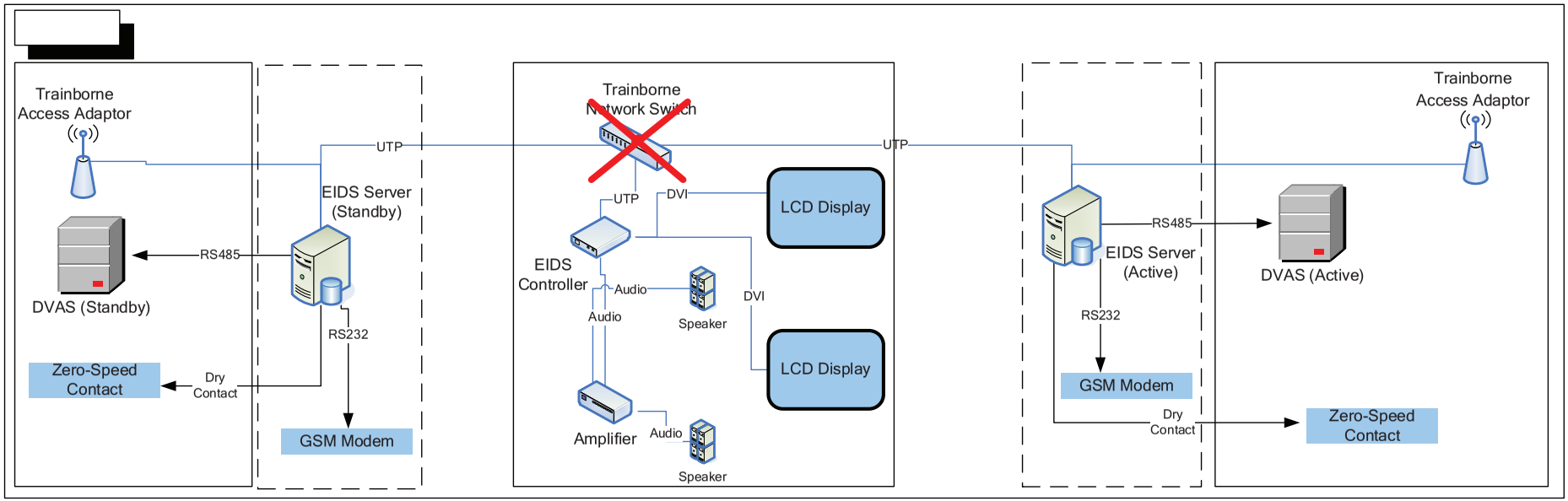
1. **DVAS (Active) polls the EIDS Server (Standby).**
2. **DVAS (Active) fails to communicate with the EIDS Server (Standby).**
3. **DVAS (Active) sends all information to the DVAS (Standby). **Note: With a delay of no more than 10s.***
4. **DVAS (Standby) sends all information to the EIDS Server (Active).**
5. **EIDS Server (Active) performs all necessary actions.**

Fault Messages:

1. **The DVAS (Active) shall be able to inform TMS that the EIDS Server at the DVAS (Active) end is out of service.**

Case4

1. One of the network switches in train car suddenly fails to operate and the Standby EIDS Server will not receive the pre-defined protocol (Heart Beat) from the active EIDS Server. The EIDS Controller starting from the car with failed network switch will not receive the streaming data from active EIDS Server and blank screen will be displayed.

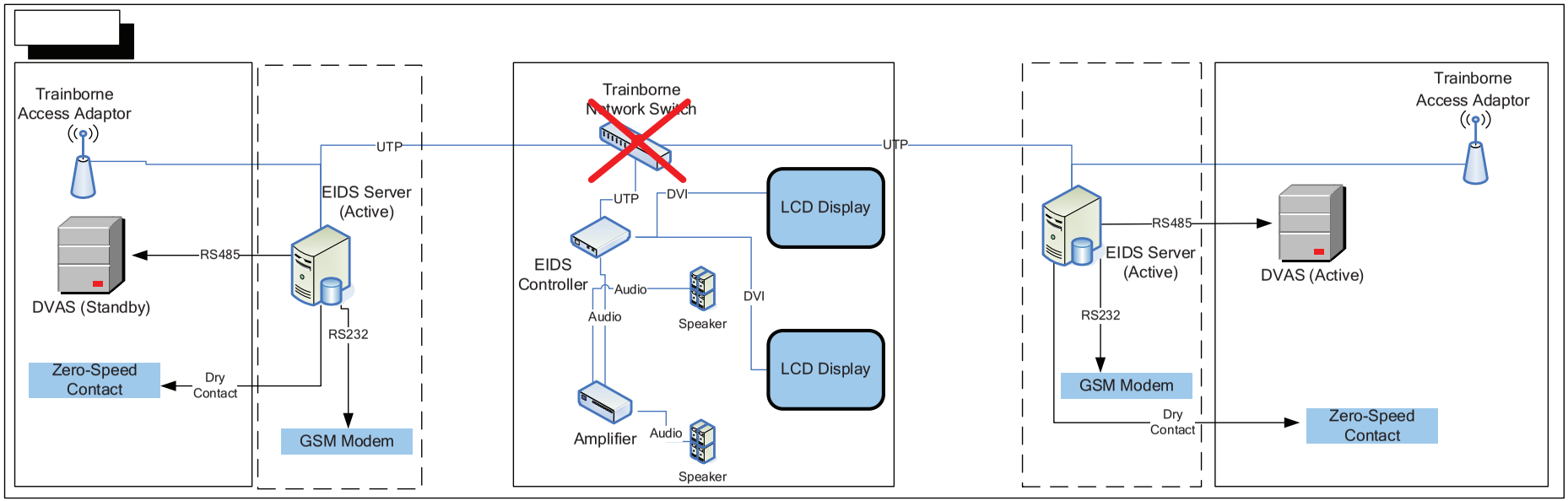


Train

2. After losing the heart beat for 30 seconds, the Standby EIDS Server will switch to Active server and send protocol to EIDS Controller next to the car with failed network switch to set the streaming data input from it. At this moment, the LCD display starting from the down-end car to the car with failed network switch may show different content files with that starting from the up-end car to the car with failed network switch.

Note:

1. No operational messages will be shown on the EIDS Panels on cars with the EIDS Controller connected to the EIDS Server attached to the Standby DVAS. This is due to no trigger will be sent out by the Standby DVAS.
2. The EIDS Server attached to the Standby DVAS shall instruct all EIDS Controller under its control to mute all audio output to ensure all Operational messages could be audible to passengers.



Train

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 5 PLATFORM SCREEN DOOR INTERFACES

1 Introduction

2 Operation Performance of the PSD and Requirements of the Train System Interfaces

3 Control Interface of PSD and Train System

4 Dimensional Interface of PSD and Train System

5 Confirmation of Design Information

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 5 PLATFORM SCREEN DOOR INTERFACES

1 Introduction

1.1 This Annex defines the interface requirements for the Platform Screen Door (PSD) and the train system.

1.2 It is a requirement that the train system in particular the passenger bodyside doors shall be designed and constructed to operate in an integrated manner with the PSD to ensure safe operation.

1.3 The Contractor shall provide:

1.3.1 Control Interface

On opening / closing of the passenger bodyside doors (refer to PS 9.8), a corresponding non-latched signal shall be sent to the trainborne ATC for transmission to PSD for synchronised operation. The transmission time of the non-latched signal measured from the time the door open / close pushbutton (refer to PS 8.8, 8.10 & 8.11) contact is operated until the signal is received by the trainborne ATC shall be 0.1 sec maximum.

1.3.2 Physical Interface

The design and construction of the passenger bodyside doors door pitch shall be in accordance with PS 16.1.1(e).

2 Operation Performance of the PSD and Requirements of the Train System Interfaces

The passenger bodyside doors shall be opened and closed in conjunction with the opening and closing of PSD. Requirements for the passenger bodyside doors are stipulated in PS 16. The following are the operational performance of the PSD:

2.1 Door Opening and Closing Time (duration of door movement)

The maximum opening time of PSD will be 3 sec and the maximum closing time will be 3.5 sec to match with the opening and closing of passenger bodyside doors.

2.2 Obstruction Detection (physical obstruction of door movement)

An obstruction detection facility will be provided for PSD. PSD will employ an obstacle detection mechanism to stop door closing force, which will be restored

after an adjustable period (0 - 10 sec). If the PSD cannot be confirmed closed after 3 obstacle detections, a door close not proven alarm will be raised at the PSD Local Control Panel. However, the passenger bodyside doors can still be able to be opened and closed independent of the PSD status. The re-opening and re-closing of passenger bodyside doors will also command re-opening / re-closing of all PSD and all PSD obstruction delay timers and the obstruction cycle counters will be reset.

2.3 Door Close Detection

A door close detection facility will be provided for the PSD. The PSD door control unit for each pair of PSD will be able to positively detect its door leaves position. If the door leaves have reached their home position and no confirmation signal of "door fully closed" is received, then the door pair will be automatically re-opened for a certain distance and re-closed immediately. The re-opening distance and the maximum number of re-openings will be adjustable by maintenance staff.

2.4 Door Synchronisation

The opening and closing of PSD will be in synchronisation with the passenger bodyside doors opening and closing (refer to clause 3 below).

2.5 PSD Local Control Panel

A PSD Local Control Panel will be fitted in each Headwall Unit / Tailwall Unit (located at station platform) which provides indication and control for the PSD system. The PSD Local Control Panel will consist of the following control and indication functions:

2.5.1 Each PSD Local Control Panel will provide the following control functions:

(a) The Signalling System will send a LOCAL CONTROL ENABLE (non-latched signal) to PSD system if the platform track circuit is occupied or failed.

(b) DOORS OPEN is a non-latched illuminated push button which will enable the DOOR OPEN command signal to be sent to all PSDs if enabled by receipt of LOCAL CONTROL ENABLE signal, indicated by illumination of the push button.

(c) DOORS CLOSE is a non-latched illuminated push button which will enable the DOOR CLOSE command signal to be sent to all PSDs if enabled by receipt of LOCAL CONTROL ENABLE signal, indicated by illumination of the push button.

(d) PSD/EED INTERLOCK OVERRIDE switch is a two position spring return keyswitch which will enable the PSD/EED INTERLOCK OVERRIDE signal to be sent to the Signalling system.

(e) LOCAL CONTROL ENABLE switch is a two position spring return keyswitch which will operate together with Doors Open / Doors Close illuminated pushbutton when PSD Local Control Panel is function enabled.

2.5.2 Each PSD Local Control Panel will provide the following indications:

(a) DOORS OPEN push button will be illuminated when the LOCAL CONTROL ENABLE command signal is received and will be extinguished when the LOCAL CONTROL ENABLE command signal is not received.

(b) DOORS CLOSE push button will be illuminated when the LOCAL CONTROL ENABLE command signal is received and will be extinguished when the LOCAL CONTROL ENABLE command signal is not received.

(c) PSD/EED CLOSED is an indicator lamp which will be illuminated when the PSD/EED CLOSED signal is confirmed and will be extinguished when the PSD/EED CLOSED signal is not confirmed.

3 Control Interface of PSD and Train System

3.1 Door Opening

The train door control circuit shall interface with the trainborne ATC system such that it is enabled for correct side door opening by the ATC unit when the following conditions are met (refer to Appendix I Annex 3) :

3.1.1 train is stationary (i.e. train speed measured by the ATC is below 1 km/h);

3.1.2 train service brakes applied; and

3.1.3 train is within ± 500 mm of the service stopping point.

The detailed passenger bodyside door controls are specified in PS 9.8.

On operation of the door open push button when the above conditions are confirmed by the trainborne ATC, a non-latched signal shall be sent to the trainborne ATC for transmission to PSD for PSD opening. This non-latched signal shall be transmitted to the PSD via an air interface (refer to clause 3.3). A

conceptual arrangement demonstrating the door opening scenario is depicted in Drg. No. C6014-14E/TSEG/077/002.

3.2 Door Closing

On operation of the door close push button, a non-latched signal shall be sent to the trainborne ATC for transmission to PSD for PSD closing. This non-latched signal shall be transmitted to the PSD via an air interface (refer to clause 3.3). When all PSD are proved closed, the ATC system will provide non-zero target speed and the train can be started by the train operator. A conceptual arrangement demonstrating the door closing scenario is depicted in Drg. No. C6014-14E/TSEG/077/003.

3.3 Air Interface

The non-latched signal for PSD opening and closing shall be transmitted via an air interface which will be provided by the return channel of the ATC system.

The Contractor shall design the train door control circuits to provide the input signals to the trainborne ATC.

The transmission time of the non-latched signal measured from the time the door open / close pushbutton contact is operated until the signal is received by the trainborne ATC (refer to clause 2.3.1(i) of Appendix I Annex 3) shall be in accordance with clause 1.3.1.

4 Dimensional Interface of PSD and Train System

4.1 The PSD setting out from centre line of track and kinematic envelope is depicted in Drg. No. C6014-14E/TSEG/077/001.

5 Confirmation of Design Information

5.1 The Contractor shall ensure that all the requirements as stipulated in this Annex are achieved.

5.2 Any change to the above requirements shall be submitted for Approval before the end of SEMP Stage 3.

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 6 DEPOT INTERFACES

1 Introduction

2 Running Maintenance Area

3 Lifting / Heavy Maintenance Area

4 Cleaning

5 Underfloor Wheel Lathe

6 Miscellaneous Interfaces

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 6 DEPOT INTERFACES

1 Introduction

The trains will be stabled and maintained at any of the Employer's existing depots and workshops. This Annex defines the standards for interfaces between the trains and the Employer's train maintenance facilities. The design of the trains shall aim to make the best use of existing equipment provided for the Urban Lines Trains, both to ensure compatibility and to minimize the number of different maintenance facilities for similar functions across the Employer's fleet.

2 Running Maintenance Area

2.1 General

2.1.1 The following activities will be carried out at the Running Maintenance Area of a depot:

(a) Preventive maintenance service checks (refer to PS 26.3.2)
(b) Corrective maintenance (refer to PS 26.4)
(c) In-situ cleaning of air conditioning units using high pressure hot water. In some depots, cleaning of roof mounted air conditioning units will be carried out at a Heavy Cleaning Track (refer to Clause 4.4 below) provide with roof level access platforms.
(d) Replacement of equipment that do not require car lifting or overhead cranes
(e) Re-commissioning of trains after car overhauls

2.1.2 The Running Maintenance Area will consist of raised tracks on a depressed floor each of 8-car long. A typical cross-section is shown in Drg. No. C6014-14E/TSEG/990/001.

2.1.3 The following service supply points will be provided at regular intervals along each running maintenance track:

(a) 240V 13A single phase and 415V 60A 3 phase AC, 50Hz electrical power supply
(b) compressed air at 7.5 bar

2.1.4 Routine in-situ charging of the batteries on the trains will be carried out at the Running Maintenance Area using a mobile battery charger.

2.2 Access to Trainborne Equipment

2.2.1 Access to the underframe of the trains will be provided by raised tracks in the Running Maintenance Area.

2.2.2 Access to the interior of the trains and to the outside of the car body will be provided by mobile platforms fitted with ladders or stairs.

2.2.3 An overhead traction supply wire will be positioned over each running maintenance track. Access to roof mounted equipment will be provided by a fixed high level platform running along the full length of a train on one side. Access gates to the platforms will be interlocked with the isolation of the overhead line.

2.3 Drainage for Air Conditioning Units

2.3.1 Drainage points for condensate from trainborne air conditioning units shall be positioned at the corners of the cars at a distance of 1250mm to 1450mm from the centre of the track, in order that the condensate will be collected at special channels on the floor.

2.3.2 During the in-situ cleaning of air conditioning units, the drainage points will be connected to a hose so that the effluent from the cleaning process can be directed to a suitable location for treatment and disposal. The design of the drainage points shall enable such connections to be made.

3 Lifting / Heavy Maintenance Area

3.1 General

3.1.1 The following activities will be carried out at the Lifting / Heavy Maintenance Area of a depot:

(a) Car overhauls
(b) Replacements of equipment that require car lifting or overhead cranes

3.1.2 The Lifting / Heavy Maintenance Area will consist of tracks laid on a flat floor area and will be provided with abovefloor or underfloor car lifting equipment. The cross-section of a typical Lifting / Heavy Maintenance Area is given in Drg. No. C6014-14E/TSEG/990/002.

3.1.3 The following service supply points will be provided at regular intervals along a heavy maintenance track:

(a) 240V 13A single phase and 415V 60A 3 phase AC, 50Hz electrical power supply

(b) compressed air at 7.5 bar

3.1.4 No overhead traction supply wire will be provided at the Heavy Maintenance Area.

3.1.5 An overhead travelling crane will be provided above the lifting / heavy maintenance tracks for the replacement of roof mounted equipment. The Contractor shall provide the special lifting attachments or load spreaders if required for handling roof mounted equipment, as part of the special tools specified in PS 24.

3.2 Access to Equipment

3.2.1 Access to the underframe and underframe mounted equipment will be provided by car lifting equipment. Cars undergoing car overhauls will be supported on accommodation bogies or car lifting equipment.

3.2.2 Disconnection of bogies and bar couplers will be carried out at pitted tracks or underfloor car lifting berths. The cross-section of a typical pitted track is shown in Drg. No. C6014-14E/TSEG/990/002.

3.2.3 Access to the interior of a car and to the outside of the car body will be provided by mobile platforms fitted with ladders or stairs.

3.2.4 Access to roof mounted equipment will be provided by fixed or mobile high level platforms.

3.2.5 An overhead travelling crane will be provided for handling heavy equipment in the Lifting / Heavy Maintenance Area.

3.3 Car Lifting

3.3.1 Jacking points shall be provided on the cars so that they can be lifted to allow access to and replacement of bogies and heavy underframe mounted equipment. The cars shall allow lifting either individually as single cars, or as a complete Train Unit coupled together without dismantling the bar couplers.

3.3.2 The design of the cars shall allow both abovefloor and underfloor car lifting equipment to be used. Details of lifting claws and working range of existing abovefloor car lifting equipment are given in Drg. No. C6014-14E/TSEG/990/004. A conceptual sketch of under-floor car lifting equipment is shown in Drg. No. C6014-14E/TSEG/990/005.

3.3.3 In order that the same car lifting equipment for the Urban Lines Trains can be used, the layout of jacking points on a car shall conform to the arrangement shown in Drg. No. C6014-14E/TSEG/990/003.

3.4 Accommodation Bogies

3.4.1 Cars undergoing car overhauls will be placed on accommodation bogies to provide an ergonomic height for working on equipment mounted on the underframe. The accommodation bogies also allow the cars to be moved around. The design of the cars shall allow existing accommodation bogies to be used for such purposes. Details of existing accommodation bogies are shown in Drg. No. C6014-14E/TSEG/990/006.

3.4.2 The Contractor shall propose for Approval any necessary modifications to existing accommodation bogies so that they can accommodate the cars supplied. Such modifications shall not affect the existing functions of the accommodation bogies. In the event that special work is required each time to convert the accommodation bogies between Urban Lines cars and cars supplied, the conversion for each bogie shall be completed within 15 minutes with not more than 0.5 man-hour.

3.4.3 Relative horizontal movements between the car body and accommodation bogies shall be constrained by mechanical stops to allow braking of the cars during shunting.

3.4.4 The design of the underframe of the trains shall allow accommodation bogies to be installed or removed from the cars using the car lifting equipment described in Clause 3.3 above.

3.5 Handling of Underframe Mounted Equipment

The design of the trains shall facilitate handling of underframe mounted equipment as follows:

(a) Mobile scissors platforms and fork lift trucks will be used for removing and refitting underframe mounted equipment.

(b) Bogies will be removed from the cars by raising carbodies on car lifting equipment described in Clause 3.3 above. When underfloor lifting equipment is used, the bogies will be rolled out under the cars along the length of the track.

(c) Bogie turntables of 3.5 m diameter will be provided for transferring bogies between adjacent tracks.

3.6 Towing

3.6.1 Cars standing on the heavy maintenance tracks will be pulled or pushed by a tractor fitted with road wheels. The tractor will be positioned at the ends or sides of the car to be moved. Towing points shall be provided at the 4 corners of each car to accommodate a tow bar for such shunting movements. Typical arrangement of towing points on Urban Lines Trains is shown in Drg. No. C6014-14E/TSEG/990/007 for reference.

3.6.2 Towing points shall also be provided on each car or each bogie to allow towing by a winch at the underfloor wheel lathe for positioning the wheels over the cutting tools.

3.6.3 Each towing point shall be designed to withstand the force required to move and stop a 8-car train on a level track at 200 m curve radius.

4 Cleaning

The design of the trains shall aim to adopt the same external cleaning processes for Urban Lines Trains without additional external cleaning operations.

4.1 Automatic External Water/Detergent Washing

4.1.1 A drive-through automated water / detergent wash plant fitted with sprays and rotating brushes will be available for external cleaning as the trains enter the depot from service.

4.1.2 The train will be driven through the plant at 5 km/h on its own power. A mixture of water and detergent will be sprayed on the carbody, followed by brushing and a final rinse with fresh water.

4.1.3 The exterior of the complete carbody between cantrails and solebar, including the end faces, will be washed.

4.1.4 The following chemicals are used for the water / detergent washing of Urban Lines Trains with aluminium bodies:

Rochester Midland Cleanaire 1200, diluted to 1:40 and Henkel P3-T-768, diluted to 1:40

4.2 Automatic External Acid Washing

4.2.1 Where the external finish of the trains requires acid washing, a drivethrough automated acid wash planted fitted with sprays and rotating brushes will be available for acid wash.

4.2.2 The train will be driven through the plant at 5 km/h on its own power. A mixture of water and acid will be sprayed onto the body and left to stand for a length of time. The mixture is then removed by water and brushes, followed by a final rinse with fresh water. The process may be repeated a few times to achieve the required standard of cleanliness.

4.2.3 The exterior of the complete carbody between cantrails and solebar will be washed.

4.2.4 The following chemicals are used for the acid washing of Urban Lines Trains with aluminium bodies:

Rochester Midland AC 500, diluted to 1:7 and
Henkel P3-allpass 271, diluted to 1:7

4.3 Cleaning of Windows

4.3.1 To prevent the accumulation of water stains, the outside surface of Urban Lines Train windows are cleaned at regular intervals using handheld power brushes and the proprietary chemical AJAX 4942 disinfectant creme cleanser.

4.3.2 The Contractor may submit alternative cleaning methods, or suitable treatment that obviate such cleaning for Approval.

4.4 Heavy Internal Cleaning

Heavy internal cleaning will be carried out with the train berthed at a heavy cleaning track. Access to the trains will be provided by platforms at floor level along the full length of the train. Power supply points and water taps will be provided at regular intervals along each platform. The trains shall be designed to utilize such facilities for internal cleaning.

5 Underfloor Wheel Lathe

5.1 The wheels of the trains will be reprofiled by an underfloor wheel lathe. The design of the bogie, wheelset and axle box shall be compatible with the Employer's underfloor wheel lathe hold down device as shown in Drg. No. C6014-14E/TSEG/990/008, so that wheels can be re-profiled without dismantling any trainborne equipment.

5.2 As an alternative, the Contractor may provide a suitable device, as part of the special tools in accordance with PS 24, which can be installed on the Employer's underfloor wheel lathes to provide the hold down function. Such device shall satisfy the following requirements:

(a) Installation or removal time: not more than 15 minutes
(b) Number of staff required: not more than 2 persons
(c) No crane or lifting equipment shall be required for handling the device

The design of the device shall be submitted for Approval.

6 Miscellaneous Interfaces

6.1 Target Holder

A target is a disc which is placed at the ends of a car or train to warn against movement of the car or train. An example of a target is shown in Drg. No. C6014-14E/TSEG/990/010. A target holder shall be provided at each end of a car according to the details shown in Drg. No. C6014-14E/TSEG/990/011.

6.2 Pneumatic Connector

6.2.1 Quick release pneumatic connectors shall be provided at strategic points in the pneumatic system to facilitate maintenance activities such as pressure measurements and charging of the system.

6.2.2 As a minimum, quick release pneumatic connectors shall be provided for the following purposes:

(a) All air pressure measurements during preventive maintenance work (refer to PS 26.3)
(b) For charging of the main air system from a shore supply
(c) Measurement of brake cylinder pressure
(d) Measurement of air suspension pressure

6.2.3 Quick release pneumatic connectors shall be compatible with the 'Schrader' plug connector shown in Drg. No. C6014-14E/TSEG/990/012.

6.3 Shore Auxiliary Supply

When the overhead line is isolated, a mobile external power supply will be provided to allow function tests to be carried out on equipment, such as air conditioning units, which are powered by the trainborne auxiliary supply system. An adequately rated 3 phase AC socket inlet shall be provided at each auxiliary converter according to PS 17.3.3 to accept a mating connector from the external power supply unit.

6.4 Recovery from Derailment and Locked Axle

6.4.1 The design of the trains shall aim to utilize the existing recovery equipment with minimum requirement for additional hardware:

(a) In the event of a derailment, the derailed car shall be restored to the running rails using a set of specialist re-railing equipment which consists of hydraulic jacks, re-railing bridge and roller carriages. The working principles of existing rerailing equipment are shown in Drg. No. C6014-14E/TSEG/990/013.

(b) In the event of a locked axle, a pair of wheel skates shall be fitted to the affected axle by jacking under the bogie frame or axle boxes. The design of existing wheel skates is shown in Drg. No. C6014-14E/TSEG/990/014.

6.4.2 The Contractor shall provide additional equipment, or modifications to existing equipment, for recovery of the trains from derailments and locked axles, as part of the special tools specified in PS 24.

6.4.3 All jacking points, including those that will be used for applying the wheel skates described in Clause 6.4.1(b) above, shall be painted with the alternate yellow and black stripes pattern shown in Drg. No. C6014-14E/TSEG/990/015.

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 7 ELECTRIC VEHICLE INTERFACES

1 Introduction

2 General Description of the Existing Electric Vehicles

3 Compatibility Requirements

4 Electric Vehicles Power Circuit Component Information

Table App-I-Annex-7-1 Stock Allocation of the Electric Vehicles
Table App-I-Annex-7-2 CM/CT-Stock Cars Power Circuit Component Information
Table App-I-Annex-7-3 G-Stock Cars Power Circuit Component Information
Table App-I-Annex-7-4 H-Stock Cars Power Circuit Component Information
Table App-I-Annex-7-5 I-Stock Cars Power Circuit Component Information
Table App-I-Annex-7-6 K Train Cars Power Circuit Component Information
Table App-I-Annex-7-7 CM/CT/I-Stock Cars Auxiliary Static Inverter Circuit Component Information
Table App-I-Annex-7-8 G-Stock Cars Auxiliary Inverter Circuit Component Information
Table App-I-Annex-7-9 H-Stock Cars Auxiliary Converter Circuit Component Information
Table App-I-Annex-7-10 K Train Cars Auxiliary Static Inverter Circuit Component Information
Table App-I-Annex-7-11 CM -Stock Cars Auxiliary Circuit Component Information
Table App-I-Annex-7-12 CT-Stock Cars Auxiliary Circuit Component Information
Table App-I-Annex-7-13 I-Stock Cars Auxiliary Circuit Component Information
Table App-I-Annex-7-14 G-Stock Cars Auxiliary Circuit Component Information
Table App-I-Annex-7-15 H-Stock Cars Auxiliary Circuit Component Information
Table App-I-Annex-7-16 Mark I/II BE Loco Power Circuit Component Information
Table App-I-Annex-7-17 Mark I/II BE Loco Auxiliary Circuit Component Information
Table App-I-Annex-7-18 Mark III BE Loco Power Circuit Component Information
Table App-I-Annex-7-19 Mark III BE Loco Auxiliary Circuit Component Information
Table App-I-Annex-7-20 C Train Cars Power Circuit Component Information
Table App-I-Annex-7-21 C Train Cars Auxiliary Static Inverter Component Information

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 7 ELECTRIC VEHICLE INTERFACE

1 Introduction

1.1 This Annex of Appendix I contains details of the existing electric vehicles, including the electrical multiple units (EMU) and battery electric locomotives (BE loco) which will be operated together with the trains on Urban Lines.

1.2 It is a requirement that the trains shall be interchangeable with the Urban Lines Trains on a train to train basis.

1.3 In order to ensure the compatibility between the existing electric vehicles and the new trains, the following system requirements and design constraints are specified according to the experience gained from the operation of the Urban Lines.

1.4 The Contractor shall provide appropriate interface specification, design study, delivery schedule, installation, testing and setting to work in order to demonstrate to the satisfaction of the Engineer that the trains are compatible with the existing electric vehicles.

2 General Description of the Existing Electric Vehicles

2.1 The EMUs are used for passenger service. EMUs equipped with DC traction propulsion are consisted of 'CM' and 'CT' stock chopper converted cars which are using self-ventilated Gate-Turn-Off (GTO) chopper, G stock chopper cars which are using forced air cooling GTO chopper, H stock chopper cars which are using self-ventilated GTO chopper and I stock chopper cars which are using forced air cooling Reverse-Conduct-Thyristor (RCT) chopper. For K Trains and C Trains, the EMUs are equipped with IGBT traction inverter for the AC traction propulsion.

2.2 The BE locos are used for hauling a consist of wagon as engineering trains. At least two BE locos are used i.e. one at each end to form a train consist and maximum of four BE locos will be used depending on the hauling loads. The BE locos are consisted of the mark I and II types BE locos which are using the forced air cooling RCT chopper and mark III type BE locos which are using forced air cooling GTO chopper. The BE locos are only equipped with the traction propulsion equipment and a 750VDC motor driven motor-alternator set.

2.3 A stock allocation summary of the above electric vehicles is shown on Table AppI-Annex-7-1.

2.4 The traction equipment of all electric vehicles are using the overhead line supply of 1,500VDC as the traction positive supply and the running rail as the traction negative returns.

2.5 For passenger service,:

2.5.1 The M Trains of CM, CT, G, H and I stock cars are comprised of: 6 power cars and 2 trailer cars i.e. the train configuration is (A - C_T - D - B - C - D - C_T - A); or

2.5.2 8 power cars i.e. the train configuration is (A - C_T - B - C - B - C - C_T - A).

where:

A Power car which is equipped with the driving cab, DC traction propulsion equipment and 1,500VDC driven auxiliary equipment and pneumatic equipment.

B Power car which is equipped with the DC traction propulsion equipment and 1,500VDC driven auxiliary equipment and pneumatic equipment.

C_T Power car which is equipped with the pantograph, DC traction propulsion equipment and 1,500VDC driven auxiliary equipment.

C Power car which is equipped with the pantograph, DC traction propulsion equipment and 1,500VDC driven auxiliary equipment.

D Trailer car which has no traction equipment.

- Couplers

2.5.3 The EMUs of K Train and C Train cars are comprised of 6 power cars and 2 trailer cars
i.e. the train configuration of K Train is (A - C - B - B - C - B - C - A)
the train configuration of C Train is (A - C - B - B1 - C1 - B - C - A)

where:

A Trailer car which is equipped with the driving cab.

B/B1 Power car which is equipped with the AC traction propulsion equipment and 415VAC driven auxiliary equipment and pneumatic equipment.

C/C1 Power car which is equipped with the pantograph, AC traction propulsion equipment and 1,500VDC driven auxiliary equipment.

- Couplers

2.6 The tare weight of the individual car type is:

Stock Type	Car Type	Weight(Tonne)
CM/CT/G/ H/I	A	41
	B	40
	C, C_T	41
	D	30
K Train	A	37
	B	41
	C	41
C Train	A	38.7
	B	40.9
	C	42
	B1	42
	C1	42

2.7 Power Circuits of the EMUs

2.7.1 For 'CM' stock and 'CT' stock chopper converted EMUs:

(a) The traction propulsion equipment are depicted in Drg. No. OD4/305/00241/0004 entitled "CT Stock Chopper Conversion Power Circuit Diagram for EMU Cars" and Drg. No. OD4/305/00141/0001 entitled "CM Stock Chopper Conversion Power Circuit Diagram For EMU Cars".

(b) The 1,500VDC driven auxiliary equipment and pneumatic equipment are depicted in Drg. No. OD4/305/00262/0001 entitled "CT Stock Chopper Conversion Auxiliary Circuit Diagram A-CT-D Cars" and Drg. No. OD4/305/00162/0001 entitled "CM Stock Chopper Conversion Auxiliary Circuit Diagram A-CT-D Cars".

2.7.2 For G stock chopper EMUs:

(a) The traction propulsion equipment are depicted in Drg. No. OD4/303/00042/0027 entitled "Power Circuit Diagram for EMU Cars".

(b) The 1,500VDC driven auxiliary equipment are depicted in Drg. No. OD4/303/00042/0108 entitled "Circuit Diagram of Static Auxiliary Inverter".

(c) The 1,500VDC driven pneumatic equipment are depicted in Drg. No. OD4/303/00063/0011 entitled "Auxiliary Circuit Diagram EMU Cars AC-T".

2.7.3 For H stock chopper EMUs:

(a) The traction propulsion equipment are depicted in Drg. No. OD4/306/00041/0001 entitled "Power Circuit Diagram for EMU Cars Additional Rolling Stock".

(b) The 1,500VDC driven auxiliary equipment are depicted in Drg. No. OD4/306/00063/0003 entitled "Circuit Diagram Of Static Auxiliary Converter".

(c) The 1,500VDC driven pneumatic equipment are depicted in Drg. No. OD4/306/00063/0004 entitled "H Stock Auxiliary Circuit Diagram EMU Cars A-CT-D Additional Rolling Stock".

2.7.4 For I stock chopper EMUs:

(a) The traction propulsion equipment are depicted in Drg. No. OD4/302/00003/0011 entitled "Schematic Diagram Of Power Circuit".

(b) The 1,500VDC driven auxiliary equipment and pneumatic equipment are depicted in Drg. No. OD4/302/00303/0002 entitled "Auxiliary Circuit Diagram A, C & D Cars Melco Chopper Unit".

2.7.5 The 'CM' and 'CT' stock chopper converted cars and G stock and H stock chopper cars uses the GTO technology and the I-stock chopper cars uses RCT technology. The K Train and C Train cars use IGBT traction inverter for the AC traction propulsion.

2.7.6 For the GTO choppers, the power circuit is effectively divided into three component sections namely a common supply, line filter and rheostatic brake section which serves two identical motor circuits. Power is supplied via the single filter circuit to two choppers, each chopper controlling a string of four motors connected in series configuration. The motor voltage and current are controlled by switching the main GTO device at an operating frequency of 260Hz. This chopper is then interlaced with the other motor circuit chopper to give a fundamental ripple frequency of 520Hz in the line.

Apart from the motoring function, the power circuit also provides electric braking, mainly in the form of regenerative brakes converting the EMU's kinetic energy into electrical energy which is returned to the overhead line supply conductor. There is also a limited facility for rheostatic braking, in which case the energy is dissipated in a resistor, to maintain electric braking through short line gaps, transient non-receptive conditions and during transition to air braking when longer term nonreceptive conditions are encountered.

2.7.7 For the RCT choppers, the eight motors are controlled by the chopper control unit which is composed of mutually coupled two-phase chopper with phase-shifting between each chopping part. Constant frequency control (i.e. 520Hz with 260Hz per unit chopper operated interlacedly with the other) will be applied for powering and braking. The brake series resistor is used to improve the regenerative brake performance in high speed region and a short-time rated auxiliary chopper and rheostatic brake resistor are provided for the reversible blending control of regenerative/rheostatic brake.

2.7.8 All EMUs are provided with auxiliary converters or static inverters. In addition, all EMUs are provided with a 1,500VDC or 415VAC motor driven air compressor.

2.7.9 For the auxiliary converter, it is made up of GTO thyristors together with associated freewheel diodes, snubber circuits and series inductors. The principal stages of power conversion process are:

(a) power supply input;
(b) input filter;
(c) step-down chopper;
(d) dc link filter;
(e) three phase inverter and transformer; and (f) inverter output filter.

Various protective circuits are employed to safeguard the system as well as to prevent the generation of harmonics which cause interference to external systems.

2.7.10 For the auxiliary static inverter, it is made up of IGBT transistors together with associated snubber circuits. The principal stages of power conversion process are:

(a) power supply input;
(b) input filter;
(c) three phase inverter and transformer; and

(d) inverter output filter.

Various protective circuits are employed to safeguard the system as well as to prevent the generation of harmonics which cause interference to external systems.

2.8 Power Circuits of the BE Locos

2.8.1 For Mark I,II BE locos:

(a) The traction propulsion equipment are depicted in Drg. No. OD4/312/00005/0001 entitled "BE Loco (MK I,II) Power Circuit Diagram Battery Electric Locomotive".

(b) The 750VDC driven auxiliary equipment are depicted in Drg. No. OD4/312/00005/0002 entitled "Dual Mode Locomotive (Mark I,II) Auxiliary Circuit Diagram".

2.8.2 For Mark III BE locos:

(a) The traction propulsion equipment are depicted in Drg. Nos. OD4/313/00005/0026 entitled "BE Loco (MK III) Power Circuit Diagram", OD4/313/00005/0027 entitled "BE Loco (MK III) Power Circuit Diagram", and OD4/313/00005/0028 entitled "BE Loco (MK III) Power Circuit Diagram".

(b) The 750VDC driven auxiliary equipment are depicted in Drg. No. OD4/313/00005/0049 entitled "BE Loco (Mark III) Auxiliary Circuit Diagram".

2.8.3 The flow of power from the 1,500VDC overhead line supply is fed to the two series wound dc motors and regulated by two dc to dc convertors i.e. choppers. The first stage of power conversion is to step the overhead line supply down to 750VDC nominal. Connected across the voltage source is a 350 cell, 365Ah lead acid battery and the second chopper. The battery is a power source for the locomotive when there is no 1,500VDC overhead line supply available. The motor chopper, using the 750VDC intermediate link as its supply, regulates the power supply to the traction motors. A motor-alternator set is connected across the 750VDC link to generate 3 phase, 440VAC 60Hz power for the locomotives and train auxiliaries. No re-generative braking function is provided by the BE locos.

2.8.4 The BE loco's power conversion equipment has four modes of operation:

(a) Battery charging mode

In this mode the line chopper charges the traction battery without power being supplied to the motors. The line switches are closed and the motor contactor open. The line chopper regulates the charging current, or the input voltage to the battery terminals.

(b) Operation with overhead line supply

In this mode the line chopper runs constantly as long as the line voltage is within limits, to maintain the correct battery charging conditions and to supply the motor alternator set. When the traction control electronics receives a power demand, the motor contactor closes, the reverser is set in the correct direction and the motor chopper controls the level of current in the two series connected motors.

(c) Operation off the traction battery

If no overhead supply is present, the line switches are opened and the line chopper disabled. If the auxiliaries circuit are set, the motor alternator set runs continuously off the traction battery and when a power demand is presented to the traction control system, the motor chopper supplies power from the traction battery to the traction motors.

(d) Operation without the traction battery

This is not a normal operational mode. However, if the traction battery has been isolated due to earth leakage or a short circuit fault, it is possible to still use the line chopper to provide a voltage source for the motor chopper for emergency operation purpose.

3 Compatibility Requirements

3.1 Electrical Compatibility

3.1.1 In order to ensure the compatibility with the 50Hz track circuit before it is obsolete by minimising the currents due to substation 50Hz ripple voltage, the following provisions have been made on the EMUs:

(a) For the propulsion choppers:

(i) Input impedance in the range 47 to 52 Hz of all traction equipment are designed to be inductive and not less than 1.2 Ω under all operating conditions. In addition, the principal resonant frequency of the input filter is not greater than 40 Hz.

(ii) An EMI monitors, namely, the 50Hz line ripple detector is provided on all EMUs, such that, for any 50Hz component which is greater than $2.5A_{rms}$ ± 5% for 250ms. The detector bandwidth is 44 Hz to 60 Hz and the time to detect the current and isolate the traction equipment will not exceed 250 ms.

(b) For the auxiliary converters:

(i) Input impedance in the range 47 to 52 Hz of all traction equipment are designed to be inductive and not less than 10 Ω under all operating conditions. In addition, the principal resonant frequency of the input filter is not greater than 40 Hz.

(ii) The filter initial charging current is limited by a series resistor. The settling time of the filter is less than 250 ms i.e. the line current of the filter of one converter falls to less than 0.25 A r.m.s. within 250 ms of closing the converter line contactor at a line voltage of 1800 VDC.

(iii) An EMI monitor, namely, the 50Hz line ripple detector is provided on all EMUs, such that, for any 50Hz component which is greater than $0.4A_{rms}$ ± 5% for 250ms. The detector bandwidth is 44 Hz to 60 Hz.

(c) For the auxiliary static inverters:

(i) Input impedance in the range 47 to 52 Hz of all traction equipment are designed to be inductive and not less than 10 Ω under all operating conditions. In addition, the principal resonant frequency of the input filter is not greater than 40 Hz.

(ii) The filter initial charging current is limited by a series resistor. The settling time of the filter is less than 250 ms i.e. the line current of the filter of one inverter falls to less than 0.25 A r.m.s. within 250 ms of closing the inverter line contactor at a line voltage of 1800 VDC.

3.1.2 Similar to Clause 3.1.1 above, the following provisions have been made for the input chopper of the BE locos for 50Hz track circuit compatibility:

(a) Input impedance in the range 47 to 52 Hz of the chopper equipment is designed to be inductive and not less than 1.2 Ω under all operating conditions. In addition, the principal resonant frequency of the input filter is not greater than 40 Hz.

(b) An EMI monitor, namely, the 50Hz line ripple detector is provided on all BE locos, such that, for any 50Hz component which is greater than $3.25A_{rms}$ ± 5% for 250ms. The detector bandwidth is 44 Hz to 60 Hz and the time to detect the current and isolate the traction equipment will not exceed 250 ms.

3.1.3 The operating frequency of the chopper equipment of all electric vehicles is 520 Hz with an allowable tolerance of ± 1 Hz.

3.1.4 A chopper frequency detector is fitted on the chopper equipment such that deviation from the operating frequency will cause the traction or auxiliary equipment to be mechanically latched out.

3.1.5 The detector settings are ± 4 Hz at the operating frequency of 520 Hz. The time to detect the drift and isolate the chopper equipment will not exceed 0.25 second.

3.1.6 For the ATP carrier frequencies of 1365 Hz and 1953 Hz, the magnitude of input current at these carrier frequencies will not exceed 200 mA_{rms}. Also, the magnitude of voltage induced in a 10 metre loop of cable clipped to the rails will not exceed 50 mV_{rms} in the 1320-1410 Hz band or 80 mV in the 1900-2000 Hz band.

3.1.7 For commutation purpose of the dc traction motors of the EMUs, the maximum motor current is 600 A and the current ripple is < 20%.

3.1.8 The design of the train system shall ensure that no adverse effect to the normal operation of the above safety provisions of the electric vehicles will be caused by the operations of the train.

3.2 Electric Braking Compatibility with the EMUs

3.2.1 The receptivity of the overhead line is determined by the presence of other motoring electric vehicles on the system able to absorb the regenerated energy. If there is insufficient capacity to absorb the regenerated energy then the line voltage will tend to rise to an unacceptable level, for example the line becomes non-receptive.

3.2.2 When a regenerating EMU encounters a non-receptive line and the system voltage rises through the range 1,670VDC to 1,770VDC then the electric brake demand is automatically reduced from maximum to minimum, and replacement air braking is blended in to maintain the overall brake effort. This will either continue until an equilibrium is achieved i.e. with a line having limited receptivity, or until minimum electric brake demand is achieved should the line be totally nonreceptive.

If the electric brake cannot be reduced quickly enough to keep the voltage below 1,770VDC, then, as the voltage rises above 1,770VDC so the thyristor of the rheostatic chopper is turned "on" to divert the regenerated energy into the brake resistor where it is dissipated as heat until the electric braking has reduced such that either equilibrium is achieved in the purely regenerative mode or the electric brake demand has ramped down to zero and the air brake has taken over i.e. the line is non-receptive. The range of operation of the rheostatic brake is between 1,770VDC with the thyristor of the rheostatic chopper at minimum "on" time, to 1,830VDC with the thyristor of the rheostatic chopper fully "on".

3.2.3 In the event of a regenerative EMU encountering a sudden complete loss of receptivity, for example traversing a line section insulator, the voltage on the unit will rise rapidly such that the thyristor of the rheostatic chopper will immediately turn on to divert the regenerated energy into the braking resistor. Additionally, the electric brake demand will commence ramping down to minimum and the air brake will commence blending in. On restoration of receptivity the voltage will revert to the line voltage and the thyristor of the rheostatic chopper would ramp "off" rapidly. Electric brake demand will ramp up to its previous level and the air brake will fade off. For a brief transient such as passing a section insulator the electric brake will be maintained through the line loss interval by the rheostatic brake.

3.2.4 The electric braking performance of the trains shall ensure its compatibility with the electric brakes of the Urban Lines Trains.

3.2.5 The electric braking performance of the trains shall also maximise the utilisation of regenerative braking energy under the co-working of the trains and the Urban Line Trains in a running mainline.

3.3 Recovery Compatibility with the EMUs

3.3.1 During the emergency operations (refer to PS 9.11), the train shall meet the two recovery requirements, namely, push out and the "train to train" emergency evacuation.

3.3.2 Pushing out of an immobile Urban Lines Train

(a) When the train is pushing out of an immobile Urban Lines Train, the trains shall be able to couple mechanically and then the following operation will be carried out at the immobile Urban Lines Train:

(i) apply all parking brakes by venting all main pneumatic air; and
(ii) release all friction brakes by operating the brake isolation cocks.

(b) The train shall be able to push the immobile Urban Lines Train under the conditions specified in PS 4.4.3 taking into account of the car weights specified in Clause 2.6 above.

(c) In order to avoid any potential electrical fault caused by the different applications of contact pins of the electrical box. Due consideration shall be given to the trainlines allocation on the electrical box such that there is no equipment damages or abnormal behaviours, in the Urban Lines Train or the train, if the cab end electrical boxes of the train and the Urban Lines Train are mated. Urban Lines Train cab end electrical box contact pin arrangements are shown on Drg. No. C6014-14E/TSEG/157/001" Urban Lines Trains Cab End Coupler Electrical Box Pin Arrangement".

(d) It shall be noted that frequent braking and re-motoring may be required during the push-out operation, the train shall be able to push the immobile Urban Lines Train from any point of the running mainline to the nearest depot at speed of less than 10 km/h without any adverse effect to the train equipment.

3.3.3 Being pushed out by an Urban Lines Train

(a) When the train became immobile and is pushed out by an Urban Lines Train, the train shall be able to be coupled mechanically and pneumatically by the Urban Lines Train. The service and emergency brake of the immobile train shall be controlled by and synchronised with the assisting Urban Lines Train.

(i) The service and emergency brake of the immobile train shall release when the emergency brake in the assisting Urban Lines Train is released. Emergency brake of the immobile train shall be applied in case of the two trains are separated, when any Emergency Stop pushbutton in the immobile train leading cab is operated, or when the emergency brake in the assisting Urban Lines Train is applied.

(ii) A 110V DC voltage will be provided from the assisting Urban Lines Train via the cab end coupler electrical head for control of the brake. The voltage is available by operation of the Emergency Switch in the leading cab of the Urban Lines Train to Emergency position after the cab end electrical boxes of the two trains are mated.

(b) It shall be noted that frequent braking and re-motoring may be required during the push-out operation, the train shall be able to be pushed by an

Urban Lines Train from any point of the running mainline to the nearest depot at a speed of less than 10 km/h without any adverse effect to the train equipment.

3.3.4 When the "train to train" emergency evacuation is performed between the train and an Urban Line Train, after these two trains are coupled, the emergency doors of the two trains shall be operated according to PS 9.11.2(c) and the detrainment plate (refer to PS 8.7.8) will be used to place over the couplers between the two trains to work as a walkway for the above "train to train" detrainment.

3.4 Shunting Compatibility with the EMUs and Locomotives

When the train is undergoing high level maintenance and train movement is required with no motive power available, a locomotive will be used to couple with the train or Train Unit for shunting purpose. Therefore, it is a requirement that the autocoupler of the train shall be compatible with the existing Urban Lines BSI coupler (refer to PS 14.1.5) used on both EMUs and locomotives.

3.5 Electro-Magnetic Compatibility (EMC) with EMUs and BE Locos

3.5.1 For the purpose of this Contract, the Contractor shall assume that there shall be no electro-magnetic interference (EMI) limit (except the limits associated with the monitoring circuits of the 50Hz line ripple detector and chopper frequency detector specified in Clause 3.1 above) applied to the Urban Lines Trains and BE locos. Similarly, no EMI immunity protection shall be required by the electric vehicles when they are operated together with the train.

3.5.2 If necessary, the Contractor shall measure the EMC performance of the electric vehicles, at his own expense, to satisfy himself with the interface design requirements. At the discretion of the Engineer, the electric vehicles can be arranged for the above purpose.

3.5.3 The design of the train system shall ensure that:

(a) The train system shall be immune against any EMI generated from the electric vehicles; and

(b) The train system shall not generate excessive EMI affecting the normal operation of the electric vehicles particularly there shall be no nuisance operation of those EMI monitors of the electric vehicles, for example, the 50Hz line ripple detector and chopper frequency detector.

3.6 Compatibility Tests

3.6.1 The Contractor shall demonstrate to the satisfaction of the Engineer by appropriate tests including on-site tests that all compatibility requirements for the electric vehicles are met.

3.6.2 By the end of SEMP stage 3, the Contractor shall perform an analysis of the 1,500VDC power circuits of the train and all electric vehicles, using well accepted modelling techniques, which shall demonstrate that the train system will not introduce any circuit resonances, or similar undesirable effects, which would cause incompatibility with the electric vehicles. The analysis shall include all operating conditions specified in this PS.

3.6.3 The analysis, together with details of the modelling system and the mathematical model of the train system shall be submitted for Approval.

3.6.4 During SEMP stage 4, the model shall be updated as design information (refer to Appendix N Clause 7) becomes available until final verification can be confirmed during compatibility tests of the vehicles at SEMP stage 5.

4 Electric Vehicles Power Circuit Component Information

The electric vehicles power circuit component information are depicted in Tables App-I-Annex-7-2 to App-I-Annex-7-21.

Table App-I-Annex-7-1 Stock Allocation of the Electric Vehicles

Contract	Car Number	Stock Type	A Car	B Car	C Car	D Car	Sub-total
E1 (CM-Stock)	AC101 - AC170	M	70		70		140
E1A (CM Stock)	BC401 - BC435	M		35	35		70
351 (CT Stock)	AC171 - AC207 BC436 - BC473 (less BC459)	T T	37	 37	37 37		74 74
351A (CT Stock)	AC208 - AC232 BC474 - BC479	T T	25	 6	25 6		50 12
451 (CT Stock) 451 (Trailer) 451 (Special "A" car) 451 (B to D Conversion)	AC233 - AC243 D601 - D702 A244 - A247 BC480 to D703, C244 BC481 to D704, C245 BC482 to D705, C246 BC483 to D706, C247	T Q T T T T T	11 4		11	 102 1 1 1 1	22 102 4 2 2 2 2
451A (Melco Chopper)	AC248 - AC256	I	9		9		18
451B (Melco Chopper)	BC459 (RCT prototype Chopper)	I		1	1		2
451C (Trailer)	D707 - D752	Q				46	46
451D/E (GEC Chopper) (Trailer)	AC257 - AC269 BC480 - BC485 D753 - D763	G G Q	13	 6	13 6	 11	26 12 11
901 (H Stock) (Trailer)	AC270 - AC286 BC486 - BC495 D764 - D785	H H Q	17	 10	17 10	 22	34 20 22
1661 (Trailer)	D786 - D788	Q				3	3
651 (K Train)	ACB301 – ACB326 BC801 – BC813	K	26	39	39		104
C6554 (C Trains)	ACB351 – ACB394 BC851 – BC872	C	44	66	66		176
		Total	256	200	386	188	1030

Contract	Car Number	Stock Type	Sub-total
333	L51 - L55	Mark I	5
936	L56 - L61	Mark II	6
971	L62 - L82	Mark III	21
		Total	32

Table App-I-Annex-7-2 CM/CT-Stock Cars Power Circuit Component Information

Dwg. OD4/305/00141/0001 and OD4/305/00241/0004 - Power Circuit Diagram For EMU Cars	
Equipment	**Specification**
AZ1,2	0.909ohm
BZ	0.34ohm
CCZ	6ohm
FCZ1,2	0.234ohm
FDZ1,2	0.2ohm
FK	1755uF
FL	5.5mH, 0.0074ohm
KDZ	9kohm
LL11,12	16uH, 0.0035ohm
LL2	6.5uH, 0.002ohm
RFK	0.22uF
SDZ1,2	100kohm
TFK	1755uF
TFL	6.9mH, 0.014ohm
TFZ	15ohm
TSN11,12 - Ci	2uF
TSN11,12 - Cs	20uF
TSN11,12 - K2-K4	68nF
TSN11,12 - RR	0.159ohm
TSN11,12 - Z2-Z5	10ohm
TSN2 - K1	6uF
TSN2 - Z1	5ohm
DSN3,21,22 - K1	1uF
DSN3,21,22 - Z1	5ohm
Traction motor - armature	0.016ohm
Traction motor - series field	0.0274ohm
Traction motor - compole field	0.0104ohm

Table App-I-Annex-7-3 G-Stock Cars Power Circuit Component Information

Dwg. OD4/303/00042/0027 - Power Circuit Diagram For E.M.U. Cars	
Equipment	**Specification**
AZ1,2	0.909ohm
BZ	0.34ohm
CCZ	24ohm
FCZ1,2	0.234ohm
FDZ1,2	0.2ohm
FK	1755uF
FL	5.5mH
KDZ	3900ohm
LL2,11,12	15.4uH
RFK	0.22uF
SDZ1,2	100kohm
TFK	1755uF
TFL	6.9mH, 0.014ohm
TFZ	15ohm
TSN11,12 - GK	2.2uF
TSN11,12 - GZ1,2	2.2ohm
TSN11,12 - K1	6uF
TSN11,12 - Z1-Z6	30ohm
TSN2 - GK	1uF
TSN2 - GZ1,2	10ohm
TSN2 - K1	6uF
TSN2 - Z1-Z3	15ohm
DSN11,12 - K1	1uF
DSN11,12 - Z1,2	10ohm
Traction motor - armature	0.016ohm
Traction motor - series field	0.0274ohm
Traction motor - compole field	0.0104ohm

Table App-I-Annex-7-4 H-Stock Cars Power Circuit Component Information

Dwg. OD4/306/00041/0001 - Power Circuit Diagram For EMU Cars	
Equipment	**Specification**
AZ1,2	0.909ohm
BZ	0.34ohm
CCZ	6ohm
FCZ1,2	0.234ohm
FDZ1,2	0.2ohm
FK	1755uF
FL	5.5mH, 0.0074ohm
KDZ	9kohm
LL11,12	16uH, 0.0035ohm
LL2	6.5uH, 0.002ohm
RFK	0.22uF
SDZ1,2	100kohm
TFK	1755uF
TFL	6.9mH, 0.014ohm
TFZ	15ohm
TSN11,12 - Ci	2uF
TSN11,12 - Cs	20uF
TSN11,12 - K2-K4	68nF
TSN11,12 - RR	0.159ohm
TSN11,12 - Z2-Z5	10ohm
TSN2 - K1	6uF
TSN2 - Z1	5ohm
DSN3,21,22 - K1	1uF
DSN3,21,22 - Z1	5ohm
Traction motor - armature	0.016ohm
Traction motor - series field	0.0274ohm
Traction motor - compole field	0.0104ohm

Table App-I-Annex-7-5 I-Stock Cars Power Circuit Component Information

Dwg. OD4/302/00003/0011 - Schematic Diagram Of Power Circuit	
Equipment	**Specification**
AFC	534uF
AFL	22uH
AFR	100ohm
BSR	0.227ohm
CDR1	0.378ohm
CDR2	0.95ohm
CHR (E5-E6)	3.325ohm
CHR (E6-E7)	3.325ohm
CHR (E7-E7D)	16.4ohm
CMC1,2	24uF
CMC3	28uF
CMCR1,2	50ohm
FC	534uF
FL	5.5mH
IS1,2	2-7mH
MSL1,2	11mH
NVR	1330ohm
NVRR	3600ohm
OVCR	2060ohm
OVCRR1	18kohm
OVCRR2	18kohm
WFR1 (E10-E15)	0.0844ohm
WFR1 (E15-E15A)	0.0535ohm
WFR2 (E13-E17)	0.0909ohm
WFR2 (E17-E17A)	0.0589ohm
Traction motor - armature coil	0.0196ohm
Traction motor - main coil	0.01233ohm
Traction motor - commutating coil	0.0310ohm

Table App-I-Annex-7-6 K Train Cars Power Circuit Component Information

Dwg. OD4/361/00742/0034 - Power Circuit Diagram For EMU Cars	
Equipment	**Specification**
CHRe	7.2ohm (3.6ohm × 2S)
DCHRe	250ohm (500ohm x 2P)
FL	10mH
OVR	2.5ohm
BR	1.776ohm
FCR	33kohm
FC	6600uF (3300uF x 2)
C11A &C11B	22uF
IM	0.148ohm (phase resistance at 150 °C)

Table App-I-Annex-7-7 CM/CT/I-Stock Cars Auxiliary Static Inverter Component Information

Dwgs. C6014-14E/TSEG/637/001 & 002 – Schematic Diagram of SIV Power Circuit	
Equipment	**Specification**
L1	9mH
R3, R4, R9	27ohm
C1, C2	3800uF
R5, R6	20k ohm
R7, R8	680 ohm
C3~C8	0.1uF

Table App-I-Annex-7-8 G-Stock Cars Auxiliary Inverter Circuit Component Information

Dwg. OD4/303/00042/0108 - Circuit Diagram Of Static Auxiliary Inverter	
Equipment	**Specification**
AICZ1,2	11ohm
DSN1 - K	0.25uF
FK	1755uF
FKDZ1,2	27kohm
FL	46mH, 0.035ohm
IT	Primary : 0.1026ohm, Secondary : 0.035ohm
KDZ1,2	3.9ohm
LFK	2000uF
LFL	7mH
LKDZ	470kohm
LL	16uH
RFIK	0.22uF
TFK	1755uF
TFL	10.1mH
TSN1 - K1	1uF
TSNA,B - K	1uF
TSNA,B - Z1,2	2.5ohm
TSN1 - Z1-Z8	10ohm
DSN1 - Z1-Z4	5ohm

Table App-I-Annex-7-9 H-Stock Cars Auxiliary Converter Circuit Component Information

Dwg. OD4/306/00063/0003 - Circuit Diagram Of Static Auxiliary Converter	
Equipment	**Specification**
AICZ1,2	22ohm
CSK1	1.5uF
CSK2	5uF
CSZ	0.195ohm
FK	1000uF
FKDZ1,2	27kohm
FL	46mH
IL1-3	4uH
ISK1-6	2uF
ISZ1-3	4.7ohm
IT	Primary : 0.1026ohm, Secondary : 0.035ohm
KDZ1,2	6ohm
LFK	2000uF
LFL	7mH
LKDZ	47kohm
LL	10uH
RFIK	0.22uF
TFK	1000uF
TFL	10.1mH
DSN1,2 - K	0.033uF
DSN1,2 - Z1,2	10ohm
DSN3 - K	0.033uF
DSN3 - Z	4.7ohm

Table App-I-Annex-7-10 K Train Cars Auxiliary Static Inverter Component Information

Dwg. OD4/361/00741/9731 - Auxiliary Circuit Diagram A-C-B Cars	
Equipment	**Specification**
FL	12mH (at 110A)
RC	250ohm (50 ohm x 5S)
RD	17.5kohm (35kohm x 2P)
FC1, FC2	3000uF
ACC	430uF × 3 phase

Table App-I-Annex-7-11 CM -Stock Cars Auxiliary Circuit Component Information

Dwg. OD4/305/00162/0001 - Auxiliary Circuit Diagram A-CT-D Cars	
Equipment	**Specification**
Air compressor - motor armature	3.52ohm
Air compressor - motor compole	1.28ohm
Air compressor - motor main field	5.97ohm
CPZ	2.33ohm

Table App-I-Annex-7-12 CT -Stock Cars Auxiliary Circuit Component Information

Dwg. OD4/305/00262/0001 - Auxiliary Circuit Diagram A-CT-D Cars	
Equipment	**Specification**
Air compressor - motor armature	3.52ohm
Air compressor - motor compole	1.28ohm
Air compressor - motor main field	5.97ohm
CPZ	2.33ohm

Table App-I-Annex-7-13 G -Stock Cars Auxiliary Circuit Component Information

Dwg. OD4/303/00063/0011 - Auxiliary Circuit Diagram EMU 'A'-'CT'-'D'	
Equipment	**Specification**
Air compressor - motor armature	6.87ohm
Air compressor - motor main field	5.42ohm
Air compressor - motor compole	3.01ohm
CPZ	2.33ohm

Table App-I-Annex-7-14 H-Stock Cars Auxiliary Circuit Component Information

Dwg. OD4/306/00063/0004 - Auxiliary Circuit Diagram EMU 'A'-'CT'-'D'	
Equipment	**Specification**
Air compressor - motor armature	6.87ohm
Air compressor - motor main field	5.42ohm
Air compressor - motor compole	3.01ohm
CPZ	2.33ohm

Table App-I-Annex-7-15 I-Stock Cars Auxiliary Circuit Component Information

Dwg. OD4/302/00303/0002 - Auxiliary Circuit Diagram A-CT-D Cars	
Equipment	**Specification**
Air compressor - motor armature	3.52ohm
Air compressor - motor compole	1.28ohm
Air compressor - motor main field	5.97ohm
CPZ	2.33ohm

Table App-I-Annex-7-16 Mark I/II BE Loco Power Circuit Component Information

Dwg. OD4/312/00005/0001 - Power Circuit Diagram	
Equipment	**Specification**
FLZ	3.47ohm
L10	8mH
C4	1uF
C5	3.3mF
R13	0.485ohm
L14	13.5mH
C3	46uF
R7-12	450ohm
L11	325uH
L7	50uH
L8	15uH
L9	15uH
L6	5.5mH
L5	17.5mH
CCZ	1.52ohm
BCZ	1ohm
C2	2.4mF
L4	10uH
FDZ	0.0259ohm
R1-6	266ohm
L3	10uH
L2	210uH
L1	1.891mH
C1	70uF
Traction motor - armature	0.0135ohm
Traction motor - interpole	0.0074ohm
Traction motor - main pole winding	0.00912ohm

Table App-I-Annex-7-17 Mark I/II BE Loco Auxiliary Circuit Component Information

Dwg. OD4/312/00005/0002 - Auxiliary Circuit Diagram	
Equipment	**Specification**
MAZ1	8ohm
MAZ2	0.25ohm
MAZ3-4	83ohm
MAZ5-6	83ohm
Motor alternator - motor armature	0.369ohm
Motor alternator - motor interpoles	0.225ohm
Motor alternator - motor shunt field	162ohm
Motor alternator - motor shunt field ballast resistor	200 - 330ohm

Table App-I-Annex-7-18 Mark III BE Loco Power Circuit Component Information

Dwg. OD4/313/00005/0026,0027,0028 - Power Circuit Diagram	
Equipment	**Specification**
NVRZ	200kohm
NVR	48.5kohm
LSCZ	3.47ohm
LFL	8mH
LFCP	3mF
TFCP	750uF
TFDZ	0.485ohm
TFL	13.5mH
LCL	7-8uH
LERCP	20uF
LSCP	0.5uF
MFL	5.5mH
BCZ	1ohm
BCL	15-20mH
MSCP	4uF
MSCZ	1.52ohm
MFCP	2400uF
FDZ	0.0259ohm
MCL	3-3.5uH
MERCP	20uF
LCDZ1-3	10kohm
LSDZ1-4	1Mohm
LSDZ5	60ohm
LDSCP1-4	0.5uF
LSZ1-6	12ohm
LFDSZ1-3	15ohm
MCDZ1-2	10kohm
MFDSZ1-3	15ohm
MDSCP1-4	0.5uF
MSDZ1-3	1Mohm
MSZ1-6	12ohmTraction motor - armature0.0135ohm
Traction motor - field	0.0912ohm

Table App-I-Annex-7-18 Mark III BE Loco Power Circuit Component Information

Dwg. OD4/313/00005/0026,0027,0028 - Power Circuit Diagram	
Equipment	**Specification**
Traction motor - interpole	0.074ohm

Table App-I-Annex-7-19 Mark III BE Loco Auxiliary Circuit Component Information

Dwg. OD4/313/00005/0049 - Auxiliary Circuit Diagram	
Equipment	**Specification**
MAZ1	8ohm
MAZ2	0.25ohm
MAZ3-4	91.5ohm
MAZ5-6	83ohm
Motor alternator - motor armature	0.369ohm
Motor alternator - motor interpoles	0.205ohm
Motor alternator - motor shunt field	162ohm
Motor alternator - motor shunt field ballast resistor	200 - 330ohm

Table App-I-Annex-7-20 C-Train Cars Power Circuit Component Information

Dwg. C6014-14E/TSEG/637/003 - Power Circuit Diagram For EMU Cars	
Equipment	**Specification**
CHRe	7.5ohm (3.75ohm × 2S)
DCHRe	250ohm (500ohm x 2P)
FL	19mH
BR	1.63ohm (At 20 °C)
FCR	33kohm
FC	6600uF (2200uF x 3)
C11A &C11B	22uF
IM	0.148ohm (phase resistance at 150°C)

Table App-I-Annex-7-21 C-Train Cars Auxiliary Static Inverter Component Information

Dwg. C6014-14E/TSEG/637/004 – Circuit Diagram of Auxiliary Static Inverter	
Equipment	**Specification**
FL	12mH
RC	50 ohm x 5
RD	75ohm x 2
FC1, FC2	6000uF, 1050V x 2s
ACC	430uF × 3

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 8 NOT USED

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 9 DYNAMIC ROUTE MAP INTERFACES

1 Introduction

2 Dynamic Route Map

Attachment App-I-Annex-9 Operation and Maintenance Manual of the Real Time Transmission Facilities

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 9 DYNAMIC ROUTE MAP INTERFACES

1 Introduction

1.1 This document defines the interface requirements for the Dynamic Route Map (DRM) and the train system/equipment including TMS, DVAS & PA, GSM Modem Assemblies and Doors.

1.2 The Contractor shall install all the DRM equipment as stipulated in PS 10.4.2. All the required connectors, interfacing plugs and sockets, earthing connections and all associated mounting materials shall be provided by the Contractor.

1.3 The Contractor shall provide accommodation including mountings, equipment cabinets and cable access for the installation of all the DRM equipment as stipulated in PS 10.4.2.

1.4 The Contractor shall provide the appropriate power supply, including the power supply interface and the protection device to all the DRM equipment as stipulated in RS/C6014/02.

1.5 The Contractor shall provide all required EMI protective measures, such as special EMC cubicle, to protect the DRM equipment in order to fulfil the EMC requirements as stipulated in RS/C6014/04.

1.6 The Contractor shall incorporate appropriate interfaces, power supply, delivery schedule, installation, testing and setting to work. The Contractor shall ensure that the equipment can be easily operated, removed and replaced.

1.7 The Contractor shall be responsible for the test and commissioning of all DRM equipment and interfaces.

1.8 EMC Consideration and Constraints

1.8.1 The Contractor shall ensure that all train equipment is designed and constructed in accordance with RS/C6014/04 or equivalent, to ensure proper functioning of all the DRM equipment.

1.8.2 The Contractor shall ensure the EMC is achieved between all the DRM equipment and train systems. The Contractor shall ensure each DRM equipment shall be fully functional without suffering interference from any other equipment.

1.8.3 The Contractor shall, through this interface, develop a Compatibility Specification which shall identify the possible interference sources and define the levels of susceptibility and emissivity for all the trainborne DRM

equipment that will guarantee compatibility in SEMP Stage 2. A Compatibility Study shall be developed in SEMP Stage 3 to document the steps taken to ensure that the defined level of susceptibility and emissivity is achieved for all DRM equipment and train systems.

1.8.4 Train systems and equipment shall be EMC tested in SEMP Stage 4 in accordance with RS/C6014/04 to demonstrate compliance with the PS. An appropriate technical construction file shall be developed in accordance with the EC EMC Directives and be certified by an appropriate Competent Body for the compliance of the EMC Directives.

2 Dynamic Route Map

2.1 The system block diagram of the DRM is shown in Figure 1. The Contractor shall define the detailed interconnection between different equipment.

2.2 Performance Requirements of the DRM and Train System Interfaces

2.2.1 General

The design of the train system shall ensure that the main objectives of the DRM summarised as below can be achieved:

(a) To obtain information of door status, next station, pre-recorded DVAS & PA message codes to display next station name, pre-recorded DVAS & PA text message in parallel with the audible announcement from DVAS & PA.

(b) To relay the received real time message via the public GSM network in the Urban Lines from the GSM Modem Assemblies to the DRM. The current displaying message on DRM displays shall be interrupted and display the received real time message in accordance to the message priorities.

(c) To obtain the route information, cab status and provide equipment status reporting and equipment control.

(d) To obtain the information of door's side open/close status to display the corresponding message on DRM displays.

2.3 Design Constraints

2.3.1 Interface with DVAS & PA

The DRM shall provide an interface means in obtaining data from DVAS & PA without affecting its integrity and function subject to the Approval of the Employer as shown in Figure 1 and in the following table:

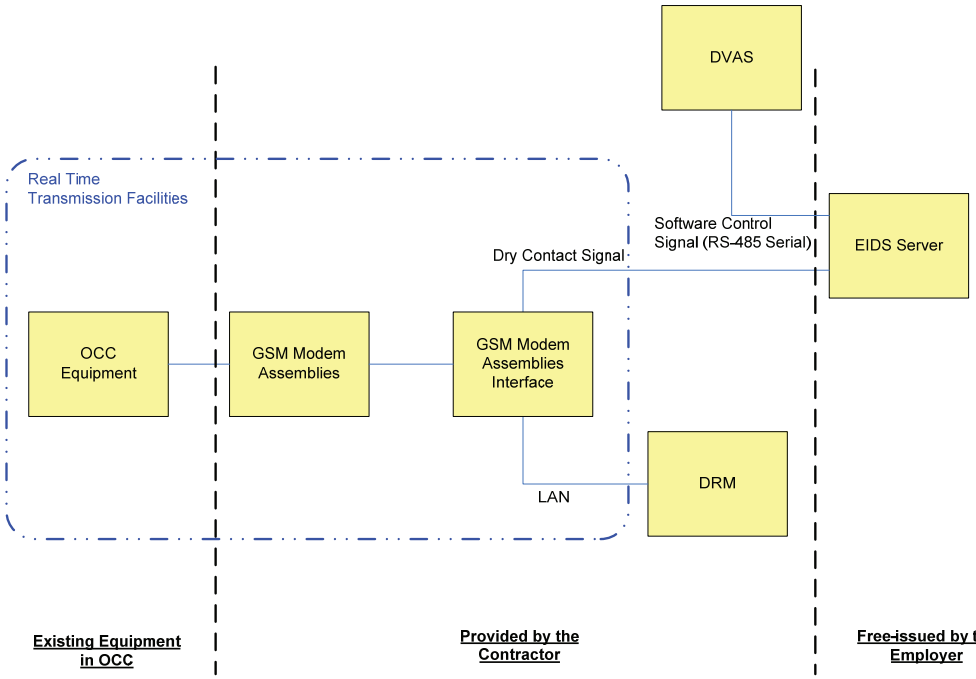
Interfaces	From	Description
Serial	DRM / DVAS & PA	Provide necessary wired communications between DRM and DVAS & PA.
	DVAS & PA	Develop the interface protocol to provide message codes to DRM for message broadcasting.

2.3.2 Interface with GSM Modem Assemblies

The DRM shall provide an interface means in obtaining data from GSM Modem Assemblies without affecting its integrity and function subject to the Approval of the Employer as shown in Figure 1 and in the following table:

Interfaces	From	Description
LAN	DRM / GSM Modem Assemblies	Provide necessary wired communications between DRM and GSM Modem Assemblies.
	GSM Modem Assemblies	Develop the interface protocol to capture live messages and train pre-recorded messages triggered from OCC to DRM for message broadcasting.

The Contractor shall purchase Wavecom Fastrack Modem M1306B or compatible equipment which shall be submitted for approval for the GSM Modem Assemblies for real time data transmission. The interface demarcation diagram is shown as follows:



(a) Power Supply and Electrical Requirement

(i) The power of the real time data receivers (GSM Modem Assemblies) shall be supplied from the DRM server and the maximum current shall be 500 mA.

(ii) The Contractor shall define and provide the power supply and electrical interface for the real time data receivers.

(b) Accommodation Requirement

The Contractor shall define the mechanical requirements (location and dimensions) to accommodate the trainborne transceivers.

(i) The size of the real time data receiver, with all necessary cases and enclosures, will not exceed 250 mm (L) x 100 mm (H) x 160 mm (W). The antennae shall not be reachable by the passengers and shall match with the saloon finish. The Contractor shall define the exact location, mounting

method and arrangement of the real time data receiver and the associated antenna.

(ii) The total weight of the trainborne real time data receiver will not be greater than 1 kg.

The Contractor shall refer to the existing Operation and Maintenance Manual of the Real Time Transmission Facilities according to Attachment App-I-Annex-9 to develop protocol of the interface between DRM and GSM Modem Assemblies.

2.3.3 Interface with TMS

The DRM shall provide an interface means in obtaining data from TMS without affecting its integrity and function subject to the Approval of the Employer as shown in Figure 1 and in the following table:

Interfaces	From	Description
Serial	DRM / TMS	Provide necessary wired communications between DRM and TMS.
	TMS	Develop the interface protocol to provide route data to DRM for route information broadcasting.
	DRM	Develop the interface protocol to provide DRM equipment status reporting to TMS and shown in graphic on TMS MMI.
	TMS	Develop the interface protocol to provide DRM equipment control functions and shown in graphic on TMS MMI.

2.3.4 Interface with Doors

The DRM shall provide an interface means in obtaining data from Doors without affecting its integrity and function subject to the Approval of the Employer as shown in Figure 1 and in the following table:

Interfaces	From	Description
Shielded Cable / Dry contacts	DRM / Doors	Provide necessary wired connections between DRM and Doors.
	Doors	Develop the door open / close status signal of A side or B side doors to DRM for displaying the related information.

2.3.5 The servers shall be of redundant designs in order to receive data/commands from different interfaces.

2.4 Confirmation of Design Information

Any change in the design constraints (including power supply, accommodation and interconnection cables wiring arrangement) as stipulated in Clause 2.2 above shall be submitted for Approval in accordance with the Configuration Control Program (refer to Appendix P) before the end of SEMP Stage 3.

Figure 1 System Block Diagram of DRM

Attachment App-I-Annex-9
Operation and Maintenance Manual of the Real Time Transmission Facilities

***The Operation and Maintenance Manual shall be read in conjunction with several interface documents which will be given after the award of the contract.**

Operation & Maintenance Manual

For

MTRCL Contract C6512-05E

Replacement of Paging System for Broadcasting Emergency EIDS Messages

Amendment History

Revision Number	Description of Change (s)	Date of Revision
V.3.9	The following sections are amended 1.1, 1.2, 1.2.3, 3.2, 3.3.3, 3.3.5, 3.4, 4.2.3, 5.3	2007-01-17
V.4.0	The following sections are amended 2.1.1, 3.3.3, 3.3.4, 4.3	2007-01-26

Table of Contents

1 GENERATION INFORMATION 5

1.1 SCOPE 5
1.2 SYSTEM DESCRIPTION 6
1.2.1 CMS Server Description 8
1.2.2 TRDR 9
1.2.3 KVM Switch 13

2 CONFIGURATION 14

2.1 GENERAL 14
2.1.1 Configuration Details 14

3 OPERATION 21

3.1 GENERAL 21
3.2 KVM SWITCH 22
3.3 CMS OPERATION 23
3.3.1 Check background processes 23
3.3.2 Check foreground processes 25
3.3.3 Alarm Monitor 28
3.3.4 Administration 33
3.3.5 Message dissemination to AEL Trains (Option 2) 57
3.3.6 Housekeeping 61
3.4 TRDR OPERATION 62

4 TROUBLESHOOTING 67

4.1 SYSTEM DIAGNOSTICS 67
4.1.1 For CMS 67
4.1.2 For TRDR 70
4.2 SYSTEM TROUBLESHOOTING 70
4.2.1 For CMS Server 70
4.2.2 For TRDR 71
4.3 CMS SIMULATOR 71
4.3.1 Procedure of installing the CMS simulator 71
4.3.2 Simulator for testing TRDR 76

5 REPLACEMENT PROCEDURE 79

5.1 FOR CMS 79
5.2 FOR TRDR 88
5.3 REINSTALLATION OF CMS SERVER 88

6 APPENDIX 115

6.1 SPECIFICATION FOR CMS PC 115
6.2 ATTACHED DOCUMENTS 116

1 Generation Information

1.1 Scope

This manual provides the information necessary to operate and maintain the Central Message Server (CMS) and Trainborne Real-time Data Receiver (TRDR) for the MTR project “Replacement of Paging System for Broadcasting Emergency EIDS Messages”

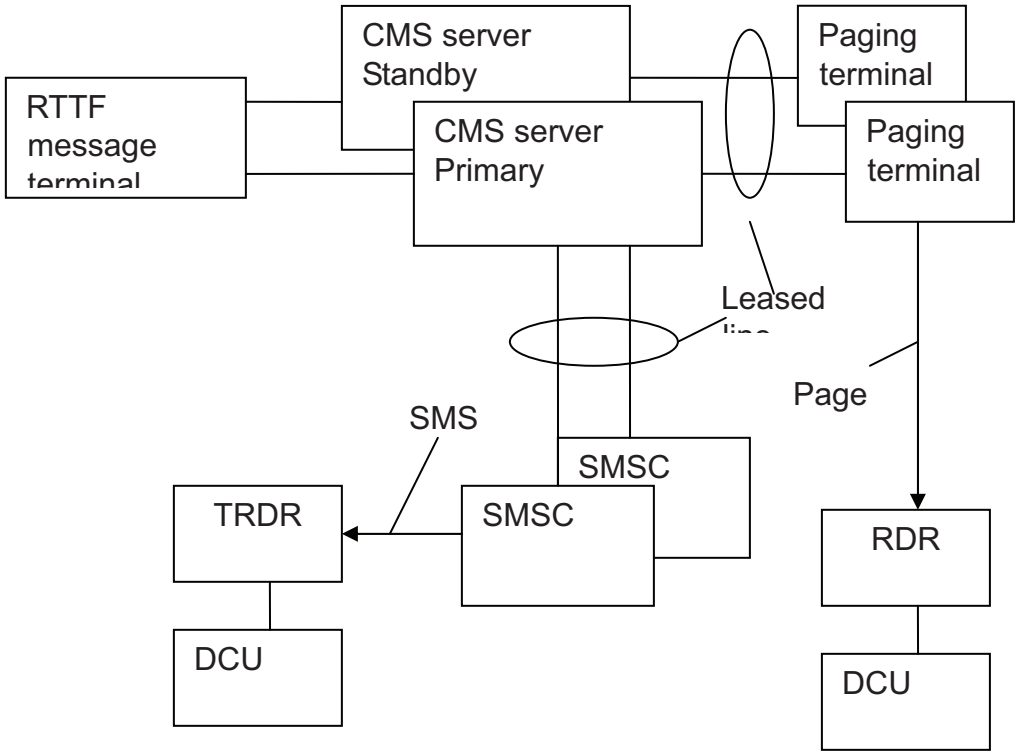
The CMS is to capture the messages from the existing Real-Time Transmission Facility (RTTF) terminal (or VCN Express Communicator), convert the messages to SMS format and send the SMS to the mobile operator.

The CMS also provides the necessary administration function for the operation and maintenance purpose.

The TRDR is a SMS receiver to replace the existing paging receiver on trains.

Option 2 includes a new interface RTTF terminal (or VCN Express Communicator) to compose and send messages for Airport Express Line trains (AEL) and the provision of TRDRs to 11 AEL trains or 22 driving cab in the AEL fleet.

1.2 System Description



The CMS server is connected between the existing RTTF terminal and the paging terminal. It accepts the RTTF message from the RTTF terminal using TAP 1.8 protocol through a serial line. The RTTF message received will be processed by the CMS server.

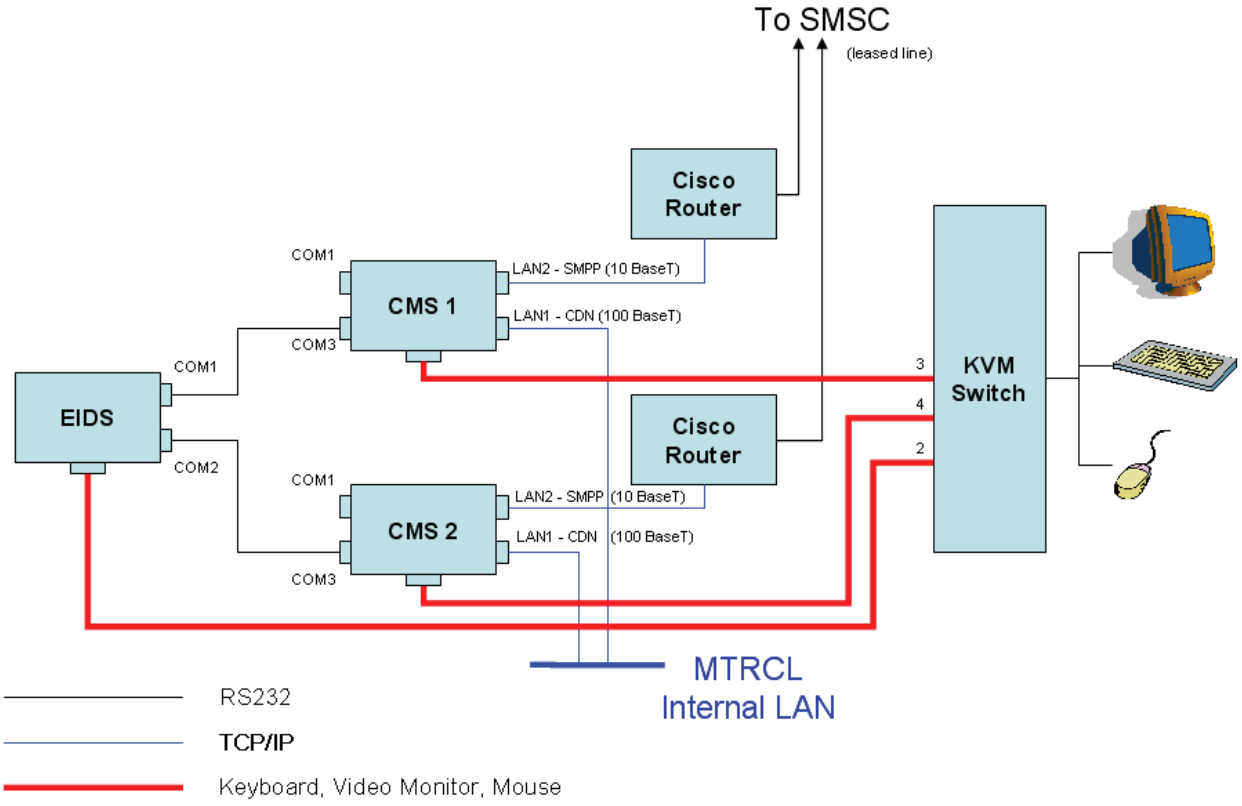
The CMS server will deliver the RTTF message to either the Paging terminal or SMSC, or both.

When the RTTF message is delivered to the paging terminal, the paging terminal will send the message to the train through their paging network. The connection between the CMS server and paging terminal is a lease line running RS232 data link protocol.

When the RTTF message is delivered to the SMSC, the SMSC will deliver the message to the train through SMS of the GSM network. The connection between CMS server and SMSC is through a lease line running on a TCPIP network. The message protocol between CMS server and the SMSC is SMPP 3.4.

The TRDR is connected to DCU, it receives the SMS message sending from CMS server and send the message to DCU for displaying.

New Systemic Diagram in OCC



CMS LAN1 – CDN (100 BaseT)
CMS LAN2 – SMPP (10 BaseT)
KVM Port2 – EIDS Terminal
KVM Port3 – CMS 1
KVM Port4 – CMS 2

1.2.1 CMS Server Description

The CMS server is installed with multiple process/service. These processes include:
- Smpp Submit Service (CMS_SmppSubmitService.exe)
- Smpp Delivery Service (CMS_SmppDeliveryService.exe)
- House Keeping Service (CMS_HouseKeepingService.exe)
- Tap Client Application (TapClientServiceForm.exe)
- Tap Server Application (TapServerServiceForm.exe)
- Alarm Monitor (AlarmMonitor.exe)
- Administration (Administration.exe)

The server is running on Windows 2003 server. It receives the RTTF message from VCN terminal through the TAP connection. The message received will deliver to the ACAR/LINE according to the RTTF message content. It can either be delivered through PSP or PMSP, or both, according to the system configuration.

If the message is being sent through the PMSP, it will be keep track to determine if it can be received by the designated train (ACAR). The delivery status can be check from the Alarm Monitor module. In addition to the delivery status, the Alarm monitor can be used to keep track of the current system connectivity, include the PSP connectivity and PMSP connectivity.

The system is configured with the Administration module which can be used to define the system setting, ACAR and the corresponding MSN (Mobile station number) mapping, User administration, House keeping etc.

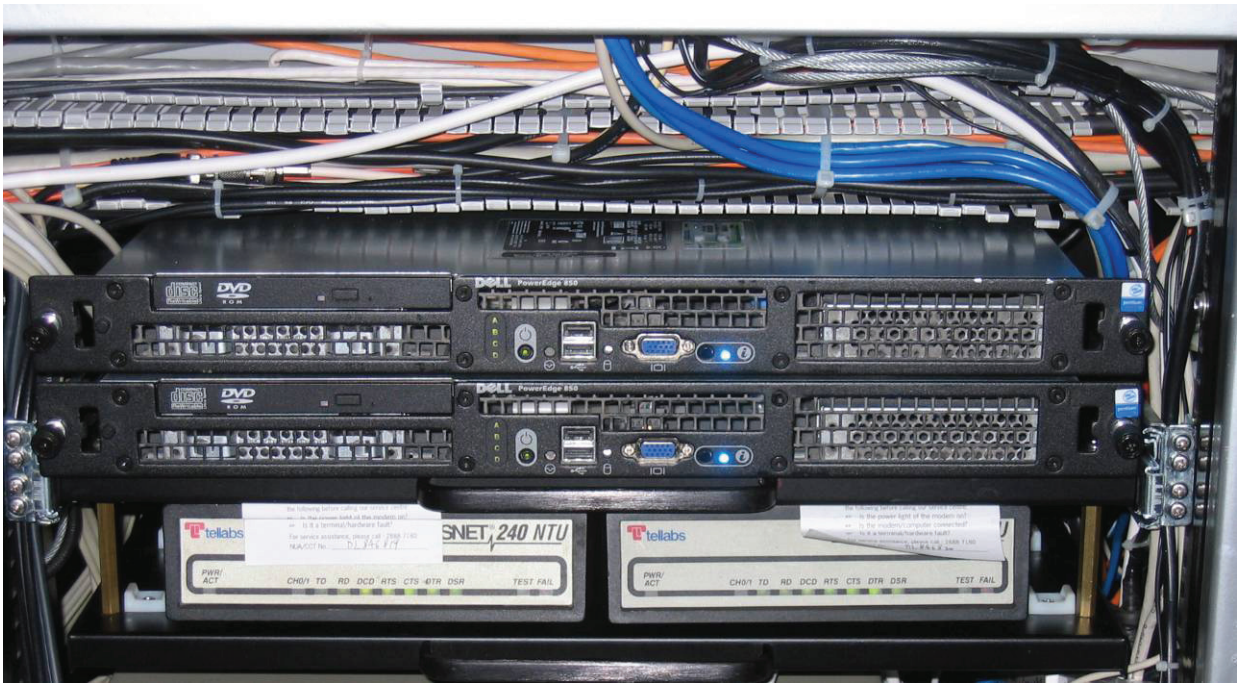
The Smpp Submit Service is used to send SMS, through the PMSP, while the Smpp Delivery Service is used to receive the SMS's delivery status.

The TAP client is used to send page through the PSP, while the TAP server is used to receive RTTF message from the VCN terminal.

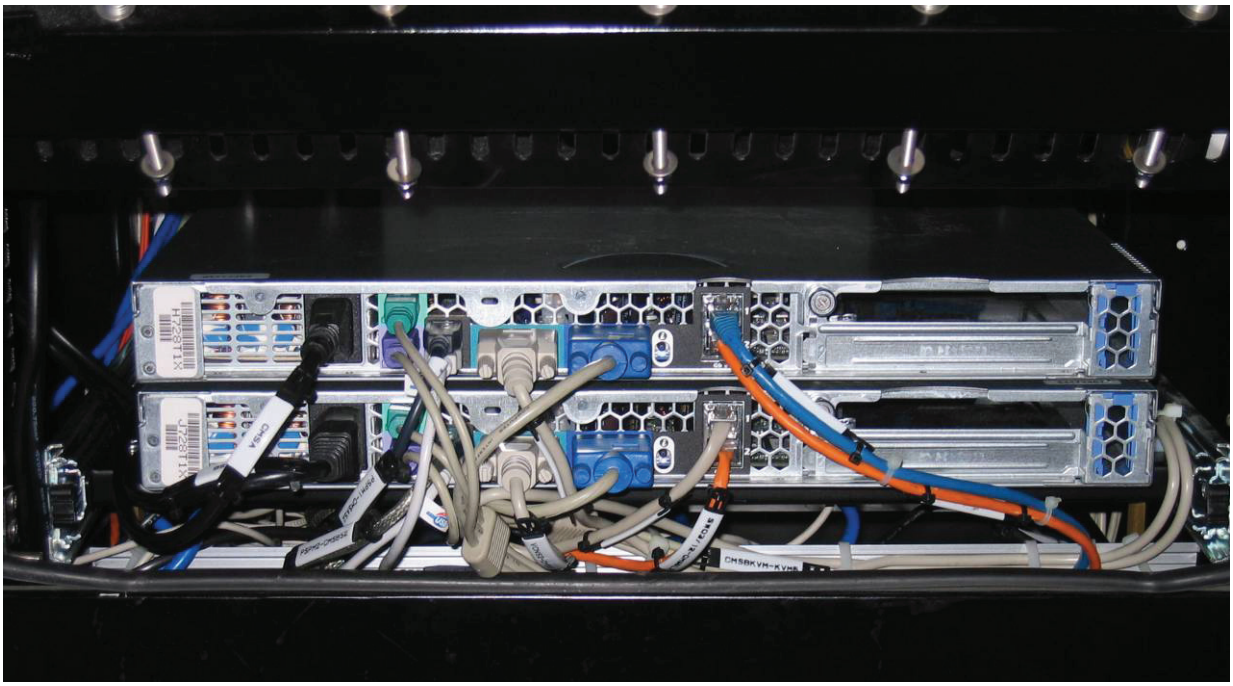
The Housekeeping Service is used to maintenance the system. It provides function such as database backup, purging etc.

Two CMS servers are running at the same time to provide hot standby. If one CMS server failure, the other can still be used to send SMS/page to the PMSP/PSP respectively.

- Front view of CMS in OCC



- Rear view of CMS in OCC



1.2.2 TRDR

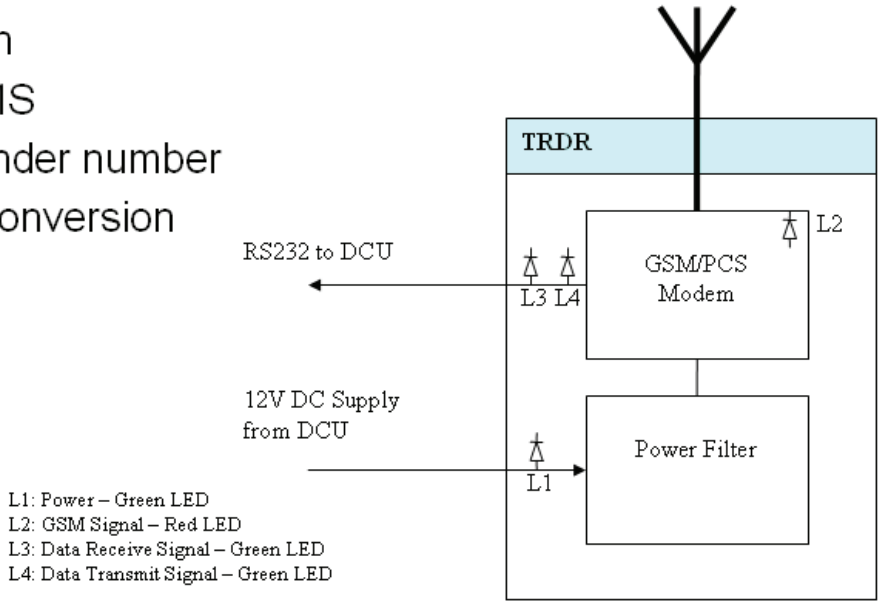
The TRDR consists of GSM modem, industrial communication controller and 12V power supply circuit. When the GSM modem receives the SMS sending from CMS server, it will trigger the controller to validate the originator of the SMS message, the

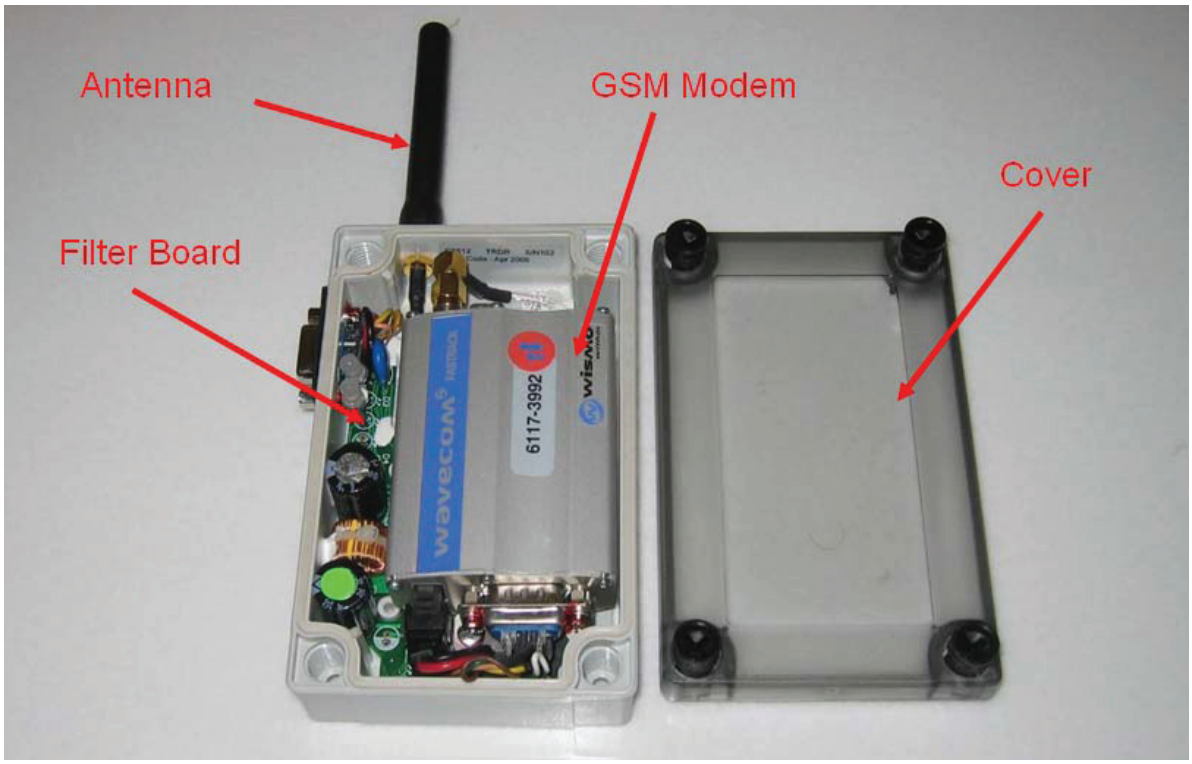
controller will convert the message to the necessary format and send it to DCU for displaying.

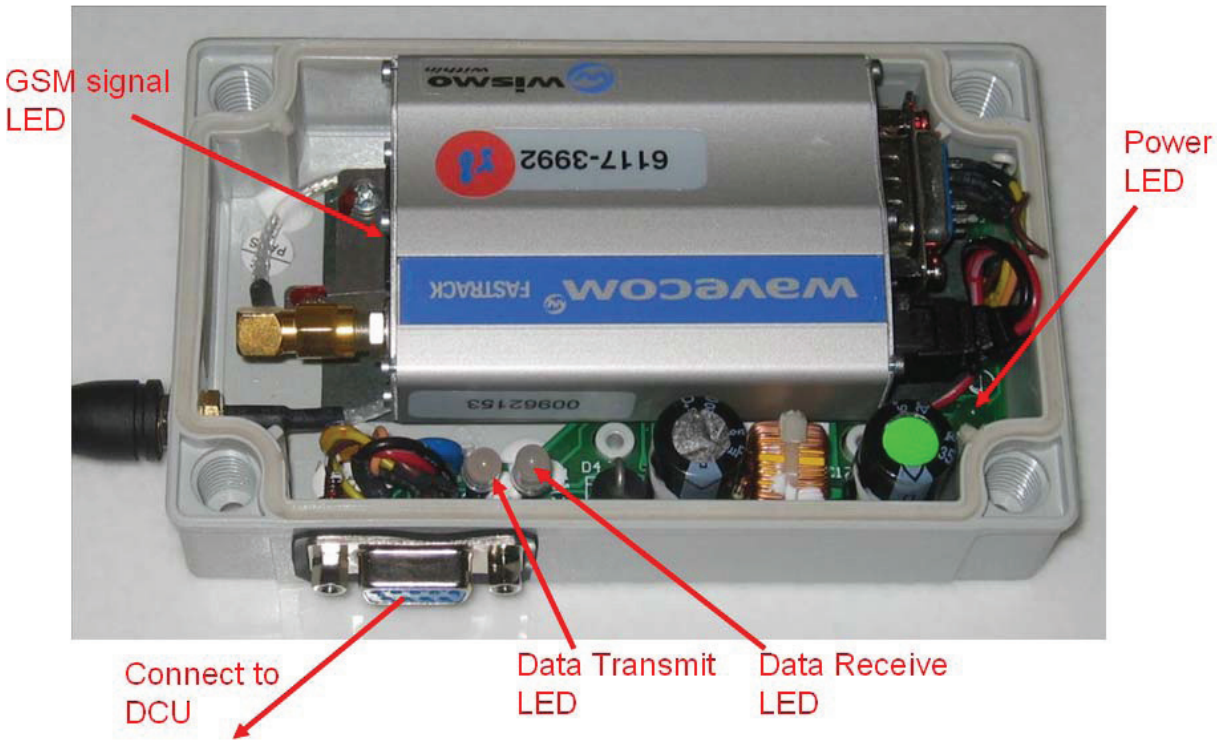
Train-bourn Real-time Data Receiver (TRDR)

TRDR Function

- Receive SMS
- Validate sender number
- Character conversion






GSM signal LED
Power LED
Connect to DCU
Data Transmit LED
Data Receive LED

SIM Card
6117-3992
wavecom
wismo

Four LED's status in TRDR during normal operation

L1: Power – Green LED, it should be ON when power on.

L2: GSM Signal – Red LED, it should be blinking in the GSM signal coverage area.

L3: Data Receive Signal – Green LED, it should be ON when connecting DCU.

L4: Data Transmit Signal – Green LED, it should be ON when connecting DCU.

1.2.3 KVM Switch

KVM (Key, Video Monitor, Mouse) Switch

- Enables a single keyboard, video monitor and mouse to control more than one computer one at a time.

- Front View

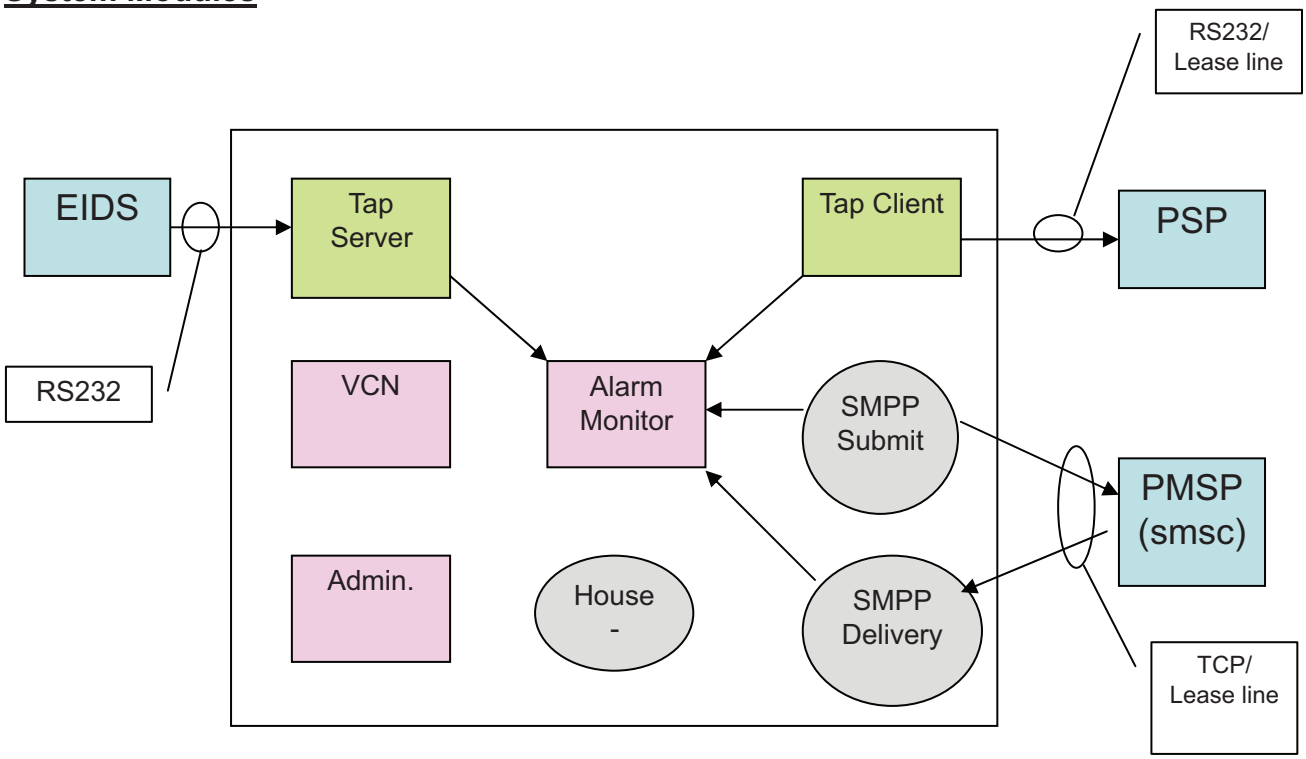
- Rear View

2 Configuration

2.1 General

This section explains all settings and adjustments that configure the CMS Server and TRDR.

System Modules



2.1.1 Configuration Details

CMS configuration

- 2 serial ports are required to connect to PSP and VCN terminal.
- The system is equipped with 2 network cards. One network card is used to connect to PMSP through the dedicated lease line. Another network card is used to connect to the secondary CMS server for database synchronization.

In the installed directory, there is a configure file which should be modified to content the requirement of the hardware or drivers settings. The configuration file is applied by the following module:

1. SMPP Submit Service configuration
2. SMPP Delivery Service configuration
3. TAP Client configuration
4. TAP Server configuration
5. House Keeping Service configuration
6. VCN Express Communicator configuration
7. Administration configuration
8. Alarm Monitor configuration

For example, the configure file will be named as “ApplicationAssembly.exe.config” the extension of the file is “.config”. For the SMPP Submit service module, the installed directory is: d:\Program Files\CMS_SmppSubmitService\, and the configure file is CMS_SmppSubmitService.exe.config.

Open the configure file using text editor, the configure file is a standard XML configure file, locate the tag: “<appSettings></appSettings>”, there are several items:

General configuration

- The configuration file of each of the module is name as ‘[module name].exe.config’ under each module’s program folder.
- The configuration file is in XML format, which contains parameter and value pair
- This part of configuration applicable to all system module

• SystemID : current system’ s ID • connectionString : database configuration parameter, (don’t change) • DBPassword : Encrypted database password. (don’t change) • SystemID2 : another online system’s ID (secondary system) • SecondaryDB : database connection parameter of the secondary system (don’t change) • SecDBPassword : Encrypted password of the secondary system • Others : Table mapping. Don’t change	<add key="SystemID" value="002" /> <add key="connectionString" value="Database=cmsdb;Data Source=127.0.0.1; User Id=root;Password=[[encPass]]" /> <add key="DBPassword" value="8Mg2nrl/jyBwkmIoaMqWOw==" /> <add key="SystemId2" value="001" /> <add key="SecondaryDB" value="Database=cmsdb;Data Source=138.9.5.61; User Id=root;Password=[[encPass]]" /> <add key="SecDBPassword" value="8Mg2nrl/jyBwkmIoaMqWOw==" /> <add key="TblAlarmMsg" value="tblalarmmsg" /> <add key="TblACar" value="tblacar" /> <add key="TblRttfMsg" value="tblrttfmsg" /> <add key="TblSmppMsg" value="tblsmppmsg" /> <add key="TblSystem" value="tblsystem" /> <add key="TblGsmMessage" value="tblgsmmsg" />

	<add key="TblTapMessage" value="tbltapmsg" /> <add key="TblTrainId" value="tbltrainid" />

Tap Client

- Functions – Send message to the PSP **(obsolete function)**
- Program folder – D:\MTR Program Files\TapClientForm
- Log file folder – D:\MTR Program Files\TapClientForm\logs
- Configuration
  D:\MTR Program Files\TapClientForm\TapClientServiceForm.exe.config

- TapSendingPort : COM port used for sending message to PSP - TapSendingBaudrate : baud rate of the COM port - Others : system configuration. No need to change by administrator	<add key="TapClientHealthCheckPeriod" value="30"/> <add key="TapClientIP" value="127.0.0.1"/> <add key="TapClientPort" value="8992" /> <add key="TapStopClientIP" value="127.0.0.1"/> <add key="TapStopClientPort" value="8997" /> <add key="TapStartClientIP" value="127.0.0.1"/> <add key="TapStartClientPort" value="8998" /> <add key="TapSendingPort" value="3" /> <add key="TapSendingBaudrate" value="19200" />

Tap Server

- Functions – Receive message from EIDS , deliver the message to PSP and PMSP according to the system configuration
- Program folder – D:\MTR Program Files\TapServerForm
- Log file folder – D:\MTR Program Files\TapServerServiceForm\logs
- Configuration
  D:\MTR Program Files\TapServerForm\TapServerServiceForm.exe.config

- TapServerSendingPort : COM port used for receiving message from EIDS - TapSendingBaudrate : baud rate of the COM port - Others : system configuration. No need to change	<add key="TapServerIP" value="127.0.0.1"/> <add key="TapServerPort" value="8995" /> <add key="TapServerSendingPort" value="1" /> <add key="TapServerSendingBaudrate" value="19200" />

Smpp Submit Service

- Functions – Send message to the PMSP
- Program folder – D:\MTR Program Files\Smpp Service
- Log file folder – D:\MTR Program Files\Smpp Service\logs
- Configuration
  D:\MTR Program Files\Smpp Service\CMS_SmppSubmitService.exe.config

- 'src_msn' : mobile station number of the SMPP service. - 'SMPPServerIP' : IP address of the SMSC connected to. - SMPPServerPort : port number of the SMSC to which SMPP connect to - SMPPServerSystemID : SMPP system ID, provided by PMSP - SMPPSystemType : System Type, provided by PMSP - SMPPWindowSize : control the windows-size when sending SMS. (Don't change) - SMPPSubmitDelay : Time delay before sending next SMS. - SubmitServierSmsExpiryTimer : Time in minutes after which, the SMS will assume expiry when the SMSC is unable to delivery the SMS. The value is expressed in ([expiry] – 480), where [expiry] is the expiry time - SubmitServerIsCharacterConversion : Perform character conversion. (Don't change) - SubmitServerIP : IP address of the server listen to external event (Don't change) - SubmitServerPort : port of the server listen to external event (Don't change)	<add key="src_msn" value="85296657479" /> <add key="SMPPServerIP" value="202.140.96.169" /> <add key="SMPPServerPort" value="10500" /> <add key="SMPPServerSysId" value="HK" /> <add key="SMPPServerPassword" value="thkcomm1" /> <add key="SMPPSystemType" value="Comm" /> <add key="SMPPWindowSize" value="256" /> <add key="SMPPSubmitDelay" value="210" /> <add key="SubmitServerSmsExpiryTimer" value="-475" /> <add key="SubmitServerIsCharacterConversion" value="1" /> <add key="SubmitServerIP" value="0.0.0.0"/> <add key="SubmitServerPort" value="8990" />

Smpp Delivery Service

- Functions – Receive SMS delivery status from SMSC of the PMSP
- Program folder – D:\MTR Program Files\CMS_SmppDeliveryService
- Log file folder – D:\MTR Program Files\ CMS_SmppDeliveryService \logs
- Configuration
  D:\MTR Program Files\CMS_SmppDeliveryService\ CMS_SmppDeliveryService.exe.config

- 'src_msn' : mobile station number of the SMPP service. - 'SMPPServerIP' : IP address of the SMSC connected to. - SMPPServerPort : port number of the SMSC to which SMPP connect to - SMPPServerSystemID : SMPP system ID, provided by PMSP - SMPPSystemType : System Type, provided by PMSP - SMPPWindowSize : control the windows-size when sending SMS. (Don' t change) - SMPPSubmitDelay : Time delay before sending next SMS. - SubmitServierSmsExpiryTimer : Time in minutes after which, the SMS will assume expiry when the SMSC is unable to delivery the SMS. The value is expressed in ([expiry] – 480), where [expiry] is the expiry time - SubmitServerIsCharacterConversion : Perform character conversion. (Don' t change) - DeliverServerIP : IP address of the server listen to external event (Don' t change) - DeliverServerPort : port of the server listen to external event (Don' t' change)	<add key="src_msn" value="85296657479" /> <add key="SMPPServerIP" value="202.140.96.158" /> <add key="SMPPServerPort" value="9500" /> <add key="SMPPServerSysId" value="HK" /> <add key="SMPPServerPassword" value="hkcomm" /> <add key="SMPPSystemType" value="Comm" /> <add key="SubmitServerIsCharacterConversion" value="1" /> <add key="DeliverServerIP" value="127.0.0.1"/> <add key="DeliverServerPort" value="8991" />

Alarm Monitor

- Functions – Monitoring the status of system
- Program folder – D:\MTR Program Files\Alarm Monitor
- Log file folder – D:\MTR Program Files\ Alarm Monitor\logs
- Configuration
  D:\MTR Program Files\Alarm Monitor\AlarmMonitor.exe.config

- TapStopClientIP : IP address of the TapClient which listen to stop event - TapStopClientPort : port of the TapClient where listen to stop event - TapStartClientIP : IP address of the TapClient which listen to start event - TapStartClientPort : port of the TapClient listen to start event - MonitorIP : Alarm monitor IP address used for listening event - MonitorPort : Alarm monitor 's port used for listening event	<add key="TapStopClientIP" value="127.0.0.1"/> <add key="TapStopClientPort" value="8997" /> <add key="TapStartClientIP" value="127.0.0.1"/> <add key="TapStartClientPort" value="8998" /> <add key="MonitorIP" value="127.0.0.1"/> <add key="MonitorPort" value="8996" />

HouseKeeping Service

- Functions – database synchronization, backup, purging, message log generation.
- Program folder – D:\MTR Program Files\HouseKeeping Service
- Log file folder – D:\MTR Program Files\HouseKeeping Service\logs
- Configuration
  D:\MTR Program Files\HouseKeeping Service\CMS_HouseKeepingService.exe.config

- DBAddress : Database server address - DBUser : Database server login user - DBName : Database name - MessageLogDirectory : folder where daily SMPP text log will be stored - BackupDirectory : folder where daily backup will be saved. - PurgeStartTime : Start of the purging - PurgeEndTime : End of purging - SyncTimeIntervalMS : time interval in milliseconds where database synchrozation run - BackupTimeIntervalMS: time interval in milliseconds where backup will be run - PurgeTimeIntervalMS: time interval in milliseconds where purging will be executed	<add key="DBPassword" value="8Mg2nrl/jyBwkmIoaMqWOw==" /> <add key="DBAddress" value="localhost" /> <add key="DBUser" value="root" /> <add key="DBName" value="cmsdb" /> <add key="MessageLogDirectory" value="D:\\CMS_Log" /> <add key="BackupDirectory" value="E:\\" /> <add key="PurgeStartTime" value="2005-1-1 00:00:00" /> <add key="PurgeEndTime" value="2100-1-1 00:00:00" /> <add key="SyncTimeIntervalMS" value="60000" /> <add key="BackupTimeIntervalMS" value="3600000" /> <add key="PurgeTimeIntervalMS" value="86400000" />

- **Functions – maintain system configuration and table maintenance**
- Program folder – D:\MTR Program Files\Administration
- Log file folder – D:\MTR Program Files\Administration
- Configuration
  D:\MTR Program Files\Administration\Administration.exe.config

- AdminMsnPrefix : mobile station number's country code as prefix - AdminMsnLength : mobile station number's length - OperationLogFolder : folder where message log will be create and generated	<add key="AdminMsnPrefix" value="852" /> <add key="AdminMsnLength" value="11" /> <add key="OperationLogFolder" value="d:\\cms_log" />

TRDR configuration

There is only one serial port in TRDR to connect DCU
Baud: 2400
Databit: 8
Stopbit: 1
Parity: No
FlowControl: No

3 Operation

3.1 General

This section contains information and instructions required for proper operation of CMS Server and TRDR.

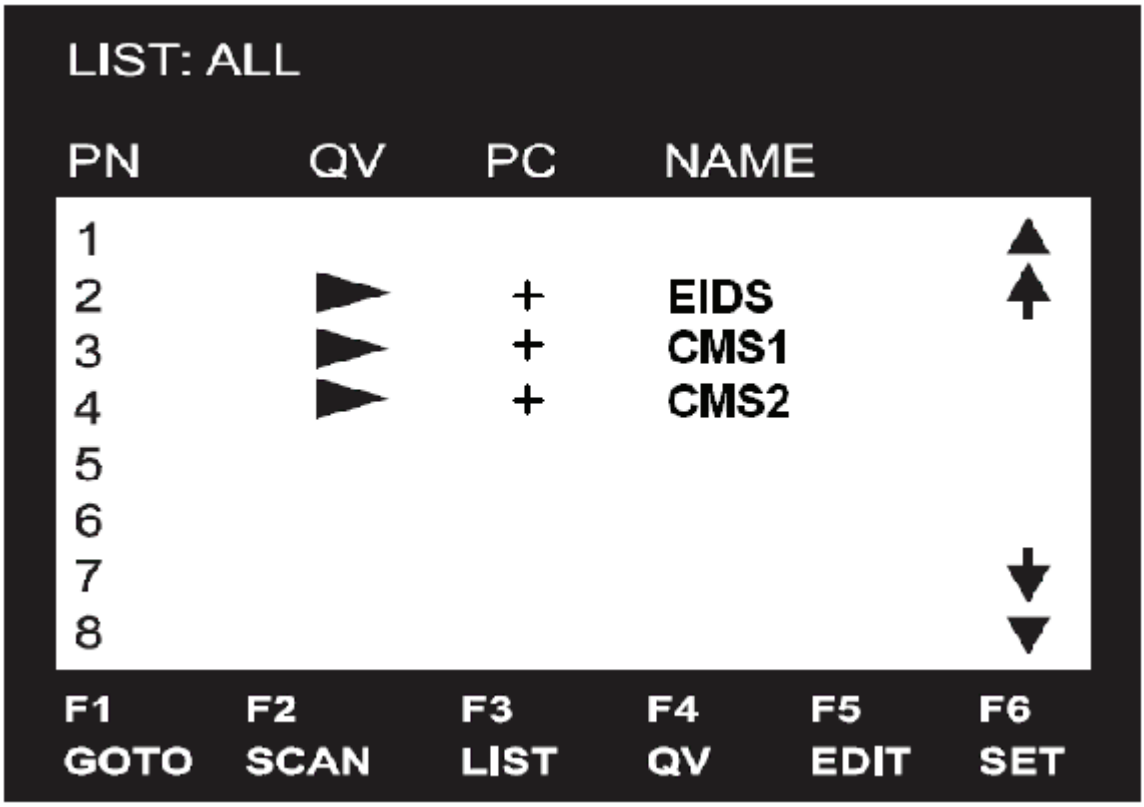
There are 3 window services or background processes running in CMS
- CMS_SmppSubmitService.exe
- CMS_SmppDeliveryService.exe
- CMS_HouseKeepingService.exe

2 foreground processes
- TapClientServiceForm.exe
- TapServerServiceForm.exe

3 applications programs
- AlarmMonitor.exe
- Administration.exe
- VCNExpressComm.exe

3.2 KVM Switch

Press Ctrl-Ctrl to go to OSD (On Screen Display) menu.



KVM Port 2 – EIDS Terminal
KVM Port 3 – CMS 1
KVM Port 4 – CMS 2

Control Keys
ESC – discard and go back
Arrow keys – move up and down
Enter – highlight server then enter

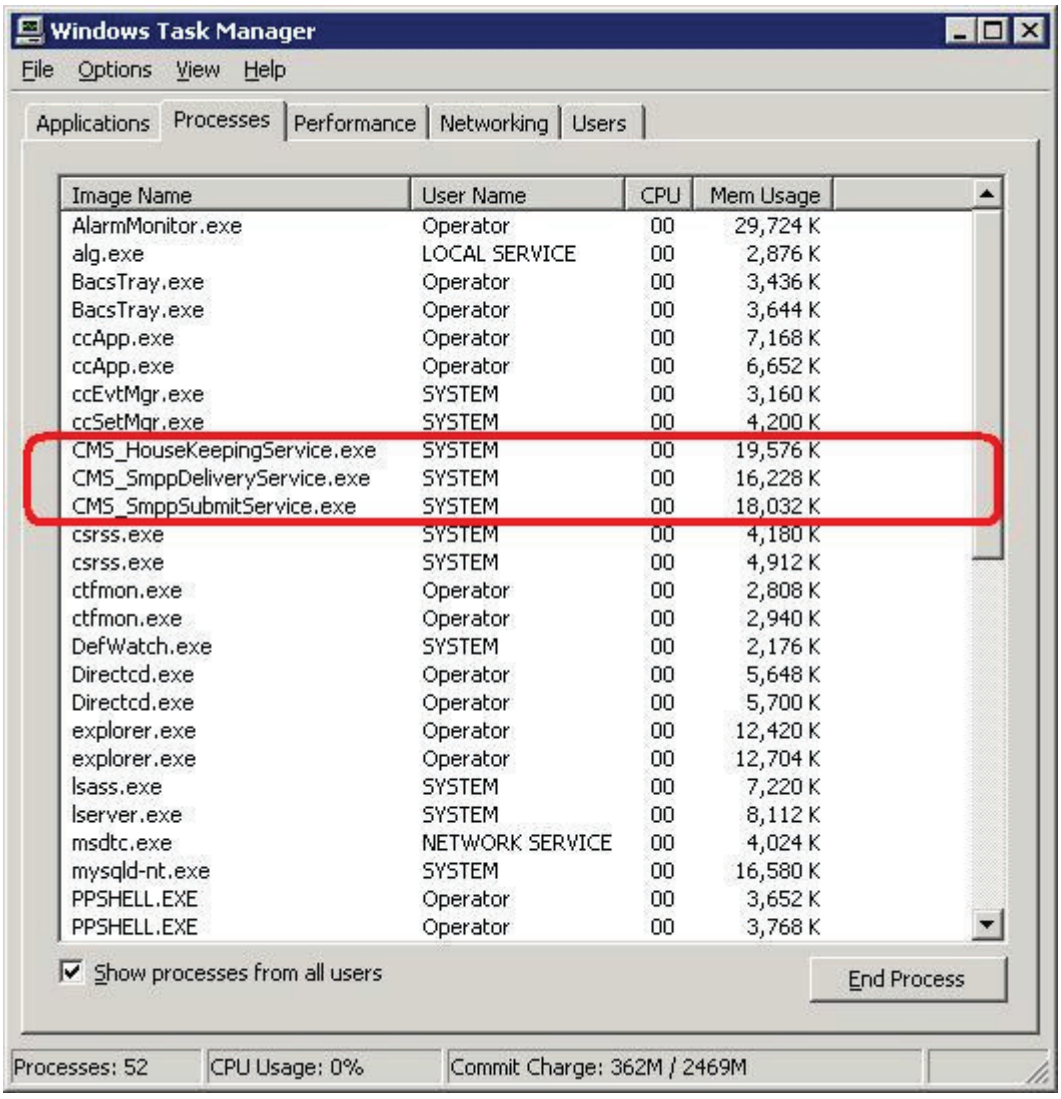
3.3 CMS operation

3.3.1 Check background processes

Procedure

- Press Ctrl + Shift + Esc keys to call Windows Task Manager
- Check the existence of the 3 background processes
  1. CMS_SmppSubmitService.exe
  2. CMS_SmppDeliveryService.exe
  3. CMS_HouseKeepingService.exe

Screenshot



The installation procedures of these three modules are similar, take house keeping service for example:

In the installation directory of House keeping Service, assumed that is "D:\MTR_Project\House Keeping Service\" in the command prompt,
Type "**InstallUtil -i CMS_HouseKeepingService.exe**", and then press enter, the house keeping service will be installed. Note that there should NOT install an instance of the same service twice, or else installation will be failed.

To uninstall the service, the same as the command prompt, and go to the installation directory. Type "**InstallUtil –u CMS_HouseKeepingService.exe**" instead. Please note that if uninstalling the service, the service status should be turned to stop.

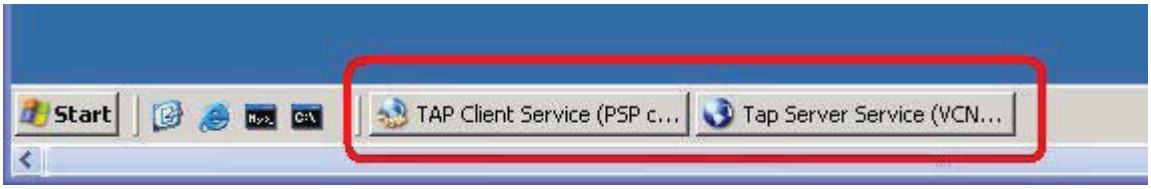
The same procedures can be applied to the modules of SMPP Submit Service and SMPP Delivery Service.

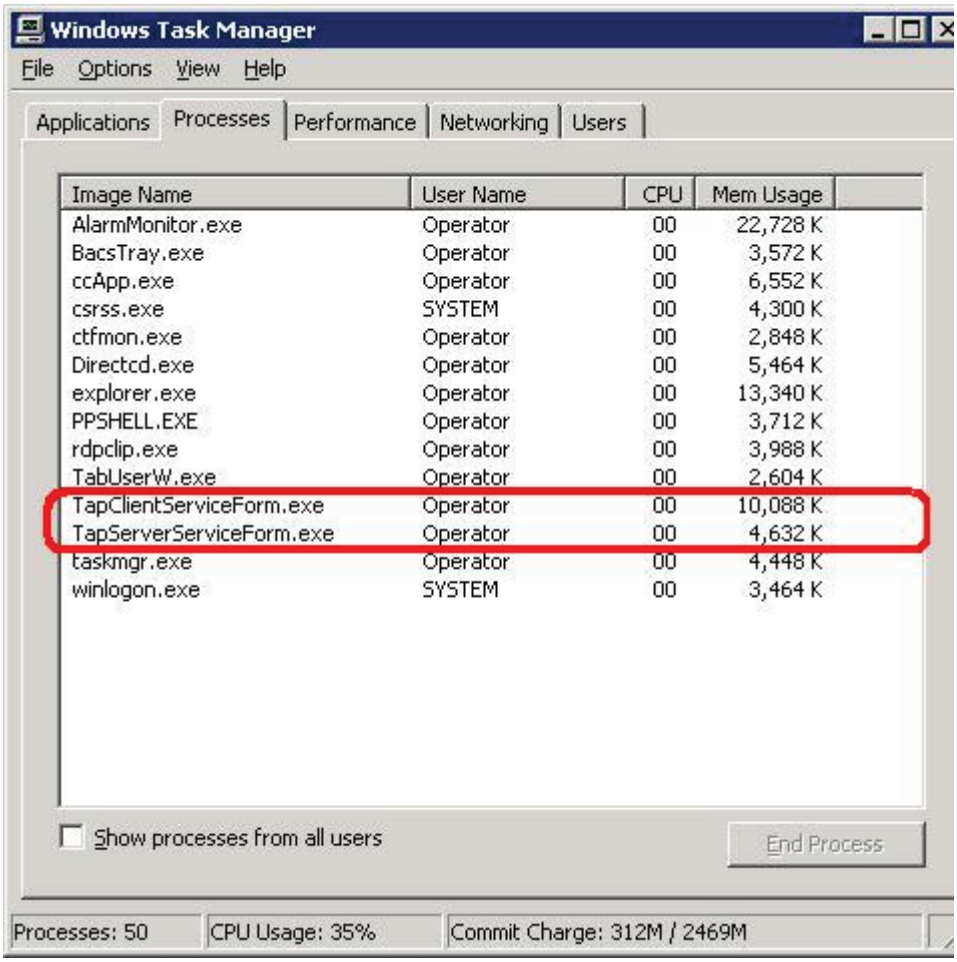
3.3.2 Check foreground processes

Procedure

- Check the Windows Task Bar or press Ctrl+Shift+Esc keys to call Windows Task Manager
- Check the existence of 2 foreground processes
  1. TapServerServiceForm.exe
  2. TapClientServiceForm.exe

- Screenshot



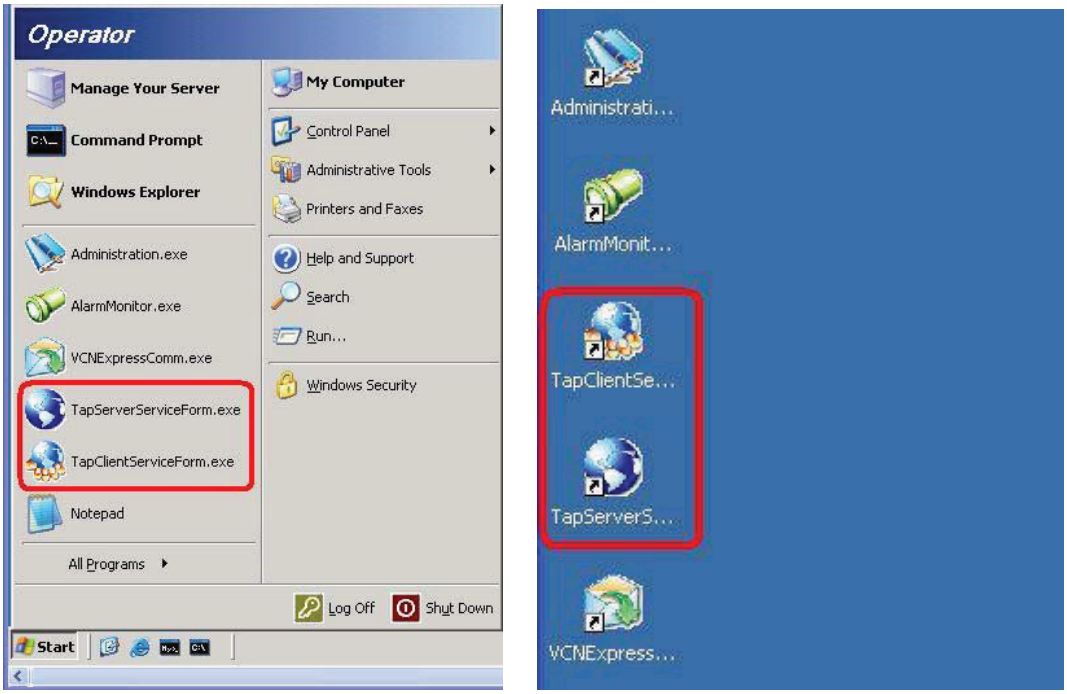


Startup these 2 processes if they are not running in the system.

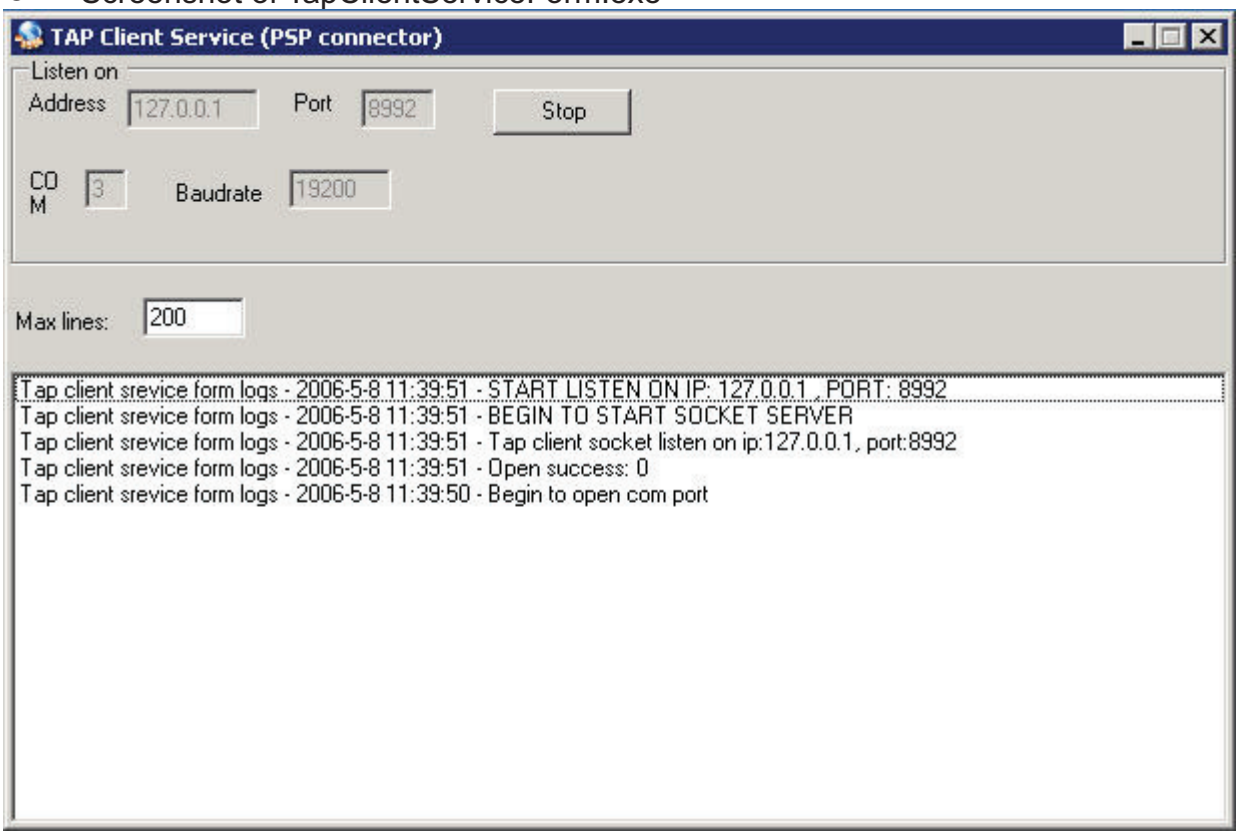
- Click [Start] -> [TapServerServiceForm.exe]
- Click [Start] -> [TapClientServiceForm.exe]

Or

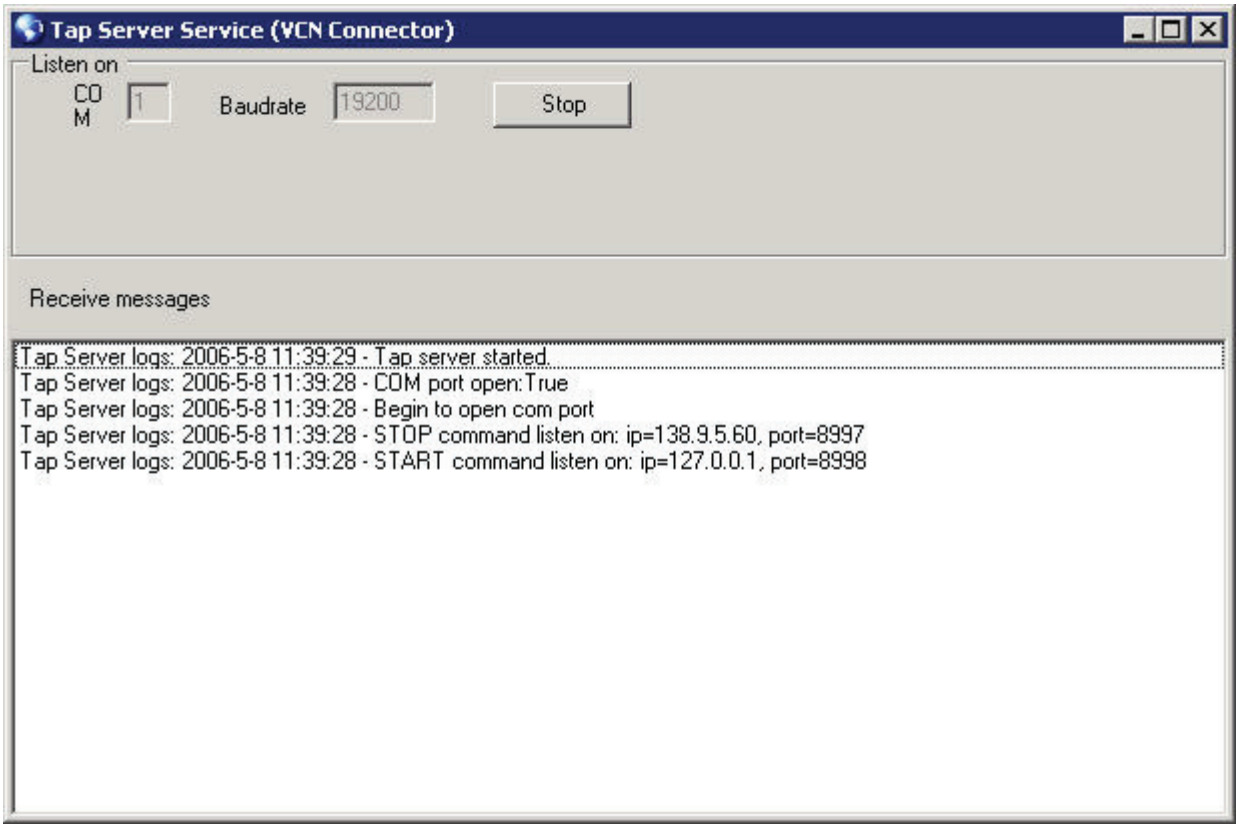
- Double click on icons of TapServerServiceForm.exe and TapClientServiceForm.exe on the Windows desktop.



- Screenshot of TapClientServiceForm.exe



- Screenshot of TapServerServiceForm.exe



3.3.3 Alarm Monitor

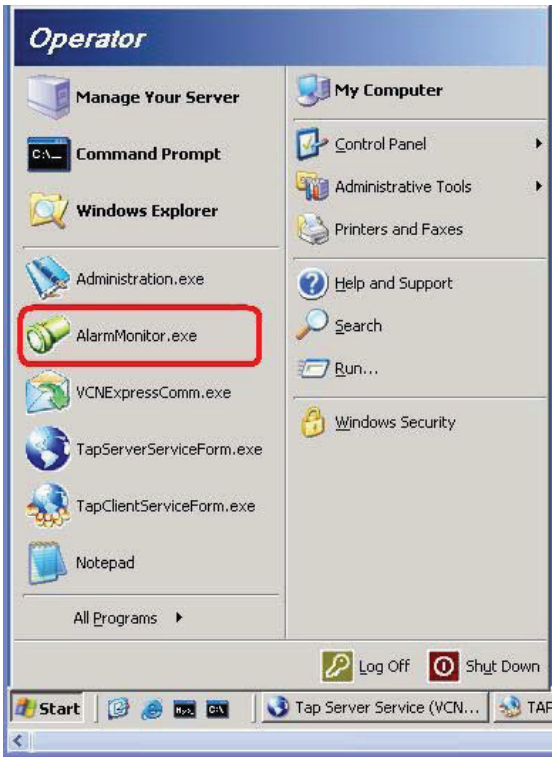
The Alarm Monitor is used for monitoring the status of SMPP connection (mobile operator's SMSC) and TAP connection (RTTF terminal); display the Alarm Message History and the SMPP message delivery status.

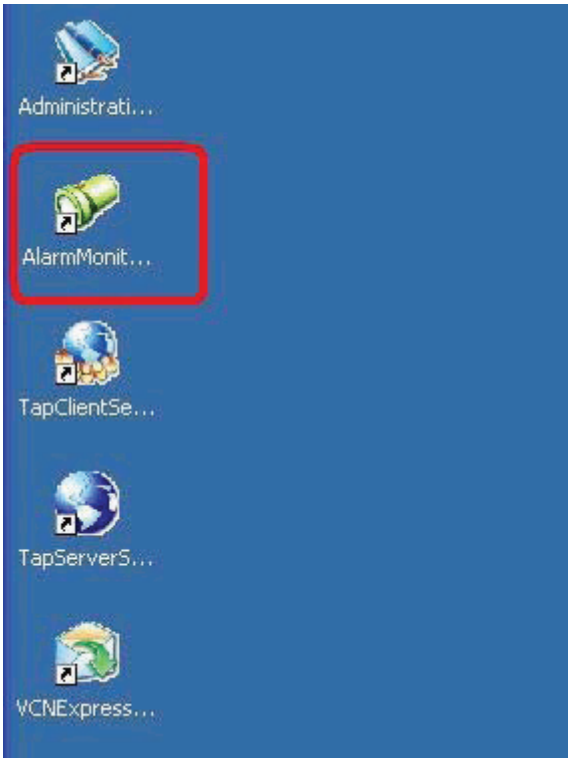
To startup this application

- Click [Start] -> [AlarmMonitor.exe]

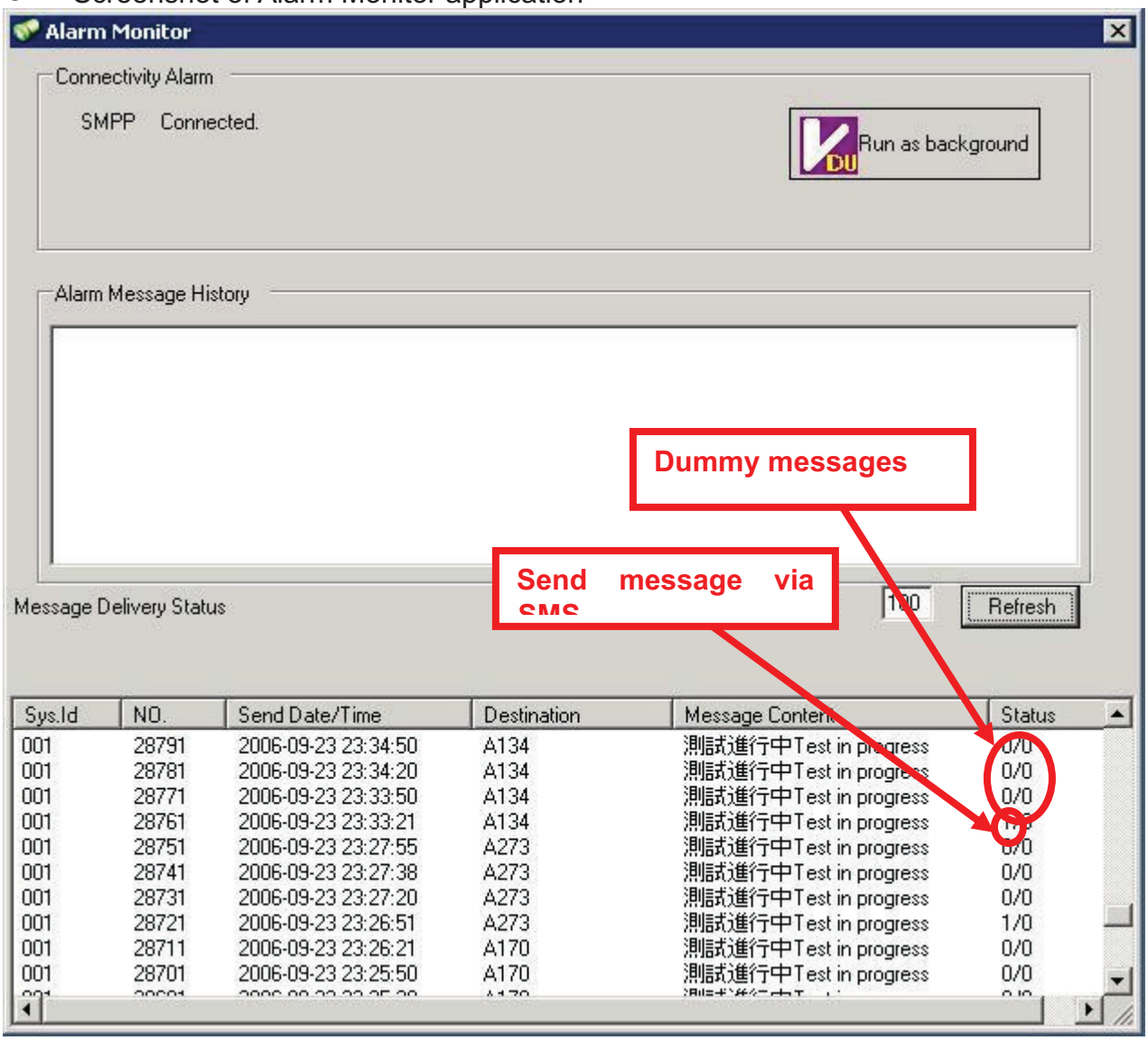
Or

- Double click on the icon of AlarmMonitor.exe on the Windows desktop.


Operator
Manage Your Server
Command Prompt
Windows Explorer
Administration.exe
AlarmMonitor.exe
VCNExpressComm.exe
TapServerServiceForm.exe
TapClientServiceForm.exe
Notepad
All Programs
My Computer
Control Panel
Administrative Tools
Printers and Faxes
Help and Support
Search
Run...
Windows Security
Log Off
Shut Down
Start
Tap Server Service (VCN...


Administrati...
AlarmMonit...
TapClientSe...
TapServerS...
VCNExpress...

- Screenshot of Alarm Monitor application



Connectivity Alarm

- To display the SMPP and TAP connections status.
- The connection status will not show if the corresponding output control is disabled by Administration.exe.

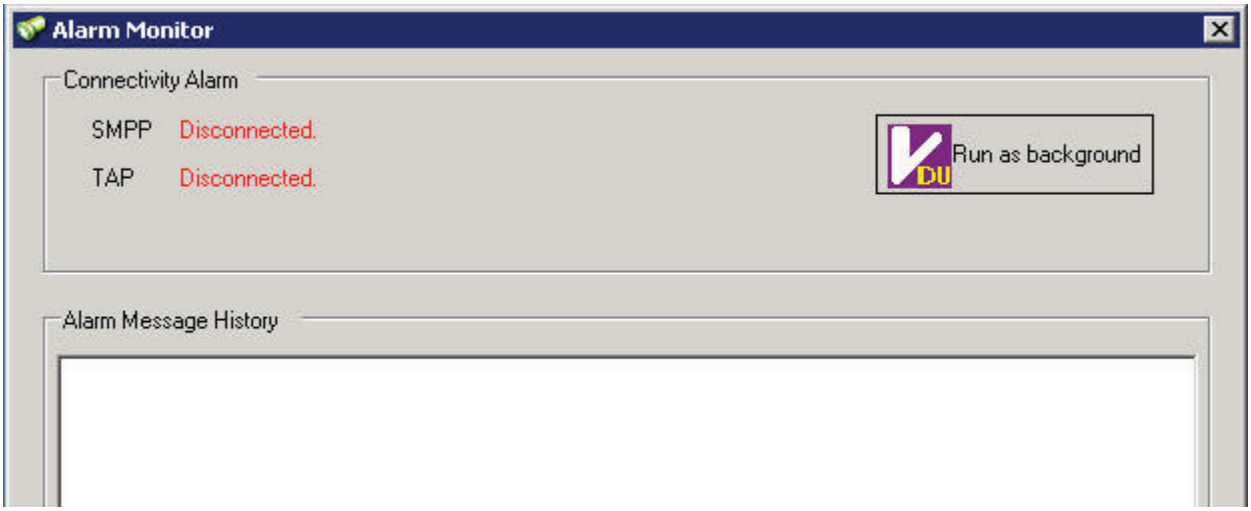
Alarm Message History

- To display run-time messages

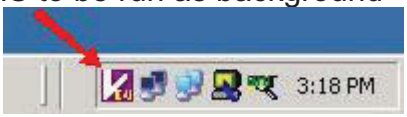
Message Delivery Status

- To display message delivery information
- Status format: <send via SMS / send via Page> (where 0=Not send, 1=Send)

- The following screenshot shows the example of the SMPP and TAP connection fails.



- Click on the button

to bring CMS to be run as background process, an icon will show in the Windows Task Bar 

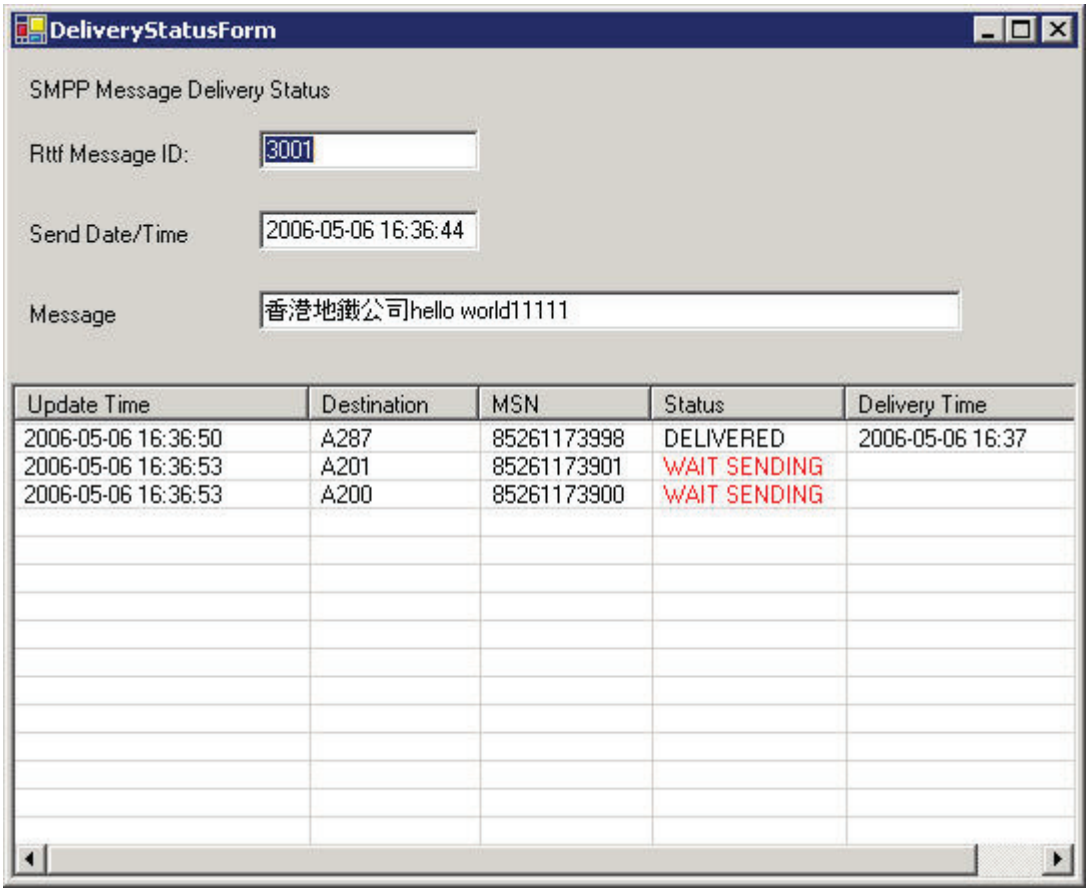
- The no. of latest record of Message Delivery Status can be changed by entering value and pressing refresh button.

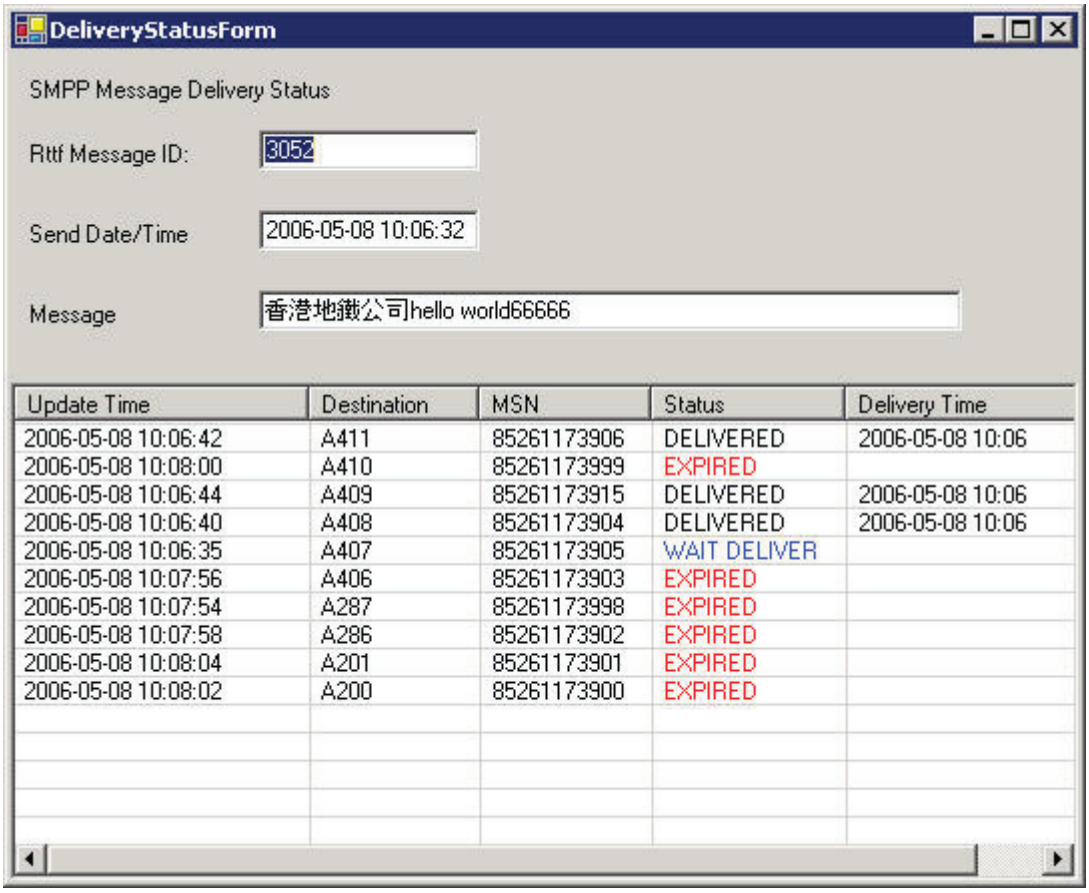
- Using a mouse to highlight and double click on any lines in the Message Delivery Status Window, the following pop-up windows will be shown.

Attention

The message delivery time provided by the Mobile operator is in Date-Hour-Minute format without second.

Since the Mobile operator update the CMS with the message delivery time in predefined periods, it is possible that the message update time may appear to be later than the delivery time.


DeliveryStatusForm
SMPP Message Delivery Status
Rttf Message ID:
3001
Send Date/Time
2006-05-06 16:36:44
Message
香港地鐵公司hello world11111
Update Time
Destination
MSN
Status
Delivery Time
2006-05-06 16:36:50
A287
85261173998
DELIVERED
2006-05-06 16:37
2006-05-06 16:36:53
A201
85261173901
WAIT SENDING
2006-05-06 16:36:53
A200
85261173900
WAIT SENDING



There are 5 delivery statuses in the system

1. WAIT SENDING - the message is ready to send and waits for the SMPP connection with SMSC.
2. WAIT DELIVER - the message is already sent to SMSC and waits for the status reply from SMSC.
3. DELIVERED - delivers the message to the SMS receiver (TRDR) successfully.
4. EXPIRED - the message cannot be delivered within 5 minutes.
5. SEND ERROR - the message is rejected by SMSC.

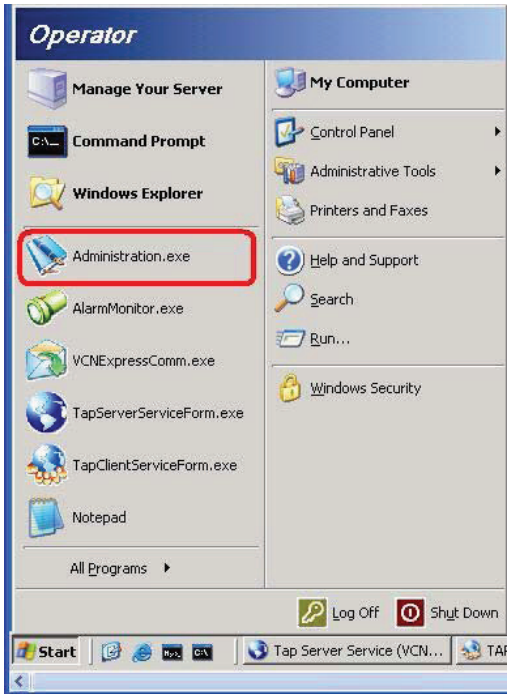
3.3.4 Administration

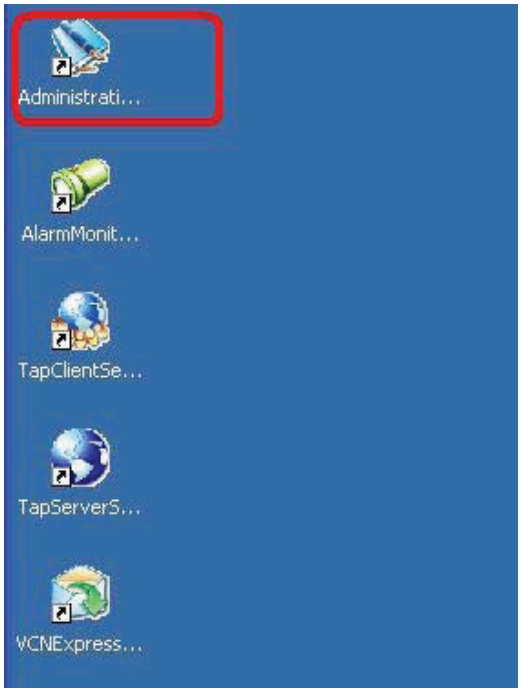
The procedure for operating the Administration.exe is shown below

- To start up the Administration.exe, click [start] -> [Administration.exe]

Or

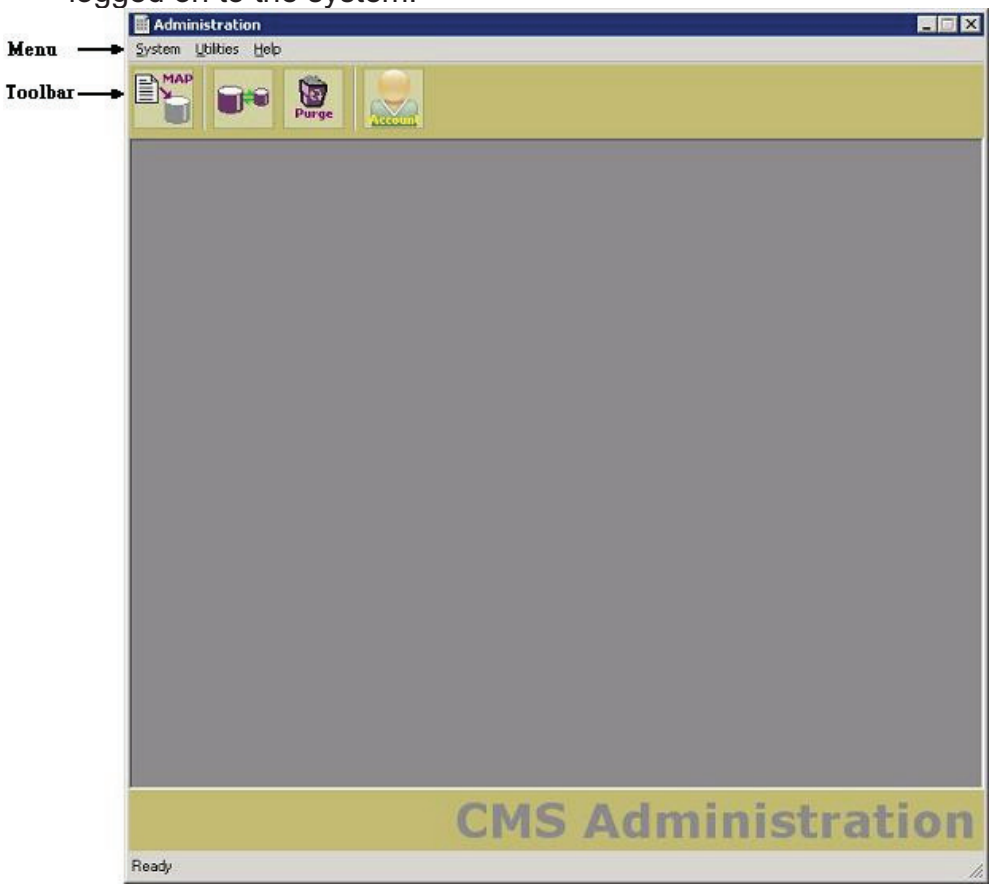
- Double the icon of Administration.exe on the Windows desktop.


Operator
Manage Your Server
Command Prompt
Windows Explorer
Administration.exe
AlarmMonitor.exe
VCNExpressComm.exe
TapServerServiceForm.exe
TapClientServiceForm.exe
Notepad
All Programs
My Computer
Control Panel
Administrative Tools
Printers and Faxes
Help and Support
Search
Run...
Windows Security
Log Off
Shut Down
Start
Tap Server Service (VCN...

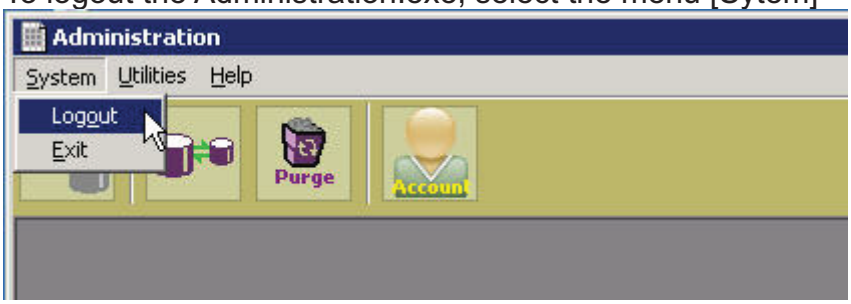

Administrati...
AlarmMonit...
TapClientSe...
TapServerS...
VCNExpress...

- Log-in prompt is shown anytime when the Administration.exe start-up.

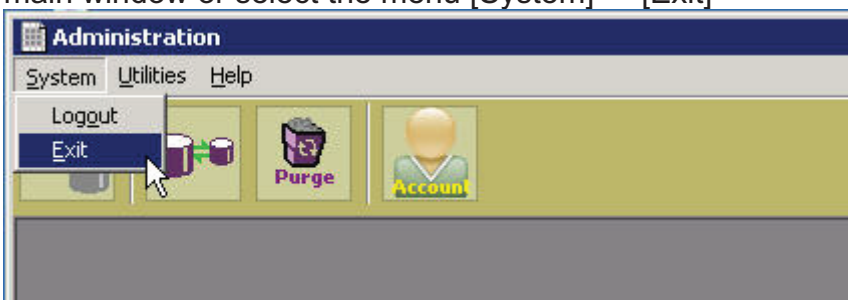
- The main window of Administration.exe is shown when the user has successfully logged on to the system.



- To logout the Administration.exe, select the menu [Sytem] -> [Logout]

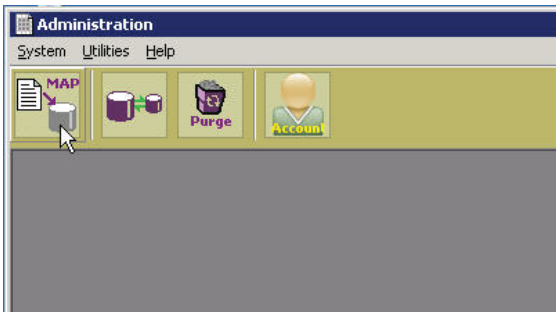


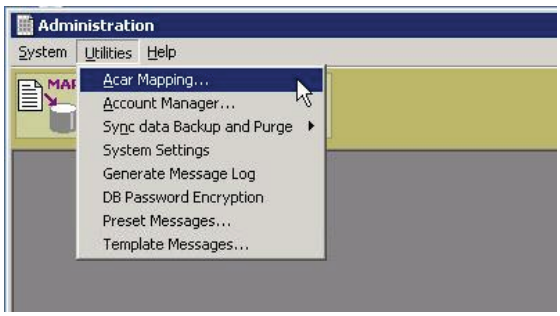
- To exit the Administration.exe, click the button at the upper right corner in the main window or select the menu [System] -> [Exit]



The exit prompt box is shown, select Yes to exit program or select No to abort.

- To start the Acar Mapping, click the first button in toolbar or select the menu [Utilities] -> [Acar Mapping…]





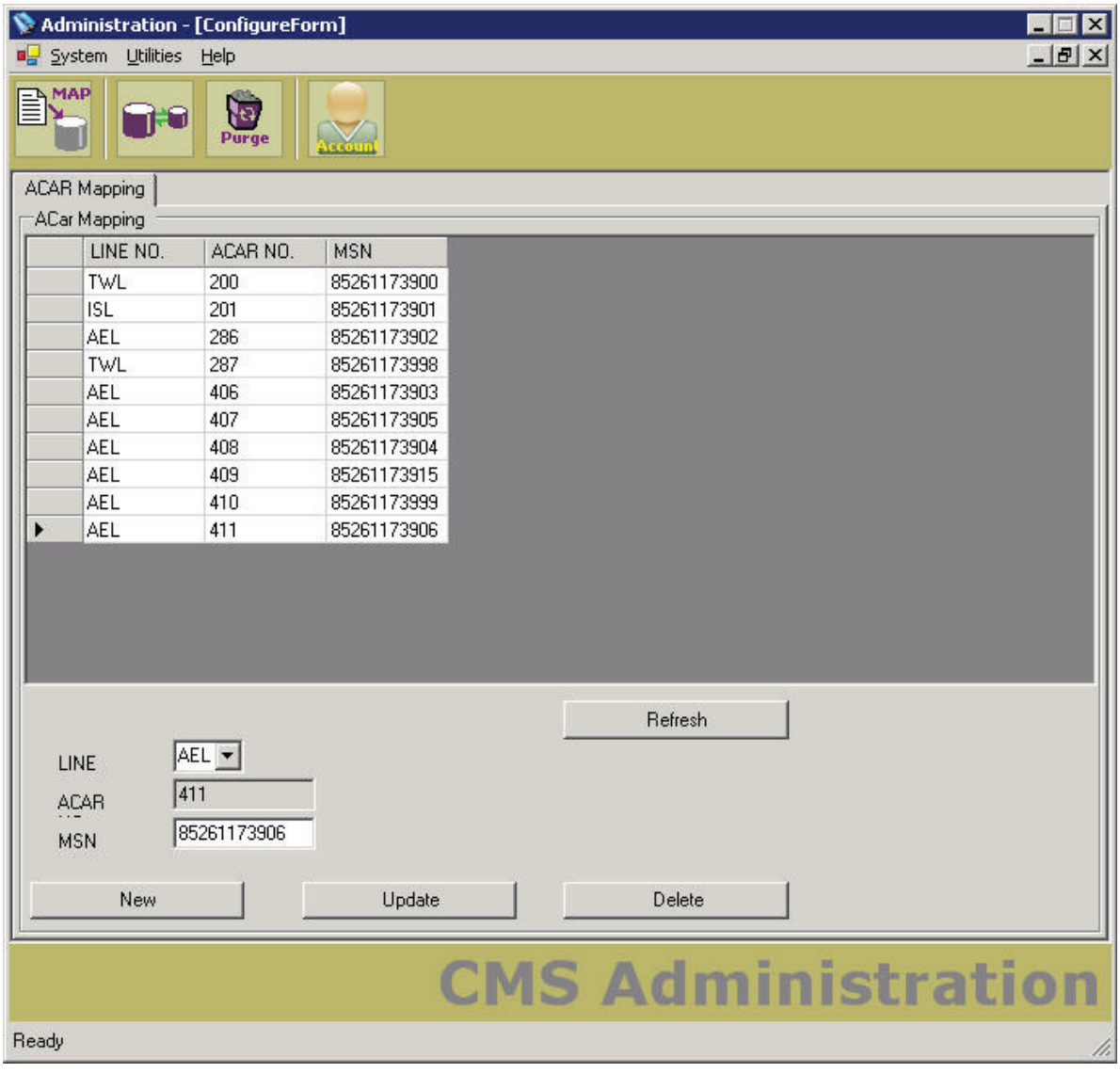
- This function is used for user to maintain in the mapping table of the Mobile Station No. (MSN) and the train no. (ACar No.) with line no. (Kwun Tong Line, Tsuen Wan Line, Island Line, Tseung Kwan O Line, Tung Chung Line and Airport Express)

Procedure

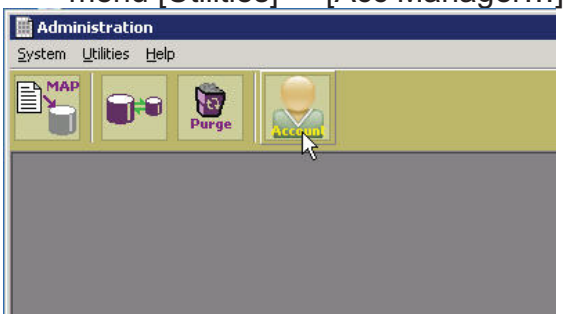
- Add new entry
  1. Click the New button
  2. Select train line no.
  3. Input A-Car no.
  4. Input MSN
  5. Click Update button

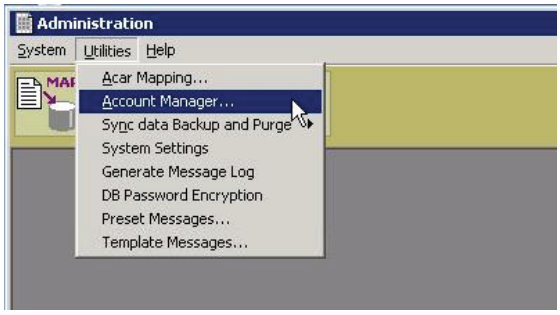
- Update entry
  1. Highlight and double click on the entry that you want to update
  2. Amend the details
  3. Click Update button

- Delete entry
  1. Highlight and double click on the entry that you want to delete
  2. Click Delete button



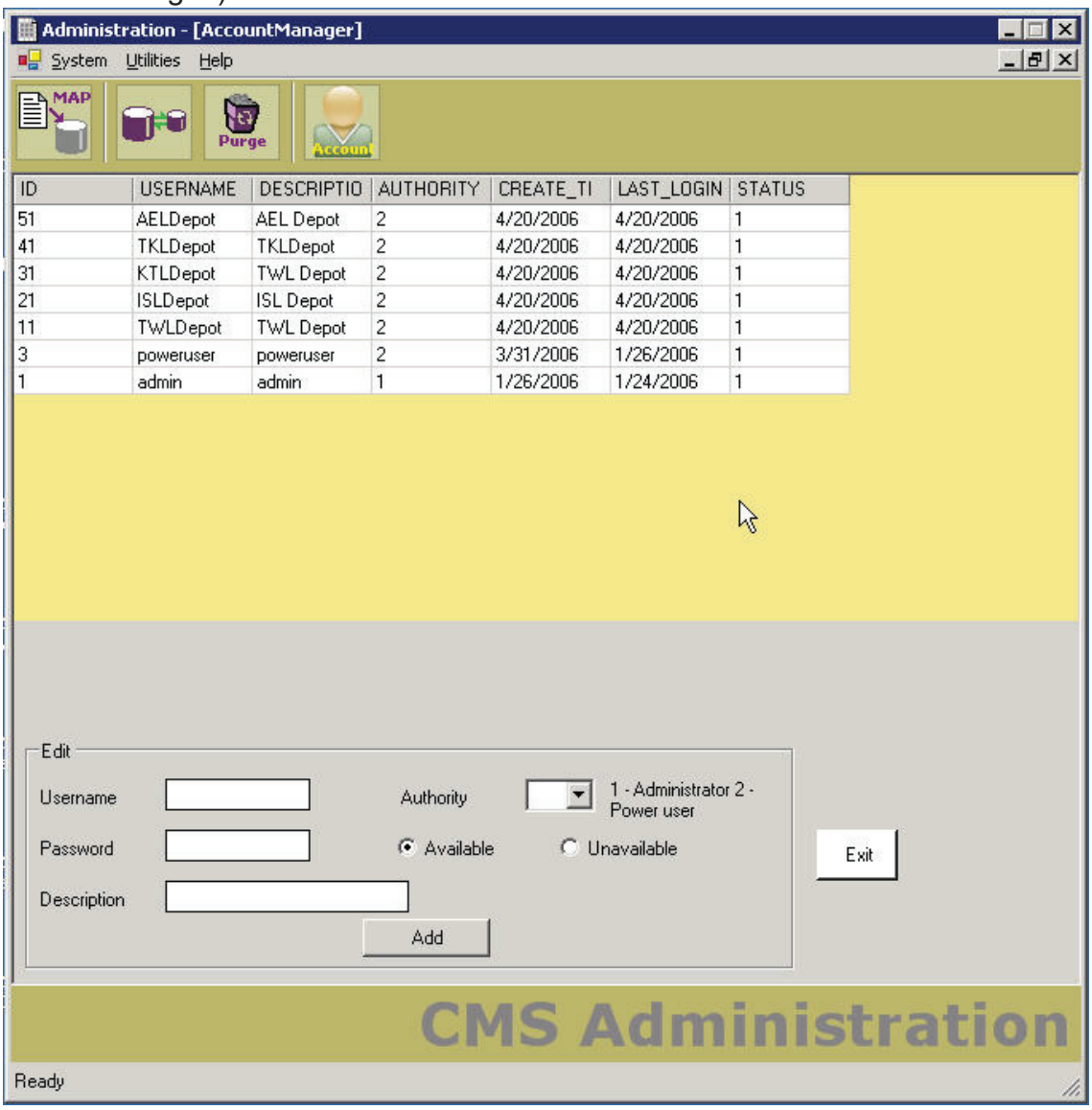
- To start user account manager, click the fourth button in toolbar or select the menu [Utilities] -> [Acc Manager…]



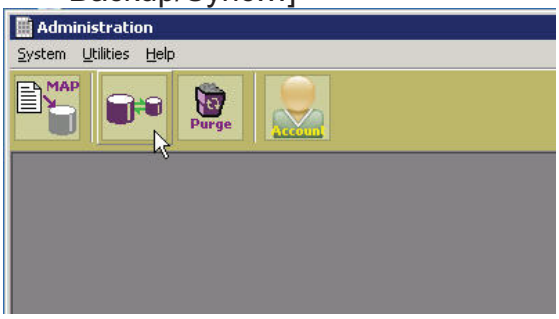


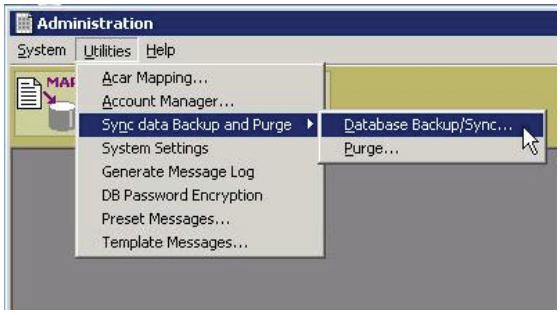
- The following window is shown for administrator to add new account or edit user account such as change password, description, authority and account status (available/unavailable)

  Authority = Administrator (access all functions)
  = Power User (Acar Mapping, Generate Message log and Preset Messages)



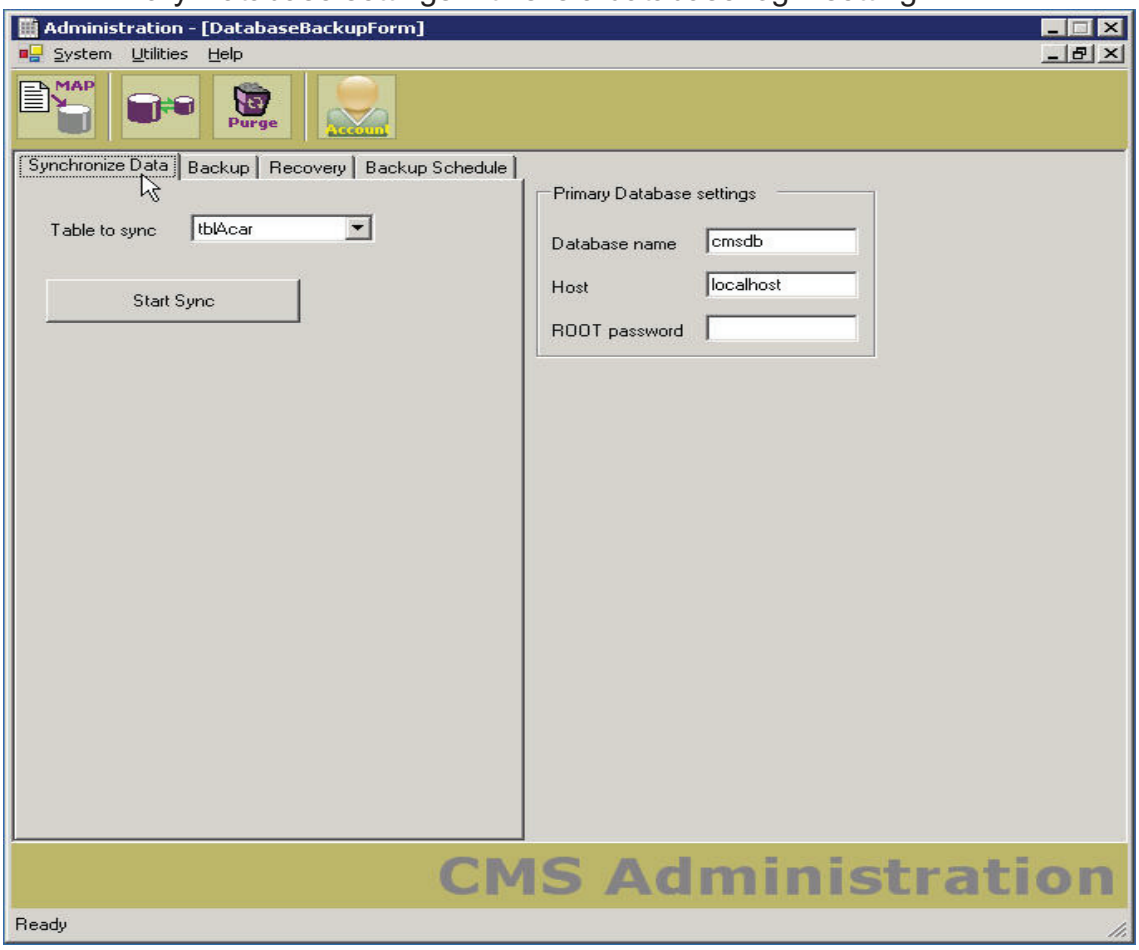
- To start database synchronize or backup, click the second button in the toolbar or select the menu [Utilities] -> [Sync data Backup and Purge] -> [Database Backup/Sync…]



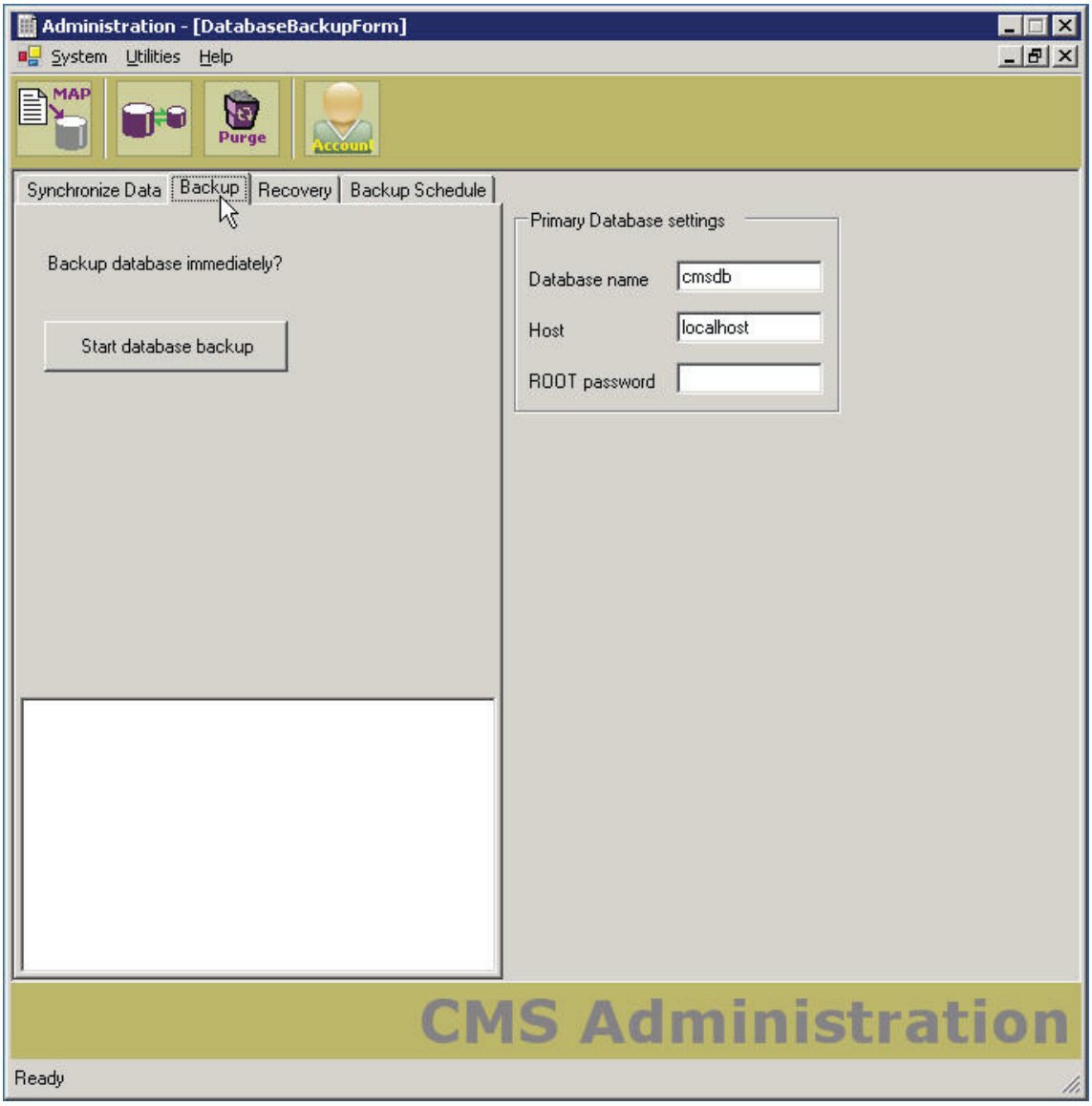


- Database synchronize data, two tables can be selected and synchronized immediately.
  1. tblAcar
  2. tbltrainid
  3. tblAdmin
  4. tblcanmsg

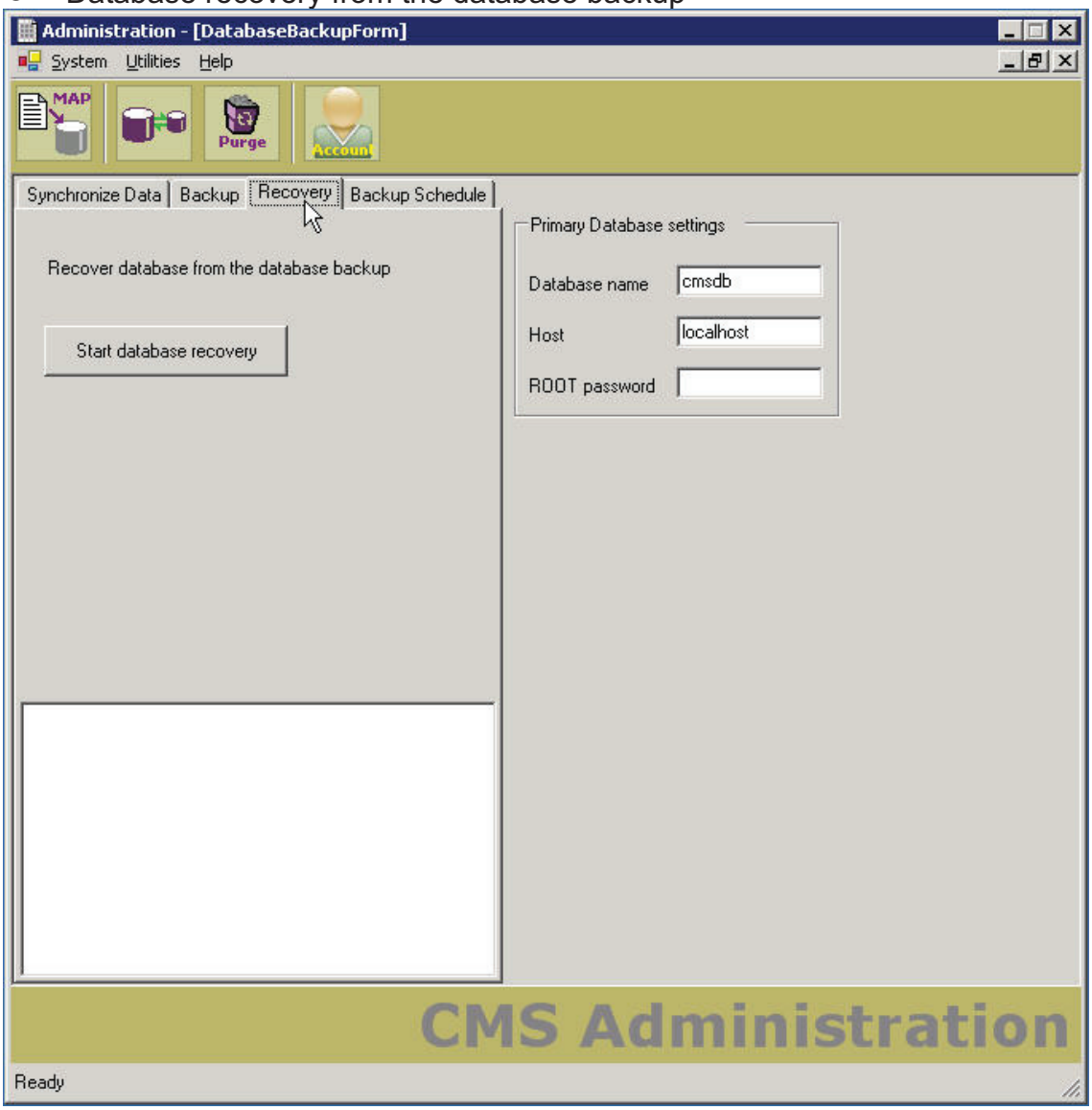
  Primary Database settings – this is a database login setting.



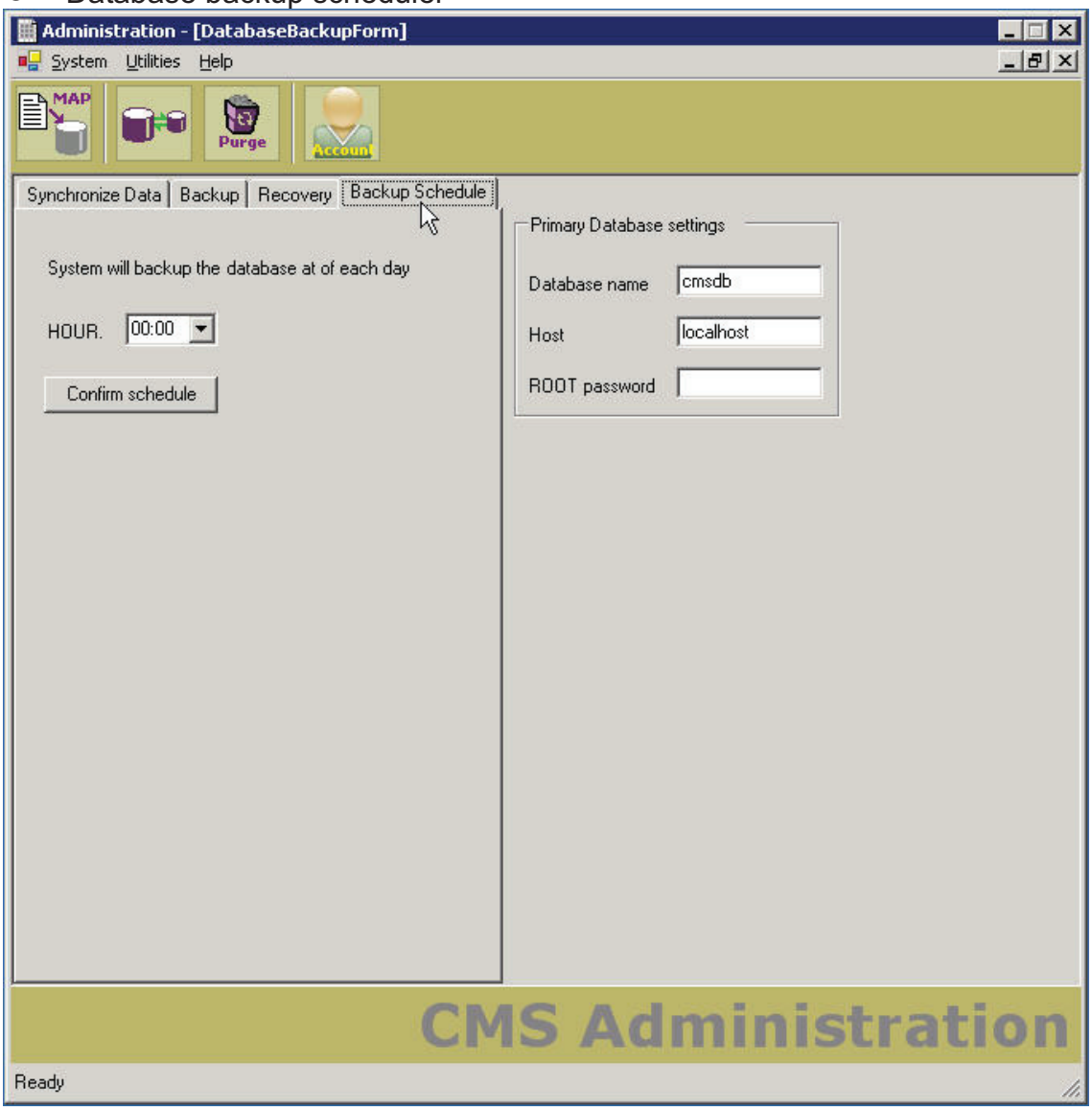
- Backup database immediately


Administration - [DatabaseBackupForm]
System
Utilities
Help
MAP
Purge
Account
Synchronize Data
Backup
Recovery
Backup Schedule
Backup database immediately?
Start database backup
Primary Database settings
Database name
cmsdb
Host
localhost
ROOT password
CMS Administration
Ready

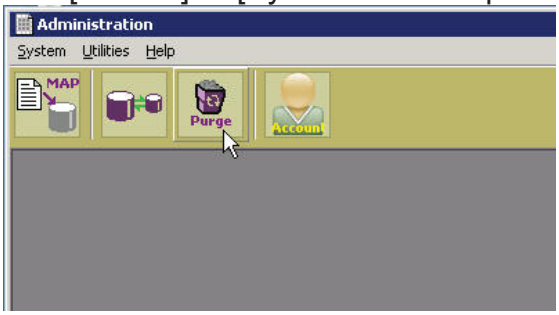
- Database recovery from the database backup

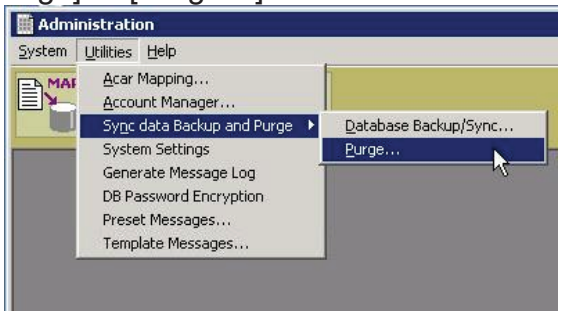


- Database backup scheduler

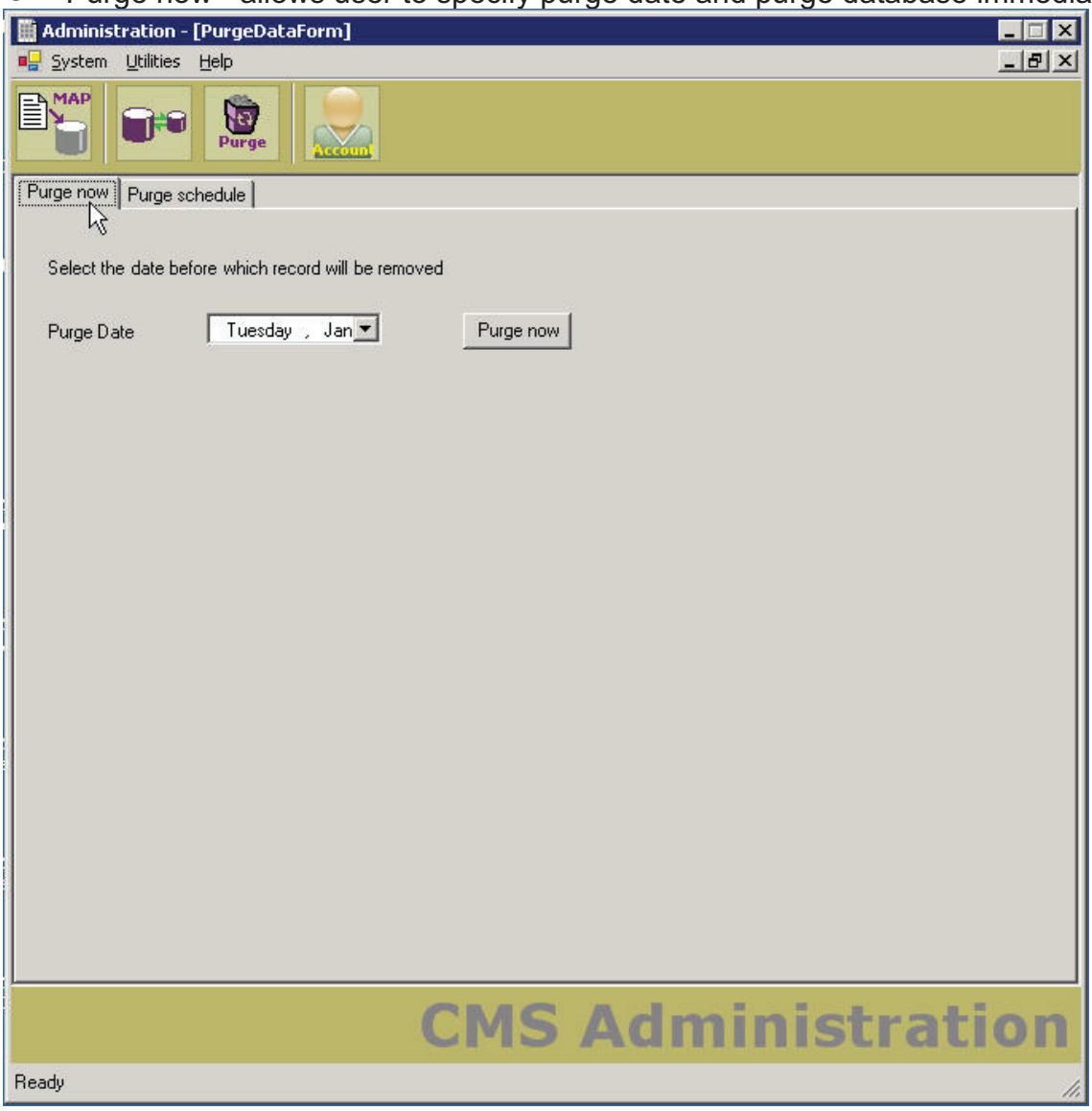


- To start database purge, click the third button in the toolbar or select the menu [Utilities] -> [Sync data Backup and Purge] -> [Purge…]

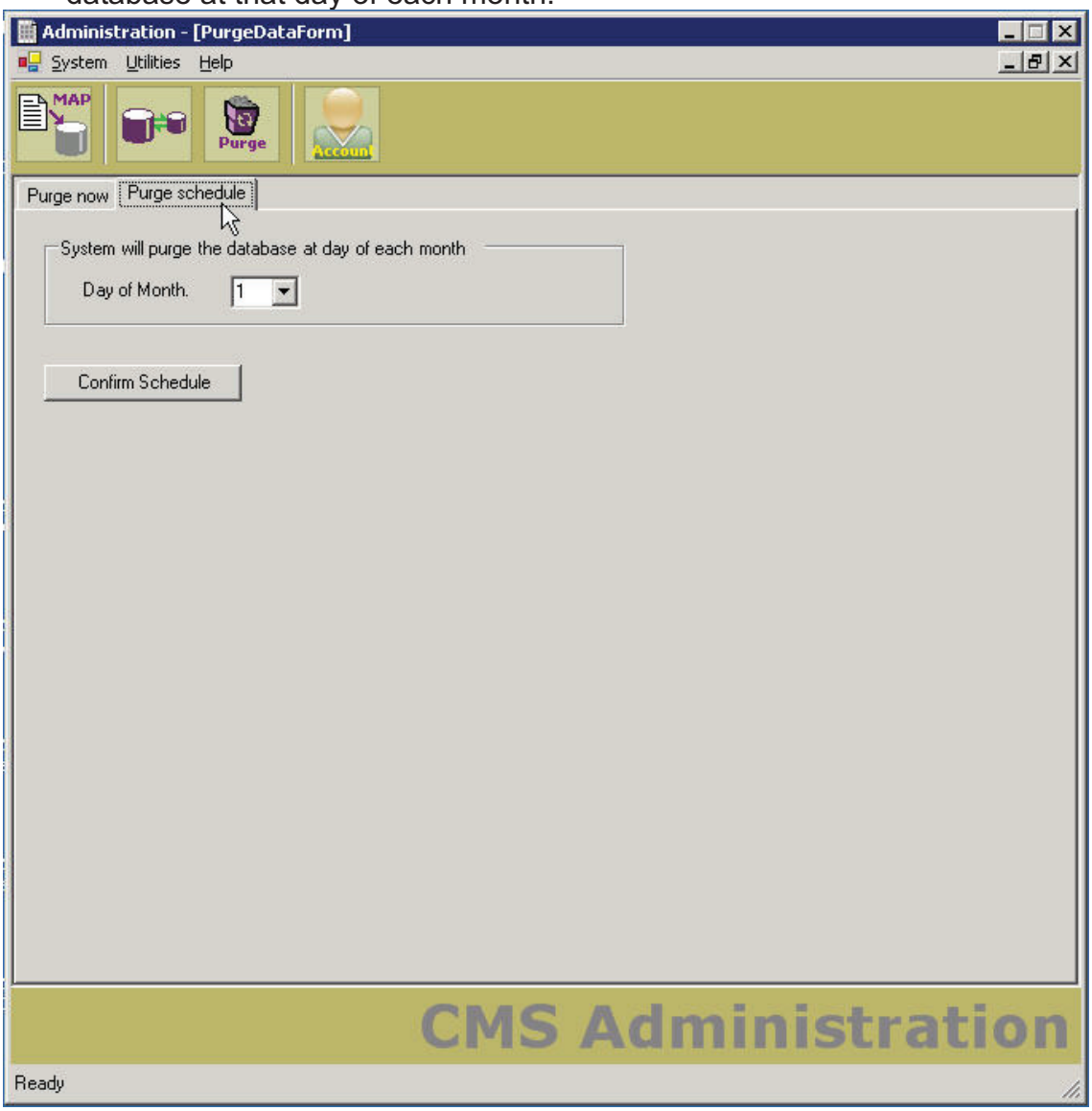




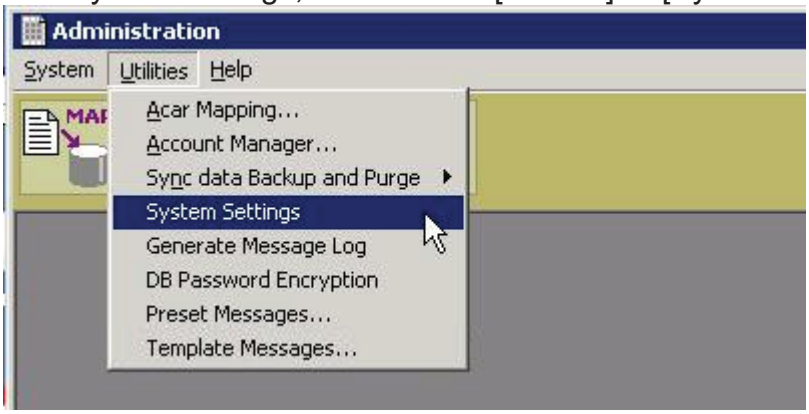
- Purge now - allows user to specify purge date and purge database immediately.



- Purge schedule – allow user to specify the day of month, system will purge the database at that day of each month.

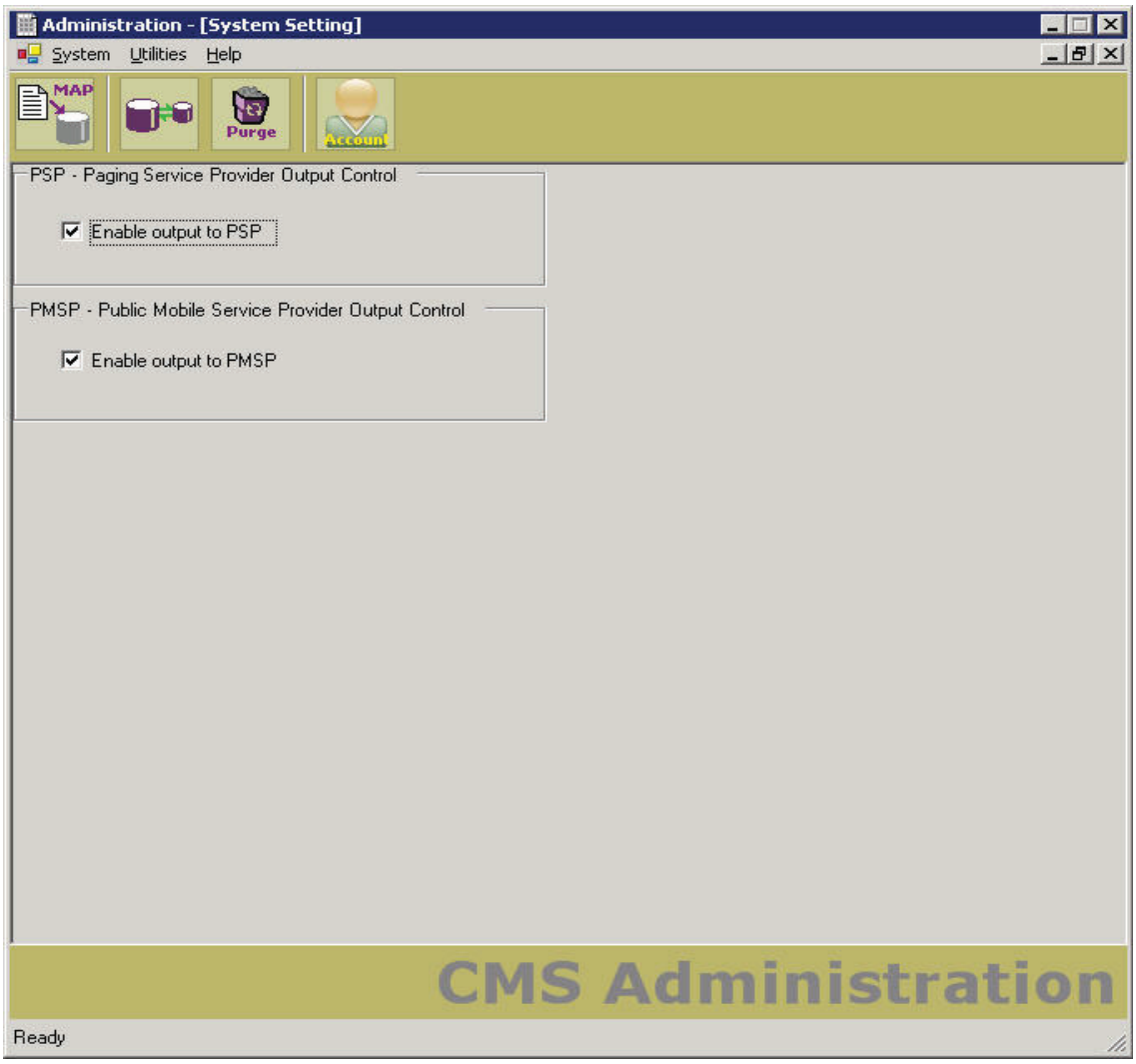


- System settings, select menu [Utilities] -> [System Settings]

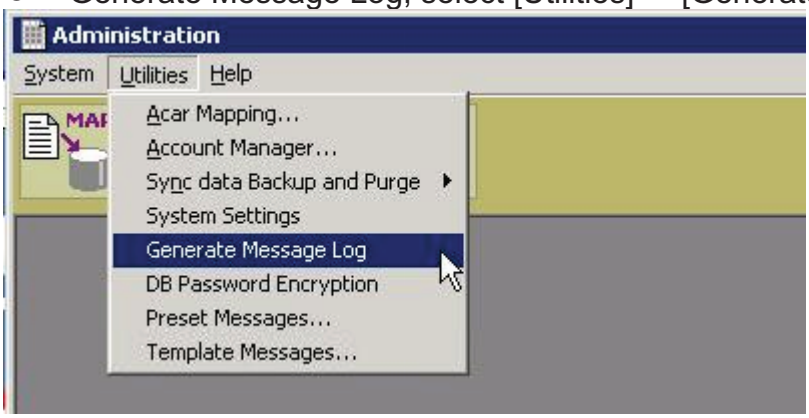


- Allows user to enable or disable Paging Service Provider Output Control (PSP) and Public Mobile Provider Output Control (PMSP).

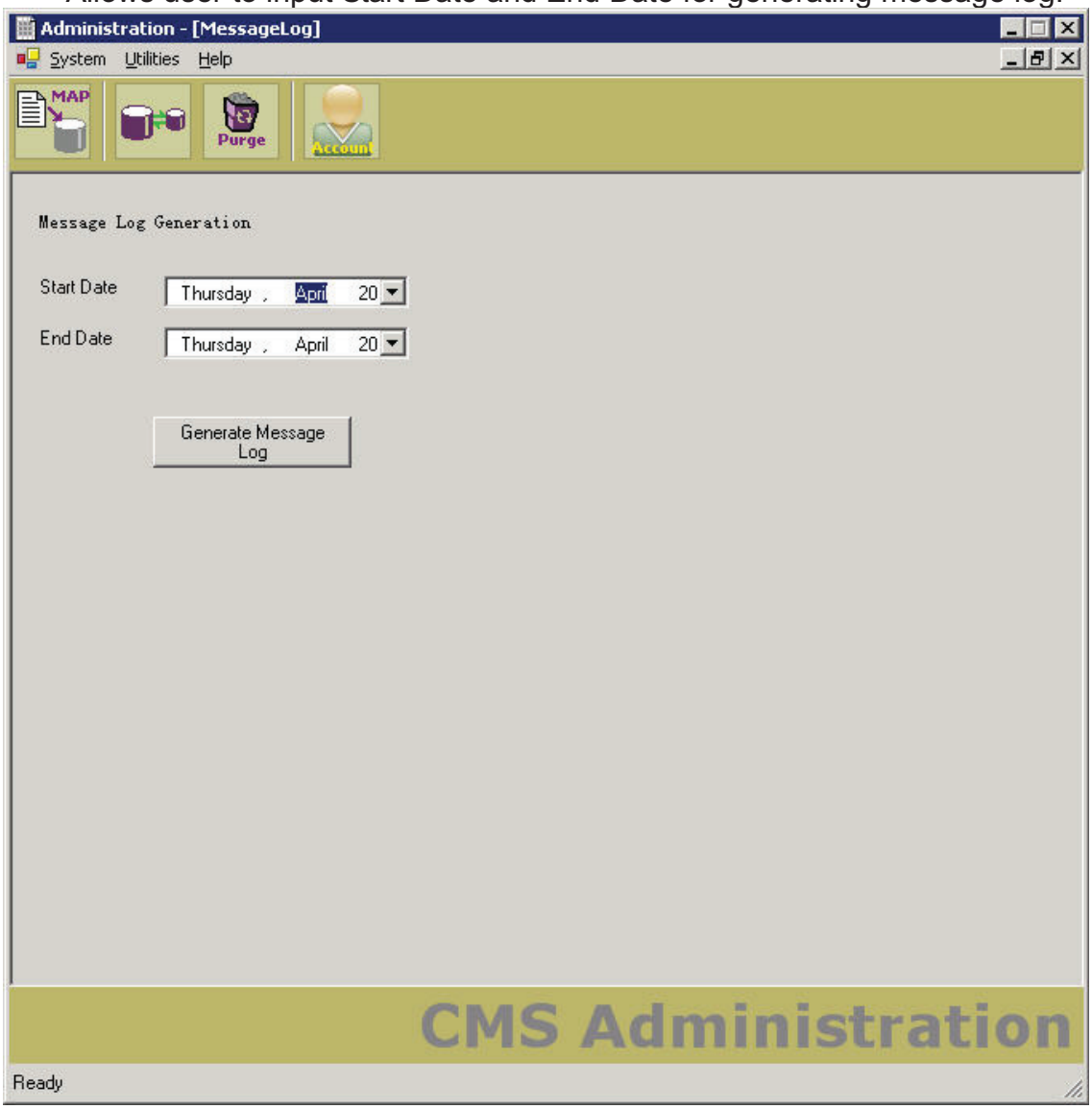
Enable output	Enable output to PMSP	Function description
On	Off	Initial setup, all trains are using RDR(pager) as EIDS message receiver.
On	On	During migration, some trains are using RDR and others are using TRDR as EIDS message receiver.
Off	On	Final setup, all trains are using TRDR as EIDS message receiver.



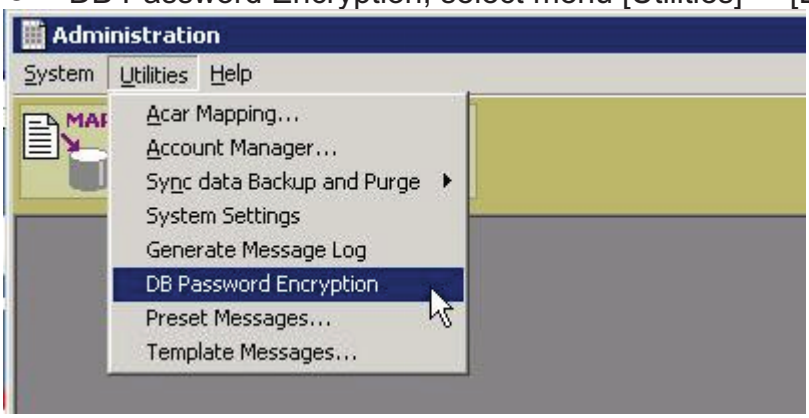
- Generate Message Log, select [Utilities] -> [Generate Message Log]



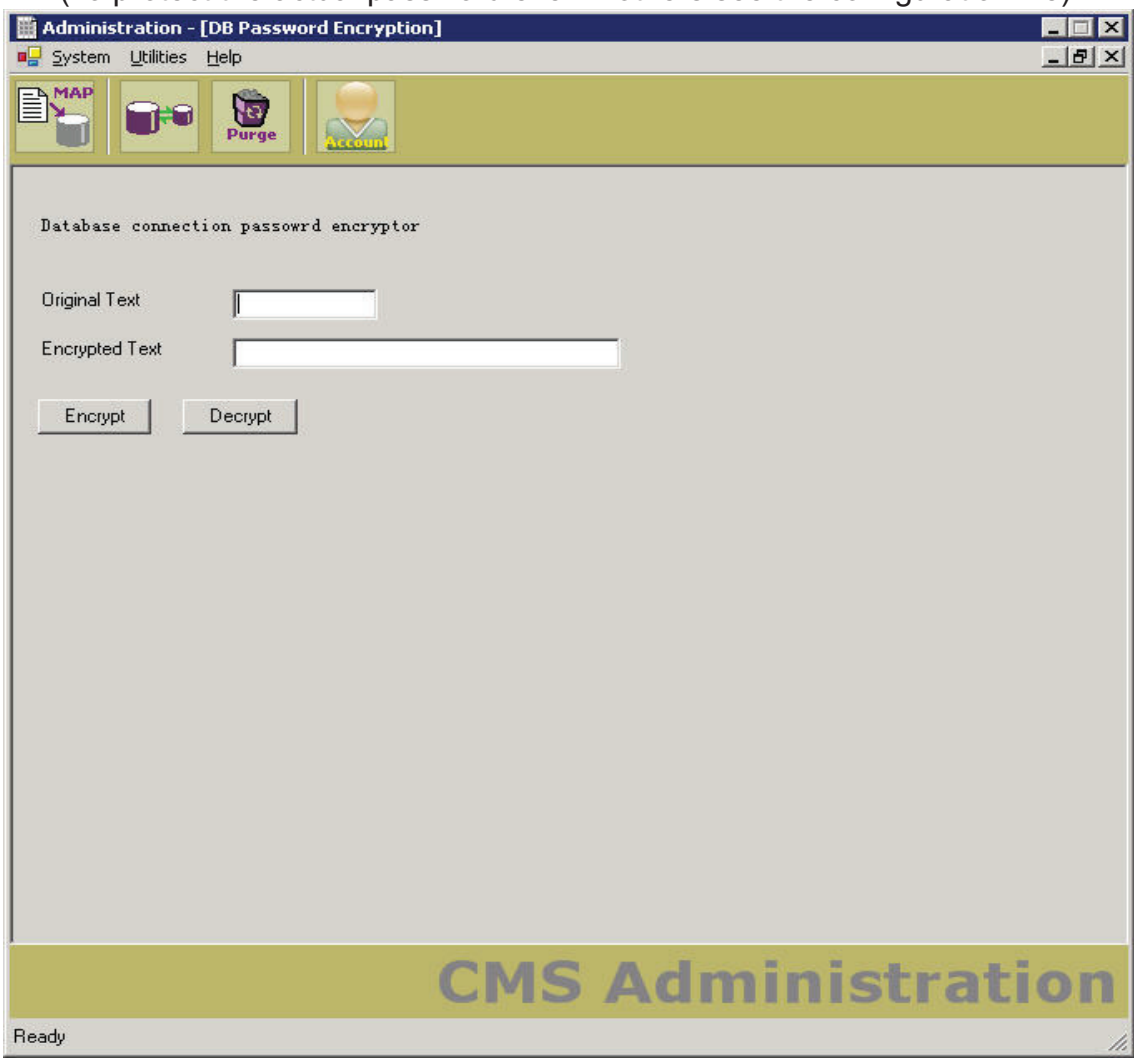
- Allows user to input Start Date and End Date for generating message log.



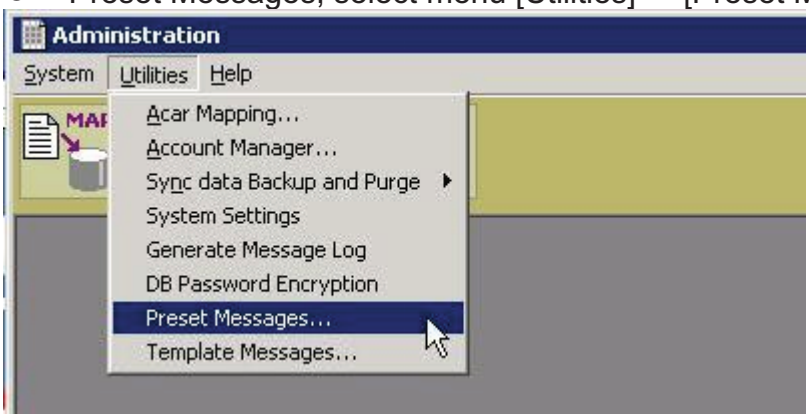
- DB Password Encryption, select menu [Utilities] -> [DB Password Encryption]



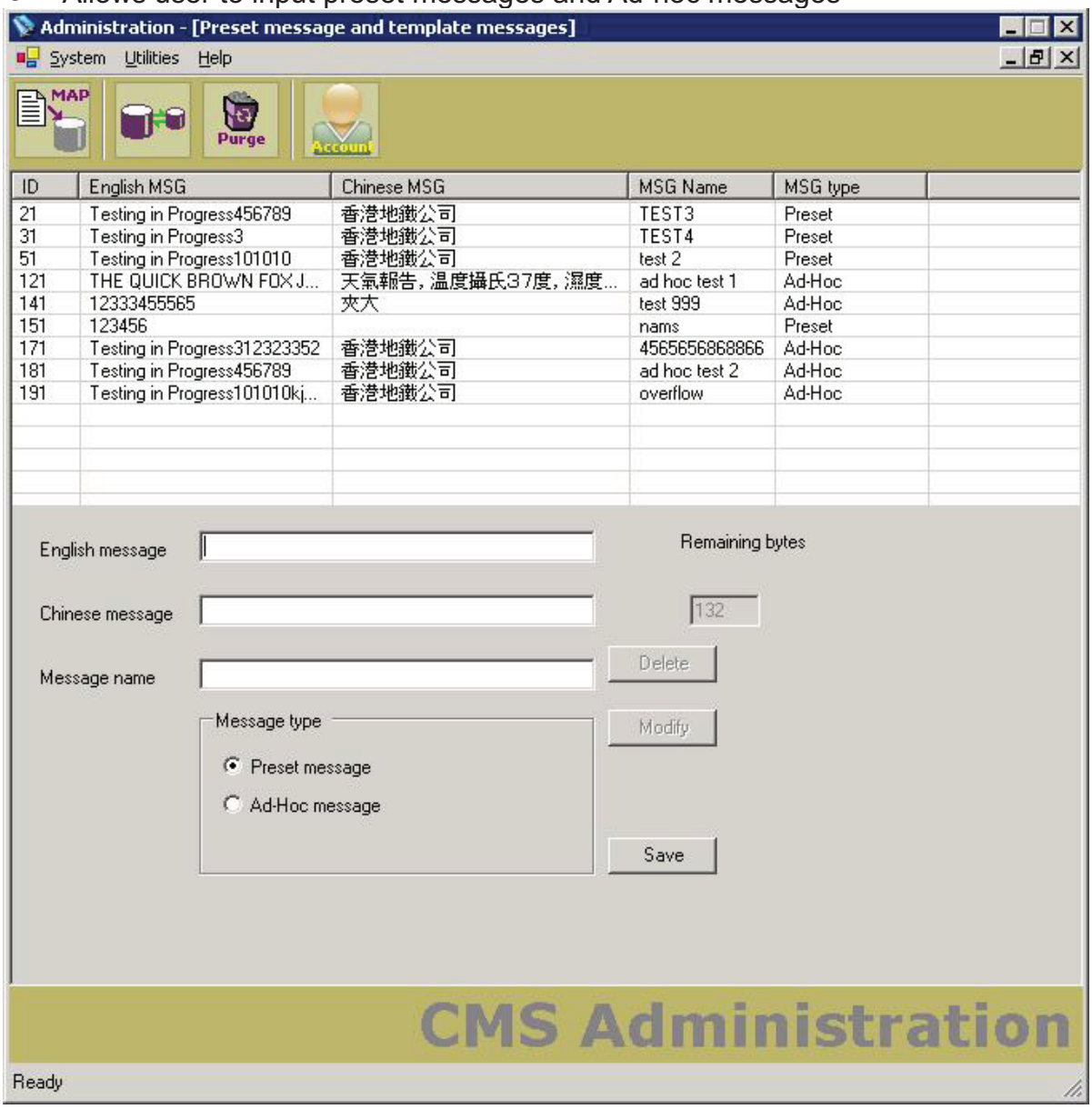
- Allows user to encrypt or decrypt a text for the database connection password. (To protect the actual password even if others see the configuration file)



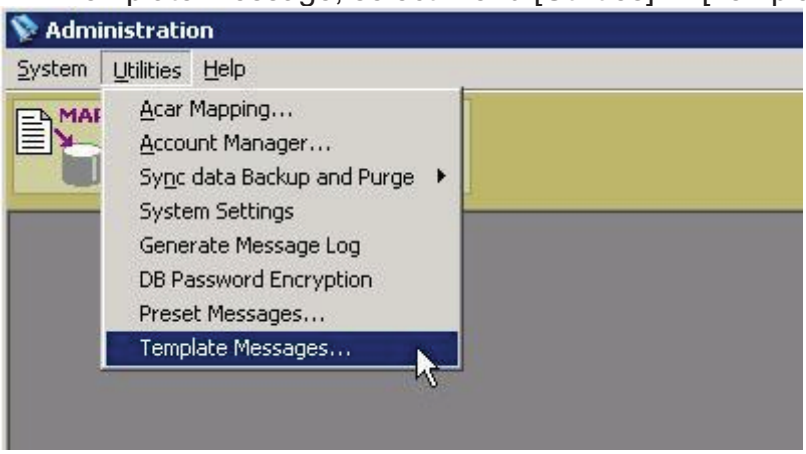
- Preset Messages, select menu [Utilities] -> [Preset Messages…]



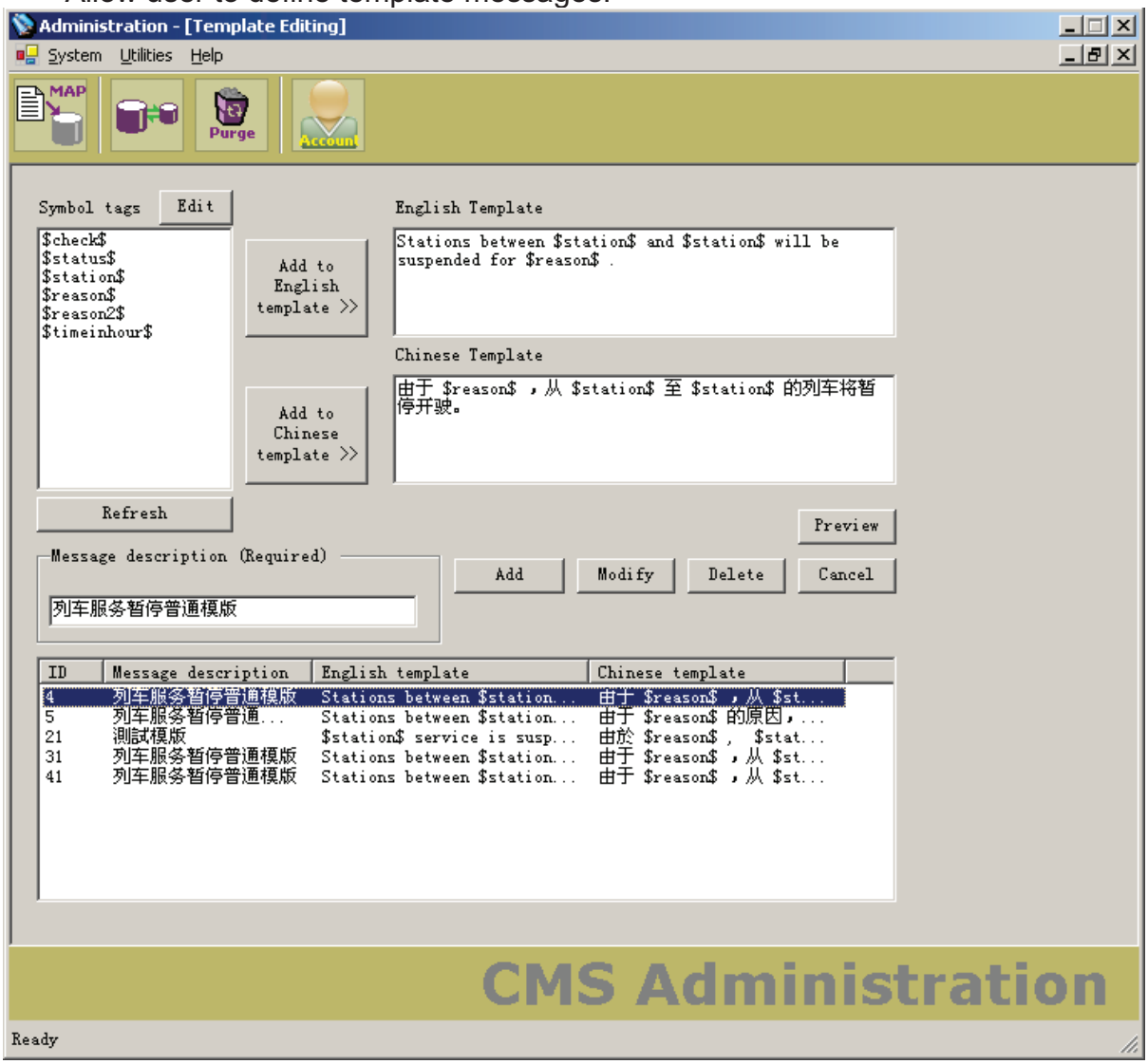
- Allows user to input preset messages and Ad-hoc messages



- Template Message, select menu [Utilities] -> [Template Messages…]

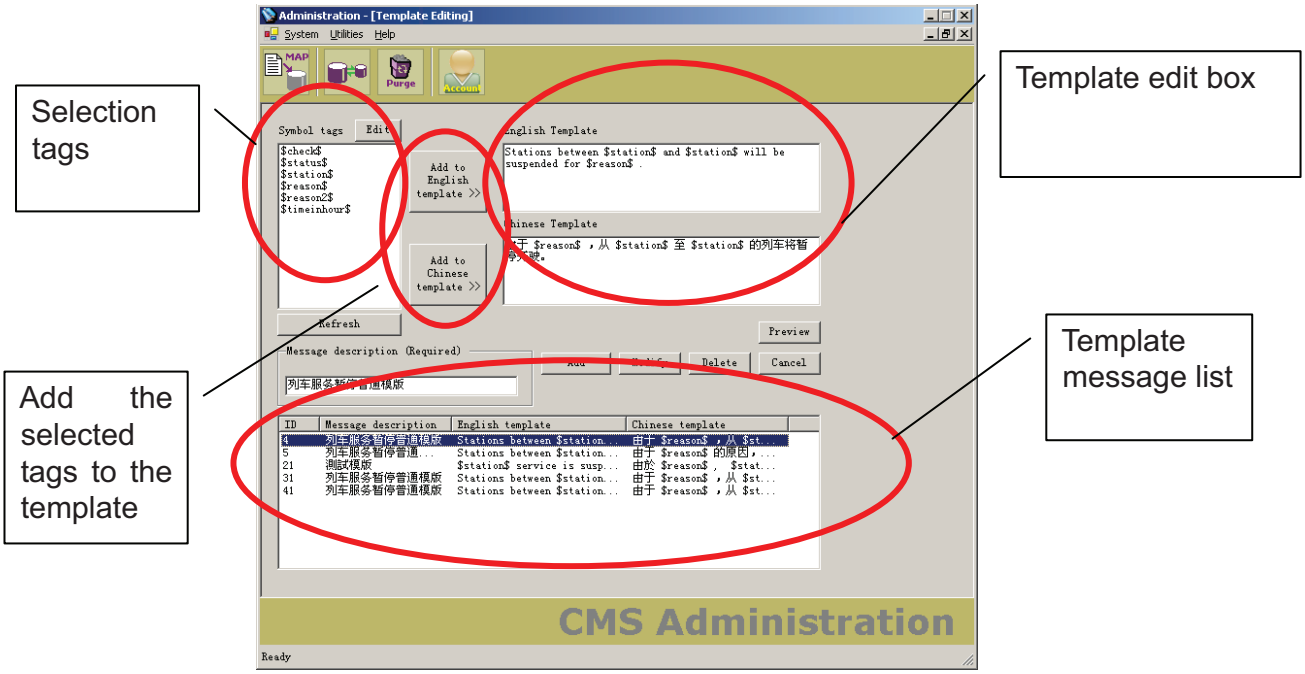


- Allow user to define template messages.

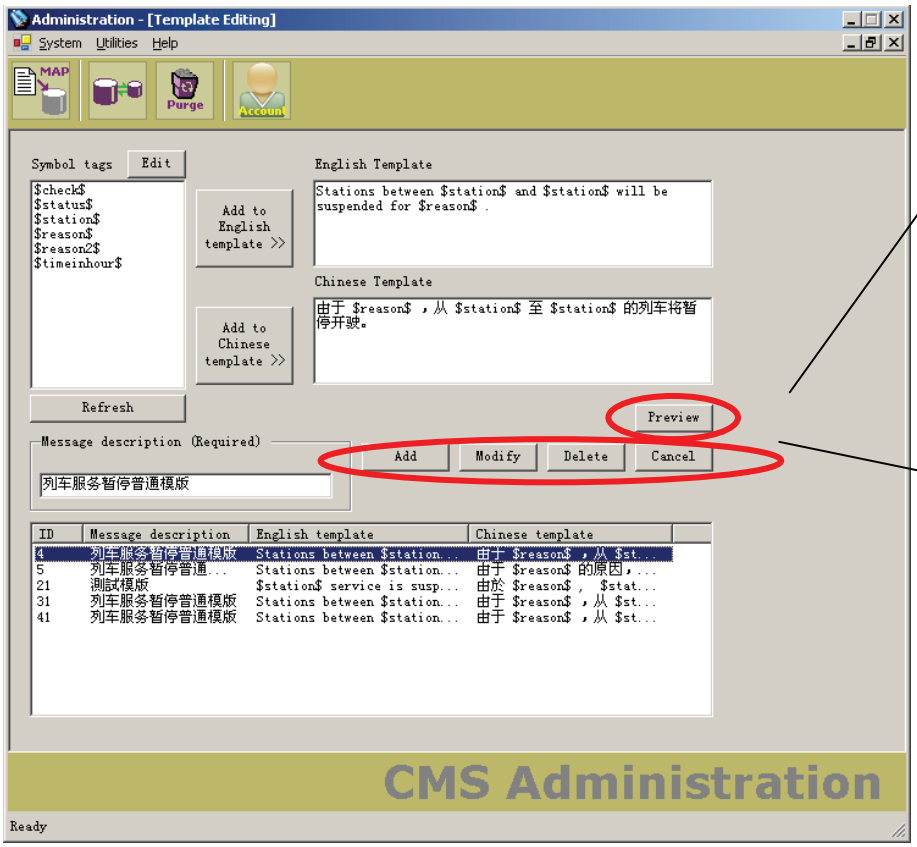


- Template Message

1. At the bottom of the screen, it's the template message list.
2. At the upper RHS, it's the template message edit box.
3. At the upper LHS, it's selection tags used by the template message



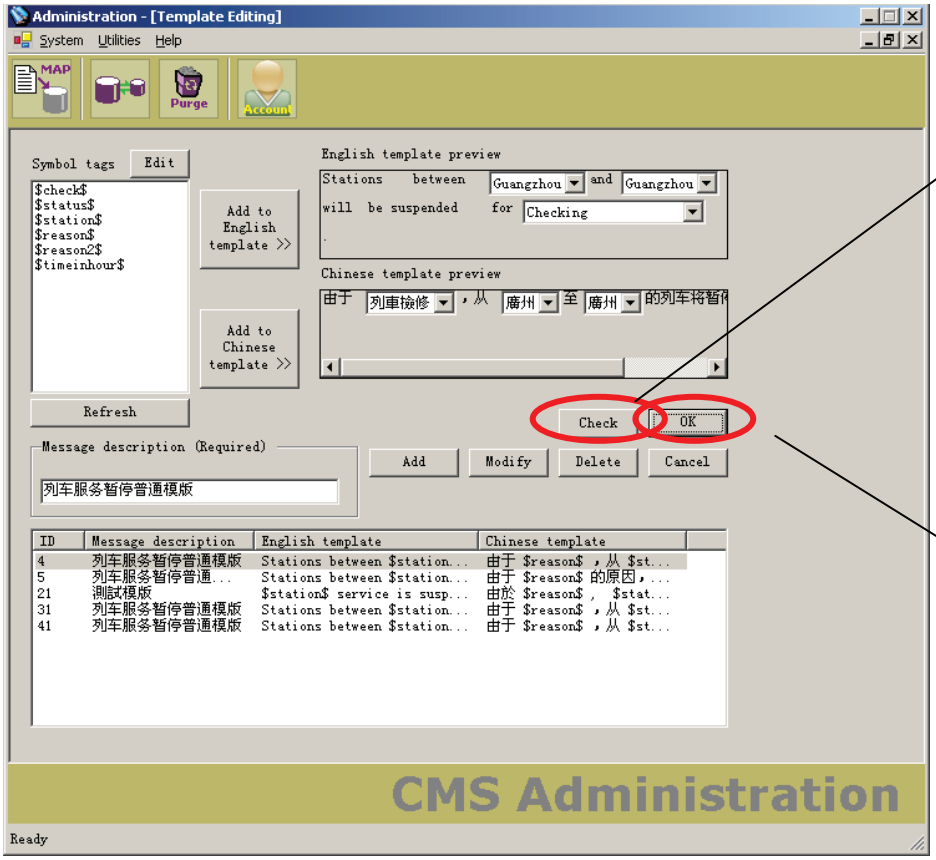
- Save / Modify / Delete template message



Previewing the template

Add, modify, delete buttons.

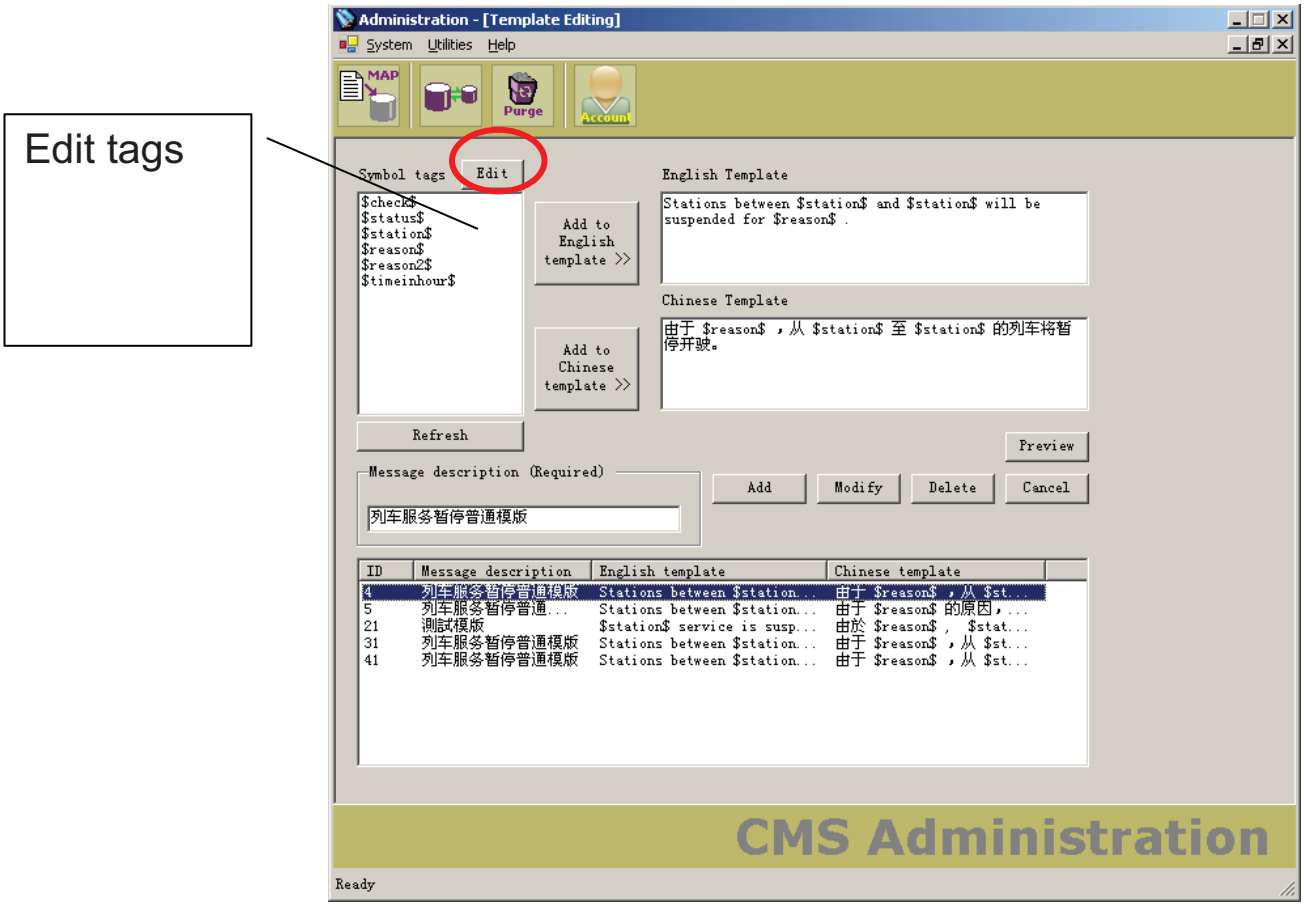
- Once the preview button click, the effect show on the operator screen will be simulated.
- You may check the message length without exceed limit by using the check button



Previewing the template

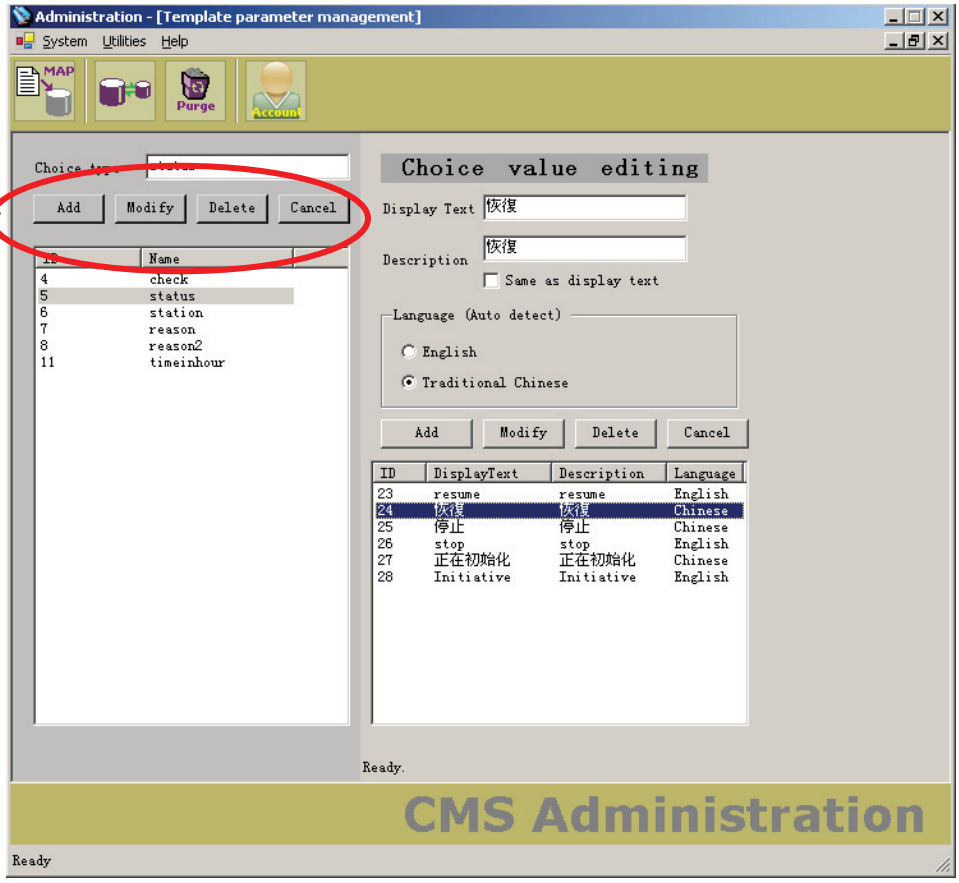
Click ‘OK’ when end of preview

- You may edit the 'tag' content by clicking the 'Edit button'



- You may add new 'tag' by input the 'Choice type' and click 'Add' button
- You may also modify/delete the selected 'tag' by click 'Modify' /' Delete' button

Add/ Modify/ Delete/ Cancel Button



3.3.5 Message dissemination to AEL Trains (Option 2)

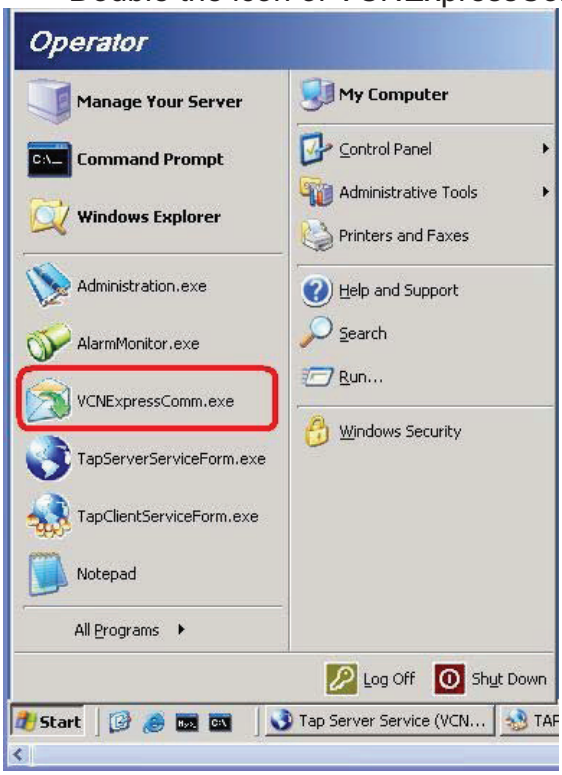
A new interface RTTF (or VCN Express Communicator) is used for the dissemination of specialized central messages from the Operations Control Centre (OCC) to Airport Express Line (AEL) trains.

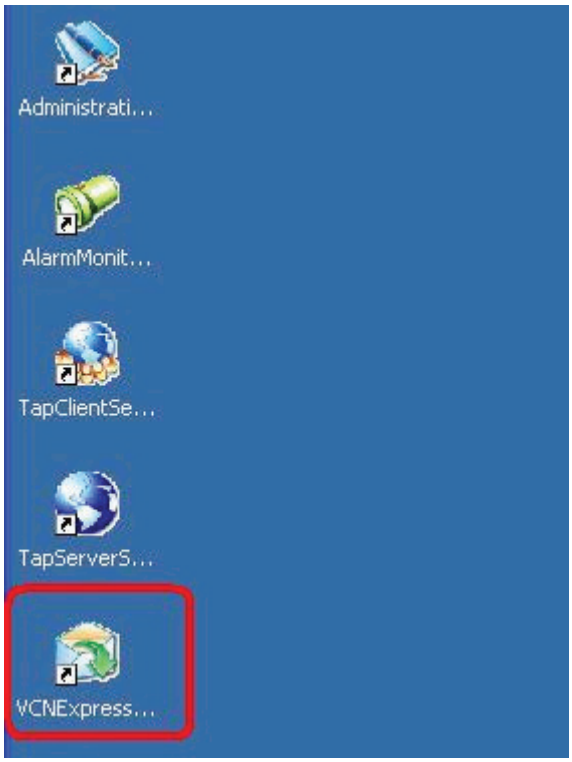
Attention
VCN Express Communicator has no interface with the SICP so user can either send to only one AEL train or to all AEL trains at a time. User shall also be responsible for checking manually if the train selected is actually in service.

- To start up the VCNExpressComm.exe, click [start] -> [VCNExpressComm.exe]

Or

- Double the icon of VCNExpressComm.exe on the Windows desktop.



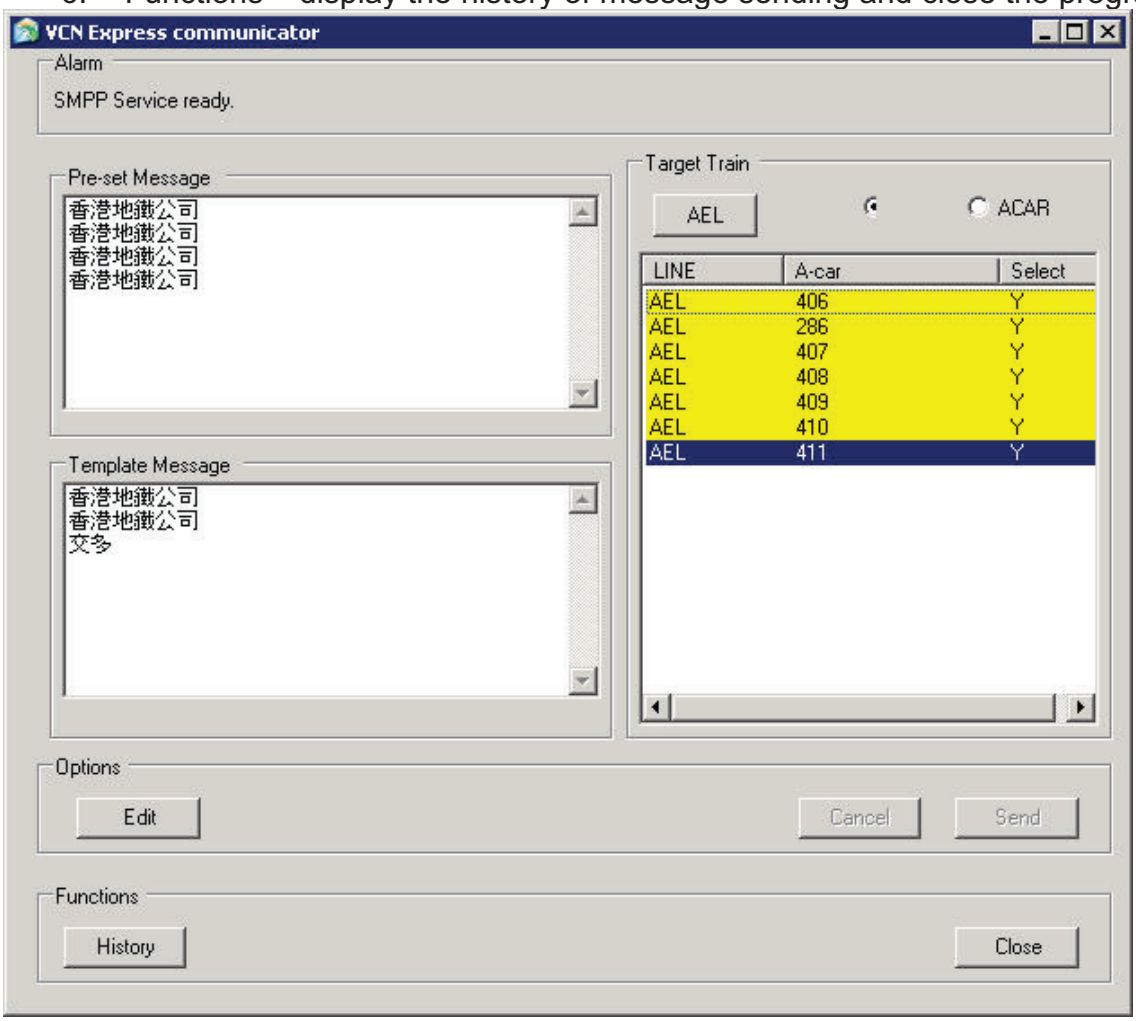


- Login prompt

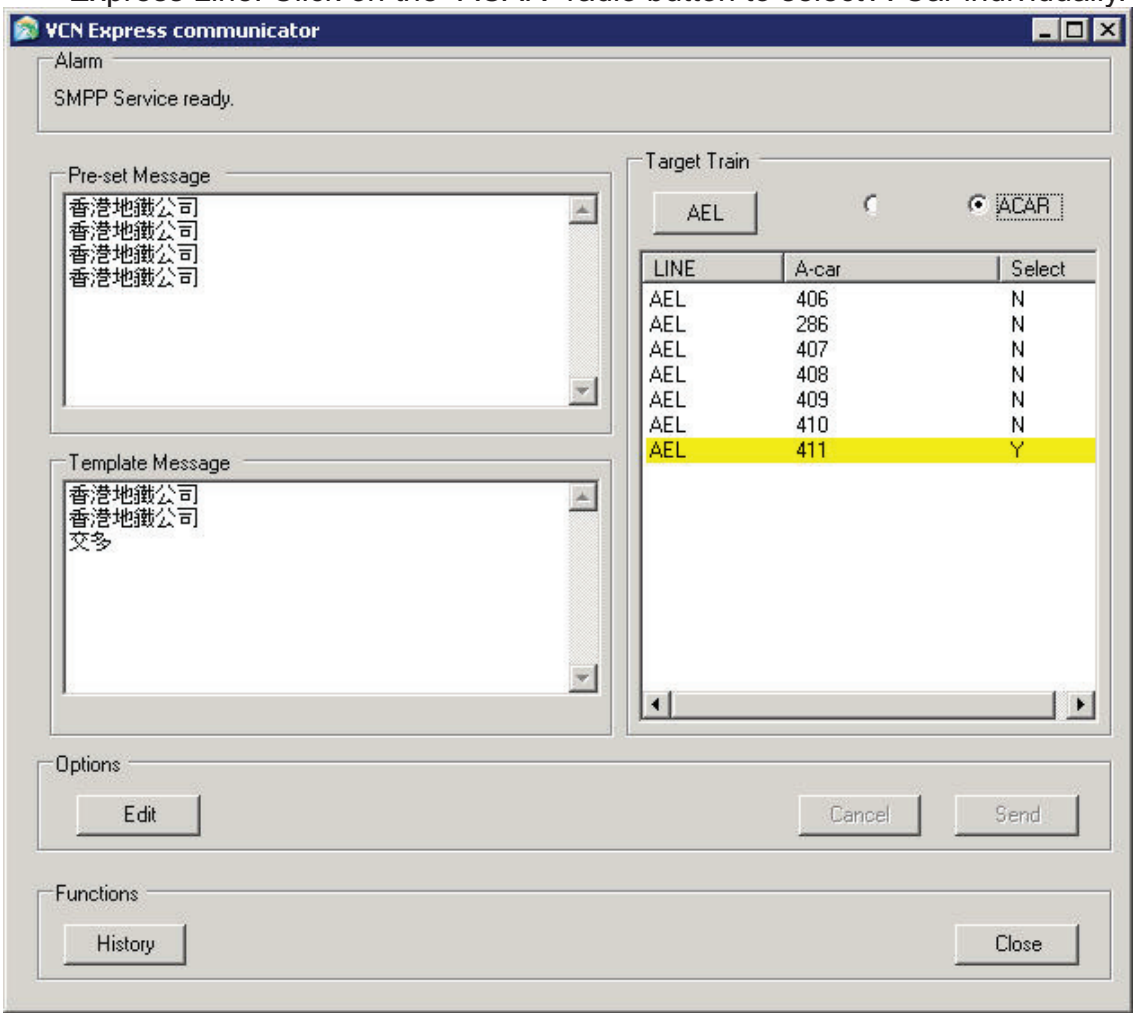
- Main screen

Functions provided in the main screen

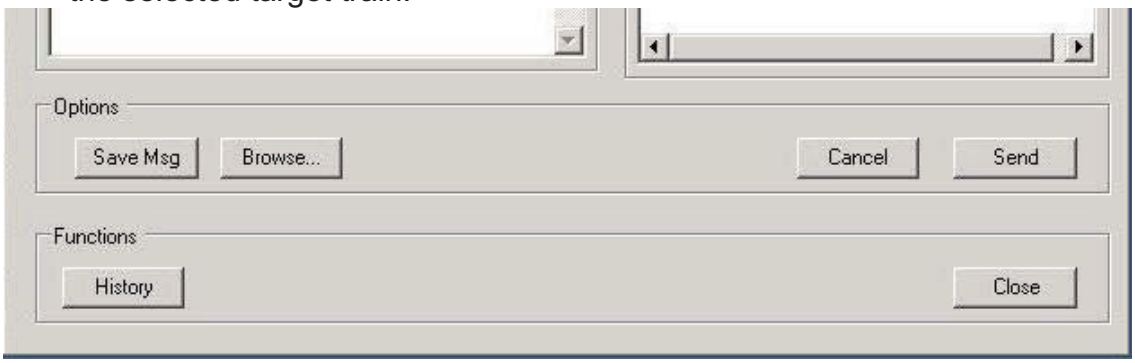
1. Alarm – display the status of SMPP connection.
2. Pre-set Message – display the pre-set messages for selection.
3. Template Message – display the template message for selection.
4. Target Train – select the train line or A-Car individually.
5. Options – allows user to edit and send the message.
6. Functions – display the history of message sending and close the program.



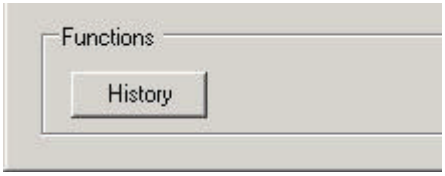
- Click on the “AEL” button or their radio button to select all trains in Airport Express Line. Click on the “ACAR” radio button to select A-Car individually.



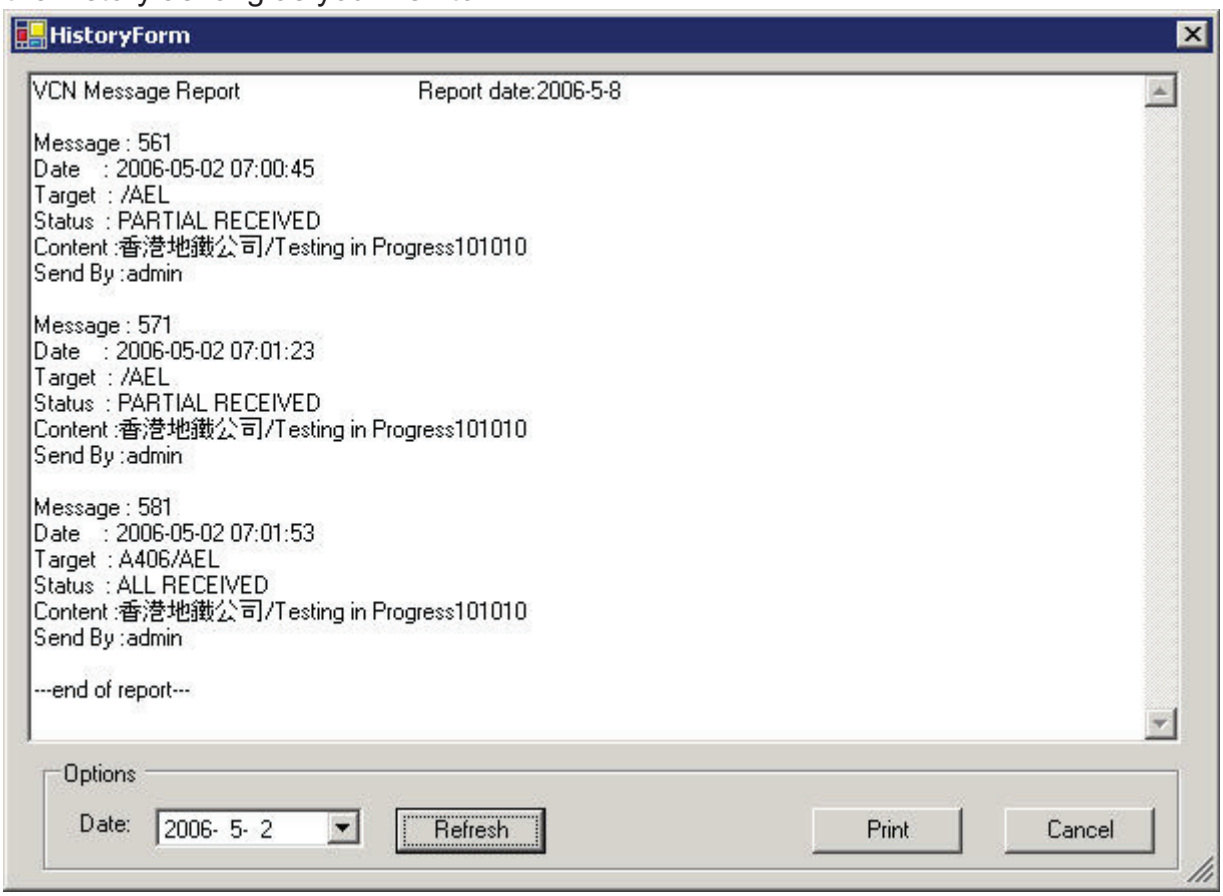
- When the Pre-set or Template message and target train are selected, click on Edit button, the message can be modified in English and Chinese message textbox and then click Send button, the message would be sent immediately to the selected target train.



- When click the Edit button, the Edit button will switch to Saving message mode and browse message mode.
- History - click the History button of the main screen.



You can go over the message status and filter the history by date. And you may print the history as long as you wish to.



3.3.6 Housekeeping

- Automatic database backup

The CMS contains a daily schedule to backup database automatically, the database backup are kept for 3 days only.

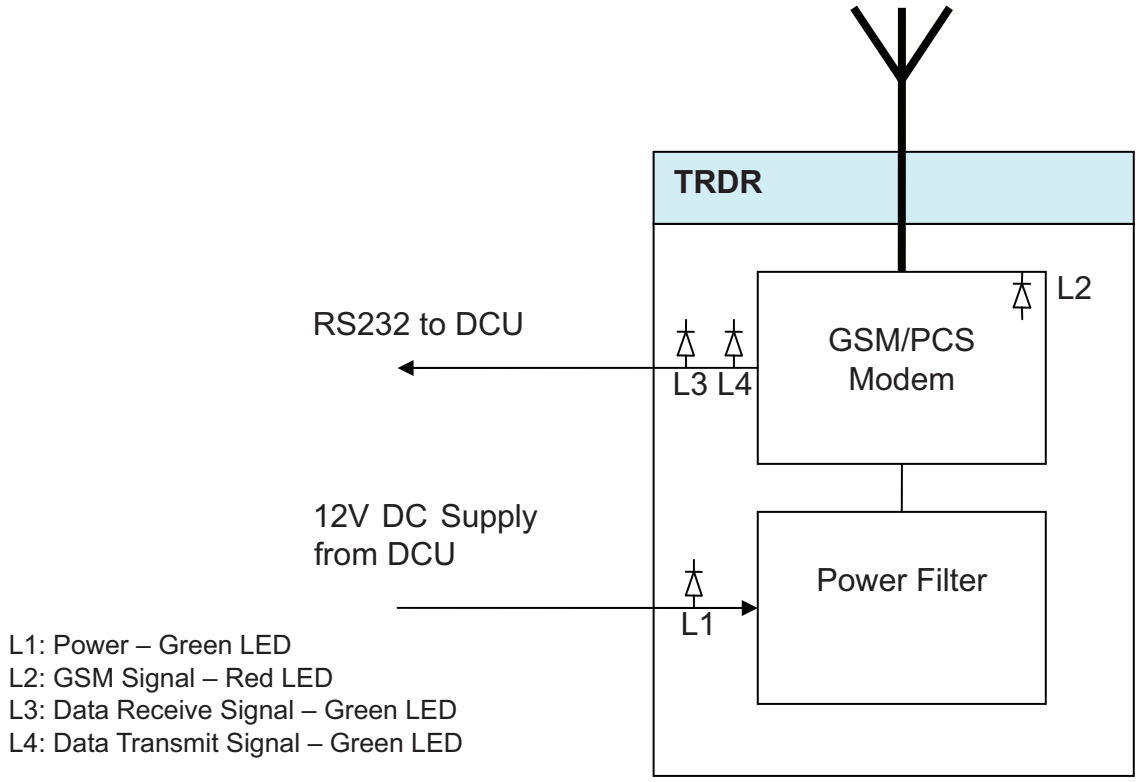
- CD-RW media

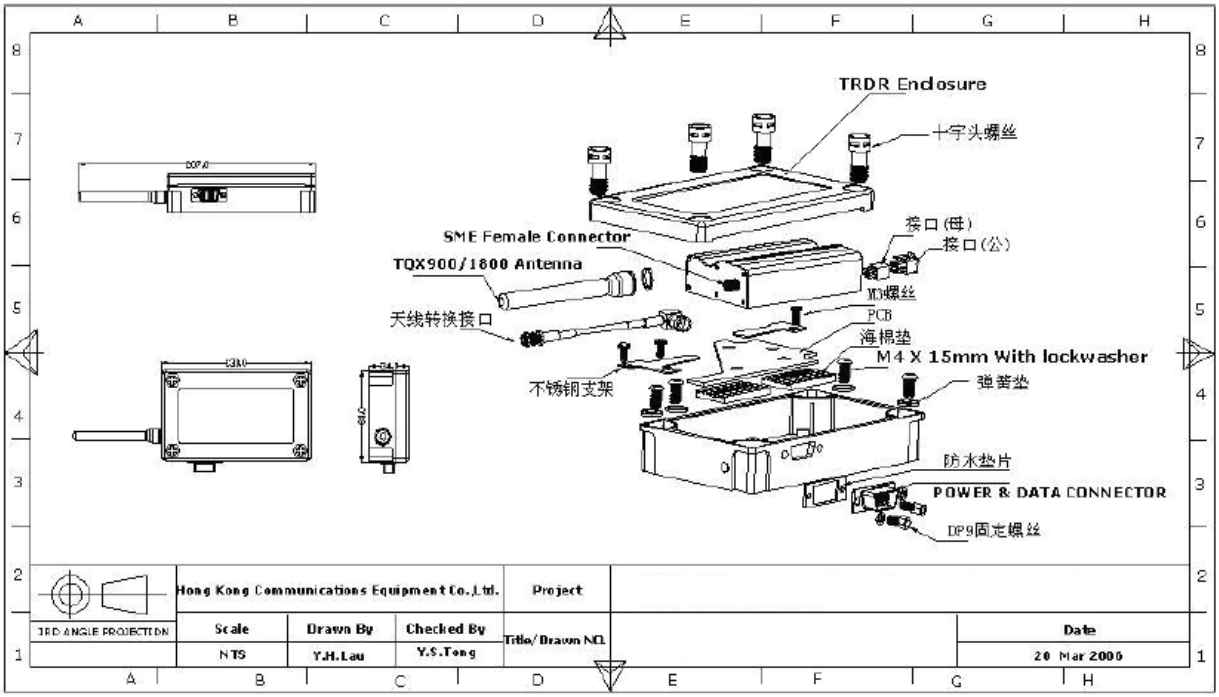
The CMS contains a CD writer, the database backup SQL files would backup to CD-RW disc and the disc should be replaced monthly with an empty disc.

- Daily SMPP log

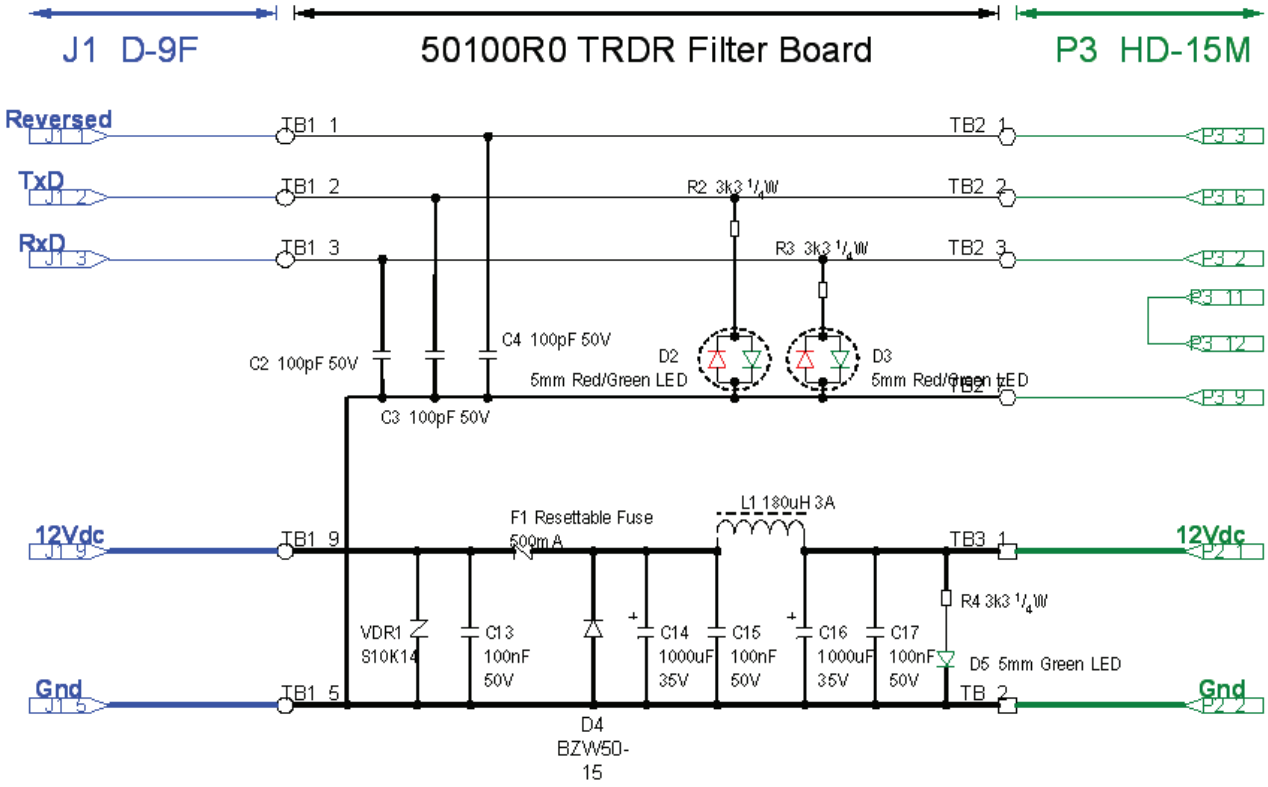
The CMS writes a daily SMPP log in D:\CMS_LOG
Filename: smpp.log.[yyyymmdd] e.g. smpp.log.20060513
The log contains the 3 timestamps which are:-
1. The time of SMS sending to SMSC
2. SMS delivery time (all second segment are zero)
3. The last updated timestamp

3.4 TRDR operation





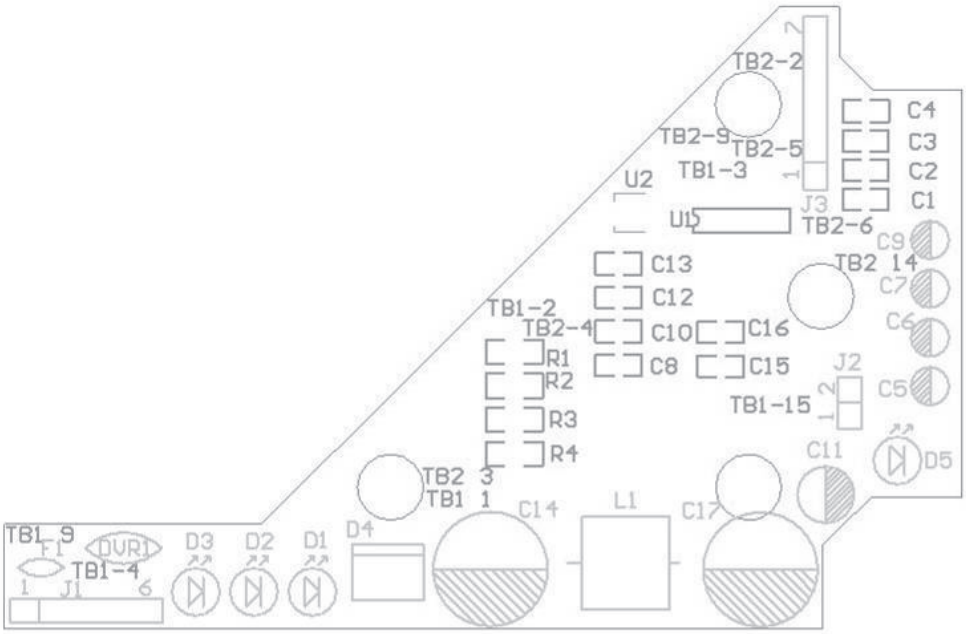
TRDR Filter Board (Wiring Diagram)

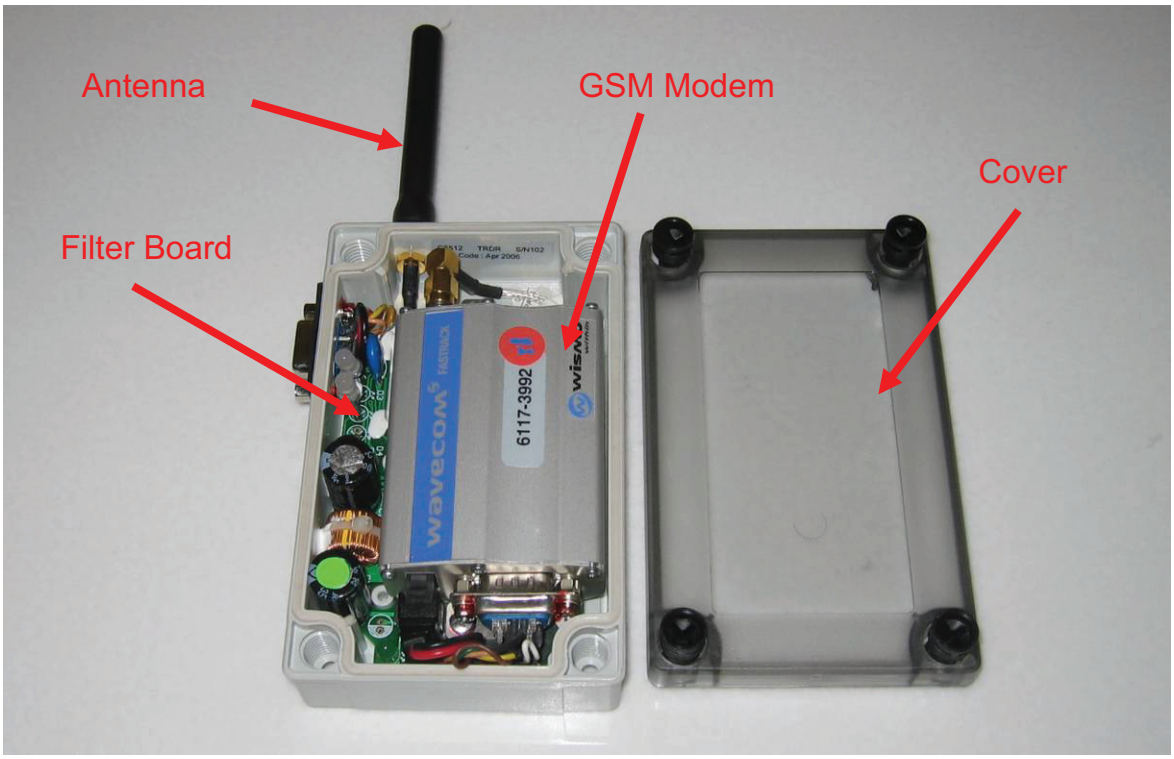


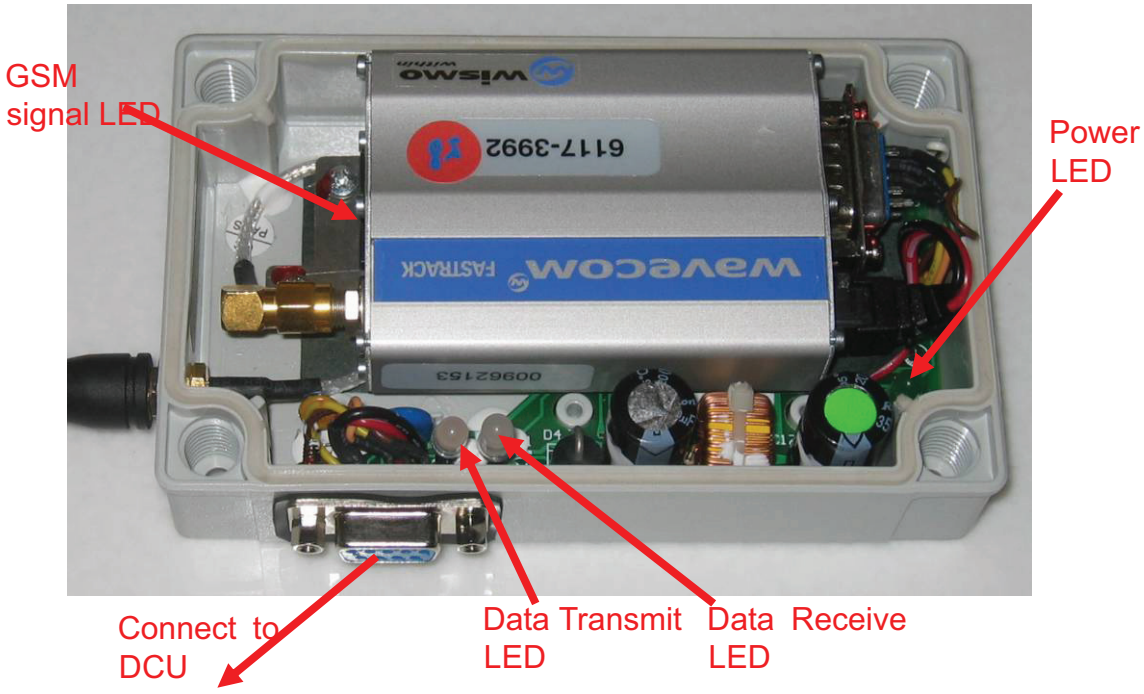
Pin assignment of TRDR

Pin 1: Reversed
Pin 2: Transmit Data
Pin 3: Receive Data
Pin 5: Ground
Pin 9: 12VDC

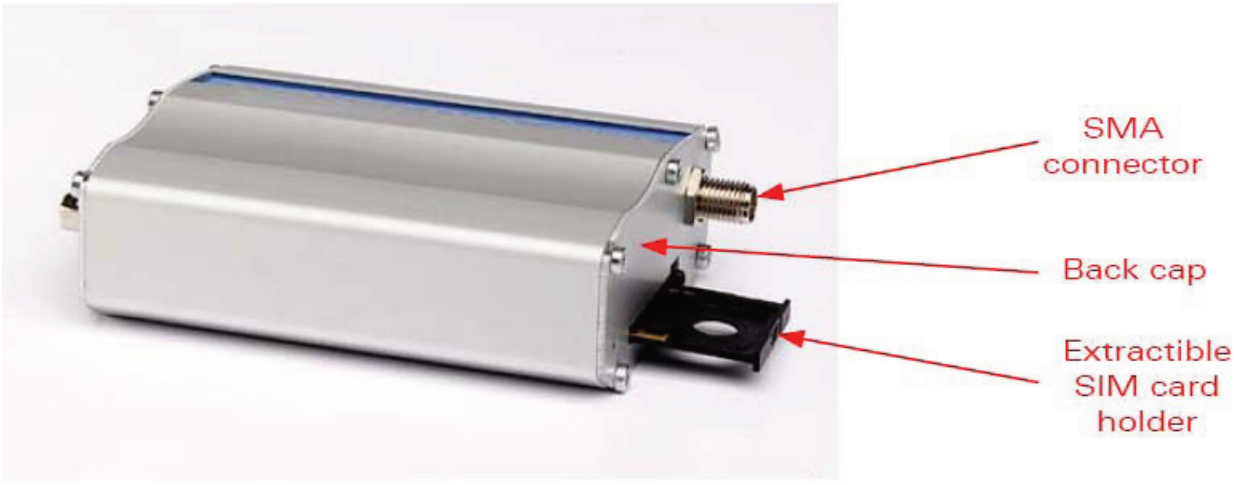
TRDR Filter Board (Component Layout)



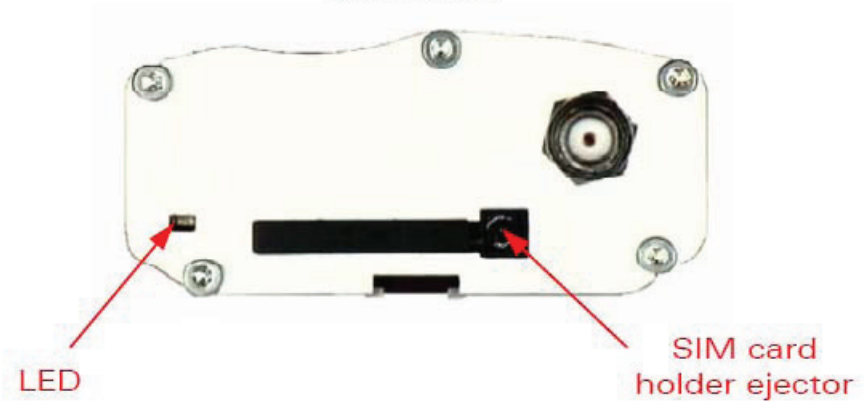



GSM
signal LED
Power
LED
Connect to
DCU
Data Transmit
LED
Data Receive
LED

SIM
Card
6117-3992
wavecom
wismo



BACK CAP



Each TRDR consists of a GSM/PCS modem (Wavecom Fastrack modem M1306B) and a 12V DC power filter with LED. The modem and the power filter will be housed in an IP 55 box of size 165 (L) x 90 (W) x 22 (D). The connection from TRDR to DCU is the RS232 connector and cable.

2. SIM card installation

The GSM modem needs a SIM card to operate, insert the SIM card into a slot on the underside of the modem module.

- LED status during normal operation

L1: Power – Green LED, it should be ON when power on.
L2: GSM Signal – Red LED, it should be blinking in the GSM coverage area.
L3: Data Receive Signal – Green LED, it should be ON when connecting DCU.
L4: Data Transmit Signal – Green LED, it should be ON when connecting DCU.

3. Update the mapping table

A user interface is provided at power user level to update the mapping table of A-car number and the mobile number of the SIM card that installed in the TRDR.

4 Troubleshooting

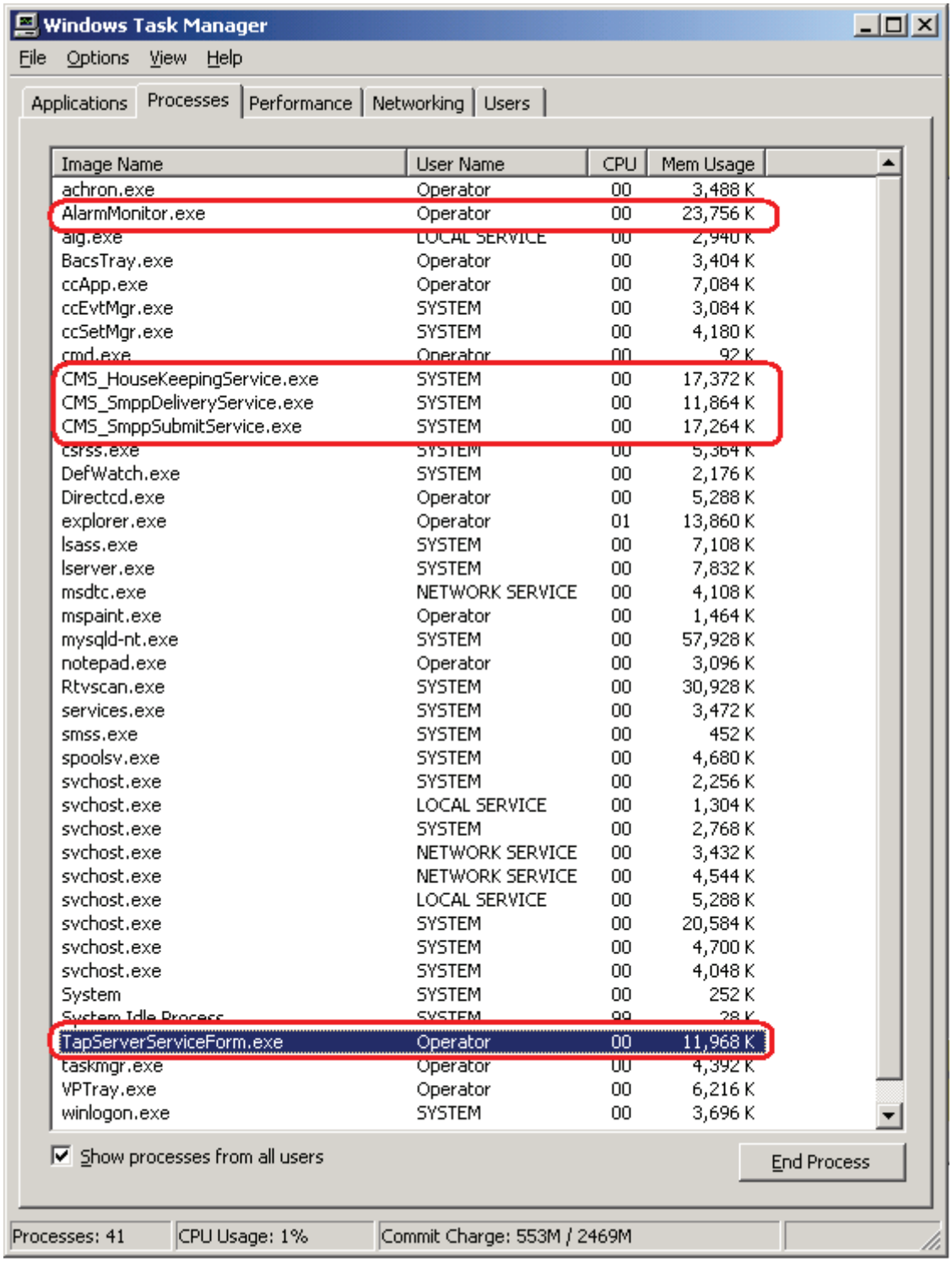
4.1 System Diagnostics

4.1.1 For CMS

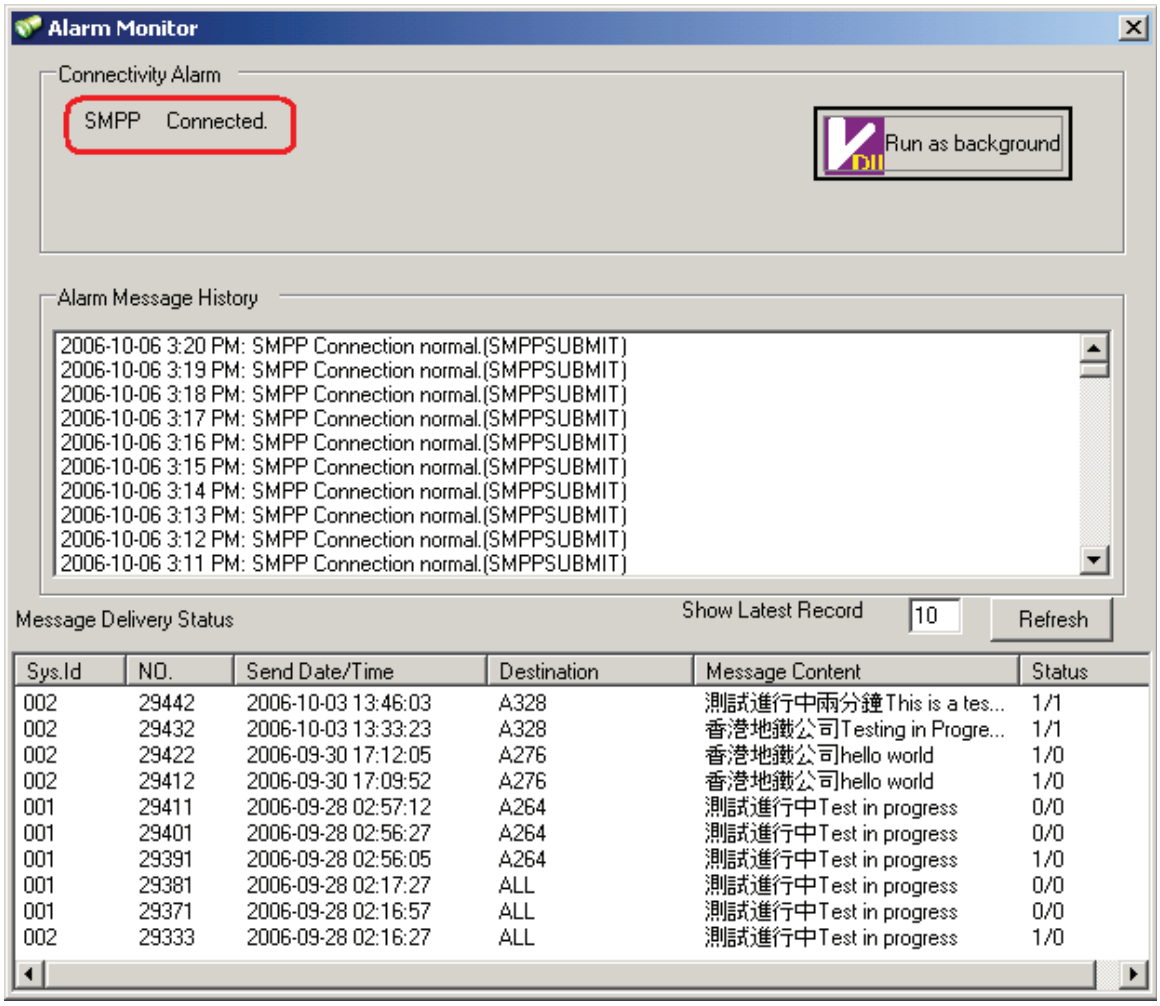
For the hardware diagnostic, please refer to Dell™ PowerEdge™ 850 Systems Installation and Troubleshooting Guide

For the CMS software diagnostic, here's testing procedure:

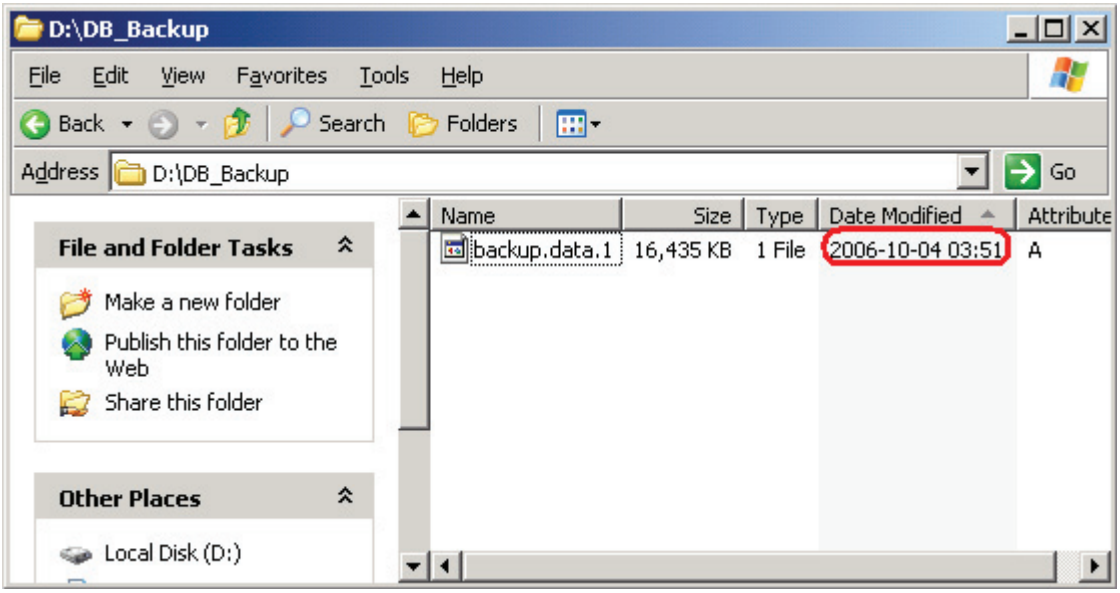
- After the server's network is properly connected, power on the server. After the server power on, check that the following program is running at the task manager:
  - AlarmMonitor.exe
  - CMS_HouseKeepingService.exe
  - CMS_SmppDeliveryService.exe
  - CMS_SmppSubmitService.exe
  - TapServerServiceForm.exe



- Testing and verification
  - Verify the Alarm Monitor program and SMPP service is working normally by check from the AlarmMonitor screen that the SMPP connection status is “Connected”



- Verify the TAP module is working normally by check from the EIDS terminal that both LINE are ready (No alarm show on the EIDS terminal)
- Verify the Administration program and Housekeeping service is working normally by start the Administration program and update the ACAR mapping. After 5 minutes, you can check from the Administration program of another live CMS server that the ACAR is updated.
- Verify the overall message sending function is working normally by shut down another live CMS server. Send a message from EIDS terminal, and check that the train can receive it correctly. (Restart the stopped CMS server after testing done)
- Verify the backup function is working normally by: on the next day, check the date of the database backup and make sure the backup function is working normally is current day.



4.1.2 For TRDR

Power up self test

1. Disconnect the RS232 connector from TRDR for 10 sec.
2. Reconnect the RS232 connector to TRDR.
3. Check the 3 Green LEDs (Power, Data send and receive), they are ON.
4. Red LED (GSM signal) is blinking.

4.2 System Troubleshooting

4.2.1 For CMS Server

1. For the server hardware diagnostic, you may refer to Dell™ PowerEdge™ 850 Systems Installation and Troubleshooting Guide

2. For the CMS software, you may check from the Alarm Monitor that:
   - If SMPP connection is normal, you may see that the SMPP status is 'connected'. Otherwise, there may be the network connection problem between SMARTONE and OCC.

4.2.2 For TRDR

1. If power fault, the Green LED (L1) is off.
2. If GSM signal fault or SIM error, the Red LED (L2) is not blinking.
3. If data receive fault, the Green LED (L3) is off.
4. If data transmit fault, the Green LED (L4) is off.

4.3 CMS Simulator

CMS Simulator is used to simulate sending RTTF message to the train. This is useful when the engineer required to test the installation of TRDR inside the train is successful. This document is the procedure of installing the Simulator.

Prerequisites

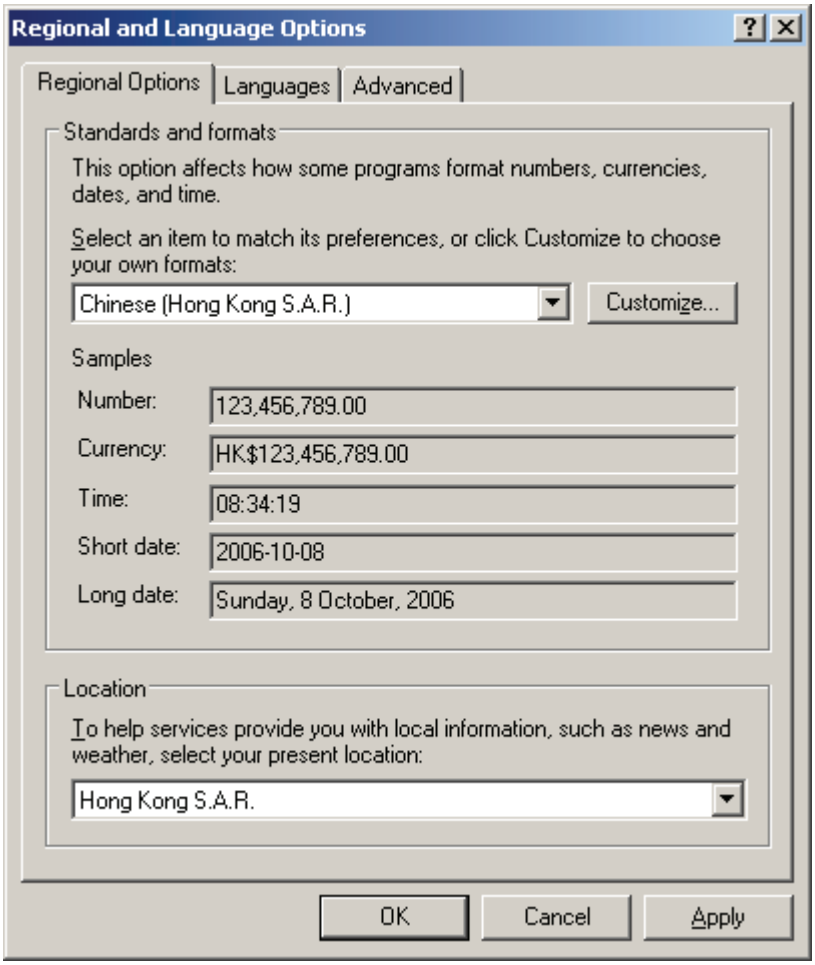
- An Intel computer installed with Window 2000 Server or Window XP professional. The latest Service Pack should be download and installed too. This server requires the Microsoft .Net framework V1.1. You have to download from Microsoft.
- The hardware requirement of the computer is:
  - CPU Intel Pentium 1.5GHz or above
  - Memory 512MB or above
  - Harddisk disk space 50GB or above
  - 1 LAN ports with 10/100 base-T Ethernet support
  - 1 serial port (configured as COM1)
- CMS simulator Installation disk is ready, which contains CMS software 'MTR Program Files', 'MySQL' database
- The engineer who will install the CMS simulator should have windows 2000 server or windows XP administration skill.
- The computer should also be installed with the proper AntiVirus software, Time synchronization software.
- Have the Simulator Installation Disk ready in the PC's CDRom. (Assume E: drive in this Procedure.)

4.3.1 Procedure of installing the CMS simulator

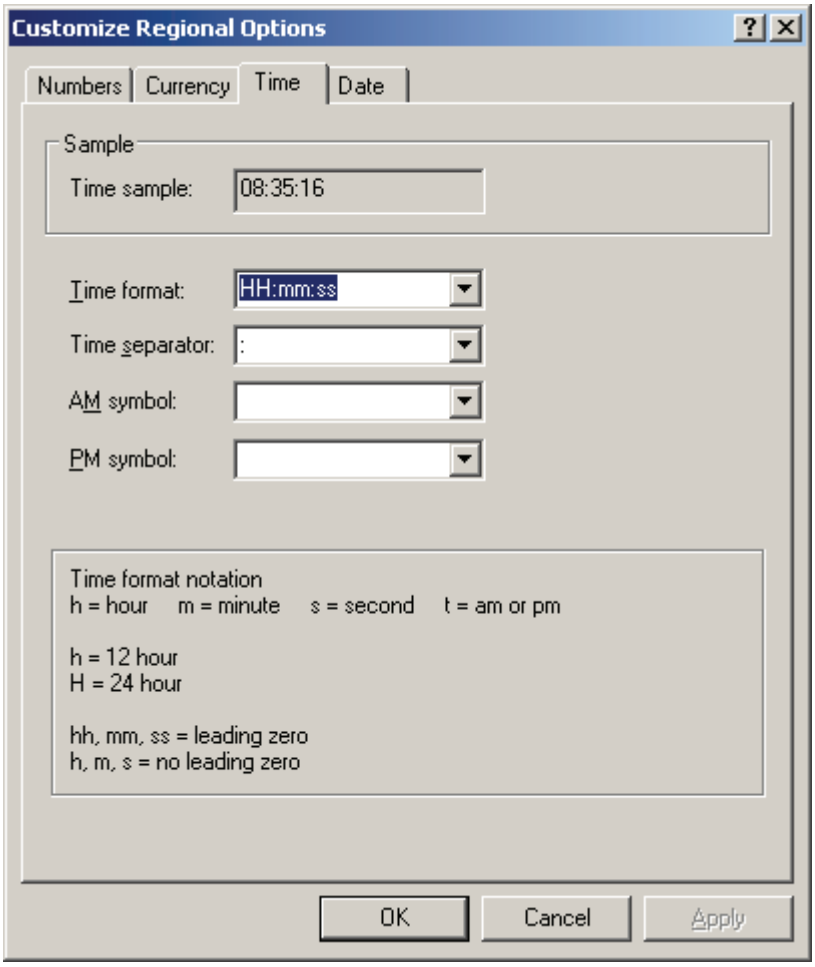
1. Power on the CMS simulator and logon as Administrator

2. Create folder
   C:\MTR Program Files

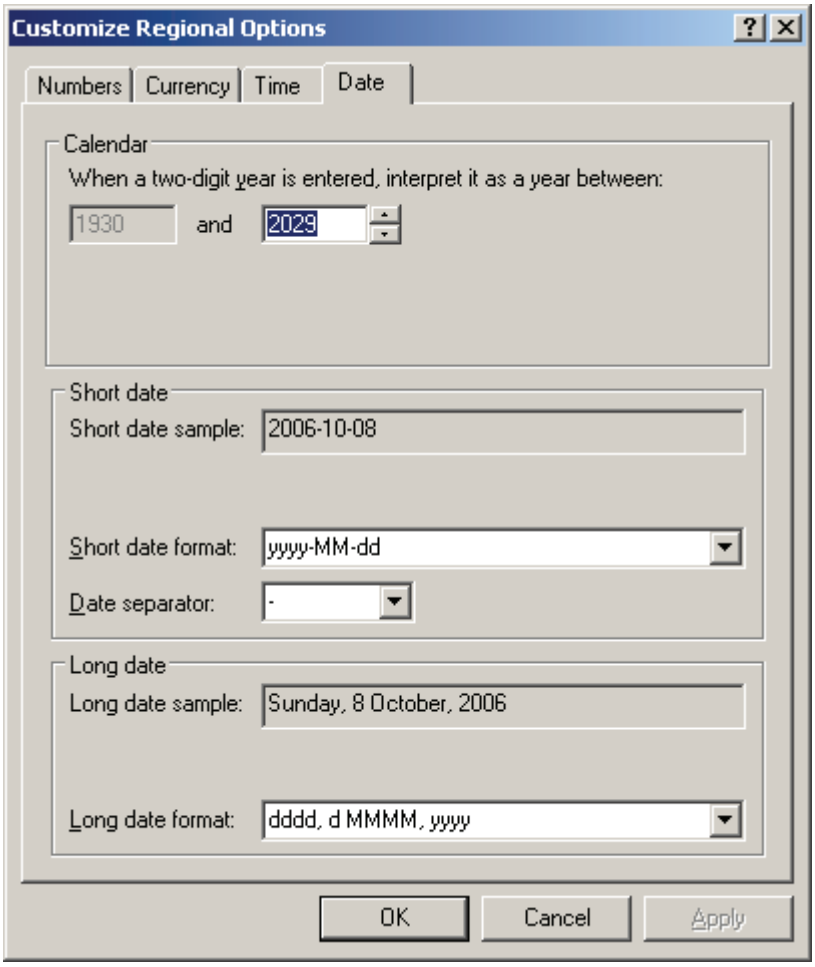
3. Change window's regional setting as followed:
   - Open control panel and select the "Regional and Language Options". At the "Regional Options" tab, click customize.



   - The "Customize Regional Options" opened, select the "Time" tab, change the time format to "HH:mm:ss".



- Then select the “Date tab, change the short date format to “yyyy-MM-dd”



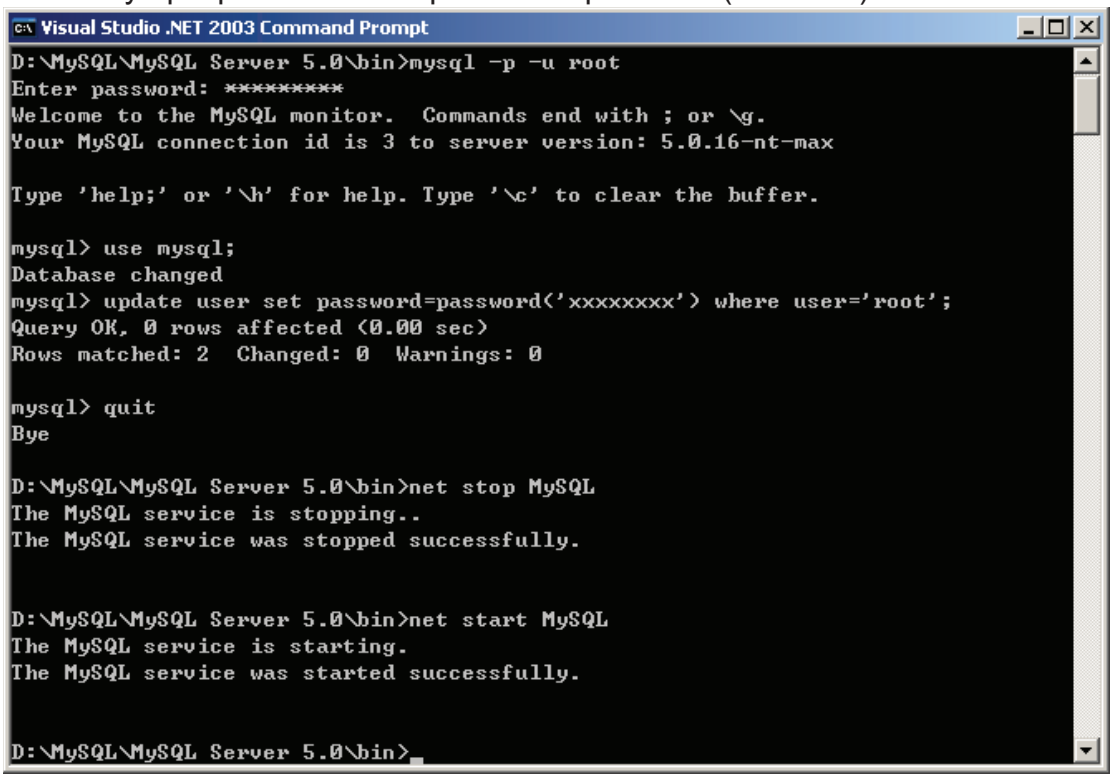
4. Install MySQL database server
   - Start the command prompt

   - Copy the MySQL database backup from the installation CD to C:
   Xcopy E:\MySQL C:\Program Files\MySQL /Y /S

   - Install MySQL as a service
   C:
   cd C:\Program Files\MySQL\MySQL Server 5.0\bin
   mysqld-max-nt.exe –install
   net start MySQL

5. This step is required if the MySQL root password has been changed after the system delivered. To change MySQL root password, you have to
   - Start the command prompt
   C:
   cd C:\Program Files\MySQL\MySQL Server 5.0\bin
   Mysql –p –u root
   Enter password:********
   mysql>*use mysql;*

mysql>update user set password=password('xxxxxxx') where user='root';



6. Install Microsoft >Net Framework 1.1
   Install .NET Framework 1.1 using the file dotnetfx.exe in the Microsoft Folder in CD.
   Install updates NDP1.1sp1-KB867460-X86.exe then NDP1.1sp1-KB886903-X86.exe in the same folder

7. Install CMS Simulator Software
   Assume that the program is to be installed in C: drive.
   - Open command prompt
   - Copy "MTR Program Files" from CDROM to C: drive

xcopy "E:\MTR Program Files" "C:MTR Program Files" /Y /S

   - Setup windows service

Cd C:\MTR Program Files\GSM Service
c:\windows\microsoft.net\framework\v1.1.4322\installutil CMS_GSMService.exe

8. You may have to create short-cut onto the desktop of windows user according to the operating requirement. Here's short-cut program:

   - Simulator
   C:\MTR Program Files\CMS Simulator\CMSSimulator.exe

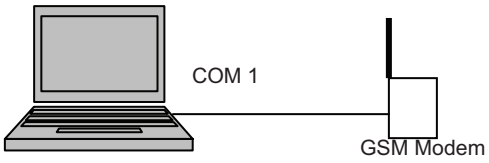
9. Connect the GSM modem to the COM1 one of the simulator computer

10. Testing and verification
    After the simulator installed, you have to test that the system is working normally by:
    - Check that "mysql-nt.exe" is running at Task Manager
    - Check that "CMS_GSMService.exe" is running at Task Manager
    - Start the simulator and check that it can send the RTTF message to the receiver through SMS.

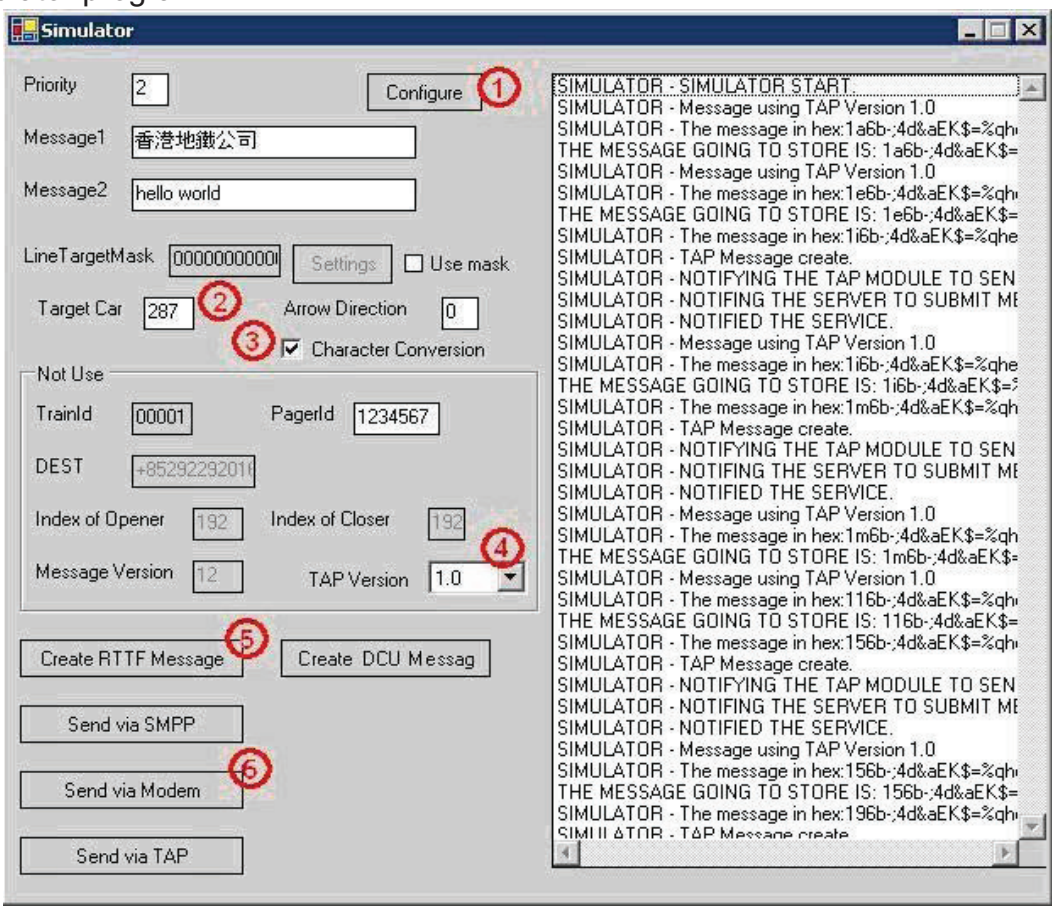
11. System installation done and ready.

4.3.2 Simulator for testing TRDR

Setup - connect the GSM modem (or TRDR) with the selected SIM card (preset mobile numbers) to COM1 of Simulator PC (Notebook Computer)

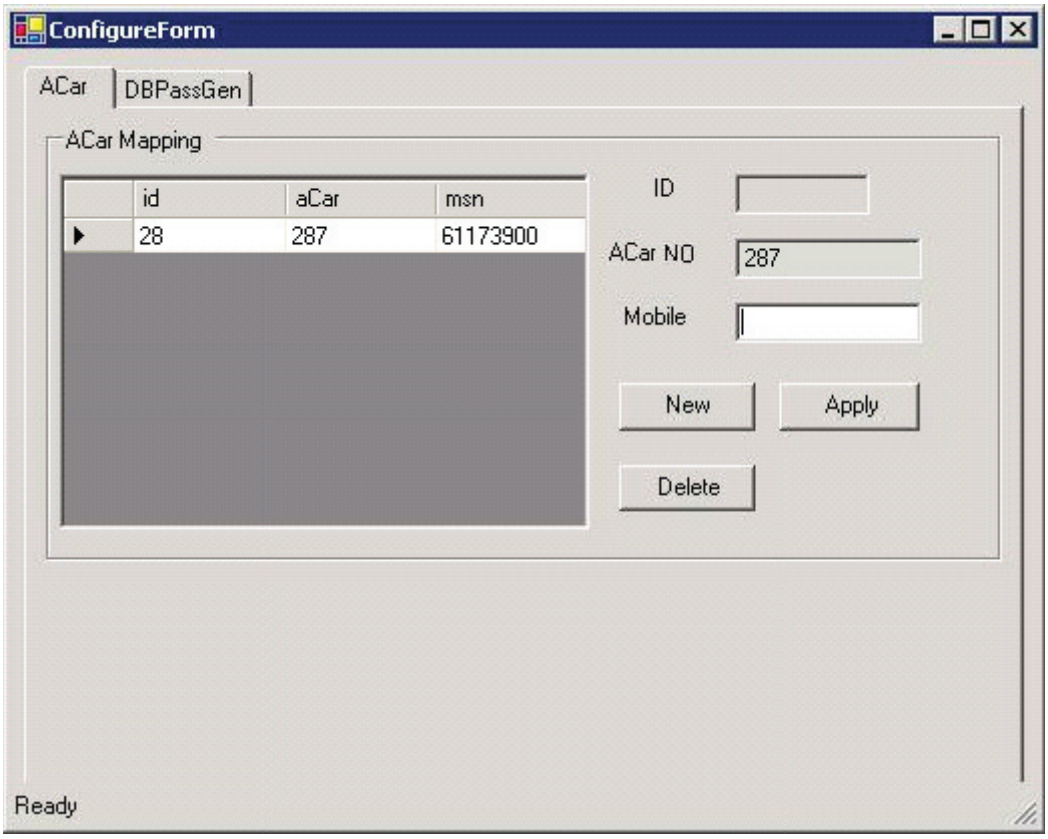


Simulator program



Operation

1. Select **Configure** to set the A-Car number and mobile number (No 852 prefix is needed) for testing, only 1 record can be entered. Close **Configure**.



2. Enter A-Car number in the **Target Car**
3. Select Character conversion and TAP version 1.0 (TAP 2.1 is for AEL TRDR).
4. Change version number by pressing **Create RTTF Message**
5. Send to GSM modem by selecting **Send via Modem.**

Notes: The message content may be changed in the box. Beware that in the Chinese character box, only double byte Chinese characters are acceptable.

5 Replacement Procedure

5.1 For CMS

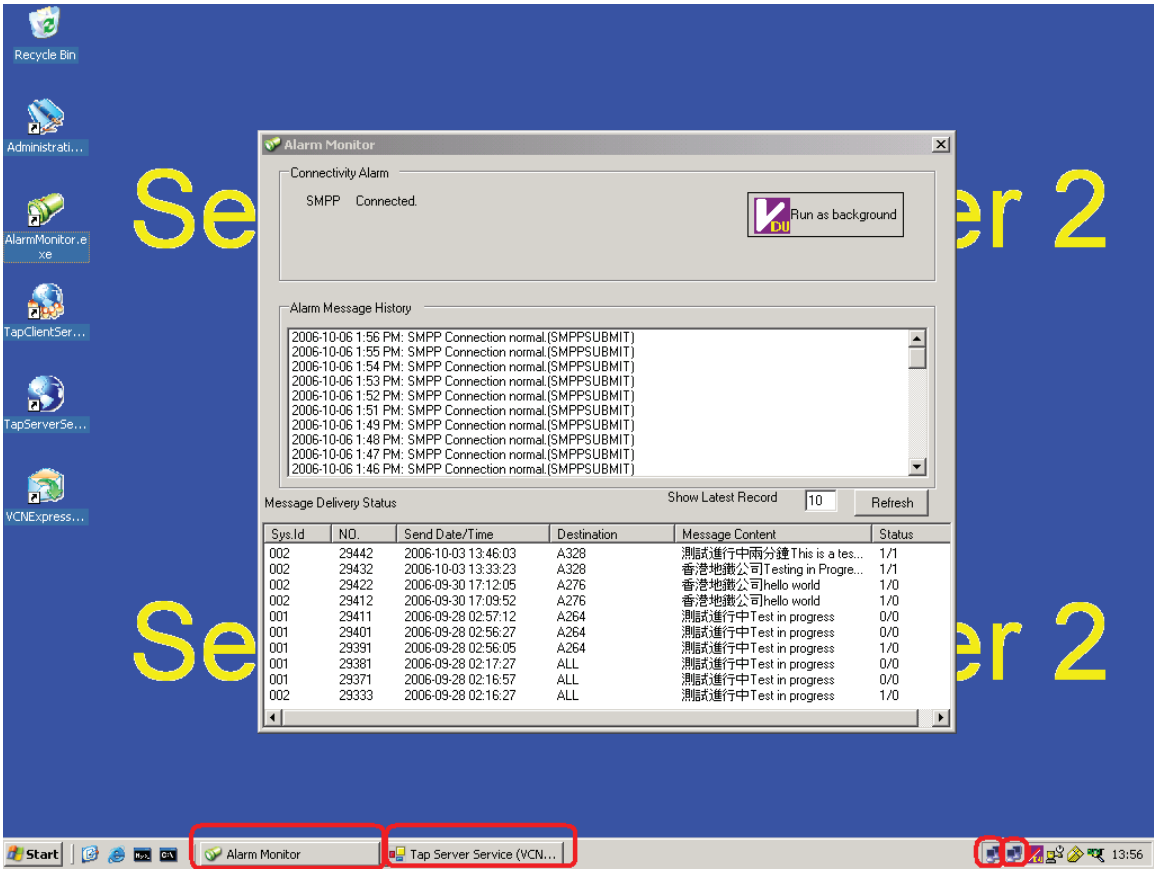
Whenever CMS1 or CMS2 server is failed, it's required to replace by the spare CMS server. This is document is telling the procedure required to replace it.

Prerequisites

- The spare CMS server is ready and installed with the Windows 2003 server, CMS software and Database.
- Latest database backup of the live CMS server. It's advised to backup the latest database from the live CMS server which is still running normally. Otherwise, you may use the latest database backup. For the backup procedure, you may refer to the administration user menu.
- The engineer who replace the CMS server should have basic windows server network administration skill.

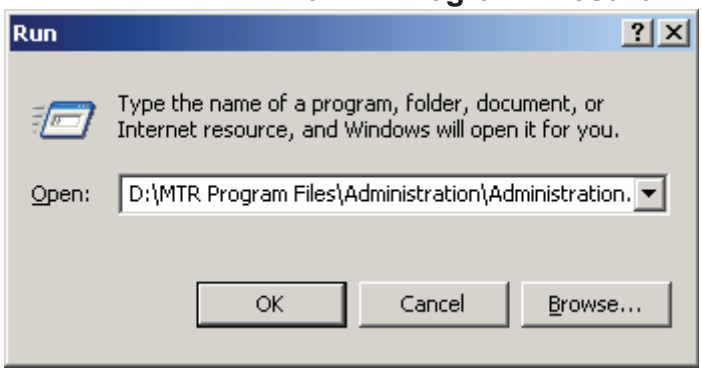
Procedure of replacing the CMS server

- Power on the spare CMS server (DO NOT connect to the live system at this moment). The server should be boot up with operating system 'Windows 2003 server'. After boot up, the server should have been logon as user 'operator' and the application 'Alarm Monitor' and 'Tap Server Form' is started on the desktop.

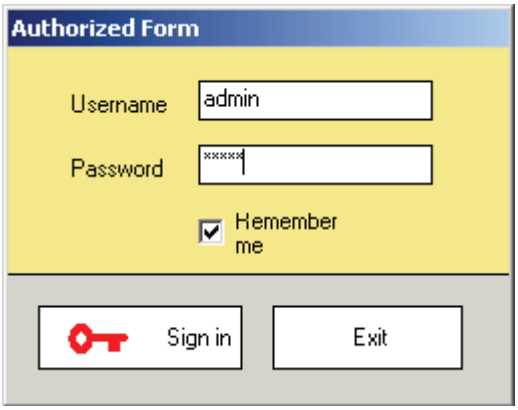


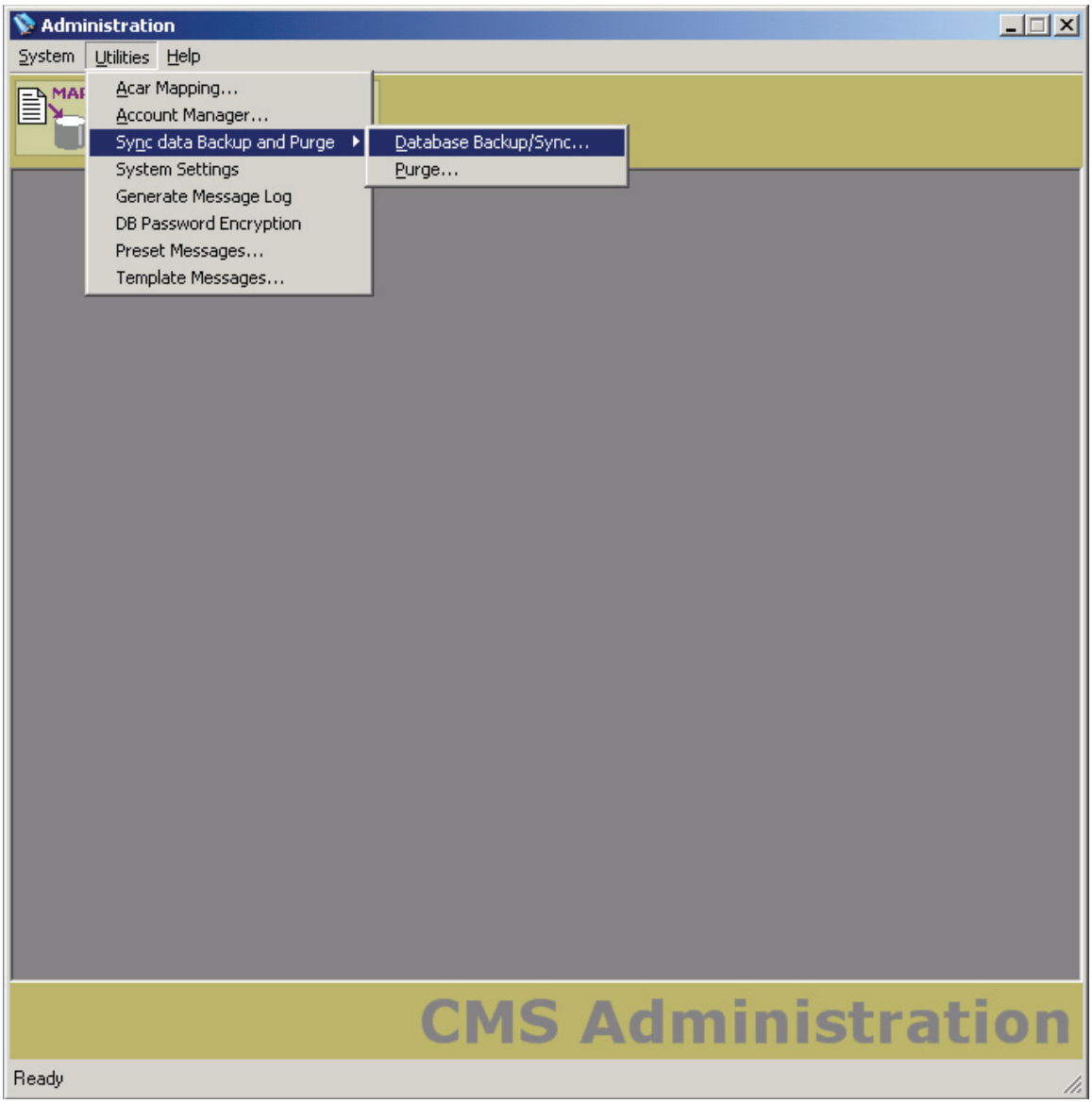
- Connect the server's LAN ports to the switch. Make sure the 2 network interface on the server is up and normal.

- Restore the latest database backup into the spare CMS server. Run the CMS administration program at
"**D:\MTR Program Files\Administration\Administration.exe**"

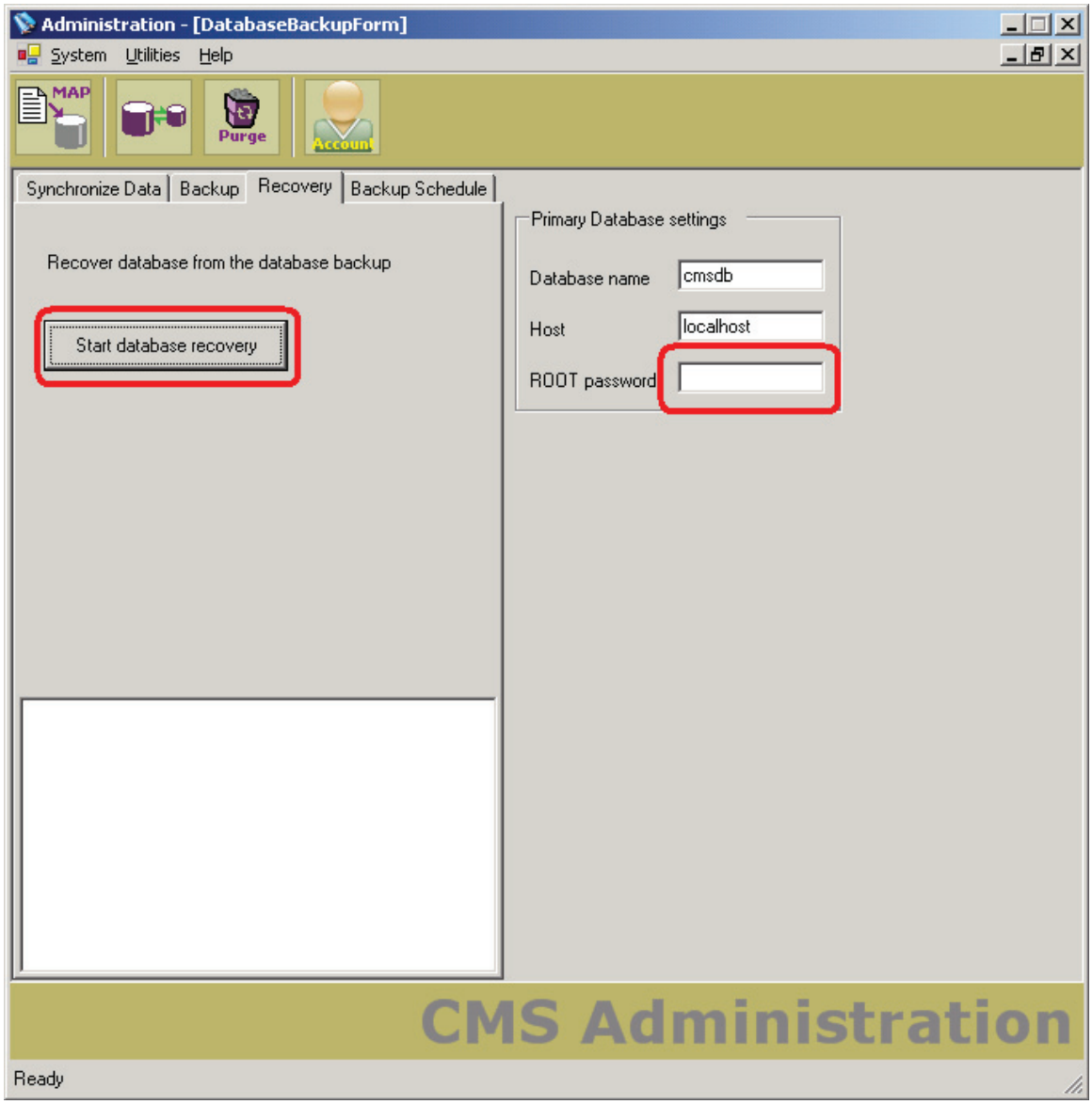


Login as administrator user. Select "Utilities->Sync data Backup and Purge->Database Backup/Sync"

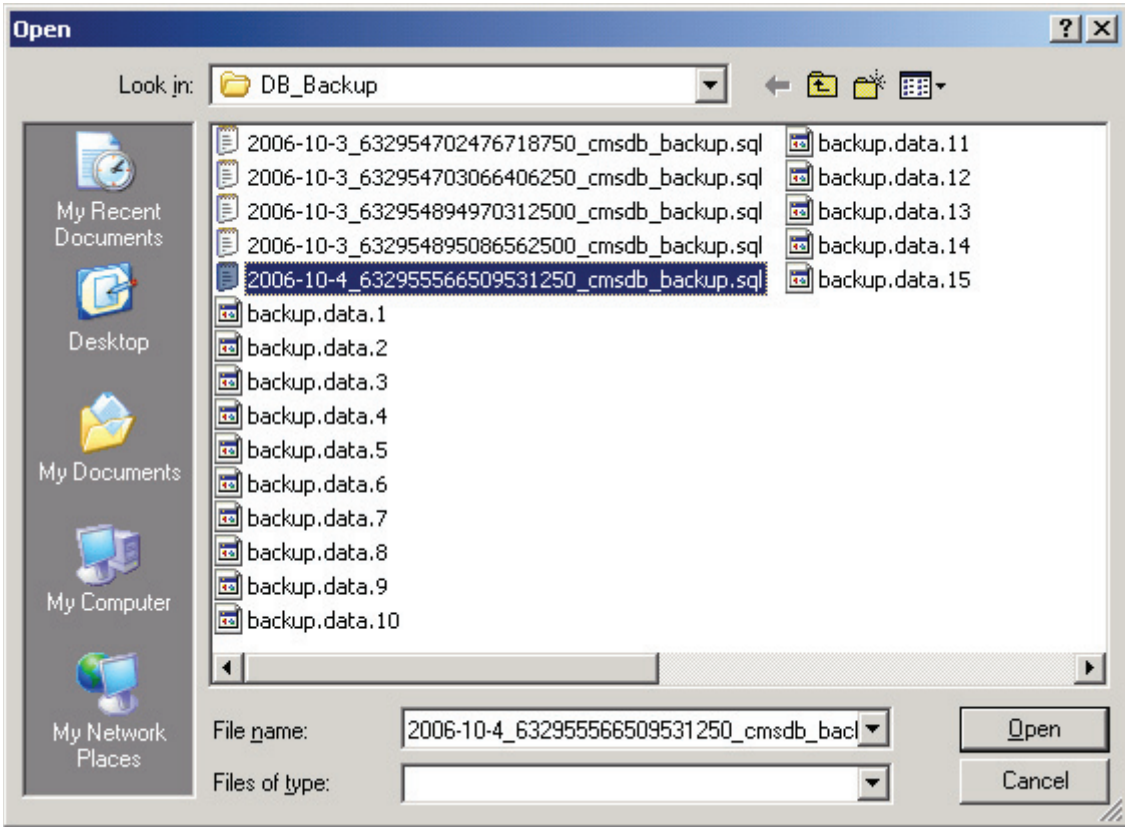




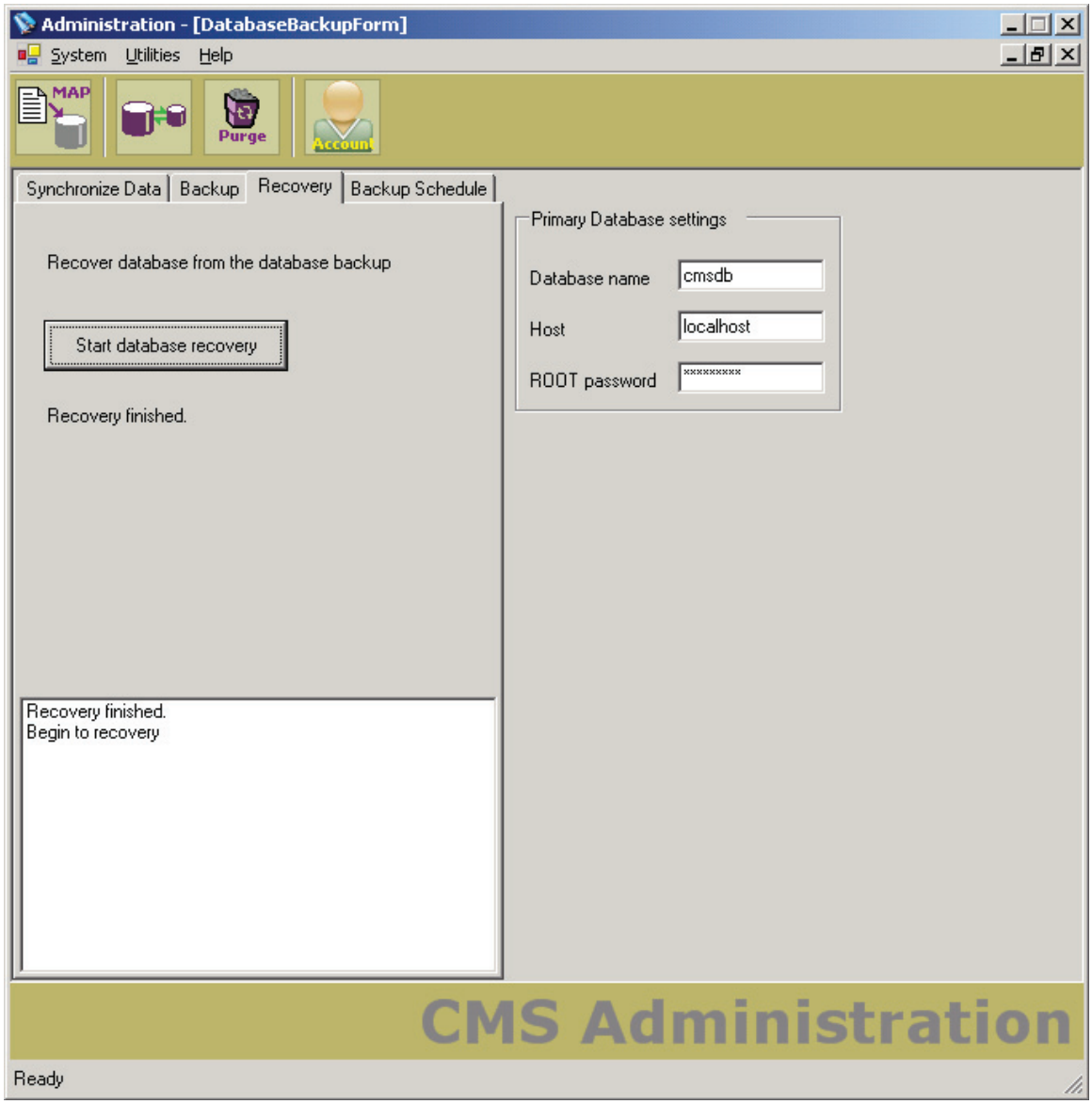
Select the tag ‘Recovery’. Input the database server’s ROOT password at the ‘Primary Database settings’. Then click ‘start database recovery’.



A pop up windows will be display and prompting you to select the database backup. Select the backup and click 'Open' to proceed.



A prompt will shown that the recovery is done. You may exit the CMS Administration program.



- Change the windows' network configuration according to the latest live configuration of CMS1 or CMS2 whatever one Is going to be replaced. For the latest configuration, you have to refer to the configuration information. The current configuration is followed (reference only):

  CMS1:

  Local Area Connection:
  - IP address: 138.9.5.60
  - Subnet mask: 255.255.252.0
  - Gateway: 138.9.5.1

  Local Area Connection 2:
  - IP address: 10.10.130.2

- Subnet mask: 255.255.255.0

Static route:
route add 202.140.96.0 mask 255.255.255.0 10.10.130.1 metric 1 –p

CMS2:

Local Area Connection:
- IP address: 138.9.5.61
- Subnet mask: 255.255.252.0
- Gateway: 138.9.5.1

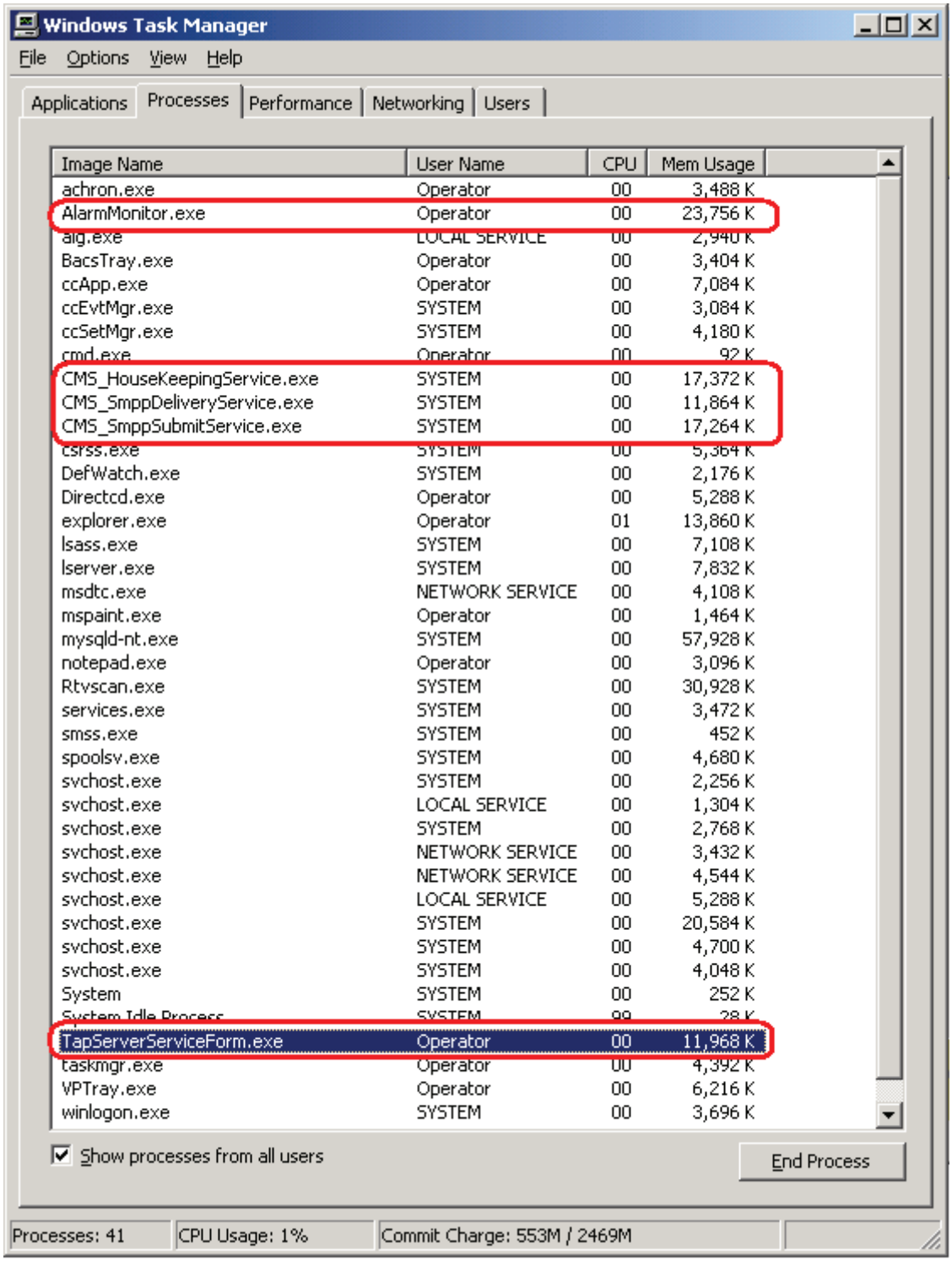
Local Area Connection 2:
- IP address: 10.10.130.66
- Subnet mask: 255.255.255.0

Static route:
route add 202.140.96.0 mask 255.255.255.0 10.10.130.65 metric 1 –p

- Replace the fail CMS server by reconnect all the serial cable and network connections. You may have to refer to the latest connection diagram. Make sure the following connector is connected:
  - 2 LAN port connected
  - serial cable connected to the EIDS terminal
  - serial cable connected to the PSP (Only if paging network is still in used)
  - CMS server's power cord

- Re-start the system

  After the server's network is properly connected. You can power on the server. After the server power on, please check that the following program is running at the task manager:
  - AlarmMonitor.exe
  - CMS_HouseKeepingService.exe
  - CMS_SmppDeliveryService.exe
  - CMS_SmppSubmitService.exe
  - TapServerServiceForm.exe

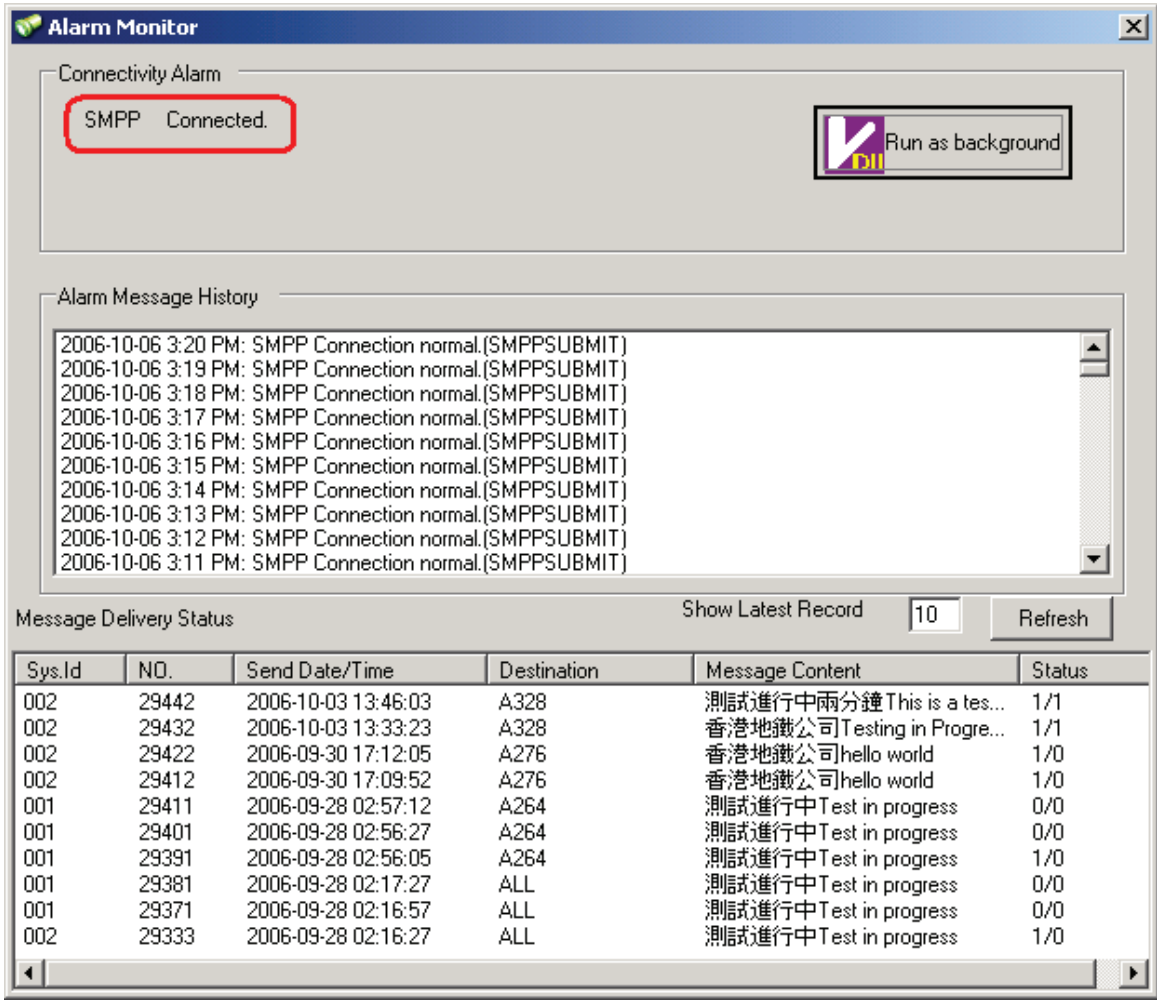


- Testing and verification

  After the system replaced, you have to test that the system is working normally by:

  Verify the Alarm Monitor program and SMPP service is working normally by:

- Check from the AlarmMonitor screen that the SMPP connection status is “Connected”



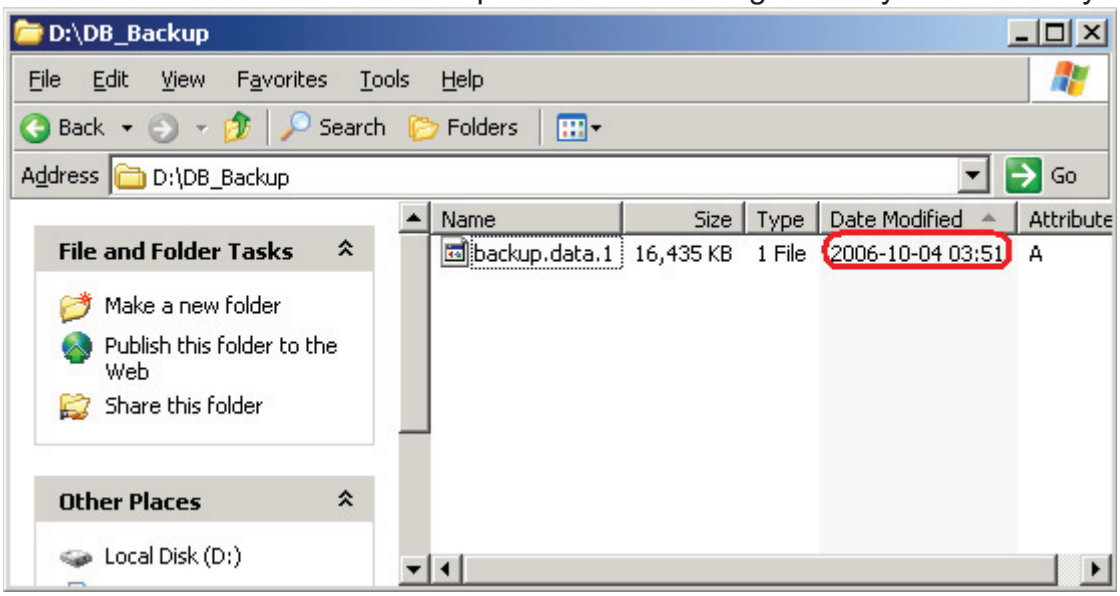
Verify the TAP module is working normally by:
- Check from the EIDS terminal that both LINE are ready (No alarm show on the EIDS terminal)

Verify the Administration program and Housekeeping service is working normally by:
- Start the Administration program and update the ACAR mapping. After 5 minutes, check from the Administration program of another live CMS server that the ACAR is updated.

Verify the overall message sending function is working normally by:
- Shut down another live CMS server. Send a message from EIDS terminal, and check that the train can receive it correctly. (Restart the stopped CMS server after testing done)

Verify the backup function is working normally by:

- On the next day, check the date of the database backup and make sure the backup function is working normally is current day.



5.2 For TRDR

There are some spare of TRDR and SIM for the faulty TRDR replacement.

Replacement Procedure for faulty SIM
1. Disconnect the RS232 connector
2. Remove the faulty SIM from TRDR
3. Insert a new SIM into TRDR
4. Reconnect the RS232 connector
5. Change the mapping of A-Car and SIM via administration terminal.

Replacement Procedure for TRDR
1. Disconnect the RS232 connector
2. Remove the faulty TRDR
3. Install the new TRDR
4. Remove the SIM from the faulty TRDR and insert it into the new TRDR.

5.3 Reinstallation of CMS Server

When the CMS server system failure due to the unrecoverable server problem, it may have to re-installation the whole system. This document is telling the procedure required to re-install the server.

Prerequisites

- An Intel server is ready. It should have been installed with the OS Windows 2003 Server and downloaded the latest Service Pack (Service Pack 1 is using now). Please note that the server should be running with Microsoft .Net framework V1.1. (By default, it's come with Windows 2003 Server)
- The hardware requirement of the server is:
  - CPU Intel Pentium 1.5GHz or above
  - Memory 1GB or above
  - ATA Harddisk disk space 100GB or above
  - 2 LAN ports with 10/100 base-T Ethernet support
  - 2 serial port (one is configured with COM1, another is configured with COM2)
- CMS server Installation disk is ready, which include CMS software 'MTR Program Files', 'MySQL' database
- Latest database backup of the live CMS server. It's advised to backup the latest database from the live CMS server which is still running normally. Otherwise, you may use the latest database backup. For the backup procedure, you may refer to the administration user menu.
- The engineer who re-install the CMS server should have windows 2003 server administration skill.
- The windows 2003 server should also be installed with the proper AntiVirus software, Time synchronization software (Network Time Protocol Client) and GoGo Pen.

Procedure of replacing the CMS server

12. Power on the spare CMS server (DO NOT connect to the live system at this moment)
    - The server should be boot up with operating system 'Windows 2003 server'.
    - Logon as Administrator

13. Create windows user account and folder
    - Create user 'operator' which is belong to the administrators group and set the password properly.
    - Create folder:
      D:\MTR Program Files
      D:\cms_log
      D:\CMS_BACKUP
    - Create other user account. You may have to create other windows user account according to the actual operation requirement.

14. Configure window 2003 server auto-logon during startup
    - You have to define the following registry key using regedit

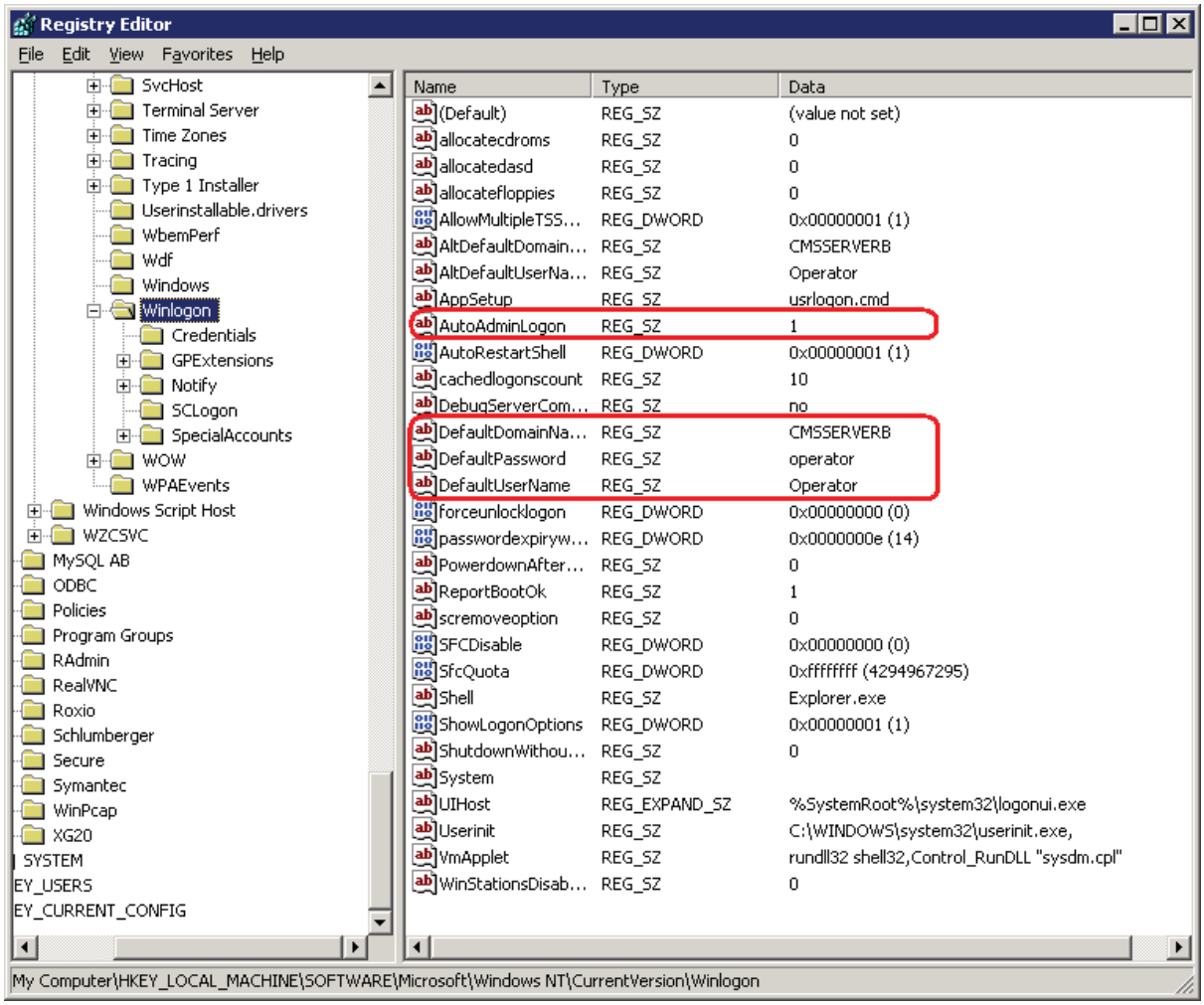
Hive:	**HKEY_LOCAL_MACHINE**
Key:	**SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon**
Name:	**AutoAdminLogon**

Type: **REG_SZ**
Value: 1 (enable auto logon)

Hive: HKEY_LOCAL_MACHINE
Key: SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon
Name: DefaultUserName
Type: REG_SZ
Value: Operator (*account to logon automatically)*

Hive: HKEY_LOCAL_MACHINE
Key: SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon
Name: DefaultPassword
Type: REG_SZ
Value: Operator (*password for DefaultUserName above)*
Caution: Password is stored in clear text. Set security permissions on Winlogon subkey to protect the account used.

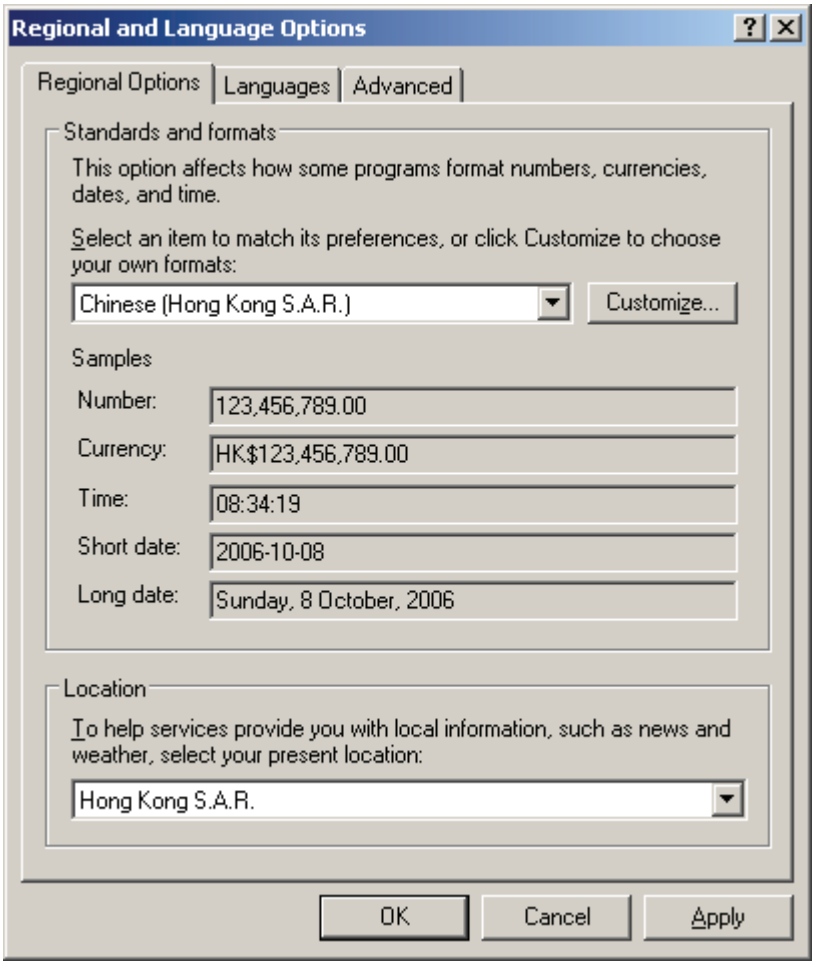
Hive: HKEY_LOCAL_MACHINE
Key: SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon
Name: DefaultDomainName
Type: REG_SZ
Value: WorkGroup (*if domain account, domain name; if local account, server name)*



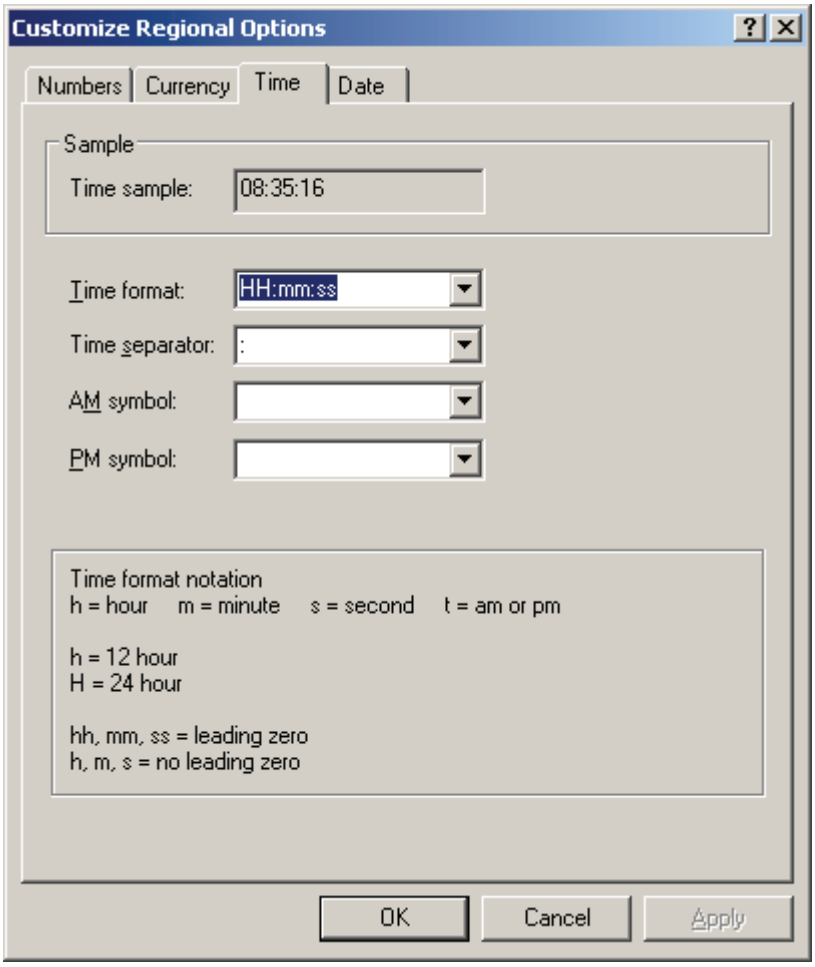
The following registry values must not exist: **LegalNoticeCaption, LegalNoticeText**.

These values force a person logging into a PC to acknowledge having read the notice. If these values exist, the legal notice dialog hangs until someone hits enter. Don't just null out the values. Delete them.

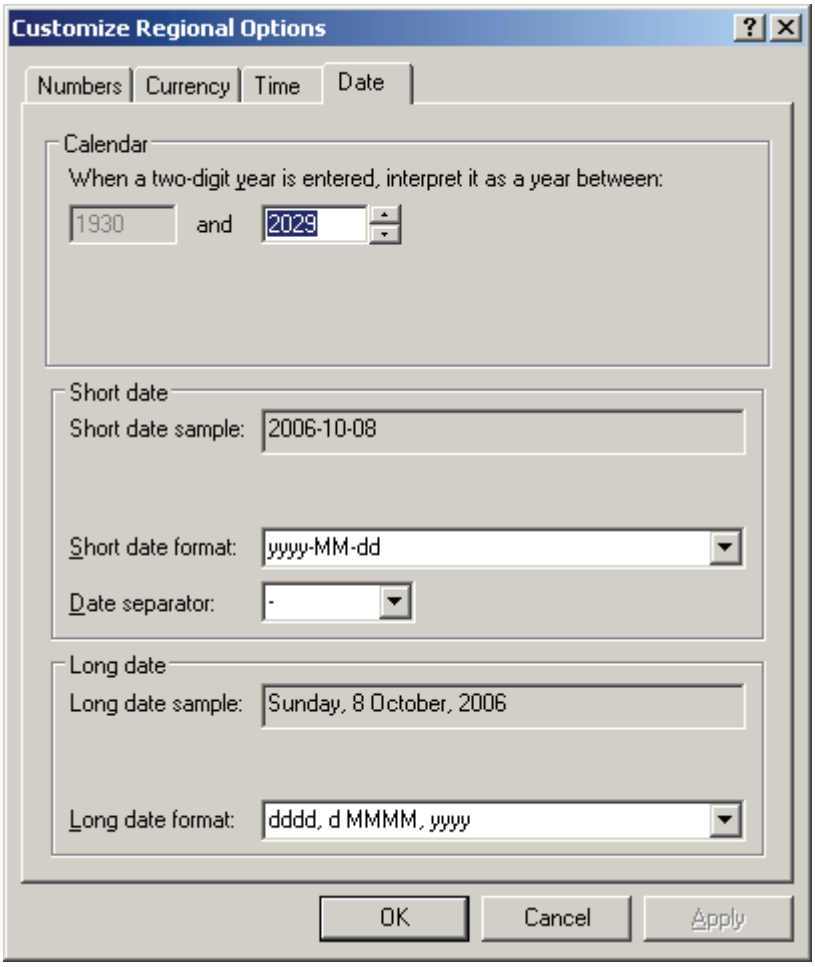
15. Change window's regional setting as followed:
    - Open control panel and select the "Regional and Language Options". At the "Regional Options" tab, click customize.



    - The "Customize Regional Options" opened, select the "Time" tab, change the time format to "HH:mm:ss".



- Then select the “Date tab, change the short date format to “yyyy-MM-dd”



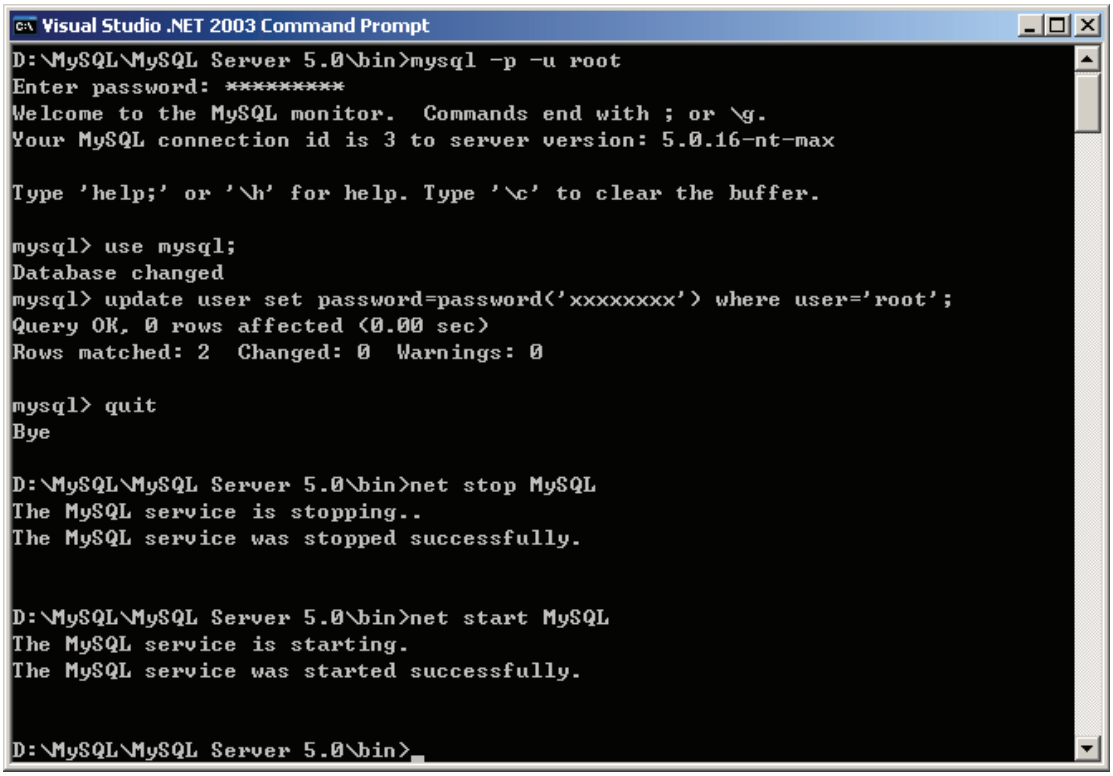
16. Install MySQL database server
    - Start the command prompt
    - Copy the MySQL database backup from the installation CD to D:

    Copy E:\MySQL D:\MySQL /Y
    - Install MySQL as a service

    D:
    cd D:\MySQL\MySQL Server 5.0\bin
    mysqld-max-nt.exe –install
    net start MySQL

17. This step is required if the MySQL root password has been changed after the system delivered. To change MySQL root password, you have to
    - Start the command prompt

    D:
    cd D:\MySQL\MySQL Server 5.0\bin
    Mysql –p –u root
    Enter password: ********
    mysql>*use mysql;*
    mysql>update user set password=password('xxxxxxx') where user='root';

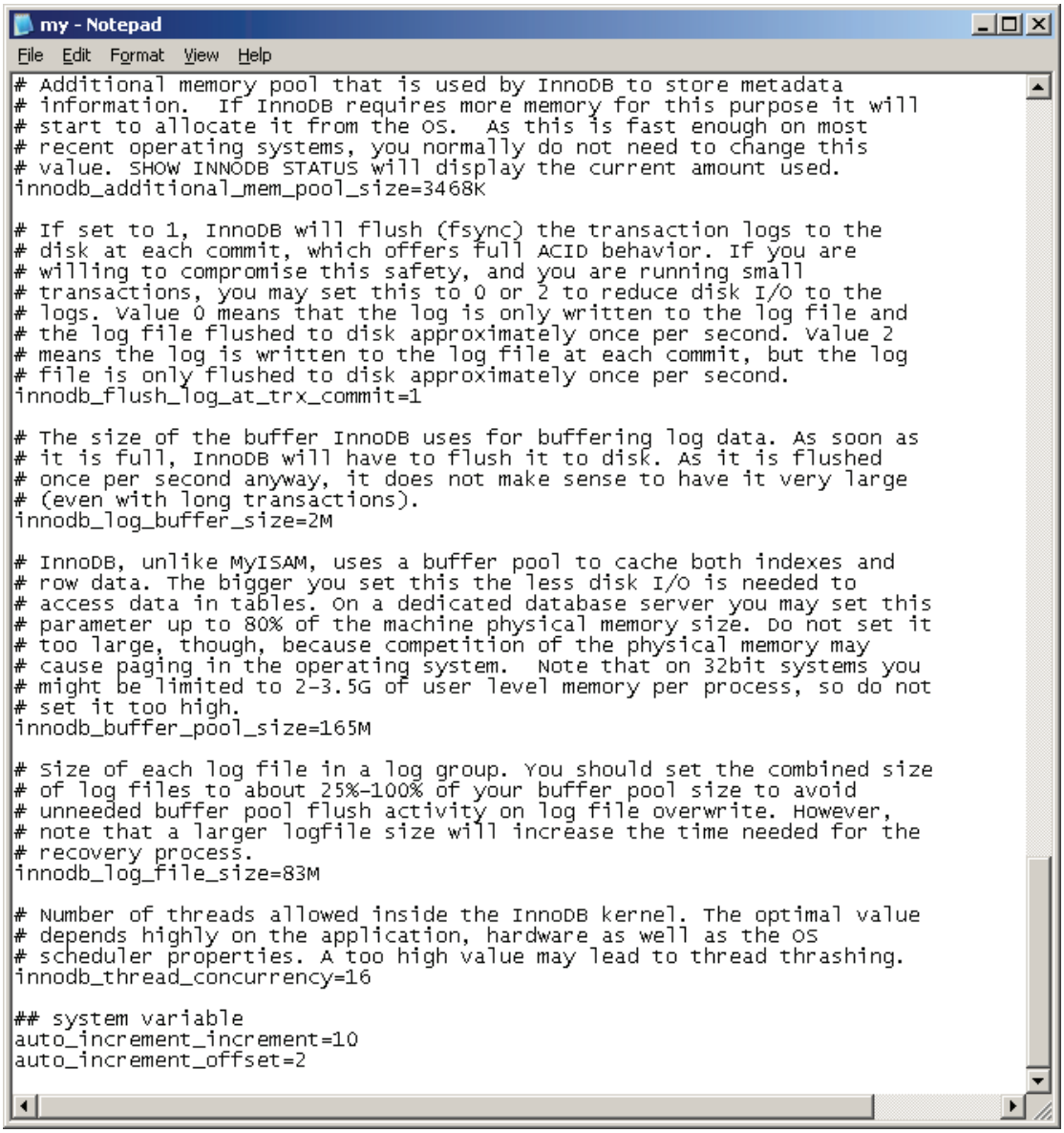


18. Change the MySQL setting in order to support data synchronization. The step is:
    - Open Notepad.exe and edit the file D:\MySQL\MySQL Server 5.0\my.ini
    - Change the following setting as according to the server. Please note that this setting must be unique amount all the CMS servers (include spare, live servers)
      auto_increment_offset=??(according to the configuration)
    - Here's the suggested configuration of the live and spare system

      <u>For primary server</u>
      auto_increment_increment=10
      auto_increment_offset=1

      <u>For secondary server</u>
      auto_increment_increment=10
      auto_increment_offset=2

      <u>For spare server</u>
      auto_increment_increment=10
      auto_increment_offset=3

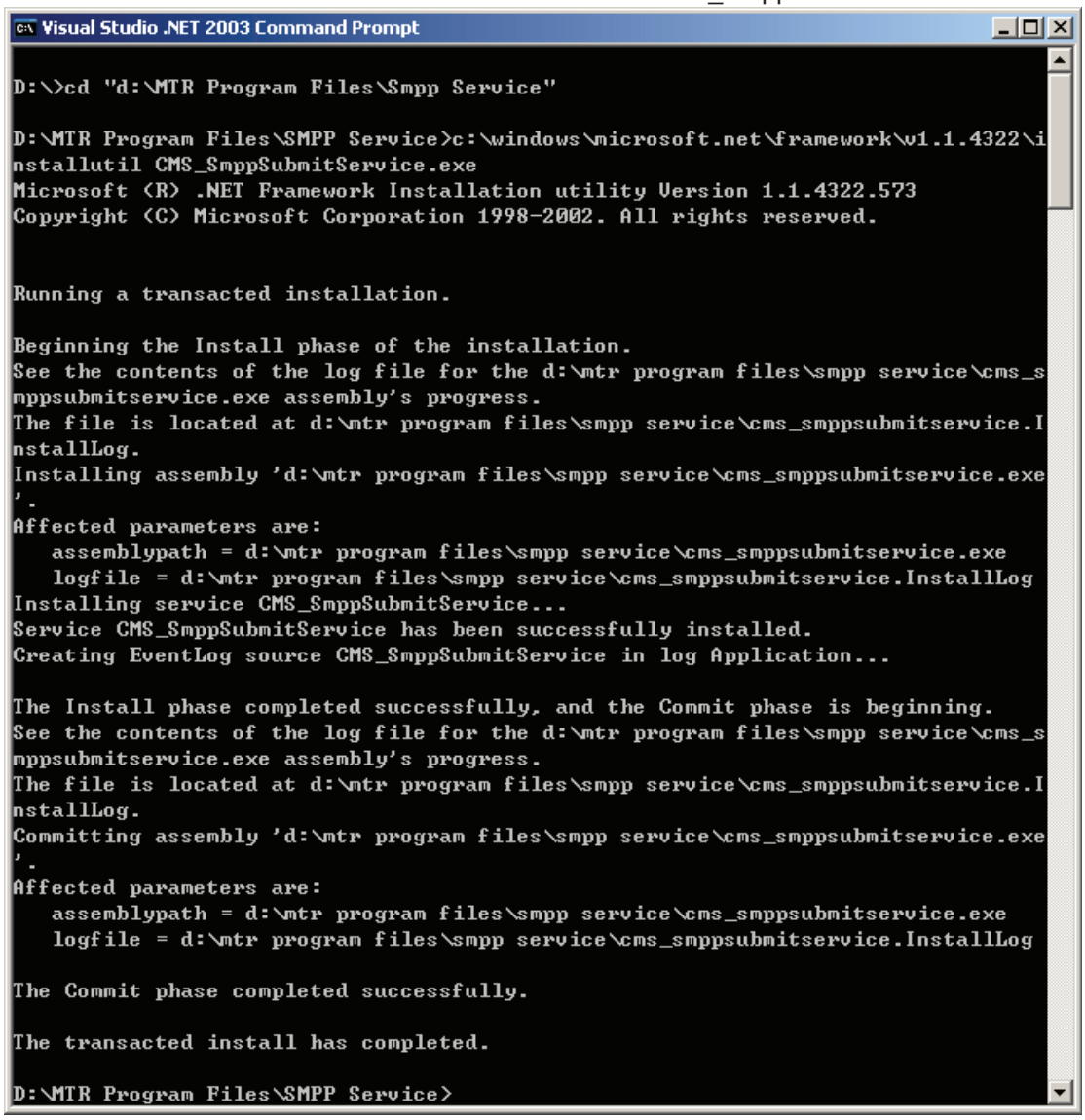

my - Notepad
File Edit Format View Help
# Additional memory pool that is used by InnoDB to store metadata
# information. If InnoDB requires more memory for this purpose it will
# start to allocate it from the OS. As this is fast enough on most
# recent operating systems, you normally do not need to change this
# value. SHOW INNODB STATUS will display the current amount used.
innodb_additional_mem_pool_size=3468K
# If set to 1, InnoDB will flush (fsync) the transaction logs to the
# disk at each commit, which offers full ACID behavior. If you are
# willing to compromise this safety, and you are running small
# transactions, you may set this to 0 or 2 to reduce disk I/O to the
# logs. Value 0 means that the log is only written to the log file and
# the log file flushed to disk approximately once per second. Value 2
# means the log is written to the log file at each commit, but the log
# file is only flushed to disk approximately once per second.
innodb_flush_log_at_trx_commit=1
# The size of the buffer InnoDB uses for buffering log data. As soon as
# it is full, InnoDB will have to flush it to disk. As it is flushed
# once per second anyway, it does not make sense to have it very large
# (even with long transactions).
innodb_log_buffer_size=2M
# InnoDB, unlike MyISAM, uses a buffer pool to cache both indexes and
# row data. The bigger you set this the less disk I/O is needed to
# access data in tables. On a dedicated database server you may set this
# parameter up to 80% of the machine physical memory size. Do not set it
# too large, though, because competition of the physical memory may
# cause paging in the operating system. Note that on 32bit systems you
# might be limited to 2-3.5G of user level memory per process, so do not
# set it too high.
innodb_buffer_pool_size=165M
# Size of each log file in a log group. You should set the combined size
# of log files to about 25%-100% of your buffer pool size to avoid
# unneeded buffer pool flush activity on log file overwrite. However,
# note that a larger logfile size will increase the time needed for the
# recovery process.
innodb_log_file_size=83M
# Number of threads allowed inside the InnoDB kernel. The optimal value
# depends highly on the application, hardware as well as the OS
# scheduler properties. A too high value may lead to thread thrashing.
innodb_thread_concurrency=16
system variable
auto_increment_increment=10
auto_increment_offset=2

19. Install CMS software
    - Open command prompt
    - Copy “MTR Program Files” from CDROM to D: drive

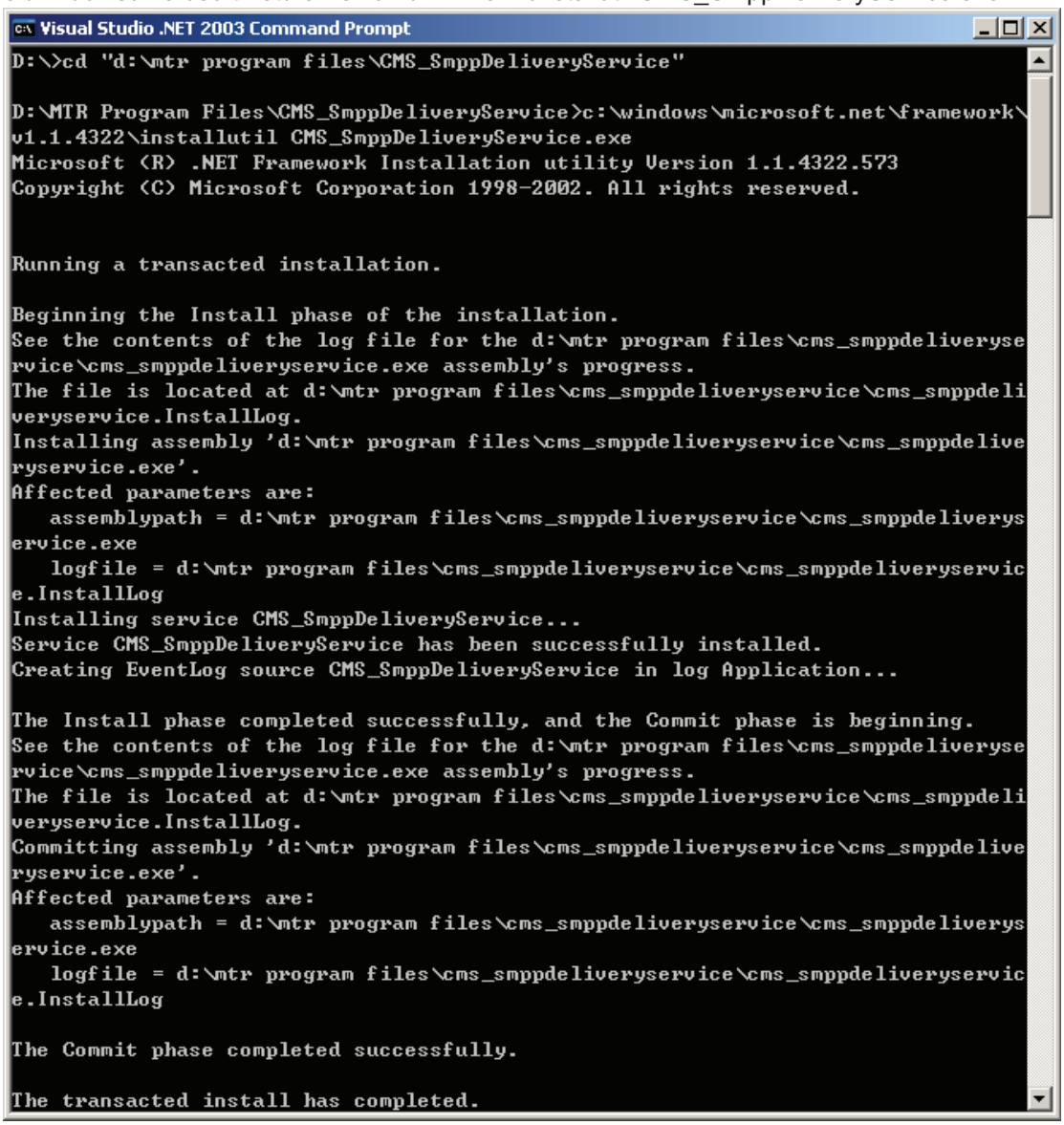
copy “E:\MTR Program Files” D:\ /Y

    - Setup windows service

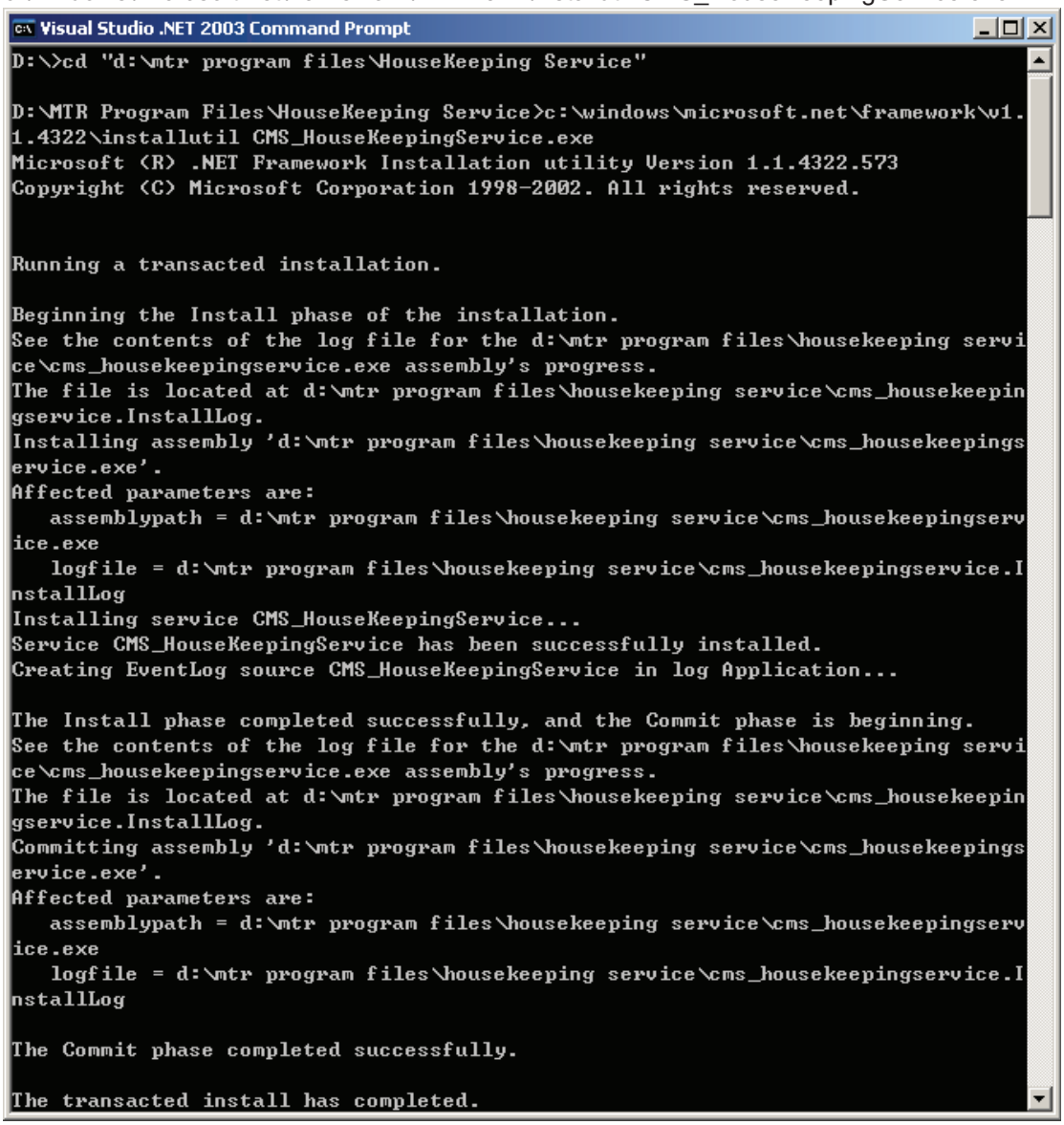
cd “d:\MTR Program Files\Smpp Service”
c:\windows\microsoft.net\framework\v1.1.4322\installutil CMS_SmppSubmitService.exe



cd “d:\mtr program files\CMS_SmppDeliverySerivce”
c:\windows\microsoft.net\framework\v1.1.4322\installutil CMS_SmppDeliveryService.exe



cd d:\mtr program files\housekeeping service
c:\windows\microsoft.net\framework\v1.1.4322\installutil CMS_HouseKeepingService.exe



20. Add the following program to windows user operator's startup, such that these program will be auto start upon system power on:
    - Tap Server Module
    D:\MTR Program Files\TapServerForm\TapServerServiceForm.exe

    - Alarm Monitor Module
    D:\MTR Program Files\Alarm Monitor\AlarmMonitor.exe

21. You may have to create short-cut onto the desktop of windows user according to the operating requirement. Here's short-cut program:

    - Tap Server Module
    D:\MTR Program Files\TapServerForm\TapServerServiceForm.exe

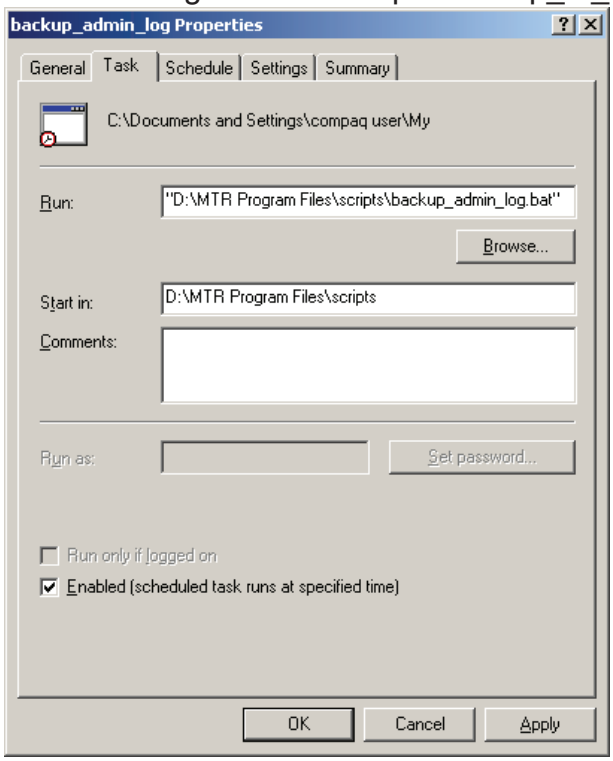
    - Alarm Monitor Module
    D:\MTR Program Files\Alarm Monitor\AlarmMonitor.exe

    - Administration Module
    D:\MTR Program Files\Administration\Administration.exe

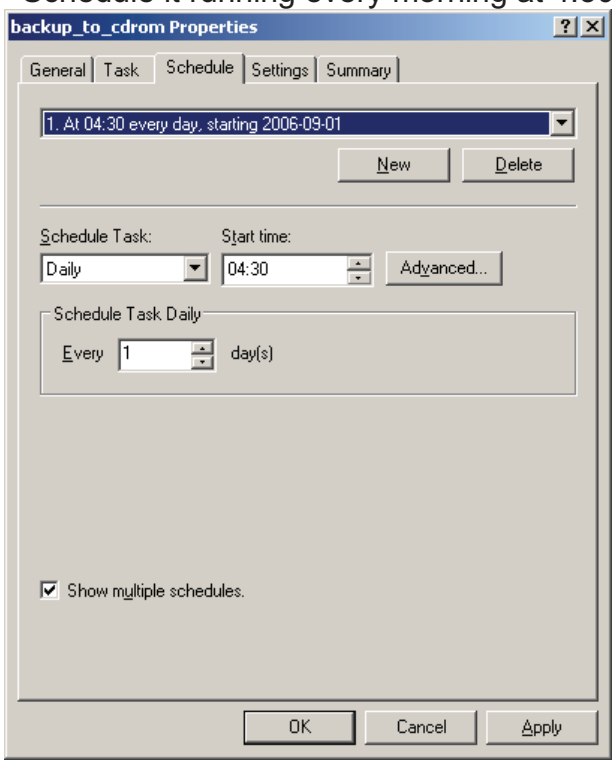
    - VCN terminal (option 2)
    D:\MTR Program Files\VCNExpressComm\VCNExpressComm.exe

    - Tap Client (when paging network is in use)
    D:\MTR Program Files\TapClientForm\TapClientServiceForm.exe

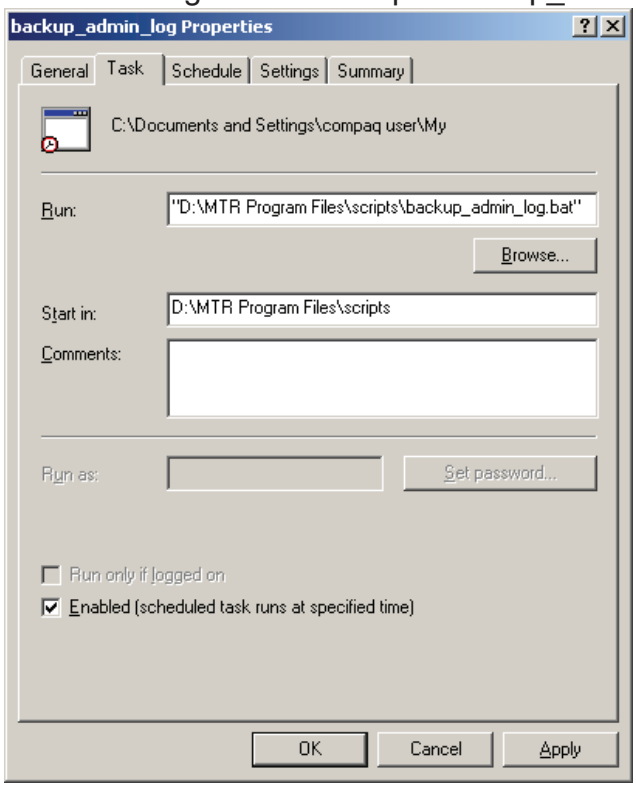
22. Create schedule using windows' Schedule and Task:
    - Backup to CDROM – copy the harddisk backup from harddisk to CDROM. It has to set task:
        i. Run the script
        "D:\MTR Program Files\scripts\backup_to_cdrom.bat"



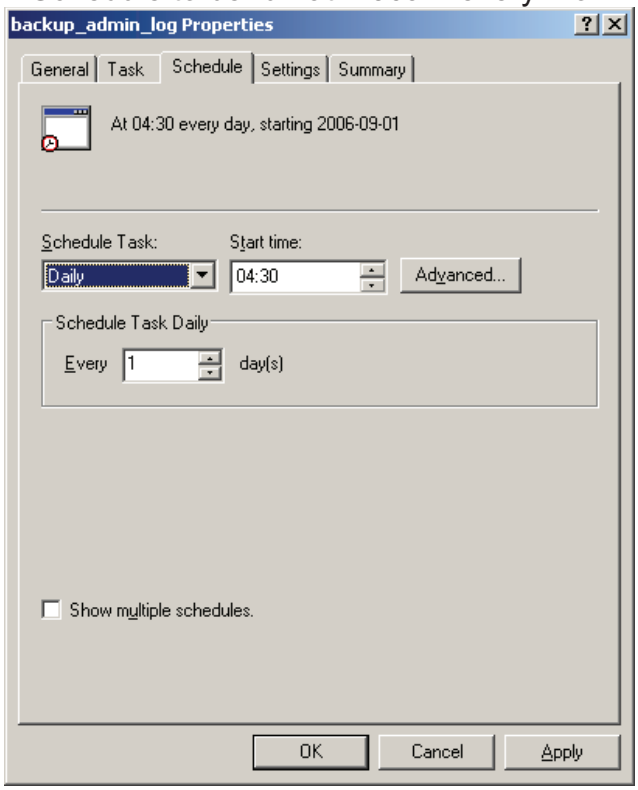
        ii. Schedule it running every morning at 4:30am



- Backup to Admin. Log – copy the administration log. It has to set task:
  i. Run the script:
  "D:\MTR Program Files\scripts\backup_admin_log.bat"

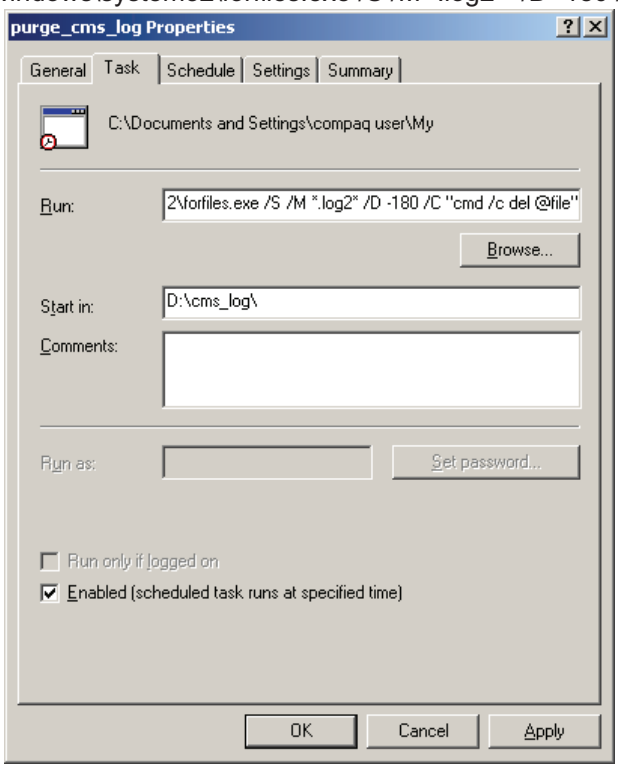


  ii. Schedule to be run at 4:30am every morning.

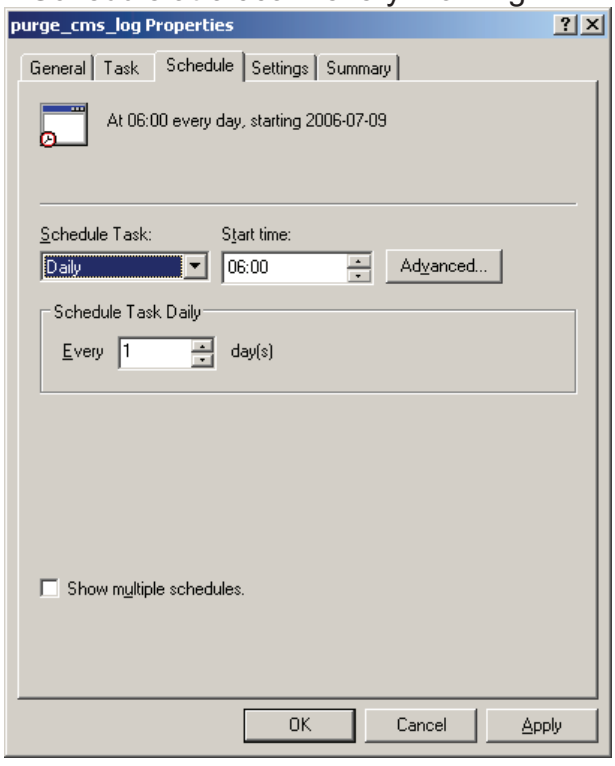


- Purge file under d:\cms_log files.
  i. Run the program:

C:\windows\system32\forfiles.exe /S /M “.log2*” /D -180 /C “cmd /c del @file”

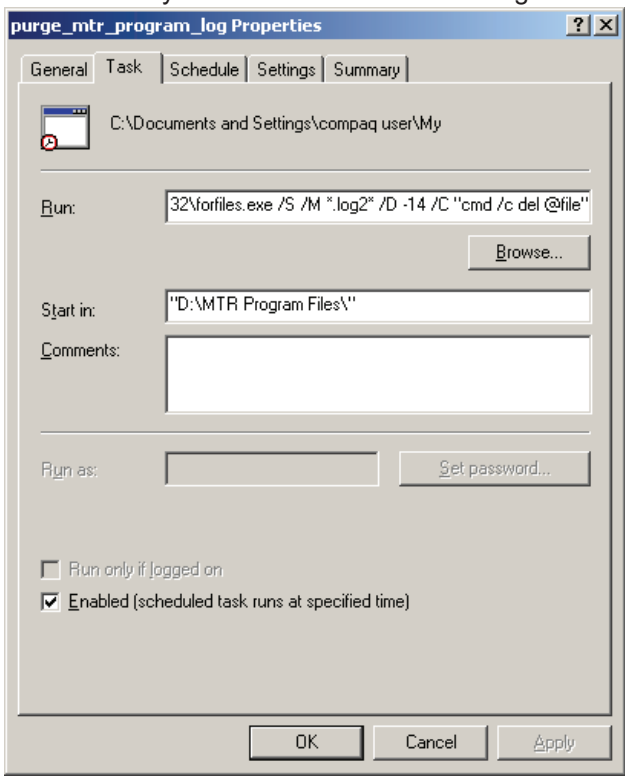


ii. Schedule at 6:00am every morning

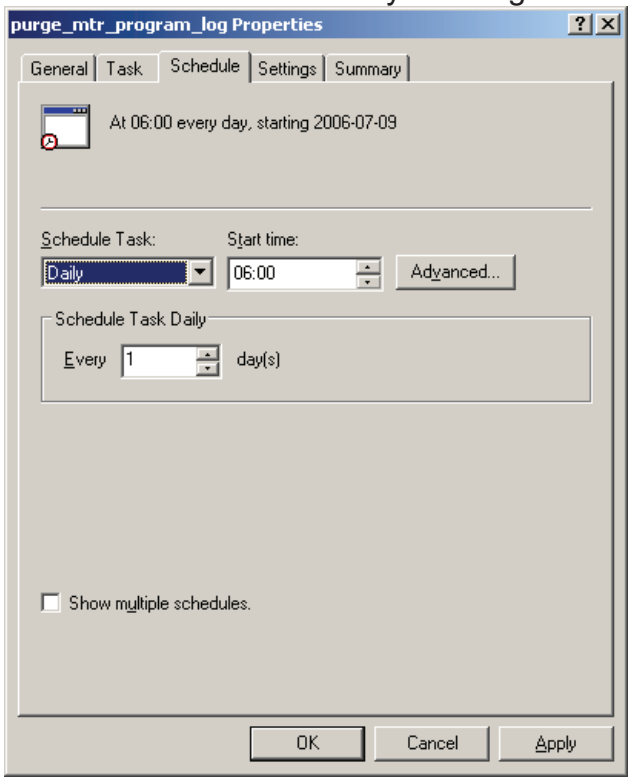


- Purge MTR program log files.
  i. Run the program:

C:\windows\system32\forfiles.exe /S /M *.log2* /D /C “cmd /c del @file”

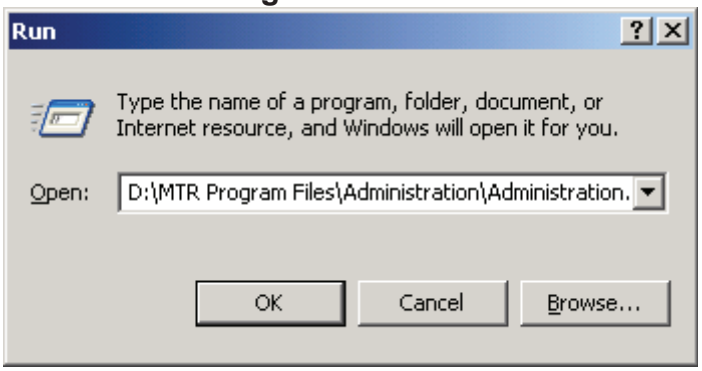


  ii. Schedule at 6:00am every morning

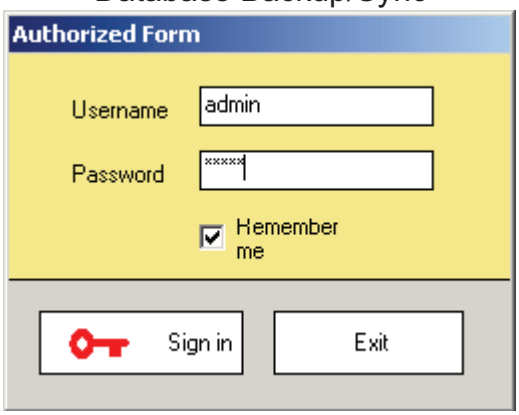


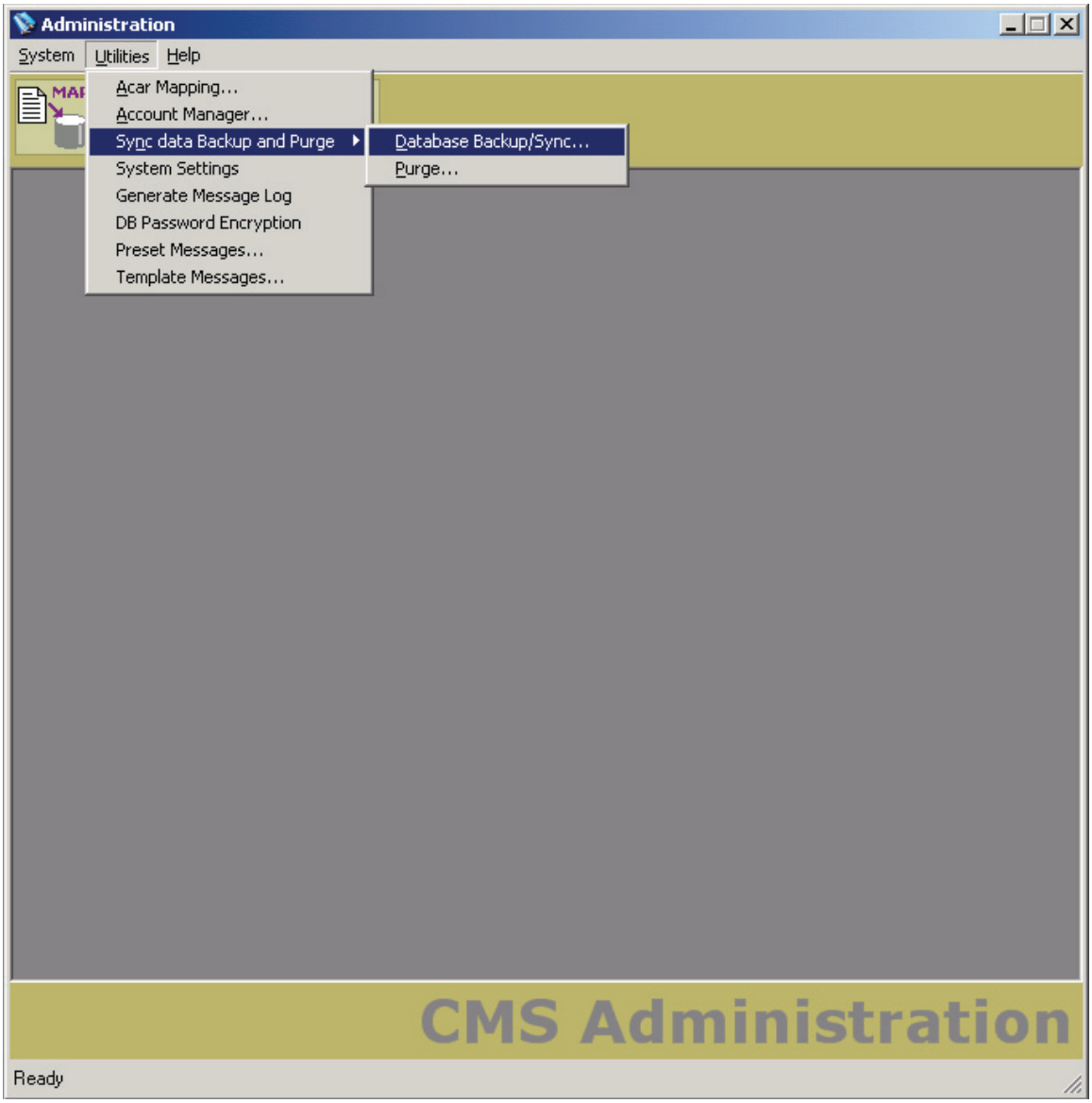
23. Restore the latest database backup into the server.

Run the CMS administration program at "**D:\MTR Program Files\Administration\Administration.exe**"

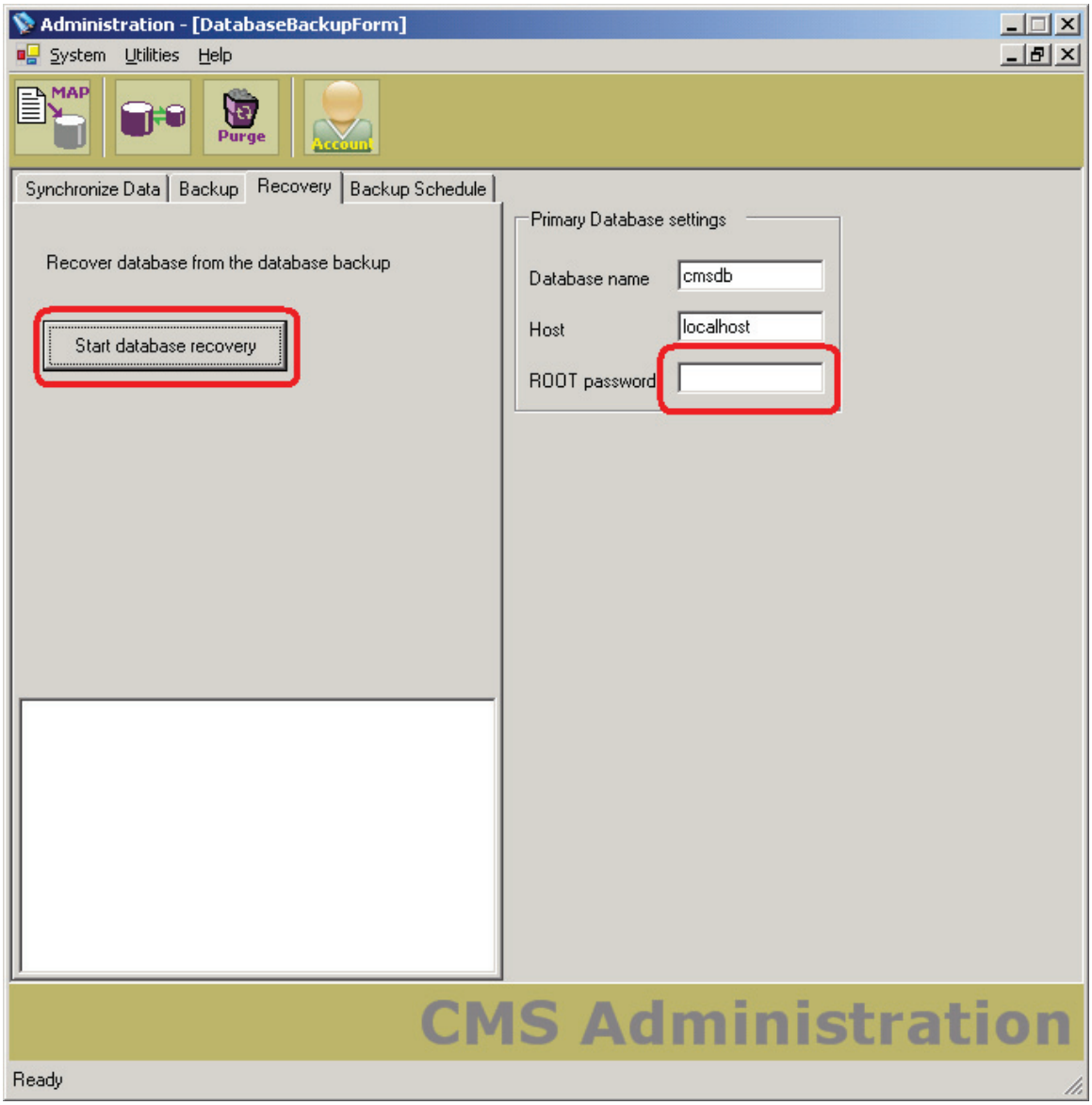


Login as administrator user. Select "Utilities->Sync data Backup and Purge->Database Backup/Sync"

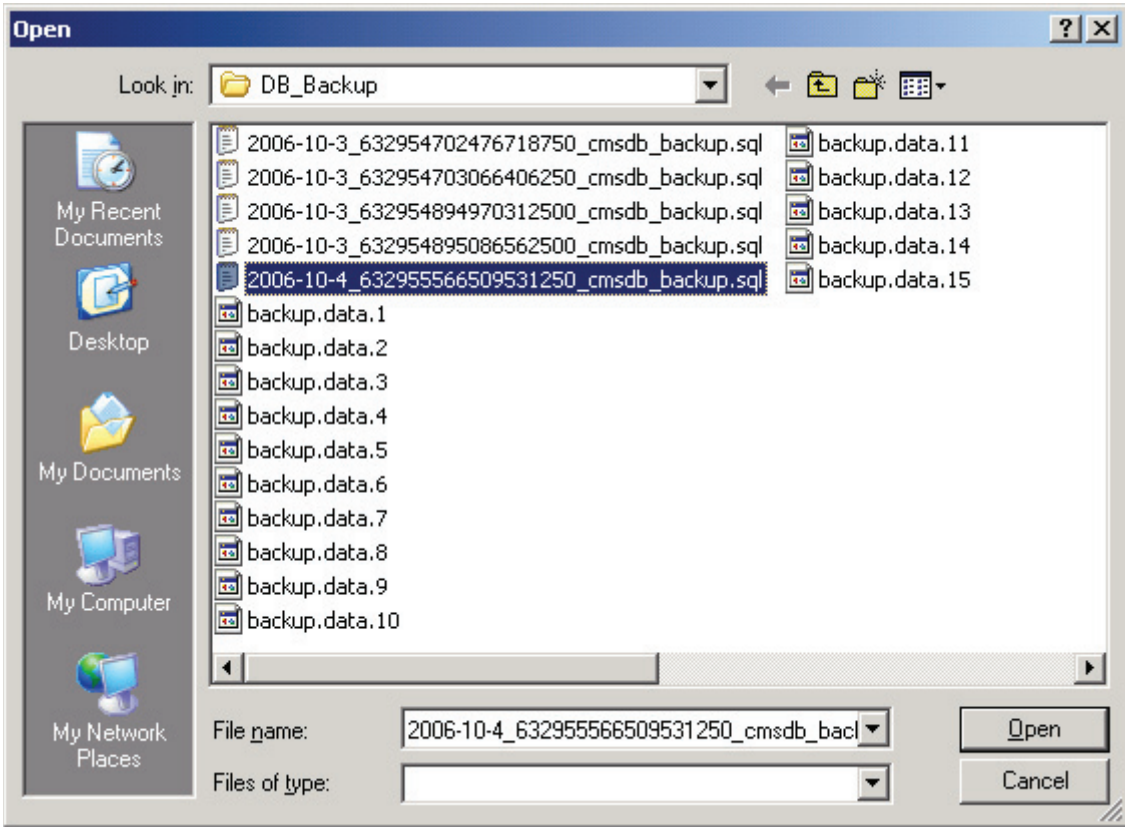




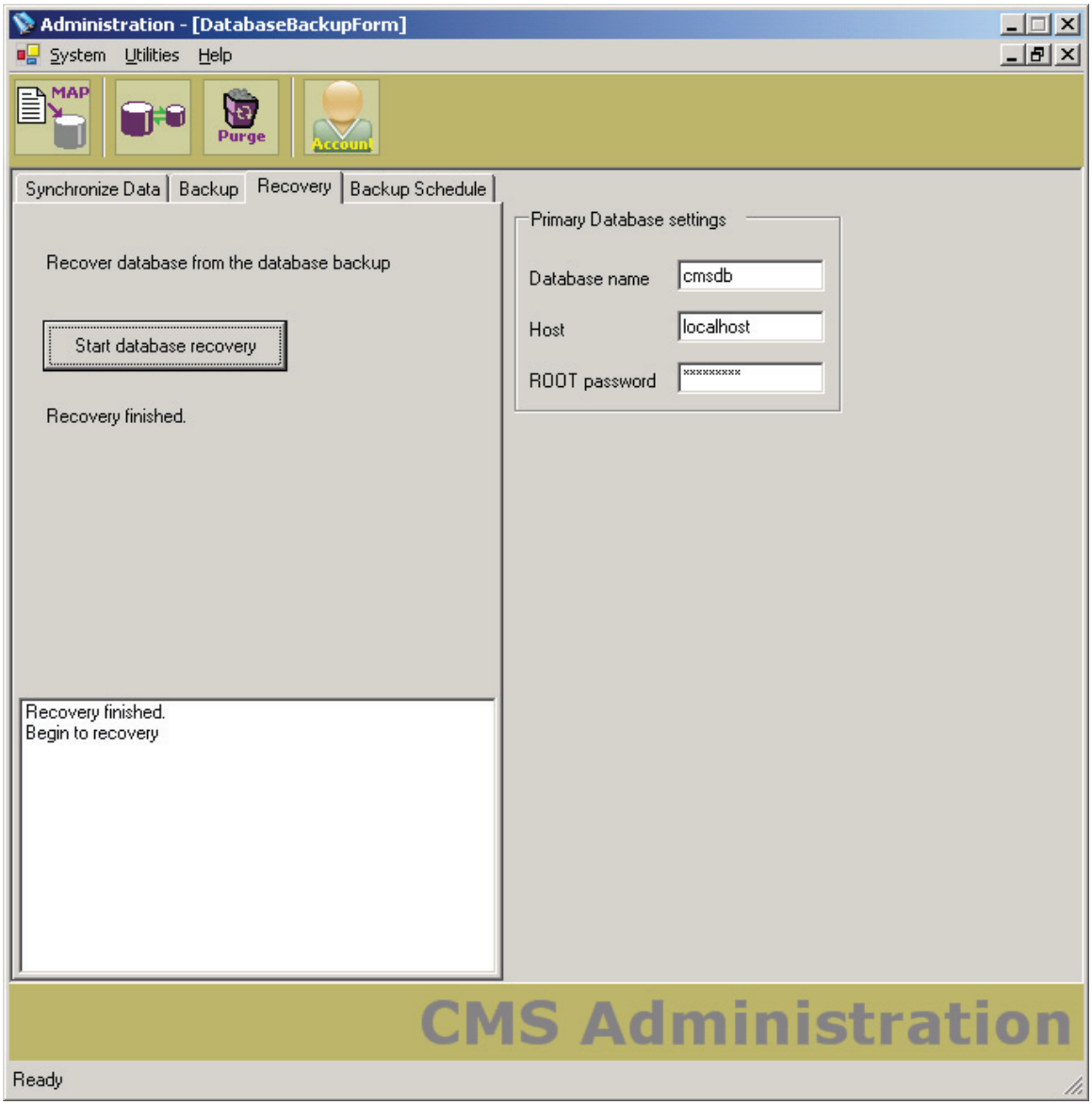
Select the tag ‘Recovery’. Input the database server’s ROOT password at the ‘Primary Database settings’. Then click ‘start database recovery’.



A pop up windows will be display and prompting you to select the database backup. Select the backup and click 'Open' to proceed.



A prompt will shown that the recovery is done. You may exit the CMS Administration program.


Administration - [DatabaseBackupForm]
System
Utilities
Help
MAP
Purge
Account
Synchronize Data
Backup
Recovery
Backup Schedule
Recover database from the database backup
Start database recovery
Recovery finished.
Recovery finished.
Begin to recovery
Primary Database settings
Database name
cmsdb
Host
localhost
ROOT password
CMS Administration
Ready

24. Change the windows' network configuration according to the latest live configuration of CMS1 or CMS2 whatever one Is going to be replaced. For the latest configuration, you have to refer to the configuration information. The current configuration is followed (reference only):

CMS1:

Local Area Connection:
- IP address: 138.9.5.60
- Subnet mask: 255.255.252.0
- Gateway: 138.9.5.1

Local Area Connection 2:
- IP address: 10.10.130.2
- Subnet mask: 255.255.255.0

Static route:
route add 202.140.96.0 mask 255.255.255.0 10.10.130.1 metric 1 –p

CMS2:

Local Area Connection:
- IP address: 138.9.5.61
- Subnet mask: 255.255.252.0
- Gateway: 138.9.5.1

Local Area Connection 2:
- IP address: 10.10.130.66
- Subnet mask: 255.255.255.0

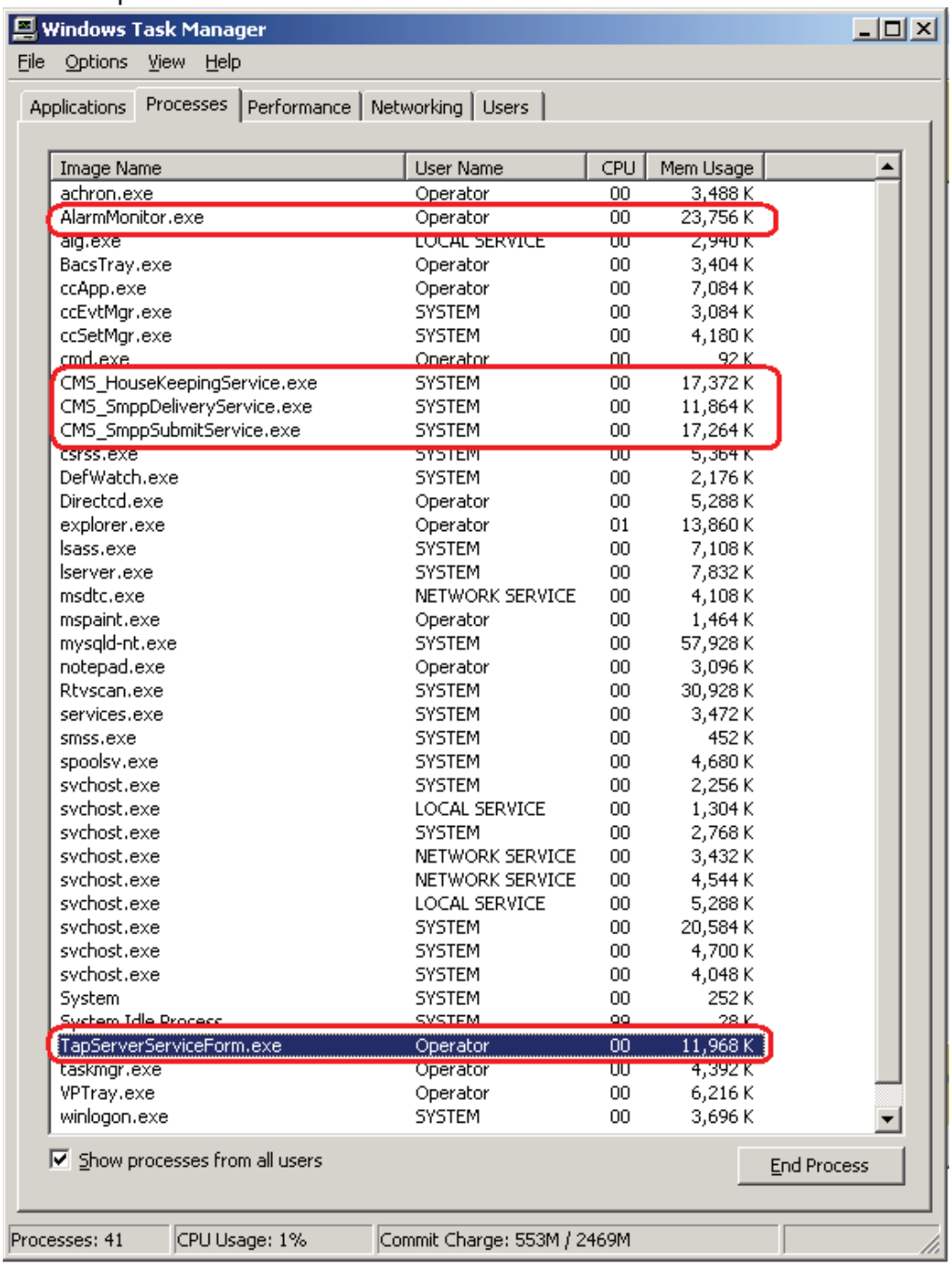
Static route:
route add 202.140.96.0 mask 255.255.255.0 10.10.130.65 metric 1 –p

25. Replace the fail CMS server by reconnect all the serial cable and network connections. You may have to refer to the latest connection diagram. Make sure the following connector is connected:
    - 2 LAN port connected
    - serial cable connected to the EIDS terminal
    - serial cable connected to the PSP (Only if paging network is still in used)
    - CMS server's power cord

26. Re-start the system

After the server's network is properly connected. You can power on the server. After the server power on, please check that the following program is running at the task manager:

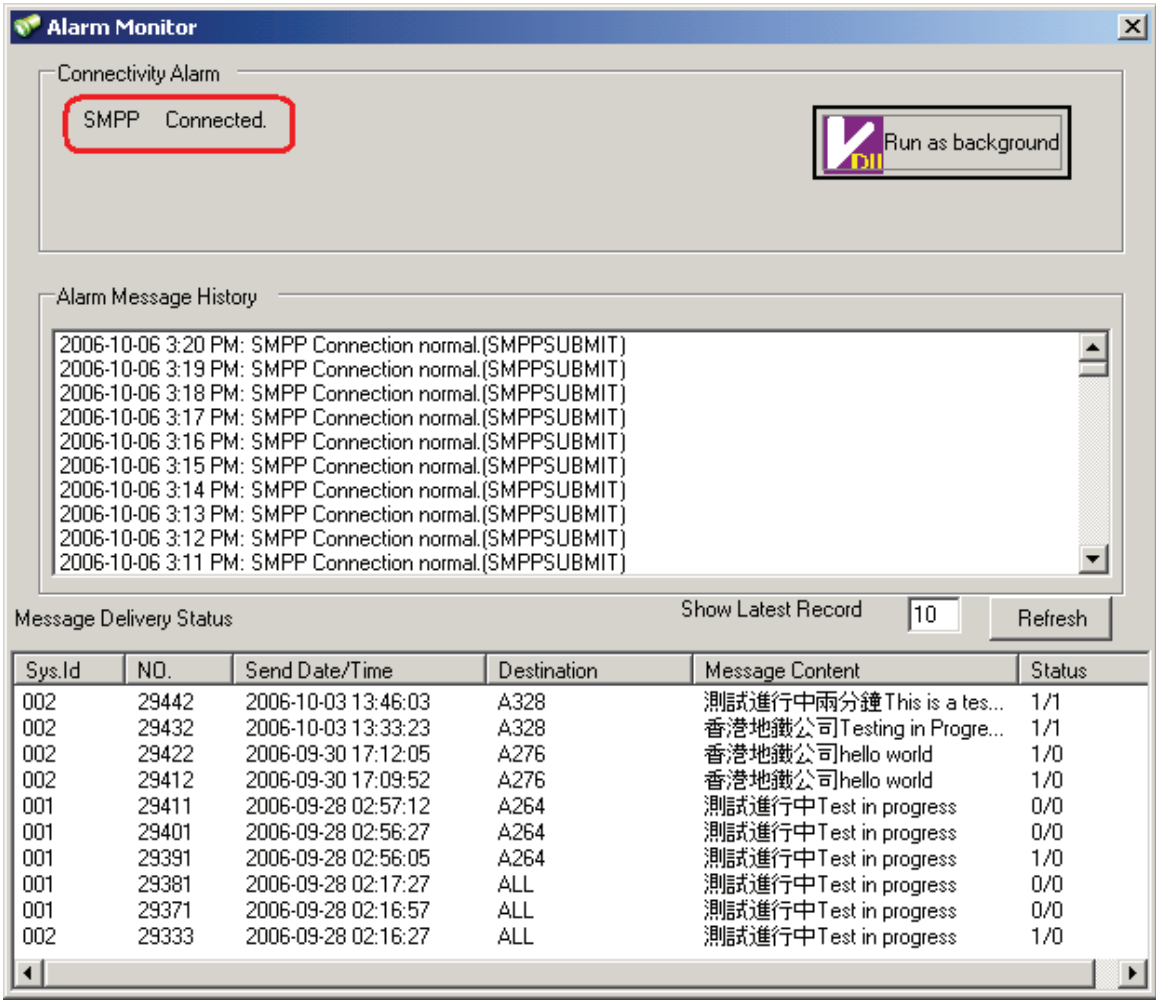
- AlarmMonitor.exe
- CMS_HouseKeepingService.exe
- CMS_SmppDeliveryService.exe
- CMS_SmppSubmitService.exe
- TapServerServiceForm.exe



27. Testing and verification

After the system replaced, you have to test that the system is working normally by:

- Verify the Alarm Monitor program and SMPP service is working normally by: Check from the AlarmMonitor screen that the SMPP connection status is “Connected”

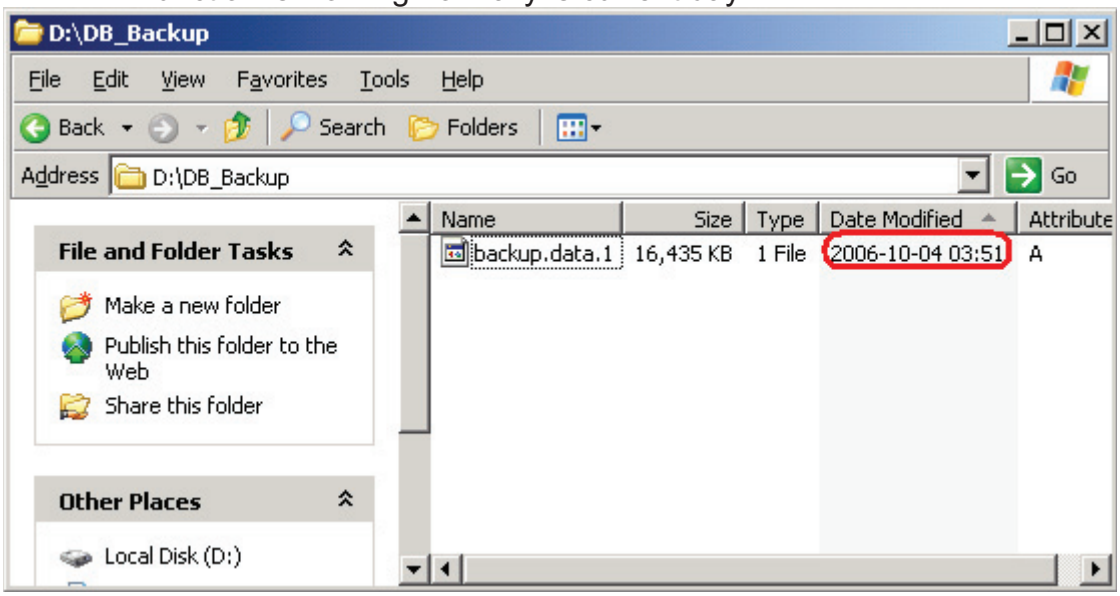


- Verify the TAP module is working normally by: Check from the EIDS terminal that both LINE are ready (No alarm show on the EIDS terminal)

- Verify the Administration program and Housekeeping service is working normally by: Start the Administration program and update the ACAR mapping. After 5 minutes, check from the Administration program of another live CMS server that the ACAR is updated.

- Verify the overall message sending function is working normally by: Shut down another live CMS server. Send a message from EIDS terminal, and check that the train can receive it correctly. (Restart the stopped CMS server after testing done)

- Verify the backup function is working normally by: on the next day, check the date of the database backup and make sure the backup function is working normally is current day.



28. System installation done and ready.

6 Appendix

6.1 Specification for CMS PC

Dell Model PowerEdge(TM) 850

with Intel(R) Pentium(R) D Proc 3.0GHz/2x1MB/L2,EM64T

-Integrated Dual Broadcom 5721J Gigabit Network Card
-Integrated XGI XG20 VGA Controller (16MB)
-Integrated SATA (2 Channels)
-Integrated USB 2.0
-Expansion Riser: 2x PCIe slots (1xPCIe x8 and 1xPCIe x4)
-1GB (2x512), DDR-2 533MHz ECC 1R Memory
-160GB (7200 RPM) SATA Hard Drive
-Microsoft(R) Windows(R) Server 2003 Standard Edition English (5 CALs)
-CD Kit for Microsoft(R) Windows(R) Server 2003 Standard Edition (English)
-Dell(TM) OpenManage(TM) Software Kit for PowerEdge(TM) 850
-CDRW/DVD Combo Drive with 24x Max Speed 8H657 -No Rack Mounting Rails
-Power Cord with IEC C13-C14 plugs for UPS/PDU connection
-User's Guide and Installation & Troubleshooting Guide for PE850 (ENG)

-Chassis

- Form Factor: 1U Rack
- Height: 1.68" (4.27 cm)
- Width: 21.50" (54.61 cm)
- Depth: 17.60" (44.70 cm)
- Weight: ~ 26.0 lbs. (11.80kg)

6.2 Attached documents

(The following documents will be provided upon request)

- Dell™ PowerEdge™ 850 Systems Installation and Troubleshooting Guide
  \Dell PowerEdge 850 Systems Documentation\it\index.htm
- Dell™ PowerEdge™ 850 Systems User's Guide
  \Dell PowerEdge 850 Systems Documentation\ug\index.htm
- Fastrack Modem M1306B User Guide
  P_Fastrack_Modem_M1306B_User_Guide.pdf
- AT Commands Interface Guide for AT x41
  AT Commands Interface Guide for revision X41c.pdf
- KVM Switch User Manual
  kvm_menu.pdf
- Cisco 805 Series Router Cabling and Setup Quick Start Guide
  805qsg.pdf
- Cisco 805 Router Hardware Installation Guide
  805hig.pdf
- Cisco 805 Router Software Configuration Guide
  805swg.pdf

APPENDIX I DESIGNATED CONTRACTS AND INTERFACING SYSTEMS
ANNEX 10 CAB SIMULATOR SYSTEM COORDINATION

1 Introduction

1.1 Definitions and Scope

1.1.1 This Annex covers the coordination requirements between the Contract and the cab simulator system to be developed.

1.1.2 This Annex only applies to train consists to be supplied under this this Contract.

1.2 Contractor Responsibilities

1.2.1 The requirements specified herein are by no means exhaustive and it remains the Contractor's responsibility to develop and execute after the commencement of the Works and throughout the execution of the Works, to ensure that:

(a) All design and interfacing issues are satisfactorily coordinated and resolved.

2 Relevant Operation/Equipment Characteristics

Not used.

3 Mechanical Interface

Not used.

4 Electrical Interface

Not used.

5 Functional Interface

5.1 General

5.1.1 The Contractor shall provide all the necessary assistance to the Cab Simulator System Contractor who shall design and build the cab simulator for the train system being built under the Contract.

6 Scope of Supply

6.1 Scope

Not used.

6.2 Information to be Supplied

6.2.1 Drawings

(a) Train configuration drawing showing outline dimensions of the entire train with details of the position of current collectors and bogies along the length of the train;

(b) All driving cab assembly drawings including cab equipment mounting details and cab structure dimensions. Driving cab layout drawings with equipment items list and details of illuminated displays and panels;

(c) Copies of the train electrical schematic diagrams;

(d) Train electrical circuit diagrams and any associated microprocessor logic;

(e) Catalogue data sheets illustrating contact block information for each switch used on all instrument panels, referenced back to panel assembly drawings in the form of an illustrated parts list or equivalent;

(f) Colour copies of drawing should be provided if any colour coding is used.

6.2.2 Performance

(a) Passenger loading data for tare, half loaded and fully loaded.

(b) Full details of train characteristics including: mass, maximum speed, acceleration, deceleration, tractive effort, current. In particular graphs of:

(1) Tractive effort and motor current (or acceleration) against speed for each Traction Brake Controller position;

(2) Braking force and motor current (or deceleration) against speed for each Traction Brake Controller position, under all different modes of operations;

(3) Brake Cylinder pressures for each brake demand for each passenger loading;

(4) Details of blending between the dynamic brake and the air brake;

(5) The number of motors per motor car and their configuration (for simulating fault conditions);

(6) Compressor cut in and out pressures and charging times for the Main Reservoir;

(7) Parking brake - force to apply and release time.

(c) Regenerative braking data (for example, line receptivity);

(d) Outline description of the function of any items appearing as modules or subassemblies (sometimes referred to as 'black boxes');

(e) Detailed description of the functioning of any items appearing as module subassemblies (sometimes referred to as 'black boxes');

(f) Pneumatics and air distribution systems diagram;

(g) Details of any audible warning devices which are fitted in the cab or will be audible in the cab;

(h) Train weights;

(i) Tunnel train resistance curves;

(j) Train resistance to motion equation or graph and rotational mass data;

(k) Train Acceptance Test Schedule;

(l) Detailed description of Train Management System interface to hardware; and

(m) Functional description of the underlying system driving them.

6.2.3 Fault Simulation

Full details of 50 nos. of fault scenarios with all outcomes (visual & audio observations) and handling procedures.

6.3 Engineer's Scope

Not used

7 Installation, Inspection and Test

7.1 Installation

Not used.

7.2 Inspection and Test

Not used.

APPENDIX J

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APPENDIX L

INTERIOR STYLING SCHEDULE

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APPENDIX L INTERIOR AND EXTERIOR STYLING SCHEDULE

APPENDIX L INTERIOR AND EXTERIOR STYLING SCHEDULE

This Appendix details the Employer's basic requirements and conceptual arrangement for the styling and finishes of the Trains. The Contractor shall base the styling proposal on this Appendix and any divergence from its directions shall be clearly identified and justified. It should be noted that the overall design responsibility shall vest on the Contractor. The Contractor shall satisfy himself that the interior design proposal does not compromise or contradict any other requirements of the Particular Specification.

Drawings referred to in this Schedule are general arrangement drawings to show key dimensions and sections to show form. They have been included for reference only and should not be used for production. The Drawings are not necessarily representative of all the details of the Employer's requirements.

The following relate to the saloon interior finishes and Drg. Nos. C6014-14E/TSEG/100/013 to C6014-14E/TSEG/100/023 inclusive shall be used as reference.

Item	Description	PS Ref.	Finish	Notes
1	Not used			
2	Seat	7.6.2	Stainless steel bead blast finish	
3	Seat Back	7.6.2	RAL 000 55 00 50% to 60% gloss level	
4	Seat Plinth	7.6.3	Stainless steel bead blast finish	
5	Saloon Ceiling Panel	7.5.6	RAL 000 90 00 50% to 60% gloss level	
6	Ceiling Coving Panel	7.5.7	RAL 000 90 00 50% to 60% gloss level	
7	Train Card Advertisement Holder	7.5.7(c)	RAL 000 90 00 50% to 60% gloss level	
8	Door Coving Panel	7.5.8	RAL 000 90 00 50% to 60% gloss level	
9	Saloon Window Panel	7.5.9	RAL 000 90 00 50% to 60% gloss level	
10	Flexible Trim	7.5.9(b)	RAL 000 55 00	
11	Draughtscreen Panel Trim	7.6.2	Stainless steel hairline finish	
12	Bodyside Coving Panel	7.5.10	RAL 000 90 00 50% to 60% gloss level	
13	Bodyside Floor Coving	7.5.11	Stainless steel bead blast finish	
14	Door Pillar Coving Panel	7.5.10	RAL 000 90 00 50% to 60% gloss level	
15	Door Pillar Floor Coving	7.5.11	Stainless steel bead blast finish	
16	Cab End Partition	7.5.13	RAL 000 90 00 50% to 60% gloss level	
17	Cab End Kickplate	7.5.13	Stainless steel bead blast finish	
18	Not used			
19	Bench Seat Back Trim	7.6.2	Stainless steel hairline finish	
20	Gangway Swing Panel	7.5.15	RAL 000 90 00 50% to 60% gloss level	
21	Gangway End Cubicle	7.5.15	RAL 000 90 00 50% to 60% gloss level	

Item	Description	PS Ref.	Finish	Notes
22	Gangway Kickplate		Stainless steel bead blast finish	
23	Doorway Ceiling LED Lighting	7.5.6	RAL 000 90 00 50% to 60% gloss level	
24	Train End Ceiling Panel	7.5.15	RAL 000 90 00 50% to 60% gloss level	
25	Gangway End Ceiling Panel	7.5.16	RAL 000 90 00 50% to 60% gloss level	
26	Not used.			
27	Passenger Bodyside Door Window	6.11.3	Tinted safety glass	
28	Double Branch Central Grabpole	7.7.1	Stainless steel satin finish with RAL 1023 section with embossed diamond pattern	
29	Not used			
30	Central Grabpole Fixing Caps	7.7.2	Lower Caps: Stainless steel satin finish	
31	Ceiling Grabrail	7.7.1	Stainless steel satin finish	
32	Seat Mounted Grabhandle	7.7.1	Stainless steel satin finish with RAL 1023 section with embossed diamond pattern	
33	Doorway Grabhandle	7.7.1	Stainless steel satin finish with RAL 1023 section with embossed diamond pattern	
34	Gangway Grabpole	7.7.1	Stainless steel satin finish with RAL 1023 section with embossed diamond pattern	
35	Gangway Grabpole Fixing Cap	7.7.5	Stainless steel satin finish	
36	Gangway Grabhandle	7.7.1	Stainless steel satin finish with RAL 1023 section with embossed diamond pattern	
37	Multi-purpose Area Horizontal Grabrail	7.7.1	Stainless steel satin finish with RAL 1023 section with embossed diamond pattern	
38	Multi-purpose Area Grabhandle	7.7.1	Stainless steel satin finish with RAL 1023 section with embossed diamond pattern	
39	Enlarged Multi-purpose Area Horizontal Grabrail	7.7.1	Stainless steel satin finish with RAL 1023 section with embossed diamond pattern	
40	Straphanger	7.7.7	Belt – ”Baby Blue” RAL 5024	
41	Draughtscreen	7.7.8	Clear, untinted safety glass	
42	Draughtscreen Panel	7.6.2	RAL 000 55 00 50% to 60% gloss level	
43	Floor covering	7.8.1	See Figure App-L-2 for doorway area and Figure App-L-3 for seat bay area for sample pattern	
44	Treadplate	7.8.5	Natural anodised aluminium	
45	Key and Lock	RS STD 15	Silver	
46	Passenger Bodyside Door Panel	7.5.12	RAL 000 90 00 50% to 60% gloss level	
47	Passenger Bodyside Door Kickplate	7.5.12	Stainless steel bead blast finish	

Item	Description	PS Ref.	Finish	Notes
48	Cab/Saloon Partition Door	7.5.14	RAL 000 90 00 50% to 60% gloss level	
49	Cab/Saloon Partition Door Kickplate	7.5.14	Stainless steel bead blast finish	
50	Passenger Alarm Emergency Handle	7.11.4	Housing RAL 000 90 00 50% to 60% gloss level	
51	Bodyside Window	6.11.3	Tinted safety glass	
52	Not Used			
53	Not Used			
54	Not Used			
55	Not Used			
56	Not Used			
57	Not Used			
58	Not Used			
59	Not Used			
60	Not Used			

The following relate to the carbody exterior finishes and Drg. Nos. C6014-14E/TSEG/060/001 to C6014-14E/TSEG/060/005 inclusive shall be used as reference.

Item	Description	PS Ref.	Finish	Notes
61	Cab Front (Centre)	6.2 & 6.13	Pantone Process Black C 70% to 80% gloss level	
62	Cab Front (Side)	6.2 & 6.13	Silver to match with 3M sticker Controltac 180-120 70% to 80% gloss level	
63	Cab Front (Red Band)	6.2 & 6.13	Pantone 201 C 70% to 80% gloss level	
64	Body Side (Black)	6.2 & 6.13	3M sticker Controltac 180-12	
65	Body Side (Grey Metallic)	6.2 & 6.13	3M sticker Controltac 180-221	
66	Body Side (Satin Aluminium)	6.2 & 6.13	3M sticker Controltac 180-120	
67	Body Side (Red)	6.2 & 6.13	3M sticker Controltac 180-2249	
68	Rain Gutter	6.2 & 6.13	Pantone 201 C 70% to 80% gloss level	

Figure App-L-1 Not used

Figure App-L-2 Floor Covering Sample Pattern for Doorway Area

Figure App-L-3 Floor Covering Sample Pattern for Seat Bay Area

APPENDIX M

LIFE CYCLE COST

August 2015

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APPENDIX M LIFE CYCLE COST

1 General

2 Energy Consumption Target

3 Maintenance Cost Target

4 Validation of Energy Consumption

5 Validation of Maintenance Cost

APPENDIX M LIFE CYCLE COST

1 General

1.1 The energy consumption target shall be computed as depicted in this Appendix and forms part of the incentive and contribution scheme. The maintenance cost evaluation forms part of evaluation of maintenance cost of life cycle cost.

2 Energy Consumption Target

2.1 The data of the following items shall be used by the Employer for the calculation of the Energy Consumption Target incorporated in the Letter of Clarification utilizing the simulation software Power Plan version 5.4.7 (supplied by Funkwerk Information Technologies York Ltd) :

(a) Tare weight

(b) Number of trailer and motor car

(c) Weight of motor car and trailer car

(d) Front area of leading car and other car

(e) Tractive effort curve at the various loaded conditions

(f) Regenerative braking curve at the various loaded conditions

(g) Overall electrical-to-mechanical efficiency and power factor at various running speed for motoring and regenerative braking at motor shaft

2.2 The parameters used for calculation of the Energy Consumption Target are as follows:

(a) The train resistance formula used shall be

$$\text{leading car } R = 0.65 + 13.15/W + 0.014V + 0.00453AV^2/nW$$
$$\text{other cars } R = 0.65 + 13.15/W + 0.014V + 0.000641AV^2/nW$$

where R = train resistance (kg/ton) W = axle weight (ton/axle)
V = train speed (km/h) n = number of axles per car
A = front area of train (m^2)

(b) Line voltage shall be taken as 1,500V DC.

(c) Wheel diameter shall be the half worn value.

(d) Jerk limit shall be taken as $0.8m/s^3$.

(e) Passenger loading is 2,584 passengers for peak hour services and

1,292 passengers for non-peak hour services

(f) The weight of each passenger shall be 60kg.

(g) Trip time requirement shall not exceed the following requirements:

(i) The total Round Trip Time without Coasting, from Train arrival at CHW to arrival at KET Turnaround through ISL Down and then from KET Turnaround back to CHW through ISL Up, shall not be more than 60 minutes with the Minimum Dwell Times as specified in the tables Table App M – 1 and Table App M – 2 below.

(ii) The total Round Trip Time under 4% Coasting, from Train arrival at CHW to arrival at KET Turnaround through ISL Down and then from KET Turnaround back to CHW through ISL Up, shall not be more than 66 minutes with the Normal Dwell Times as specified in the tables Table App M – 1 and Table App M – 2 below.

Table App M – 1

Up direction		
Station	**Minimum Dwell Time (Second)**	**Normal Dwell Time (Second)**
KET	32	32
HKU	32	32
SYP	32	32
SHW	32	32
CEN	29	29
ADM	40	43
WAC	28	28
CAB	27	27
TIH	17	17
FOH	19	21
NOP	19	26
QUB	29	38
TAK	19	34
SWH	18	27
SKW	18	30
HFC	16	26
CHW	30	47

Table App M – 2

Down direction		
Station	**Minimum Dwell Time (Second)**	**Normal Dwell Time (Second)**
CHW	30	47
HFC	16	19
SKW	24	27
SWH	16	31
TAK	25	35
QUB	29	37
NOP	23	51
FOH	23	33
TIH	22	37
CAB	36	48
WAC	37	49
ADM	35	46
CEN	36	42
SHW	32	32
SYP	32	32
HKU	32	32
KET	47	47

(h) The total annual number of round trips for 78 trains for peak hour services and non-peak hour services are 98,748* and 155,922* respectively.

(i) Rotating mass to the tare weight, 10% for motor car and 5% for trailer car.

(j) The Overhead line voltage for Powering, Braking and Overhead line receptivity will be calculated by simulation software Power Plan based on the service headway for both peak and non-peak service hours.
The service headway for peak and non-peak hour service are 112 second and 245 second respectively.

(k) Maximum line voltage for regeneration in Power Plan is set to 1770V.*

(l) Braking effort in Power Plan is set to reduced linearly from 100% to 0% from line voltage 1670V to 1770V.*

2.3 The simulation results shall include the total energy consumption of a train of which the alignments, gradients and speed limits are detailed in the Drawings for the following round trip conditions. The simulation is based on the all-out condition running in ISL between CHW and KET, with the train motors operating at full power to the maximum designed speed, and running at the maximum designed speed at all times as far as it can be achieved, under the following loading conditions.

(a) 2,584 passengers for peak hours services

(b) 1,292 passengers for non-peak hours services

2.4 Using the round trip energy figures from the simulation described in clause 2.3 of this Appendix, the Energy Consumption Target will be computed as follow:

(a) The annual energy consumption for peak hour services shall be obtained by multiplying the round trip energy calculated according to clause 2.3 of this Appendix with the annual number of round trips for peak hours services given in clause 2.2(h) of this Appendix.

(b) The annual energy consumption for non-peak hour services shall be obtained by multiplying the round trip energy calculated according to Clause 2.3 of this Appendix with the annual number of round trips for non-peak hours services given in clause 2.2(h) of this Appendix.

(c) The total annual energy consumption will be obtained by adding the 2 energy consumption figures from (a) and (b) above.

(d) The total energy consumption over the 20 years life will be computed by multiplying the figure from (c) by 20. This is the Energy Consumption Target.

3 Maintenance Cost Target

3.1 The data of the following items shall be used for evaluation of Maintenance Cost Target incorporated in the Letter of Clarification are as follows:

3.1.1 Preventive Maintenance (PM) Labour Costs

(a) Check type

(b) Mileage between checks (in terms of thousand km)

(c) Standard man-hours of each service check type

3.1.2 Preventive Maintenance (PM) Material Costs (Top 6 high spending items proposed

(a) Material item

(b) Unit price (in terms of HKD)

(c) Average replacement interval (in terms of thousand km)

(d) Total number per train

(e) % of top 6 high spending items in Total PM material cost

3.1.3 Overhaul (OH) Labour Cost

(a) Check type

(b) Mileage between check overhaul interval for each type of overhaul

(c) Standard man-hour required for completing each service check type

(d) Total number per train

3.1.4 Overhaul Material Cost (Top 12 high spending items proposed)

(a) Material item

(b) Unit price (in terms of HKD)

(c) Average replacement interval (in terms of thousand km)

(d) Total number per train

(e) % of the top 12 high spending item in total overhaul material cost

3.2 The parameters used for the calculation of the Maintenance Cost Target are as follows:

(a) Labour rate of HK$150 per hour

(b) The annual mileage of the fleet is 62,534 car-kkm

(c) The maintenance costs for PM and OH are averaged out for the entire operation of 20 years.

(d) Annual maintenance expenses are paid at the end of the year, which labour costs and spare costs do not escalate.

(e) Total number of train is 78 and number of cars per train is 8.

3.3 Each individual task of a given maintenance operation, including PM and OH, shall be measured by a list of tasks to be undertaken at different time intervals and the manning levels required and quantity, type and cost of spare items required. After the maintenance operation, the train involved shall be restored to service condition.

3.4 Preventive Maintenance (PM) shall include all required service checks on a complete train; inspections of critical equipment or assembly requiring frequent inspection and maintenance and the justifications; and inspections of equipment that are subject to condition based maintenance. PM costs per thousand car km shall be determined based on the total labour and material costs as per the following formulas:

$$\text{Labour costs per car kkm} = \sum \frac{\text{PM Man-hours of each check type} \times \text{Staff hourly rate}}{\text{Running mileage between checks} \times \text{No. of cars per train}}$$

$$\text{Material costs per car kkm} = \sum \frac{\text{Unit price} \times \text{Total no. per train}}{\text{Average replacement interval} \times \text{No. of cars per train}}$$

3.5 The Overhaul Costs per thousand car km shall be determined based on the total labour and material costs as per the following formulas:

$$\text{Labour costs per car kkm} = \sum \frac{\text{Overhaul man-hours of each check type} \times \text{Staff hourly rate}}{\text{Running mileage between checks} \times \text{No. of cars per train}}$$

$$\text{Material costs per car kkm} = \sum \frac{\text{Unit price} \times \text{Total no. per train}}{\text{Average replacement interval} \times \text{No. of cars per train}}$$

4 Validation of Energy Consumption

4.1 The Energy Consumption Target incorporated in the Letter of Clarification shall be subject to the following validations for the application of the Energy Consumption Incentive and Contribution Scheme.

4.2 Interim simulations of energy consumption shall be carried out for verification during the System Engineering Management Plan (SEMP) stages 3 and 4 (refer to PS 21.3.4) and the results of these simulations shall be submitted under the associated SEMP report (PS 21.3.5).

4.3 Given that the trip times stipulated in clause 2.2 of this Appendix are achieved, the Energy Consumption Target shall be validated against the finalized manufacturing information and methodology specified in clause 2.1 to 2.4 above during the SEMP stage 5 (refer to PS 21.3.4) by the Engineer using the same model for establishing the Energy Consumption Target above. The validated data shall be submitted under the associated SEMP report (refer to PS 21.3.5 refers).

5 Validation of Maintenance Cost

5.1 To verify that the targets stipulated in Clause 3.1 of this Appendix are achieved, the Maintenance Cost Target incorporated in the Letter of Clarification shall be validated.

5.2 Not used.

5.3 Interim evaluations of maintenance costs shall be carried out for verification during the System Engineering Management Plan (SEMP) stages 3 and 4 (refer to PS 21.3.4) and the results of these evaluations shall be submitted under the associated SEMP report (refer to PS 21.3.5).

5.4 The Maintenance Cost Target specified in the Letter of Clarification shall be verified against the finalized manufacturing information and methodology specified in clauses 3.1 to 3.5 above during the SEMP stage 5 (refer to PS 21.3.4) by conducting tests as stipulated below. The validated data shall be submitted under the associated SEMP report (refer to PS 21.3.5).

(a) Maintainability shall be demonstrated by conducting tests on representative tasks of the following PM and OH check types. Reference shall be made to MIL-STD-471 in the formulation of the maintainability tests and the tests details shall be submitted for Approval.

PM Check Type	Details
A Check*	A Check (Every 7.5 kkm +/ - 3 days) A Check is to be superseded by B1 to B4 Checks and C check.
B Check*	B Check (B1 to B4 Checks, every 15 kkm +/ - 3 days) B Check Pattern: B1 --> B2 --> B3 --> B4 --> B1 … All type of B Checks is to be superseded by C Check.
K Check*	K Check (Every one year, -24 / +72 days) K Check Pattern: K1 --> K2 --> K3 --> K4 --> K1 … K Check is to be superseded by C Check.

OH Check Type	Details
C Check*	C Check (Every 480kkm, +/- 6 months) Overhaul Pattern: C1 --> C2 --> C3 --> C4 --> C5 --> C1 …

* The maintenance interval of the above Check Types is of minimum requirement.

(b) Maintainability shall be demonstrated by conducting tests on the following PM and OH spare parts that marked with **. The test details shall be submitted for Approval.

Type of Spare	Details
PM spare parts:	1. Brake pad – motor car**
	2. Brake pad - trailer car **
	3. Pantograph carbon strip**
	4. Wheel flange dry solid lubricant**
	5. Cab air conditioning system air filter**
	6. Saloon air conditioning system air filter**

Type of Spare	Details
OH spare parts:	1. Axle box bearing**
	2. Wheel
	3. Brake disc**
	4. Air spring (Secondary suspension) **
	5. Bogie vertical damper repair kit
	6. Traction motor bearing**

Type of Spare	Details
	7. Battery
	8. Gangway bellow (Half-gangway)
	9. Saloon door nosing rubbers (Female and male rubbers)
	10. High Speed Circuit Breaker **
	11. In-saloon CCTV camera
	12. Cooling fan bearings (Auxiliary power supply system) **

(c) Replacement effort shall be demonstrated by conducting tests on the above PM and OH spare parts that marked with **.The test details shall be submitted for Approval.

APPENDIX N

DESIGN DATA

August 2015

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APPENDIX N DESIGN DATA

1 General

2 Design Documents

3 System Engineering Management System

APPENDIX N DESIGN DATA

1 General

1.1 The following lists the minimum Design Data required by the Engineer to be submitted for Approval according to GS Section 10.9 and 10.10. The Design Data listed below shall be submitted at the appropriate System Engineering Management Plan (SEMP) stage (refer to PS 21.3.4).

1.2 The SEMP reports of each stage and its associated design plans (refer to PS 21.2.3) shall be submitted prior to the SEMP presentation (refer to PS 21.3.5).

2 Design Documents

2.1 Based on the design plans (refer to PS 21.2.3) that serve as the design input to the System Engineering Management System (refer to PS 21.1), the following four level of design documents shall be produced and submitted as the design output to this System Engineering Management System:

Level 1: System Requirements Document (SRD)
Level 2: System Specification Document (SSD)
Level 3: System Design Document (SDD)
Level 4: Design Information (DI)

2.2 Level 1 - System Requirements Document (SRD)

2.2.1 The SRD is the top level design document which explains how the requirements of the PS are to be achieved. Proposal of system classifications shall also be provided in the SRD.

2.2.2 Design review of SEMP stage 1 shall be conducted when the SRD has been established.

2.3 Level 2 - System Specification Document (SSD)

2.3.1 The SSD is the second level design document which defines how the requirements of the SRD shall be fulfilled by the individual systems (such as, car body and traction system). This document shall demonstrate the Contractor's understanding of the system's functional requirements and of interface requirements between systems including the Contractor’s own systems and those of other interfacing contractors.

2.4 Level 3 - System Design Document (SDD)

2.4.1 The SDD defines how each system as defined in the SSD shall be achieved. The purpose of this SDD is to evaluate the optimization, correlation, completeness, and risks associated with the allocated technical requirements of a system. Due considerations shall be given to ensure all issues as stipulated in the design plans are fully addressed. Also a summary of the related design submission lists shall be included for each system SDD.

2.4.2 Basic manufacturing and/or procurement considerations shall also be reviewed and planning for production engineering in subsequent phases shall be addressed.

2.4.3 Design review on the SSD and SDD shall be timely conducted particularly when the manufacturing and/or procurement works have been started.

2.4.4 For those systems which involves the electronic and software based drive and/or control functions, the following additional four documents shall be provided:

(a) Software Requirements Specification (SRS)

The SRS shall define the major components of the software design, including data and internal interfaces. The overall structure of the software in terms of the processes involved shall be included.

(b) Software Detailed Design Specification (DDS)

The DDS shall define how each software module defined in an SRS is to be achieved. A DDS shall be either in a form of description and block diagram or pseudo-code. Signal/data paths to other DDS or circuit diagrams shall also be defined.

(c) Hardware Functional Block Specification (FBS)

The FBS shall define, in block diagrammatical form, the functions implemented on a printed circuit board or electronic assembly. Signal/data paths to other DDS, FBS or circuit diagrams shall also defined.

(d) Control Block Diagram (CBD)

The CBD shall show how the control software DDSs and electronic hardware FBSs interconnect to achieve the overall control function. Detailed design information shall not be shown here but provided in the individual design submissions.

2.4.5 The detailed requirements of the software shall comply with RS/C6014/05.

2.5 Level 4 - Design Information (DI)

2.5.1 The DI shall provide the detailed design information of:

(a) Detailed design proposal of system, assembly and component. Supplementary information, such as drawing, diagram, datasheet, calculations and product catalogue, shall also be provided, as appropriate;

(b) Test and inspection specification;

(c) Test and inspection result;

(d) Operation and Maintenance Manual;

(e) Training proposal;

(f) Deliverables of software according to RS/C6014/05.

3 System Engineering Management System

3.1 According to the definition of SEMP, the Design Data shall be grouped into 5 corresponding design packages, and the submission program of these 5 packages of Design Data shall be carefully organised, so that the at each stages of SEMP, sufficient design information are provided to demonstrate the required level of design development are achieved.

3.2 Based on the above 5 design packages of Design Data, the proposed level of design information to be submitted at each stage of SEMP shall be provided in the Design Data Submission Plan (refer to PS 21.3.2).

3.3 Consideration shall be given on the preparation of the Design Data Submission Plan, in order to ensure that the required submission dates of interface Design Data are met.

3.4 Criteria for the SEMP Stages

SEMP Stages	Design Documents to be Submitted	Status of completion*
SEMP 1: Stage of Concept Exploration;	Level 1: System Requirements Document (SRD)	100% Completion
SEMP 2: Design Development and Review;	Level 2: System Specification Document (SSD) Level 3: System Design Document (SDD)	> 90% Completion > 70% Completion
SEMP Stages	Design Documents to be Submitted	Status of completion*
SEMP 3: Design Verification and Validation;	Level 2: System Specification Document (SSD) Level 3: System Design Document (SDD) Level 4: Design Information (DI)	100% Completion > 90% Completion > 70% Completion
SEMP 4: Engineering and Manufacturing Development Phase;	Level 3: System Design Document (SDD) Level 4: Design Information (DI)	100% Completion > 90% Completion
SEMP 5: Inspection, Testing and Training;	Level 4: Design Information (DI)	100% Completion

*: The proportion of the total numbers of Design Data to be submitted of which at least an Approved in Principle status was received on the related submission(s).

APPENDIX O

DELIVERY OF EQUIPMENT

August 2015

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APPENDIX O DELIVERY OF EQUIPMENT

1 General

1.1 The Contractor shall be responsible for delivery of all equipment to the various sites as defined below.

1.2 The Contractor shall comply with the COC Clauses 25 and 26 on the insurance of the equipment to be supplied under the Contract.

1.3 The Contractor shall prepare, protect, deliver and store the equipment in accordance with GS Section 11.

2 Delivery of Equipment

2.1 Trains

(a) The trains shall be delivered to the site as described in PS 30 and Appendix G.

(b) The Contractor shall supply all manpower, lifting equipment, temporary bogies, and other equipment necessary to deliver the trains and assemble them into a safe condition for movement in the depots and the Urban Lines.

2.2 Special Tools and Test Equipment

All special tools and test equipment shall be delivered to Urban Line Depots (CWD, KBD, TKD and TWD). The Engineer will advise the delivery site for each item of equipment before shipment to Hong Kong commences.

2.3 Spares

All spare parts ordered under the Contract shall be delivered to the Main Stores, Kowloon Bay Depot, Hong Kong.

2.4 Documentation

All documentation and design data supplied under the Contract shall be delivered to the Engineer at the address stated for correspondence.

APPENDIX P

CONFIGURATION CONTROL PROGRAMME

August 2015

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APPENDIX P CONFIGURATION CONTROL PROGRAM

1 Introduction

2 Scope

3 Purpose

4 Intended Use

5 Engineering Change Proposal

6 Specification Change Notice

APPENDIX P CONFIGURATION CONTROL PROGRAM

1 Introduction

1.1 This Appendix delineates configuration control requirements and provides instructions for preparing and submitting proposed engineering changes (which is an alteration in the approved Configuration Identification List (refer to PS 21.3.10(c)) of a Configuration Item (refer to PS 21.3.10(a)(iv)) under development, delivered or to be delivered) and related information. Such changes require a complete analysis of the impact if the engineering change described by an Engineering Change Proposal (which is a proposed engineering change and the documentation by which the change is described, justified, and submitted for Approval) were implemented.

1.2 The data package submitted with an Engineering Change Proposal shall contain a description of all known interface effects and information concerning changes required in the approved Configuration Identification List.

1.3 The configuration control requirements as stipulated in this Appendix shall be imposed on both the contractor and subcontractors.

1.4 This Appendix covers requirements for submission of the above Engineering Change Proposal and Specification Change Notice. The Specification Change Notice is a document used to propose, transmit and record changes to a specification. In proposed form prior to Approval, the Specification Change Notice supplies proposed changes in the text of each page affected. In final approved form, the Specification Change Notice summarizes the approved changes to the text of each page affected.

2 Scope

2.1 This Appendix establishes the requirements, formats, and procedures to be utilized in the preparation of configuration control documentations. Included are requirements for:

2.1.1 maintaining configuration control of Configuration Items, both hardware and software;

2.1.2 preparing and submitting Engineering Change Proposal and Specification Change Notice.

3 Purpose

The purpose of this Appendix is to establish configuration control requirements and procedures applicable to the Contract.

4 Intended Use

This Appendix shall be used by the Contractor and the Engineer to:

4.1.1 Establish and maintain effective configuration control of the approved Configuration Identification List;

4.1.2 Propose engineering change to the approved Configuration Items, both hardware and software which are designed, developed or modified for meeting the Contract requirements;

4.1.3 Prepare Specification Change Notice; and

4.1.4 Control the form, fit and function of in-house developed items used in Configuration Items, including proprietary and non-developmental items. Non-developmental items are existing developed and available hardware or software that are capable of fulfilling the specified performance requirements, thereby minimizing or eliminating the need for costly research and development programs. A Non-Developmental Item is usually an off-the-shelf or commercial-type product, but may also include hardware or software already developed by or for the rolling stock applications.

5 Engineering Change Proposal

5.1 Application

Configuration control requirements established by this part of the Appendix apply only to the Configuration Identification List which has been Approved.

5.2 Classification

An engineering change shall be classified as Class I or Class II by the originator in accordance with the following definitions:

5.2.1 Class I Engineering Change

A proposed engineering change to a Configuration Item shall be determined to be Class I by examining whether the required performance would be impacted as a result of implementing the change.

5.2.2 Class II Engineering Change

A Class II engineering change identifies a minor change to a Configuration Item or its documentation that can be affected entirely by the Contractor within the scope of the Contract effort without changing the approved Configuration Identification List. Class II changes are also applicable during production and are normally identified and processed to correct documentation errors or to enhance Contractor productivity without detriment to the Engineer.

Both Class I and II Engineering Change Proposals shall be submitted for Approval.

5.3 Procedures

The steps for preparing and processing an engineering change consist of the following:

5.3.1 determination of a need for the change;

5.3.2 establishment by the originator of a classification of the engineering change as Class I or Class II as agreed by the Engineer;

5.3.3 preparation of an Engineering Change Proposal;

5.3.4 submission to the Engineer;

5.3.5 review;

5.3.6 Approval by the Engineer;

5.3.7 incorporation of approved Engineering Change in the Configuration Item and in the Configuration Identification List;

5.3.8 status accounting;

5.3.9 verification of change accomplishment; and

5.3.10 distribution of documentation change.

5.4 Preparation of Engineering Change Proposal

Although the Engineering Change Proposal originator can be either the Engineer or the Contractor, all formal Engineering Change Proposal shall be prepared by the Contractor.

5.5 Supporting Data

All Engineering Change Proposal shall be supported by drawings and other data if required to justify and describe the change and to determine its total impact including assessments of changes to system operational characteristics. Any testing done by the Contractor to validate concepts or new technology to be employed in the proposed engineering change should be presented if such test data is vital to the decision regarding acceptance of the change.

5.6 Submission of Engineering Change Proposal

To facilitate preparation and submission of Engineering Change Proposal, the Contractor may use automated processing techniques provided all essential and applicable data elements are addressed sequentially. Where facilities exist, electronic transfer should be considered to expedite processing. The Contractor shall not implement any class of proposed engineering change until it is Approved.

5.7 Revisions of Engineering Change Proposal

With the agreement of the Engineer, an Engineering Change Proposal shall be revised when major alterations or changes to the initial Engineering Change Proposal are necessary in order to describe the proposed change.

5.8 Amendments to Engineering Change Proposal

With the agreement of the Engineer, an amendment shall be provided to clarify, correct, add to, delete from or make other minor changes to a submitted or previously amended Engineering Change Proposal. Amendments to an Engineering Change Proposal shall explicitly state the change to the previous document.

6 Specification Change Notice

6.1 Application

A Specification Change Notice shall be prepared to propose a change to a specification that is affected by an Engineering Change Proposal and the specification is one that is maintained by the Engineering Change Proposal originator. Or when authorized, a Specification Change Notice shall be used to update a specification, unrelated to an Engineering Change Proposal or design change. Errors of a minor nature (such as typographical errors and punctuation) normally shall not be corrected, except as an incidental part of the next technically required Engineering Change Proposal and accompanying proposed Specification Change Notice.

6.2 Purpose

The Specification Change Notice is a document used to propose, transmit, and record changes to a specification. The Specification Change Notice is used as a cover sheet and may serve as a letter of transmittal. The page changes associated with that Specification Change Notice shall be attached and shall constitute an integral part of the Specification Change Notice.

6.3 Proposed Specification Change Notice

6.3.1 A proposed Specification Change Notice shall be used to propose to the specification approving activity the exact change in specification paragraphs, figures or other content that will be distributed to users if the Engineering Change Proposal is approved. The proposed modification in content submitted with the proposed Specification Change Notice may be in the form of specification change pages or as an enclosure on which the proposed changes in sentences, paragraphs, figures and tables, are described.

6.3.2 The Contractor shall not implement any change in the specification until the proposed Specification Change Notice is Approved under an Engineer's Instruction.

6.4 Approved Specification Change Notice

With the agreement of the Engineer, an approved Specification Change Notice shall be issued to all parties concerned to implement and record the required specification change. It shall also provide a summary listing of pages affected by all previously approved changes. Specification Change Notice is not cumulative insofar as transmittal of change pages from previous change is concerned, and changes distributed with previous Specification Change Notice remain in effect unless changed or cancelled by a Specification Change Notice of later issue. However, the summary of current changes is a cumulative summary as of the date of approval of the latest Specification Change Notice.

6.5 Changed pages

Updated and reissued pages shall be complete reprints of pages suitable for incorporation by removal of old pages and insertion of new pages. All portions affected by the change shall be indicated by a symbol in the right hand margin adjacent to the change and encompassing all changed portions. When changed pages are issued for specifications with pages printed on both sides of a sheet, and only the page on one side of a sheet is affected by the change, both sides of the sheet shall be reissued. The unchanged side shall be reprinted without change and shall not carry the date of the change or be included in the change summary as being affected by the change.

6.6 Supersession

When a proposed Specification Change Notice must be revised and resubmitted, the resubmitted Specification Change Notice shall retain the same basic Specification Change Notice number but must be re-identified as a revision to avoid confusion with the original submission.

APPENDIX Q

LIST OF NAMED SUPPLIERS

August 2015

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APPENDIX Q LIST OF NAMED SUPPLIERS

1 The Contractor shall note that the equipment included in this Appendix do not imply the Approval of a specific equipment. It is the responsibility of the Contractor to ensure full compliance with the requirements of the PS for all materials and working practices to be used.

2 The Contractor shall procure the following equipment from the corresponding Named Suppliers :

Item No.	Description	Supplier	Details	PS Reference
1	Train borne Radio Sets (TRS)	CLP Engineering Limited 36/F, Asia Trade Centre, 79 Lei Muk Road, Kwai Chung, New Territories, Hong Kong. Telephone : (852) 2429 0379 Fascimile : (852) 2711 5881 Email : vincechow@clp.com.hk	Contact Person : Mr. Vince Chow Project Manager MTRC Contract No. C3564.A-06E	PS 18.2 and Appendix I Annex 4
2	In-cab Closed Circuit Television (CCTV)	Ogier Electronics Ltd Sandridge Park, Porters Wood, St Albans, Herts AL3 6PH England Telephone : +44 (0)1727 845547 Fascimile : +44 (0)1727 852186 Email : jacqui.robbins@ogierelectronics.com	Contact Person : Ms. Jacqui Robbins Marketing Director MTRC Contract No. : C4062.02	PS 18.3 and Appendix I Annex 4
3	Not used	Not used		Not used

Item No.	Description	Supplier	Details	PS Reference
4	RFID Tags for Train Radio	CLP Engineering Limited 36/F, Asia Trade Centre, 79 Lei Muk Road, Kwai Chung, New Territories, Hong Kong. Telephone : (852) 2429 0379 Fascimile : (852) 2711 5881 Email : vincechow@clp.com.hk	Contact Person : Mr. Vince Chow Project Manager MTRC Contract No. C3564.A-06E	PS18.9 and Appendix I Annex 4
5	RFID Tags and System Reconfiguration for RFID Axle Box Temperature Detection System	Shenzhen Aerospace Innotech Corporation Limited Add: F9, Block D, SZAAT Building, 10th Road Kejinan,Hi-Tech Park, Nanshan District, Shenzhen City, Guangdong, China. Postcode: 518057 Telephone : 0086-755-26727072 ext 8005 Fascimile : 0086-755-2672 7070 E-mail: sales@htrfid.com		PS18.10 and Appendix I Annex 4

MTR CORPORATION LIMITED

CONTRACT C6014-14E

PROCUREMENT OF NEW TRAINS

Particular Specification

Volume 3 of 4

August 2015

MTR CORPORATION LIMITED

CONTRACT C6014-14E

PROCUREMENT OF NEW TRAINS

PARTICULAR SPECIFICATION

WORKING DOCUMENT

VOLUME 3 OF 4

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CONTRACT C6014-14E
PROCUREMENT OF NEW TRAINS
PARTICULAR SPECIFICATION
WORKING DOCUMENT

CONTENTS

[VOLUME 1 OF 4]

Section 1: Introduction

Section 2: Definitions and Abbreviations

Section 3: Scope of the Works

Section 4: System Description and Performance Requirements

Section 5: Infrastructure Constraints

Section 6: Car Body Structure and Exterior

Section 7: Interior of Car Body

Section 8: Cab Facilities and Layout

Section 9: Operation and Control

Section 10: Train Management System

Section 11: Traction and Braking Equipment

Section 12: Bogies and Suspensions

Section 13: Pneumatics and Air Distribution Systems

Section 14: Gangways and Couplers

Section 15: Air Conditioning and Ventilation

Section 16: Doors

Section 17: Auxiliary Electrical Supply

[VOLUME 1 OF 4 (CONT'D)]

Section 18: Communications

Section 19: Not Used

Section 20: Materials and Workmanship Requirements

Section 21: Design Requirements

Section 22: Testing Requirements

Section 23: Training Requirements

Section 24: Spare Parts, Special Tools and Test Equipment

Section 25: System Assurance

Section 26: Maintenance Requirements

Section 27: Quality Management

Section 28: Environmental Requirements

Section 29: Programme

Section 30: Site Arrangements

Section 31: Interface Arrangements

Section 32: Attendance

[VOLUME 2 OF 4]

APPENDICES

Appendix A: Schedules of Drawings

Appendix B: Codes and Standards

Appendix C: Schedule of Tests

Appendix D: Not Used

Appendix E: Schedule of Delivery

Appendix F: Engineer's Preliminary Programme, Project Calendar, Schedule of Critical Dates and Schedule of Key Dates

Appendix G: Site Layout and Works Areas

Appendix H: Rules and Procedures for Working Within or Adjacent to the Railway

- Annex 1 P-Licensing System - Caring and Coaching System for New Contractor Workers
- Annex 2 Contractor Fitness for Duty Management

Appendix I: Designated Contracts and Interfacing Systems

- Annex 1 P-way Interface (Track Data)
- Annex 2 Overhead Line/ Traction Power Supply System Interfaces
- Annex 3 ATC Interfaces
- Annex 4 Communications Interfaces
- Annex 5 Platform Screen Door Interfaces
- Annex 6 Depot Interfaces
- Annex 7 Electric Vehicle Interfaces
- Annex 8 Not Used
- Annex 9 Dynamic Route Map Interfaces
- Annex 10 Cab Simulator System Coordination

Appendix J: Not Used

Appendix K: Not Used

Appendix L: Interior Styling Schedule

[VOLUME 2 OF 4 (CONT'D)]

Appendix M: Life Cycle Cost

Appendix N: Design Data

Appendix O: Delivery of Equipment

Appendix P: Configuration Control Programme

Appendix Q: List of Named Suppliers

[VOLUME 3 OF 4]

ROLLING STOCK STANDARDS

RS/C6014/01:	Data Transmission and Management
RS/C6014/02:	Constructional and Workmanship Requirements
RS/C6014/03:	Electrical and Design Requirements
RS/C6014/04:	Electromagnetic Compatibility
RS/C6014/05:	Software
RS/C6014/06:	Cables
RS/C6014/07:	Pneumatic Equipment
RS/C6014/08:	Fire Performance
RS/C6014/09:	Wheelsets
RS/C6014/10:	Pantograph
RS/C6014/11:	Battery
RS/C6014/12:	Operation and Maintenance Manual
RS/C6014/13:	Noise Performance and Measurement
RS/C6014/14:	Operability Design Guidelines
RS/C6014/15:	Keys and Locks
RS/C6014/16:	LED Lighting Standard

[VOLUME 4 OF 4]

Drawings

ROLLING STOCK STANDARD RS/C6014/01
DATA TRANSMISSION AND MANAGEMENT

1 Introduction

2 Standards

3 Definitions and Abbreviations

4 General Requirements

5 Conceptual Architecture of TMS

6 Train Communication Network (TCN)

7 Central Processing Unit (CPU)

8 Local Processing Unit (LPU)

9 Event Recorder

10 ATC / Comms Gateway

11 Interface with ATC

12 Passenger Information System (PIS)

13 Not used

14 Not used

15 Real Time Protocol and Interface

16 Loading

17 Resource Spare Capability

18 Data Management

19 Testing Requirements

20 Maintenance Requirements

21 System Engineering Management System

Table STD01-1 Not used

Table STD01-2 Not used

Table STD01-3 Not used

Table STD01-4 Not used

Table STD01-5 Not used

Table STD01-6 Not used

Table STD01-7 Not used

Table STD01-8 Not used

ROLLING STOCK STANDARD RS/C6014/01
DATA TRANSMISSION AND MANAGEMENT

1 Introduction

1.1 This Standard specifies the conceptual architecture of the Train Management System (TMS) (refer to PS 10). It also specifies the TMS data transmission and management requirements together with the TMS interface with other train subsystems.

2 Standards

2.1 International Standards

EIA RS-232C: 1969	Electronic Industries Association standard for interface between data terminal equipment and data communication equipment employing serial binary data interchange
EIA RS-485: 1983	Electronic Industries Association standard for electrical characteristics of generators and receivers for use in balanced digital multipoint systems
ISO 7498-1: 1996	Information Processing Systems - Open Systems Interconnection - Basic Reference Model
ISO 9646-1: 1996	Information Technology - Open Systems Interconnection - Conformance testing methodology and framework Part 1: General Concepts

3 Definitions and Abbreviations

3.1 Definitions

Not used.

3.2 Abbreviations

The following abbreviations are used in this Standard:

OCC	Operations Control Centre
OSI	Open System International
ATC	Automatic Train Control
CPU	Central Processing Unit
DCU	Display Control Unit
EDD	Electronic Destination Display
EIDS	Electronic Information Display System
EMC	Electromagnetic Compatibility
DRM	Dynamic Route Map
LAN	Local Area Network
LPU	Local Processing Unit
MMI	Man Machine Interface
PIS	Passenger Information System
SEMP	System Engineering Management Plan
TCN	Train Communication Network
TMS	Train Management System

4 General Requirements

4.1 The TMS shall be equipped with a Train Communication Network (TCN) which provides a data communication service for connecting trainborne systems and devices. It shall enable the transfer of information, commands and signals among the trainborne systems and devices.

4.2 The TMS shall be supplied by the primary DC circuit via the D2 wire (refer to PS 17.4.1(d)) and shall remain fully operational in case of loss of traction or auxiliary power supply (refer to PS 17.1.4). The TMS shall be designed and constructed such that minimum power is drawn from the battery (via the D2 wire) when the traction or auxiliary power is lost in the event of failure or when all pantographs are lowered.

4.3 The TCN shall be designed and constructed to ensure that all the performance requirements of the TMS as stipulated in PS 10 are achieved.

4.4 The TMS and the TCN shall conform to the EMC requirements as stipulated in RS/C6014/04.

4.5 All software of the TMS and the TCN shall conform to the requirements as stipulated in RS/C6014/05.

4.6 TMS Initialisation

4.6.1 Initialisation of the TMS shall be started automatically when the train operator presses and releases the Auxiliary On pushbutton (refer to PS 8.10) either in the driving cab or hostler cab.

4.6.2 Initialisation shall consist of two parts, the TCN initialisation (refer to clause 6.2) and the train systems initialisation (refer to clause 4.6.3). The TCN initialisation shall be completed within the time as stipulated in PS 10.2.1 for start of data communication service. The train systems initialisation shall be completed within the time as stipulated in PS 10.2.1 for acquiring the healthy status of all the train subsystems, driving cab controls and hostler cab controls under TMS monitoring.

4.6.3 The train systems initialisation shall be started in parallel with the TCN initialisation. When Auxiliary On pushbutton is pressed, the pantographs shall be raised to energise the auxiliary system. Static function and sequence testing for all trainborne systems, driving cab controls and hostler cab controls shall be initiated to verify correct functions.

4.6.4 During TCN and train systems initialisation, the display terminal (refer to PS 10.8.2) shall display a message indicating that TMS initialisation is in progress and no user operation / command shall be accepted.

5 Conceptual Architecture of TMS

5.1 The conceptual architecture of the TMS is illustrated in Drg. No. C6014-14E/TSEG/497/001. The TMS shall consist of, as a minimum, the following equipment:

(a) a TCN with a two-level bus hierarchy structure
(b) dual redundant Central Processing Units (CPU) with real time clocks in each A car (refer to PS 4.5.1)
(c) a Local Processing Unit (LPU) in each car
(d) an Event Recorder in the middle unit i.e. BC car (refer to PS 4.5.1)
(e) a display terminal with touch screen as input device in each A car (refer to PS 4.5.1), integrated in the driving console (refer to PS 8)
(f) an ATC / Comms Gateway in each A car

5.2 The Contractor may propose an alternative TMS architecture for Approval.

6 Train Communication Network (TCN)

6.1 The TCN shall be based on a two-level bus hierarchy structure consisting of a Train Bus (refer to clause 6.3) and Vehicle Bus (refer to clause 6.4). Train Bus and Vehicle Bus shall be connected via a Gateway (refer to clause 6.5).

6.2 TCN Initialisation

6.2.1 The TCN initialisation shall be started once the conditions as described in clause 4.6.1 have occurred. No train operator intervention is required during the initialisation process.

6.2.2 The TCN shall first check the healthy status of all the TCN equipment including Train Bus, Vehicle Buses, ATC / Comms Gateways, Gateways, CPU's with real time clock, LPU's, display terminal, Event Recorder and Control Interface Units. All equipment failures shall be logged, displayed on the display terminal and reported to the train operator.

6.2.3 The TCN shall then configure itself automatically under the control of the master CPU (refer to clause 7.3) for identifying each car and individually addressing each connected device. All connected devices shall receive a unique address identifying its position and orientation (left/right, front/rear) with respect to the master CPU as well as the address of all other devices on the TCN.

6.2.4 Once the initialization process is completed, data communication service shall be started and data shall be able to be transferred among any connected devices.

6.2.5 Default operating and control parameters / values and recording schemes of the Event Recorder shall be transmitted to each train subsystems. These default operating parameters / values shall be able to be viewed, edited and changed by maintenance staff when the TMS is in the Maintenance Mode (refer to clause 18.9). The default operating and control parameters / values shall set all train subsystems / devices in the safe state (for example brakes to be applied and doors closed).

6.2.6 The train consist will be uncoupled / coupled from time to time by maintenance staff. The TCN shall be able to maintain correct operation of both the Train Bus and Vehicle Bus on all uncoupled units. This may be achieved by automatic or manual operation of switches, insertion of matching resistors or other methods. Once uncoupling / coupling is completed, the TCN shall re-configure itself automatically (with new addresses available to all connected devices) to enable the data communication service. The train consist as recognized by the TCN shall be displayed in the display terminal under all conditions including the coupling / uncoupling process.

6.3 Train Bus

6.3.1 Dedicated screened coaxial cables shall be used for the Train Bus. Fibre optic cable or a shielded twisted cable may be proposed as an alternative.

6.3.2 The Train Bus shall be able to transmit data at a minimum baud rate of 1.0 Mbits/sec.

6.3.3 The Train Bus shall transmit signals on the dedicated train line wires through the length of the train and across the electrical contacts of the electrical connection boxes of the automatic couplers and the semipermanent bar couplers.

6.3.4 The Train Bus shall be provided in a dual redundant configuration. The data on the two lines of the Train Bus shall be continuously monitored and shall be identical. In case of failure of one line, data shall still be able to be transmitted and received via the operational line. The faulty wire shall be detected and reported to the master CPU.

6.4 Vehicle Bus

6.4.1 Dedicated screened coaxial cables shall be used for the Vehicle Bus. Fibre optic cable or a shielded twisted cable may be proposed as an alternative.

6.4.2 The Vehicle Bus shall be able to transmit data at a minimum baud rate of 1.0 Mbits/sec.

6.4.3 More than one car shall be able to be connected together to form a logical unit to share the same Vehicle Bus. To reduce the number of gateways and maximise the performance of the network, the Vehicle Bus shall have the ability to span over three cars by means of jumper cables in order to form a logical unit.

6.4.4 The jumper cables and the associated connectors shall be adequately rated and protected in accordance with RS/C6014/02 and RS/C6014/03.

6.4.5 The Vehicle Bus shall be provided in a dual redundant configuration. The data on the two lines of the Vehicle Bus shall be continuously monitored and shall be identical. In case of failure of one line, data shall still be able to be transmitted and received via the operational line. The faulty wire shall be detected and reported to the master CPU.

6.5 Gateway

6.5.1 The Gateway shall be provided on a train unit basis (refer to PS 4.5.1(b)) to connect the Train Bus and Vehicle Buses for facilitating data exchange

between these two levels of data buses.

6.5.2 Consideration shall be given to reduce the bandwidth requirement of the Train Bus. Only information required throughout the train shall be passed from the Vehicle Buses to the Train Bus.

6.6 Fault Tolerance

The TCN shall be designed and constructed such that correct operation of it shall be maintained regardless of the health of the equipment connected to it. Failure of a piece of equipment shall not prevent unrelated equipment from normal working. This shall apply to the following scenarios:

(a) occasional corruption or loss of data
(b) Train Bus and Vehicle Buses interruption or short circuit
(c) denied access to Train Bus and Vehicle Buses
(d) configuration error
(e) loss and reintegration of network nodes

7 Central Processing Unit (CPU)

7.1 Dual redundant CPU's shall be provided in each A car which shall execute the application program and for the overall control and administration of the TMS.

7.2 The two CPU's shall be arranged in hot standby configuration - with one as the online unit and the other as hot standby. A hardware watchdog facility shall be provided to enable detection of faulty CPU. On detection of the online CPU as faulty, the hot standby CPU shall automatically take over the control and become the online CPU. The TMS shall be fully operational after the switch over and disruption of data communication service shall be less than 500 msec.

7.3 The master CPU of the TCN during initialization shall be the online CPU in the odd numbered A car (refer to PS 4.5.1(b)) under all TMS initialization conditions (refer to clause 4.6.1). In case the even numbered A car is opened up by the train operator, the master CPU of the TCN shall again be the odd numbered A car online CPU during the TMS initialization process. On completion of the TMS initialization process, the master CPU of the TCN shall be switched back to the even numbered A car online CPU with only the TCN initialization repeated during the switching.

7.4 After TMS initialization, the active cab will be switched from time to time between the odd numbered and even numbered A cars. The master CPU of TCN shall be switched accordingly such that the on line CPU of the active cab shall always be the master CPU of TCN. Only reconfiguration of the TCN is required during the switching and the train systems initialization shall not be triggered.

7.5 The CPU's in the non-active cab shall act as backup to the CPU's in the active cab. In the event of failure of both the CPU's in the active cab, the CPU's in the nonactive cab shall automatically take over the control and maintain all the TMS functions.

7.6 The online CPU shall interface with the display terminal for operation of the MMI (refer to PS 10.8) in providing information display and receipt of operator commands.

7.7 The design of the CPU's shall ensure that the performance of memory size, real time processing capability, real time response, reliability and ease of programming are optimised.

7.8 Real Time Clock

7.8.1 Each CPU shall be provided with a real time clock. The real time clock of the master CPU of TCN shall act as the System Master Clock for the TMS and synchronize all the TCN equipment and all connected devices / train subsystems.

7.8.2 The System Master Clock shall synchronize all the TCN equipment and connected devices / train subsystems time during the TMS initialization process and regularly thereafter.

7.8.3 Not used.

8 Local Processing Unit (LPU)

8.1 A LPU shall be provided in each car which shall interface with various devices and intelligent train subsystems in order to enable the data communication service.

8.2 The location for mounting the LPU shall be carefully selected in order to facilitate easy access for maintenance and minimize the wiring works between the devices and train subsystems and the LPU.

8.3 To reduce the complexity of the LPU, the LPU and connected devices / train subsystems shall be designed and constructed such that peer to peer communication between devices / train subsystems on the same car shall not be required to be routed through the LPU as far as practicable.

8.4 Failure of any LPU shall not cause any global loss of the TMS functionality.

9 Event Recorder

9.1 The Event Recorder shall record faults detected in the train, vital operational signals and equipment performance parameters.

9.2 The Event Recorder shall be able to be configured to apply different recording schemes for the three different types of data as stipulated in clauses 9.3 to 9.5.

9.3 Faults Detected

9.3.1 The condition under which a fault is detected shall be recorded together with the fault to assist the analysis of the failure. The parameters to be recorded shall include:

(a) Fault type
(b) Car number
(c) Date and time the fault is detected
(d) Station name
(e) Line number
(f) Train speed
(g) Date and time the fault is cleared

9.3.2 The Event Recorder shall also be able to record other digital and analogue data which shall assist the fault analysis. The list of data to be recorded shall be optimised for each fault.

9.3.3 Features shall be provided to prevent the repeated recording of a permanent failure on the train to avoid memory overflow. This shall include overwriting the previous faults recorded based on a first-in-firstout principle, stop recording when memory is full or to record the first and the last few occurrences of the same fault only.

9.4 Vital Operational Signals

9.4.1 Vital operational signals shall be continuously monitored by the TMS and recorded by the Event Recorder. The list of vital operational signals shall be subject to Approval.

9.4.2 The recording of vital operational signals shall be triggered by the change of the signals to minimise memory requirement. Digital data shall be recorded when there is a change in status. Analogue data shall be recorded when the change of data is above a pre-defined value.

9.5 Equipment Performance Parameters

9.5.1 Equipment performance parameters selected via the TMS display terminal (refer to clause 9.6 below) which reflect the condition of the equipment shall be recorded by the Event Recorder.

9.5.2 Only the latest sample of performance parameters shall be recorded and shall cover at least 200 samples or the latest 30 minutes data for each selected parameter.

9.5.3 The sample size shall be adjustable for each selected parameter.

9.6 Configuration of the Event Recorder shall be able to be performed remotely via the TMS display terminal when the TMS is in the Maintenance Mode (refer to clause 18.10). The recording schemes for each of the three different types of data as stipulated in clauses 9.3 to 9.5 shall be able to be changed via the TMS display terminal.

10 ATC / Comms Gateway

10.1 An ATC / Comms Gateway shall be provided in each A car (refer to PS 4.5.1) to interface with the trainborne ATC and Communications equipment. The conceptual architecture of the ATC / Comms interface is illustrated in Drg. No. C6014-14E/TSEG/497/002.

10.2 The ATC / Comms Gateway shall connect the following trainborne equipment to the TCN to enable data communication service:

(a) ATC
(b) DVAS and PA

10.3 The design and construction of the ATC / Comms Gateway shall ensure that the interface requirements of the trainborne ATC (refer to Appendix I Annex 3) and Communications equipment (refer to PS 18 and Appendix I Annex 4) are satisfied

10.4 The ATC / Comms Gateway shall interface with the trainborne ATC via a RS 232 serial link interface (refer to clause 11).

10.5 The ATC / Comms Gateway shall interface with the DVAS and PA via a RS 485 serial link interface.

10.6 The conceptual data flow between ATC, DVAS and PA , EIDS and DRM is illustrated in Drg. No. C6014-14E/TSEG/497/003.

11 Interface with ATC

The TMS shall interface with the existing trainborne ATC system supplied by Siemens under Contract 652. The same communication interface as detailed in Appendix I Annex 3 shall be provided.

12 Passenger Information System (PIS)

12.1 Interface with TMS

The PIS shall obtain the following information from TMS:

12.1.1 Route Code

Route code contains the information of the line and direction in which the train is running. The route code shall include the eight normal service line numbers and the special line numbers due to train service regulation.

12.1.2 Station Code

Station code contains the information of the next station the train will arrive. A new station code shall be received from the TMS when the train leaves the head-wall of each station.

12.1.3 Door Status Code

Door open / close signal contains the information on the status of the door. Doors will be opened when the train stops at a platform, and will be closed when the train is ready for departure.

12.1.4 Destination Code

Destination code contains information of the terminal station the train will arrive. This code shall be received from TMS during initialization of the PIS or re-initialization at any station of the running line due to train service regulation.

12.1.5 Platform Side Code

This code contains the platform side on which the passenger doors will be opened at next station. The data structure shall represent the following four different states, namely, left, right, left and right, and undefined.

12.1.6 DRM On and Off Commands

The DRM on and off commands are used to enable and disable the displays' of the DRM's respectively.

12.1.7 LED Test Command

This command shall initiate the LED test on PIS equipment including EDD and ETND.

12.1.8 Self-Test Command

This command shall initiate the self-test on all DRMs.

12.2 DRM

(a) The DRM shall make use of the information received from the TMS (refer to clause 12.1), DVAS & PA, GSM Modem Assemblies and Doors and display in video format. The details of the display behaviours shall be submitted for approval during detailed design stage.

(b) Message displaying

There shall be five categories of messages to be displayed by the DRM in video format as described in PS 10.4.2 (h).

(c) Message Priority

(i) The display sequence of all categories of messages shall be controlled by the DRM according to the message priority as described in PS 10.4.2 (h). Message of higher priority shall interrupt the message being displayed on the DRM displays with lower priority.

(ii) Any message having been interrupted by higher priority message shall be displayed again after the completion of the higher priority message.

(iii) Messages shall not interrupt the message being displayed on the DRM displays with the same or higher priority. The message shall be displayed after the completion of the current message.

(d) Train Service Regulation Requirement

The design of the DRM shall facilitate the following train service regulation and display the correct route information as soon as new data are received from the TMS.

(i) Change of line during service

The train may change line during the service run. The DRM shall be able to display the correct destination according to the change of the route code.

(ii) Turn short at station

The train may be turned short at some stations. The DRM shall be able to display the destination according to the change of the destination code.

(iii) Time out protection

The time out protection shall be provided as soon as the TMS interface is detected to be fail, the DRM's station and arrow indicators of the route information shall be switched off in order not to show any incorrect information to the passengers. Upon receipt of valid signal from the TMS, the DRM's station and arrow indicators of the route information shall be switched on again and response according to the signal command.

12.3 EDD

The EDD shall display the destinations and special messages according to Drg. No. C6014-14E/TSEG/060/008.

12.4 EIDS

12.4.1 Not used.

12.4.2 Not used.

12.4.3 Not used.

12.4.4 Train Data Network

(a) The EIDS shall use a dedicated Train Data Network to exchange data and information between EIDS Server and EIDS Controllers installed in different cars.

(b) The Train Data Network shall allow transmission of data and information throughout the entire length of train.

(c) The Train Data Network shall be designed to minimise the needs for individual trainline wires and hardwires across couplers. Cat.5e compliant cable shall be employed but fibre optic cable may also be proposed as an alternative.

(d) Any failure of the Train Data Network shall automatically be isolated and shall not affect the operation of the DCU and the interface with the DVAS and PA.

(e) The Contractor shall ensure that the Train Data Network is designed and constructed to meet all the EMC requirements as stipulated in RS/C6014/04.

12.4.5 Interface with DVAS and PA

(a) The EIDS Server shall interface with the DVAS and PA installed in the driving cab via a RS 485 serial link as stipulated in the Attachment App-I-Annex-4 of Appendix I Annex 4.

(b) The Contractor shall provide all necessary cables and connectors according to the detailed cable and connector information as stipulated in the Attachment App-I-Annex-4 of Appendix I Annex 4.

(c) Not used.

(d) The EIDS Server shall receive the above control messages when :

(i) The train door open/close status changes (status of door proving loop circuit PS 9.9.7); or
(ii) The station message button (refer to PS 18.4.17(b)) or repeat button (refer to PS 18.4.17(b)) on the MCP / ACP of the DVAS and PA is pressed; or
(iii) The special message button (refer to PS 18.4.17(b)) on the MCP of the DVAS and PA is pressed; or
(iv) The emergency message button (refer to PS 18.4.17(b)) on the MCP of the DVAS and PA is pressed.
(v) The front emergency door (refer to PS 18.4.13(j)) is required for detrainment of passengers.

For the cases (iii) & (iv), the message code shall be reset to "20 HEX" after transmitting the message code to the EIDS Server for 5 seconds.

(e) Not used.

(f) The EIDS Server shall get the next transmission update either by pressing the station message / special message / emergency message buttons or when the train door status changes or when the front emergency door is required for detrainment.

(g) Communication Protocol

The Contractor shall conduct exhaustive study and investigation to verify the correctness of the protocol (Refer to Attachment App-I-Annex-4 of Appendix I Annex 4) provided by the Employer in order to develop the interface to fulfill the requirements of this specification.

(h) The interface between the DVAS and PA and the EIDS Server shall be designed such that normal operation of the DVAS and PA shall not be affected by failure of the connected EIDS Server and vice versa.

12.4.6 Interface with EID Panel

(a) The EIDS Controller shall interface with the EID Panel via a RS 485 serial link as stipulated in the Attachment App-I-Annex-4 of Appendix I Annex 4.

(b) The Contractor shall provide all necessary cables and connectors according to the detailed cable and connector information as stipulated in the Attachment App-I-Annex-4 of Appendix I Annex 4.

(c) Communication Protocol

The Contractor shall conduct exhaustive study and investigation to verify the correctness of the protocol (Refer to Attachment App-I-Annex-4 of Appendix I Annex 4) provided by the Employer in order to develop the interface to fulfill the requirements of this specification.

13 Not used.

14 Not used.

15 Real Time Protocol and Interface

15.1 The TMS shall employ a non-proprietary and industrially proven real time operating system and networking protocol to ensure that the requirements as stipulated in this Standard and PS 10 are fully satisfied.

15.2 The TCN functions shall be layered with reference to the OSI 7-layer model for networks defined in ISO 7498-1. It is accepted that not all layers shall be used or fully implemented but development and enhancement at any one layer shall be accomplished without modification being required to any other layers.

15.3 Network protocol employing either deterministic or non-deterministic medium access control method may be adopted for the Train Bus and Vehicle Bus.

15.4 A minimum number of network protocols shall be adopted and shall work cooperatively with each other in the sense that minimum conversion overhead is required.

15.5 An error checking mechanism (employing cyclic redundancy check sum for each data package, byte truncation and data field length check) shall be adopted to ensure that errors introduced during transmission shall be detected and shall not affect the result of the application using the data. Erroneous messages shall be

automatically filtered out and discarded without propagating in the TCN.

15.6 Any erroneous message shall not cause any train subsystems / equipment to be in an unsafe state.

15.7 The Contractor shall submit for Approval calculations and quantitative analysis of the network traffic and the delay-throughput characteristics to demonstrate full compliance with the requirements.

15.8 The Contractor shall provide detailed justification on the choice of network protocols based on the requirements as stipulated in this Standard and PS 10.

15.9 Interface with LPU

15.9.1 It is preferred that each train sub-system except the ATC/Comms and the DRM interface to be connected to the TMS shall possess network intelligence such that they can be directly connected to the Vehicle Bus without routing through the LPU. The ATC / Comms and DRM interface shall still possess network intelligence. The ATC / Comms shall be connected to the TMS via the ATC / Comms Gateway while the DRM's shall be connected to the TMS LPU via multi-drop RS 485 interface.

15.9.2 Multi-drop interface of RS 485 may be used as alternative to connect the train sub-system to the LPU.

16 Loading

16.1 Processor Loading

For all CPU's, LPU's, ATC / Comms Gateways, Gateways and Control Interface, the processor loading shall not exceed the following figures :

(a) Processor loading not exceeding mean - 50% of the processor time
(b) Processor loading not exceeding peak - 80% of the processor time

16.2 TCN

For the TCN, the loading of the networks shall not exceed the following figures:

(a) Network loading not exceeding mean - 40% of the network time
(b) Network loading not exceeding peak - 60% of the network time

17 Resource Spare Capability

17.1 Memory and Input/Output Facilities

A minimum of 20% spare capacity of processing power and memory storage shall be provided in each CPU, LPU, ATC / Comms Gateway, Gateway and Control Interface.

17.2 The minimum spare capacities for input and output shall be as shown in the table below:

Input and Output Facilities	Minimum Spare Capacities
Digital Inputs	10 DC inputs per Car 1 AC input per Car
Analogue Inputs	2 DC inputs per Car
Digital Outputs	2 DC output per Car
Serial Interface	2 RS485 port with at least 50% spare communication capacity per car
Network Interface	1 spare Vehicle Bus port per each car 1 spare Train Bus port per each A car

18 Data Management

18.1 The TCN shall cater for the following two different types of data:

18.1.1 Process data which consist of frequent, time-critical but short duration data (for example traction test control data)

18.1.2 Message data which consist of less urgent but possibly lengthy data (for example logging)

18.2 The TCN shall support the transmission of the two types of data by offering the following data transmission service:

18.2.1 Periodic data transmission which transmits data at a regular interval

18.2.2 Sporadic data transmission which transmits data on request or when triggered by an event

18.3 Periodic Data Transmission

18.3.1 Periodic data transmission service shall occupy a fixed portion of the basic bus activity period. During this period, process data which are critical shall be transmitted.

18.3.2 The transmission shall be processed without a check back to avoid delay in receiving acknowledgement from receivers.

18.3.3 Freshness supervision by the master CPU shall be employed to avoid operating with obsolete data as a result of equipment failure. When a specified time has expired, a flag associated with this process data shall be set to indicate that it has not been refreshed within the allowable time period and the data shall be regarded as invalid.

18.3.4 Error recovery is inherent due to the cyclic transmission of data. A lost sample shall be refreshed in next transmission. The safety of transmission shall be guaranteed by this cyclic transmission and the cyclic redundancy check sum (refer to clause 15.5) associated with each package of process data.

18.4 Sporadic Data Transmission

18.4.1 Sporadic data transmission service shall occupy the remaining portion of the basic bus activity period. It shall transmit message data, if there is any, which is less urgent.

18.4.2 The transmission shall be processed with check back by the receiving unit to ensure a reliable transmission.

18.4.3 In the event that the sporadic data transmission service is used for transmitting safety related control signals (refer to PS 9.9), a higher priority shall be assigned which ensures that they are transmitted in advance of other lower priority data.

18.5 The Contractor shall submit calculations and quantitative analysis for Approval to demonstrate that the allocation of periodic and sporadic data transmission is appropriate in delivering the required performance.

18.6 Fault / Logging Data Management

18.6.1 Local memory shall be provided for each train subsystems to store all event logging and detected faults (refer to PS 10.3.6).

18.6.2 Only those faults that are required to be acknowledged by the operator or displayed on the TMS display terminal shall be transmitted. Also, data that is required to be stored in the Event Recorder shall also be transmitted.

18.6.3 Copies of each of the detected faults shall be transmitted from the TMS to the OCC in accordance with PS 10.3.6.

18.7 To cater for different operating scenarios, the TMS shall operate in the following three modes:

(a) Operator Mode
(b) Maintenance Mode

18.8 Operator Mode

18.8.1 This is the default operating mode of the TMS when train coupling / uncoupling is not required and data download / upload with the testing equipment of TMS (refer to PS 24.3.9 (f)) is not required.

18.8.2 The periodic and sporadic data transmission services shall be maintained as per the designed condition for normal passenger service.

18.9 Maintenance Mode

18.9.1 This mode shall be password protected and can only be initiated by authorised maintenance staff.

18.9.2 The maintenance staff shall be able to view and change all the available operating and control parameters of each train subsystems and the recording schemes of the Event Recorder.

18.9.3 The maintenance staff shall also be able to edit and change the TCN configuration and settings in this mode.

18.10 Data Format

18.10.1 Data shall be transmitted and stored in binary format in the TMS to enhance the storage and transmission efficiency.

18.10.2 Conversion software shall be provided in both the TMS and the maintenance terminal to allow the conversion of binary data into commercially available spreadsheet or database format including Microsoft Excel and Access.

19 Testing Requirements

19.1 The Contractor shall perform comprehensive testings on the TCN and TMS to demonstrate full compliance with the Specification. The Contractor shall make reference to ISO 9646-1 in preparing the test specification and test coverage.

19.2 The following, as a minimum, shall be tested:

19.2.1 TCN network performance including the real time network protocol, network traffic and throughput, loading and resource spare capability

19.2.2 Each TCN equipment functional and performance requirements including Vehicle Buses, Train Bus, CPU, LPU, Gateway, ATC / Comms Gateway, Event Recorder and Control Interface

19.2.3 All data transmission services and modes of Data Management

19.3 A three stage testing strategy shall be adopted to verify and validate the TMS functionalities:

19.3.1 Prototype Test

(a) Prototype test shall be conducted prior to the commencement of SEMP Stage 4.

(b) A complete set of real TCN equipment shall be set up to establish a simulated TMS to verify the functions and performance of the TCN as stipulated in PS 10 and this Standard.

(c) Train subsystems shall be simulated to provide the same data input / output characteristics as the real equipment. The number of simulated train subsystems shall be the same as the real train to simulate the actual traffic conditions.

19.3.2 TMS System Integration Test

(a) TMS system integration test shall be conducted by the end of SEMP Stage 3.

(b) A complete set of real TCN equipment and a complete set of real train subsystems interfacing equipment shall be set up to verify the functions and performance of the TMS as stipulated in PS 10 and this Standard. The number of train subsystems interfacing equipment to be connected shall be the same as the real train.

19.3.3 TMS Vehicle Level Test

(a) TMS vehicle level test shall be conducted by the end of SEMP Stage 4.

(b) Tests conducted during TMS system integration test shall be repeated on a complete train fitted with all the TCN equipment and all train subsystems to verify the functions and performance of the real TMS as stipulated in PS 10 and this Standard.

20 Maintenance Requirements

20.1 A maintenance port employing either RS 232 or RS485 serial interface shall be provided for each TCN equipment including CPU, LPU, Gateway, ATC / Comms Gateway, Event Recorder and Control Interface and each microprocessor based train subsystems interfaced with the TMS. These maintenance ports shall enable

connection with the maintenance terminal (refer to clause 20.2 below) to provide the following maintenance functions:

20.1.1 downloading of fault logs (all types of fault detected including critical fault, operating event, maintenance event, record and notice (refer to PS 10.3.6(b)) and historical operation data in either binary format or in commercial spreadsheet or database format (Microsoft Excel or Access) after conversion by the conversion software

20.1.2 adjustment of operating and control parameters

20.1.3 fault diagnosis of equipment for identification of the faulty part down to the LRU level (refer to PS 26.2.5)

20.2 The maintenance terminal shall be in the form of a portable notebook computer (PC) (refer to PS 24.3.11) and shall be able to be connected to each of the equipment as stipulated in Clause 20.1 above.

20.3 Protocol analysis software shall be provided in the maintenance terminal to allow it to function as a protocol analyzer that can:

20.3.1 analyze the Train Bus and Vehicle Buses traffic including data throughput and data transmission failure rate

20.3.2 analyze the data exchange on any selected interface connection on the TCN (for example analyze traffic between LPU and Gateway, between LPU and Control Interface) with detailed information on the timing, sequence and content of data sent and received

21 System Engineering Management System

21.1 SEMP Stage 1

The Contractor shall prepare and submit the following for Approval during SEMP Stage 1:

21.1.1 The overall architecture of the TMS including Train Bus, Vehicle Buses, CPU, LPU, Gateway, ATC / Comms Gateway, Event Recorder and Control Interface

21.1.2 The real time operating system and network protocol to be adopted together with their predicted performance and high level functionality

21.1.3 A high level data management document that list all the predicted network traffic and their volume under all operating scenarios

21.1.4 The predicted resource spare capacity for all the equipment

21.1.5 Detailed design specifications of all hardware and software interfaces with subsystems connecting to the TMS

21.2 SEMP Stage 2

The Contractor shall prepare and submit the following for Approval during SEMP Stage 2:

21.2.1 Calculation and quantitative analysis of the network traffic and the delay-throughput characteristics for each type of data transmission service (periodic and sporadic data transmission

21.2.2 A detailed data management strategy document that list all the predicted network traffic together with their assigned data transmission service and priority

21.2.3 A MMI prototype with a description document and simulation program to allow the operator to explore its operability

21.2.4 A detailed questionnaire on the prototype MMI for collecting feedback of operators and then perform all necessary changes to the MMI based on the collected feedback

21.3 SEMP Stage 3

The Contractor shall prepare and submit the following for Approval during SEMP Stage 3:

21.3.1 Test specifications for the three stage testing (refer to clause 19.3) to demonstrate the full compliance with the specification

21.3.2 Test reports for the prototype test and TMS system integration test

21.3.3 MMI with description document and simulation program for final verification

21.4 SEMP Stage 4

The Contractor shall prepare and submit the test report for the TMS vehicle level test for Approval during SEMP Stage 4.

21.5 SEMP Stage 5

The Contractor shall consolidate into a single document all the testing results, calculations, theoretical analysis and design studies to demonstrate the full

compliance with the Specification and submit the document for Approval during SEMP Stage 5.

Table STD01-1 Not used

Table STD01-2 Not used

Table STD01-3 Not used

Table STD01-4 Not used

Table STD01-5 Not used

Table STD01-6 Not used

Table STD01-7 Not used

Table STD01-8 Not used

ROLLING STOCK STANDARD RS/C6014/02
CONSTRUCTIONAL AND WORKMANSHIP REQUIREMENTS

1 Introduction

2 Standards/Reference

3 Definitions

4 General Requirements

5 Interchangeability

6 Bolted Joints and Fasteners

7 Welding

8 Labels and Rating Plates

9 Bearings and Pivots

10 Mountings and Enclosures

11 Pneumatic Systems

12 General Material Specification

13 Cable

14 Cable Joints and Connections

15 Cable Enclosure

16 Conduit, Trunking and Ducting

17 Cable Runs

18 Insulators and Insulating Panels and Boards

19 Circuits and Earthing

20 Circuit Diagrams

21 Auxiliary Contacts

22 Power Contacts

23 Rotating Electrical Machines

24 Coils and Windings

25 Plugs and Plug-in Components

26 Relays and Contactors

27 Low Voltage Components

28 Protection Devices

29 Resistors

30 Capacitors

31 Instruments

32 Electronic Equipment

33 Health and Safety Requirements for Construction Works

34 Testing Requirements

35 System Engineering Management System

36 Paint Performance

ROLLING STOCK STANDARD RS/C6014/02
CONSTRUCTIONAL AND WORKMANSHIP REQUIREMENTS

1 Introduction

1.1 This Standard covers constructional details and workmanship requirements for the train system.

1.2 The standards and practices detailed in this Standard shall be observed as the minimum standards which are acceptable to the Engineer.

1.3 The Contractor may offer alternative standards which are equivalent to or better than those herein, and which the Contractor shall justify to the satisfaction of the Engineer.

1.4 The Contractor shall adopt the up-to-date best practice and workmanship to execute the Works to the highest standards and to the satisfaction of the Engineer.

2 Standards/Reference

IEC 60051 Part 1 to 9	Direct acting indicating analogue electrical measuring instruments and their accessories
IEC 60077-1: 1999	Railway applications - Electric equipment for rolling stock - Part 1: General service conditions and general rules
IEC 60077-2: 1999	Railway applications - Electric equipment for rolling stock - Part 2: Electrotechnical components - General rules
IEC 60077-3: 2001	Railway applications - Electric equipment for rolling stock - Part 3: Electrotechnical components - Rules for d.c. circuit-breakers
IEC 60077-4: 2003	Railway applications - Electric equipment for rolling stock - Part 4: Electrotechnical components - Rules for AC circuit-breakers
IEC 60077-5: 2003	Railway applications - Electric equipment for rolling stock - Part 5: Electrotechnical components - Rules for HV fuses

IEC 60269-1: 2006	Low Voltage Fuses – Part 1: General requirements
IEC 60269-2: 2006	Low Voltage Fuses – Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) - Examples of standardized systems of fuses A to I
IEC 60322: 2001	Railway applications - Electric equipment for rolling stock - Rules for power resistors of open construction
BS EN 60349-1: 2010	Electric traction - Rotating electrical machines for rail and road vehicles - Part 1: Machines other than electronic convertor-fed alternating current motors
BS EN 60349-2: 2010	Electric traction - Rotating electrical machines for rail and road vehicles - Part 2: Electronic convertor-fed alternating current motors
IEC 60529: 2001	Specification for Classification of Degrees of Protection Provided by Enclosures
IEC 60947-1: 2007	Low-voltage switchgear and controlgear - Part 1: General rules
IEC 60947-2: 2001	Low-voltage switchgear and controlgear - Part 2: Circuit-breakers
IEC 61082-1: 2006	Preparation of documents used in electrotechnology – Part 1: Rules
BS 2572:1995	Specification for phenolic laminated sheet and epoxy cotton fabric laminated sheet
BS 2618: 1975	Specification for Electric Traction Equipment
BS 3692: 2014	ISO metric precision hexagon bolts, screws and nuts.
BS 4174: 1972	Self tapping screws and metallic drive screws
BS 4183: 1967	Machine screws and machine screw nuts. Metric Series

BS 4568-1: 1970	Specification for steel conduit and fittings with metric threads of ISO form for electrical installations. Steel conduit, bends and couplers
BS EN ISO 7010: 2012	Graphical symbols - Safety colours and safety signs - Registered safety signs
BS 7608: 2014	Guide to fatigue design and assessment of steel products
BS 7671: 2001	Requirements for electrical installations. IEE Wiring Regulations. Sixteenth edition
BS 8118: Part 1: 1991	Structural use of aluminium: Part 1: Code of practice for design
BS 9000 Part 1 to Part 3	General requirements for a system for electronic components of assessed quality.
BS EN 1011-1: 2009	Welding – Recommendations for welding of metallic materials - Part 1: General guidance for arc welding
BS EN 1011-2: 2001	Welding – Recommendations for welding of metallic materials - Part 2: Arc welding of ferritic steels
BS EN 1011-3: 2000	Welding – Recommendations for welding of metallic materials - Part 3: Arc welding of stainless steels
BS EN 1011-4: 2000	Welding – Recommendations for welding of metallic materials - Part 4: Arc welding of aluminium and aluminium alloys
BS EN ISO 15607: 2003	Specification and qualification of welding procedures for metallic materials – General rules
BS EN ISO 15609-1: 2004	Specification and qualification of welding procedures for metallic materials – Welding procedure specification – Part 1: Arc welding
BS EN ISO 15609-2: 2001	Specification and qualification of welding procedures for metallic materials – Welding procedure specification – Part 2: Gas welding

BS EN ISO 15609-5: 2011	Specification and qualification of welding procedures for metallic materials – Welding procedure specification – Part 5: Resistance welding
BS EN ISO 15614-1: 2004	Specification and qualification of welding procedures for metallic materials – Welding procedure test – Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys
BS EN ISO 15614-2: 2005	Specification and qualification of welding procedures for metallic materials – Welding procedure test – Part 2: Arc welding of aluminium and its alloys
BS EN ISO 15614-12: 2014	Specification and qualification of welding procedures for metallic materials – Welding procedure test – Part 12: Spot, seam and projection welding
BS EN 287-1: 2011	Qualification test of welders – Fusion welding – Part 1: Steels
BS EN ISO 9606-2: 2004	Qualification test of welders – Fusion welding – Part 2: Aluminium and aluminium alloys
BS EN 1418: 1998	Welding personnel – Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials
BS EN 473: 2008	Non-destructive testing – Qualification and certification of NDT personnel – General principles
BS EN 12062: 1998	Non-destructive examination of welds – General rules for metallic materials
BS EN 970: 1997	Non-destructive examination of fusion Welds - Visual examination
BS EN 571-1: 1997	Non-destructive testing – Penetrant testing: Part 1: General principles

BS EN 1289: 1998	Non-destructive testing of welds – Penetrant testing of welds – Acceptance levels
BS EN 1290: 1998	Non-destructive testing of welds – Magnetic particle testing of welds
BS EN 1291: 1998	Non-destructive testing of welds – Magnetic particle testing of welds – Acceptance levels
BS EN 1714: 1998	Non-destructive testing of welds – Ultrasonic testing of welded joints
BS EN 1712: 1997	Non-destructive testing of welds – Ultrasonic testing of welded joints – Acceptance levels
BS EN 1435: 1997	Non-destructive testing of welds – Radiographic testing of welded joints
BS EN 12517-1: 2006	Non-destructive testing of welds – Part 1: Evaluation of welded joints in steel, nickel, titanium and their alloys by radiography – Acceptance levels
BS EN ISO 5817: 2014	Welding – Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) – Quality levels for imperfections
BS EN ISO 10042: 2006	Welding – Arc-welded joints in aluminium and its alloys – Quality levels for imperfections
BS EN ISO 1234: 1998	Split pins
BS EN ISO 2320: 2008	Prevailing torque type steel hexagonal nuts – Mechanical and performance requirements
BS EN ISO 7719: 2013	Prevailing torque type all-metal hexagonal nuts, style 1 – Property classes 5, 8 and 10
BS EN ISO 7042: 2013	Prevailing torque type all-metal hexagonal nuts, style 2 – Property classes 5, 8, 10 and 12
BS 3900: Part E7: 1974	Methods of test for paints – Part E7: Resistance to impact (falling ball test)
BS AU 148: Part 15: 1969	Methods of test for motor vehicle paints – Part 15: Resistance to chipping

ASTM D4060 - 2007	Standard test method for abrasion resistance of organic coating by the Taber Abraser
BS EN ISO 1518: 2001	Methods of test for paints – Part E2: Scratch test
BS EN ISO 2409: 2013	Paints and varnishes – Cross cut test
BS EN ISO 6860: 2007	Paints and varnishes – Bend test (conical mandrel)
BS EN ISO 1520: 2007	Paints and varnishes – Cupping test
BS EN ISO 2813: 2000	Paints and varnishes – Determination of specular gloss of non-metallic paint films at 20°, 60° & 85°
BS EN 50085-1: 2005	Cable trunking and cable ducting systems for electrical installations - Part 1: General requirements
BS EN 61386-1: 2008	Conduit systems for cable management - Part 1: General requirements
BS EN 61249-2-7: 2002	Materials for printed boards and other Interconnecting structures Part 2-7: Reinforced base materials clad and unclad - Epoxide woven glass laminated sheet of defined flammability (vertical burning test),copper-clad.
BS EN 61373: 2010	Shock and Vibration requirements for rolling stock equipment
MIL-STD-1472G	Department of Defense Design Criteria Standard: Human Engineering
MIL-HDBK-759C	Handbook for Human Engineering Design Guidelines

3 Definitions

The following definitions shall apply:

Heavy Current :	Currents in excess of 30 A.
Light Current :	Currents of 30 A or less.
High Voltage :	In excess of 300 V, to earth.

Low Voltage :	300 V or less, to earth.
Auxiliary Contact :	A contact in a low voltage circuit.
Power Contact :	A contact which is not covered by the definition of auxiliary contact.
Enclosure :	A closed space in which equipment is mounted.
Contact Enclosure :	A small enclosure in which auxiliary contacts only are mounted.
Terminal :	A fixed point to which a conductor can be attached to form a connection.
Termination :	A device fixed to a cable or other conductor to enable it to be attached to a terminal.

4 General Requirements

4.1 All equipment shall be constructed in a sufficiently robust manner, and arranged so as not to suffer deterioration, wear, or damage due to vibration or shock loads encountered in traction service.

4.2 Equipment shall be arranged into groups where practicable, the items of any one group being mounted on a common frame or the equivalent, complete with such as wiring and piping.

4.3 All equipment shall be protected against damage such as those caused by dirt, dust and moisture.

4.4 Corrosion Protection

4.4.1 The Contractor shall submit for Approval a system to provide corrosion protection for the life of the train.

4.4.2 The Contractor shall take into consideration that all equipment shall be operated under a prevailing tropical weather and corrosive ambient conditions.

4.4.3 Closed or inaccessible areas shall be internally covered with an adequate corrosion protection coating immediately after completion of fabrication.

4.4.4 All corrosion protection measures shall be permanent without causing any contamination.

5 Interchangeability

5.1 The Contractor shall minimize the number of different equipment models on the train. As far as practicable, the same model of equipment shall be used to fulfill similar functions at different applications. For example, the same relay model may be employed to fulfill similar switching functions in different circuits.

5.2 Equipment items or components of the same model shall be readily interchangeable. They shall be designed and manufactured so that no additional fitting, machining, adjustment or modification, other than those approved by the Engineer, would be necessary during replacement.

This is particularly important, such as in the case of covers, bearing caps, equipment mountings and door leaves, which will be replaced or interchanged frequently among different locations after maintenance work. At the request of the Engineer, the Contractor shall provide demonstration on any specified equipment to show that such requirement is satisfied.

5.3 In cases where the same mounting arrangement, such as an electrical plug or pneumatic valve, is provided on different equipment which are not interchangeable, the Contractor shall design the mountings so that the equipment will not be mixed up during installation.

This shall be achieved by providing suitable identification devices such as colour coding or special markings. The use of such devices shall be submitted for Approval. Should the Engineer consider such devices inadequate, the Contractor shall provide a non-interchangeable design to make wrong installation impossible.

5.4 The requirement in Clause 5.3 above shall also apply to cases where it is possible to install or assemble an equipment item in a number of different orientations, such as mating halves of a housing or non-symmetrical cams on a shaft.

6 Bolted Joints and Fasteners

6.1 All fasteners shall be in ISO Metric size as far as possible. The following standards shall be applied where appropriate:

BS 3692: 2014 for hexagonal bolts, screws and nuts
BS 4183: 1967 for machine screws & nuts

BS 4174: 1972 for self tapping screws
BS EN ISO 1234: 1998 for split cotter pins
BS EN ISO 7719: 2013 or BS EN ISO 7042: 2013 for prevailing torque nuts

6.2 Due consideration shall be given in the design stage to the tolerance of components to ensure interchangeability of components. The use of fitted bolts shall be minimised and shall only be used subject to Approval.

6.3 For permanent fixings connections or those where dismantling is unlikely, two piece rivets such as AVDELOK or HUCKBOLT or other similar fasteners shall be used subject to Approval. Blind fasteners such as BOM or MAGNA-LOK rivets or similar shall not be used for structural connections.

6.4 For fixings connections which will be dismantled for maintenance, the following methods shall be used.

6.4.1 Bolted connection shall use documented torque tightening procedures and shall be submitted for Approval. Hexagon head bolts Grade 8.8 and nuts Grade 8 shall be used. Where secondary locking is required, which include all structural bolted joints and bolted joints subjected to high levels of vibration, prevailing torque nuts to BS EN ISO 7719: 2013 or BS EN ISO 7042: 2013 shall be used. The mechanical performance of prevailing torque nuts shall conform to BS EN ISO 2320: 2008.

6.4.2 Setscrews (Grade 8.8) and stud connections (Grade 8.8 studs with grade 8 prevailing torque nuts to BS EN ISO 7719: 2013 or BS EN ISO 7042: 2013) shall only be used where it is not possible to make a bolted connection. The use and the proposed method of locking shall be submitted for Approval.

6.5 Spring washers shall not be used for secondary locking for all structural bolted joints and bolted joints subjected to high levels of vibration. In non-structural bolted joints, spring washers shall be used for secondary locking.

6.6 Mating surfaces shall be machined flat and shall be clean and free from paint or rust.

6.7 Suitable precautions, which shall be subject to Approval, shall be taken to prevent corrosion in joints involving dissimilar metals.

6.8 Tapped holes in aluminium shall, in all cases, be provided with suitable thread inserts. Items of proprietary equipment which are normally supplied without wire thread inserts may be exempted from this requirement, subject to Approval

6.9 Where tab washers are proposed the material chosen shall be sufficiently hard to prevent settlement of the joint and consequent loss of bolt preload. Mild steel tab washers shall not be used.

6.10 The Contractors torque tightening procedure shall include provision for marking torque tightened fasteners with coloured paint to indicate that the torque tightening procedure has been correctly carried out.

7 Welding

7.1 General

7.1.1 All welding work shall be under the control of a suitably qualified welding engineer nominated by the Contractor as his representative.

7.1.2 All welding equipment shall conform to relevant national or international standards which shall be subject to Approval.

7.1.3 Permanent backing strips shall not be used unless otherwise Approved.

7.2 Standards

7.2.1 All fusion welding of metallic materials shall conform to BS EN 1011-1: 2009.

7.2.2 Arc welding of ferritic steels shall conform to the requirements of BS EN 1011-2: 2001.

7.2.3 Arc welding of stainless steels shall conform to the requirements of BS EN 1011-3: 2000.

7.2.4 Arc welding of aluminium and aluminium alloys shall conform to the requirements of BS EN 1011-4: 2000.

7.2.5 Standards for materials and processes not covered by the specifications given in Clauses 7.2.2, 7.2.3 and 7.2.4 shall be submitted for Approval.

7.3 Materials

7.3.1 All materials shall be clearly identified and shall have certificates of chemical composition and mechanical properties which shall be held by the Contractor.

7.3.2 Materials shall be free from laminations and lamellar defects.

7.3.3 Fusion faces in the areas to be welded shall be prepared for 25 mm surface and both sides shall be free from paint, rust and other contaminants. Any solvents used to achieve this shall be thoroughly dried off prior to welding.

7.4 Critical Welds

7.4.1 All welds which fall into any of the categories defined (a), (b), and (c), below, shall be designated as Critical Welds.

(a) Welded joints from which failure would represent a risk to safety of the car.

(b) Welded joints which are designed with a Miner's Summation, evaluated in accordance with 'Miners Rule' (BS 7608: 2014 or BS 8118-1: 1991) and the relevant fatigue load cases from the car Particular Specification, greater than 0.7.

(c) Welds in load bearing members which are not readily accessible for inspection during maintenance and overhaul.

7.4.2 Critical Welds shall be clearly identified on manufacturing drawings.

7.5 Welding Procedures

7.5.1 All welding shall be carried out in accordance with documented welding procedure specifications and shall conform to BS EN ISO 15607: 2003 and relevant parts of BS EN ISO 15609. The suitability of the welding procedure specifications shall be established by testing of test specimens in accordance with the relevant parts of BS EN ISO 15614. Following satisfactory completion of testing the welding procedure specifications shall be submitted for Approval.

7.5.2 Welding consumable shall be such that the mechanical properties of the completed joint shall not be less than those specified for the parent materials.

7.5.3 The requirements of Clause 7.5.1 shall apply to procedures for rectification of defects in welds.

7.5.4 Welding on production units shall not commence until Approval of the relevant welding procedures has been given.

7.6 Welder Approvals

7.6.1 All welders shall be Approved in accordance with BS EN 287-1: 2011 for steels and BS EN ISO 9606-2: 2004 for aluminium and aluminium alloys. Destructive testing of the test pieces is required.

7.6.2 All welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding shall be Approved in accordance with BS EN 1418: 1998.

7.6.3 The Contractor shall maintain records of welder Approvals, welding operator Approvals and resistance weld setter Approvals, together with full supporting evidence. This information shall be made available on request.

7.7 Approval Testing and Witnessing

7.7.1 Witnessing of weld procedure, testing of welds and Approval of the results shall be carried out by a nationally or internationally qualified welding engineer independent of the Contractor and subject to Approval.

7.7.2 All testing associated with welding procedure and welder tests shall be carried out by an independent nationally accredited test house, which shall be subject to Approval prior to the commencement of testing.

7.7.3 Welding audit shall be carried out by a nationally or internationally qualified welding engineer independent of the Contractor to ensure the approved welding procedures had been followed by the Contractor. Any corrective actions arising from the welding audit shall be rectified by the Contractor and the welding audit report shall be subject to Approval.

7.8 Non-Destructive Testing (NDT)

7.8.1 Visual inspection of all welded joints before, during and after welding, together with any additional examinations required by the welding procedures, shall be carried out.

7.8.2 The Contractors NDT programme and procedures shall be subject to Approval before the commencement of any testing.

7.8.3 NDT procedure writers and NDT operators shall hold an appropriate valid certificate of competency from a recognised national or international organisation and suitably qualified in accordance with BS EN 473: 2008.

7.8.4 Detailed procedures, which shall include definitive acceptance standards, for all NDT examinations shall be prepared in accordance with BS EN 12062: 1998. Quality level B to BS EN ISO 5817: 2014 for welded joints in steel or BS EN ISO 10042: 2006 for aluminium and its alloys shall be

adopted for critical weld examinations with the testing techniques, testing levels and acceptance levels of NDT standards as stipulated in Annex A of BS EN 12062: 1998. Quality level C to BS EN ISO 5817: 2014 for welded joints in steel or BS EN ISO 10042: 2006 for aluminium and its alloys shall be adopted for non-critical weld examinations with the testing techniques, testing levels and acceptance levels of NDT standards as stipulated in Annex A of BS EN 12062: 1998.

7.8.5 Procedures for the examination of welds in steel and the respective acceptance levels shall conform to the following standards:

Visual Inspection	BS EN 970: 1997
Penetrate Flaw Detection	BS EN 571-1: 1997 BS EN 1289: 1998
Magnetic Particle Inspection	BS EN 1290: 1998 BS EN 1291: 1998
Ultrasonic Testing	BS EN 1714: 1998 BS EN 1712: 1997
Radiographic Testing	BS EN 1435: 1998 BS EN 12517-1: 2006

For materials not covered by the above specifications the standards shall be subject to Approval.

7.8.6 Welds designated critical in accordance with Clause 7.4 shall be subjected to 100% volumetric NDT inspection during the start up of production. This shall be reduced to 10% of welds of each type when the Contractor has demonstrated, by consistently achieving the quality levels required by Clause 7.8.4 and 7.8.9, that he has control of the processes involved. A minimum of 3 production units shall normally be required to achieve this.

7.8.7 If a Critical Weld is found during normal production (i.e. when 10% testing is taking place) to fall below the acceptance limits required by Clause 7.8.4 and 7.8.9, then the Contractor shall perform a 100% check on all similar Critical Welds produced since the previous NDT inspection was carried out, and shall carry out rectification on any welds which do not achieve the required standard. The inspection level on subsequent units shall revert to 100% until it can be demonstrated that the required quality levels can be consistently achieved. Demonstration of the required quality levels shall be for Approval.

7.8.8 Where production runs are broken by a period of 3 months or longer then the requirements of Clause 7.8.6 shall apply when production is re-started.

7.8.9 The acceptance level for imperfection in welded joints in steel shall conform to quality level B for critical welds and quality level C for noncritical welds in accordance with BS EN ISO 5817: 2014. The acceptance level for imperfection in welded joints in aluminium and its alloys shall conform to quality level B for critical welds and quality level C for non-critical welds in accordance with BS EN ISO 10042: 2006.

7.8.10 Welds failing NDT examination shall be rejected or repaired using approved welding repair procedures. Details of the defects leading to the failure together with proposals for repair of the defect shall be submitted for Approval. The Contractor shall investigate the causes of the defect and make proposals for remedial action in production. Repair of the weld shall not take place without prior Approval.

7.8.11 Results of all tests shall be recorded and made available on request. The records shall enable each weld to be identified. Hard stamping of the structure for this purpose shall not be allowed.

8 Labels and Rating Plates

8.1 Engraved plastic labels shall be black letters on a white background. Alternatively, black on to white background rear indented will also be accepted.

8.2 Unless otherwise stated, all safety labels shall comply with BS EN ISO 7010: 2012.

8.3 Labels shall be legible and durable.

8.4 The use of insulation or adhesive tapes for the fixing of labels will not be accepted. The use of self adhesive plastic or paper labels will again not be allowed.

8.5 Warning label shall be written in both Chinese and English. Assistance of Chinese translation from the Engineer will be provided upon request.

8.6 Each character or letter printed or engraved on the label shall not be less than 5mm.

8.7 All items of apparatus shall be labelled with the maker's name and the type and/or form of the piece of apparatus.

8.8 The position in which apparatus is nearly mounted but not the apparatus itself, shall be labelled clearly with the circuit designation of the piece of apparatus there mounted without obstacles. Where a contactor, for example, is referred to as LS1, it will be sufficient to label the position with such reference. Such labels shall be clear and easy to be read and securely fixed adjacent to the mounting position. Covers, arc-chutes, and similar removable interchangeable items shall not be labelled.

8.9 All enclosures containing equipment where voltage to earth exceeds 200 V shall be clearly marked.

8.10 All labels fitted to the exterior of equipment cases, and all warning labels shall be consistent in content and appearance between different items of equipment.

9 Bearings and Pivots

9.1 All bearings and pivots shall be of ample proportions to withstand shock loads and vibration in addition to the normal static and dynamic loads.

9.2 Plain bearings shall be of the dry type (incorporating graphite compound, P.T.F.E. or nylon, lubricant retaining bearing metal or similar).Plain bearings or pivots requiring periodic applications of oil or grease at inspections shall not be used. Lubrication or inspection, if required between overhauls, shall be subject to Approval.

9.3 For bogie applications, sliding bearings will only be accepted where it can be demonstrated that the application cannot be served by a suitably designed rubber bearing.

9.4 Rolling element bearings shall be of the pre-packed pre-lubricated and sealed type and shall run between overhauls without re-lubrication or replacement.

9.5 Care shall be taken to ensure that brinelling does not occur.

9.6 Where pre-packed bearings are not applicable, the arrangement shall be submitted for Approval and the means of lubrication replenishment shall be fitted with Tecalemit Type ND6160 nipples or equivalent.

9.7 Replenishment interval shall not be less than 1 year and the recommended annual replenishment quantity of grease shall be stated.

9.8 For bogie and traction motor applications, the bearing manufacturer proposed by the Contractor shall be reputable and has solid experience on electrified railway industry.

10 Mountings and Enclosures

10.1 General

All inside mounted equipment shall be arranged in self contained groups and enclosed to protect them from the effects of dirt, dust and moisture. Unless otherwise specified, all equipment mounted in the saloon area shall be sealed to IEC 60529: 2001 IP54 and all equipment mounted in the external area, such as underframe and roof, shall be sealed to IEC 60529: 2001 IP65.

10.2 Ventilation of Enclosures

10.2.1 Air inlets, outlets and vents shall be fitted with louvres or otherwise designed so that ingress of rain or rubbish is prevented, irrespective of whether the car is moving or stationary and independent of the wind direction. In the case of forced ventilation the filter (if provided) or a suitable settling chamber may be relied on to remove any rain which passes the louvres provided that the complete system meets the requirement of efficient filtration. Any louvre or guard, intended to prevent the ingress of rubbish should not reduce the enclosure ventilation with guard or louvre 75% blanked off. The battery enclosures shall be presented from the accumulation of explosive gases during charging.

10.2.2 The term filter, in the context of this Clause, covers any device to remove dust, dirt, and rain drops from the air. Where filters are proposed, they shall be of the dry type and shall not require cleaning more frequently than at 12 monthly intervals under the conditions as stated in PS 26. Such cleaning shall be by knocking or blowing off the dirt. If washing of the filters is required, this shall not be at more frequent intervals than six months, and easy access for removal of the filter shall be provided.

10.2.3 Inertial separators are permitted for traction equipment and other 1,500 V machines, and shall be maintenance free between 5 years overhauls.

10.2.4 Oil wetted air filters shall not be used.

10.2.5 For equipment cases containing power equipment which could possibly produce electric arcing during operation means shall be provided to prevent the production and accumulation of corrosive gases.

10.3 Mounting of Groups

10.3.1 An equipment group may be mounted in a box or case, or on a frame or panel. The individual items of equipment shall be so arranged that they can be removed separately, or in sub-groups as appropriate. Any group mounting shall be self supporting when out of the car and sufficiently strong to be lifted out complete under normal workshop conditions.

10.3.2 Equipment groups requiring the fitting of strengthening before lifting the group off the car will not be Approved unless a significant weight saving can be demonstrated. All the equipment in one location shall be mounted in one group unless sub-division is Approved.

10.3.3 Anti-vibration resilient mounts shall be incorporated on the fixings of the rotating machines, such as cooling fan, traction or inverter inductor, transformers to avoid the transmission of vibration onto the carbody or its structure.

10.3.4 Underframe equipment mountings shall be designed such that, in the event of failure of any of the fixings, the equipment case or module shall be prevented from falling onto the track.

10.4 Wiring and Piping of Groups

10.4.1 All groups shall be complete with internal wiring and pipe work.

10.4.2 The connections to the group shall be taken to suitable terminal bars. Where suitable cable runs can be arranged, the Engineer may approve the running of heavy current cables direct to equipment and not via the group terminal bars, provided he is satisfied that the work of disconnection and reconnection is not thereby increased.

10.4.3 Groups containing equipment which may produce arcs, such as heavy duty contactors or circuit breakers, shall have the low voltage terminals mounted in such a position that arcing to the terminals is prevented. Consideration shall be given to mounting such terminals in a separate enclosure.

10.4.4 Cables entering equipment cases shall be limited to those connecting to equipment within that case, such case shall not be used as terminal boxes.

10.5 Types of Enclosure

10.5.1 Inside and underframe mounted equipment shall be in sealed enclosures. Equipment mounted in such enclosures shall be treated as mounted in clean conditions as specified in BS 2618 clause 3. Where enclosures, as described above cannot be adopted, ventilation of enclosures, naturally or forced air, shall be considered. Equipment mounted in such enclosures shall be treated as mounted in dirty conditions as specified in BS 2618 clause 3, except that enclosure pressure ventilated with filtered air shall be designated as clean areas.

10.5.2 In the case of machines, the machine frame forms the enclosure. Machines shall be regarded as inside mounted and shall comply with this Clause.

10.6 Underframe Enclosures

10.6.1 Clipped covers shall be used where regular access to equipment is necessary, and bolted covers shall be used elsewhere on the underframe. Covers shall be light weight, shall be fully compliant with RS/6014/08, shall be designed to prevent distortion and damage. Clipped covers shall withstand vibration standard BS EN 61373: 2010, to reduce the chance of cover being totally released, the number of clips shall be at least two, shall be fitted with lifting handles and safety chains in the event of clips being released, the covers should not infringe KE. Clipped covers shall be provided with location guides to facilitate location and correct fitting by one man. Particular care shall be exercised in ensuring a good seal against the ingress of dust and water, for the life of the equipment. Furthermore, water shall be prevented from accumulating on seals and gaskets.

10.6.2 Covers which are substantially flat may be light weight metal pressings otherwise meeting the above requirements.

10.6.3 The design should refer to US Department of Defense Standard MIL-STD-1472G “Design Criteria Standard – Human Engineering” and MIL-HDBK-759C “Handbook for Human Engineering Design Guidelines”.

10.7 Enclosures Inside the Car

10.7.1 In the case of body mounted equipment other than in the passenger area, suitably stiffened lift-off hinged doors may be used. Doors hung on "piano" hinges shall be used in passenger areas. Doors shall be secured by Approved locks in cabs or passenger compartments.

10.7.2 Bolts shall only be used to secure doors or covers where access is infrequent. Where bolts are used for hinged doors or covers they shall be captive to the door or panel.

10.7.3 No enclosures will be allowed in or opening into passenger areas, which contain apparatus whose voltage exceeds 300 V to earth.

10.7.4 Enclosures in which heat or arcs may be generated shall be lined with barriers of insulating material. These materials shall also be used for vents, where required. The design of such vents in the case of heavy duty equipment shall be such that the arc has a clear path to the outside of the enclosure and such that the vents do not tend to impede the emerging gas.

10.8 Access to Equipment

10.8.1 Equipment with moving parts shall be so arranged that the moving parts are easily accessible for inspection and maintenance. The location of any item requiring adjustment shall be for Approval.

10.8.2 In the case of contactors, relays and cam-operated switch groups it shall be possible, without breaking any pipe joints, or any electrical connections except those to the item concerned and without disturbing any other equipment, to change the following:-

(a) All contact tips and flexible copper braids.

(b) All arc chutes and arcing horns.

(c) All contactors and relays.

(d) All magnet valves.

(e) All auxiliary contact enclosures complete.

(f) All plug-in cards.

This requirement may, at the Engineer's discretion, be extended to other apparatus.

10.9 Openings

In the case of air inlets, outlets or vents accessible from the platforms or areas to which passengers have access, it shall not be possible to touch, or to insert any object into any moving or electrically energised equipment, including blower or fan rotors. Any such inlet, outlet or vent which is mounted other than in such an area shall be covered with a mesh or grille so that it is impossible to insert a hand or finger to a dangerous extent.

10.10 Roof Mounted Equipment

Roof mounted equipment may be mounted externally in a recessed area of the roof, or inside the roof cavity. Outside mounted equipment shall follow the roof profile as closely as possible. Such equipment shall be water tested before assembly, and, if repair is required, it shall be completely removed from the car. The design shall ensure that penetration of water cannot occur, either at sealing surfaces or at fixing points.

10.11 Outside Mounted Equipment

Where outside mounted equipment on the underframe is mounted within 750 mm of the structure gauge and includes bare conductors energised at high voltage, an earthed screen (solid or mesh) shall be provided to prevent accidental contact with staff walking beside the car.

10.12 Underframe Mounted Battery Box

10.12.1 The battery shall be mounted, half in each of two battery boxes, one on either side of a car.

10.12.2 These battery boxes shall be suspended from the underframe.

10.12.3 Inside the battery box, the battery set shall be mounted in a detachable battery tray with a suitable sliding pull out arrangement to facilitate easy access for battery maintenance.

10.12.4 The battery box location shall be arranged to provide easy access for maintenance inspection and topping up of water.

10.12.5 Vents shall be provided in the top, ends and back of box.

10.12.6 The battery box floor shall be shaped to support and locate the battery and to assist drainage. A lip shall be provided at the front to prevent spillage from running down the front of the box. Ample drainage outlets shall be provided, which shall discharge clear of all equipment, and otherwise as low down as practicable.

10.12.7 The battery boxes shall be made of steel lightweight construction suitably protected with two coats of epoxy paint.

10.12.8 A lid, with top mounted lift off hinges shall be provided with safety straps.

10.12.9 With the lids removed, the whole front of the box shall be clear. Vents shall be provided in the top, ends and back of box.

10.12.10 The lid, in the closed position, shall be secured by spring clips.

10.12.11 The battery tray shall incorporate a secure quick release safety locking mechanism to keep the battery set in position, of which the locking and releasing position shall be easily identifiable.

10.12.12 Activation of the locking mechanism shall separate the battery tray from the battery box.

10.12.13 This battery tray shall be mounted on angles and, arranged so that a fork lift truck can lift the half battery out in its box as a unit once the cables and box fixings are released.

11 Pneumatic Systems

The requirements on pneumatic systems including the electro-pneumatic control valve shall refer to RS/C6014/07.

12 General Material Specification

The general material specifications shall refer to PS 20.

13 Cable

13.1 All conductor shall have a current-carrying capacity not less than the maximum current demand it normally carries, be capable of withstanding the prospective fault current, and suitable for operation in the environment and at the design voltage of the insulation

13.2 The minimum quantity of inflammable material shall be used in the construction of all cables which shall, as far as is practicable, minimise the production of smoke and toxic fumes in the event of fire or short circuit.

13.3 Detailed requirements for cables shall refer to RS/C6014/06.

14 Cable Joints and Connections

14.1 All connection at a cable termination or joint shall:

14.1.1 Be mechanically and electrically sound;

14.1.2 Be protected against moisture, mechanical damage and any vibration liable to occur;

14.1.3 Not impose any appreciable mechanical strain on the fixings of the connection;

14.1.4 Not cause any harmful damage to the cable conductor;

14.1.5 Be appropriate to the size and type of conductors with which they are to be used; and

14.1.6 Be suitably insulated for the voltage of the circuits in which they are situated.

14.2 No strand of a stranded conductor in a cable core shall be cut away in making a cable joint or termination.

14.3 Unless otherwise approved, all cable terminations shall be of the crimped type and soldered connections shall not be used.

14.4 All mechanical clamps and compression-type sockets shall securely retain all the wires of the conductor.

14.5 For the purposes of Approval, samples of types of crimped lugs, or other terminations shall be submitted with the following information:

(a) Maker, Maker's Mark and Type Number.

(b) Cable size and stranding for which the cable lug is suitable.

14.6 The Engineer may require tests before Approval and will require to be satisfied that the quality of crimping will be maintained by the carrying out of regular tests on all equipment under the supervision of his representative.

14.7 High voltage cables, of conductor sizes up to 6 mm^2 shall be crimped with a lug which grips the insulation as well as the conductor, or other arrangements made to prevent excessive flexing of the core where it emerges from the lug.

14.8 The insulation need not be crimped where the conductor size exceeds 6 mm^2 irrespective of the insulation grade, however if the cable is in a position where movement occurs, such as earth brush, then suitable crimping shall be provided to prevent stress of the conductor at the point of connection to the crimp.

14.9 Lugs shall be closed-end type unless otherwise Approved.

14.10 Terminals shall be of the steel screwed post type securely moulded into an insulating base. All power terminations on one stud shall be assembled together without intervening, such as nuts and washers. Studs or bolts shall not be used to carry current.

14.11 Alternative forms of terminals will be considered where appropriate but post terminals are mandatory for safety circuits.

14.12 Terminal posts or the equivalent shall be mounted horizontally or vertically downwards. Vertical posts shall only be used if the posts are completely shielded from the possibility of being bridged by a conducting object dropped onto or lying across the terminals. Horizontal posts shall be so arranged that there is little possibility of an object lying across two posts. Failure of a fixed terminal shall not result in scrapping of a complete piece of equipment.

14.13 Cables terminating in plugs or sockets may be secured by soldering where the plug is too small for crimping to be practicable and a suitable cable clamp provided.

14.14 Terminals and terminal boxes shall be so arranged that water collecting in ducts and conduits cannot reach live parts.

14.15 Terminals for circuits of different voltages shall be kept in separate groups. Negative and neutral terminals shall be grouped separately.

14.16 Cable glands shall securely retain without damaging the outer sheath of the cables.

14.17 Electrical connections shall not be used as the sole means of mechanical support for components other than those mounted on printed circuit boards. Contactors and other equipment which are specifically designed to be mounted via its electrical connections is exempt from this requirement provided that the appropriate manufacturers data sheets are submitted for information to the Engineer.

15 Cable Enclosure

15.1 Cable enclosures as protective conductors

15.1.1 Types of protective conductors, such as circuit protective conductors, earthing conductors, of which shall be formed by rigid steel conduits, trunking or ducting.

15.1.2 Metallic enclosures where used as protective conductors shall:

(a) Have a cross-sectional area according to BS 7671:2001;

(b) Have an electrical continuity achieved and maintained to afford protection against mechanical, chemical or electrochemical deterioration; and

(c) Permit the connection of other protective conductors at every predetermined tap-off point.

15.1.3 All cable enclosures shall be properly supported and of a type suitable for any risk of mechanical damage to which they may be liable in normal conditions of service or adequately protected against such damage.

15.1.4 Where cable enclosures pass through fire barriers, the opening made shall be sealed according to the appropriate degree of fire resistance (refer to RS/C6014/08).

15.2 Where cable enclosures are not used as protective conductors, the non-metallic enclosures can be used provided that the material used shall comply with RS/C6014/08.

16 Conduit, Trunking and Ducting

16.1 Conduit

16.1.1 Conduit shall be of an approved rigid non-metallic grade except where high mechanical strength or electrical continuity is a requirement.

16.1.2 Metallic conduit where Approved shall be of solid drawn seamless zinc coated steel.

16.1.3 The conduit and fittings shall comply with BS4568-1:1970 Screwed type, Class 4 or equivalent.

16.1.4 The nominal minimum outside diameter of any rigid conduit to be used shall be 16mm with a minimum wall thickness of 1.4mm.

16.1.5 The outlets of all metallic conduits shall be protected by suitable bushes. All steel conduits, conduit fittings and the associated metallic boxes for the enclosure of electrical accessories shall be protected against corrosion on both the inside and outside surfaces.

16.1.6 An adequate number of suitably sized adaptable boxes shall be provided in conduit installation to enable cables to be drawn in easily and without damage.

16.1.7 Conduits in exposed locations shall be provided with an effective means of sealing the cable entry to prevent the ingress of water and condensed moisture.

16.1.8 The use of flexible conduits will not be accepted except across movable vibration or thermal isolation joints.

16.1.9 Flexible steel conduits shall comply with BS EN 61386-1:2008 or equivalent. In addition, the conduits shall be of the metallic water tight pattern with oversheath.

16.1.10 Workmanship

(a) Conduits shall not be bent in such a manner which appreciably distorts their original cross-sectional shape or causes damage to the conduits.

(b) Burrs, sharp edges and projections shall be removed from the internal surfaces and ends of conduits, ducting or other enclosures when installed.

(c) Where the protective coating on a metallic enclosure has been damaged after installation, such surface shall be effectively restored by paint or other suitable coating to prevent corrosion.

16.2 Trunking

16.2.1 Steel trunking and fittings shall comply with the requirements specified in BS EN 50085-1: 2005 or equivalent.

16.2.2 Steel trunking installations shall be constructed using manufacturer's standard fittings such as tee or angle pieces, throughout as far as practicable.

16.2.3 All steel trunking and fittings shall be protected against corrosion.

16.2.4 The steel trunking installation shall be made mechanically and electrically continuous throughout and be effectively earthed.

16.2.5 Electrical continuity shall be achieved by means of connecting a protective conductor of adequate size across the two adjacent ends of the trunking.

16.2.6 Every entry to the trunking installation shall be provided with smooth bore bushes or grommets and the return edge of the lid of the trunking shall be left intact in order to prevent and/or to be protected against the ingress of water.

16.3 Ducting

16.3.1 Ducts shall be sealed all round, including any removable lids or covers, against ingress of moisture and dirt.

16.3.2 Lids shall be provided to enable the cables to be introduced easily into the duct.

16.3.3 The cables and cable loom shall be cleated or otherwise secured into the duct sufficiently frequently to prevent movement.

16.3.4 Ducting with top access lids shall be avoided whenever possible and will not be accepted for under floor mounting.

16.3.5 Duct lids shall not be used for cable support.

16.4 Space Factor

Space factor of at least 45% shall be provided for all cable conduits, trunkings and ductings.

17 Cable Runs

17.1 General

17.1.1 All cables shall be run in a vertical or horizontal direction, where practicable and shall be secured flat or in a bundle, such as on the surface of body panels, columns, partitions or ceilings, throughout the entire route.

17.1.2 Where cables run as a span, such as between beams, trusses, rigid support throughout their entire length shall be used.

17.1.3 Cables crossing an expansion joint shall be formed into a loop such that any movement in the joint shall not stress the cables.

17.1.4 Where a wiring system passes through elements of car construction such as floors, walls and roofs, the opening remaining after passage of the

wiring system shall be sealed according to the degree of fire resistance specified in RS/C6014/08.

17.1.5 The internal bending radii of all cables shall not exceed the limit provided by the associated cable manufacturers.

17.1.6 All cables external to equipment cases or ducts must be protected by conduits, trunking or ducts.

17.2 Heavy Current Connections

17.2.1 Heavy current connections may be by cable or bare strip.

17.2.2 Heavy current cables run in ducts or unprotected shall be adequately cleated or secured against chafing or movement. Unprotected power cables, suitably sheathed, shall be cleated at not more than 400 mm centres. For the smaller cable size cleat distances less than this may be necessary. Such cables may be run bundled together as necessary to give additional support.

17.2.3 Cable runs shall not cross a horizontal floor or surface except where unavoidable, and then a clearance of at least 25 mm shall be left beneath the cables, and where the likelihood exists of the cables being damaged they shall be protected by a removable tread plate.

17.2.4 Bare copper strip may be used within enclosures, with the following provisions:

(a) The conductor shall be of adequate stiffness, and shall be adequately supported and clamped against movement, resonance or vibrations.

(b) Adjacent conductors may be separated by an insulator to ensure correct spacing and to give increased stiffness.

(c) The arrangements shall be such that no stress is placed on the terminations by the conductors.

(d) All bends radii shall be appropriate to the hardness of the copper strip used.

17.2.5 Where cables pass through holes in the traction motor frame, oil resistant resilient bushes suitably clamped shall be provided to prevent chafing of cables and to seal against the ingress of oil and water.

17.3 Light Current Connections

17.3.1 Light current connections outside enclosures shall be by cables protected by conduits or ducts, or unprotected where so Approved.

17.3.2 Cables inside enclosures may be run unprotected, and, where more than one cable, made up into cable looms.

17.3.3 Cable looms shall be made up by fastening them together to form a neat bundle. The individual cables shall be laid parallel and pulled straight and shall have a neat appearance. Particular care to obtain parallel lays shall be taken where looms go round corners.

17.3.4 The looms shall be fastened at not more than 150 mm intervals. Fastenings shall also be applied at the start and finish of any bend, and at the point at which one or more cables leave the loom so as to secure the leaving cables. The term fastening includes the application of flame retardant lacing cord or of Approved, non metallic, proprietary fasteners to secure the bundle. The use of self adhesive tape or lacing cord will not be accepted. Care shall be taken that the fastenings are not tightened excessively. Fastenings shall only be applied using the manufacturers recommended tool to obtain the tightening force appropriate to the cable.

17.3.5 As far as practicable cables shall leave looms at right angles, to give a neat appearance. Sufficient slack shall be allowed to prevent a constraint being placed on cable terminations.

17.3.6 The use of proprietary cable ducting and support systems inside enclosures as an alternative to the foregoing requirements shall be submitted for Approval.

17.3.7 High and low voltage cables shall be kept separate. Where cables of greater than 200 V between conductors are Approved as being carried in the same jumper as other cables they may be run together as far as the adjacent junction box. AC cables shall not be run so as to result in eddy current heating of conduits.

17.3.8 Light current cables or cable looms shall be adequately secured to supports. Cables or cable looms shall be supported sufficiently frequently to prevent movement chafing or vibration in service.

17.4 Location of Cables and Looms

17.4.1 Cables and looms shall be run in such positions that they are clear of apparatus and do not impede access for maintenance. They shall be

clear of high temperature and electric arc areas. Arc or heat barriers to protect the cable runs shall be provided where it is not possible to avoid such areas, in such a way as to allow circulation of air around the cables.

17.4.2 Sharp edges over or near which cables or looms may run shall be protected. The possibility of displacement in service shall be duly considered. Where cables pass through metallic partitions polychloroprene grommets or equivalent protection shall be provided.

17.5 Cable Identification

17.5.1 Cable markers shall be located so that they can be read easily.

17.5.2 They shall be an Approved non metallic type with clear markings, and of a type that does not come loose, age nor deteriorate due to UV Light, dirt, grease or contact with other contaminants which may be encountered in a railway environment. Neoprene rubber markers will not be accepted. Markers requiring dilating fluid will not be accepted. Cables markers displaying numerals shall be coloured in accordance with the international colour code. The numerals shall be embossed or otherwise permanently marked to the satisfaction of the Engineer. Samples shall be submitted for Approval.

17.5.3 All cables, both within and outside enclosures and equipment cases shall be identified with cable markers. Wire looms within electronic racks are excluded from this requirement.

17.6 Conduit Runs

Conduit shall be adequately secured and supported by clips or otherwise. Welding of conduit will not be accepted. Metallic conduit shall be used on bogies, in exposed positions on the underframe, and to protect the cables between the pantograph and protective devices for the traction and auxiliary supplies. Nonmetallic conduit shall be used elsewhere except as Approved.

17.7 Safety Circuits

17.7.1 Insofar as is practicable safety circuits shall be run direct to apparatus and not to terminal bars. Where it is essential that intermediate terminals be used, (for example, circuits which pass through intercar jumpers) the terminals shall be covered and separated from others terminals. All safety circuit cables shall be coloured yellow.

17.7.2 The Engineer will direct which circuits or sub-circuits shall be designated safety circuits within the meaning of this Clause.

17.8 Inter-car and Inter-unit Connections

17.8.1 Inter-car connection shall be by an Approved form of multicore cables taken to contact boxes integral with the semi-couplers. Additional inter-car connection not via contact boxes of the couplers may only be considered for special applications and is subject to Approval.

17.8.2 1,500 V connections shall be by bolted cables.

17.8.3 Inter-unit connection shall be by an Approved form of multicore cables taken to contact boxes integral with the Auto-couplers. Connection and disconnection shall be established automatically (refer to PS 9.7.2 and 9.7.4) during coupling and uncoupling. Additional inter-unit connection not via contact boxes of the couplers may only be considered for hostler positions. If the connection and disconnection of the additional inter-unit connection is not automatic, uncoupling shall be disabled until the additional inter-unit connection is disconnected manually to prevent damages to the additional inter-unit connection. Use of additional inter-unit connection not via contact boxes of the couplers is subject to Approval.

17.8.4 Care shall be taken that the cables run in easy bends without undue flexing.

17.9 Train Wires

All multicore train wires shall be run from coupler to coupler, irrespective of whether required by the circuit, except where the circuits demand otherwise.

17.10 Spare Wires

17.10.1 Spare wires shall be provided and terminated in the same way as other wires.

17.10.2 The spare wires shall be shown on the wiring diagram and labelled with cable markers in the same way as all other wires.

17.10.3 As a minimum requirement, the following spare control hardwires shall be provided for future uses:

(a) Between the electrical connection boxes of the auto-couplers: all remaining electrical connections shall be provided with spare wires.

(b) Between underframe connection boxes at car ends: 6 nos. of spare wires shall be provided.

(c) Between underframe connection boxes and equipment cases: 4 nos. of spare wires shall be provided.

(d) Connection boxes between underframe and saloon: 6 nos. of spare wires shall be provided.

(e) Between saloon connection boxes and equipment inside the saloon: 4 nos. of spare wires shall be provided.

17.10.4 All spare wires shall be properly secured and insulated by capsulate.

18 Insulators and Insulating Panels and Boards

18.1 All insulating material used for the train shall be non-hygroscopic, anti-tracking and substantially non-ignitable. Phenolic resin bonded paper or phenolic resin bonded fabric to BS 2572:1995, shall be used for panels or for small insulators of simple shape.

18.2 All surfaces of insulators or insulating panels shall be smooth, hard, free from air bubbles, cracks, scratches, inclusions or similar surface imperfections.

18.3 Moulded resin insulators for areas where arcs are present, including brush gear support insulators, shall be moulded of a suitable grade of silica filled epoxy resin, or similar approved material so formulated that, in the event of a flashover, the insulator can be cleaned and fit for further service by wiping or, in severe cases by minimal cleaning with aluminium oxide paper.

18.4 The insulators shall have a smooth finish without special surface coating.

18.5 Brush gear support insulators shall be fitted with a PTFE replaceable sleeve.

18.6 Ceramic insulators shall only be used where Approved, and Approval will only be granted where alternative materials cannot be used.

18.7 Moulded mica tubes or components of similar materials shall not be used.

19 Circuits and Earthing

19.1 General

19.1.1 This Clause covers all car electrical circuits.

19.1.2 Simplicity is required in circuit design. The number of different types of component shall be minimised.

19.1.3 Unless specifically approved by the Engineer, DC and single phase AC circuits shall be such that one pole of each device shall be connected directly to the negative or neutral line, without switches, fuses or contacts on the negative side.

19.1.4 The practice of de-energising devices by short-circuiting the operating coil will not be permitted. The use of economy resistors or of separate pull in and hold coils for contactors, solenoids or similar devices will not be accepted.

19.2 1,500V Traction Circuits

1,500V traction circuits shall be protected by overload and/or current balance relays operating Approved fault rupturing devices. Fuses will not be accepted. A high speed fault limiting device shall be provided. The device shall meet the requirements of IEC 60077. Pantographs, lightning arrestors, and lead-in cables may be regarded as protected by the sub-station system.

19.3 1,500V Auxiliary Circuits

1,500V auxiliary circuits shall be protected by fuses. In all cases, the fault discriminating characteristics of the system shall be submitted for Approval.

19.4 Low Voltage Circuits

19.4.1 DC power sources shall be protected on the input side where practicable. In the case of a battery, it shall be protected by fuses in both the positive and negative lines installed in close proximity to the respective battery terminals. The unprotected positive and negative battery cables and terminals shall be physically segregated.

19.4.2 Battery switches shall be provided.

19.4.3 AC power sources shall have a fuse or miniature circuit breakers (MCB) in each phase and the neutral shall be earthed.

19.4.4 Fuses, except as mentioned above, shall only be used where Approved.

19.4.5 Protection and isolation of low voltage circuits other than the above shall be by MCB. Note that in all cases, these will be backed up by the power source fuses.

19.4.6 Where regular switching is anticipated, separate switches shall be provided in addition to the MCBs.

19.5 Cable Ratings

Rating of cables of 4.0 mm^2 or larger shall not be less than 90% of the rating of the protecting fuse or MCB. 2.5 mm^2 cable may be protected by an MCB of up to 30 A rating and 1 mm^2 cable may be protected by an MCB of up to 20 A rating.

19.6 Earthing

19.6.1 Separate insulated earthing bars shall be provided for the 1,500VDC, 110VDC and 440VAC circuits.

19.6.2 Earthing bars for 1,500V circuits shall be connected to at least two earthing brush boxes on different bogies by separate cables.

19.6.3 Car bodies shall be earthed to at least two other earthing brush boxes also on different bogies.

19.6.4 Traction motor frames shall be connected to the adjacent earthing brush box in all cases where the earthing brush boxes shall not be used for the car body earths. The same earthing brush boxes shall not be used for the 1,500V circuit and for the car body earths.

19.6.5 Earthing brush boxes shall be insulated from their mountings for 750V and arranged so that build up of dirt cannot short circuit the insulation. Care shall be taken that earth paths in parallel to the earth brushes via bearings are prevented.

19.6.6 The pantograph down lead conduit construction and earthing shall provide a low impedance path to any likely fault current. The conduit(s) shall be of heavy gauge weather-proof construction and be adequately earthed to the underframe by an earthing bar used solely for this purpose. Proper sealing shall be provided to protect the conduit entry against the ingress of water.

19.6.7 Low voltage earthing bars shall be connected directly to the car body by a bolted link.

19.6.8 The negative or neutral of each separate AC or DC circuit including power sources shall be connected separately to the earthing bar of the car in which is the appropriate power source. For the purposes of this Clause,

the negative of each circuit supplied by a separate MCB shall be considered a separate circuit.

19.6.9 In the case of train line negative the connection shall be in the operative cab made by a suitable contactor.

19.6.10 Resilient mounted equipment shall be provided with earth links.

19.6.11 Such as all equipment cases and resistor frames, mountings on the underframe must be properly earthed by an earthing cable connected to an earthing pad on the underframe.

19.6.12 Where equipment with secondary or tertiary insulation systems are used, all live and floating conductors shall be protected by an earthed cover.

19.6.13 The negative or neutral of each separate AC or DC circuit including power sources shall be connected separately to the corresponding earthing bar of the car in which the power source originates. For the purposes of this Clause, a separate circuit shall be considered to be that circuit that is supplied by an individual MCB.

19.6.14 In the case of the train line negative the connection shall only be made at one point. This shall be achieved in the car of the active driving cab via the use of a suitably rated contactor.

19.6.15 All metallic boxes, cases and enclosures containing electrical equipment, including cable ducts, which are not intended to be part of the live circuit shall be properly earthed with an insulated flexible earth bond to the relevant earth bar.

19.6.16 Earthing by means of a flexible earth bond shall be required on each equipment case irrespective of whether the equipment case is directly mounted to the car body.

19.6.17 For auxiliary voltage circuits designed with earth returns within the metallic equipment case these shall be connected to a common, insulated earthing terminal bar which shall be connected to the appropriate earthing bar by a flexible earth bond.

19.6.18 Where the metallic equipment case is constructed of a ferrous metal the earth terminal shall be welded to the casing.

19.6.19 Non-ferrous metallic equipment cases shall also require a permanently fixed earthing terminal mounted in a way to ensure that any electrolytic action is prevented.

19.6.20 Both earthing terminals and the flexible earth bonds shall be suitably sized to accommodate the prospective fault current, also taking into account the relevant fault detection/isolation system.

19.6.21 The physical length of the flexible earth bond shall be as small as practically possible and its purpose shall be clearly distinguishable.

19.6.22 Detachment of either end of the flexible bond shall be such that it does not fall into any moving parts or on to any electrical item that may be live.

19.6.23 The position of the earth terminal/stud assemblies and the associated earthing cables shall enable the termination to be easily connected without the requirement to remove any equipment or apparatus.

19.6.24 All earth terminations shall be clearly visible.

19.6.25 An associated group of electrical components, from a common power source, not within an equipment casing shall be suitably earthed at one common point.

19.6.26 Loop earthing between items of equipment is not acceptable.

19.6.27 Where equipment with secondary or tertiary insulation systems are used, all live and floating conductors shall be protected by an earthed cover.

19.6.28 In the event of non-metallic boxes, cases and enclosures being used there shall be no metallic fastenings passing from the inside to the outside which can be inadvertently energised electrically by a fault occurring inside the box, case or enclosure.

19.6.29 The cross sectional area of the earthing cable shall not be less than that of the incoming supply to the case or frame.

19.6.30 Any earth fault or insulation breakdown shall not cause any object accessible to maintenance or operating staff to become live.

19.6.31 The removal of any earthed equipment or item shall not interrupt the earthing arrangement of any other remaining earthed electrical equipment.

19.6.32 Special earthing arrangements for electronic equipment where required, shall be submitted for Approval, and shall be compatible with the above.

19.6.33 Screens shall be provided on circuits to meet the requirements of the equipment or system concerned.

19.6.34 The screen shall be continuous through all intermediate connections/components on a car.

19.6.35 Screen earths and low auxiliary earths shall not be terminated on the same terminal.

19.6.36 The screen shall not form a path for circulating currents.

20 Circuit Diagrams

Circuit diagrams shall be clear and easy to interpret and shall comply with IEC 61082-1:2006.

21 Auxiliary Contacts

21.1 Auxiliary contacts shall be of the silver butt type. They shall be contained in a separate dust proof contact enclosure under an Approved type of cover. In the case of small relays and the like the whole relay may be contained in the enclosure. The contact enclosure is required irrespective of the type of enclosure of the main equipment. The cover shall be transparent plastic and all fixings shall be captive. Acrylic resin will not be accepted.

21.2 The Engineer shall be satisfied that condensation of moisture inside the contact enclosure will be prevented. Contacts shall be adequately protected against corrosion.

21.3 The above requirements also apply to the contact section of master controllers, but the enclosure may be formed by the controller case and need not be of transparent plastic.

21.4 The connections shall be made outside the contact enclosure. It shall be possible, as far as practicable, to remove a contact enclosure complete and substitute another of the same type without removing the contact cover.

21.5 Notwithstanding the above, the use of an Approved type of small contactor for several applications, either as a relay or as a contactor, shall be considered, even if it does not fully comply with the foregoing, to economise on equipment types.

22 Power Contacts

22.1 All power contacts shall be fitted with contact tips, securely fixed to their support and arranged for easy removal without further dismantling. Contact screws of size M8 or larger shall not be provided with screwdriver slots. Current shall be taken

from moving contacts by flexible copper braids, amply proportioned and having end connections secured by crimping only, with flared ends to avoid abrasion of the shunt. Braids shall be supported and restrained so as to prevent damage due to excessive movement or vibration. Passage of current through springs or bearings shall be positively prevented.

22.2 Fixings of all blowout coils and connections shall be submitted for Approval. Blowout coils shall be connected on the positive side of the contacts. Permanent magnet blowouts shall be submitted for Approval.

22.3 Arc horns which are removed with the arc chute are not permitted. Where used, the associated flexible lead shall be sleeved.

22.4 The Contractor shall satisfy the Engineer that all arc chute components have adequate resistance to erosion and burning from the arcs to which they may be subjected.

22.5 Arc chutes shall be of a manageable size. Arc chutes that weigh more than 5 kg shall include an inner replaceable arc box to avoid changing the whole assembly when cheek wear occurs.

23 Rotating Electrical Machines

23.1 The design of all rotating electrical machines used for the train shall be complied with BS EN 60349-1:2002 for non-electronic convertor-fed alternating current motors and complied with BS EN 60349-2:2002 for electronic convertor-fed alternating current motors.

23.2 All rotating electrical machines, particularly those are underfloor mounted, shall be fitted with resilient mountings to eliminate transmission of mechanical vibrations to the carbody.

23.3 Rotating parts shall also be adequately guarded and protected against ejection under failure conditions. Suitable protection shall be put in place to guard against the ejection of rotating parts under failure conditions.

23.4 The rotating electrical machines shall be of the self ventilated type, with simple means provided for exclusion of dust and water. Alternatively, fully enclosed proven air cooled type motor will be considered.

24 Coils and Windings

24.1 This Clause shall apply to all coils and windings, including relay and contactor coils, inductances and transformers, but excluding coils and windings for machines or for oil immersed equipment.

24.2 All coils shall be fully impregnated, or encapsulated by a system rated class H, and shall be continuously rated at the maximum working voltage and/or current, except where Approved.

24.3 Connections to coils shall be to terminals securely fixed to the coil body, to which the ends of the winding can be brought, and which can carry a suitable fixing for the incoming lead.

24.4 Coils with leads which are brought out from the coil shall be submitted for Approval. The leads shall be of suitably insulated multistrand wire and taken to an adjacent terminal block. The joint between the winding and the lead shall be taped or otherwise fixed into the coil body.

24.5 All coils shall be securely fixed to their cores, or otherwise arranged to prevent movement in service.

25 Plugs and Plug-in Components

All multipin plugs, plug-in relays, component boards, electronic cards or racks, or the like shall comply with the following:

25.1 The plug or device shall be adequately and positively secured against working loose.

25.2 The plug contacts shall be adequate and proof against failure to make good contact.

25.3 Incorrect insertion of the plug or device and consequent damage to the contact shall be positively prevented by the use of a guide, shield, or otherwise.

25.4 The cable shall be attached to the plug or socket by an Approved method. Where the cable size is 1.0 mm^2 or larger crimped connection shall be used except where otherwise Approved.

25.5 All the plugs and sockets shall be labelled.

25.6 The caps shall be provided to cover equipment sockets when removed from the car.

26 Relays and Contactors

26.1 Calibrated relays shall have the adjusting mechanism securely locked after setting. Calibration marking on the relays will not be required.

26.2 Where the use of time delay relays is accepted they shall not use liquid damping to obtain the time delay unless the damper is of the fully sealed type.

26.3 Microswitches of the fully sealed type will be considered subject to satisfactory performance on an endurance test, as part of a contactor or otherwise.

27 Low Voltage Components

27.1 Low voltage components such as all low voltage switches, rotary switches and push buttons indicator lamps shall be submitted for Approval.

27.2 The size, colour and brightness of fault indicator and similar lights shall be submitted for Approval. If filament lamps are used the lamp bulbs shall be underrun by energising them at less than 90% of their rated voltage. Filament lamps shall use dim/bright indication.

27.3 Low Voltage toggle switches shall have a quick action mechanism. Switch contacts shall be of the wiper or wiping butt type. Alternatively the use of switches or push buttons with the whole contact part mounted in a sealed box, will be considered. Toggle switches shall have the "Off" position upwards (2 position type) or in the mid position (3 position type) except where otherwise Approved.

27.4 Rotary switches shall have a quick action mechanism and shall be capable of continuous rotation in either direction. They shall have a steel shaft not less than 9 mm at the least section. Except where otherwise specified they shall have the position for normal service with the operating handle vertical.

27.5 Push buttons, except where otherwise specified, shall be shrouded.

28 Protection Devices

28.1 Miniature Circuit Breakers

28.1.1 Miniature circuit breakers (MCBs) shall be of the magnetically tripped type, with a frame size of 100 A, in accordance with IEC 60947-1 : 2007 and IEC 60947-2 : 2001. The OFF and Tripped position shall be the same, with toggle downwards.

28.1.2 The toggle shall be arranged to include means to attach securely, a label or a seal, but tripping of the device shall not be inhibited by such a seal. Operation of the tripping mechanism shall return the toggle to the OFF position. MCBs having alternative arrangements shall not be offered.

28.1.3 The MCB's offered shall be available in the combinations set out in with IEC 60947-1 : 2007 and IEC 60947-2 : 2001, incorporating trip for coils remote operation, auxiliary contacts rated at not less than 0.5 A, 110 VDC., alternative breaker current/time tripping characteristics and with minimum trip currents between 101 % and 125 % of the rated current. The load rating calculations for each MCB shall be submitted for Approval. The calculation shall be revised based on loads measured on the cars, and MCB ratings amended as necessary.

28.1.4 Particular care shall be taken to ensure adequate creepage distances to earth and between terminals of adjacent MCBs are maintained with the units grouped as closely as possible.

28.1.5 MCBs shall be mounted in such a way that shrinkage of insulating panels does not cause loosening of the electrical connections.

28.1.6 Access shall be provided to the rear of the insulating panel, which may be hinged for this purpose where so Approved. Where mounted on a switch board in a cab or similar positions a front sheet metal cover shall be provided, so arranged that any one MCB can be removed from the front without disturbing the rest, after removal of an escutcheon plate or otherwise.

28.1.7 Irrespective of the toggle position, the upper connection to all MCBs shall be the line (AC circuits) or the positive (DC circuits).

28.2 Fuses

All fuses shall comply with IEC 269-1, and associated fuse carriers with IEC 60269-1: 2006 and IEC 60269-2: 2006. Fuse carriers shall be back inserted, provision being made to remove the complete fuse panel.

29 Resistors

29.1 Heavy Current Resistors

29.1.1 Heavy current resistance elements shall comply with IEC 60322 : 2001 and shall be of the edgewound corrosion resistant, unbreakable "nonsag" type. Such resistors shall have a negligible temperature coefficient.

29.1.2 High voltage heavy current resistor elements shall be mounted on, and insulated from (primary insulation) a steel sub-frame and the subframe itself shall be mounted on and insulated from (secondary insulation) the main resistance frame. All insulation shall be suitable for the system voltage. Care shall be taken that adequate strength and insulation is provided at the support for the sub-frame. Mica tubes, as part of insulator assembles, will not be accepted.

29.1.3 All power resistor frames must be safety-earthed.

29.2 Light Current Resistors

29.2.1 Light current resistors shall be of the wire or strip wound type, with the conductor set in vitreous enamel. Where the wire size exceeds l mm the use of vitreous enamel is not mandatory but in all cases the coating, if any, shall not tend to peel off or disintegrate.

29.2.2 The sliders of pre-set resistors shall be adequately locked in position. If adjustment is required between overhauls then the use of rotary preset resistors is a requirement. Such resistors shall have a means of preventing casual adjustment of the setting.

29.2.3 Resistors shall have a resistance within ±5% of the nominal value, unless otherwise specified or Approved. The value, rating and tolerance shall be marked on the resistor.

29.2.4 Carbon rod, or carbon track resistors will not be accepted. Silicon carbide resistors will not be permitted unless the Engineer is satisfied that they are adequately rated.

29.2.5 High voltage protective resistances shall have a rating to match the characteristic of the protective fuse or other device and shall be subject to Approval.

30 Capacitors

30.1 The type of capacitor used for each application shall be submitted for Approval. The service life of electrolytic capacitors shall be at least 10 years.

30.2 Fuses and discharge resistors where required, shall not be integrated with the capacitors.

31 Instruments

31.1 General

31.1.1 This Clause covers electrical and pneumatic instruments. Detailed design requirements regarding the operability of instruments shall refer to RS/C6014/14.

31.1.2 All electrical instruments and their accessories shall be of an Approved type, to IEC 60051 Part 1 to Part 9, with a true zero, with movements suitably damped for rail traction service and shall comply with the following requirements as appropriate.

31.1.3 Instruments shall be suitable for mounting in or on a panel vertically, or at an angle to the vertical of 30° or less. The panel may be of ferrous or other material.

31.1.4 Zero adjustment shall be provided on all instruments. Adjustors shall be accessible only from the rear of the instrument, and without opening the core.

31.1.5 All screws shall be effectively locked. Use of a locking compound will be considered.

31.1.6 Electrical instruments shall be suitable for a circuit working voltage of 660 V to earth and a minimum high potential test of no less than 3000 V to earth.

31.2 Driver's Desk Instruments

31.2.1 The term "Driver's Desk Instruments" includes such as speedometers, ammeters and pneumatic pressure gauges.

31.2.2 Instrument cases shall be weather-proof, and of rugged construction. Small openings for ventilation in the rear of the case may be provided subject to Approval.

31.2.3 All instrument dials shall have at least 100 mm diameter dial and 240° scale (both dimensions approx.) marked with black figures on a white or opaque dial as appropriate. The instrument glass shield shall be positively secured.

31.2.4 All instruments shall incorporate dials and/or pointers with luminous elements with an approved half life, emitting no detectable radiation and containing no radioactive material.

31.2.5 The scale markings and pointer shall be clearly legible from full daylight through to complete darkness. No significant light shall escape into the cab from the scale and none at all from elsewhere.

31.2.6 The method of illumination should minimise dazzle in the tunnel environment and maximise visibility in bright sunlight. Glass covers should be of toughened and diffused type.

31.3 Other Instruments

These shall be at least 75 mm dia approx. surface or flush mounted, to an Approved drawing and shall have a 100° (approx.) scale. Battery charging ammeters, if provided, shall have a centre zero ±50° scale. Illumination will not be required.

31.4 Accuracy

31.4.1 The accuracy of instrument systems (i.e. overall accuracy including accessories) from 10% to 90% f.s.d. of the instrument shall be as under :

(a) Desk mounted instrument systems which include speedometer generators, AC or DC current transformers or the like: ±3%

(b) Other desk mounted instrument system: ±2%

(c) Instrument systems other than (a) or (b) above: ±5%

31.4.2 All accessories shall be interchangeable. Accessories having means of adjustment will be considered, but, once set, it shall, for systems as set out in (b) above, be possible to fit any instrument and still obtain the above specified accuracy grade without adjustment, and the instrument resistance shall be selected accordingly.

32 Electronic Equipment

32.1 General

32.1.1 Electronic equipment shall comply with RS/C6014/03. The use of alternative specifications/standards may be permitted at the discretion of the Engineer.

32.1.2 All electronic equipment shall be subject to the following provisions:

(a) Electronic equipment shall normally be mounted in "clean" enclosures, such as sealed against ingress of dirt and moisture. Large components or those that dissipate considerable heat such as transformers and resistors may be mounted outside the enclosures. Heat sinks and cooling fins may penetrate the enclosure so that the dissipating element is outside and the component in a clean area.

(b) Groups of less than 10 kg weight may be arranged at self contained, easily removable and replaceable units, with external connections brought to a plug and socket.

(c) Any software used in the electronic equipment shall comply with RS/C6014/05.

(d) If microprocessor control equipment is used, software documentation shall be provided in accordance with RS/C6014/05. In addition, any special test equipment or facilities for testing and checking of the microprocessor based PCBS shall be declared. Any software used to carry out the automatic tests shall be provided together with associated document and test procedures by the Contractor at no additional cost to the contract sum.

(e) Adjustable or pre-set resistors shall not be used.

(f) The LEDs used shall have the following conventions:

Red - indicate fault condition (normally off)
Green - indicate normal operation condition (normally on).
Yellow - indicate status of system (normally can be on or off)

32.1.3 Circuit boards in safety control system, such as the braking system, which, if the train is operated with card removed, could cause damage, directly or indirectly, shall be connected through a safety circuit to disable the train if a circuit board is removed.

32.2 Printed Circuit Board (PCB)

32.2.1 Material

(a) The material for the PCB shall be:

(i) high impact resisting,
(ii) non-absorbent,
(iii) anti-corrosive,
(iv) flame retardant,

(v) ozone and Ultra-violet resisting, and
(vi) produce low smoke and nil toxic fume such as carbon monoxide in the event of fire or short circuit.

(b) The copper laminate shall be firmly attached to the board and shall be resistant to blistering and peeling when heated with a soldering iron.

(c) The minimum thickness of PCB shall be at least 1.6mm.

32.2.2 The laminate used shall be epoxy-glass based to BS EN 61249-27 :2002 or CEM equivalent type.

32.2.3 The board which is designed for free of maintenance, shall be potted by Epoxy. The potting material shall be of UL94V-0 rated.

32.2.4 Track Layout and Artwork

(a) Track to track, track to pad, and pad to pad spacing shall in general be as wide as the electrical clearance can allow.

(b) The cross-section of each circuit track shall be adequate to prevent fusing or delamination of the track under fault conditions before the protecting device, such as, fuse, has been able to interrupt the fault current.

32.2.5 Component Layout and Fixing

(a) Component parts shall be located, secured and disposed with respect to each other and the structure members so that they can be inspected, removed and replaced without damage to or causing an undue disturbance of other parts or wiring.

(b) All components shall be mounted such that they do not become damaged or disconnected when the equipment is subjected to any type and routine tests.

(c) All components shall be mounted on one side only.

(d) Physical separation and protection of the terminals and wiring shall be provided by means of insulation separators.

32.2.6 Protective Coatings

(a) All PCB assemblies shall be protected on both sides with a flame retardant protective transparent coating, in order to prevent deterioration or corrosion due to moisture and atmospheric contaminants. The coating

shall not have any adverse reaction with any other materials or components used. The coating shall be solvent removable with cleaner for PCB repairing purpose.

(b) The type of coating and cleaner shall be submitted for Approval.

32.2.7 Components

All components shall comply with BS 9000 Part 1 to Part 3.

32.2.8 Sourcing

(a) Components with complete physical and functional compatibility according to the manufacturers' published data together with a reliable source shall be used.

(b) All integrated circuits and semi-conductor device shall be standard devices available from at least two different manufacturers.

32.2.9 Choke and Transformer

The chokes and transformers listed in the component list are the special purpose devices which shall be supplied by the Contractor. Windings shall be vacuum impregnated or encapsulated and shall terminate on a terminal board mounted on the item. Secondary windings shall be isolated from the primary winding. The Contractor shall state the insulating material used, submit information and demonstrate operational compatibility.

32.2.10 Component Cooling

(a) All power electronic switches and heat dissipated components shall be of natural cooling type.

(b) Cooling fans shall not be used within electronic equipment unless a positive indication of fan failure is provided for maintenance purpose and subject to Approval.

32.2.11 Push Button Switches

(a) Not used.

(b) The contacts shall be rated for a life of not less that 10 years and shall be capable of operating under emergency conditions of multiple unit operation.

(c) Terminals shall accept ring tongue crimps. The push button design shall be capable of assembly with at least 3 normally open plus one normally closed contacts.

(d) The contract rating shall not be less than 2 A inductive with a time constant of 15ms at 110 VDC.

32.2.12 Connectors

(a) All PCBs shall be connected to the internal case or rack wiring as appropriate by means of approved multipin connectors.

(b) Connectors between PCBs or electronic modules and the train wiring and/or other racks or cases shall be by means of multipole connectors.

(c) Unless otherwise Approved, the use of PCB edge connectors will not be permitted.

(d) The contact area of each connector shall be plated with to a minimum thickness of 1.25µm of gold over a minimum of 0.75µm of low stress nickel.

(e) Mechanical polarisation to prevent insertion into the wrong socket shall be provided to all PCBs.

32.2.13 Locking

Each PCB or module shall be positively retained in the rack or case by a fastener or spring loaded locking pin.

32.2.14 Limitation of failure

In any electronic rack system, the failure of any one module or individual circuit board shall neither cause loss of the electronics power supply within the rack, nor cause subsequent failure of circuits on other PCBs or modules.

32.2.15 Status monitoring

Each PCB or module shall incorporate indicator and/or test socket mounted on the front panel which shall show:

(a) power supply on;

(b) status of digital inputs/outputs; and

(c) status of analogue inputs/outputs.

32.2.16 Test points

(a) Test points shall be provided in appropriate locations on modules and PCBs. A negative return test point shall be provided.

(b) The test points shall accept a standard 2mm diameter plug and shall be sited with sufficient clearance to permit a standard oscilloscope probe to be attached to the plug.

(c) As an alternative, these test points may be wired through a connector to a portable test and monitor box.

(d) Whichever method is used, each test point shall be clearly identified on both the equipment and on any related drawings.

32.3 Use of Microprocessor or Software Based Equipment

32.3.1 Single microprocessors shall not be used in circumstances where a single fault condition could result in any unsafe conditions. Where microprocessor based equipment is used in a safety application, a minimum of three independent processors shall be used, with any output recurring a minimum 2 out of 3 vote before being activated.

32.3.2 Where microprocessor system incorporates technology such as surface mounted component, multilayer circuit boards or flexible PCBs, the Contractor shall provide evidence demonstrating that satisfactory operational experience has been gained on the successful use of these technologies in a similar railway environment.

32.3.3 It is preferred that Integrated Circuits (ICs) are soldered directly into the circuit board. This includes all forms of memory IC and microprocessors. The use of sockets in specific instances will be considered at the discretion of the Engineer and will generally be limited to the installation of pre-programmed devices containing the operating software for the system. Where IC sockets are employed, the devices contained therein shall be positive retained once installed.

32.3.4 Microprocessor based system shall have watchdog circuits to ensure correct software operation. The watchdog circuit should not be reset except when the main control program, including all subroutines and

allied programs, is running correctly. When the watchdog circuit detects a fault, it shall trigger hardware forcing all system outputs into a safe state before resetting the system and then the system shall enter into a self-test mode. Normal operation shall only be resumed if all self-test checks are satisfactory.

32.3.5 Power supply rails shall be closely monitored. Any transient or dip likely to cause data corruption, or partial loss of correct hardware initialisation states, shall be detected and outputs forced into a safe state. When the power supply recovers, all ICs shall be reset and the system re-initialised.

32.3.6 Microprocessor systems shall incorporate self-test and diagnostic facilities to locate and indicate faults within the system. It is preferred that the system has sufficient inbuilt diagnostic capabilities to automatically identify all system faults. However, any additional in-built test hardware or software shall not lead to reduced system reliability or safety. It shall also be possible to use such diagnostic facilitates whilst the equipment is in normal operation in order that real-time events may be monitored whilst the train is in motion.

32.3.7 Design consideration shall be given to the diagnostic facilitates to record system behaviour and parameters for a period before and after a trigger signal initiated from the diagnostics terminal for maintenance purpose.

32.3.8 Where microprocessor systems require additional test or diagnostic equipment, this shall be portable for use on the train. It shall wherever possible derive its power supply from that of the system under test. Where the test/diagnostic equipment employs portable computers, the Contractor shall provide means of powering such equipment from the low voltage power supply of the train.

32.3.9 Test equipment shall be robust and easy to use with the minimum of specialist training.

32.3.10 Light Emitting Diodes (LEDs) shall be used to indicate faulty modules to allow rapid fault diagnosis and maintenance.

32.3.11 Faults occurring during system operation shall be logged with information stored in non-volatile memory. The data stored shall be accessed by a portable hand-held terminal for maintenance purposes, shall be concise and allow the nature of the fault to be clearly identified. The hand-held terminal shall also be used to access or control any inbuilt system maintenance functions such as signal state monitoring and control of output signals for test purposes.

32.3.12 Design consideration shall be provided to access and adjust within safe limits the operating parameters of the equipment for test and development purpose. Any alternations thus made will be lost whenever the equipment is re-initialised.

32.3.13 Microprocessor bus signals shall be properly terminated to prevent cross-talk or corruption of signals. Bus signals shall be well separated and ground planes used on PCBs to reduce susceptibility to electromagnetic interference.

32.3.14 Additional requirements of the microprocessor based system on the application of train management system shall refer to RS/C6014/01.

33 Health and Safety Requirements for Construction Works

33.1 The Contractor and his subcontractors shall comply with the health and safety requirements specified in GS Section 15 and the relevant statutory regulations, especially the Factories and Industrial Undertakings Ordinance, Dangerous Goods Ordinance and their subsidiary legislations of the Hong Kong Government.

33.2 The Contractor and his subcontractors will be required to stop work whenever any of the above requirements is found breached and will not be allowed to resume work until the satisfactory rectification of the unsafe condition.

34 Testing Requirements

Tests shall be carried out according to the relevant/approved standards.

35 System Engineering Management System

The mechanical, electrical and electronic equipment shall follow the overall design development schedule of the associated system according to the approved System Engineering Management Plan.

36 Paint Performance

36.1 All painted surfaces shall have a service life of at least 15 years.

36.2 The paint coating shall resist mechanical damage in accordance with the following requirements for its specified life:

(a) Scratch resistance in accordance with BS EN ISO 1518: 2001 when using a 2.5 kg load. The paint coating shall not be penetrated.

(b) Impact resistance in accordance with BS 3900: Part E7: 1974. The paint coating shall have no signs of cracking, flaking and detachment from the substrate.

(c) Chip resistance in accordance with BS AU 148: Part 15: 1969. The degree of damage shall not exceed Grade 2.

(d) Abrasion resistance in accordance with ASTM D4060 - 2007, shall be such that the weight loss shall not exceed 30 mg after 500 cycles, using CS10 wheels detailed in the Taber Abrader Test.

36.3 Paint adhesion in accordance with BS EN ISO 2409: 2013 shall meet Class 0. The spacing of cuts shall depend on the thickness of paint coating and type of substrate as stipulated in BS EN ISO 2409: 2013.

36.4 Paint elasticity for metal substrate shall

(a) not exceed 25 mm crack length when subjected to bending around a conical mandrel as defined in BS EN ISO 6860: 2007.

(b) not have crack with a minimum depth of indentation of 3.5 mm at a cupping test apparatus as defined in BS EN ISO 1520: 2007.

36.5 The paint coating shall be capable of withstanding all contaminants encountered in normal service as well as the cleaning materials, cleaning methods and cleaning routines detailed in the PS.

36.6 The gloss level of the painted surface shall be determined by reflectometer geometry of 60° in accordance with BS EN ISO 2813: 2000. The variation shall be less than 10 units or 20% of the mean value.

36.7 The painted surface shall not exhibit any mottling, cracking, blistering or other forms of deterioration throughout its service life.

36.8 All painted surfaces shall match and display a uniformity of colour throughout their service life.

ROLLING STOCK STANDARD RS/C6014/03
ELECTRICAL AND ELECTRONIC DESIGN REQUIREMENTS

1 Introduction

2 Standards/Reference

3 General Requirements

4 Specific Requirements

5 Testing Requirements

6 System Engineering Management System

Table STD03-1 Summary Effects of Electrical Shock

Table STD03-2 Example Bonding Impedances and Bonding Class

Table STD03-3 Surface Creepage and Electrical Clearance Values for Equipment in Circuits Operating at Voltages Exceeding 250V and not Exceeding 3000V

ROLLING STOCK STANDARD RS/C6014/03
ELECTRICAL AND ELECTRONIC DESIGN REQUIREMENTS

1 Introduction

1.1 This Standard shall be applicable to the electrical and electronic equipment, hereafter in this Standard called the equipment, to be used on the trains.

1.2 Only equipment and materials which meet the requirements of this Standard shall be used on the train.

1.3 Wherever quoted standards duplicate requirements for a particular criterion, the more stringent standard shall apply. Any conflict in requirements shall be brought to the attention of the Engineer.

1.4 Where the Contractor proposes a variation from this Standard he shall state the area and the reasons for Approval.

1.5 This Standard shall be read in conjunction with the RS/C6014/02 to ensure all equipment are designed, fabricated and installed such that it is capable of being operated, maintained, inspected and tested satisfactory for the train system and without any safety hazard to personnel.

2 Standards/Reference

IEC 60077-1 : 1999	Railway applications - Electric equipment for rolling stock - Part 1: General service conditions and general rules
IEC 60077-2 : 1999	Railway applications - Electric equipment for rolling stock - Part 2: Electrotechnical components - General rules
IEC 60077-3 : 2001	Railway applications - Electric equipment for rolling stock - Part 3: Electrotechnical components - Rules for d.c. circuit-breakers
IEC 60077-4 : 2003	Railway applications - Electric equipment for rolling stock - Part 3: Electrotechnical components - Rules for AC circuit-breakers
IEC 60077-5 : 2003	Railway applications - Electric equipment for rolling stock - Part 3: Electrotechnical components - Rules for HV fuses

IEC 60571:2006	Electronic Equipment Used on Rail Vehicles
IEC 60990:1999	Methods of Measurement of Touch-Current and Protective Conductor Current
BS EN 50155:2007	Railway Applications - Electronic equipment used on rolling stocks
BS EN 50153:2002	Railway Applications - Rolling Stock - Protective Provisions Relating to Electrical Hazards
BS 2618:1975	Electric Traction Equipment
BS EN ISO 7010:2012	Graphical symbols - Safety colours and safety signs - Registered safety signs
BS 9522 N003 :1990	Detail specification for Multi-contact circular electrical connectors for d.c. and low frequency applications Bayonet coupling non-barrier sealed, environment resistant with rear insertable, rear release, rear removable crimp contacts also barrier sealed with non-removable solder contact styles Full plus airframe fit assessment
BS 5825:1991	Specification for low voltage switchgear and control gear for industrial use. Mounting rails. G-profile for the fixing of terminal blocks
BS EN 50121-1: 2006	Railway applications – Electromagnetic compatibility - Part 1: General
BS EN 61373:1999	Shock and Vibration requirements for rolling stock equipment
RIA 22:1990	The Technical Guide on EMC for Electronic Equipment Used on Traction and Rolling Stock
RS/C6014/02	Constructional and Workmanship Requirements

3 General Requirements

3.1 Safety Requirements

3.1.1 Workmanship and Material

(a) Good workmanship shall be used in the construction and installation of the equipment installation.

(b) Detailed requirements of general workmanship shall refer to RS/C6014/02.

(c) All equipment and wiring shall be out of sight of passengers when installed within the car body, except where the equipment is specifically intended for their use.

(d) All materials chosen and used in equipment installation shall be purposely designed for the intended application and shall not cause undue fire risk or electrical hazard.

3.1.2 Protection

(a) Electrical equipment shall be mechanically and electrically protected so as to prevent danger from shock, burn, or other injury to persons or damage to property or from fire of an electrical origin.

(b) Mechanical protection shall include the provision of protective covers, guards and means of identification, the display of warning notices and the placing of equipment out of reach. The design of safety signs shall be complied with BS EN ISO 7010:2012.

(c) Electrical protection shall include the provision of isolation, protective devices and earthing facilities as well as equipotential bonding of all the exposed conductive parts and extraneous conductive parts. Design of the protective provisions shall comply with BS EN 50153:2002.

(d) For the purpose of maintenance, it is important to ensure the safety of persons approaching the equipment to work on it or attend to it. It shall be noted that equipment shall not only be so constructed and protected as to be suitable for the conditions under which they are required to operate, but shall also be installed to be capable of being maintained, inspected and tested with due regard to safety.

3.2 Circuit Arrangement

3.2.1 Division of Circuits

(a) The equipment shall be divided into circuits where necessary or practicable and each circuit shall be separately protected and controlled.

(b) Each circuit shall be protected by an overcurrent protective device with its operating current value closely related to the current demand of the current-using equipment connected or intended to be connected to it and to the current carrying capacity of the conductor connected.

(c) A fault on one circuit shall not result in the shutting down of any unrelated parts of the installation as far as reasonably practicable.

3.2.2 General Requirements

(a) Each circuit shall be provided with means of interrupting the supply on load and isolation for electrical servicing and testing purpose without affecting other circuits.

(b) Unless otherwise specified, all hardwired control circuit shall be supplied by the DC output of the auxiliary converter (refer to PS 17.4).

(c) Safety related circuits (refer to PS 9.9) shall be electrically separated from one another and from other circuits.

(d) For the safety related circuits, a dedicated pairs of wire shall be provided for both poles of DC supply and means of circuit isolation (e.g. circuit breakers, relay contacts or contactor contacts) shall also be provided at both poles of supply to facilitate a "double cut" circuit isolation of the safety related circuit.

(e) Single phase loads in an installation with three phase supply shall be evenly and reasonably distributed among the phases.

3.2.3 Current Demand

(a) The current rating of a circuit shall not be less than the current demand of the circuit.

(b) The current demand of a circuit shall be the same as the rating of the overcurrent protective device of the circuit.

(c) The nominal current or current setting of the devices shall not be less than the design current of the circuit.

(d) The nominal current or current setting of the devices shall not exceed the lowest of the current-carrying capacities of any of the conductors in the circuit.

(e) The current causing effective operation of the devices shall not exceed 1.45 times the lowest of the current-carrying capacities of any of the conductors of the circuit.

(f) Sufficient safety margin shall also be provided on determining the current rating of a circuit.

(g) For a circuit having non-simultaneous or cyclic loads such that only one of these loads can be in use at any one time, the greatest of these loads shall be used in calculating the current demand of the circuit.

3.2.4 Isolation and Switching

(a) An equipment shall be provided with a main switch or circuit breaker and a means of isolation to cut off all voltages. These two functions may be incorporated in a single device.

(b) The main switch or circuit breaker shall interrupt all live conductors and be capable of cutting off the full load current of the equipment from supply.

(c) Every circuit or group of circuits shall be provided with:
(i) a means of isolation; and
(ii) a means of interrupting the supply on load.

3.3 Fire Performance

The material for the equipment shall, as far as is practicable, have a high resistance to fire propagation and minimise the production of smoke and toxic fumes in the event of fire or short circuit. The materials shall meet the fire performance requirements to RS/C6014/08.

3.4 Shock and Vibration Performance

The equipment shall be designed to withstand shocks and mechanical vibrations during operation. The equipment shall meet the requirements of IEC 60077-1:1999, IEC 60077-2:1999, IEC 60077-3:2001, IEC 60077-4:2003, IEC 60077-5:2003, IEC 60571:2006 and BS EN 61373:1999 as appropriate, for shock and vibration resistance.

3.5 Design Requirement for Electrical Equipment

The electrical equipment shall comply with the specifications of IEC 60077-1:1999, IEC 60077-2:1999, IEC 60077-3:2001, IEC 60077-4:2003, IEC 60077-5:2003.

3.6 Design Requirement for Electronic Equipment

The electronic equipment shall comply with the specifications of IEC 60571:2006, BS EN-50155:2007 and RIA 22.

3.7 Electromagnetic Compatibility Requirement

The electrical and electronic equipment shall comply with the Rolling Stock standard RS/C6014/04.

4 Specific Requirements

4.1 Selection Criteria for Electronic and Electrical Components

The Contractor shall ensure that:

4.1.1 Components selected have ratings and characteristics appropriate to their applications and are able to withstand the electrical, mechanical and environmental stresses to which they will be subjected during manufacture, storage and use, when incorporated in the equipment.

4.1.2 Components are defined by a specification reflecting the requirements of Clause 4.1.1.

4.1.3 Components are selected to minimise the range to be stocked by the Engineer as spares.

4.1.4 Components are selected to maintain continuity of supply for the life of the equipment.

4.1.5 Procedures and controls governing selection and use of components to meet the policy set out in the configuration control program (refer to Appendix P) shall be defined in the Contractor’s and subcontractor’s work instructions and these are traceable by the Contractor’s quality management system (refer to PS 27).

4.2 Sources of Supply

4.2.1 Components selected shall be obtained from manufacturers or distributors able to supply them with evidence of conformity to the relevant specification.

4.2.2 The Contractor shall ensure traceability of components.

4.3 Grounding Concepts

4.3.1 Objective

(a) Since proper grounding is fundamental for reliable electrical and electronic circuits, the design of electrical grounding shall adhere to a proven set of requirements and design approaches to produce safe and trouble-free electrical and electronic circuits.

(b) The grounding practice used in the design and assembly of electrical and electronic systems shall protect personnel and circuits from hazardous currents and damaging fault conditions.

4.3.2 System Grounding Requirements and Design Approaches

(a) The design of electrical and electronic systems shall comply with the following as a minimum:

(i) A ground reference plane shall be established that will hold the grounds for all systems, subsystems, equipment metallic components, surfaces, and electrical and electronic parts at the potential of the base structure;

(ii) Within equipment, power shall have dedicated returns;

(iii) Except for a single-point reference, all electrical signal and power grounds shall be electrically isolated from each other, and each separately derived electrical system shall be electrically connected to structure at only one point;

(iv) A dedicated power return shall be used except where necessary to support system requirements.

(b) The following design approaches shall be considered for the design of these systems:

(i) Within equipment, conditioned electrical power shall be DC isolated from chassis and structure except at a single point;

(ii) Within equipment, the single-point reference shall be routed external to the equipment for termination to ground, or routed directly to the chassis for termination;

(iii) The control power bus return shall be independent of the primary electrical power return and shall be referenced to the return system at a single point;

(iv) Secondary and tertiary electrical power shall be single-point grounded and shall be returned to that single reference ground point;

(v) When all single-point grounds are not terminated to chassis or structure, secondary and tertiary electrical power shall be DC isolated by a minimum of 1 megohm;

(vi) Power conversion performed to supply conditioned power to several devices or functions shall re-establish a single-point ground reference for the serviced equipment or functions;

(vii) Equipment shall not depend on other equipment for reference or grounding, either signal or power, unless it is also dependent upon the other equipment for its power;

(viii) Signal circuits with frequencies below 2 MHz, with interfaces external to equipment, shall be balanced and isolated from chassis;

(ix) All returns and references shall be brought out of equipment on individual connector pins;

(x) Shield connections shall be made to connector shells or to connector pins that are, or will be, grounded when mated;

(xi) Single-ended circuits with the lowest frequency component equal to or above 2 MHz shall be coupled by coaxial or screened twist pair cable with the shield or screen terminated 360 degrees at each end;

(xii) External to an equipment, single-ended electrical signals shall be prohibited for signal frequencies below 2 MHz except where electrical isolation is maintained.

4.3.3 Shock Prevention

(a) Proper grounding shall be provided to protect personnel from accidental contact with metallic elements that may have hazardous voltage potentials due to system faults or accidental contact between energized elements and equipment chassis, frame or cabinet structure.

(b) Case voltage rise shall be limited to reduce currents to levels that do not produce adverse reactions and possible secondary effects. Typically, case voltage rise shall be limited to prevent hazardous currents. Table

STD03-1 summarizes the alternating and direct currents and their shock effects.

(c) In order to evaluate the performance of shock prevention, the measuring method of touch-current specified in IEC 60990:1999 shall be applied.

4.3.4 Bonding

(a) The integrity of interconnected conductive elements shall be ensured by electrical bonding, a process in which components or modules shall be electrically connected to provide a low-impedance conductor.

(b) Positive mechanical locking means, such as, clamps, bolts and screw attachments, washers and materials, shall be used to ensure consistent bonding of equipment under various temperatures and corrosion environments.

(c) The use of jumper cables will not be accepted except across movable vibration or thermal isolation joints.

(d) Surface preparation for bonded joints shall begin by removing all anodic film, grease, paint, lacquer, or other high-resistance properties from the flaying surfaces.

(e) Correct use of scrapers, abrasives or chemical cleaning methods to provide a clean, smooth bonding surface shall be adopted according to the type of joint (i.e., metal-to-metal, metal-to-non metal or non metalto-non metal).

(f) Example bonding impedances for selected bonding classes are shown in Table STD03-2.

4.3.5 Cabling/Connector Grounding

(a) Since cabling extending outside grounded enclosures is vulnerable to radiated emissions if cable lengths are a significant portion of the wavelength of the system's highest operating frequencies, adequate shielding and grounding shall be provided to ensure proper system operation.

(b) Shield terminations at connectors shall be gripped by the connector back shell to provide a low impedance 360 degree connection.

(c) Soldered connections shall not be used due to the difficulty in repair and wiring changes.

4.3.6 Detailed requirements and practices of circuit earthing shall refer to RS/C6014/02.

4.4 Equipment Construction

4.4.1 In order to facilitate efficient trouble shooting or equipment replacement, the various parts of the electrical and electronic equipment supplied shall be grouped into small sections, such as in the form of equipment panel, module and box.

4.4.2 As far as possible, plugs and sockets compatible with MIL-C-26482 and connectors conforming to BS 9522 N003 :1990 shall be used for connecting each section of equipment group. In addition, the coupling shall be indicated by an audible click and the alignment shall be provided with 3 red dots on the receptacle and plug.

4.4.3 The use of modular design particularly with the DIN rail mounting arrangements conforming to BS 5825:1991 shall be encouraged, so that the individual equipment can be removed for maintenance with minimum disturbance to the other equipment.

4.4.4 To configure the individual electrical and electronic equipment section, the Contractor shall arrange all of the equipment according to the principles of ease to access in which it can be maintained. In providing satisfactory space for the maintainer to carry out his tasks, the Contractor shall take account of the basic human data considerations of body size, strength and stamina. Detailed requirements on maintainability shall refer to PS 26.

4.5 Electrical Creepage and Clearance

4.5.1 Electrical creepage and clearance shall be as specified in BS2618:1975 and comply with Table STD03-3.

4.5.2 In addition, the following design considerations shall be applied:

(a) Voltages less than 250 V shall be treated as 250 V unless otherwise Approved.

(b) In the case of equipment mounted on the roof of the vehicle or in dirty conditions, horizontal or similar surfaces liable to retain dirt shall be excluded in determining creepage distances. The minimum clearance pantograph to roof structure shall be taken as 75 mm except for the vertical clearance pantograph to roof, which may be 50 mm.

(c) The length of an insulating tube or equivalent used to carry compressed air directly to an item energised at 1,500VDC shall be at least 400 mm. Such a tube shall be located so that condensate cannot collect in the high voltage item or insulating tube.

(d) Creepage or clearance where arcs are present, or creepage along the outside of a cable sheath shall be 200% of that specified above.

(e) Creepage or clearances in the case of double insulated equipment shall be subject to Approval.

5 Testing Requirements

5.1 The testing requirements for all equipment shall refer to IEC 60077-1:1999, IEC 60077-2:1999, IEC 60077-3:2001, IEC 60077-4:2003, IEC 60077-5:2003, IEC 60571:2006, BS EN 50155:2007, BS EN 50121-1: 2006 and BS EN 61373:1999 or equivalent.

5.2 All test results, data, graphs and analysis of results shall be submitted for Approval.

5.3 When an item of equipment has been previously tested to comply with the requirements stipulated in this Standard, then the previous Type Test results may be accepted by the Engineer and shall be submitted for Approval.

6 System Engineering Management System

The electrical and electronic design shall follow the overall design development schedule of the associated system according to the approved system engineering management plan.

Table STD03-1 Summary Effects of Electrical Shock

Alternating Current at 60Hz (mA)	Direct Current (mA)	Reaction
0.5-1	0-4	Perception
1-3	4-15	Surprise
3-21	15-80	Reflex action
21-40	80-160	Muscular inhibition
40-100	160-300	Respiratory block
> 100	> 300	Usually fatal

Table STD03- 2 Example Bonding Impedances and Bonding Class

Bonding Class	Impedance
A (Antenna installation)	DC resistance < 2.5 milliohms
H (Shock hazard)	DC resistance < 100 milliohms
R (RF potentials)	DC resistance < 2.5 milliohms Impedance < 100 milliohms up to 1 MHz
S (Static charge)	≤ 1 ohm (conductive structure) ≤ 1000 ohms (composites) ≤ 1000 ohms (conductive subassemblies) ≤ 1 ohm (pipe and hose)

TABLE STD03-3 Surface Creepage and Electrical Clearance Values for Equipment In Circuits Operating At Voltages Exceeding 250 V and Not Exceeding 3000 V

Nominal line voltage	Minimum surface creepage values			Minimum electrical clearance values	
	Clean Conditions	Dirty Conditions	Roof Mounted	Inside Mounted	Outside Mounted
volts	mm	mm	mm	mm	mm
250 to 600	12	30	60	12	25
750	20	50	65	12	35
1200	30	60	80	15	45
1500	40	70	90	20	50
2400	60	90	115	25	65
3000	75	100	140	30	75

Notes: The following meanings have been assigned to the terms used in the headings of Table STD03-3:

(a) Clean conditions. Applies to equipment mounted in vehicle compartments, switch-group (control-group) cases, cupboards and all enclosed apparatus.

(b) Dirty conditions. Applies in particular to resistors mounted in a resistor compartment, beneath the underframe or on the roof of the vehicle.

(c) Roof mounted. Applies in particular to ceramic insulators for pantographs and for bare conductors. It does not apply to rubber piping for pantograph air supply or to roof cabling, to which larger values shall be applied.

(d) Inside mounted. Applies to equipment mounted either in an enclosure which is dust-proof or in a chamber where clean conditions apply.

(e) Outside mounted. Applies to equipment which does not fulfil the conditions for inside mounting.

(f) Electrical clearance. The values given in the table do not apply to situations influenced by electrical arcs.

ROLLING STOCK STANDARD RS/C6014/04
ELECTROMAGNETIC COMPATIBILITY

1 Introduction

2 Standards
- 2.1 International Standards
- 2.2 European Standards
- 2.3 Local Standards/Regulations
- 2.4 Rolling Stock Standards

3 Definitions and Abbreviations
- 3.1 Definitions
- 3.2 Abbreviations

4 Compatibility Requirements
- 4.1 Interference Considerations
- 4.2 General Electromagnetic Interference
- 4.3 Rolling Stock Radiated and Conducted Emissions
- 4.4 Rolling Stock Equipment Immunity Levels

5 Communication Equipment Compatibility

6 Signalling Equipment Compatibility

7 Public Systems Compatibility

8 Testing Requirement
- 8.1 Vehicle Level
- 8.2 Equipment Level

9 System Engineering Management System
- 9.1 SEMP Stage 1
- 9.2 SEMP Stage 2
- 9.3 SEMP Stage 3
- 9.4 SEMP Stage 4
- 9.5 SEMP Stage 5

10 Supply Filter

ROLLING STOCK STANDARD RS/C6014/04
ELECTROMAGNETIC COMPATIBILITY

1 Introduction

The purpose of this Standard is to define the Electromagnetic Compatibility (EMC) requirements of this Contract. It covers the EMC requirements between trainborne equipment, signalling equipment, communications equipment, power supply equipment, nearby equipment and adjacent external installations. All the supplied trainborne equipment shall operate reliably in terms of performance and functionality in the electromagnetic environment existing in the Urban Lines and shall not affect other third parties within or near the Urban Lines.

If the supplied equipment affect any system for the operation, support of service, and safety of the Urban Lines, further works shall not be allowed on the supplied equipment until the Contractor has eliminated the interference to the affected systems.

2 Standards

The supplied equipment shall meet the following standards, where applicable, on EMC requirements:

2.1 International Standards

2.1.1 IEC 61000-4-1 : 2006
Testing and Measurement Techniques
Section 1 : Overview of IEC 61000-4 series

2.1.2 IEC 61000-4-2 : 2001
Testing and Measurement Techniques
Section 2 : Electrostatic Discharge Immunity Test

2.1.3 IEC 61000-4-3 : 2006
Testing and Measurement Techniques
Section 3: Radiated, Radio-Frequency, Electromagnetic Field Immunity Test

2.1.4 IEC 61000-4-4 : 2004
Testing and Measurement Techniques
Section 4: Electrical Fast Transient/Burst Immunity Test

2.1.5 IEC 61000-4-5 : 2005
Testing and Measurement Techniques

Section 5: Surge Immunity Test

2.1.6 IEC 61000-4-6 : 2006
Testing and Measurement Techniques
Section 6: Immunity to Conducted Disturbances, Induced by Radio-Frequency Fields

2.1.7 IEC 61000-4-8 : 2001
Testing and Measurement Techniques
Section 8: Power Frequency Magnetic Field Immunity Test

2.1.8 CCITT Recommendation K Series

2.2 European Standards

2.2.1 BS EN 50121-3-1 : 2006
Railway Applications - Electromagnetic Compatibility, Rolling Stock - Train and Complete Vehicle

2.2.2 BS EN 50121-3-2 : 2006
Railway Applications - Electromagnetic Compatibility, Rolling Stock - Apparatus

2.2.3 Not used

2.2.4 BS EN 61000-6-4 : 2007
Electromagnetic Compatibility – Generic Standards - Emission Standard for Industrial Environments.

2.2.5 BS EN 61000-6-2 : 2005
Electromagnetic Compatibility - Generic Standards - Immunity for Industrial Environments.

2.2.6 BS EN 55011 : 2007
Limits and Methods of Measurement of Radio Disturbance Characteristics of Industrial, Scientific and medical (ISM) Radio-Frequency Equipment

2.2.7 Not used

2.2.8 BS EN 45502-2-1 :2003
Active Implantable Medical Devices Part 2-1

2.3 Local Standards/Regulations

2.3.1 Hong Kong Telecommunication (Control of Interference) Regulations 1993 Edition (Chapter 106 subsidiary legislation)

2.4 Rolling Stock Standards

Refer to RS/C6014/02 on the general specification for electronic and electrical equipment used on trains.

2.5 Whenever quoted standards duplicate requirements for a particular performance criterion, the more applicable standard shall apply at the discretion of the Engineer.

2.6 The Contractor may propose alternative EMC standard(s) for Approval.

3 Definitions and Abbreviations

3.1 Definitions

Not used.

3.2 Abbreviations

The following abbreviations are used in this Standard :

ATO	Automatic Train Operation
ATP	Automatic Train Protection
CCTV	Closed Circuit Television
CID	Criminal Investigation Department
EMC	Electromagnetic Compatibility
FMECA	Failure Modes Effects and Criticality Analysis
PABX	Private Automatic Branch Exchange
SCADA	Supervisory Control and Data Acquisition
TMS	Train Management System

4 Compatibility Requirements

4.1 Interference Considerations

The Contractor shall take into account the following interference mechanisms in his design and take all necessary measures to eliminate their impact on the supplied equipment:

4.1.1 Radiated interference - at a distance greater than approximately one sixth of a wavelength away from a radiating antenna or interfering source the radiation field dominates and is the mechanism to be considered;

4.1.2 Induced interference - can be due to direct magnetic induction from power electronics and cables. The induction field produced by rate of change of current not equal to zero is the most significant component at distances less than one sixth of a wavelength away from the disturbing source;

4.1.3 Conducted interference - can take several forms:

(a) Interference present on the power supply to equipment

(b) Equipment that shares a common earth return can be subjected to interference from other equipment due to voltage drops across the return path

(c) Signalling equipment that uses the running rails as conductors to transmit or receive signals is subject to interference coupled into the running rails as a result of traction return current in the running rails

(d) Equipment with external interface can be subjected to interference present on interface cables and wires

4.1.4 Electrostatic discharge - occurs under dry atmospheric conditions in which electrostatic discharge from the human body (can become charged to several thousand volts) can result in loss of data or may physically damage equipment containing sensitive components.

4.2 General Electromagnetic Interference

The Contractor shall ensure that there is sufficient protection to prevent Electromagnetic Interference (EMI) from any components and systems of the supplied trainborne equipment, including traction motors and auxiliary converters, from affecting the following on-board systems and systems within and adjacent to the Urban Lines. Components and systems to be considered shall include, as a minimum, the following :

4.2.1 All trainborne electronic and electrical equipment including those for doors (refer to PS 16), air conditioning and ventilation system (refer to PS 15), pneumatics and air distribution system (refer to PS 13), traction and braking (refer to PS 11), auxiliary electrical supply (refer to PS 17) and train management system (refer to PS 10).

4.2.2 All trainborne communication equipment including the equipment listed in PS 18

4.2.3 All trackside and adjacent communication systems including :

(a) All communication and SCADA equipment and cables

(b) Communication systems in all Urban Lines stations, Operation Control Centre (OCC), all Urban Lines Depots

(c) Train Radio system

(d) Hand Portable Radio system

(e) Royal Hong Kong Police and Criminal Investigation Department (CID) Radio system

(f) Fire Services Department Radio system

(g) Paging system

(h) Public Mobile Radio-telephone system

(i) Personal Communication Network system

(j) Public Broadcast Services and Communication Services including AM radio, FM radio and pay phone

(k) Direct Line Telephone, Private Automatic Branch Exchange Telephone (PABX) and Tunnel Telephone

4.2.4 Urban Lines Signalling and Automatic Train Control system including both the trackside and trainborne equipment and cables

4.2.5 Customer goods and appliances including:

(a) Personal cassette and compact disc players

(b) Personal (portable) computers including electronic organisers

(c) All magnetic media appliances - audio/video/computer

(d) Hearing aids and heart pace makers

4.2.6 Public Address system

4.2.7 Passenger Information Display system

4.2.8 In-Cab and platform CCTV

4.2.9 Platform Screen Door

4.2.10 Sensitive equipment (for example monitors, computers) in Platform Supervisory Booth and Station Control Room

4.2.11 Implantable medical devices (shall conform to BS EN 45502-2-1:2003)

4.3 Rolling Stock Radiated and Conducted Emissions

4.3.1 As a minimum requirement, the maximum levels of radiated EMI and conducted emission of trainborne equipment shall not exceed the levels specified in the European Standard BS EN 61000-6-4 : 2007, BS EN 50121-3-1 : 2006 and BS EN 50121-3-2 : 2006.

4.3.2 The specific emission requirements as detailed in Clause 5.3, 6.3 and 6.4 for ensuring electromagnetic compatibility with communication and signalling equipment shall be observed.

4.4 Rolling Stock Equipment Immunity Levels

4.4.1 All trainborne electrical and electronic equipment shall be immune from any radiated electromagnetic interference produced by other pieces of trainborne equipment and external sources. All electrical and electronic equipment shall be immune from electromagnetic field strengths of 20 V/m (146 dBμV/m) in the frequency range of 27 - 3000 MHz.

4.4.2 Any equipment which contains sensitive electronic components to electrostatic discharge and is likely to be handled or touched by personnel or customers shall be protected against electrostatic discharge.

4.4.3 All trainborne electrical and electronic equipment shall be immune to the conducted interference levels as defined in the European Standard BS EN 61000-6-2 : 2005 in the frequency range 150 kHz to 80 MHz.

4.4.4 The possible external and internal sources of emission that may affect the trainborne equipment include :

(a) Radio systems of the Urban Lines including Train Radio, Hand Portable Radio, Royal Hong Kong Police and Criminal Investigation Department (CID) Radio, Fire Services Department Radio, Paging, Public Mobile Radio-telephone and Personal Communication Network

(b) Traction and auxiliary equipment including the auxiliary converter and lighting inverter

(c) Magnetic fields generated from traction motors and catenary

(d) Passenger Information Display system

4.4.5 The sensitive equipment on board which are susceptible to the sources described in Clause 4.4.4 include:

(a) Propulsion system, auxiliary load, air-conditioning unit, lighting inverter control and monitoring equipment

(b) Train Management System (TMS)

(c) Digital Voice Announcement System and Public Address (DVAS and PA)

(d) In-Cab CCTV trainborne video display and control equipment

(e) Dynamic Route Map (DRM), Electronic Information Display System (EIDS), Electronic Destination Display (EDD) and Electronic Train Number Display (ETND)

(f) All other electronic equipment

5 Communication Equipment Compatibility

5.1 The communication equipment of the Urban Lines shall operate reliably in terms of performance and functionality in the electromagnetic environment produced by the trains.

5.2 The Contractor shall liaise and co-operate with the Communication contractor in the exchange of EMC data and related equipment performance characteristics to produce a compatible system.

5.3 In addition to the requirements detailed in Clause 4.3, the radiated emission measured at a distance 1 m in any direction from any component of the supplied communication equipment shall not be greater than the field strength for the frequency bands shown in the following table, except the equipment designated to use the bands listed in the table. The measurement shall be taken with the bandwidth specified in the following table for the corresponding frequency bands.

Permissible Radiated Emissions from the Supplied Equipment

Item	Radio Equipment Susceptible to Interference from the Supplied Equipment		Frequency Range (MHz)	Channel Bandwidth (kHz)	Maximum Level dB(μV/m) (Note 1)
1.	Not used		-	-	-
			-	-	-
2.	Not used		-	-	-
3.	Criminal Investigation Department (CID) Radio		380 - 430	25	13.7
4.	Paging	24 Ch.	171.8 - 172.8	25	11.8
		60 Ch.	279 - 281	25	11.0
5.	Fire Services Department Radio, TETRA		806 - 863	25	20.2
6.	Royal Hong Kong Police Radio		440 - 446	25	14.9
7.	CDMA and TDMA Mobile TelePhone		825 - 845 870 - 890	1200	-98 dBm (Note 3)
8.	GSM Mobile TelePhone		890 - 915 935 - 960	200	-98 dBm (Note 3)
9.	PCS Mobile Telephone		1710 - 1785 1805 - 1880	200	-102 dBm (Note 3)
10.	Third Generation Mobile Telephone		1904 - 2025 2110 - 2170	3840	-103 dBm (Note 3)
11.	Wireless LAN Equipment (2.4G)		2400 - 2483.5	5000	-107 dBm (Note 3)
12.	Wireless LAN Equipment (5.8G)		5725 - 5850	5000	-107 dBm (Note 3)
13.	In-Cab CCTV Beacon Equipment (Note 2)		5828	1000	-43 dBm (Note 4)
14.	In-Cab CCTV Video Equipment (Note 2)		12765 - 12961	1000	-65 dBm (Note 4)

Note (1): Maximum Allowable Radiated Emission from the Supplied Equipment in dBm (μV/m) (Quasi Peak)
Note (2): Applicable to trackside and trainborne equipment only
Note (3): The value is adjusted for measurement with a 0dB gain dipole antenna at 1m apart
Note (4): The measurement shall be taken at 2m (instead of 1m). The value is adjusted for measurement with a 20dB gain Horn antenna at 2m apart

5.4 The Contractor shall limit levels of chopper/inverter harmonic currents/inrush current into trainborne filters and provide sufficient train input impedance to limit 600 Hz and 1200 Hz supply ripple currents. This shall be carried out to a degree such that induced voltages on sheathed communication cables shall not exceed the CCITT recommendations under normal and fault conditions.

5.5 All trainborne communication equipment supplied by the Communication contractor will be immune to any magnetic fields generated by trains, catenary/power return rails, power cables and traction motors.

5.6 The maximum psophometric current measured at the supply interface of the train under all conditions and at all times shall not be greater than:

5.6.1 10 A averaged over 20 second period

5.6.2 12.2 A averaged over 4 second period

5.6.3 13 A instantaneous value, where instantaneous is defined as the weighted value of a current over 20 millisecond samples treated as a repetitive waveform

5.6.4 The psophometric weighting shall be to the CCITT requirements described in the CCITT recommendations. The method of adding individual currents shall use a weighted RSS (root-sum-squares) method and the total shall not exceed the levels stated above. The conditions specified in this Clause shall apply under all normal modes of operation.

5.7 In addition to the EMC requirements for all trainborne equipment, the Contractor shall ensure that under normal supply conditions the static magnetic fields due to cables and traction motors and inductors in the power circuits and static magnetic fields due to currents in the overhead catenary and return rails, shall not cause noticeable effect on any saloon passenger information display boards, TMS display terminals or In-Cab CCTV trainborne video displays.

6 Signalling Equipment Compatibility

6.1 The signalling equipment of the Urban Lines shall operate reliably in terms of performance and functionality in the electromagnetic environment produced by the trains.

6.2 The Contractor shall refer to Appendix I Annex 3 ATC Interfaces on the Signalling System EMC data and related equipment performance characteristics to produce a compatible system.

6.3 Compatibility with the Urban Lines Signalling System

6.3.1 The existing Urban Lines track circuits operate at 8 - 12 kHz. The Contractor shall liaise with the Engineer to ensure compatibility.

6.3.2 The existing Urban Lines track to train continuous transmission operates at 50 - 60 kHz. The Contractor shall liaise with the Engineer to ensure compatibility.

6.3.3 The existing Urban Lines platform return channel operates at 140 kHz. The Contractor shall liaise with the Engineer to ensure compatibility.

6.3.4 The existing Urban Lines beacons operate at 90 - 110 and 140 kHz. The Contractor shall liaise with the Engineer to ensure compatibility.

7 Public Systems Compatibility

The Contractor shall ensure that any static or alternating magnetic fields generated by the trains shall not interfere with the correct operation of customer goods or any magnetic media as listed in Clause 4.2. The flux density between the floor level and 2 m above floor level shall not exceed 1 mT. These limits shall apply under all normal modes of operation.

8 Testing Requirement

In order to ensure and demonstrate EMC compliance, a comprehensive programme of testing is required to be performed by the Contractor. The tests shall include, as a minimum, the following:

8.1 Vehicle Level

8.1.1 Vehicle Interference Test

The complete vehicle shall be designed and tested for influences to typical installations in the vicinity of the Urban Lines to EN 50121-3-1 : 2006.

8.1.2 Vehicle Immunity Test

The complete vehicle shall be designed and tested for electromagnetic field immunity to EN 50121-3-1 : 2006.

8.2 Equipment Level

8.2.1 Equipment Performance Criteria for Immunity Tests

All equipment supplied shall not become dangerous or unsafe, or be damaged as a result of the application of the immunity tests. One of the following performance criteria shall apply according to the tests performed :

(a) Performance Criterion A :

The equipment under test shall maintain normal performance within the specified limits throughout the course of the tests. No software codes or data shall be affected in any way by the tests.

(b) Performance Criterion B :

The equipment under test may suffer from a temporary degradation or loss of function or performance during the tests. The equipment under tests must be self-recoverable without any operator intervention or system reset upon withdrawal of the test waveforms/signals. No software codes or data shall be affected in any way by the tests.

8.2.2 Interference Test

(a) Radiated Frequency Emission

All equipment supplied shall be designed and tested to BS EN55011:2007 Group 1 Class A emission levels for radiated frequency emission.

(b) Conducted Emission

All equipment supplied shall be designed and tested to BS EN55011:2007 Group 1 Class A emission levels for conducted emission.

8.2.3 Immunity Test

(a) Radiated Frequency Immunity

All equipment supplied shall be designed and tested to IEC 61000-43:2006 Class 3 immunity levels for radiated frequency immunity. The performance criterion A (refer to Clause 8.2.1(a)) shall apply.

(b) Electrostatic Discharge Immunity

All equipment supplied shall be designed and tested to IEC 61000-42:2001 Class 3 immunity levels for electrostatic discharge immunity. The performance criterion B (refer to Clause 8.2.1(b)) shall apply.

(c) Fast Electrical Transient Immunity

All equipment supplied shall be designed and tested to IEC 61000-44:2004 Class 3 immunity levels for fast electrical transient immunity. The performance criterion B (refer to Clause 8.2.1(b)) shall apply.

(d) Surge Immunity

All equipment supplied shall be designed and tested to IEC 61000-45:2005 Level 3 immunity levels for surge immunity. The performance criterion B (refer to Clause 8.2.1(b)) shall apply.

(e) Conducted Disturbances Immunity

All equipment supplied shall be designed and tested to IEC 61000-46:2006 Level 2 immunity levels for conducted disturbances immunity. The performance criterion A (refer to Clause 8.2.1(a)) shall apply.

(f) Power Frequency Magnetic Field Immunity

All equipment supplied shall be designed and tested to IEC 61000-48:2001 for power frequency magnetic field immunity. The severity level shall be submitted for Approval. The performance criterion A (refer to Clause 8.2.1(a)) shall apply.

These tests are not meant to be exhaustive in demonstrating EMC compliance. The Contractor shall propose additional tests as appropriate in order to demonstrate full EMC compliance.

9 System Engineering Management System

9.1 SEMP Stage 1

The Contractor shall prepare and submit an EMC plan for Approval during SEMP Stage 1. The EMC plan shall include the following:

9.1.1 The name and title of a person acting as single point of contact on EMC matters. Any subsequent change of nominated person shall be subject to Approval.

9.1.2 The roles and responsibilities of staff involved in EMC on the Contract, their job titles, previous experience and qualifications on EMC matters.

9.1.3 An organization chart highlighting persons involved in EMC on the Contract.

9.1.4 The overall methodology and steps to be taken on EMC throughout the Contract with expected dates of actions including documentation submission dates.

9.1.5 An initial list of design documentation, test specifications and test reports with a single paragraph description of each document to indicate compliance with the Standard.

9.2 SEMP Stage 2

Based on the EMC Plan, the Contractor shall prepare and submit an EMC philosophy document for Approval during SEMP Stage 2 which shall at least include the following:

9.2.1 Detailed methodology and steps to be taken on EMC

9.2.2 Design practices to be adopted throughout the design process to ensure EMC is ultimately achieved

9.2.3 Identification of emissive and susceptible equipment to which the design practices will be applied

9.2.4 Identification of interface(s) between systems that are sensitive to EMI and methods to achieve EMC

9.2.5 A signalling compatibility specification that include:

(a) A listing of interference sources and mechanisms applicable to each sub-system with quantitative analysis to define the worst case values of interference signals

(b) A review of the system design with quantitative analysis to determine whether the worst case levels of interference signals will disrupt normal operation of the system

(c) A description of proposed remedial measures to correct any identified problems

9.2.6 A communication compatibility specification that include:

(a) Identification of interference sources

(b) Design practices to be adopted to achieve EMC on communication equipment

9.3 SEMP Stage 3

Based on the EMC philosophy document, the Contractor shall prepare and submit an EMC design review document during SEMP Stage 3 for Approval which shall at least include the following:

9.3.1 Radiated EMI Requirements

Documentation shall be provided to demonstrate by design how the emission of radiated EMI has been minimized and also to demonstrate

the steps which have been taken to achieve the required immunity of equipment to radiated EMI from all other sources.

9.3.2 Magnetic Field Requirements

Documentation of all calculations to show that the magnetic field requirements have been satisfied.

9.3.3 Inductive Interference Requirements

Documentation of all calculations to show that the psophometrically weighted current taken by the train does not exceed that specified in the Specification.

9.3.4 Conducted Interference Requirements

Documentation of all calculations to show the conducted interference requirements have been satisfied.

9.3.5 Signalling Compatibility Study

Documentation of steps taken to avoid interference with the Urban Lines Signalling systems. The areas to be covered shall include:

(a) List of specific EMC requirements for each signalling equipment type

(b) Description of the traction and auxiliary equipment including circuit diagrams

(c) Fault tree analysis

(d) Failure modes effects and criticality analysis (FMECA)

(e) Normal and fault supply ripple current calculations for traction and auxiliary converter

(f) Supply filter resonant frequency design

(g) RFI shielding methods

(h) Analysis of the control system regarding potential EMI mechanisms

9.3.6 Communication Compatibility Study

Documentation of steps taken to avoid radiated EMI from trains affecting communication equipment.

9.3.7 Test Schedule

A schedule of tests to be conducted which define the specifications to be used for each test, the location where the test will be carried out, the facilities required and other parties involved. The minimum number of tests as specified in Clause 8 shall be included in the schedule.

9.3.8 Test Specification

Specifications for each test specified in the test schedule shall be produced in detail.

9.4 SEMP Stage 4

9.4.1 The Contractor shall submit report demonstrating that all EMC measures (such as installation of EMC shielding and ground plate) as identified and Approved in the EMC philosophy document and EMC design review document have been fully implemented to the required standards. Manufacturing and installation plan/procedures and inspection report highlighting the EMC related measures shall be included.

9.4.2 The Contractor shall conduct the specified testings during SEMP Stage 4. These shall be grouped into the vehicle and equipment level.

9.5 SEMP Stage 5

The Contractor shall consolidate all the testing results, calculations, theoretical analysis and design studies into a single document and submit the document to demonstrate the full EMC compliance with the Standard.

10 Supply Filter

10.1 A Radio Frequency Interference (RFI) filter shall be fitted to the trains. The purpose of this filter is to attenuate conducted emissions in the radio frequency bands through the catenary/running rail power supply to ensure that the requirements as stipulated in Clauses 5.4 and 5.6 are satisfied.

10.2 The filter shall be connected between the catenary/running rail incoming supply and all electronic/electrical equipment connected to this supply with the exception of high speed circuit breakers and over-voltage protection equipment. At least one RFI filter shall be provided for each pantograph.

10.3 The RFI filter shall consist of a ferrite cored inductor and a low inductance capacitor of at least 1µF.

10.4 The use of internal or external fusing elements within a multi-capacitor assembly is not accepted for input filter capacitors. Failure of individual capacitors shall be detected and the defective unit shall be shut down.

10.5 The supply filter shall provide sufficient impedance at 600 Hz and 1200 Hz to ensure that the ripple current in the catenary supply is sufficiently small to ensure that the touch voltage on all track side and nearby cables is below CCITT limits.

ROLLING STOCK STANDARD RS/C6014/05
SOFTWARE

1 Introduction

2 Standards

3 Definitions and Abbreviations

4 General Requirements

5 Software Quality Plan

6 Software Development Programme

7 Software Lifecycle

8 Dependability Requirements

9 Software Development

10 Software Re-use

11 Software Verification and Validation

12 Software Maintenance

13 Software Interface

14 Software Security

15 Software Project Management

16 Software Design Documentation

17 Software Test Documentation

18 Software Configuration Management

19 Software Audit

20 Operation and Maintenance Documentation

21 Development Environment

22 Software Licenses and Ownership

23 System Engineering Management System

Figure STD05-1 Reference Software Lifecycle

Table STD05-1 Format for Software Quality Plan

Table STD05-2 Format for Software Configuration Management Plan

ROLLING STOCK STANDARD RS/C6014/05
SOFTWARE

1 Introduction

The purpose of this Standard is to define the quality and control requirements on all software supplied under this Contract and shall apply to all sub-contractors and suppliers. It covers software that are supplied as a stand-alone entity, as a separately identifiable part of a larger system or as an integral to a system being supplied. The objective is to ensure that all software supplied are designed structurally and logically, fully documented, thoroughly tested in a systematic manner such that they can achieve high quality in terms of safety, reliability, testability, traceability and maintainability.

2 Standards

2.1 International Standard

All software supplied by the Contractor shall comply with the requirements of BS ISO-90003:2004 Software engineering Guidelines for the application of ISO 9001:2000 to computer software.

3 Definitions and Abbreviations

3.1 Definitions

3.1.1 The term "software" shall cover both software and firmware.

3.1.2 A software work package is defined as a group of software and/or firmware items which fulfil the defined requirements and shall be validated and tested as one logical unit.

3.1.3 The supplier of a software work package is defined as the organisation responsible for supplying or developing that software work package to fulfil Contract requirements.

3.1.4 Dependability Level

(a) Dependability level is a classification assigned to a software work package to indicate the sensitivity of a possible fault within the package to its impact on people or service with respect to safety, customer service, environmental obligations and revenue. The level can be A, B or C.

(b) All software work packages responsible for delivering the safety related controls (refer to PS 9.9) shall be of dependability level A. All other software work packages shall be of dependability level B.

3.1.5 Development Level

(a) Development level is a classification assigned to a software work package to indicate the level of development or change that has to be undertaken to produce software which meets the technical requirements. The level can be A, B or C.

(b) The Contractor shall define the development level of each software work package in the software quality plan.

(c) The development level of a software work package is defined as C if the package is a commercial, off-the-shelf or existing, service proven software package with a demonstrable installation base, release history and proper documentation. The software can only be classified as level C if the source code, external interface, databases structure and parameters structure are used without any modification.

(d) The development level of a software work package is defined as B if the following conditions are met:

(i) It is a service proven software (a service proven software is one which has been used in similar contracts at least six months prior to the Tender Out Date and which has not been changed since then)

(ii) Less than 20% changes of the functional or technical performance

(iii) Less than 20% changes of the number of lines of codings (excluding all comment lines) and the number of modules.

(e) The development level of a software work package is defined as A if neither B nor C is applicable.

3.2 Abbreviations

The following abbreviations are used in this Standard:

SEMP	System Engineering Management Plan
SRS	System Requirements Specification
STP	Software Test Plan
SWATS	Software Acceptance Test Specification
SWDS	Software Design Specification

SWMDS	Software Module Design Specification
SWMTS	Software Module Test Specification
SWRS	Software Requirements Specification
SWTS	Software Test Specification
SWVVP	Software Verification and Validation Plan
UART	Universal Asynchronous Receiver / Transmitter

4 General Requirements

4.1 Where the software is to be provided by an organisation other than the Contractor, the Contractor shall pass on all requirements in their entirety and without modification to the organisation. The Contractor shall, however, remain responsible at all time for all the works.

5 Software Quality Plan

5.1 The Contractor shall submit to the Engineer for review a draft software quality plan during SEMP stage 1 (refer to PS 21.3.4). The draft software quality plan shall clearly define those activities relating to the supply of software.

5.2 Within thirty days of receipt of the Engineer's comments on the draft software quality plan, the Contractor shall submit a final software quality plan for Approval incorporating the directions and requirements from the Engineer on the draft plan.

5.3 If the software quality plan is to be revised at any time during the Contract then the proposed changes shall be sent to the Engineer for review. Changes to the software quality plan shall only be made subject to Approval. Any change made to the software quality plan shall accord to the Contractor's configuration management procedures.

5.4 The software quality plan shall:

(a) Define the controls and methods necessary to ensure that the quality processes appropriate for the development are selected by the Contractor.

(b) Define the responsibility and authority of the key personnel responsible for the development, verification, testing and integration of the software.

(c) Define the organisational and working relationships between the Contractor and all the suppliers.

(d) Define the software lifecycle, or software lifecycles, that shall be used to control the development of software.

(e) Identify the software work package(s) to be produced and the development level that have been assigned with detailed justification. If prototyping techniques are employed for development, then the associated software work package(s) shall be of development level A and detailed development and control procedures shall be submitted.

(f) List the inputs into and the outputs from each lifecycle phase. The list shall be specific and comprehensive and shall contain both software and documentation.

(g) List all contractual deliverables including all documents to be produced in each phase of the lifecycle(s).

(h) Specify the guidelines, standards, software metrics, codes of practice, methodologies including naming convention of parameters and variables, languages and tools to be applied at each lifecycle phase.

(i) Reference the Contractor's quality control and quality assurance procedure including the Configuration Control Program (refer to Appendix P) that shall apply to the Contract.

(j) State the review points which shall clearly differentiate between internal activities and those which involve the Engineer.

(k) Specify and reference the procedure to be adopted to ensure the security of the software.

(l) Discuss all the internal and external risks including programme slip, uncontrollable external factor, supplier's staffing and experience involved and the contingencies planned.

(m) The software quality plan shall contain the content in Table STD05-1.

6 Software Development Programme

The Contractor shall prepare and maintain a software development programme for the Contract and shall submit the programme for Approval. This programme shall be linked to the overall Contract Programme and shall:

(a) Define the schedule of the whole software development effort.

(b) Define activities for each phase of the software lifecycle at individual software work package level.

(c) Highlight software related milestones.

(d) Define the schedule of activities for software testing.

(e) Define the critical path of software development of the Contract.

7 Software Lifecycle

7.1 The Contractor shall define the software lifecycle, or lifecycles to be used for the design, development, testing and integration of software in the software quality plan.

7.2 The Contractor shall map the phases of the defined software lifecycle(s) against the phases of the reference lifecycle which is a 'V' shaped software lifecycle (sequential lifecycle model) as shown in Figure STD05-1.

7.3 As a minimum, the Contractor shall ensure that the following phases for software work package of different development levels are incorporated in their lifecycle:

Software Lifecycle Phase	Development Level		
	A	B	C
System Requirements Analysis	Y	Y	Y
Software Requirements Analysis	Y	Y	Y
Software Architectural Design	Y	Y	-
Software Module Design	Y	Y	-
Software Module Coding	Y	Y	-
Software System Integration	Y	Y	Y
System Integration	Y	Y	Y
Acceptance Testing	Y	Y	Y
Defect Liability Period	Y	Y	Y

7.4 Lifecycle Phases

7.4.1 System Requirements Analysis

During this phase, the Contractor shall refine the initial concept and precise requirements for each system / equipment, as set out in the Contract documents, into a system requirements specification (SRS) as stipulated in Clause 16.2. All interfaces with external systems shall be addressed in the SRS.

System assurance activities shall be conducted for software work packages with dependability level of A and B as detailed in Clause 8.

7.4.2 Software Requirements Analysis

During this phase, the Contractor shall define the functions and specifications of the software and the associated test requirements. Based on the system requirements specification (SRS) the Contractor shall express the requirements and functions of the software for each system / equipment into a software requirements specification (SWRS) as stipulated in Clause 16.3. All interfaces with external systems shall be clearly specified in the SWRS.

The software acceptance test specification (SWATS) shall be developed alongside with the software requirements specification (SWRS). It shall describe the installation and acceptance requirements of the delivered software product at the operation and maintenance site(s).

7.4.3 Software Architectural Design

During this phase, the Contractor shall transform the requirements for software for each system / equipment as defined in the software requirements specification (SWRS) into an architecture that describes its top-level structure and identify all the software modules in the software design specification (SWDS) as stipulated in Clause 16.4.

The software test specification (SWTS) shall be developed alongside with the software design specification (SWDS). It shall describe the criteria which the completed software is required to satisfy before it proceeds to the software acceptance testing.

7.4.4 Software Module Design

Modular design shall be adopted for all software. During this phase, the Contractor shall completely specify the software modules in the software module design specification (SWMDS) as stipulated in Clause 16.5 based on the software design specification (SWDS) produced during the software architectural design phase.

The software module test specification (SWMTS) shall be developed alongside with the software module design specification (SWMDS). It shall describe the criteria which the completed module is required to satisfy before it is integrated into the rest of the software system.

7.4.5 Software Module Coding

The Contractor shall code each individual software module to meet the requirements defined in the software module design specification (SWMDS). Module testing shall be performed in accordance with the software module test specification (SWMTS) to ensure that the modules fulfil their specification.

7.4.6 Software Integration

The Contractor shall integrate the tested software modules to produce the complete software. The integrated modules shall be tested in accordance with the software test specification (SWTS) and test report shall be submitted.

7.4.7 System Integration

The Contractor shall integrate the tested software with the hardware to form a complete system. The complete system shall be tested in accordance with the software acceptance test specification (SWATS) and a test report shall be submitted. Interface tests with external systems shall be included.

7.4.8 Acceptance Testing

During this phase the software and / or system shall be submitted for acceptance by the Engineer. Test shall be carried out to demonstrate that the system or software meets all the technical requirements. Acceptance will be in two stages – factory acceptance test shall be performed at the Contractor's site and site acceptance test shall be performed at the installation site. Test reports shall be submitted for each stage.

7.4.9 Defects Liability Period

Following completion of the Works, the Contractor shall implement a controlled cycle for software maintenance in line with the procedures defined by the software quality plan and software configuration management plan.

8 Dependability Requirements

8.1 For software work packages with dependability level A or B, they shall form part of the elements requiring to undertake the system assurance process (refer to PS 25).

8.2 The Contractor shall carry out all the system assurance tasks for these software work packages as stipulated in PS 25.

9 Software Development

The supply and development of software shall be governed by the software quality plan. The followings are the minimum development and design guidelines to be incorporated in the software quality plan and adopted throughout the whole development lifecycle:

9.1 Structured Language

The Contractor shall use structured languages for all software developments. Any exceptions to this requirement shall be submitted for Approval prior to development.

9.2 Code of Practice

The Contractor shall follow a documented code of practice to develop and modify the software. The code of practice shall define the design rules, such as prohibited features and source codes layout rules. Alternatively, a documented method statement defining all the practices and rules for software development may be accepted.

9.3 Traceability

The Contractor shall adhere to industrially recognized analysis methods and design methods during the requirements analysis phase and throughout the design process such that traceability of all levels of requirement, design and testing are maintained. The methods shall be supported by computer aided software engineering (CASE) tools. These tools shall provide automated facilities to verify the system requirements throughout the lifecycle phases.

9.4 Compiler and Operating System

9.4.1 All compilers and code generators should have passed a validation suite to demonstrate their compliance against an international standard. A non-certified compiler shall only be used subject to Approval.

9.4.2 The Contractor shall use the latest version of a compiler unless there is a strong reason for not doing so. An old version of a compiler shall only be used subject to Approval.

9.4.3 All undocumented and non-standard features of the language or operating system shall not be used.

9.5 Consistency

The software shall respond to a given situation in a single manner. The possibility of indeterminate states and solution routes shall be excluded.

9.6 Unused Spare Interrupts

The software shall disable all unused spare interrupts and contain dummy returns at all unused interrupt vectors.

9.7 Safety Critical Fault Protection

For software driven systems having a dependability level of A, a fully independent non-software system shall also be provided in case of software fault.

9.8 Software Design

9.8.1 The software shall follow a structured and modular design. Each program or module shall be designed such that it can be viewed in terms of its inputs and outputs alone, without reference to the details of how it processes them.

Each module shall be totally independent of the particular algorithmic or programming techniques used in all the other modules.

9.8.2 Self-modifying program will not be allowed.

9.8.3 Each module shall be self-contained and its removal from the system shall only disable the unique function performed by the module and nothing else.

There shall be a high degree of isolation between program modules. Effect of changes on a module shall change only the contents of that module and not have cascaded, scattered impact throughout the program.

9.8.4 Header, footer and remarks shall be used extensively to clearly specify the module and its logic. The module size excluding remarks, header and footer shall preferably not take up more than 150 lines of high level language or 250 lines of assembly level code.

9.8.5 Independent and separate compilation of individual modules will be allowed.

9.8.6 Structured programming techniques shall be used with single entry and single exit point for each module. Unconditional branch statements shall not be used.

9.8.7 The software shall be readable and maintainable. All garbage codes (codes that are not executed under any circumstances) shall be removed.

9.8.8 The format of the source code shall be standardized, properly indented, sufficiently and clearly commented. Each module shall have a concise introductory comment section describing the function of the module, the algorithm used, the significance of important internal variables, the data structure, the call convention, the meaning/format of the required inputs and generated outputs.

9.8.9 Constant parameters that are commonly used by different modules and those that require frequent tuning shall be named and defined in the global data definition area, instead of being incorporated into the program statements. They shall be referred to by name throughout the program.

9.8.10 The naming of variables and parameters shall be standardized and meaningful such that they are clearly recognizable. The Contractor shall establish a naming convention and submitted together with the software module design specification (SWMDS) for Approval.

9.8.11 The software shall be robust and defensive programming methodology shall be employed. Validity range and plausibility checking on input/output parameters shall be performed. Upon detection of system irregularities or run-time errors, appropriate exception handling routines shall be invoked in order to recover the system to the normal operation state and a log file shall be created to record the system status and the actions taken.

9.8.12 The software shall be designed for easy testing. Each module shall be able to be tested separately by feeding in simulation parameters or signals through the external hardware interface. Diagnosis code shall be inserted where appropriate.

9.8.13 The software shall be concise and efficient. Main and disk memory requirements shall be minimized. Sub-routines that are shared by a number of different programs or modules shall be put into the system library.

9.9 Millennium Issue

The performance and the functionality of the software / system shall not be affected by any changes to the date format caused by the advent of the year 2000 and shall ensure the following:

9.9.1 No value for current date shall cause any interruption in the operation of the software / system.

9.9.2 All manipulation of time-related data shall produce the desired results for all valid date values within the application domain.

9.9.3 Date elements in interfaces and data storage shall permit specification of the century without ambiguity.

9.9.4 Where any date element is represented without a century, the correct century shall be unambiguous for all manipulations involving that element.

10 Software Re-use

10.1 For software of development level A and B, the Contractor shall employ software re-use techniques wherever practical to minimise the development, coding, testing, documentation and maintenance activities.

10.2 The Contractor shall identify the scope and extent of software re-use for each software work package in the software quality plan.

10.3 The first instantiation, i.e. the original or parent of any software design, module, program or product which is to be re-used shall be developed in line with all the requirements of this Standard.

10.4 The first instantiation of any re-usable software shall be placed under the control of the Contractor's software configuration management procedures (refer to Clause 18.3) prior to issue for re-use.

10.5 Re-usable software shall not be issued for re-use until its development lifecycle and documentation are complete including testing and verification. Software developed with lifecycles different to the reference model may be adopted subject to Approval.

10.6 Traceability of all re-used software shall be maintained through the software configuration management procedures. All re-used software items shall be clearly identified and shall include a reference allowing traceability to the original.

10.7 The Contractor shall not modify any aspect of a re-used item of software.

10.8 For each instantiation of a re-usable software item, the Contractor will not be required to repeat those phases of the development lifecycle up to the integration test phase which have been completed in the first instantiation. Software and system integration, acceptance testing and defect liability shall be provided.

11 Software Verification and Validation

11.1 The Contractor shall be responsible to ensure and demonstrate the conformance of the final software to the software requirements specification (SWRD) through the software validation process consists of verification and testing activities.

11.2 The Contractor shall be responsible to develop a software verification and validation plan (SWVVP) that defines all the verification and testing activities. This plan shall cover all software delivered including those provided by subcontractors or vendors.

11.3 Software Verification and Validation Plan

The software verification and validation plan (SWVVP) shall specify the timing, controls and methods necessary for the verification and testing processes and shall be submitted for Approval. The software verification and validation plan (SWVVP) shall include the following :

11.3.1 It shall define the organisation, schedule, resources, responsibilities, tools, techniques and methodologies for software verification and testing.

11.3.2 It shall define the software verification activities to be performed and the documentation to be produced as detailed in Clause 11.4.

11.3.3 It shall define the software testing to be performed and the documentation to be produced as detailed in Clause 11.5.

11.4 Software Verification

Structured review and software metrics shall be used to verify the software which include:

11.4.1 Specification Review

(a) A specification review is concerned with ensuring that the requirements, design and test specifications generated during the software lifecycle adequately specify the software to be produced and the criteria on which the software shall be judged. The Engineer shall have the rights to send

representatives (who may be an independent organization) to participate in these specification reviews.

(b) The specification review shall:

(i) ensure that the specifications conform to the Contract requirements;

(ii) confirm the adequacy of the technical solution;

(iii) system requirements have been appropriately allocated to hardware and software items;

(iv) software requirements are consistent, feasible, testable and accurately reflect system requirements;

(v) design implements proper sequence of events, inputs, outputs, interfaces, logic flow, allocation of timing and sizing and error definition, isolation and recovery;

(vi) ensure that the document is complete, clear and unambiguous.

(c) Record of the specification reviews shall be submitted in SEMP stage 3 and shall be presented for inspection during software audit on request.

11.4.2 Module Code Review

(a) All codes shall be examined to ensure that they are traceable by documents and records to design and requirements, testable, correct and compliant with requirements and coding standards.

(b) All codes shall be examined to ensure that proper event sequence, consistent interfaces, correct data and control flow, completeness, appropriate allocation timing and sizing and error definition, isolation and recovery have been implemented.

(c) As a minimum the module code review shall consist of a structured walkthrough of the software listings.

(d) Record of module code reviews shall be submitted in SEMP stage 3 and shall be presented for inspection during software audit on request.

11.4.3 Software Metrics

(a) For any software work package with a development level of A and B, software metrics shall be used throughout the entire software lifecycle to

plan, manage and improve the process and to control and predict the quality of software.

(b) The following metrics shall be collected at each individual software development phase:

Lifecycle Phase	Software Metrics to be collected
Requirements Analysis and Design Phases	(i) Defects found via specification review or in subsequent development stages (ii) Function size (iii) Number of calls from individual module (iv) Effort spent in person-months (v) Requirements stability
Software Module Coding Phase	(i) Cyclomatic complexity (ii) Module size (iii) Comment frequency (iv) Number of components successfully completed from design through module test (v) Effort spent in person-months (vi) Requirements stability

(c) The Contractor shall define in the software quality plan metrics to be collected at individual software development phases and establish goals to be achieved.

(d) The Contractor shall use collected measures to track progress, adjust the process to correct out-of-bound conditions and to evaluate impacts of these adjustments.

(e) Automated tools shall be used to facilitate the metrics measurement process.

(f) Metrics measurements shall be recorded for verification and audit purpose and shall be submitted in SEMP stage 3.

11.5 Software Testing

11.5.1 The Contractor shall be responsible to develop a software test plan (STP) that defines the philosophy, objectives and schedule of test activities to be performed and the plan shall be submitted for Approval. The plan shall:

(a) Define the roles, responsibilities, independency and authorities of the key personnel responsible for the testing of the software.

(b) Identify the software items to be tested with a description of the features to be tested and features not to be tested.

(c) Describe the approach and method for testing, including how pass / fail criteria are defined, what are the suspension criteria and what are the resumption requirements.

(d) Define what are the test deliverables and submission schedule for each level of testing.

(e) Detail the tasks required for the testing. This shall include the environmental, staffing and training needs for testing.

(f) Define the schedule of testing in accordance with the software development programme (refer to Clause 6).

(g) The Contractor shall demonstrate that there is sufficient processing power so that the execution of the time-critical tasks shall not take more than 80% of the real time under peak conditions and shall not take more than 50% under normal conditions.

11.5.2 Module Testing

(a) Every module shall be tested against the software module test specification (SWMTS) to ensure that it accurately represents the program design and that it conforms to the requirements of the software module design specification (SWMDS).

(b) The tests shall be designed to demonstrate that :

(i) any valid input or combination of inputs produces a correct output;

(ii) any invalid input is correctly handled in a controlled manner;

(iii) error messages generated by the module are appropriate and meaningful.

(c) Every module shall be tested after the code has been proof-read by the programmer and has been successfully reviewed.

(d) The record of the test shall form part of the test documentation to be submitted.

11.5.3 Software Integration Testing

(a) Modules shall be combined in a controlled manner and tested against the software test specification (SWTS) to ensure that the combination accurately represents the program design and that it performs as required by the software design specification (SWDS).

(b) The tests shall be designed to demonstrate that :

(i) any valid input or combination of inputs produces a correct output;

(ii) any invalid input is correctly handled in a controlled manner;

(iii) message dialogues and sequencing between integrated modules are correct;

(iv) error messages are meaningful.

(c) The records of the test shall form part of the test documentation to be submitted.

11.5.4 System Integration Testing

(a) The software and hardware shall be combined and tested to ensure that the system accurately represents the system design and that it performs as it is required to do by the system design specification (SDS).

(b) Interface tests with external systems shall be performed to demonstrate full compliance of all interfaces to the software design specification (SWDS) and system design specification (SDS).

(c) The records of the test shall form part of the test documentation to be submitted.

11.5.5 Factory Acceptance Test

(a) The factory acceptance test are tests to be carried out in the Contractor's premises before delivery. The test shall demonstrate that the system, both hardware and software, meets the technical requirements as stipulated in the Particular Specification.

(b) The factory acceptance test specification shall be prepared by the Contractor and submitted for Approval. The philosophy of testing, indicating the reasoning leading to the choice of tests shall be explained.

(c) The test shall be carried out in a hardware and software environment which simulates the final configuration of the system. Only the functional or performance tests which cannot be conducted in a simulated environment, due to their nature and complications, may be combined with site acceptance test subject to Approval.

(d) All tests shall be carried out exactly as detailed in the test specifications. Any deviations from the specified procedure shall only be made with prior Approval. The details of the deviation, the reasons and the signatures shall be recorded and form part of the test documentation to be submitted

(e) All factory acceptance test specifications, at every level, shall be subject to configuration management and change control by the Contractor.

(f) The result of the factory acceptance tests, together with any re-testing as a result of failure, shall be recorded and signed by authorised personnel of the Contractor and the Engineer's representatives.

11.5.6 Site Acceptance Test

(a) The site acceptance test are tests to be carried out on site after installation, which shall demonstrate that the system, or software, meets the requirement of this Particular Specification, in terms of functionality and performance.

(b) Site acceptance test shall include but not be limited to the following categories of tests:

(i) Integration Test with Other Contractors

The Contractor shall coordinate through the Engineer’s representative with the Designated and Interfacing Contractors (refer to PS 31) in preparing an integrated test specification and shall be submitted for Approval at least 12 weeks prior to the test as per Approved programme.

The Contractor shall and the Designated Contractors will provide the necessary equipment and manpower in carrying out the test for their own equipment and system which will be witnessed by the Engineer or his representative.

The Contractor shall plan for and carry out any additional tests which deem necessary for proving the complete and successful integration with the interfacing systems.

(ii) Total Systems Integration Tests

Having completed the integrated tests with respective contractors individually, the Contractor shall perform total system integration tests to demonstrate that all system modules can coordinate their works with each other in harmony and that all functional requirements are satisfied. No clash or abnormality shall result from having various combinations of possible operations being carried out simultaneously.

(iii) System Performance Test

Having completed the total system integration tests, the Contractor shall carry out system performance tests to prove that all performance requirements laid down in the Particular Specification are met.

The Contractor shall set up continuous monitoring, recording the performance for a period of at least 4 weeks of service operation by the Employer. The result shall meet all the performance criteria described in the General Specification and Particular Specification.

(c) Only factory acceptance test and site acceptance test are required for software work package of development level C. The Approval for use of a particular commercial package does not imply the acceptance of the software. It is the responsibility of the Contractor to ensure that all these software work packages, either executed independently or integrated together, can achieve the desired functions as specified.

11.5.7 Regression Testing

The Contractor shall conduct regression testing throughout the testing phases following changes to the software. Regression testing shall test the particular changes that have been made and show that the unmodified software has not been corrupted by the change and the software meets its technical requirements.

11.5.8 Interface Protocol Testing

Within two months after the completion of a design interface with each interfacing system as per the Approved programme, the Contractor shall

develop a protocol simulator and deliver to the respective Designated and Interfacing Contractor for his testing of the communication interface.

12 Software Maintenance

12.1 The Contractor shall be responsible for the software correction and improvement during the Defects Liability Period to ensure that the performance of the equipment fully satisfies the requirements in the Particular Specification.

12.2 Changes made to the software shall be controlled in a manner which achieve the same level of specification, review, implementation and testing as used for throughout the development life cycle.

12.3 All changes made to the software shall be made according to the defined software configuration management procedures.

12.4 The Contractor shall define how upgrade media is to be delivered to site, installed and tested.

13 Software Interface

13.1 A software interface shall be classified as an internal interface or external interface.

13.2 An internal interface is an interface between two software work packages within the scope of the Contract.

13.3 An external interface is an interface between a software work package within the scope of the Contract and works of other contractors'.

13.4 For all internal interfaces, the Contractor shall be considered as the prime interfacing party.

13.5 The Contractor shall be considered as the prime interfacing party for all Communication Interfaces (refer to Appendix I Annex 4) and Depot Interfaces (refer to Appendix I Annex 6). The Contractor shall be considered as the supporting interfacing party for all ATC Interfaces (refer to Appendix I Annex 3) and PSD Interfaces (refer to Appendix I Annex 5).

13.6 The prime interfacing party for a defined interface shall be responsible for:

13.6.1 analyze interface requirements;

13.6.2 prepare interface specifications which form part of the system requirements specification (SRS);

13.6.3 define and agree with supporting interfacing parties and the Engineer a programme for exchange of design information and integrated testing;

13.6.4 design and implement protocols;

13.6.5 conduct integrated tests during the site acceptance tests and commissioning.

13.7 The supporting interfacing party for a defined interface shall be responsible for:

13.7.1 work with the prime interfacing party via the Engineer to agree interface specifications and programme;

13.7.2 implement interface protocols in accordance with the interface specifications and programme;

13.7.3 conduct factory acceptance test and support site acceptance test and commissioning.

14 Software Security

14.1 The Contractor shall define procedures to maintain the security of the software. Aspects to be considered shall include:

14.1.1 Sabotage

The Contractor shall describe what measures are to be taken to protect the software against sabotage during the development phase. This description should define the physical restrictions as well as procedural measures and specific tests to be carried out on the software.

14.1.2 Unauthorised Access

The Contractor shall describe what measures are to be taken to protect the software against unauthorized access and subsequent modification. This description should define both physical restrictions and procedural methods.

14.1.3 Virus

The Contractor shall ensure software which is susceptible to viruses is developed in environments certified free from computer viruses. To

achieve this, the Contractor shall use proper virus detection software and suppression tools, as Approved. Approval of the software tools shall not relieve the Contractor of his obligations to ensure that the software is free of viruses.

14.2 All software delivered to site shall be accompanied by evidence that demonstrates the media is free of viruses.

15 Software Project Management

The Contractor shall perform software project management as follows:

15.1 The Contractor shall be responsible for managing the performance of all software supplier(s) and the quality of their work. The Contractor shall be responsible for the validation of all sub-contracted work.

15.2 The Contractor shall ensure that his software supplier(s) conform to the Approved software quality plan, software development programme and software configuration management plan.

15.3 If an internal interface involves more than one software supplier, the Contractor shall act as the prime interfacing party.

15.4 The organisational and working relationships between the Contractor and all the suppliers shall be described in the software quality plan.

15.5 If any key member of the software team becomes unavailable, the Contractor shall inform the Engineer together with qualified replacement for Approval. The replacements shall start working on the Contract at least one month before the departure of the original member.

15.6 The Contractor shall freeze the software requirements specification (SWRS) and the software design specification (SWDS) as a formal baseline for subsequent development phases upon the full Approval of the specifications. Any necessary functional and/or technical changes to these documents shall be subject to Approval.

15.7 During site acceptance test and commissioning, the Contractor and his software supplier(s) shall provide technical staff at the test or commissioning site to support defect analysis, software configuration control over change requests and proper distribution and installation of software changes.

15.8 The Contractor shall ensure that software defects shall be rectified, tested, validated, configured and delivered to the test or commissioning site in accordance with the Approved programme.

16 Software Design Documentation

16.1 The Contractor shall produce and submit software design documentation in accordance with the requirements for SEMS as stipulated in Clause 23.

16.2 System Requirements Specification (SRS)

The system requirements specification shall include:

16.2.1 functions and capabilities of the system;

16.2.2 Contract requirements;

16.2.3 safety and human-factors engineering;

16.2.4 interface specifications detailing the requirements of all interface with external systems;

16.2.5 operations;

16.2.6 maintenance requirements and

16.2.7 design constraints

16.3 Software Requirements Specification (SWRS)

The software requirements specification shall include:

16.3.1 Functional and capability specifications including performance, physical characteristics, and environmental conditions under which the software is to perform;

16.3.2 Specification of Interfaces external to the software including:

(a) the input and output communication ports;

(b) communication protocols, procedures and performance;

(c) exception handling and recovery;

(d) message formats (for example maximum message length) and message frequency.

16.3.3 Safety specifications including:

(a) software failure detection, identification and isolation;

(b) remedial procedures;

(c) redundancy;

(d) fail safe operation;

(e) fall-back procedures and reconstruction of destroyed or incorrectly altered data;

16.3.4 Human-factors engineering specifications including:

(a) man machine interfaces and ergonomic factors;

(b) operational procedures together with any potential unsafe actions and the possible cause of them;

(c) human procedures within the system that are likely to be bottlenecks or cause any special problems;

(d) areas needing concentrated human attention that require significant training or elaborate aids.

16.3.5 Data definition and database requirements

16.3.6 User operation and execution constraints / requirements that may include existing or imposed software or hardware platform, support availability and environmental conditions

16.4 Software Design Specification (SWDS)

The software design specification shall include:

16.4.1 A general description including:

(a) a system description describing the computer hardware and peripheral equipment to be used and the external interfaces of the software;

(b) a summary of functions to be performed by the software;

(c) general constraints including regulatory policies, software limitation (for example due to operating system), hardware limitation (for example

signal timing requirements), interfaces to other applications, parallel operation, control functions, higher-order language requirements, signal handshake protocols (for example XON-XOFF, ACK-NACK), safety and reliability considerations, timescales and customer imposed constraints defined in the software requirement specification.

16.4.2 A functional requirements section including:

(a) a description of all the functional requirements;

(b) a description of all input data including the sources of inputs, quantities, units of measure, timing and ranges of valid input;

(c) a description of operations to be performed on the input data including validity check, operations sequence including timing of events, abnormal situations response (overflow, communication failure and error handling), parameters affected by operations, initialisation and reinitialisation requirements and any methods used for transforming the inputs into corresponding outputs (such as equations, mathematical algorithms, logical equations);

(d) a description of all output data including the destinations, quantities, units of measure, timing and ranges of valid output including accuracies and tolerances.

16.4.3 A performance requirements section including:

(a) a description of static numerical requirements including the number of simultaneous users to be supported, number of files and records to be handled and sizes of tables and files and

(b) a description of dynamic numerical requirements including the number of transactions and tasks and the amount of data to be processed within certain time periods for both normal and peak workload conditions.

16.4.4 A design constraints section including:

(a) a description of any limitations imposed by the software (for example use of a software may limit the number of simultaneous users) and

(b) a description of any requirements for the software to operate inside various hardware constraints (for example limits on primary and secondary memory).

16.4.5 An external interface requirements section including:

(a) a description of all the human interface to the software product including the required screen formats, page layout and content of any reports or menus, relative timing of inputs and outputs and availability of some form of programmable function keys;

(b) a description of the logical characteristics of each interface between software and hardware including the devices to be supported and protocols or other peripheral interfaces required;

(c) a description of the use of other required software products and interfaces including the name, mnemonic, specification number, version number and source of the software products;

(d) a description of the communications interfaces such as local area network protocols.

16.4.6 Database requirements for any database to be developed as part of the software including frequency of use, accessing capabilities, data element and file descriptors, relationship of data elements, records and files and static and dynamic organisation.

16.4.7 A general design section including:

(a) The breakdown of the software into modules and shall identify all modules to be developed or incorporated into the software.

(b) The global structures used in the software implementation including the structure of data types defined in terms of basic types of the programming language, structure of individual files and the distribution of data between files, structure of data in memory, code libraries which may be called on implicitly or explicitly by the software and interfaces with hardware and other software and the interfaces between the constituent modules. The use of global variables and direct access memory shall also be specified here.

(c) The overall structure of the software shall be formally described using a method suitable for the application including flow charts, pseudo code description and structured design methodologies. The constituent modules which make up the software and their inter-relationship shall also be formally described.

(d) The means by which the design structures can fulfil the functional requirements identified in Clause 16.4.2 shall be described.

(e) The means by which the design structures can fulfil the performance requirements identified in Clause 16.4.3 shall be described.

(f) The means by which the design structures can meet the design constraints requirements identified in Clause 16.4.4 shall be described.

(g) The means by which the design structures can fulfil the external interface requirements identified in Clause 16.4.5 shall be described.

(h) The means by which the design structures can fulfil the database requirements identified in Clause 16.4.6 shall be described.

16.4.8 A module requirements section including:

(a) Identification of all global variables and routines that are accessible by all modules and components.

(b) Identification of all software libraries which are available to the software.

(c) Individual module details including function of the module, entry and exit conditions which the module satisfies, failure conditions which the module handles, any register preservation, any mathematical formulae or principles which the module is required to use and any special requirements like module size or execution time.

16.5 Software Module Design Specification (SWMDS)

The software module design specification shall define each of the software modules identified in the software design specification. It shall include:

16.5.1 A brief summary of the module, its function and its components;

16.5.2 General information of the module including :

(a) module entry conditions - how the module's components are entered/activated;

(b) module exit conditions – how the module’s components exit/terminate;

(c) any code insert statements used;

(d) what failures and failure conditions are detected and reported;

(e) any registers used;

(f) module generation details - how the module is generated together with the options used (for example compiler/assembler options);

(g) details of libraries used by the module including any libraries explicitly named in the module, any libraries implicitly used and any common procedures used and

(h) initialisation process for the module.

16.5.3 Data interfaces of the module including:

(a) input / output parameters - any input and output parameters passed during the activation and return from the module and shall be related to the entry and exit conditions in Clause 16.4.2;

(b) any absolutes or constants used;

(c) any global variables used;

(d) any local variables used within the module's components;

(e) any direct interfacing with hardware such as memory mapped UART (universal asynchronous receiver / transmitter) registers.

16.5.4 Program description of the module including:

(a) any mathematical formulae or principles used;

(b) an unambiguous written description of the components within the module;

(c) any special resources required at run-time (such as minimum and maximum number of disc accesses required, memory required);

(d) flow chart or pseudo-code description of the components of the module and

(e) references to all relevant documentation.

17 Software Test Documentation

17.1 Software Acceptance Test Specification (SWATS)

The software acceptance test specification shall describe the installation and acceptance requirements of the delivered software product at the operation and maintenance site(s). It shall include:

17.1.1 the purpose of the test and the relationship with the overall system acceptance testing;

17.1.2 the tests to be performed including characteristics to be tested and the associated acceptance criteria and

17.1.3 the test strategy describing any special test instruments, software, techniques or set ups that are mandatory.

Test data shall be selected so as to systematically test all requirements stated in the software requirements specification.

17.2 Software Test Specification (SWTS)

The software test specification shall describe the criteria which the completed software is required to satisfy before it proceeds to the software acceptance testing. It shall include:

17.2.1 the purpose of the test;

17.2.2 the reference to the relevant requirement and design item;

17.2.3 the tests to be performed including characteristics to be tested and the associated acceptance criteria and

17.2.4 the test strategy describing any special test instruments, software, techniques or set ups are to be used.

Test data shall be selected so as to systematically test all requirements laid down in the software design specification.

17.3 Software Module Test Specification (SWMTS)

The software module test specification shall describe the criteria which the completed module is required to satisfy before it is integrated into the rest of the software system. It shall include:

17.3.1 the purpose of the test;

17.3.2 the reference to the relevant requirement and design item;

17.3.3 the tests to be performed including characteristics to be tested and the associated acceptance criteria and

17.3.4 the test strategy describing any special test instruments, software, techniques or set ups are to be used.

Test data shall be selected so as to systematically test all sections of the software module design specification.

18 Software Test Documentation

18.1 The Contractor shall define and implement effective software configuration management procedures to control changes during the software lifecycle.

18.2 The Contractor shall use a commercially available software package to perform configuration management functions.

18.3 Software Configuration Management Plan

The Contractor shall define the software configuration management procedures in the software configuration management plan. The software configuration management plan shall include the following:

18.3.1 It shall define the controls and methods for identifying, organizing and controlling modifications to the software. The software configuration management plan shall be submitted for Approval.

18.3.2 It shall define configuration identification to enable the unique identification, content and build state to be determined for each software product, program and module. The software product, program and module shall form the configured items held under configuration control. The configuration control process shall identify the current and historic status of each configured item.

18.3.3 It shall define a change control process to allow for software and documentation changes to be made whilst ensuring the functionality of the system is in a known and visible state. The change control process shall allow changes to be made from the development phase through site acceptance, commissioning and Defect Liability Period. These changes will typically arise from functional requirement changes, anomalies, maintenance upgrading or design changes.

18.3.4 It shall define problem reporting by which problems with software or documentation are identified and the appropriate action is taken, tracked and verified.

18.3.5 It shall define the media control process to be taken to ensure that software source code, databases and documentation are adequately archived. Such provisions shall allow the retrieval and regeneration of all software and documentation. Media control also covers the cataloguing

of, and access to, the physical media on which source code, documentation and other relevant material is stored.

18.3.6 It shall define the configuration audits, reviews and status accounting processes.

18.3.7 It shall define how to perform configuration management and control on interfaces with other parties, including the Designated Interfacing Contractors and suppliers (refer to PS 31).

18.3.8 It shall define how to perform configuration management and control on software developed / supplied by subcontractor / vendor.

18.3.9 It shall describe the use of the automated configuration management software package in assisting the configuration management process

18.3.10 It shall contain the content in Table STD05-2.

18.4 In the event that any test is failed, the Contractor shall, at his own expense, take whatever action is deemed necessary, such as, rectification, re-adjustment or design changes to the satisfaction of the Engineer, in order to meet the testing requirement. The Engineer may, at his discretion, request the undertaking of further tests to validate the design changes undertaken at the Contractor's cost.

18.5 A full report of all failures occurring during testing shall be submitted to the Engineer, who may require that a modification be carried out to rectify any defects thus encountered. The Engineer may, at his discretion, request the undertaking of further tests to validate the design changes undertaken at the Contractor's cost.

18.6 Modifications required to make software work packages to pass tests shall be applied to all similar software work packages. Modification instructions, test instructions and modification programme shall be submitted for Approval in accordance with the software configuration management plan (refer to Clause 18.3). Approval will not be granted unless the Engineer is provided with sufficient information to demonstrate that regression testing (refer to Clause 11.5.7) has been performed.

19 Software Audit

19.1 Auditing of the Contractor's and subcontractor's / supplier's software development activities will be carried out by the Engineer, or his representatives (who may be an independent organization) whenever appropriate. Seven days of advance notice will be given to the Contractor. The Contractor shall co-operate with the audit team and shall provide timely and reasonable access to all personnel, activities, software, documentation, and records connected with the development

activities. This shall include documentation which is not required to be submitted for formal review, and the Contractor's internal documentation and procedures governing the technical, quality and project management aspects of the Contract.

19.2 The Contractor shall provide support to the audit team during any visit to the Contractor's or his subcontractor's / supplier's site (hereafter referred as Contractor's site). Such support shall include the use of office space and facilities, telephone and fax machine, and the provision of a member(s) of the Contractor's staff sufficiently familiar with the Contract and the Contractor's procedures to enable the auditing activity to be progressed in an efficient manner.

19.3 Based on the information supplied by the Contractor during the tendering process, the Engineer will advise the Contractor an audit plan at the start of the Contract. Depends on the Contractor's performance during the Contract the Engineer may escalate or de-escalate the auditing activities. The Contractor shall accept that any variation to the plan necessitated by the Contractor's lack of performance is within the agreed scope of the Contract.

19.4 For software work package of development level C the audit plan shall be as follows:

19.4.1 audit at Contractor’s site prior to factory acceptance test

19.4.2 audit at Contractor's site at the completion of factory acceptance test and prior to delivery

19.4.3 audit at the installation site throughout the installation phase up to the completion of site acceptance testing

For the Contractor's guidance the above audits are anticipated to be of one manday duration each.

19.5 For software work package of development level of A or B, the Audit Plan shall be as follows:

19.5.1 audit at the Contractor's site during the requirements, design, coding and integration phases

19.5.2 audit at Contractor’s site prior to factory acceptance test

19.5.3 audit at Contractor's site at the completion of factory acceptance test and prior to delivery

19.5.4 audit at the installation site throughout the installation phase up to the completion of site acceptance testing

For the Contractor's guidance the above audits are anticipated to be of two mandays duration each. The audit at Clause 19.5.1 shall be repeated at nominally three month intervals whilst these phases are in progress.

19.6 The Contractor shall, if requested at any time by the Engineer, deliver the source code of software work package of development level A or B for off-site audit against the Contractor's codes of practice. This audit may be carried out by an independent organization on behalf of the Engineer. The Contractor shall cooperate with this audit and provide detailed technical support on the software to the Engineer or his representatives.

20 Operation and Maintenance Documentation

20.1 The operation and maintenance documentation shall describe the system as installed and to provide sufficient information for users, maintainers and developers to execute their responsibilities throughout the working life of the system. All documentation shall be submitted for Approval.

20.2 The operation and maintenance documentation shall comprise individual package of operation manual, software maintenance manual and source code listings.

20.3 Operation Manual

The operation manual shall include a general description of the facilities available to each operator who will communicate with the system, including those operators who will only receive outputs from the system or be affected in some other way by the system. All controls, screen and printout formats and keyboard layouts shall be fully described.

20.4 Software Maintenance Manual

20.4.1 The software maintenance manual shall fully describe how to maintain and rebuild the software after a change to the source code.

20.4.2 The manual shall also describe how system configuration changes can be made, for example changing parameter data or adding peripheral equipment.

20.4.3 Information requirements for software maintenance shall include, as a minimum, the following:

(a) Database and Parameters Change

Procedures for modifying the system database, displays, configurable system parameters, including guidelines describing the reasons for doing so.

(b) System Software Regeneration

Procedures for regeneration of the as-installed system software from source material, e.g. Operating system and language compiler.

(c) Application Software Regeneration

Procedures for regeneration of the application software from supplied source material or media.

(d) Security Copies

Procedures for maintaining security back-up copies of system software, application software, static data files and live data files, and the method of reconstituting these from the backup copy.

(e) Utilities

Operating instructions for all system utilities, eg. Disk formatter, crash dump analyzer.

(f) Error/Log Messages

A comprehensive list of all system error messages and log messages, including cause, consequence and recommended actions on the occurrence of each.

(g) Diagnostics

Diagnostic methods and any performance reporting facilities.

(h) Program Development

Procedures for modifying and expanding the application software.

20.5 Source Code Listings

20.5.1 The source code for all software modules of software work package of development level A or B shall be provided in both hard copy and electronic format. Fully annotated source listings of all software modules shall be submitted. Reference to relevant design and test specifications

shall be included such that all software modules can be easily traced back to the Contract requirements through all levels of software design.

20.5.2 The source code listings shall be subject to validation by the Engineer or his delegate when delivered to make sure it is the up-to-date version of the software installed.

20.5.3 Data Structure Manual

All file structures, database records, internal lists and tables shall be comprehensively described.

21 Development Environment

21.1 The Contractor shall deliver a comprehensive set of facilities for software work packages of development level A or B to enable the Employer to carry out software maintenance and enhancement after the Defect Liability Period which include the following:

21.1.1 All software development tools (for example requirement definition/traceability tool, design tool, test tool, compiler/translator) used by the Contractor throughout the entire software lifecycle

21.1.2 All data residing in or generated from these software development tools;

21.1.3 All interfaces and/or supporting facility for interacting with these development tools.

21.2 A development manual shall be provided for each development environment including proprietary software packages. This shall include:

(a) System Manual;
(b) Reference Manual;
(c) User Manual;
(d) Installation Manual;
(e) Programming Manual;
(f) Quick Reference Manual;
(g) Tutorial Manual and
(h) Release Notes.

22 Software Licenses and Ownership

22.1 In respect of software work package of development level C, the Contractor shall ensure, prior to procurement, that all licenses are transferred to the Employer.

Where possible, the Employer shall be a sub-licensee on all software licenses when they are originally procured by the Contractor. All licenses shall be transferred to the Employer following site acceptance.

22.2 In respect of software work package of development level C originating within the Contractor's organization including associated divisions, parent companies, and subsidiaries, and in respect of all software work package of development level A or B, the Contractor shall deliver following site acceptance to the Engineer for retention by him a complete copy of the source code, executable code, software design documentation, and any specialised development tools required for maintenance of the same, including editors, compilers, and linkers. Such items may be used by the Employer without the prior written consent of the Contractor unless:

22.2.1 the owner of the software enters into any composition or arrangement with its creditors or enters into liquidation whether compulsory, or voluntary (other than for the purposes of solvent reconstruction or amalgamation) or has a receiver or administrative receiver appointed over all or any part of its assets or undertaking or a petition is presented for an administrative order; or

22.2.2 the owner of the software ceases to trade; or

22.2.3 the owner of the software assigns copyright in the software and the Contractor fails within sixty (60) days of such assignment to procure in favour of the Employer, a licence from the new owner in the same terms as that required by the Contract; or

22.2.4 the Contractor's employment is terminated under any agreement with the Employer for the operation and/or maintenance of the system or he is in breach of his obligations under the contract.

22.2.5 In respect of software work package of development level A, the ownership of, and intellectual property rights to, the software shall reside with the Employer.

23 System Engineering Management System

23.1 SEMP Stage 1

The Contractor shall prepare and submit the following documents for Approval during SEMP stage 1:

23.1.1 The software quality plan as defined in Clause 5.

23.1.2 The software development programme as defined in Clause 6.

23.1.3 The software verification and validation plan as defined in Clause 11.3.

23.1.4 The software configuration management plan as defined in Clause 18.

23.2 SEMP Stage 2

The Contractor shall prepare and submit the following documents for Approval during SEMP stage 2:

23.2.1 The system requirements specification (SRS) and software requirements specification (SWRS) as defined in Clause 16.2 and Clause 16.3.

23.2.2 The software acceptance test specification (SWATS) as defined in Clause 17.1.

23.3 SEMP Stage 3

The Contractor shall prepare and submit the following documents for Approval during SEMP stage 3:

23.3.1 The software design specification (SWDS) and software module design specification (SWMDS) as defined in Clause 16.4 and Clause 16.5.

23.3.2 The software test specification (SWTS) and software module test specification (SWMTS) as defined in Clause 17.2 and Clause 17.3.

23.3.3 The specification and module code review documentation as defined in Clause 11.4.1 and Clause 11.4.2.

23.3.4 The software metrics measurement documentation as defined in Clause 11.4.3.

23.4 SEMP Stage 4

The Contractor shall prepare and submit the following documents for Approval during SEMP stage 4:

23.4.1 The test reports of all levels of testing conducted including software module test, software integration test and system integration test as defined in Clauses 11.5.2, 11.5.3 and 11.5.4.

23.5 SEMP Stage 5

The Contractor shall prepare and submit the following documents for Approval during SEMP stage 5:

23.5.1 The test reports of all acceptance testing conducted including factory acceptance test and site acceptance test as defined in Clauses 11.5.5 and 11.5.6.

23.5.2 All post acceptance documentation as defined in Clause 20 and all development environment as defined in Clause 21.

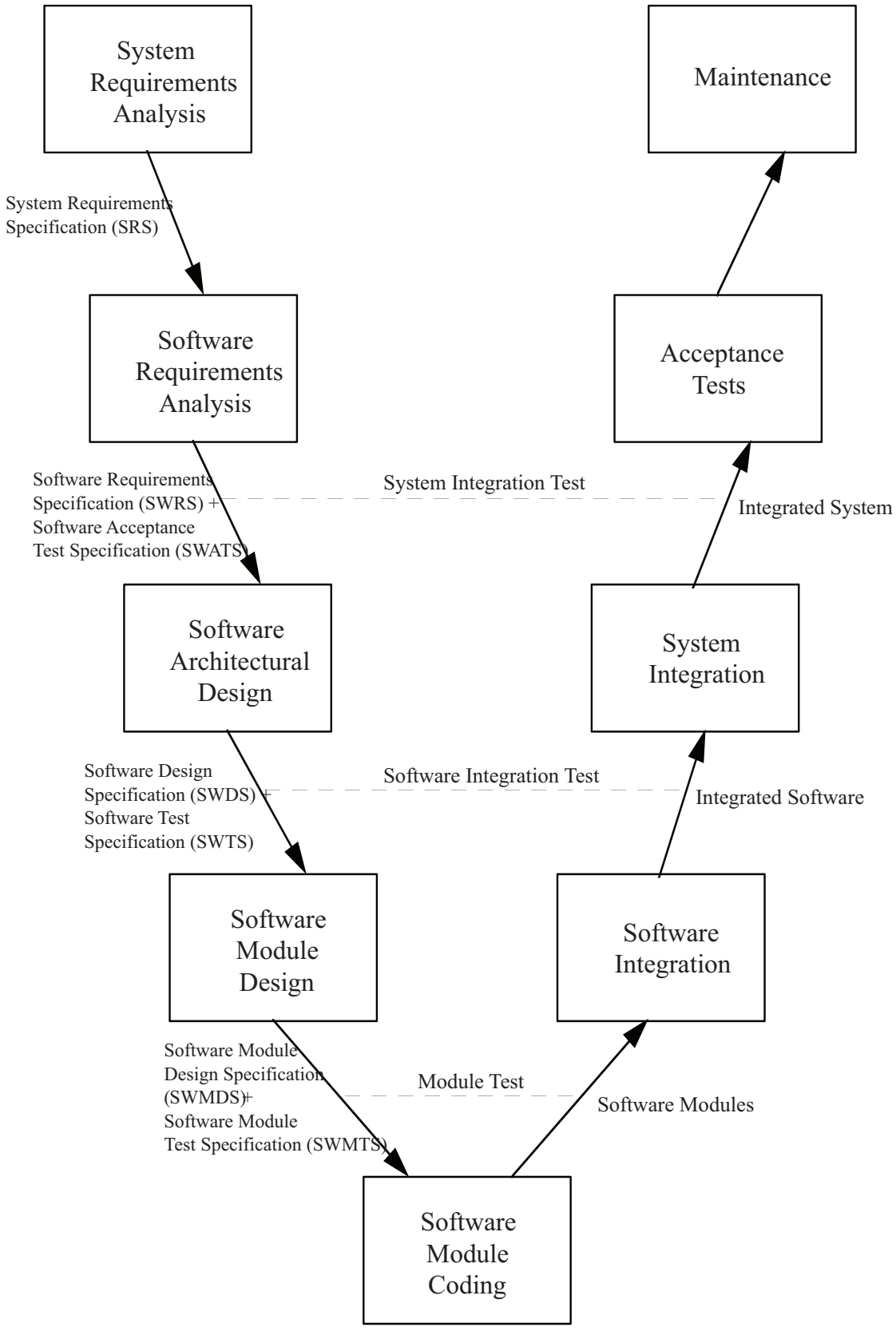


Figure STD05-1 Reference Software Lifecycle

Table STD05-1 Format for Software Quality Plan

Software Quality Plan

1. Purpose
2. Reference Document
3. Management
   - 3.1. Organization
   - 3.2. Tasks
   - 3.3. Responsibilities
4. Deliverables
   - 4.1. Purpose
   - 4.2. List of Software Work Package and Development Level
   - 4.3. Submission Requirements
5. Software Development Lifecycle
   - 5.1. Mapping to the Employer's Reference Standard
   - 5.2. Input and Output Document for each Phase
6. Standards, Practices, Conventions and Metrics
   - 6.1. Assurance and Control of Compliance
   - 6.2. Reference Standard
     - 6.2.1. Documentation Standards
     - 6.2.2. Design Standards
     - 6.2.3. Coding Standards
     - 6.2.4. Testing Standards
     - 6.2.5. Review and Audit Standards
7. Reviews and Audits
8. Test and Integration
9. Problem Reporting and Corrective Action
10. Tools, Techniques and Methodologies
11. Software Supplier Control
12. Records Collection, Maintenance and Retention

Table STD05-2 Format for Software Configuration Management Plan

Software Configuration Management Plan

1. Introduction
2. Software Configuration Management
    - 2.1. Organization
    - 2.2. Software Configuration Management Responsibilities
    - 2.3. Applicable Policies, Directives and Procedures
3. Software Configuration Management Activities
    - 3.1. Configuration Identification
        - 3.1.1. Identifying Configuration Items
        - 3.1.2. Naming Configuration Items
        - 3.1.3. Acquiring Configuration Items
    - 3.2. Change Control
        - 3.2.1. Requesting Changes
        - 3.2.2. Evaluating Changes
        - 3.2.3. Approving or Disapproving Changes
        - 3.2.4. Implementing Changes
    - 3.3. Problem Reporting
    - 3.4. Media Control
    - 3.5. Configuration Status Accounting
    - 3.6. Interface Control
    - 3.7. Subcontractor / Vendor Control
4. Software Configuration Management Schedules
5. Software Configuration Management Resources
6. Software Configuration Management Plan Maintenance

ROLLING STOCK STANDARD RS/C6014/06
CABLES

1 Introduction

2 Standards/Reference

3 General Requirements

4 Operation Condition

5 Insulation and Sheathing

6 Conductors

7 Ratings

8 Characteristics of Wires and Cables

9 Screened Cables

10 Special Cables

11 Radio Frequency (RF) Cables for Telecommunication Systems

12 Communication and Data Transmission Cables

13 Alternative Specifications

14 Cable Schedule

15 Testing Requirements

16 System Engineering Management System

Figure STD06-1 Test Arrangement for Abrasion Resistance

ROLLING STOCK STANDARD
RS/C6014/06 CABLES

1 Introduction

1.1 This is a material standard which specifies the construction, design and performance requirement of low smoke halogen free rolling stock power and control cables for the train.

1.2 All cables used on the train shall comply with this Standard, and the latest version of relevant requirements of British Standard Specifications (BS), International Electrotechnical Commission (IEC) standards, or equivalent national standards.

1.3 Wherever quoted standards duplicate requirements for a particular criterion, the more stringent standard shall apply. Any conflict in requirements shall be brought to the attention of the Engineer.

2 Standards/Reference

BS 5308:1986	Instrumentation cables
BS EN 50117-1:2002	Coaxial Cables Part 1: Generic Specification
BS 6360:1991	Conductors in insulated cables and cords
BS EN 50200:2006	Method of test for resistance to fire of unprotected small cables for use in emergency circuits
BS 6469:1990	Insulation and sheaths of electric cables
BS 6500:2000	Electric cables Flexible cords rated up to 300/500 V, for use with appliances and equipment intended for domestic, office and similar environments
BS 6853:1999	Code of practice for fire precautions in the design and construction of passenger carrying trains
BS EN 45545-2:2013	Railway applications-Fire protection on railway vehicles Part 2: Requirements for fire behavior of materials and components
IEC 60811:1985	Common test methods for insulating and sheathing materials of electric cables

NF C 32-021:1985	Test Methods for Cables Used under Special Conditions
NF C 93-522:1982	Electrical Wires for Wrapped Connections

3 General Requirements

3.1 Minimum quantity of inflammable material shall be used in the construction of all cables which shall minimise the production of smoke and toxic fumes in the event of fire or short circuit.

3.2 All cables shall have high resistance to fire propagation. Hazardous conditions arising from the overheating or ignition of cables shall be avoided.

3.3 Demonstrations shall be included to certify the absence of any halogen, phosphorus and sulphurous compounds in the cable materials.

3.4 The cable sheath shall be able to withstand at least 150℃ of hot air for 10 minutes with no deterioration to its property and without exhibiting surface cracks or punctures.

3.5 The primary wires and cables shall not suffer any damage or punctures after a prolonged exposure to mineral oil.

3.6 Single core and multi-core power cables shall be suitable for use with voltages of 500V or 1500V either DC or AC up to frequency of 1000 Hz.

3.7 Control cables shall be suitable for use with voltage up to 250VDC or AC up to frequency of 1000 Hz.

3.8 Communication cable shall be suitable for use with voltage up to 16 $V_{peak\text{-}to\text{-}peak}$ for arcnet, 20 $V_{peak\text{-}to\text{-}peak}$ for serial data link (such as RS 485), 2 $V_{peak\text{-}to\text{-}peak}$ with highest frequency of 10M bits/s for ethernet.

3.9 The cable shall meet the following quality assurances:

(a) Maximum differences of the cable wall thickness (including cable insulation and sheath);

(b) Consistency of cable and conductor diameters;

(c) No wrinkles/permanent damages to the cable insulation shall be caused by bending.

4 Operation Condition

4.1 All insulation and sheath shall be moisture and heat resistant.

4.2 The maximum continuous conductor temperature appropriate to the application conditions and the maximum conductor short circuit temperature shall not be lower than 90℃ and 250℃ respectively.

4.3 The cables to be used for the following circuits shall meet all requirements according to the BS EN 50200: 2006:

(a) Safety related controls (refer to PS 9.9);

(b) Train and passenger information management (refer to PS 9.10);

(c) Emergency operations (refer to PS 9.11); and

(d) Special controls (refer to PS 9.12).

5 Insulation and Sheathing

5.1 Material

5.1.1 All cables shall have an insulating sheath and shall exhibit low flame propagation when exposed to fire. Hazardous conditions arising from the overheating or ignition of cables shall be avoided.

5.1.2 Natural rubber and thermoplastic materials shall not be used.

5.1.3 Insulation and sheathing material shall be of extruded material or tape lapping.

5.1.4 Insulating materials which are made by tape lapping shall have their overlapping surfaces bonded together and the tape overlapping shall exceed 66.7%.

5.1.5 Lapped sheaths shall be made of a single tape with an overlapping exceeding 50%.

5.1.6 It shall be possible to strip the outer sheath of multi-core or pair cables from the core without damage to any component in the core and it shall also be possible to strip all primary insulation cleanly from the conductor.

5.2 Appearance

5.2.1 The insulation and sheath shall be smooth and free from defects which would affect performance or use. There shall be no surface irregularities such as rippling, bubbling and bulging, and no excretion, pleats or visible deformation.

5.2.2 Cable sheathing for all safety circuits shall be coloured yellow. The colour of other cables and the cores shall be agreed between the Engineer and the Contractor.

5.2.3 Cable identification marking on the outer sheath surface shall at least contain the following minimum requirements:

(a) The type of insulating material;
(b) The nominal cross-sectional area of the conductor;
(c) The rated voltage in Volts;
(d) The type of wire or cable and the composition;
(e) The reference of wire and cable specification;
(f) The manufacturer's logo and year of manufacturing; and
(g) The markings shall be printed no more than 1 m apart.

Details of the marking are to be agreed between the Engineer and the Contractor.

5.2.4 The colour of the sheath and the printing shall be permanent and remain legible for the service life of the cables.

5.3 Geometrical Characteristics

The Contractor shall submit the dimensions for all the cables, including the maximum, nominal and minimum values of diameters and thicknesses of the insulating covers, the outer sheaths and the screening, for Approval. These shall be measured in accordance with BS 6469:1990 or IEC 60811:1985.

5.4 Mechanical Characteristics

5.4.1 The tensile strength shall exceed 7 MPa and the elongation at break shall exceed 100%. The stress at 50% elongation shall be recorded for reference.

5.4.2 The measurements shall be carried out in accordance with BS 6469:1990 or IEC 60811:1985.

5.5 Physical and Chemical Performance

All insulation and sheathing shall have excellent resistance against moisture, heat, mineral oil, acids, alkalis, all conventional impregnating varnishes and potting resins, ozone, ultraviolet light and sunlight radiation. Test for physical and chemical performance shall refer to Clause 15.2.

6 Conductors

6.1 All conductors shall be stranded and tinned and shall be in accordance with all relevant aspects of BS 6360 for tinned annealed copper.

6.2 The core of the wires shall be stranded or twisted, singly or together, and must conform to flexibility class 5 as defined in BS 6360:1991.

6.3 Test for conductor performance shall refer to Clause 15.3.

6.4 To enhance circuitry reliability, all cables shall be designed such that if one conductor in a bunch is subjected to the maximum possible fault current within the tripping time of the protective device, other adjacent cables are not affected.

7 Ratings

7.1 All cables shall be rated with sufficient capacity for their intended duty and sized appropriately in relation to the design load current, circuit protection setting, ambient temperature of 40℃ and the installation condition.

7.2 All cables shall be required to operate in conditions where a combination of installation conditions and current flow may result in conductor temperature not exceed 85℃.

7.3 Cable ratings shall be in accordance with Drg. No. C6014-14E/TSEG/010/008

.

7.4 The size of the cable conductor shall be such that the drop in voltage from the origin of the installation to any point of that installation does not exceed 2.5% of the nominal supply voltage when the conductors are carrying the full load current, but disregarding starting conditions.

7.5 The cross sectional area of the earthing cable shall not be less than that of the incoming supply to the case or frame.

8 Characteristics of Wires and Cables

8.1 Geometrical Assembled Characteristics

8.1.1 The cores and cables shall be cylindrical.

8.1.2 The difference between two values of the diameter recorded in any two directions shall not exceed 15% of the upper limit of diameter specified in Clause 5.3.

8.1.3 Diameter measurements shall be carried out in accordance with BS 6469:1990 or IEC 60811:1985.

8.1.4 For multicore cables, the length of lay of the cores of a layer shall not exceed twenty times of the actual diameter of that layer.

8.2 Mechanical Characteristics

8.2.1 All cables shall have the properties of easy processability (such as removal of insulation).

8.2.2 The individual cores of multicore cables shall have sufficient cohesion to form a closely bonded assembly but without adhesion presenting any difficulties in separating the cores.

8.2.3 All cables shall have good resistance against cutting, abrasion and notch propagation.

8.2.4 Test for mechanical characteristics shall refer to Clause 15.4.

8.3 Electrical Characteristics

8.3.1 Transverse Dielectric Strength

Test for transverse dielectric strength shall refer to Clause 15.5.1.

8.3.2 Transverse Disruptive Voltage

Test for transverse disruptive voltage shall refer to Clause 15.5.2.

8.3.3 Longitudinal Dielectric Strength

Test for longitudinal dielectric strength shall refer to Clause 15.5.3.

8.3.4 Stability of Insulation

Test for stability of insulation shall refer to Clause 15.5.4.

8.3.5 Insulation Resistance

Test for insulation resistance shall refer to Clause 15.5.5.

8.3.6 Conductor Temperature

The maximum continuous conductor temperature appropriate to the application conditions and the maximum conductor short circuit temperature shall in no case be lower than 90°C and 250°C respectively.

8.4 Physical / Chemical Characteristics

8.4.1 Dimensional Change

Test for dimensional change shall refer to Clause 15.6.

8.5 Fire Specification

8.5.1 General

(a) The reaction of cables to fire is specified in respect of flame retardancy, smoke emission and toxic fume emission.

(b) The requirements of fire performance qualifications shall refer to Clauses 15.7.1 to 15.7.3.

8.5.2 Flammability, Smoke Emission and Toxic Fume Emission

Test for flammability shall refer to Clause 15.7.4.

8.5.3 Qualification

(a) Qualification of a single cable size and type may be achieved by meeting the requirements given above.

(b) Qualification of a cable type for diameters from d to 2d (max) may be achieved by cables of diameter d and 2d meeting the requirements.

(c) Subject to Approval, qualification of a range wider than that given by d to 2d may be possible depending on the extent of the passes achieved.

8.6 Additional Information

The Contractor shall submit the following data of all cables for Approval.

8.6.1 Maximum conductor short circuit current carrying capacity for one second duration

8.6.2 Relative permittivity of the insulation

8.6.3 Maximum dielectric loss angle of the insulation

8.6.4 Thermal resistivity of the insulation

8.6.5 Fire loading of the cable (MJ/kg)

8.6.6 Weight per unit length

9 Screened Cables

9.1 For single core screened cable, the screening braid shall be made of 0.1 mm diameter tinned copper strand.

9.2 For two cores screened cable, the screening braid shall be made of 0.12 mm diameter tinned copper strand. The cable shall consist of a group of twisted primary wires.

9.3 The filling factor shall not be less than 0.6, as defined in BS 6500:2000. In the case of multi-pair cable, the screens shall be electrically isolated from each other.

9.4 The oversheath material of the screen cable shall have an insignificantly low surface leakage property to prevent the flow of leakage current between the screen braid and the outer sheath.

10 Special Cables

10.1 As deemed necessary, the Contractor may recommend to the Engineer the use of cables of special construction, for example of reduced wall insulation, which do not fully comply with all the above requirements. These cables may include those used in electronic equipment and inside enclosures.

10.2 The Contractor shall submit all the relevant information of these cables for Approval.

11 Radio Frequency (RF) Cables for Telecommunication Systems

11.1 General

11.1.1 Dielectric

The cable dielectric shall be solid high density polyethylene.

11.1.2 Double Screening (if required)

Screening shall be achieved by the use of copper braid or aluminium tube with an overlap so that full 100 % coverage of the dielectric is afforded (Note: spray on types of construction are not acceptable).

11.1.3 The screening effectiveness shall comply with BS EN 50117-1:2002.

11.2 Feeder Coaxial Cable for Radio

Electrical Requirements:

Capacitance	101 pF/m max.
Characteristic impedance	50 ± 3 Ω
Relative propagation velocity	at least 66 %
Longitudinal loss at 100 m	150 MHz < 7.2 dB
	400 MHz < 13.8 dB
	900 MHz < 23.0 dB

11.3 CCTV Cable

Electrical Requirements:	
Capacitance	68 pF/m max.
Characteristic impedance	75 ± 3 Ω
Relative propagation velocity	at least 66 %
Longitudinal loss at 100 m	10 MHz < 2.0 dB
	100 MHz < 6.2 dB
	500 MHz < 11.0 dB
	1000 MHz < 22.0 dB

12 Communication and Data Transmission Cables

12.1 Screening

12.1.1 Screening shall be achieved by the use of laminated tape, consisting of an aluminium foil bonded to a polyester film for strength, applied to the cable with an overlap so that full 100 % coverage of the conductors is afforded (Note : spray on types of construction are not acceptable).

12.1.2 A drain wire or continuity conductor, laid under and in contact with the aluminium foil shall be provided and shall be in accordance with BS 5308 clauses 7 and 10 as appropriate.

12.1.3 The tinned annealed copper conductor, which may be of solid or stranded construction, in keeping with current manufacturing techniques, shall have a minimum cross-sectional area of 0.5 mm^2.

12.1.4 The maximum resistance of the drain wire or continuity conductor provided shall meet with the requirements of BS 6360:1991.

12.1.5 Individual shield of twisted pairs coverage shall be greater than 90%.

12.2 The twisting arrangement shall be no less than 12 twists per meter.

12.3 Electrical Requirements:

Impedance characteristic	120 Ω±10%
Attenuation	< 15 dB/km
Distributed capacitance	46 pF/m
Capacitive unbalance to shield	< 1.5 pF/m at 1.0 BR
Crosstalk rejection	> 55 dB (if 2 pairs in the same cable)

13 Alternative Specifications

Consideration will be given to the use of alternative materials with specifications equivalent to the above requirements. The Contractor shall make proposals for Approval.

14 Cable Schedule

The Contractor shall submit for Approval a cable schedule of all the cables to be used in the train. The content of this cable schedule shall include but not limit to: the application, cross-sectional area, stranding, voltage grade, colour, cable specification, outer diameter, type of cable end terminal, wiring diagram symbol and quantities.

15 Testing Requirements

15.1 As a minimum requirement, the Contractor shall carry out relevant tests as specified below on all cables to demonstrate their compliance with the requirements stipulated in this Standard.

15.2 Physical and Chemical Performance

15.2.1 The Contractor shall carry out all the relevant tests as listed in BS 6469:1990 or IEC 60811:1985, such as, the resistance to heat, resistance to mineral oil and resistance to ozone, for all types of cable sheaths and insulations to be used to demonstrate the physical and chemical properties.

15.2.2 Resistance to Acids and Alkalis

The cable sample shall be immersed in accordance with NF C 32-021:1985 in acid and alkali baths for 168 ± 1 hours at 23 ± 2 ^{o}C, after which the mechanical characteristics shall be determined according to Clause 5.4 of this Standard. Tubular samples shall be immersed with their ends protruding. The acid and alkali baths shall be the normal solution of hydrochloric acid and sodium hydroxide respectively. After immersion, measurement of the mechanical characteristics shall be repeated according to Clause 5.4 and the variation in stress at 50% elongation from the unaged samples shall not exceed 25%.

15.3 Conductor

All the tests as specified in BS 6360:1991, including elongation test and electrical resistance test, shall be carried out.

15.4 Mechanical Characteristics

The Contractor shall carry out appropriate tests for all types of cables to be used to demonstrate the compliance with the associated mechanical properties. As a minimum requirement, the cables shall be successfully tested to the following tests for mechanical characteristics:

15.4.1 Adherence of Cores of Multicore Cables

The individual cores of multicore cables shall have sufficient cohesion to form a closely bonded assembly, but with adhesion presenting any difficulties in separating the cores in use. This shall be checked by taking a length of cable approximately half the length of twist of the outer core layer, and removing the sheath and any separators. This assembly shall

be allowed to fall from a height of 500mm onto a horizontal rigid surface, when the cores and any fillers shall separate on impact.

15.4.2 Resistance to Cutting

This test shall be carried out on finished cable samples of 500mm length in accordance with NF C 93-522:1982, however the increase in load shall be obtained by moving the knife at 5 ± 1 mm/min, and shall be carried out at tow temperatures, 20 ± 5°C and 90 ± 5°C. The value of the load required to produce electrical continuity between the knife and the conductor shall exceed the following values:

For conductor sections up to 35mm^2	120N at 20°C	20N at 90°C
For conductor sections over 35mm^2	500N at 20°C	100N at 90°C

15.4.3 Resistance to Abrasion

(a) Test Arrangement

(i) The test equipment shall be arranged according to Figure STD06-1.

(ii) For the test of abrasion resistance of insulation and sheath, the abrasion blade (refer to testing blade A as shown on Figure STD06-1) shall be applied with a force of 10N for cables of cross sections of 1.5 to 35mm^2. The abrasion blade shall be applied with a force of 20N for cables of cross sections in excess of 35mm^2.

(iii) A testing weight of at least 200g shall be provided to the steel wire abrasion blade (refer to testing blade B as shown on Figure STD06-1) for the test of abrasion resistance of marking.

(iv) For test of abrasion resistance of insulation and sheath, an electrical circuit with 50VDC and 0.05ADC supply shall be provided. Such that when the abrasion blade has penetrated the insulation or sheath of the cable sample and contacted with the cable conductor, the test equipment including the stroke counter shall be switched off automatically.

(b) Abrasion resistance of insulation and sheath

(i) A hardened tungsten carbide blade shall be mounted perpendicularly to the axis of the cable sample as shown on Figure STD06-1. This testing blade shall be rubbed over the cable sample

with an amplitude of oscillation of 10 to 20 mm with a frequency of 50 ± 5 cycles per minute.

(ii) The sample shall be securely clamped and shall undergo four tests at each of two temperatures of 20 and 90°C.

(iii) After each test, the sample shall be moved 100mm and rotated through 90°. Each test is complete when the abrasion blade has contacted the conductor of the cable sample.

(iv) The test requirement is the arithmetic mean of the four tests and the number of cycles to failure shall be greater than the following:

For conductor sections up to $35mm^2$	250 cycles at 20°C	20 cycles at 90°C
For conductor sections over $35mm^2$	500 cycles at 20°C	400 cycles at 90°C

(c) Abrasion resistance of marking

Test method which is similar to the test of abrasion resistance of insulation and sheath, shall be provided for test of abrasion resistance of marking, except that only three tests shall be made and the test result shall be after the three tests, no continuous strip shall be visible on the marking for at least 150 double-strokes.

15.4.4 Notch Propagation

The cable shall be notched to a depth of a third of the sheath thickness around its circumference. It shall be coiled round and secured to a mandrel of diameter six times the external diameter of the sample, such that two coils are on each side of the notch. This assembly shall be subjected to the following temperatures for four hours each:

(a) -25 +0/-5 °C
(b) 20 ± 5°C
(c) 90 ± 5°C

At the end of the test, the assembly shall be removed from the oven, and allowed to attain ambient temperature before being subjected to the voltage strength in Clause 15.5.1 at a voltage of three times the rated voltage plus 500V or 8kV, whichever is the greater, for a period of 1 minute. No breakdown shall occur in this test.

15.5 Electrical Characteristics

15.5.1 Transverse Dielectric Strength

(a) A sample shall be fully immersed, except for the ends which shall protrude by about 150 mm, in water at 20 ± 5℃ for 24 hours. With the sample still immersed, a sinusoidal alternating voltage with frequency between 49 and 61 Hz of the specified value shall be applied to the cable for 5 minutes.

(b) The test voltages are:
1500 V rms for 250 V rated control cables;
2500 V rms for 500 V rated single core cables;
6000 V rms for 1500 V rated single core cables;
5000 V rms between conductors for 500 V rated multicore cables.

(c) The cable under test shall withstand the test voltage without breakdown or perforation.

15.5.2 Transverse Disruptive Voltage

With the test set up similar to that in Clause 15.5.1, the applied voltage is increased in 2 kV steps every minute until breakdown occurs.
Breakdown shall occur above the following values:
5000 V rms for 250 V rated control cables;
6000 V rms for 500 V rated single core cables;
15000 V rms for 1500 V rated single core cables;
12000 V rms for 500 V rated multicore cables.

15.5.3 Longitudinal Dielectric Strength

A 320 mm sample shall have two annular electrodes attached. These shall consist of copper wire which shall be wrapped around the centre part of the sample with their internal windings about 50 mm from each other. The resultant assembly shall be immersed in water at 20±5℃ for four hours with a length of 50 mm at each end being left out of the water. Then, the assembly shall be removed from the water, and the surface dried with lint free filter paper. The assembly shall then be subjected to an A.C. voltage as specified below with a frequency of 49 to 61 Hz applied between the electrodes. The leakage current between the two electrodes shall be measured after 10 seconds loading, and shall be less than 1 mA.

The voltage shall then be raised uniformly at a maximum rate of 100 V per second until flashover occurs. The flashover voltage shall not be less than the values specified below.

	Test voltage	Flashover voltage
Control cables	1500 V	5 kV
Power cables	2000 V	10 kV

15.5.4 Stability of Insulation

A five metre sample shall be dipped into a solution of sodium chloride at about 10 g/l, maintained at 60 ± 2℃ for 150 ± 1 hours, with a length of about 250 mm at each end being left out of the solution. Throughout the duration of the test, a direct current supply is connected to the cable. The test voltage shall be:

750 V for 250 V rated control cables; 1000
V for 500 V rated cables;
2500 V for 1500 V rated cables.

The cable shall withstand the test voltage with breakdown.

15.5.5 Insulation Resistance

Immediately following the voltage strength test in Clause 8.3.1, the insulation resistance at ambient temperature shall be measured. The test shall also be carried out at high temperature, for which a five metre sample shall be immersed for two hours in water at 60 ± 2℃, with the exception of the ends which shall protrude by about 100 mm.

The value of insulation resistance in MΩ/km shall be used to calculate the coefficient K, from the following formula:

$$K \frac{R}{\log d \frac{D}{}}$$

Where R is the measured insulation resistance
D is the mean outer diameter of cable
d is the mean diameter of conductor

The minimum values of K shall be:

	20℃	60℃
Control cables	5000	50
Power cables	500	10

15.6 Tests for Dimensional Change

A 320 mm sample shall be placed in an oven for 16 hours at 125 ± 2°C. The sample shall then be removed and allowed to cool to ambient temperature. After cooling, measurements shall be taken of any extension or retraction of the covering. The maximum retraction shall be 3 mm and the maximum extension shall be 6 mm.

15.7 Fire Specification

15.7.1 In respect of flame retardancy, cables shall be qualified by suitable performance in three small scale tests. These are, a flammability test on the sheath, a flammability test on the cable and a parameter (related to rate of reaction to fire) derived from the smoke emission test. In the event of failure in any of these tests qualification may be attempted by resort to a larger scale test.

15.7.2 In respect of smoke emission, cables shall be qualified by resort to a test on the complete cable.

15.7.3 In respect of toxic fume emission cables shall be qualified by resort to a test on the sheath.

15.7.4 Flammability, Smoke Emission and Toxic Fume Emission

The cables shall meet the requirements for vehicle category Ia specified in the Table 13 (interior cable) and Table 14 (exterior cable) of the standard BS 6853:1999 or HL3 specified in R15 (interior cable) and R16 (exterior cable) of the standard BS EN 45545-2:2013.

16 System Engineering Management System

16.1 The cables design shall follow the overall design development schedule of the associated system according to the approved system engineering management plan.

16.2 There are five essential stages of cables design developments:

16.2.1 SEMP Stage 1

The Contractor shall submit a conceptual cable schedule to demonstrate the correct understanding and specification of the requirements specified in this Standard.

16.2.2 SEMP Stage 2

Upon the completion of the design development of the individual sub-system, the Contractor shall submit a detailed cable schedule according to Clause 14 to demonstrate the correct applications of cables for each sub-system.

16.2.3 SEMP Stage 3

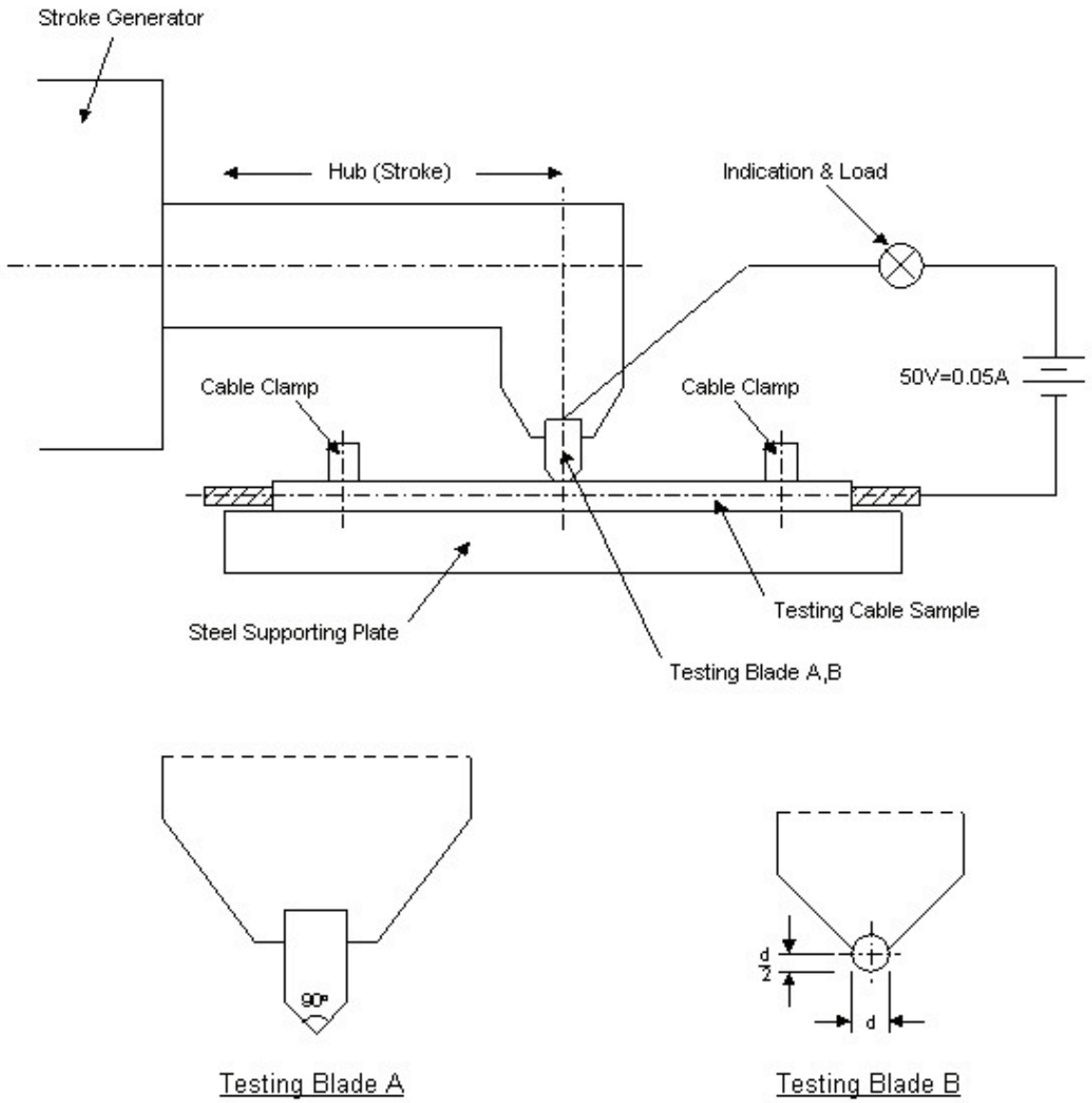
According to the results of design verification and validation of the individual sub-system, the Contractor shall revise cable schedule, if necessary, to update the final selections of cables for each sub-system.

16.2.4 SEMP Stage 4

A test plan shall be submitted to detail the testing methodology and programme of each cable testing activities. The Contractor shall carry out all the tests as listed in the approved test plan accordingly.

16.2.5 SEMP Stage 5

Upon the completion of the above cable tests, the Contractor shall submit all test results for Approval.



Test arrangement for abrasion resistance of insulation and sheath and indelibility of marking

Figure STD06-1 Test Arrangement for Abrasion Resistance

ROLLING STOCK STANDARD RS/C6014/07
PNEUMATIC EQUIPMENT

1 Introduction

2 Standards/Reference

3 General Requirements

4 Major Pneumatic Equipment

5 Piping and Fittings

6 Air Hose

7 Control Equipment

8 Accessories

9 Testing Requirements

10 System Engineering Management System

ROLLING STOCK STANDARD RS/C6014/07
PNEUMATIC EQUIPMENT

1 Introduction

This Standard contains details of standards and practices for the design, selection, manufacture, maintenance and operation of pneumatic systems, and related components and equipment.

2 Standards/Reference

BS EN 12449: 1999	Copper and copper alloys – Seamless, round tubes for general purposes
BS EN 286: Part 3: 1995	Simple Unfired Pressure Vessels designed to contain Air or Nitrogen - Part 3: Steel pressure vessels designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock
BS EN 10216: Part 5: 2004	Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 5: Stainless steel tubes
BS 3682: Part 1: 1994	Railway brake hose – Part 1: Specification for compressed air brake hose
BS EN 60529: 1992	Degrees of protection provided by enclosures (IP code)
BS EN 61373: 1999	Railway applications – Rolling stock equipment – Shock and vibration tests

3 General Requirements

3.1 This Standard may not necessarily include all technical requirements for pneumatic systems, and shall be subject to amendments and additions specified in the relevant PS.

3.2 The standards and practices detailed in this Standard shall be observed as the minimum standards which are acceptable to the Engineer. The Contractor may propose alternative standards which are equivalent to or better than this Standard for Approval.

3.3 All equipment shall be constructed in a sufficiently robust manner and arranged so as not to suffer deterioration, wear or damage due to vibration or shocks encountered in traction service.

3.4 The pneumatic air system shall be designed and constructed so as to minimise leakage.

4 Major Pneumatic Equipment

4.1 Air Compressor Unit

4.1.1 Air compressors shall be oil-tight and, in particular, have no external oil pipework or compression fittings in the oil circuit which may loosen and cause oil leakage. Topping-up of the oil shall be possible without spillage when mounted on the car.

4.1.2 Facilities shall be provided to check oil levels. Using dip-sticks for this purpose will not be accepted.

4.1.3 The air compressor shall be suspended beneath the car on resilient mountings.

4.1.4 In the event of failure of either one or all resilient mountings the air compressor unit shall remain secure.

4.1.5 All bolted connections between the air compressor unit, resilient mountings and mounting brackets and between the mounting brackets and the carbody, shall be provided with a method of secondary locking to prevent loosening or loss of any component due to vibration.

4.1.6 If the operation of the compressor requires the use of a coolant fluid, only the machine lubricating oil shall be used for cooling purpose.

4.1.7 If a cooling fan is required, it shall be directly driven from the air compressor unit without using belts or other detached drive system.

4.1.8 The compressor shall have a useful working life at least equal to the life of the train.

4.2 Air Dryer

4.2.1 All equipment shall be mounted in one frame as a single unit.

4.2.2 The control of the air dryer shall be either electrical or pneumatic.

4.3 Air Reservoir

4.3.1 All reservoirs shall be designed and manufactured in accordance with BS EN 286 Part 3: 1995.

4.3.2 The use of corrosion-protected ferrous materials for reservoirs shall be submitted for Approval.

4.3.3 The maximum working pressure shall be the same as the Main Reservoir Pipe safety valve "open" setting.

4.3.4 The main reservoir shall be fitted with a suitable automatic drain valve and shall have capacity not less than ten times the maximum air volume consumed by the equipment per minute.

4.3.5 All reservoirs, other than the brake supply reservoirs, shall be provided with drain cocks.

4.3.6 The brake supply reservoir shall have a plugged drain.

4.3.7 The plugged drain shall be able to release any air pressure inside the reservoir before it is fully unplugged.

4.3.8 All drain cocks fitted shall be easily accessible.

4.3.9 All drain cock handles shall point downwards in the closed position.

5 Piping and Fittings

5.1 The pipework and fittings shall be designed to withstand a pressure of 1.5 times the Main Reservoir Pipe safety valve pressure setting.

5.2 The various parts of the whole system and the equipment supplied shall be subdivided into sections, each section being provided with a vented isolating cock

and a strainer. Where a check valve is incorporated in the system means of venting the system shall be provided.

5.3 As far as possible pipe runs shall be direct, short and straight, avoiding unnecessary use of bends and fittings. Pipe bends shall be of as large a radius as possible (minimum of 3 times the pipe diameter), particularly on safety critical systems.

5.4 Drain point(s) shall be provided in the piping system and shall be located at the lowest point of the relevant section to effectively drain off any accumulated condensate within the system.

5.5 Stainless steel piping to BS EN 10216: Part 5: 2004 shall be used on bogies.

5.6 Nylon pipe of not more than 12 mm outside diameter may be used for short runs where replacement of the pipe can be carried out without removal of other equipment. The application of nylon tube shall be submitted for Approval.

5.7 Flexible elastomer hoses shall be used only for drophoses and intercar connections.

5.8 Other than the applications in Clauses 5.4 to 5.7, solid drawn copper pipe to BS EN 12449: 1999 in material condition H070 or equivalent suitable for the working pressure specified in Clause 5.1 shall be used.

5.9 All pipes shall be cut with correct pipe cutting tools in order to avoid introduction of metal particles into the system. All pipework shall be thoroughly blown out and cleaned before service.

5.10 Taper-threaded pipe connections shall be sealed with a proprietary sealing compound used in accordance with the manufacturer's instructions.

5.11 Parallel thread fittings shall be sealed with a proprietary sealing washer.

5.12 PTFE tape and fibre washers shall not be used.

5.13 All pipes shall be adequately secured and cleated to prevent failure from sagging and vibration. The cleats shall incorporate a resilient surface to prevent chafing and fretting of the tubing. Cleats shall not be positioned in highly stressed areas.

5.14 All fittings, valves and components shall be non-ferrous or stainless steel.

5.15 Fittings for metallic tubing shall be made of the same materials as the pipework. Brass fittings shall be acceptable for copper piping.

5.16 The strainers, check valves and isolating cock shall be grouped in an easily accessible panel.

5.17 Equipment other than strainers and cutout cocks, shall be mounted such that it can be removed for maintenance without breaking pipe joints.

5.18 Diaphragms and air valve seals shall be of the non-metallic type. The use of leather as a gasket, seal or packing material will not be accepted.

5.19 Life of diaphragms and seals shall be at least 5 years. Exceptions to this requirement may be made for cutout cocks and compressor check valves, which shall operate in air temperatures of up to 150℃.

5.20 The types of fitting used shall be submitted for Approval.

6 Air Hose

6.1 Compressed air hose shall be of an Approved type stamped with the manufacturing date to be used for all applications.

6.2 Air brake hoses shall be manufactured, tested and inspected in accordance with the requirements of BS 3682: Part 1: 1994 or equivalent.

6.3 Pantograph hoses shall have a minimum insulation resistance of not less than 50 MΩ over a 400 mm length.

7 Control Equipment

7.1 Air Cylinder

All air cylinders (other than brake cylinders), pistons and pneumatic valves shall be of a type which does not require lubrication between overhauls.

7.2 Electro-pneumatic Control Valve

7.2.1 The valve shall not significantly change its speed or operational performance over the range of temperatures experienced by the equipment in operation.

7.2.2 The relays or electro-pneumatic valves used on the various systems shall be capable of operation without malfunctioning under the influence of vibration or impact up the following conditions:

(a) Brake system : 10g longitudinally - single shock only

(b) Wheel slip-slide protection system : 10g longitudinally
(c) Other pneumatic control system : 10g longitudinally

7.2.3 To reduce the noise of valve in operation, all exhaust ports shall be fitted with a metal type silencer to the following requirements:

(a) The silencer shall not reduce the flow capability of the valve by more than 5%.

(b) The silencer material shall be capable of being cleaned and re-used. Porous plastic silencers will not be acceptable.

7.2.4 Spool type valves shall be installed so that the axis of the spool lies across the width of the car and the solenoid armatures are vertical.

7.2.5 Poppet type valves shall be installed so that both the axis of the valve and the solenoids are vertical.

7.2.6 All control valves shall be sub-base mounted.

8 Accessories

8.1 Pressure Regulators

8.1.1 The workable range of the pressure regulators shall be selected to have a range for the working pressure setting to be adjusted.

8.1.2 Pressure regulators shall incorporate a simple device on the adjustment to prevent tampering by unauthorised persons.

8.2 Pressure Switch/Governor

8.2.1 The pressure switch/governor shall be proven type for railway application.

8.2.2 Suitable working range of the pressure switch/governor shall be selected to match the pressure of the system to be controlled.

8.2.3 The pressure switch/governor shall be capable to withstand for the maximum pressure of the system without damage.

8.2.4 The pressure switch/governor shall have maximum sensitivity within the working range.

8.2.5 The setting of the pressure switch/governor shall be easily adjustable without using any special tools.

8.2.6 Means shall be provided to prevent drifting of the setting.

8.2.7 All settings shall be submitted for Approval.

8.2.8 The pressure switch/governor shall be sealed to IP 65 as defined in BS EN 60529: 1992.

8.3 Pressure Transducer

8.3.1 The pressure transducer shall not require frequent calibration without affecting the precision and accuracy.

8.3.2 The accuracy of the pressure transducer shall be ±1%.

8.3.3 The output of the pressure transducer shall be linear in either voltage or current and protected against short circuit, incorrect polarity and overload up to 50 Vdc.

8.3.4 The pressure transducer shall be compact and sealed to IP 65 as defined in BS EN 60529: 1992.

8.3.5 The pressure transducer shall be capable to work in railway environment, industrial grade piezo-resistive type will be preferable.

8.4 Pressure Gauges

8.4.1 Pressure gauges shall not require an electrical supply in order to provide a pressure reading of the required accuracy.

8.4.2 All pressure gauges shall be glazed and sealed to IP 54 as defined in BS EN 60529: 1992.

8.4.3 All pressure gauges shall be installed so that the gauge glazing may be cleaned easily, to maintain legibility, without requiring any components to be dismantled.

8.4.4 Any pressure gauges shall be installed so that they can be replaced within 15 minutes after the appropriate isolation has been made.

8.4.5 All gauges shall, unless otherwise specified, provide analogue pressure readings with an accuracy of ± 5%.

8.4.6 All pressure gauges shall be capable of operating to the specified accuracy for a period of 10 years without adjustment.

8.4.7 Brake Pressure Gauge

(a) The gauges shall have a range equal to the maximum regulated Main Reservoir Pipe pressure.

(b) The gauge shall be calibrated in 1 bar increments or 20% of full scale increment, whichever is greater.

8.4.8 Sub-System Gauges

(a) A pressure gauge shall be provided on each sub-system within each car which normally operates below Main Reservoir Pipe pressure.

(b) The gauges shall have a range equal to the maximum regulated Main Reservoir Pipe pressure.

(c) The gauge shall be calibrated in 1 bar increments or 20% of full scale increment, whichever is greater.

8.5 Isolating Cock

8.5.1 All isolating cocks shall be clearly labelled to identify the function of the cock.

8.5.2 Isolating cocks shall be of the ball valve type which operates through a nominal angle of 90°, unless otherwise specified.

8.5.3 Isolating cock handles shall be of the simple lever type (but not 'T' handle) and shall be arranged so that the longitudinal axis of the handle is nominally parallel to the direction of air flow when the isolating cock is open (different orientation may be considered for the air receiver drain cocks).

8.5.4 Isolating cocks shall be installed so as to permit their replacement within 15 minutes.

8.5.5 The cock handles shall be coloured in yellow for easy identification. If any brake isolation cock to be fitted, it shall be coloured as specified in the PS to distinguish from others.

8.5.6 The cock handles shall be provided with the provision that the isolation cocks can be locked with breakable seals if required. If breakable seal shall be fitted, it shall be provided as specified in the PS.

8.6 Drain Cock

Drain cock handles shall point vertically downwards when the cock is closed. All other cocks shall be open when the handle is along the line of pipe, and shall either have a vertical spindle, or the handle shall fall to the open position. The drain cock handles shall be provided with the provision that the drain cocks can be locked with breakable seals if required.

8.7 Chokes

8.7.1 Pneumatic chokes shall be provided, if necessary, to protect equipment from damage or to minimise the consequences of equipment failure.

8.7.2 Protection chokes shall be installed immediately upstream of the item of equipment being protected.

8.7.3 Chokes shall be easily accessible and removable.

8.7.4 Variable chokes shall not be used.

9 Testing Requirements

9.1 All reservoirs shall be tested to BS EN 286 Part 3: 1995.

9.2 Air brake hoses shall be tested and inspected in accordance with the requirements of BS 3682: Part 1: 1994 or equivalent.

9.3 All pneumatic equipment shall be tested to BS EN 61373: 1999 for shock and vibration testing requirements.

10 System Engineering Management System

As all pneumatic equipment form part of the Pneumatic and Air Distribution System, the pneumatic equipment design shall follow the overall design development schedule of the System according to the System Engineering Management System.

ROLLING STOCK STANDARD RS/C6014/08
FIRE PERFORMANCE

1 Introduction

2 Standards/Reference

3 Definitions / Abbreviations

4 General Requirements

5 Fire Resistance Requirements

6 Reaction to Fire Methods

7 Testing Requirements

8 System Engineering Management System (SEMS)

ROLLING STOCK STANDARD RS/C6014/08
FIRE PERFORMANCE

1 Introduction

Fire performance requirements are specified in the two usual areas of (materials) reaction to fire and (items / structures) fire resistance. The reaction to fire performance includes reference to both smoke and toxic fume emission in addition to flame retardancy. The materials required are therefore of a Limited Fire Hazard (LFH) type in the widest sense of the phrase.

2 Standards/Reference

2.1 International Standards

BS 476: Pt 4: 1970	Fire tests on building materials and structures – Part 4: Non-combustibility test for materials
BS 476: Pt 6: 1989	Fire tests on building materials and structures – Part 6: Method of test for fire propagation for products
BS 476: Pt 7: 1997	Fire tests on building materials and structures – Part 7: Method of test to determine the classification of the surface spread of flame of products
BS 476: Pt 20: 1987	Fire tests on building materials and structures - Part 20: Method for determination of the fire resistance of elements of construction (general principles)
BS 476: Pt 22: 1987	Fire tests on building materials and structures – Part 22: Methods for determination of the fire resistance of non-loadbearing elements of construction
BS EN ISO 4589: Pt 2: 1999	Plastics – Determination of burning behaviour by oxygen index – Part 2: Ambient-temperature test
BS EN ISO 4589: Pt 3: 1996	Plastics – Determination of burning behaviour by oxygen index – Part 3: Elevated-temperature test
BS EN ISO 9239 Pt 1: 2002	Reaction to fire tests for floorings – Part 1: Determination of the burning behaviour using a radiant heat source
BS 6853: 1999	Code of practice for fire precautions in the design and construction of passenger carrying trains

NF X 70-100	Fire tests - Analysis of Pyrolysis and combustion gases – Tube furnace method
BS EN 45545: Pt 1: 2013	Railway applications – Fire protection on railway vehicles Part 1: General
BS EN 45545: Pt 2: 2013	Railway applications – Fire protection on railway vehicles Part 2: Requirements for fire behavior of materials and components

2.2 Rolling Stock Standards

RS/C6014/06	Cables

3 Definitions / Abbreviations

Ext	Exterior
FT	Flammability Temperature
HP	Horizontal Prone
HS	Horizontal Supine
Int	Interior
LFH	Limited Fire Hazard
OI	Oxygen Index
V	Vertical

4 General Requirements

4.1 This Standard specifies categories of material, tests and requirements of fire resistance and reaction to fire.

4.2 The requirements for the reaction to fire performance of the main material surfaces vary depending on the location and orientation of the material. The locations are split into interior and exterior. The orientation is described as one of three types.

Horizontal Supine (HS)	- orientation as a floor
Vertical (V)	- orientation as a wall
Horizontal Prone (HP)	- orientation as a ceiling

Some testing is item specific and is referenced and described as such.

4.3 The requirements apply to all materials which shall comply with BS 6853: 1999 Cat-1a or BS EN 45545:2013 HL-3. Where materials are contained in a box, e.g.

an equipment case, and the box is sealed and constructed from a material which has fire resistance (by inspection or from certification) commensurate with the fire load within the box, then subject to Approval, the enclosed materials need not comply.

4.4 A category of materials is defined as being minor; i.e. of minor usage. These categories are intended to be used for materials, the amount of which in any particular area, is insufficient to justify its consideration as a surface. As an indication the limiting surface may be taken as $0.2m^2$ when measured over a maximum linear distance of 1m.

4.4.1 For interior use, items up to 500g may be considered in this category. For exterior use, items up to 2kg may be considered to be in this category.

4.4.2 For interior use items below 100g do not require testing. For exterior use items below 400g do not require testing.

4.5 The right is reserved to require testing and compliance for items below the testing threshold weights if inspection, say, of a materials schedule, indicates that the grouping or density of such items may lead to a hazardous situation developing.

5 Fire Resistance Requirements

5.1 Floor

5.1.1 The floor shall achieve 30 minutes integrity and insulation (to a temperature defined below), when tested to BS 476: Parts 20 and 22.

5.1.2 The test shall be carried out on an indicative scale, nominally $1m^2$, and without additional loading. The floor sample shall be of a sufficient size to accommodate examples of any floor penetrations used on the vehicle. These shall also achieve the required fire resistance.

5.1.3 The insulation requirement shall be met, travelling from the underbody into the saloon, at the surface of the first material which is both within the car bodyshell and is combustible to BS 476: Part 4.

5.1.4 The insulation requirement is that the average temperature of the defined surface shall not exceed 250 ℃ with any single point not exceeding 300 ℃.

5.1.5 The function of the integrity requirement is to ensure that the products of the underbody fire do not achieve easy access to the saloon.

5.1.6 The function of the insulation requirement is to ensure that combustible materials forming the floor of the saloon do not produce significant amounts of smoke or toxic fume directly within the saloon by being heated to near their decomposition temperatures.

5.2 Equipment Cubicle Interface with Saloon or Cab

5.2.1 The saloon or cab face of the equipment cubicle interface shall achieve 20 minutes integrity to BS 476: Parts 20 and 22.

5.2.2 In carrying out the test consideration shall be given to avoiding spurious effects caused as a result of the metallic circumference of the wall/floor of the train expanding within a "fixed" ceramic structure, a situation which will not occur in practice.

5.3 Saloon/ Cab Partition Interface

5.3.1 The saloon face of the saloon/ cab partition interface shall achieve 20 minutes integrity to BS 476: Parts 20 and 22.

5.3.2 In carrying out the test consideration shall be given to avoiding spurious effects caused as a result of the metallic circumference of the wall/floor of the train expanding within a "fixed" ceramic structure, a situation which will not occur in practice.

5.4 Cavities

5.4.1 Any cavity formed in the wall which is not filled to both faces with a noncombustible (classified by BS 476: Part 4) insulating material shall be prevented from "communicating" with any ceiling cavity by the inclusion of a barrier at the wall cavity/ceiling interface. The function of the barrier is to prevent ready movement of air up towards any ceiling void promoting a "chimney" or "stack" effect.

5.4.2 Any cavity formed in the ceiling which is not filled to both faces with a non-combustible (classified by BS 476: Part 4) insulating material shall be compartmented across its width at distances not exceeding 5m by the inclusion of a barrier. The function of the barrier is to prevent ready movement of air through the void which would promote conditions of high heat transfer efficiency.

5.4.3 The barrier shall be prepared from a material which is either by inspection, or from certification, capable of achieving 30 minutes integrity to BS 476: Parts 20 and 22. No fire resistance test of the full structure is required.

5.4.4 The interface between the barrier and the interior faces of the cavity shall be protected or bonded in such a way that ready movement of fire products between the barrier and either of the faces is prevented when exposed to fire. Intumescent protection should be considered.

5.4.5 The design and materials shall be submitted for Approval.

5.5 Seat Shell (Back & Base)

5.5.1 It is required that the material used to form the seat shell (back and base) protects the seat trim from the effects of fire occurring under or around the seat.

5.5.2 The material shall, therefore, either by inspection or from certification be capable of achieving 10 minutes integrity to BS 476: Parts 20 and 22. No fire resistance test of the full seat is required.

6 Reaction to Fire Methods

6.1 Surfaces

6.1.1 Flame Retardancy

The methods to be used are BS 476: Parts 6 and 7 and BS EN ISO 9239 Part 1. Both shall be used in standard form and the requirements are given in standard form with the exception that certain surfaces are required to be Nil spread for the BS 476: Part 7 test. This is not a formal categorisation under the standard but the information is available in the full report of the tests.

6.1.2 Smoke Emission

The methods used are BS 6853 Annex D8.4 Panel test (vertical and horizontal prone) and BS 6853 Annex D8.6 Flooring test (horizontal supine). The requirements are given in the standard form using the standard units.

6.1.3 Toxic Fume Emission

(a) The method used is NF X 70-100. The methodology is as standard but there is a requirement to measure and consider an additional species, nitrogen dioxide (in the form of nitric oxide and nitrogen dioxide combined, quoted as nitrogen dioxide).

(b) The standard normally generates toxic fume emission in units of milligrams of species per gram of material combusted. For surfaces this value needs to be converted to a notional value on an area basis using information specific to the application; e.g. the weight per unit area of the material. (If this leads to unrealistically high values for thick materials, this will be considered, in the event of a contravention of the requirements occurring, on a case by case basis where an effective depth of surface will be defined by the Engineer).

(c) The results for all the gases measured, with the addition of nitrogen dioxide, should be expressed as grams of toxin per m^2 of surface. The value generated for each toxin is weighted for relative effect by dividing by the reference values also in gm^{-2}. These values are given in Clause 7.1.

The resulting ratios shall be summed to give the weighted summation ratio, "R". This ratio is allowed to vary reflecting changes in location and amount of material destroyed.

6.2 Cables

See RS/C6014/06.

6.3 Upholstered Seat Faces

6.3.1 Flame Retardancy

(a) The surfaces of both the upholstered seat cushion (base) and seat squab (back) shall be treated as for general surfaces within the car. Where the surfaces are very similar or identical it is not required to perform two tests.

(b) The selected test methods (refer to Clause 6.1.1) are limited to certain thicknesses of sample. The test piece shall consist of the surface of the seat to the greatest depth conveniently tolerated by the test method and shall be closely representative of the real seat.

6.3.2 Smoke Emission

This is item specific. The test method used shall be BS 6853 Annex D8.5 Seating test. The test shall be carried out on the fully upholstered seat.

6.3.3 Toxic Fume Emission

Data shall be supplied on the loose covers (in isolation) and on the foam core, using the normal NF X 70-100 test protocol but with the data being augmented by measuring nitrogen dioxide. The data shall be converted to

a gm^{-2} basis as described in Clause 6.1.3 and the contribution from the various layers summed. In the event of a contravention of the requirements occurring, any unrealistically high values will be reviewed by the Engineer who may allow an adjustment made based on an effective depth of surface available. Any adjustment will be made on the basis of the results of observations made, particularly in the smoke emission test and on the nature of the design.

6.4 Seat Shell Back & Seat Base

6.4.1 Flame Retardancy

These surfaces shall be treated exactly as for the equivalently orientated surfaces described in Clause 6.1.1.

6.4.2 Smoke Emission

These surfaces shall be treated exactly as for the equivalently orientated surfaces described in Clause 6.1.2.

6.4.3 Toxic Fume Emission

These surfaces shall be treated exactly as for the equivalently orientated surfaces described in Clause 6.1.3

6.5 Minor Materials

6.5.1 Flame Retardancy

These materials shall be subjected to testing by BS EN ISO 4589 Part 3 Annex A, thereby determining the Flammability Temperature (FT). If the material is unsuitable for testing by this method; e.g. a thermo-plastic which is mobile at temperature, then recourse shall be made to the Oxygen Index (OI) method BS EN ISO 4589 Part 2.

6.5.2 Smoke Emission

The materials shall be tested to BS 6853 Annex D8.3 Small-scale test using an open fine wire mesh support. If the material or item is unsuitable for testing with this support; e.g. a thermo-plastic which is mobile at temperature, then recourse shall be made to a copper foil tray support.

6.5.3 Toxic Fume Emission

The method used shall be NF X 70-100 augmented, as described in Clause 6.1.3, by the inclusion of nitrogen oxides expressed as nitrogen dioxide. A weighted summation shall be carried out. The reference levels for calculating this are given in Clause 7.4.

7 Testing Requirements

7.1 Surfaces

Property	Location Int/Ext	Orientation HS/V/HP	Method	Requirement
Flammability	Int	HS	BS 476 Pt7 or BS EN ISO 9239 Pt1	Class 2 >7.5 kWm^{-2}
		V	BS 476 Pt6 BS 476 Pt7	i_1<6, I<12 Class 1
		HP	BS 476 Pt6 BS 476 Pt7	i_1<6, I<12 Class 1, Nil spread
	Ext	HS	BS 476 Pt7 or BS EN ISO 9239 Pt1	Class 2 > 7.5 kWm^{-2}
		V	BS 476 Pt7	Class 1
		HP	BS 476 Pt7	Class 1, Nil spread
Smoke	Int	HS	BS 6853 D8.6	Ao<220
		V & HP	BS 6853 D8.4	Ao(ON)<2.6 Ao(OFF)<3.9
	Ext	HS	BS 6853 D8.6	Ao<370
		V & HP	BS 6853 D8.4	Ao(ON)<4.4 Ao(OFF)<6.6
Toxic Fume	Int	HS	NF X 70-100	R<5.0
		V & HP	NF X 70-100	R<1.0
	Ext	HS	NF X 70-100	R<8.5
		V & HP	NF X 70-100	R<1.7

The reference levels for calculating the weighted summation ratio are given below.

Reference Levels (gm^{-2})	
CO_2	14000
CO	280
HF	4.9
HCl	15
HBr	20
HCN	11
NO_2	7.6
SO_2	53

7.2 Cables

See RS/C6014/06.

7.3 Seats

Property	Part Shell/Trim	Orientation Back/Base	Method	Requirement
Flammability	Trim	Back	BS 476 Pt6 BS 476 Pt7	i_1<6, I<12 Class 1
	Shell	Back/Base	BS 476 Pt6 BS 476 Pt7	i_1<6, I<12 Class 1
	Trim	Base	BS 476 Pt7	Class 2
Smoke	Trim	Full Seat	BS 6853 D8.5	Ao<8.7
	Shell	Back/Base	BS 6853 D8.4	Ao(ON)<2.6 Ao(OFF)<3.9
Toxic Fume	Trim	Back	NF X 70-100	R<2.0
		Base	NF X 70-100	R<3.5
	Shell	Back/Base	NF X 70-100	R<1.0

It should be recalled that the toxic fume weighted summation ratio for the seat trim (back and base) shall be made on the basis of adding the contributions from the various layers.

The reference levels for calculating the weighted summation ratio shall be as for surfaces given in Clause 7.1.

7.4 Minor Materials

Property	Location Int/Ext	Method	Requirement
Flammability	Int/Ext	BS EN ISO 4589 Pt3 A else BS EN ISO 4589 Pt2	FT>300°C else OI>34%(V/V)
Smoke	Int	BS 6853 D8.3	Ao<0.017
	Ext	BS 6853 D8.3	Ao<0.029
Toxic Fume	Int	NF X 70-100	R<1.0
	Ext	NF X 70-100	R<1.7

The reference levels for calculating the weighted summation ratio are given below.

Reference Levels (gm^{-2})	
CO_2	14000
CO	280
HF	4.9
HCl	15
HBr	20
HCN	11
NO_2	7.6
SO_2	53

8 System Engineering Management System (SEMS)

8.1 SEMP Stage 1

The Contractor shall prepare and submit a Fire Engineering Plan as part of SEMS (refer to PS 21.2.3 and PS 21.10) for Approval. The plan shall include, but not be limited to, the following:

(a) The name and credentials of the Contractor's fire specialist.

(b) Detail statement of the role and responsibility of fire specialist.

(c) Methodology to be adopted for prediction the power output from fire flash over.

(d) Development of a schedule of non-metallic materials used in the construction of the train to identify the following, but not be limited to:

(i) type and description of material
(ii) quantity
(iii) location and orientation
(iv) test to be required
(v) certification
(vi) fire load

(e) Development of a fire load schedule for the train.

(f) Preliminary identification of potential fire hazard area.

(g) Formulation of relevant fire specifications for sub-contractors in order to achieve final fire performance requirements.

(h) Preliminary predictions for power output with description of the prediction method and how the predictions were carried out, including all assumptions made.

(i) Preliminary calculations of the fire load schedule for the train together with the fire load density.

(j) Provision for revised predictions and fire load schedule as further information becomes available during subsequent SEMP stages.

8.2 SEMP Stage 2

8.2.1 The Contractor shall submit detailed predictions on fire power output and calculations of the fire load schedule hence the fire load density based on the chosen materials.

8.2.2 The Contractor shall evaluate the fire load reduction measures subsequent to exceeding of permitted fire load as specified in PS 20.

8.2.3 The Contractor shall submit all certification of readily tested materials for Approval.

8.3 SEMP Stage 3

8.3.1 The Contractor shall carry out all necessary fire test using representative production material to verify and validate the design.

8.3.2 The Contractor shall submit a revised fire prediction based on the test results. The predictions shall include details of :

(a) Details of any changes from the previous predictions with detailed explanations.

(b) Fire specifications contracted by the manufacturers of material with details of any deviations from the original specifications.

(c) Evaluation of any areas of risk with proposed contingency measures for these areas

(d) Details of any areas of development required to achieve the specifications, together with development plans for these areas.

8.3.3 The Contractor shall submit all certification of tested materials for Approval apart from that required in Clause 8.2.3.

8.4 SEMP Stage 4

8.4.1 The Contractor shall submit revised predictions on fire power output and calculations of the fire load schedule hence the fire load density subsequent to development of engineering, manufacture, production and installation.

8.4.2 The Contractor shall provide detail explanation/justification of any deviations from the previous predictions or calculations.

8.4.3 The Contractor shall propose details of any remedial measures which are necessary, together with plans for implementation of these measures.

8.5 SEMP Stage 5

8.5.1 The Contractor shall perform and submit final assessment/ calculations to confirm the predicted fire power output, fire load schedule and fire load density of the completed vehicles and trains.

8.5.2 The Contractor shall submit all test and inspection reports for Approval.

ROLLING STOCK STANDARD RS/C6014/09
WHEELSETS

1 Introduction

2 Standards/Reference

3 General Requirements

4 Axles

5 Wheels

6 Wheelsets

7 Systems Engineering Management System

ROLLING STOCK STANDARD RS/C6014/09
WHEELSETS

1 Introduction

This Standard defines the mandatory requirements for wheelsets.

2 Standards/Reference

BS EN 13260: 2003	Railway Applications – Wheelsets and Bogies – Wheelsets – Product Requirements
BS EN 13261: 2003	Railway Applications – Wheelsets and Bogies – Axles – Product Requirements
BS EN 10216: Part 5: 2004	Railway Applications – Wheelsets and Bogies – Wheels – Product Requirements
ISO 9001: 2000	Quality Management Systems – Requirements

3 General Requirements

3.1 This Standard covers the requirements for wheels, axles and assembled wheelsets and the details requirements which are either not specified, inappropriate, or are given as points to be agreed within the standards defined in Clause 2 above.

3.2 Manufacture and inspection of assembled wheelsets and the components comprising the wheelsets shall be carried out under a certified ISO 9001 quality management system.

4 Axles

4.1 Axles shall be in accordance with BS EN 13261: 2003.

4.2 Axles shall be supplied in steel grade EA1T as specified in BS EN 13261: 2003 Annex A.

4.3 Axles shall be stamped on one end with a unique serial number allocated by the Engineer.

4.4 Residual stresses shall be measured by X-ray diffraction method as specified in BS EN 13261: 2003 Clause 3.6.4.

4.5 The axle supplied shall be qualified in accordance with the requirements and procedures as specified in BS EN 13261: 2003 Annex I.

4.6 The product qualification documents as specified in BS EN 13261: 2003 Annex I Clause I.5 shall be submitted for Approval.

4.7 The axle fabrication quality supervision shall be made by batch sampling method as given in BS EN 13261: 2003 Annex J Clause J.4. The inspection results on permeability to ultrasound, internal integrity, surface integrity, surface appearance, geometry and dimensions of all axles shall be submitted as routine test results together with the associated train log book (refer to PS 22.8.7).

5 Wheels

5.1 Wheels shall be in accordance with BS EN 13262: 2004.

5.2 Wheels shall be supplied in steel grade ER8 as specified in BS EN 13262: 2004 Clause 1.

5.3 Wheels shall be stamped with a unique serial number, allocated by the Engineer, on the inside face of the rim in a position where it will be visible after assembly of the wheelset and where it will not be removed by subsequent reprofiling of the wheel.

5.4 Residual stresses shall be measured by ultrasonic method as specified in BS EN 13262: 2004 Annex D.

5.5 The wheel supplied shall be qualified in accordance with the requirements and procedures as specified in BS EN 13262: 2004 Annex E.

5.6 The product qualification documents as specified in BS EN 13262: 2004 Annex E Clause E.5 shall be submitted for Approval.

5.7 The wheel fabrication quality supervision shall be made by batch sampling method as given in BS EN 13262: 2004 Annex F Clause F.4. The inspection results on hardness on rim (homogeneity), internal integrity, state of surface, surface integrity, static imbalance, geometry and dimensions of all wheels shall be submitted as routine test results together with the associated train log book (refer to PS 22.8.7).

6 Wheelsets

6.1 Wheelsets shall be in accordance with BS EN 13260: 2003.

6.2 The design of wheelsets shall be such that the inner wheel bosses and gearwheel bosses overhang their respective seats on the axle by a minimum of 6 mm to minimise the possibility of fretting corrosion.

6.3 Assembly of wheels and gear wheels onto the axle shall be carried out by shrink fitting.

6.4 The mechanical resistance of the wheelset assembly as specified in BS EN 13260: 2003 Clause 3.2.1 shall be carried out in all assembled wheelsets.

6.5 The electrical resistance as specified in BS EN 13260: 2003 Clause 3.2.3 shall be carried out in all assembled wheelsets.

6.6 The maximum permissible dynamic imbalance as specified in BS EN 13260: 2003 Clause 3.2.4 shall be less than 125 gm and shall be carried out in all assembled wheelsets.

6.7 The dimensions and tolerances of the wheelset assemblies as specified in BS EN 13260: 2003 Clause 3.2.5 shall be carried out in all assembled wheelsets.

6.8 The axles of all assembled wheelsets shall be subjected to ultrasonic examination in order to detect any defects resulting from the assembly as specified in BS EN 13260: 2003 Annex F Clause F3.2.

6.9 The wheelset assemblies supplied shall be qualified in accordance with the requirements and procedures as specified in BS EN 13260: 2003 Annex E.

6.10 The product qualification documents as specified in BS EN 13260: 2003 Annex E Clause E.5 shall be submitted for Approval.

6.11 The inspection results on mechanical resistance of the wheelset assembly, electrical resistance, maximum permissible dynamic imbalance, axle ultrasonic examination of assembled wheelset, dimensions and tolerances of all assembled wheelsets shall be submitted as routine test results together with the associated train log book (refer to PS 22.8.7).

7 Systems Engineering Management System

Not applicable.

ROLLING STOCK STANDARD RS/C6014/10
PANTOGRAPH

1 Introduction

2 Standards/Reference

3 General Requirements

4 Compatibility Requirements with the Overhead Line (OHL) System

5 Testing Requirements

6 System Engineering Management System

Figure STD10-1 Pantograph Head Profile

Figure STD10-2 Specification for Silver Copper Contact Wire

Figure STD10-3 Pantograph Mounting Arrangements on the Existing Pantograph Well

ROLLING STOCK STANDARD RS/C6014/10
PANTOGRAPH

1 Introduction

This Standard specifies the requirements of pantograph of the train.

2 Standards/Reference

IEC 60494-2: 2002	Pantographs for Metros and Light Rail Vehicles
IEC 60077-1: 1999	Railway Applications – Electric Equipment for Rolling Stock – Part 1: General Service Conditions and General Rules
IEC 60077-2: 1999	Railway Applications – Electric Equipment for Rolling Stock – Part 2: Electrotechnical components – General Rules
BS 2618: 1975	Specification for electric traction equipment
BS EN 61373: 1999	Rolling Stock Equipment – Shock and Vibration Tests

Unless otherwise specified, the pantograph shall meet the above standards.

3 General Requirements

3.1 Basic Design

3.1.1 The nominal 1,500VDC power supply shall be obtained from the OHL contact wire by means of a pantograph. The pantographs shall be mounted on the power units of the train and shall be electrically independent of all other pantographs.

3.1.2 All pantographs shall be of single arm type with 4 nos. of carbon strips on the pantograph head.

3.1.3 All pantographs in a train consist shall be controlled by either local unit or hard wired trainline.

3.1.4 The pantograph shall be designed in such a manner that the standstill loading as specified in Clause 3.4.1 does not cause excessive carbon or

overhead wire temperature rise when drawing current from a single contact wire. Note that the safe limit for copper contact wire is 200℃.

3.1.5 The design operation speed range shall be 0 - 90 km/h.

3.1.6 The rated service pressure of the pneumatic air supply for the pantograph shall be 5.5 bar.

3.1.7 The actuation method of the pantograph shall be "air raised - spring operated".

3.1.8 The exterior of the pantograph shall be painted red.

3.2 Pantograph Head Profile

The pantograph head profile shall be in accordance with that shown in Figure STD10-1.

3.3 Pantograph Head Assembly

3.3.1 In order to minimise the effect of arcing when the pantograph is forced to drop on load, a "knuckling" action which is a combined rolling and sliding motion, shall be provided on the pantograph head assembly, such that when the pantograph is raised to the overhead contact wire, initial contact shall be made at the outermost edge of the carbon strip and, as the contact proceeds, the pantograph head rolls and slides over the overhead contact wire until final contact is made at all four carbon strips. This action shall be reversed when the pantograph lowers.

3.3.2 The maximum pantograph head mass shall be less than 15.4kg.

3.4 Electrical Duty

Each pantograph shall be able to withstand the following maximum currents.

3.4.1 Standstill-continuous: 120 A

3.4.2 Starting current at standstill, for 5 s: 700 A

3.4.3 At 30 km/h, during acceleration to 90 km/h: 1.3 kA (instantaneous)

3.4.4 At 90 km/h: 400 A

3.4.5 Maximum short circuit: 50 kA for 20 ms

3.5 Operation Range

The pantograph head shall be held in contact with the overhead wire with a constant force over the full range of working height from 3800 to 5300 mm measured above top of rail level.

3.6 Pantograph Rising

A pantograph shall be able to rise to its maximum working height in a time not exceeding 10 s from the moment at which the pantograph starts to rise and without undue shock.

3.7 Pantograph Lowering

Pantograph lowering movement shall be initially fast enough to extinguish the arcing caused by the auxiliary load (refer to Clause 3.4.1 above) and with adequate damping to avoid shock before reaching the fully stowed position. The total lowering time shall not exceed 7 sec.

3.8 Contact Force

The pantograph contact force over the whole operating range shall be 120 ± 10 N.

3.9 Retaining Force

The pantograph shall be retained at the fully stowed position when there is no air supply to raise it. The above pantograph position shall be retained when a vertical upward force of not less than 75N is exerted at the pantograph head.

3.10 Transverse Rigidity

When a transverse force of 300N is applied on either side of the pantograph head hinge, the displacement shall be symmetrical and the difference between the extreme positions shall not exceed 20-40mm as specified in IEC 60494-2: 2002. After each application of force, no permanent deformation shall be detectable.

3.11 Structural Strength

The pantograph and its mountings including the insulators shall be sufficiently strong and tested to BS EN 61373:1999. The test shall be conducted with the pantograph in the raised position with the pantograph carbons in contact with a simulated contact wire.

3.12 Clearances

3.12.1 When a pantograph is at fully stowed position, the vertical clearance between itself and the structural gauge shall not be less than 100 mm i.e. the pantograph shall not infringe the kinematic envelope as shown in Drg. No. C6014-14E/TSEG/010/001.

3.12.2 An electrically insulated pantograph well shall be provided on the roof for the accommodation of the pantograph. The clearance between the pantograph (with respect to any live part of its equipment) and the pantograph well shall be at least 75 mm except for the vertical clearance between pantograph and pantograph well, which shall be at least 40 mm.

Use of un-insulated pantograph well is subject to Approval by the Engineer.

3.13 Pantograph Carbon Strip

3.13.1 Type of Carbon Strip

(a) A suitable carbon strip grade shall be recommended by the Contractor. However, the plain carbon grade of AR129 or equivalent carbon strip is preferred. Carbon strip made by metal impregnated material which shall not cause any excessive wear to the contact wire than the plain carbon strip, may be considered but subject to Approval.

(b) The recommended carbon strip shall have the following properties and characteristic which shall be equivalent to or better than the plain carbon grade of AR129 carbon strip:

(i) Minimum wear rate of carbon
(ii) Minimum wear on the OHL contact wires
(iii) Good commutating ability
(iv) Fast formation of patina
(v) Good Electrical and thermal conductivity
(vi) Sufficient mechanical strength and adequate elasticity
(vii) Small contact voltage drop
(viii) Good overload ability

(c) In order to meet the requirement of maximum pantograph head mass as specified in Clause 3.3.2, the maximum weight of the carbon strip shall be 1.45kg per strip.

(d) The following properties of the recommended carbon strip shall be specified:

(i) Specific electrical resistivity

(ii) Recommended contact pressure
(iii) Hardness and bend strength
(iv) Current density
(v) Maximum allowable operating temperature
(vi) Maximum peripheral speed
(vii) Coefficient of friction
(viii) Bulk density of the carbon strip
(ix) Metal content
(x) Gross weight of the carbon strip

(e) Carbon strip grade, manufacturer identification and date of manufacturing shall be clearly marked on the carbon for easy reference.

3.13.2 Length and Width of Contact Strip

In order to enable adequate width to keep in touch with the overhead wire during operation, the length of contact strip of the pantograph shall not be less than 800 mm and the width of each contact strip shall not be less than 33 mm.

3.13.3 Service Life of the Carbon Strip

(a) The minimum distance of the kilometre run of the pantograph between replacement of the carbon strip shall be 300,000 km under the electrical duties specified in Clause 3.4.

(b) Minimum permissible thickness of the proposed carbon strip provided by the supplier shall be clearly marked on the carbon strip to facilitate maintenance check and inspection.

3.14 Automatic Drop Device

3.14.1 In order to protect the pantograph against the overhead line (OHL) contact wire obstruction caused by OHL equipment damage, an automatic drop device shall be provided to immediately lower down the pantograph once an abnormal pantograph head shock is detected. The maximum response time between an obstacle detected and dropping of the pantograph shall be 2 secs.

3.14.2 The above shock detection function shall function in either direction of travel.

3.14.3 The shock detection sensitivity shall be easily adjustable.

3.14.4 The automatic drop devices shall be synchronised between each pantograph such that all the other pantographs of the train shall be lowered by any detection device detecting an obstacle in order to avoid further damage. Same response time specified in Clause 3.14.1 above for all pantographs shall be achieved.

3.14.5 In the event of operation of the automatic drop device, the following requirements shall be met:

(a) the location of the obstacle detector detecting the obstacle shall be reported to the train operator and logged into the Event Recorder;

(b) the propulsion system shall be commanded to stop operation in order to avoid sustained arcing; and

(c) the train operator shall be made aware of OHL supply power loss due to lowering down of pantographs.

3.14.6 Once the automatic drop device is operated, the pantographs shall remain in the lowered position until it is reset by the train operator.

3.14.7 A remote automatic drop device isolation function shall be provided to isolate any automatic drop device on a pantograph basis via the train management system. However, the functions specified in Clause 3.14.5 shall be retained after the remote isolation of automatic drop device is operated.

4 Compatibility Requirements with the Overhead Line (OHL) System

4.1 General Description of the OHL Contact Wires

Two OHL contact wires are provided on all main running lines and some depot lines. Single contact wires are provided on other tracks such as crossovers and stabling sidings.

4.2 Material of the OHL Contact Wires

The carbon strips shall be compatible with the above OHL contact wire which is made from 120mm^2 silver copper. For further details of the material specification of the contact wire, please refer to Figure STD10-2.

4.3 Specific Parameters

The design of the pantograph shall be compatible with the following specific parameters:

4.3.1 Spring rate of head suspension: 49 kN/m

4.3.2 Damping of head suspension: 0 Ns/m

4.3.3 Effective frame mass: 8 kg

4.3.4 Frame damping (ascending): 107 Ns/m

4.3.5 Frame damping (descending): 105 Ns/m

4.3.6 Friction in frame: 4 to 6 N

4.3.7 For design purposes, the following dynamic parameters are assumed to be negligible:

(a) Aerodynamic force on head (Ns^2/m^2)
(b) Aerodynamic force on frame (Ns^2/m^2)

4.4 Pantograph Mountings

The pantograph shall be mounted to the roof by 4 nos. of M20 bolts via insulators. Details of mounting arrangements shall be as shown in Figure STD10-3.

5 Testing Requirements

Tests shall be carried out to demonstrate compliance with IEC 60494-2.

6 System Engineering Management System

Since the pantograph is part of the traction system, the pantograph design shall follow the overall design development schedule of the traction system according to the Approved system engineering management plan.

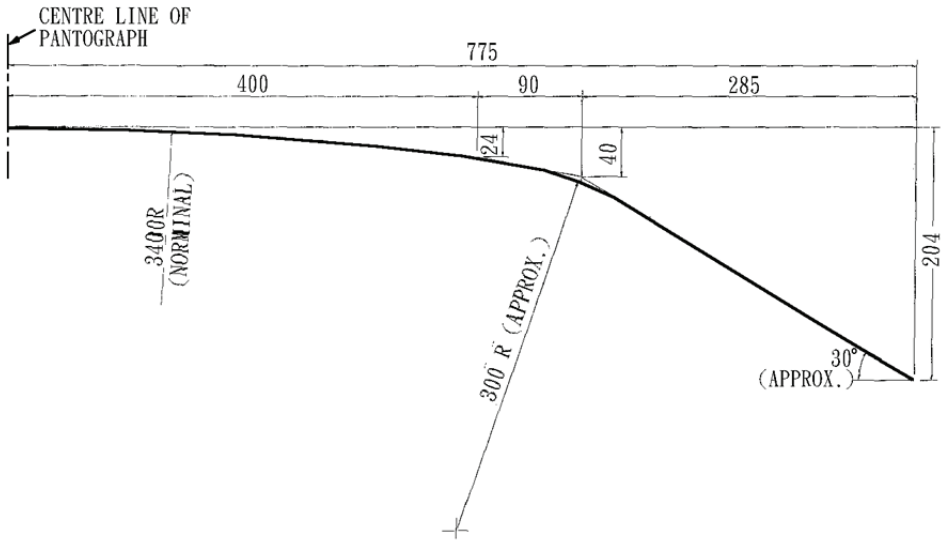
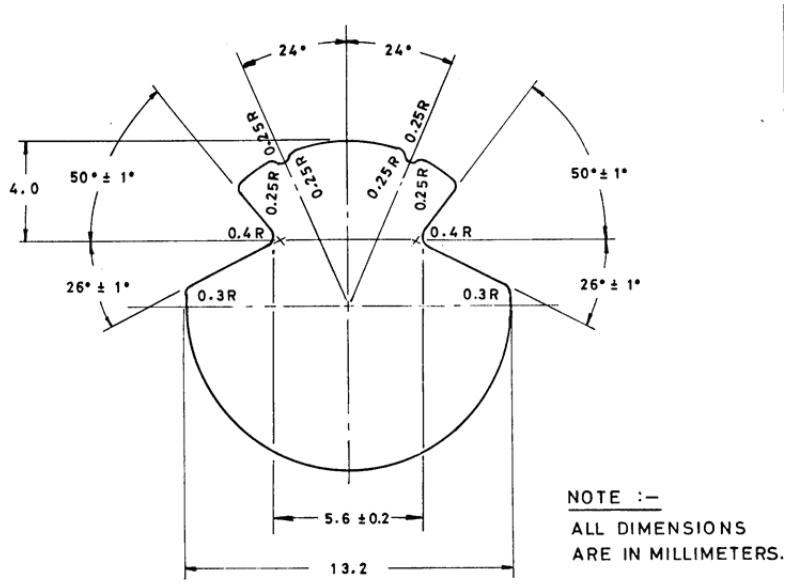


Figure STD10-1Pantograph Head Profile

Note: All dimensions are in mm



SPECIFICATION:

NOMINAL SECTION AREA — — — — — — — 120 mm^2 ± 4%

MATERIAL: COPPER — — — — — — — — 99.88% TO 99.91%
SILVER — — — — — — — — 0.09% TO 0.12%

MAXIMUM RESISTANCE AT 20° C — — — — — 0.1488 Ω / km

NOMINAL MASS — — — — — — — — — — 1 070 kg / km

MODULUS OF ELASTICITY — — — — — — — 12.4 x 10^4 N / mm^2

MINIMUM TENSILE STRENGTH — — — — — 350 N / mm^2

COEFFICIENT OF EXPANSION — — — — — 17 x 10^{-6} / °C

Figure STD10-2 Specification for Silver Copper Contact Wire

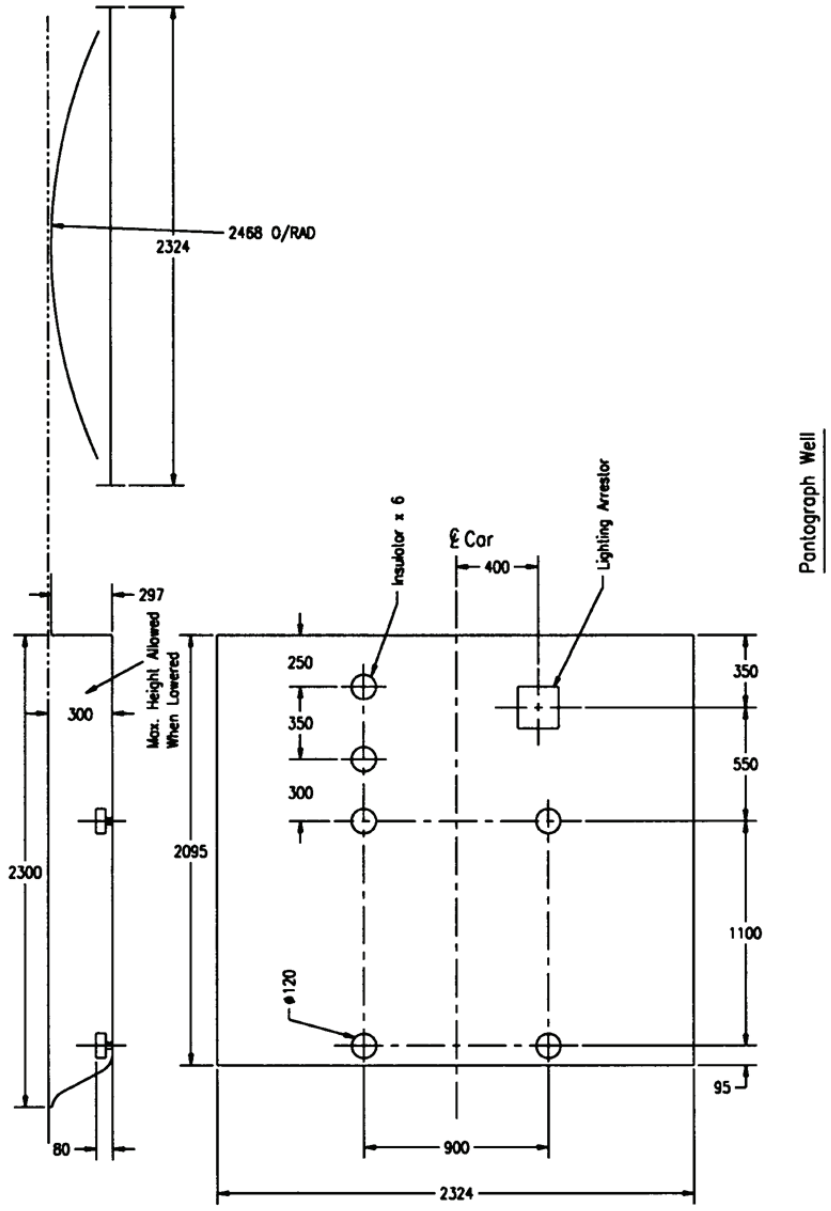


Figure STD10-3 Pantograph Mounting Arrangements on the Existing Pantograph Well

ROLLING STOCK STANDARD RS/C6014/11
BATTERY

1 Introduction

2 Standards/Reference

3 General Requirements

4 Performance Requirements

5 Battery Capacity

6 Maintenance Requirement

7 General Arrangement of Cells

8 Capacity Guarantee

9 Testing Requirements

10 System Engineering Management System

ROLLING STOCK STANDARD RS/C6014/11
BATTERY

1 Introduction

1.1 The Standard specifies the general requirements, in particular related to the material requirements, of the batteries used on the train.

1.2 The batteries shall provide a standby power supply for the DC control circuit and emergency systems on the train when the normal 110VDC supply is interrupted. The DC source is derived from the 3 phases AC auxiliary supply on the train during normal operation.

2 Standards/Reference

IEC 60077-1:1999	Rules for electric traction equipment
IEC 60623:2001	Vented nickel-cadmium prismatic rechargeable single cell
IEC 60993:1989	Electrolyte for vented nickel-cadmium cells
BS 6853:1999	Code of practice for fire precautions in the design and construction of passenger carrying trains
BS EN 45545-2:2013	Railway applications-Fire protection on railway vehicles Part 2: Requirements for fire behavior of materials and components
BS EN 60254-1:2005	Lead-acid traction batteries - General requirements and methods of test
BS EN 60896-21:2004	Stationary Lead-acid batteries – Part 21: Valve regulated types-Methods of test
BS EN 60896-22:2004	Stationary Lead-acid batteries – Part 22: Valve regulated types-Requirements
BS EN 61373: 1999	Railway applications – Rolling stock equipment – Shock and vibration tests

3 General Requirements

3.1 Type of Battery

3.1.1 The battery shall be of the nickel cadmium type and shall comply with the specifications of IEC 60993 - Electrolyte for vented nickel-cadmium cells and IEC 60623 - Vented nickel-cadmium prismatic rechargeable single cell.

3.1.2 Alternatively, the battery shall be of Gel type lead acid battery and shall comply with the specifications of BS EN 60254-1: Lead-acid traction batteries; BS EN 60896-21: Stationary Lead-acid batteries – Part 21: Valve regulated types-Methods of test; and BS EN 60896-21: Stationary Lead-acid batteries – Part 22: Valve regulated types- Requirements.

3.2 Case Material

3.2.1 The cell case of the battery shall be made of stainless steel.

3.2.2 The use of alternative material for the cell case may be submitted for Approval. However, the alternative material to be used shall possess the following characteristics.

(a) high impact resisting,
(b) non-absorbent,
(c) alkaline resisting,
(d) anti-corrosive,
(e) flame retardant,
(f) halogen, sulphurous and phosphorous compound free,
(g) ozone & ultra-violet resisting, and,
(h) produce low smoke and minimal toxic fume such as carbon monoxide in the event of fire or short circuit.

3.2.3 All materials used in the accessories e.g. shrouds, crate, reinforcement fitting, protective cover, inter-cell connector, inter-cell cables etc., shall be of flame retardant, low smoke and toxic free complying the fire performance requirement in BS EN 61373: 1999. Additional fire requirements of material shall refer to RS/C6014/08.

4 Performance Requirements

4.1 Normal Daily Load Duty

4.1.1 The daily loading of the battery set on the trains shall be assumed to be shallow discharging.

4.1.2 The battery set on the train shall be designed to cater for the load cycle four times a day. The Contractor shall provide details of the load cycle according to the design of the 110VDC circuit.

4.2 Normal Annual Load Duty

For maintenance purpose, the battery shall be discharged twenty (20) times per year at the emergency load duty stipulated in Clause 4.3 below.

4.3 Emergency Load Duty

4.3.1 The battery shall be designed to supply the emergency loadings, such as, lighting and ventilation, of the train for a period of 1 hour.

4.3.2 Throughout this one hour discharging period, the discharging current shall be specified by the Contractor with respect to the emergency loading according to the design of the 110VDC circuit and the terminal voltage of the battery shall not fall below 77 VDC.

4.3.3 For the purpose of calculating the required battery capacity, the Contractor shall assume that, before performing the emergency load duty, the battery is being continuously float charged and has reached a capacity of 80% of the maximum fully float charged capacity.

4.4 Compatibility with the Charging System on the Train

The battery shall be compatible with the charging system on the Train.

4.5 Maximum Charging and Discharging Current

The battery shall be designed to withstand a maximum charging and discharging current of not less than 100A with no adverse effect on its life and reliability.

5 Battery Capacity

5.1 The battery shall be able to comply with the normal and emergency load duties as stipulated in Clause 4 above throughout its expected life.

5.2 The expected life of the battery shall not be less than 15 years (nickel-cadmium battery) / 5 years (lead acid battery) after installing on the train.

5.3 The battery shall be able to operate with the charging system of the train and an operating environment as stipulated in the GS throughout its design life.

5.4 The Contractor shall submit capacity calculations to demonstrate a full compliance of the required load duties. For this purpose, the Contractor shall submit data including but not be limited to the following:

5.4.1 Discharge voltage characteristics of the battery from 80 % of fully float charged condition at 45A down to lowest permissible voltage per cell.

5.4.2 Aging factor of capacity against its life time.

5.4.3 The maximum available capacity of the battery (as a percentage of the fully float charged capacity) when the battery is under the float charge arrangement of the train.

5.4.4 Expected life of the battery when it is subject to the load duties and the charging arrangement.

5.4.5 Variation of battery capacity against operating temperature.

5.4.6 Charge/discharge cycle life

5.4.7 Total battery service mass (with tolerance) including cells, trays and relevant accessories.

6 Maintenance Requirement

6.1 The battery shall require minimal maintenance and attendance throughout its design life. In case of vented battery and with the charging arrangement of the train and at an ambient temperature of $30^{O}C$, the battery shall not require the topping up of electrolyte for more than once in every 6 months.

6.2 The Contractor shall estimate the water consumption rate against years of service and specify the electrolyte reserve in c.c. of the battery cell and the average internal gas recombination efficiency factor

6.3 The Contractor shall specify the recommended maintenance schedule (monthly check, yearly check, etc.) and procedures (electrolyte refilling, capacity testing, etc.) for the battery.

6.4 The requirements of using special tools and equipment for maintenance purpose shall be specified.

7 General Arrangement of Cells

7.1 The general arrangement and layout of cells in the battery trays shall comply with the requirements stipulated in clauses 8 of IEC 60077-1.

7.2 All materials used, such as, shrouds, trays and reinforcement fittings, shall comply with RS/C6014/08.

7.3 When calculating the minimum internal plan dimensions of the tray, the maximum cell dimensions shall be used.

7.4 The battery shall be housed in two identical steel crates. The Contractor shall submit the dimensions of each cell together with a layout diagram showing the arrangement and connection of the cells inside the crates.

8 Capacity Guarantee

8.1 The battery shall be capable of meeting the emergency load duty after in service for 15 years (nickel-cadmium battery) / 5 years (lead acid battery) .

8.2 The Contractor shall guarantee that, without renewing the electrolyte, the 5-hour rated capacity of the battery shall not be less than 90% of its rated capacity at the end of the first 5 years service (nickel-cadmium battery) / 2 years service (lead acid battery). The service conditions being as stipulated in Clause 6 above.

8.3 The Contractor shall declare and guarantee that the percentage decrease of the 5hour rated capacity shall not exceed 5% of the 5-hour rated capacity after 2 years (nickel-cadmium battery) / 1 years (lead acid battery) of service without renewing the electrolyte.

8.4 The Contractor shall submit calculations to demonstrate a full compliance of the capacity guarantee criterion stipulated in Clauses 8.1, 8.2 and 8.3 above.

8.5 At the end of the Defects Liability Period, the Contractor shall undertake to carry out capacity verification tests in accordance with clause 4.2 of IEC 60623 or BS EN 60254-1 on an agreed numbers of cell samples which are randomly selected from those 2 years old batteries. The acceptance test criterion stipulated in clause 4.2 of IEC 60623 or BS EN 60254-1 shall be modified in line with the declared remaining available capacity after 2 years of service.

8.6 The Contractor shall submit the capacity verification test specification for approval. The test arrangements are specified as follows:

8.6.1 Three batches of battery cells, each consists of at least 16 cells, shall be randomly selected by the Engineer from the 2 years old supplied batteries for the test. The Contractor shall undertake to transport those cells to the factory and to carry out the approved capacity verification tests.

8.6.2 After the tests, the Contractor shall re-condition all the tested cells to the 5-hour rated capacity and return them to the Engineer. The tests shall be witnessed by the representative of the Engineer.

8.6.3 The Contractor shall guarantee that those re-conditioned cells are capable of meeting the emergency load duty as stipulated in Clause 6.3 above after in service for the remaining 13 years (nickel-cadmium battery) / 3 years (lead acid battery).

8.6.4 If any two of the three batches of battery cells fail to pass any part of the capacity verification tests, all battery supplied shall be deemed to have capacity design failure and the Contractor shall be liable to replace all the supplied batteries at his own cost.

8.6.5 The battery replaced shall be of improved design and of adequate capacity to comply with all the requirements stipulated in the PS.

8.6.6 If only one or none of the three batches of battery cells fails to pass any part of the capacity verification tests, the failures, if any, shall be considered as isolated cases and not a fleet problem. In this case, the Contractor shall be liable to replace all the defective cells.

8.6.7 The Contractor shall submit a full set of comprehensive investigation reports for all defective cells found in the tests to the Engineer.

9 Testing Requirements

9.1 Shock and Vibration

The batteries and trays shall comply with the requirements on the vibration and shock tests stipulated in BS EN 61373: 1999.

9.2 Acceptance Test

The batteries shall be tested in accordance with the requirements stipulated in clause 4 of IEC 60623 clause 5 of BS EN 60254-1 and clause 6 of BS EN 60896-21 where appropriate.

10 System Engineering Management System

The battery design shall follow the overall design development schedule of the associated auxiliary system particularly the 110VDC circuit according to the approved system engineering management plan.

ROLLING STOCK STANDARD RS/C6014/12
OPERATION AND MAINTENANCE MANUAL

1 Introduction

2 Scope

3 Organization of this Standard

Part A General Requirements for Operation and Maintenance (O&M) Manual

Part B Contents of Individual Volumes of O&M Manual

Appendix STD12 -1 Style for O&M Manual

Appendix STD12-2 Contents of Work Instructions

ROLLING STOCK STANDARD RS/C6014/12
OPERATION AND MAINTENANCE MANUAL

1 Introduction

This Standard specifies the requirements for Operation and Maintenance (O&M) Manuals for the trains.

2 Scope

2.1 Printed O&M Manual

The Contractor shall provide O&M Manuals printed on paper, hereafter referred to as the printed O&M Manual, in sufficient details to enable the Engineer to operate, test, maintain, overhaul and repair the trains to meet the specified performance requirements. As a minimum requirement, the O&M Manual shall include the following:

Volume I: Technical Descriptions Manual

Volume II: Train Operator's Manual

Volume III: Equipment Maintenance Manual

Volume IV: Fault Diagnostics Manual

Volume V: Illustrated Parts Catalogue

Volume VI: Software Manual

Volume VII: Special Tools and Test Equipment

Volume VIII: Vendor Documentation

3 Organization of this Standard

3.1 Part A of this Standard describes general requirements for the O&M Manual.

3.2 Part B of this Standard describes the contents of individual volumes of the O&M Manual.

Part A General Requirements for Operation and Maintenance (O&M) Manual

A.1 General

A.1.1 The O&M Manual shall fully describe the operation and maintenance of all systems, sub-systems, equipment and components in the trains.

A.1.2 The Contractor shall co-ordinate, within the manuals, the cross-referencing of all interfaces and areas associated with interconnecting equipment and systems covered by the Contract.

A.1.3 The O&M Manual shall contain no irrelevant or ambiguous information and shall relate specifically to the Contract.

A.1.4 Nomenclature or references to any items of equipment, diagrams, figures, tables, numbers or units shall be consistent throughout the text. Unless otherwise Approved, all measurements shall be in S.I. units.

A.1.5 The Contractor may use manufacturer's data and handbooks for individual items of equipment that are a sub-component of the overall system (including printed circuit boards), provided that they are integrated into the description of the equipment, and are identified in the table of contents.

A.1.6 Precautions and warnings regarding human safety and safety of equipment shall be included where applicable.

A.1.7 Where an item is not designed for local repair and shall be returned to the manufacturer as a unit for overhaul, the Contractor shall still provide information on the function, construction and working principles of the equipment. Instructions for assessing the performance of the equipment locally shall be provided in the O&M Manual. The type of repairs to be carried out by the manufacturer shall also be specified together with the associated commissioning tests and acceptance criteria.

A.2 Language and Style

The O&M Manual shall be written in simple and concise English. The style of writing shall follow the requirements specified in Appendix STD12-1.

A.3 Format and Layout

A.3.1 Page Orientation

Page orientation shall generally be portrait, unless tables or diagrams require the use of landscape orientation.

A.3.2 Margins

The following margins shall be used for A4 pages:

Top	= 0.7"
Bottom	= 0.4"
Left	= 1"
Right	= 1"

A.3.3 Text Font and Size

Fonts and sizes for text shall be as follows:

normal text	=	Times New Roman (11pt)
Heading 1	=	Arial (14pt - bold)
Heading 2	=	Arial (13pt - bold)
Heading 3	=	Times New Roman (11pt - bold)

A.3.4 Line Spacing

Line spacing shall not be smaller than 1.

A.3.5 Subdivisions

A.3.5.1 Each individual volume in the O&M Manual may have a number of books depending on their size.

A.3.5.2 Each volume shall be divided into chapters. Each chapter shall be divided into sections, sub-sections and further sub-division as appropriate.

A.3.5.3 Each new chapter, section, sub-section and each new work instruction shall begin on a new page.

A.3.6 Numbering of Text

A.3.6.1 The manuals shall be collated and numbered in proper order according to a logical and consistent system.

A.3.6.2 Chapters, sections and subsections shall be numbered in Arabic numerals.

A.3.6.3 Decimal numbers (1, 1.1, 1.1.1, ... down to the 3rd level) shall be assigned to sub-divisions under each section, or depending on the length of the document, subsections. Small letters or Roman numerals in parenthesis

((a), (b), (i), (ii), ...) and bullets points may also be used to facilitate presentation and reference.

A.3.7 Page Header

Each page of the O&M Manual shall have a header which contains the following information:

A.3.7.1 the contract number of the Contract
A.3.7.2 the volume number and title of the manual
A.3.7.3 the number and title of the chapter, section and subsection to which the page belongs
A.3.7.4 the revision number and date of the page
A.3.7.5 the page number
A.3.7.6 for work instructions, the title and reference number of the work instruction shall also be shown

A.3.8 Page Numbering

Each page of the manuals shall have a page number that is unique in the manuals. The page number shall be in the following format:

VV - cc - ss - bb - nn

where:

VV is the volume number
cc is the chapter number
ss is the section number
bb is the sub-section number
nn is a page number which begins from 1 for each subsection or work instruction

A.4 Paper

A.4.1 All manuals shall be printed on A4 international size paper. Foldout diagrams or illustrations may be given in A3 paper. In such cases the title of the diagram or illustration shall be visible in the lower right corner when the sheet is folded.

A.4.2 The paper used shall be of good quality and of adequate thickness for frequent handling and shall be for Approval.

A.4.3 The paper and ink shall resist smearing, fading and deterioration with age and shall be suitable for use in a workshop environment.

A.5 Binding

A.5.1 All manuals shall have a locked binding of the “peg” or “ring” type, to avoid loss of pages through rough handling. The manuals shall be able to be laid flat when open at each page.

A.5.2 The binding shall allow for all changes and additions to be readily made.

A.5.3 A spine bearing the contract number, volume number, name of the manual, book number and the number and names of the constituent chapters shall be provided on each manual. Spines shall be colour coded: a different colour shall be given to each volume. Spines for manuals in the same volume shall be of the same colour.

A.5.4 The cover and spine shall be stiff and protected by plastic or other material to withstand frequent handling in a work floor environment.

A.5.5 A pocket shall be provided in the back of each binder for keeping loose drawings and notes.

Note: Spring-back, threaded and spiral binding will not be accepted.

A.5.6 Dividers with tabs shall be provided to separate each chapter and section in the manuals. Chapter and section numbers shall be shown on the tabs.

A.6 Software for the Production of the Manual

A.6.1 The text of the Manual shall be produced in Microsoft Word 2003 (or a later version as Approved).

A.6.2 Drawings shall be produced using Autocad™ 2002 (or a later version as Approved). Under special circumstances, the Engineer may accept drawings that are scanned into documents.

A.6.3 Large tables of data shall be prepared in databases using Microsoft Excel 2003 (or a later version as Approved) linked into the text files.

A.6.4 File Naming Conventions

The Contractor shall propose a systematic convention for naming files in the O&M Manual for Approval. The convention shall enable the identity of the document to be inferred readily from the file name.

A.6.5 Figures

The use of external figures is not recommended as there is a risk that some thirdparty tools such as 'viewer' may not support them.

A.6.6 Table of Contents

A table of contents shall be provided according to Clause B.1 below. This shall be generated by the software, not typed into the document.

A.6.7 Hyper-links

If possible, hyper-links should be built for each item in the table of contents. In addition, if a figure is referred to in a paragraph, a hyper-link should be built so that the figure can be more easily looked up.

A.6.8 Headers and Footers

Important information shall not be placed into a header or footer, due to the possibility of its being corrupted or lost during file conversions.

A.7 Equipment Hierarchy

A.7.1 Equipment on the train shall be organized under a classification scheme hereafter called the equipment hierarchy. All equipment systems, assemblies, subassemblies, components, down to the smallest replaceable item shall be assigned to different levels in a hierarchical structure. The first level (level 1) of the equipment hierarchy shall consist of the following:

1 Vehicle Structure
2 Structure and Vehicle Interior Fittings
3 Bogies and Suspension
4 Gangways and Couplers
5 Traction System
6 Brake System
7 Auxiliary Electrical System
8 Door System
9 Air Conditioning
10 Pneumatic and Air Distribution System
11 Train Management System (including Event Recorder)
12 Communication Equipment

A.7.2 All equipment information in the O&M Manual shall be presented using the equipment hierarchy as a framework. A separate chapter shall be provided for each level 1 item in the equipment hierarchy. Separate sections and subsections shall be provided systematically for equipment and components under the level 1

item. Where appropriate, a chapter 0 with the title 'Train Complete' shall be provided to cover information that applies to the train as a complete system.

A.7.3 To facilitate reference, the same chapter, section and subsection numbers shall be used consistently for the same equipment throughout the O&M Manual.

A.7.4 The Contractor may propose modification to equipment hierarchy for Approval.

A.8 Copyright

The content of all documentations shall become the property of the Employer, who shall have the right to reproduce any part or the complete documents, as he wishes.

Part B Contents of Individual Volumes of the O&M Manual

B.1 General Requirements

B.1.1 The first part of each book of the O&M Manual shall contain the following:

B.1.1.1 A title page specifying the volume number, title of the manual and the book number.

B.1.1.2 A revision control sheet detailing the amendments made to the manual.

B.1.1.3 A table of contents for the complete O&M Manual. It shall list the numbers and titles of all the volumes, parts and chapters in each book.

B.1.1.4 A table of contents for the particular volume to which the book belongs. It shall list the numbers and titles of all the books, parts, chapters and sections in the volume.

B.1.1.5 A general introduction detailing the purpose, use and limitations of the manual and reference to other manuals in the set.

B.1.1.6 A list of abbreviations.

B.1.2 A table of contents shall be provided for each chapter. It shall be placed immediately after the chapter divider. It shall list the number, title and beginning and ending page numbers of each section in the chapter. The reference numbers and titles of individual checklists and work instructions shall also be listed in the table of contents.

B.1.3 A table of contents shall be provided for each section. It shall be placed immediately after the section divider. It shall list the number, title and beginning and ending page numbers of each subsection or further sub-divisions in the section. The reference numbers and titles of individual checklists and work instructions shall also be listed in the table of contents.

B.2 Volume I Technical Descriptions Manual

B.2.1 General Requirements

B.2.1.1 This manual shall provide technical descriptions and performance specifications of the train and its subsystems. It shall include adequate information on the design of the trains to enable the Employer to carry out maintenance and modification to the equipment.

B.2.1.2 The manual shall consist of two parts:

Part A Overall System Descriptions
Part B Technical Descriptions of Equipment Systems

The contents of each part are detailed below.

B.2.2 Volume I Part A - Overall System Descriptions

This part shall contain technical information on the train as a complete system. It shall provide details on the following aspects:

B.2.2.1 General descriptions of the train and its subsystems.

B.2.2.2 Basic physical dimensions, kinematic envelope and weights

B.2.2.3 Overall design criteria and operation conditions such as duty cycle, useful life, power supply, environmental conditions

B.2.2.4 Performance data such as maximum speed, passenger capacity, acceleration and braking rates, ride comfort, acoustic performance, energy consumption and reliability.

B.2.2.5 A list of major equipment supplied, with quantity, model number and the name of the manufacturer

B.2.2.6 Numbering of equipment positions on the train

B.2.3 Volume I Part B - Technical Descriptions of Equipment Systems

B.2.3.1 This part shall contain technical information on individual equipment systems. The descriptions shall be presented systematically using the equipment hierarchy as a framework. Information on microprocessor based equipment such as hardware configuration and expansion capabilities shall also be provided.

B.2.3.2 The information to be covered shall include, but not be limited to, the following:

(a) Descriptions of the system or equipment and its components, identifying any special features such as interlocks and protective devices.

(b) Locations of the system or equipment and its components on the train

(c) Functions of the system or equipment including inputs, outputs and interfaces with other equipment or systems, with the aid of functional block diagrams

(d) Descriptions of the control of the system or equipment covering all possible modes of operation

(e) Operation principles, including those for emergency and derated modes of operation

(f) Equipment layouts, arrangement drawings, location diagrams, control schematics, block diagrams, exploded views, wiring diagrams

(g) Overall design assumptions, system and equipment specifications and performance characteristics in terms of power, current, flow-rate, temperature, pressure and other relevant parameters. The minimum acceptable performance level in which an equipment shall be allowed in service, with due consideration of maintenance and operational requirements, shall also be specified.

B.3 Volume II Train Operator's Manual

B.3.1 General Requirements

B.3.1.1 This manual shall provide operating information and instructions for both the train operator and any other operation staff that are required to handle the trains, including station staff. The information shall cover both normal operating conditions and emergencies.

B.3.1.2 Safety precautions and critical points shall be emphasised so that they are brought to the attention of the operation staff involved.

B.3.1.3 This manual shall consist of three parts:

Part A Operating Information
Part B Operation Instructions
Part C Fault Handling and Recovery Instructions

The contents of each part are detailed below.

B.3.2 Volume II Part A - Operating Information

This part shall detail the location, function and operating procedures for all operating elements, including train controls, the Train Management System, indicators, safety devices and emergency equipment.

B.3.3 Volume II Part B - Operation Instructions

This part shall consist of step-by-step instructions for all operating procedures such as those for preparing, starting up, normal running, shutting down, coupling and uncoupling under normal and emergency conditions. Such instructions shall be presented in the form of general work instructions as detailed in Appendix STD12-2.

B.3.4 Volume II Part C - Fault Handling and Recovery Instructions

B.3.4.1 This part shall contain handling and recovery procedures for both common faults and for more serious events such as derailments, locked axles and collisions. Such procedures shall be designed for train operators and operation personnel with the objective of minimizing service disruptions so that train service may be restored in the shortest possible time. They shall cover, but not be limited to, all train failure scenarios defined in the Register of Train Failures described in PS 25.

B.3.4.2 Such instructions shall be presented in the form of general work instructions as detailed in Appendix STD12-2.

B.4 Volume III Equipment Maintenance Manual

B.4.1 General

B.4.1.1 This manual shall provide all documentation necessary for engineering personnel to carry out all types of maintenance work, including preventive and corrective maintenance and conditioning monitoring, on the trains. It shall cover all maintenance activities starting from those at train level through equipment systems, assemblies and subassemblies down to the lowest level components that require maintenance attention.

B.4.1.2 This manual shall consist of three parts:

Part A General Maintenance Information
Part B Preventive Maintenance Schedules and Checklists
Part C Maintenance Work Instructions

B.4.1.3 Tabulated information, such as schedule of lubricants, torque values, master maintenance schedule and maintenance task matrices in the manual shall be prepared in the form of databases. Such databases shall be handed over to the Engineer as part of the O&M Manual submissions.

B.4.2 Volume III Part A - General Maintenance Information

This part shall consist of the following items which are applicable to the train as a whole:

B.4.2.1 A statement on the approved maintenance programme (refer to PS 26.1.1) and maintenance policy (refer to PS 26.1.2) for the trains. This shall specify the maintenance objectives, maintenance approach, basic assumptions, organization of preventive maintenance work (refer to PS 26.3.1), types of maintenance sessions (refer to PS 26.3.1(c)) and the associated maintenance intervals and maintenance logistics.

Where applicable, recommendations for the appropriateness of Condition Based Maintenance shall be given.

B.4.2.2 General standard practices applicable to the maintenance and repair of train equipment.

B.4.2.3 A schedule of all lubricants, cleaning agents, chemicals, and other consumable materials stating:

- where used
- quantities
- brand and grade of recommended lubricant
- safety precautions
- storage and disposal requirements

B.4.2.4 Detailed data sheets for all hazardous substances

B.4.2.5 Torque schedule for various types of fasteners. Locking method and/or thread adhesives used for each application shall be stated.

B.4.2.6 A list of paints for structures and parts.

B.4.2.7 Material specification list for structures and parts.

B.4.2.8 List of items which are recommended to be returned to the original equipment manufacturer for repair / maintenance.

B.4.2.9 Schedules of frequently referenced acceptance criteria and equipment performance specifications for major equipment.

B.4.2.10 Schedule of equipment which are subject to deterioration with time and the corresponding shelf lives.

B.4.2.11 General descriptions and procedures for handling derailments, locked axles, collisions and similar events. The procedures shall enable maintenance personnel to clear the train from the site safely and rapidly

so that train service can be restored in minimum time. Such procedures shall be presented in the form of maintenance work instructions as described in Appendix STD12-2.

B.4.2.12 Schedule of all cleaning work described in PS 26.5 covering all Approved technical details according to PS 26.5.3.

B.4.3 Volume III Part B - Preventive Maintenance Schedules and Checklists

B.4.3.1 This part shall contain schedules and matrices which provide an overview and details of all preventive maintenance work to be carried out on the trains. It shall consist of items described in B.4.3.2 to B.4.3.4 below.

B.4.3.2 Master Maintenance Schedule

(a) The Master Maintenance Schedule shall tabulate all preventive maintenance actions to be carried out in-situ on the trains, including inspections, servicing, replacement / replenishment of consumable, non-destructive tests, removal of equipment from cars for overhauls / scrapping, major part replacements during equipment overhauls as well as commissioning checks.

(b) The Master Maintenance Schedule shall be presented in the framework of the equipment hierarchy. Maintenance actions for the complete train or car, for example re-commissioning tests, shall be presented under the title Train Complete.

(c) Maintenance actions shall be grouped into maintenance tasks as defined in PS 26.3.1(b).

(d) Each maintenance task shall have a unique task number and a title. They shall be organized around individual equipment in the equipment hierarchy and shall form the basic building blocks of all service checks, car overhauls and scheduled equipment replacements.

(e) Each entry in the Master Maintenance Schedule shall contain the following information:

(i) Name of the equipment
(ii) Applicable car types
(iii) Maintenance task number and title
(iv) Maintenance actions covered in the maintenance task
(v) Maintenance interval and tolerance
(vi) Required man-hours
(vii) Reference number of relevant work instructions

B.4.3.3 Maintenance Tasks Matrix

(a) This is a table which specifies exactly which maintenance tasks are to be carried out at different service checks, car overhauls and scheduled equipment replacements for each type of unit, ranging from the lowest level checks up to mid-life overhauls.

(b) The principle of balanced-check defined in PS 26.3.2(a) shall be adopted in making up the contents of B service checks.

B.4.3.4 Maintenance Checklists

(a) A maintenance checklist defines all maintenance actions to be carried out on a unit in a service check, car overhaul or scheduled equipment replacement.

(b) A maintenance checklist shall be produced for each type of unit for different types of service checks, car overhauls and scheduled equipment replacements.

(c) The contents of a maintenance checklist shall contain, but not be limited to, the following:

(i) A unique reference number and a title
(ii) Maintenance interval in terms of running distance and service time
(iii) Tolerance in maintenance interval
(iv) Downtime
(v) Manpower and skills requirements
(vi) A bill of materials listing all essential replacement parts
(vii) Details of individual constituent maintenance tasks, i.e. maintenance task title, task number, maintenance actions and reference to relevant work instructions

(d) Maintenance tasks in a maintenance checklist for service checks shall be grouped under the following stages:

(i) Preparation and safety precautions
(ii) Inspections and servicing with overhead supply energized
(iii) Inspections and servicing with the overhead line isolated
(iv) Testing and recommissioning to restore the train back to service condition, with the overhead line energized

(e) Maintenance tasks in a maintenance checklist for car overhauls shall be grouped under the following stages:

(i) Preparation and safety precautions
(ii) Car lifting (optional, depending on the design of the equipment)
(iii) Replacement of equipment for overhauls
(iv) Inspections and servicing with overhead supply isolated
(v) Testing and recommissioning to restore the train back to service condition, with the overhead line energized

(f) Maintenance tasks in a maintenance checklist for scheduled equipment replacement shall be grouped under the following stages:

(i) Preparation and safety precautions
(ii) Replacement of equipment
(iii) Testing and recommissioning to restore the train back to service condition

(g) Maintenance checklists shall be presented in the format of general work instructions described in Section 1 of Appendix STD12-2.

B.4.4 Volume III Part C - Maintenance Work Instructions

B.4.4.1 This part shall contain all work instructions for the maintenance of the trains.

B.4.4.2 Each maintenance work instruction shall provide detailed technical information and step-by-step instructions for shop floor staff to carry out a specific maintenance work. They shall provide quantitative acceptance criteria for inspections / tests and define the performance level of the equipment to be achieved after the maintenance work.

B.4.4.3 Acceptance criteria and performance specifications that are frequently referred to shall be tabulated in schedules to facilitate standardization, reference from other documents and subsequent updating.

B.4.4.4 All maintenance work instructions shall be written in the format specified in Appendix STD12-2.

B.4.4.5 Maintenance work instructions shall be produced for the following maintenance operations:

(a) Details of maintenance actions referred to in maintenance tasks. Such actions shall be presented under individual items in the equipment hierarchy.

(b) System function tests and commissioning procedures (for example after corrective maintenance and car overhauls) to ensure that a train is in service condition

(c) Dismantling and re-installation of equipment from / to the cars (reference shall be made to testing and commissioning in (b) above)

(d) Equipment overhauls (refer to PS 26.3.1(d)), which shall include the following activities:

(i) testing and fault finding (for repairs of defective equipment)
(ii) dismantling
(iii) cleaning and inspection
(iv) repair, reconditioning and adjustment
(v) re-assembly
(vi) calibration, testing and re-commissioning

(e) Repair to body structures for anticipated modes of damage throughout the life of the trains

B.5 Volume IV Fault Diagnostics Manual

B.5.1 This manual shall provide information and instructions for maintenance personnel to identify and rectify failures on the train.

B.5.2 The information provided shall include, but not be limited to, the following:

B.5.2.1 Location, functions and interpretation of fault indications, alarms and fault messages

B.5.2.2 User guides for onboard self-diagnostics and fault logging equipment, including the Event Recorder

B.5.2.3 User guides for special diagnostic and test equipment

B.5.2.4 Trouble-shooting procedures for common faults classified under items in the equipment hierarchy. Such procedures shall be prepared in the form of maintenance work instructions specified in Appendix STD12-2.

B.5.3 A trouble-shooting procedure shall consist of the following parts:

B.5.3.1 A table or tree diagram showing all failure symptoms which may be found on the equipment

B.5.3.2 Methods to identify the cause of failure down to the defective Line Replaceable Units plus the corresponding rectification procedure

(a) For failures where the cause and effect relationship is straight forward, systematic tabulation of common symptoms, causes and rectification action shall be provided.

(b) For failures which require complicated diagnosis and testing, the trouble-shooting process shall be presented in the form of flowcharts, fault trees or cause and effect tables complemented with notes and explanations. Such information shall present an overview of the trouble-shooting process and shall enable maintenance personnel to take the shortest path in identifying and rectifying the failure.

B.5.3.3 Quantitative acceptance criteria and performance specifications for tests and measurements to be made during trouble shooting.

B.5.3.4 Tests and inspections to prove that the failure has been removed.

B.5.3.5 Instructions and tests to restore the train back to service condition.

B.5.3.6 Drawings for control schematics and signal flow diagrams with reference values at equipment inputs, outputs and test points

B.6 Volume V Illustrated Parts Catalogue

This manual shall consist of two parts:

Part A Equipment Hierarchy
Part B Parts Lists and Illustrations

B.6.1 Volume V Part A - Equipment Hierarchy

This part shall document the equipment hierarchy down to the first 3 sub-levels for each item defined in A.7 of this Standard.

B.6.2 Volume V Part B - Parts Lists and Illustrations

B.6.2.1 General

(a) This part shall consist of combinations of parts lists and illustrations covering all equipment on the trains starting from the top of the equipment hierarchy down to the smallest replaceable component.

(b) All parts lists and illustrations shall be cross-referenced to each other by proper indexing under the equipment hierarchy.

(c) All parts must bear unique part numbers. Identical parts used in different locations shall be highlighted with inter-changeability information in the parts lists.

(d) Standard items such as nuts, bolts, fixings, bearings, bulbs, resistors, capacitors, inductors and common electronic components can be described as such, and shall not necessarily require a part number unless it is a non-standard or specially made product. Descriptions for these standard items shall include the material and all necessary identification data and ordering parameters such as BS/DIN/ISO standards, voltage, rating, grade and dimensions.

B.6.2.2 Parts Lists

(a) Parts lists shall be prepared in the form of databases. Such databases shall be handed over to the Engineer as part of the manual submissions.

(b) A parts list shall include the following information:

(i) Header:

- the reference number of the parts illustration
- the reference number of relevant engineering drawings
- title

(ii) Information for each item in the list:

- item number in the parts drawing
- part name and description
- unit of measure
- quantity per car / assembly
- part numbers assigned by the original equipment manufacturer (OEM) and the Contractor (if different). All parts shall bear unique part numbers
- name of the OEM
- applicable car type and interchangeability information
- space for the Employer's coding and reference (12 digits) - special handling instructions (if any)

B.6.2.3 Parts Illustrations

(a) These shall be cut away drawings and 3-dimensional exploded views for identification of all parts.

(b) Each parts illustration shall have a unique reference number which shall be quoted in the relevant parts lists.

(c) All parts in the illustrations shall be clearly denoted by item numbers in sequence of their relativity, showing their exact positions within the assembly or equipment.

B.7 Volume VI Software Manual

B.7.1 General

B.7.1.1 The software manual shall provide software documentation covering each software module in accordance with RS/C6014/05.

B.7.1.2 The documentation shall be sufficiently comprehensive to allow any competent software programming organisation to make programme &/or system modifications, without recourse to the Contractor.

B.7.2 Contents of the Software Manual

The software documentation for each module shall include, but not be limited to the items listed below.

B.7.2.1 General information on the software module including:

(a) functional description
(b) linkage with other modules
(c) error routines, and any special considerations
(d) list of in/output data

B.7.2.2 Memory maps for both internal and peripheral memory with descriptions for all the following items:

(a) programmes
(b) data files
(c) overlay areas, and
(d) memory available for expansion

B.7.2.3 Data flow diagrams

B.7.2.4 Truth tables, state diagrams, equations.

B.7.2.5 Initialisation and program loading requirements, test records, use of test software

B.7.2.6 Program listing with comprehensive program comment statements

B.7.2.7 Records of software modifications (date, reason, description)

B.7.2.8 Programming manuals relevant to operating systems and languages

B.7.2.9 Software environment configuration and the method of set up for the system and its development system

B.7.2.10 Description and documentation of the software development method and tools employed eg. CASE tools

B.7.2.11 Convention (in-house or international) used in the design/programming of the software

B.8 Volume VII Special Tools and Test Equipment

This volume shall contain comprehensive operation and maintenance information for all special tools and test equipment, including software and hardware, required for the maintenance and operation of the trains. As a minimum requirement, all special tools and test equipment supplied in accordance with PS 24 shall be covered. Such information shall include, but not be limited to, the following:

B.8.1 Technical specification and drawings

B.8.2 Application and functional description

B.8.3 Operation procedures

B.8.4 Maintenance and calibration procedures in the form of maintenance work instructions described in Appendix STD12-2.

B.8.5 Illustrated parts catalogues (if any) in a similar format to Volume III

B.9 Volume VIII Vendor's Documentation

This shall include all sub-suppliers documentation which are not included in other manuals. It shall only contain minor components.

Examples: Catalogue of small components (connectors, cables)

Manuals for standard hardware (for example, operation manual of a printer and software installation manuals for a PC)

Vendor's information on small parts (for example ballast for fluorescent tube) and other printed matter

These documents shall have a reference number and be filed in a logical order.

Appendix STD12-1 Style for O&M Manual

1 General Writing Style

1.1 Level of Detail

1.1.1 Technical information shall contain all of the information necessary for the user to perform the task involved or to comprehend a description.

1.1.2 The O&M Manual shall retain enough information to permit the user to perform the documented maintenance without error or loss of time due to insufficient information.

1.2 Comprehensibility

1.2.1 Present descriptive text in a logical order (for example, in operational sequence or in signal flow sequence) and include summary headers for individual paragraphs whenever needed for clarity.

1.2.2 Maintain consistent terminology, style, and format throughout the O&M Manual.

1.2.3 When procedural text is combined with graphics, use the following rules to abbreviate, so long as the meaning is not altered or obscured.

(a) Eliminate articles.

(b) Begin sentences with transitive verbs (action verbs).

(c) Use the imperative mood whenever appropriate.

1.3 Emphasis

Use bold text for all words and phrases which need to be emphasised.

Note: Words that require stronger emphasis are bold and capitalised.

Example:

This is an **optional** procedure. The **safety switch SHALL** be set before operation.

1.4 Notes and Examples

Some guidelines to follow when using these terms are:

1.4.1 the word is in bold text followed by a colon
1.4.2 there is an indent after the colon
1.4.3 the first word in the text is in initial capitals
1.4.4 the text shall word wrap and be a hanging indent, and
1.4.5 the label can be plural if there is more than one eg. Notes.

Example:

This is an example of how to present examples in an O&M manual.

1.5 Aligning Notes and Examples

Where there is a combination of notes and examples within one paragraph, they are to be aligned as shown below.

Example:

Example: This is an example.

Note: This is a note.

1.6 Multiple Notes

When there is more than one point to be included as a note, the label “Notes” is to be used, and each note is to be numbered.

Example:

Notes:

1. This is the first note.

2. This is the second note.

1.7 Spelling - Use of S/Z

In words that can be spelt using either s or z (eg. organize/organise) the letter s shall be used (eg. organise).

1.8 Paragraphs and Sentences

Limit paragraphs to a single idea. Limit sentences to a single thought; avoid compound or complex sentences. Whenever possible, limit words to those that are short and familiar to the target audience. Eliminate long, complex sentences

and paragraphs through the use of lists. The resulting parallel portions of sentences shall be individually listed as follows:

The beat frequency oscillator has three components:

(1) ...

(2) ...

(3) ...

1.9 Capitalization

1.9.1 All equipment names are to have initial capitals.

1.9.2 Types of equipment, eg. indicator, switch, push button are to begin with:

initial capitals when they are part of an equipment name, eg. Emergency Switch, and lower case when they are used generically, eg. check all switches.

1.9.3 When referring to modes or positions, then mode and position does not begin with an initial capital, eg. normal position, test mode.

1.10 Quotes

When it is necessary to use quotation marks, double quotation marks are to be used.

Example:

“quote”

1.11 Numbers in Documents

1.11.1 Use numerals for all numbers.

Examples:

1 to 99.
Steps 1 to 5.
Load 4, 8 or 16 modules.

1.11.2 When you have two numerals together, spell out one of the numbers.

Examples:

Ten 3-person teams.
Add 5 seven times.

1.11.3 Use numerals and leading 0 for decimals less than 1.

Example:

0.1253.

1.11.4 Spell out the number if it starts a sentence.

Example:

Ten operators are needed for this task.

1.12 Indicating Time

When it is necessary to indicate time, begin sentences with "when" clauses. Example: "When power supply voltage stabilizes..."

1.13 Bulleted Lists

1.13.1 A bulleted list shall not appear in the middle of a sentence. It appears at the end of an introductory sentence.

1.13.2 Use bulleted lists for:

lists within paragraphs, and points in a series (normally separated by commas in normal prose).

1.13.3 A bulleted list shall contain at least:

2 points if each point contains more than one word, or 3 points if each point contains only one word.

1.13.4 An introductory sentence shall always go before a bulleted list. The following table explains punctuation rules that apply to introductory sentences.

If the introduction...	**then the introductory sentence shall end with a...**
is a complete sentence	full stop.

is not a complete sentence	colon.
assumes that a list is following, eg. ends in the word “follows” or “following”	colon.

1.13.5 Second Level Bullets

For second level bullets, the following is an example of spacing.

Example:

Things I need to do tomorrow are:

- get up and shower,
- eat breakfast, and
- drive to work, making sure to: ○ stop at the dry cleaners, and ○ get petrol.

Note: If the 2nd level bullets are all only one line, then there is no return between the 1st and 2nd level bullets.

1.14 Definitions

Definitions shall be given as a complete sentence, even if in a glossary.

Example:

A definition is the act of stating a precise meaning.

1.15 Abbreviations/Acronyms

1.15.1 The full form of an abbreviation shall be given when it first appears in the text. A list of abbreviations shall be provided in each volume of the manuals.

1.15.2 Do not use full stops between letters in acronyms.

1.15.3 The abbreviations ie. and eg. do not have a full stop between the letters.

2 Style Related to Computer Systems

2.1 Entering Information

2.1.1 When referring to general text which shall be entered onto a screen or form, use the word “Enter”.

Example:

Enter the train's speed.

2.1.2 When referring to specific text which shall be entered onto a screen or form, use the word "Type" or "Write" and make the specific information bold, using capital and small letters as required.

Examples:

Type **abc** in the FUNCTION field. Write **XYZ** in the Address field.

2.2 Field and Screen Names

Field and screen names appear in the document as they appear on the screen or form, including capital and small letters.

2.3 Key Strokes

When identifying keys on a keyboard or key pad, enclose them in square brackets.

Examples:

[Alt]
[A]
[F1]

2.4 Multiple Key Strokes

When two or more keys shall be pressed together, they are separated by +.

Example:

Press [Alt] + [F3].

2.5 Locating Information

2.5.1 To point out information on the screen, use the following terminology:

- at the top of the screen (line 1)
- near the top of the screen (lines 2-15), and
- near the bottom of the screen (lines 16-24).

Example:

The screen name is at the top of the screen.

2.5.2 System messages are written in quotation marks with an introductory sentence of "The following message is displayed:".

Example:

The following message is displayed: "The test is now completed".

2.6 Online

The word online is one word. There is no hyphen in this word.

2.7 Captions on Graphics

The text formatting for captions is:

- mixed case
- not bold
- Arial 10 point
- centred beneath the graphic

Appendix STD12-2 Contents of Work Instructions

All work instructions shall include items described under section 1 below as a minimum. Maintenance work instructions shall also include additional items specified under section 2 below.

1 General Work Instructions

1.1 Number and Title:

The number and title of the work instruction. Each work instruction shall have a unique reference number.

1.2 Application:

A statement of the type of cars, equipment, location and the circumstances (for example normal train operation, emergency and maintenance examination) under which the work instruction is applicable.

1.3 Safety precautions:

A clear statement of:

- any hazards associated with the equipment or procedures, and
- the actions required by operators or maintenance personnel to ensure safety.

All safety precautions shall be printed in bold capital letters.

1.4 Procedure:

Step-by-step instructions shall be clear, logical and sufficient for carrying out procedures or activities.

The instructions should be supported, where possible, by a flow chart and, where appropriate, by a check sheet.

The software used to produce the flow chart(s) shall be identified, to enable reproduction.

2. Additional Items to be Included in Maintenance Work Instructions

2.1 Special tools:

A list of special tools, jigs, and inspection, measuring and test equipment required for execution of the maintenance work.

2.2 Materials:

A list of materials and the quantities required to carry out the maintenance work.

2.3 Essential replacement parts:

A list of all parts which shall be replaced, regardless of their condition, during the maintenance work.

2.4 Illustrations:

A list of illustrations attached to, or included in, the work instruction.

2.5 Reference drawings and manuals:

A list of drawings by drawing number and title and/or supplier provided manuals which are referenced in the work instruction.

2.6 Reference forms:

Sample of record forms to be completed during the maintenance work.

Note: If any of the items listed above are not applicable, the paragraph heading shall still be included and the words “Not applicable” recorded below it.

ROLLING STOCK STANDARD RS/C6014/13
NOISE PERFORMANCE AND MEASUREMENT

1 Introduction

2 Standards

3 General Requirements

4 Noise Levels

5 Method for Determining Audible Tones in Noise

6 Testing Requirement

7 System Engineering Management System

ROLLING STOCK STANDARD RS/C6014/13
NOISE PERFORMANCE AND MEASUREMENT

1 Introduction

The purpose of this Standard is to define the requirements for interior and exterior noise performance and to define the standards which shall be used to confirm compliance with the noise requirements.

2 Standards

BS EN ISO 3381: 2005	Railway applications - Acoustics - Measurement of noise inside railbound vehicles
EN ISO 3095: 2005	Railway applications - Acoustics - Measurement of noise emitted by railbound vehicles
BS EN ISO 4287: 2000	Geometric Product Specification – Surface texture: Profile method – Terms, definitions and surface texture parameters
BS EN ISO 4288: 1998	Geometric Product Specification texture – Profile method: Rules and procedures for the assessment of surface texture
ANSI S12.10:1985	Methods of the Measurement and Designation of Noise Emitted by Computer and Business Equipment

3 General Requirements

3.1 The Contractor shall make every effort to reduce the internal and external noise in the train.

3.2 The motors, compressors, fans and any other auxiliary equipment shall be as noiseless as technically possible.

3.3 Equipment and components shall be mounted to minimize the generation and propagation of airborne and structure borne noise. Similarly, the interior of the cars - i.e. floors, outer and inner walls, doors, ceiling and windows - shall be designed to minimize transmission of airborne and structure borne noise. Such

noise reducing measures which are needed to comply with the stated requirements shall be established by the Contractor.

3.4 Irritating, audible pure tones, rattling and clattering shall not occur.

3.5 Where the term *passenger positions* is used in connection with measurement and checking of noise and vibrations, it shall be taken to cover positions of both seated and standing persons.

3.6 The requirements shall be met by all cars in a train consisting of 8 cars.

3.7 Unless otherwise specified, all measurements shall be made in accordance with BS EN ISO 3381: 2005 and EN ISO 3095: 2005. According to these standards the measured quantity (noise level) is A-weighted sound pressure level with time weighting FAST (L_{pAF}) in dB re 20 μPa.

3.8 The specified levels are given as two values as follows:

Target/Acceptance e.g. **80/83** dB

The target levels shall be used in design/modelling predictions. The acceptance levels are mandatory and shall be achieved in practice. They include all measurement uncertainties and shall not be exceeded.

3.9 Train speed measurements shall be made with an independently calibrated measurement system.

3.10 Unless otherwise specified, all noise measurements with cars running shall be performed over the Urban Lines.

3.11 The Contractor shall carry out prototype testing on his own test track. The track and wheels on the test vehicle shall meet the following requirements:

Track: Corrugation of no greater than 10 μm Ra, cut-off length = 2.5 mm

Wheels: Surface roughness of no greater than 10 μm Ra, cut-off length = 2.5 mm

Track/wheel requirements are with reference to BS EN ISO 4287: 2000 and BS EN ISO 4288: 1998.

3.12 Effects of Tonal Noise

If clearly audible tones occur, 5 dB will be added to the measurement value before comparison with the specified requirement. The criteria for occurrence of clearly audible tones are given in Clause 5 of this Standard.

3.13 Effects of Impulsive Noise

If impulsive noise occurs then 5 dB will be added to the measurement value before comparison with the specified requirement.

4 Noise Levels

4.1 Exterior Noise Levels

4.1.1 Train Stationary

(a) With a train stationary on a straight, level track and all auxiliary systems operating simultaneously under the loading conditions which generate the maximum noise, the noise level measured at a position 7.5 m horizontally from the track centre line and 1 500 mm above the head of the rail, shall not exceed **70/72** dB at any point along the length of the train on either side.

(b) Noise level resulting from simultaneous operation of all saloon doors on one side measured at any position 7.5 m horizontal from the track centre line and 1 500 mm above the head of the rail, shall not exceed **70/75** dB.

4.1.2 Train Moving on Surface Section

With a train moving at all speeds up to 80 km/h on a straight, level track, and operating in any mode of acceleration, including starting from standstill, deceleration, including friction braking, or coasting, with all auxiliary systems operating simultaneously in maximum condition, the noise level measured on either side, at 25 m from track centre line and 1 500 mm above the head of the rail, shall not exceed **75/78** dB.

4.1.3 Train Moving at Curves

The noise level generated by the new wheels for a tare (M1) train running over a depot curved track of radius 140 m at constant speed of 20 km/h under a dry weather, measured at a fixed position on the inner side of the curve of 7.5 m horizontally from the track centre line and 1 500 mm above the head of the rail, shall not exceed **86/89** dB.

4.2 Interior Noise Levels

4.2.1 Train Stationary

(a) In an empty car with all auxiliary equipment operating simultaneously at maximum capacity, the noise level in the car saloon and driver's cab shall not exceed **66/69** dB in accordance with the requirements of BS EN ISO 3381: 2005.

(b) In an empty car the noise produced by simultaneous operation of all saloon doors on one side of the car, without operation of any other auxiliary equipment shall not exceed **72/77** dB, at all points in the car 1 000 mm from the doors and 1 500 mm above the floor.

4.2.2 Train Moving on Surface Section

(a) When an empty train operates at all speeds of up to 80 km/h with all auxiliary systems operating simultaneously at maximum conditions and with the car operating in any mode of acceleration, including starting from standstill, deceleration including friction braking, or coasting, the noise level in the car interior shall not exceed the following values when measured in accordance with BS EN ISO 3381: 2005.

Train Operator's Cab ─ 70/73 dB

Compartments ─ 65/68 dB

Vestibule
Bogie area
Intercar connection
} ─ 67/70 dB

(b) The areas of the vehicle referred to in (a) above shall be as follows:

Train operator's cab	The cab area forward of the cab rear bulkhead
Compartments	Saloon areas not covered by the areas referred to below
Vestibule	Door areas between adjacent draught screens
Bogie area	An area immediately above the bogies equal in length to the overall length of the bogie
Intercar connection	The area between saloon bulkheads on adjacent vehicles located in the intercar connection at a height of 1500 mm above floor

4.2.3 Train Moving in Underground or Tunnel Sections

For a train moving at all speeds up to 80 km/h in any tunnel, with all auxiliary systems operating simultaneously and with the car operating in any mode of acceleration, deceleration or coasting, the noise levels, excluding noise generated by pressure pulses when entering tunnels and noise generated by passing vehicles, in the car interior and the train operator's cab shall not exceed the values given in Clause 4.2.2 (a) by more than 9 dB.

4.3 Speech Intelligibility

Refer to PS 18.4.19.

4.4 Train Operator's Exposure to Noise

In the train operators's cab, the train operator's noise exposure level L_{Aeq8h} shall not exceed an 8 hour L_{eq} of **80** dB, excluding all audible warnings and messages, for a typical shift which shall be assumed to comprise 4 hours of continuous duty, 45 minutes break, and a further 3 hours of continuous duty. Details of journeys, speed profiles and track conditions are given in Appendix I Annex 1. A test to confirm compliance with this requirement shall be performed and the results shall be submitted for Approval.

5 Method for Determining Audible Tones in Noise

5.1 The method is based on the psycho-acoustic concept of critical bands and the objective of the method is to give the same judgement of the prominence of any tones as an average listener.

5.2 The method is based on the Zwicker Critical Bands, and is in most details equivalent to ANSI S12.10:1985. It consists of three steps:

(a) Frequency analysis.

(b) Determination of the sound pressure level of the tone(s) and the sound pressure level of the masking noise within a critical band centered at the tone frequency.

(c) The difference between the levels (ΔL_{tn}) is compared to a criterion curve, and it is decided whether the tone is "Prominent".

5.3 Frequency Analysis

5.3.1 Any kind of narrow band frequency analyzer may be used, but the effective analysis bandwidth (equivalent to the noise bandwidth) shall be less than the values shown in the table below:

Tone Frequency, Hz		20-63	63-200	200-630	630-2k	2k-6.3k	6.3-20k
Effective analysis bandwidth	Abs.	20 Hz	20 Hz	20 Hz	22 Hz	57 Hz	126 Hz
	Rel.	32%	10%	3.5%	2.8%	2%	1.6%

(For an FFT analysis, this condition is fulfilled if the actual tones are placed on the upper 2/3 of the frequency range).

5.3.2 If the tone as well as the noise is stationary, the analysis time should be at least 2 minutes, 200-500 spectra should be averaged. For non-stationary conditions see Clause 5.8.

5.3.3 In the case of a tone complex with closely spaced tone components, an even finer resolution may be needed to determine the level of the masking noise correctly.

5.4 Determination of Sound Pressure Levels

5.4.1 The bandwidth of the critical bands are:

Center Frequency (f_c), Hz	20-500	Above 500
Bandwidth	100 Hz	20% of f_c

5.4.2 The critical band is positioned with centre frequency coincident with the tone frequency. If more closely spaced tones are present, the critical band is placed so that it includes the largest possible number of the most prominent tones. The lowest critical band is 20 Hz - 120 Hz.

5.5 Sound Pressure Level of Tone, L_{pt}

The sound pressure level of the tone L_{pt} is read from the analysis. It may be necessary to correct for the picket-fence effect of digital narrow band analyzers. If more tones are present in the same critical band, their levels are added on energy basis to give the total L_{pt}.

5.6 Sound Pressure Level of the Masking Noise within a Critical Band, L_{pn}

5.6.1 The sound pressure level of the noise is determined from the same analysis as if the tones were not present. All peaks resulting from the tones and their possible sidebands are disregarded.

5.6.2 The total noise level within a critical band, L_{pn} may be found as the average level within the critical band, $L_{pn,avg}$, and corrected to the bandwidth of the critical band:

$$L_{pn} = L_{pn,avg} + 10\log_{10}\frac{\text{Critical Bandwidth}}{\text{Effective Analysis Bandwidth}}$$

5.6.3 $L_{pn,avg}$ can be determined by visually averaging of the spectrum apart from the tones.

5.6.4 Alternatively, the level may be found by energy summing of all analysis bands within the critical band not due to tones. In this a correction must be made for the effective analysis bandwidth being generally wider than the frequency reduction. With the commonly applied Hanning weighting function, the analysis bandwidth is 1.5 times the resolution.

5.7 Evaluation

The difference between the tone level and the noise level, $\Delta L_{tn} = L_{pt} - L_{pn}$, is compared to a criterion curve, cf. Figure STD13-1. If ΔL_{tn} is below the lower curve, the tone is masked and cannot be detected by average listeners. If ΔL_{tn} is above the upper criterion curve, the level of the tone is 6.5 dB above the threshold and is described as "Prominent" by average listeners. For rating of noise a +5 dB penalty is then applied. The equation of the criterion curve is:

$$\Delta L_{tn.crit} = 4.5 - \log_{10}[1 + \left(\frac{f^{2.5}}{502}\right)]$$

5.8 Non-Stationary Conditions

5.8.1 If the level of the frequency of the tone is varying, the highest level of the tone is found from a frequency analysis using time weighting F. A minimum of 5 analyses shall be carried out and the average computed from the average of the highest 5 levels. The level of the masking noise is found by averaging over at least 2 minutes.

5.8.2 It is difficult to approximate time weighting constant F by use of an FFT analyzer. The following method is recommended, being validated for ordinary 400-lines FFT analyzers:

(a) With a full scale frequency of 1 kHz, a single spectrum approximates time weighting F.

(b) With a full scale frequency of 2 kHz or higher, the exponential average of two spectra approximates to time weighting F. In this connection it must be made sure that the "real time" frequency of the analyzer is not exceeded.

5.9 More Tones in Separate Critical Bands

If there are several tones (or groups of tones) in different critical bands, each critical band is evaluated separately. The critical band giving cause for the largest ΔL_{tn} contains the most dominant tone(s).

6 Testing Requirement

To ensure and demonstrate compliance with the noise requirements, the Contractor shall carry out a comprehensive programme of testing which shall include, in addition to tests on the completed vehicles and trains, tests on individual items of equipment to demonstrate the validity of the noise prediction model (refer to PS 21.8).

7 System Engineering Management System

7.1 SEMP Stage 1

The Contractor shall prepare and submit a noise plan (part of the SEMP, refer to PS 21) for Approval during SEMP Stage 1. The noise plan shall include:-

(a) The name and credentials of the Contractors proposed noise specialist for Approval prior to commencement of work in this area.

(b) Details of the validated computer model which shall be used to evaluate airborne and structure borne noise levels of the entire cars and key noise sources.

(c) Design review with identification of noise sources and airborne and structure borne noise transmission paths.

(d) Determination of airborne and structure borne noise source strength for all relevant noise sources, which shall include, but not be limited to:-

(i) Wheelsets (wheel-rail contact noise)
(ii) Motors
(iii) Gears
(iv) Compressors
(v) Pneumatic equipment
(vi) Air conditioners

(vii) Doors
(viii) Traction and auxiliary control equipment

(e) Evaluation of airborne and structure borne noise reducing measures for the car body including, but not be limited to, floor, sidewall, roof, doors, windows, ventilation openings, air conditioner ducting and interconnection gangways.

(f) Formulation of relevant noise specifications for sub-contractors in order to achieve final noise specifications.

(g) Predictions for the exterior and interior noise levels for the train travelling at full speed based on the computer model as octave band pressure levels and the Aweighted sound level.

(h) A description of the prediction method and how the predictions were carried out, including and assumptions made.

(i) Provision for revised noise predictions as further information becomes available during SEMP Stages 2, 3, 4 and 5.

7.2 SEMP Stage 2

The Contractor shall submit updated noise predictions based on detailed noise specifications developed for all major items of equipment and accepted by the suppliers of the equipment. The report shall include:-

(a) Detailed noise specifications for all the equipment.

(b) Preliminary designs for the vehicle showing any special measures necessary to achieve the noise levels such as floor arrangement and air conditioning ducting.

7.3 SEMP Stage 3

The Contractor shall submit a revised noise prediction based on the noise levels contracted with the manufacturers of equipment. The predictions shall include the following:-

(a) Details of any changes from the previous predictions with detailed explanations.

(b) Noise specifications contracted by the manufacturers of equipment with details of any deviations from the original specifications.

(c) Evaluation of any areas of risk with proposed contingency measures for these areas.

(d) Details of any areas of development required to achieve the specifications, together with development plans for these areas. This shall also include details of any testing programmes for sub systems, for example the floor, air conditioning units and motors, and finite-element modelling, for example with gearboxes.

7.4 SEMP Stage 4

The Contractor shall submit a revised noise prediction based on the noise levels achieved during testing of the individual items of equipment. The predictions shall include information on:-

(a) Noise levels for the equipment, together with test reports which confirm that the levels will be achieved.

(b) Explanation of any deviations from the specified levels for the equipment.

(c) Details of any remedial measures which are necessary, together with plans for implementation of these measures.

7.5 SEMP Stage 5

The Contractor shall carry out testing on completed vehicles and trains to demonstrate that the overall noise requirements have been achieved and shall submit detailed final test reports for Approval.

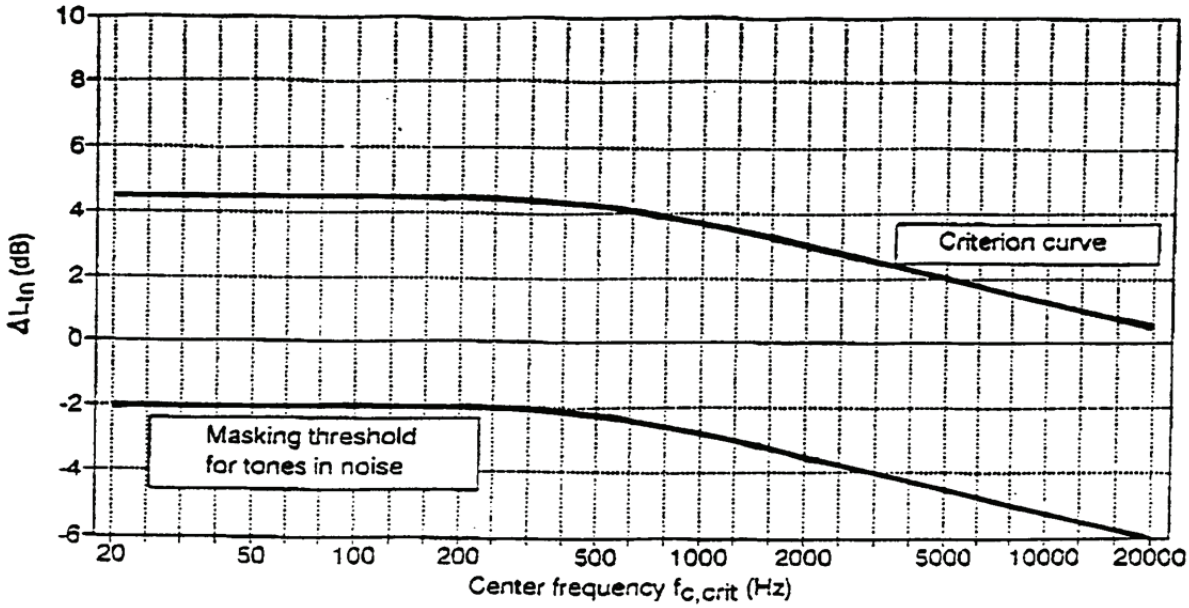


Figure STD13-1 Evaluation Chart

ROLLING STOCK STANDARD RS/C6014/14
OPERABILITY DESIGN GUIDELINES

1 Introduction

2 Standards/Reference

3 Definition

4 Scope

5 Purpose

6 General Requirements

7 Detailed Requirements

8 Testing Requirements

9 System Engineering Management System

Table STD14-1 Anthropometric Data for Hong Kong Chinese Adults

Figure STD14-1 Development of Levels 1 and 2 Design Documents with respect to Operability Design

Figure STD14-2 Operability Design Life Cycles

ROLLING STOCK STANDARD RS/C6014/14
OPERABILITY DESIGN GUIDELINES

1 Introduction

1.1 The main objective of this Standard is to help the Contractor to be aware within the pre-design of the human factors of the train systems.

1.2 The Contractor shall design with operability in mind, so that train operation may be carried out as far as possible in an efficient and user friendly manner.

2 Standards/Reference

BS EN 60073: 2002	Basic and Safety Principles for Man-Machine Interface, Marking and Identification - Coding Principles for Indication Devices and Actuators
BS EN 60447: 2004	Basic and Safety Principles for Man-Machine Interface, Marking and Identification – Actuating Principles
BS EN ISO 6385: 2004	Ergonomic Principles in the Design of Work Systems
BS EN ISO 10075-2: 2000	Ergonomic Principles Related to Mental Workload - Part 2: Design Principles

3 Definition

Human factors engineering is the systematic application of knowledge about human sensory, physical, intellectual, and motivational attributes to the design of equipment, software, tasks, documentation, and the environment of the work place to better suit people. The ultimate objective of human factors engineering is to achieve maximum human efficiency in system development, operation, and maintenance.

4 Scope

This Standard presents descriptive detail, technical data and diagrams relating to some of the important issues concerned with the human factors concept in operability and the operator’s requirements for train operation, maintenance and training tasks.

5 Purpose

5.1 This Standard embodies procedures, techniques, practices and tools which when followed or used correctly will reduce, but not necessarily eliminate the probability that the use of equipment may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and in no way absolves either the Contractor, sub-Contractor or the supplier from statutory and all other legal obligations relating to health and safety at any stage of the Contract or use.

5.2 Particular attention is drawn to the following hazard(s), although the list is not necessarily exhaustive and the inclusion of such a list does not absolve the Contractor from the obligations referred to in this Clause:

(a) Upper limb pains and discomfort.
(b) Eye and eyesight effects.
(c) Fatigue and stress.
(d) Epilepsy.
(e) Facial dermatitis.
(f) Electro magnetic radiation.
(g) Implications of user error.

5.3 The details contained within this Standard do not replace or take precedence over any act or ordinance related to health and safety. The requirements of this Standard and of any Health and Safety Regulations are to be seen as complementary.

6 General Requirements

6.1 Objectives

6.1.1 All systems, equipment and facilities supplied under the scope of work of the Contract shall provide work environments which foster effective procedures, work patterns, and personnel safety and health, and which minimize factors that degrade human performance or increase error.

6.1.2 Design shall be such that operator workload, accuracy, time constraint, mental processing and communication requirements do not exceed operator capabilities. Design shall also minimize personnel and training requirements within the limits of time, cost, and performance trade-offs.

6.1.3 In order to ensure the human requirements are satisfied, the design principles stipulated in the BS EN ISO 6385: 2004 and BS EN ISO 10075-2: 2000 shall be applied. In addition, the operating and safety principles specified in the BS EN 60073: 2002 and BS EN 60447: 2004 shall be followed in the design of man-machine interfaces. Wherever the

above standards duplicate requirements for a particular criterion, the more stringent standard shall apply and any conflict in requirements shall be brought to the attention of the Engineer. Any variation from these standards may be proposed, the Contractor shall state the area and the reasons for Approval.

6.1.4 In view of the fact that operability and qualification are closely related concepts. Therefore, operation training shall be provided by the Contractor in a manner that training is designed for qualification purpose. Such that at the end of the operations training, the Corporation's operators are fully qualified and able to perform the specified train operation and the associated system functions if called upon. The detailed requirements of the training requirements shall be referred to PS 23.

6.2 Standardization

6.2.1 Controls, displays, marking, coding, labelling, and arrangement schemes (equipment and panel layout) shall be uniform for common functions of all equipment.

6.2.2 Criterion for selecting off-the-shelf commercial equipment shall be the degree to which the equipment conforms to this Standard. Where offthe-shelf equipment requires modification in order to interface with other equipment, the modification shall be designed to comply with the criteria herein.

6.3 Function Allocation

Design shall reflect allocation of functions to personnel, equipment and personnel equipment combinations to achieve:

6.3.1 Required sensitivity, precision, time, and safety.

6.3.2 Required reliability of system performance.

6.3.3 Minimum number and level of skills of personnel required to operate and maintain the system.

6.3.4 Required performance in a cost-effective manner.

6.4 Human Engineering Design

The design of train systems, equipment and facilities shall reflect human engineering factors that affect human performance, including, when applicable:

6.4.1 Satisfactory atmospheric conditions including composition, pressure, temperature and humidity, including safeguards against uncontrolled variability beyond acceptable limits.

6.4.2 Range of acoustic noise, vibration, acceleration, shock, blast, and impact forces and safeguards against uncontrolled variability beyond safe limits.

6.4.3 Protection from thermal, mechanical, electrical, electromagnetic, visual, and other hazards.

6.4.4 Adequate space for personnel, their equipment, and free volume for the movements and activities they are required to perform during operation and maintenance tasks under both normal and emergency conditions.

6.4.5 Efficient arrangement of operation and maintenance workplace, equipment, controls, and displays.

6.4.6 Adequate natural or artificial illumination for the performance of operation and control.

6.4.7 Safe and adequate passageways, ladders, platforms, detrainment ramp, and other provisions for ingress, egress, and passage under normal and emergency conditions.

6.4.8 Provisions for minimizing psychophysiological stress effects of mission duration and fatigue.

6.4.9 Design features to assure rapidity, safety, ease and economy of operation and maintenance in normal and emergency maintenance environments.

6.5 Fail Safe Design

A fail safe design shall be provided in those areas where failure can cause catastrophe through damage to equipment, injury to personnel or inadvertent operation of critical equipment.

6.6 Simplicity of Design

The equipment shall represent the simplest design consistent with functional requirements and expected service conditions. It shall be capable of being operated, maintained, and repaired in its operational environment by personnel with a minimum of training.

6.7 Interaction

The design of the system shall reflect the interaction requirements of the Train Management System (refer to PS 10).

6.8 Safety

Design shall reflect applicable system and personnel safety factors, including minimization of potential human error in the operation and maintenance of the system, particularly under emergency or non-routine conditions.

7 Detailed Requirements

7.1 Control/Display Integration

7.1.1 General criteria

(a) Relationship

The relationships of a control to its associated display and the display to the control shall be immediately apparent and unambiguous to the operator. Controls should be located adjacent to (normally under or to the right of) their associated displays and positioned so that neither the control nor the hand normally used for setting the control will obscure the display.

(b) Design

Control-display relationships shall be apparent through proximity, similarity of groupings, coding, framing, labelling, and similar techniques.

(c) Complexity and precision

The complexity and precision required of control manipulation and display monitoring shall be consistent with the precision required of the system. Control/Display complexity and precision shall not exceed the capability of the operator (in terms of discrimination of display detail) or exceed the operator's manipulative capability under the dynamic conditions and environment (in terms of manual dexterity, coordination or reaction time) in which human performances expected to occur.

(d) Feedback

Feedback on control response adequacy shall be provided as rapidly as possible. Critical control functions, such as those entered by keyboard, shall provide adequate feedback to the operator prior to entry to ensure

that the keyed entry is, in fact, errorless and the one that the operator desires to enter.

(e) Illumination

Adjustable illumination shall be provided for visual displays, including display, control and panel labels and critical markings, that must be read under darkened conditions.

7.1.2 Position Relationships

(a) Functional grouping

Functionally related controls and displays shall be located in proximity to one-another i.e. arranged in functional groups, e.g., power, status, test.

(b) Functional group arrangement

(i) Sequence

Functional groups of controls and displays shall be located to provide for left-to-right or top-to-bottom order of use, or both.

(ii) Access

Providing that the integrity of grouping by function and sequence is not compromised, the more frequently used groups and the most important groups should be located in areas of easiest access. Control-display groups required solely for maintenance purposes shall be located in positions providing a lesser degree of access relative to operating groups.

(iii) Functional group marking

Functional groups may be set apart by outlining with contrasting lines which completely encompass the groups.

(iv) Consistency

Location of recurring functional groups and individual items shall be similar from panel to panel. Mirror image arrangements shall not be used.

(c) Location and arrangement

Whenever an operator must use a large number of controls and displays, their location and arrangement shall be designed to aid in determining which controls are used with which displays, which equipment component each control affects, and which equipment component each display describes.

(d) Arrangement within groups

Controls and displays within functional groups shall be located according to operational sequence or function, or both.

(i) Simultaneous use

A visual display that must be monitored concurrently with manipulation of a related control shall be located so that the operator is not required to observe the display from an extreme visual angle and thus introduce the possibility of parallax error.

(ii) Multiple displays

When the manipulation of one control requires the reading of several displays, the control shall be placed as near as possible to the related displays and preferably beneath the middle of the displays, but not so as to obscure displays when manipulating the control.

(iii) Combined control

When separate displays are affected by a combined control (e.g., traction and brake controller), the display shall be arranged from left to right with the combined control underneath the centre of the displays, but not so as to obscure displays when manipulating controls.

(iv) Separate panels

When related controls and displays must be located on separate panels and both panels are mounted at approximately the same angle relative to the operator, the control positions on one panel shall correspond to the associated display positions on the other panel. The two panels shall not be mounted facing each other.

(v) Emergency use

Emergency displays and controls shall be located where they can be seen and reached with minimum delay (e.g., warning lights within a 30-degree cone about the operator's normal line of sight; emergency control close to its related warning display or the nearest available hand in its nominal operating position).

7.1.3 Movement Relationships

(a) Lack of ambiguity

Display indicators shall clearly and unambiguously direct and guide the appropriate control response. The response of a display to control movements shall be consistent, predictable, and compatible with the operator's expectations.

(b) Time lag

The time lag between the response of a system to a control input and the display presentation of the response shall be minimized, consistent with safe and efficient system operation.

(c) Moving pointer circular scales

Clockwise movement of a rotary control or movement of a linear control forward, up, or to the right shall produce a clockwise movement of circular scale pointers and an increase in the magnitude of the setting.

(d) Moving pointer linear scales

Clockwise movement of a rotary control or movement of a linear control forward, up, or to the right shall produce a movement up or to the right for horizontal and vertical scale pointers and an increase in the magnitude of the reading.

(e) Fixed pointer circular/linear scale

Displays with moving scales and fixed pointers or cursor should not be used.

(f) Direct linkage

When there is a direct linkage between control and display (e.g., radio frequency selector and station pointer), a rotary control shall be used if the indicator moves through an arc of more than 180 degrees. If the indicator moves through an arc of less than 180 degrees, a linear control

may be used, provided the path of control movement parallels the average path of the indicator movement and the indicator and control move in the same relative direction.

(g) Common plane

Controls shall be selected so that the direction of movement of the control will be consistent with the related movement of an associated display, equipment component, or vehicle.

(h) Parallel movement

Direction-of-movement relationships shall be adhered to when control and display are parallel in line of movement.

(i) Labelling

When control-display relationships specified herein cannot be adhered to, controls shall be clearly labelled to indicate the direction of control movement required.

(j) Movement direction

When a rotary control and a linear display are in the same plane, the part of the control adjacent to the display shall move in the same direction as the moving part of the display.

7.1.4 Control Display Movement Ratio

(a) Minimization of time

Control display ratios for continuous adjustment controls shall minimize the total time required to make the desired control movement (i.e., slewing time plus fine adjusting time), consistent with display size, tolerance requirements, viewing distance, and time delays.

(b) Range of display movement

When a wide range of display element movement is required, small movement of the control shall yield a large movement of the display element. When a small range of display movement is required, a large movement of the control shall result in small movement of the display, consistent with final accuracy required.

(c) Knob, coarse setting

When a knob is provided for making coarse display element settings on linear scales of 0.4 to 2.5 mm tolerance for approximately 150 mm display element movement shall be provided for one complete turn of the knob.

(d) Knob, fine setting

For fine setting on linear scales of 0.2 to 0.4 mm tolerance for 25 to 50 mm of display element movement shall be provided for one complete turn of the knob.

(e) Lever, coarse setting

When a lever is provided for coarse settings of 0.4 to 2.5 mm tolerance for one unit of display element movement shall be used to three units of lever movement.

7.2 Displays

7.2.1 Visual and/or audio displays should be utilized to provide the operator with a clear indication of equipment or system conditions for operation under any eventuality commensurate with the operational and maintenance philosophy of the system under design.

7.2.2 All visual/audio displays shall be equipped with circuit test devices or other means of operability test.

7.2.3 When several different visual/audio signals are to be used to alert an operator to different types of conditions, discriminable difference shall be provided.

7.2.4 When a visual/audio signal is designed to persist as long as it contributes useful information, a shut-off switch controllable by the operator, the sensing mechanism, or both, shall be provided, depending on the operational situation and personnel safety factors.

7.2.5 Whether visual/audio warning signal are designed to be terminated automatically, by manual control, or both, an automatic reset function shall be provided. The automatic reset function shall be controlled by the sensing mechanism which shall recycle the signal system to a specified condition as a function of time or the state of the signalling system so that the warning device can sound again if the condition repeats.

7.3 Controls

7.3.1 Selection

(a) Distribution of work load

Controls shall be selected and distributed so that none of the operator's limbs will be overburdened.

(b) Consistency of movement

Direction of control movement shall be consistent with the related movement of an associated display, equipment component, or vehicle. In general, movement of a control forward, clockwise to the right, or up or, pressing a control, shall turn the equipment or component on, cause the quantity to increase, or cause the equipment or component to move forward, clockwise, to the right, or up.

7.3.2 Arrangement and Grouping

(a) Grouping

All controls which function in sequential operation necessary to a particular task, or which operate together, shall be grouped together along with their associated displays. When several steps of a sequence are selected by one control, the steps shall be arranged by order of occurrence to minimize control movements and prevent cycling through unnecessary steps. Cycling through the control's ON/OFF position shall be avoided.

(b) Sequential operation

Where sequential operations follow a fixed pattern, controls shall be arranged to facilitate operation.

(c) Location of primary controls

The most important and frequently used controls shall have the most favourable position with respect to ease of reaching and grasping (particularly rotary controls and those requiring fine settings).

(d) Consistency

The arrangement of functionally similar, or identical, primary controls shall be consistent from panel to panel throughout the system, equipment, or vehicle, e.g., a movement of a control to the right or left should result in a corresponding movement of a displayed element to the right or left.

(e) Remote controls

Where controls are operated at a position remote from the display, equipment, or controlled vehicle, they shall be arranged to facilitate direction-of-movement consistency.

(f) Maintenance and adjustment

In general, controls used solely for maintenance and adjustment shall be covered during normal equipment operation, but shall be readily accessible and visible to the maintenance technician when required.

(g) Coding

(i) Location-coding

Controls associated with similar functions should be in the same relative location from operator work station to work station and from panel to panel.

(ii) Size-coding

No more than three different size of controls shall be used in coding controls for discrimination by absolute size. Controls used for performing the same function on different items of equipment shall be the same size. When knob diameter is used as the coding parameter, differences between diameters shall not be less than 13 mm (0.5"). When knob thickness is the coding parameter, differences between thicknesses shall not be less than 10 mm (0.4").

(iii) Shape-coding

Primary use of shape coding for controls is for identification of control knobs or handles by "feel;" however, shapes shall be identifiable both visually and tactually.

(h) Colour-coding

(i) Choice of colours

Controls shall be black or grey. If colour coding is required, only the following colours shall be selected for control coding:

Red, Green, Orange-Yellow and White.

(ii) Relation to display

When colour-coding must be used to relate a control to its corresponding display, the same colour shall be used for both the control and the display.

(i) Prevention of accidental actuation

(i) Location and design

Controls shall be designed and located so that they are not susceptible to being moved accidentally, particularly critical controls whose inadvertent operation might cause damage to equipment, injury to personnel or degradation of system functions.

(ii) Methods

For situations in which controls must be protected from accidental actuation, one or more of the following methods, as applicable, shall be used:

(1) Locate and orient the controls so that the operator is not likely to strike or move them accidentally in the normal sequence of control movements.

(2) Recess, shield, or otherwise surround the controls by physical barriers. The control shall be entirely contained within the envelope described by the recess or barrier.

(3) Cover or guard the controls. Safety or lock wire shall not be used.

(4) Provide the controls with interlocks so that extra movement or the prior operation of a related or locking control is required.

(5) Provide the controls with resistance (i.e., viscous or coulomb friction, spring-loading, or inertia) so that definite or sustained effort is required for actuation.

(j) Dead man controls

Dead man controls, which will result in system shut-down to a noncritical operating state when force is removed, shall be utilized wherever operator incapacity can produce a critical system condition.

7.4 Labelling

7.4.1 General

(a) Application

Labels, legends, placards, signs or markings, or a combination of these shall be provided whenever it is necessary for personnel to identify, interpret, follow procedures or avoid hazards, except where it is obvious to the observer what an item is and what he or she is to do with it.

(b) Label characteristics

Label characteristics shall be consistent with such factors as:

(i) Accuracy of identification required.
(ii) Time available for recognition or other responses.
(iv) Distance at which the labels must be read.
(v) Illuminant level and colour.
(vi) Criticality of the function labelled.
(vii) Consistency of label design within and between systems.

(c) Orientation and location

(i) Orientation

Labels and information thereon should be oriented horizontally so that they may be read quickly and easily from left to right.

(ii) Location

Labels shall be placed on or very near the items which they identify, so as to eliminate confusion with other items and labels. Labels shall be located so as not to obscure any other information needed by the operator. Controls should not obscure labels.

(iii) Standardization

Labels shall be located in a consistent manner throughout the equipment and system.

7.4.2 Contents

(a) Labels should primarily describe the functions of equipment items. (b) Capital letters shall be used.

7.4.3 Qualities

(a) Brevity

Labels shall be as concise as possible without distorting the intended meaning or information and shall be unambiguous.

(b) Familiarity

Words shall be chosen on the basis of operator familiarity whenever possible, provided the words express exactly what is intended. For particular users (e.g., maintenance technicians), common technical terms may be used even though they may be unfamiliar to nonusers. Abstract symbols (e.g., squares and Greek letters) shall be used only when they have an accepted meaning to all intended readers. Common, meaningful symbols (e.g., % and +) may be used as necessary.

(c) Visibility and legibility

Labels and placards shall be designed to be read easily and accurately at the anticipated operational reading distances, vibration/motion environment, and illumination.

(d) Access

Labels shall not be covered or obscured by other units in the equipment assembly.

(e) Label life

Labels shall be clear and distinct, have high contrast, be mounted so as to minimize wear or obscurement by grease, grime, or dirt, and shall remain legible for the overhaul interval of the equipment on which they are mounted.

7.5 Anthropometry

7.5.1 Design and sizing shall ensure accommodation, compatibility, operability, and maintainability by the Hong Kong Chinese user population.

7.5.2 Generally, design limits shall be based upon a range from the 5th percentile female to the 95th percentile male values for critical body dimensions. When two or more dimensions are used simultaneously as design parameters, appropriate multivariate data and techniques should be utilized.

7.5.3 The limited anthropometric data presented in this Standard in Table STD14-1 is intended to provide general design guidance.

7.5.4 Use of these data shall take the following into consideration:

(a) The nature, frequency, safety, and difficulty of the related tasks to be performed by the operator of the equipment.

(b) The position of the body during performance of these tasks.

(c) Mobility or flexibility requirements imposed by these tasks.

(d) Increments in the design-critical dimensions imposed by the need to compensate for obstacles, projections, etc.

(e) Increments in the design-critical dimensions imposed by protective clothing or equipment, packages, lines, padding, etc.

7.6 Human-computer Interface (HCI)

7.6.1 General

(a) Computer programs and equipment interfaces shall provide a functional interface between the system for which they are designed and users (operators/maintainers) of that system.

(b) This interface shall optimize compatibility with personnel and shall minimize conditions which can degrade human performance or contribute to human error.

(c) The purpose of this part is also to influence the operational effectiveness of manned systems in a positive way by ensuring that the design of human computer interfaces support effective human computer interaction.

(d) This part is intended to reduce the risk of computer-based systems being put into service in which the performance of capability of the system's users results in the system failing to satisfy operability requirements.

(e) Operability requirements addressed include the overall standards of system effectiveness, the levels of user training, support and effort required to achieve those standards, and considerations of system availability, reliability and user acceptance.

7.6.2 Standard Procedures

(a) Users shall be provided standard procedures for similar, logically related transactions.

(b) Computer response

Every input by a user shall consistently produce some perceptible response output from the computer.

(c) On-line guidance

Users shall be provided on-line data and command indices, and dictionaries, to guide selection and composition for data and command entries. Definitions of allowable options, system capabilities, procedures, and ranges of values shall be displayable at the user's request.

(d) System status

Users shall be provided information at all times on system status regarding operational modes, availability, and loads, either automatically or by request.

(e) Log-on procedures

In applications where users must log-on to the system, log-on shall be a separate procedure that must be completed before a user is required to select among any operational options.

(i) Automatic log-on display

Appropriate prompts for log-on should be automatically displayed on the user's terminal with no special action required other than turning on the terminal.

(ii) Log-on-feedback

Users shall be provided feedback relevant to the log-on procedure that indicates the status of the inputs.

(iii) Log-on delay

If a user cannot log-on to a system, a prompt should be provided to explain the reason for this inability. Log-on processes should require minimum input from the user consistent with the requirements prohibiting illegal entry.

(f) Log-off procedures

When a user signals for log-off, the system should check pending transactions to determine if data loss seems probable. If so, the computer should prompt for confirmation before the log-off command is executed.

(g) Computer failure

In the event of partial hardware/software failure, the program should allow for orderly shutdown and establishment of a check-point so restoration can be accomplished without loss of computing performed to date.

7.6.3 Data display

(a) Display format

(i) Consistency

Display formats should be consistent within a system.

(1) When appropriate for users, the same format should be used for input and output.

(2) Data entry formats should match the source document formats.

(3) Essential data, text, and formats should be under computer, not user, control.

(ii) Criticality

Only data essential to the user's needs shall be displayed.

(1) Readily usable form

Data presented to the user shall be in a readily usable and readable form such that the user does not have to

transpose, compute, interpolate or mentally translate into other units, number bases or languages.

(2) Order and sequences

When data fields have a naturally occurring order (e.g., chronological or sequential), such order shall be reflected in the format organization of the fields.

(iii) Labels and titles

Each display shall be labelled with a title or label that is unique within the system. To make the display as meaningful as possible and to reduce user memory requirements, every field or column heading should be labelled.

(1) Display title

Every display should begin with a title or header at the top, describing briefly the contents or purpose of the display. There shall be at least one blank line between the title and the body of the display.

(2) Command entry, prompts, messages at bottom

The last several lines at the bottom of every display should be reserved for status and error messages, prompts, and command entry.

(b) Display content

(i) Standardization

The content of displays within a system shall be presented in a consistent, standardized manner.

(ii) Information density

Information density shall be held to a minimum in displays used for critical task sequences. A minimum of one character space shall be left blank vertically above and below critical information with a minimum of two character spaces left blank horizontally before and after.

(c) Display coding

(i) Use

Coding shall be employed to differentiate between items of information and to call the user's attention to changes in the state of the system. Coding should be used for critical information, unusual values, changed items, items to be changed, high priority messages, special areas of the display, errors in entry, criticality of command entry, and targets. Consistent, meaningful codes shall be used. Coding shall not reduce legibility or increase transmission time.

(ii) Flash

Flash coding shall be employed to call the user's attention to mission critical events only. No more than 2 flash rates shall be used. Where one rate is used, the rate shall be between 3 and 5 flashes per second. Where two rates are used, the second rate shall be less than 2 per second.

(iii) Colour

Colour coding may be employed to differentiate between classes of information in complex, dense, or critical displays.

(iv) Shape

Shape coding may be used for search and identification tasks. When shape coding is used, the codes selected shall be based on established standards or conventional meanings.

(d) Dynamic displays

Changing alphanumeric values which the operator must reliably read shall not be updated more often than once per second. Changing values which the viewer uses to identify rate of change or to read gross values shall not be updated faster than 5 times per second, nor slower than 2 per second, when the display is to be considered as real-time.

(e) Interactive control

(i) General

(1) General design objectives include consistency of control action, minimized need for control actions, and minimized memory load on the user, with flexibility of interactive control

to adapt to different user needs. As a general principle, it is the user who should decide what needs doing and when to do it.

(2) The selection of dialogue types should be based on anticipated task requirements and user skills. Different types of dialogue imply differences in system response time for effective cooperation.

(3) Wherever possible, graphical icons shall be used to represent controlled or indicated items of equipment. The icons shall indicate the function which they represent.

(4) Wherever possible, function keys shall be provided as an efficient means for entering frequently used commands such as "Help". The assignment of function keys shall be standardized and consistent.

(ii) Response time

System response times shall be consistent with operational requirements. Required user response times shall be compatible with required system response time. Required user response times shall be within the limits imposed by total user tasking expected in the operational environment.

(iii) Simplicity

Control/display relationships shall be straightforward and explicit. Control actions shall be simple and direct, whereas potentially destructive control actions shall require extended user attention such that they are not easily acted on.

(iv) Accidental actuation

Provision shall be made to prevent accidental actuation of potentially destructive control actions, including the possibility of accidental erasure or memory dump.

(v) Compatibility with user skill

Controls shall be compatible with the lowest anticipated user skill levels. Experienced users should have options which shortcut intervening steps necessary for inexperienced users.

(vi) Availability of information

Information necessary to select or enter a specific control action shall be available to the user when selection of that control action is appropriate.

(vii) Concurrent display

Control actions to be selected from a discrete set of alternatives shall have those alternatives displayed prior to the time of selection. The current value of any parameter or variable with which the user is interacting shall be displayed. User control inputs shall result in a positive feedback response displayed to indicate performance of requested actions.

(viii) Hierarchical process

When hierarchical levels are used to control a process or sequence, the number of levels shall be minimized. Display and input formats shall be similar within levels and the system shall indicate the current positions within the sequence at all times.

(ix) User memorization

The requirement to learn mnemonics, codes, special or long sequences, or special instructions shall be minimized.

(x) Dialogue type

The choice of dialogue type (e.g., form filling, menus, command language) for interactive control shall be compatible with user characteristics and task requirements.

(xi) Computer processing constraints

The sequence of transaction selection should generally be dictated by user choices and not by internal computer processing constraints.

(xii) Feedback for correct input

Control feedback responses to correct user input shall consist of changes in state or value of those elements of the displays which are being controlled in an expected and logically natural form. An

acknowledgement message shall be employed only in those cases where the more conventional mechanism is not appropriate or where feedback response time must exceed one second.

(xiii) Feedback for erroneous input

Where control input errors are detected by the system, error messages shall be available and error recovery procedures shall also be provided.

(xiv) Control input data display

The presence and location of control input data entered by the user shall be clearly and appropriately indicated. Data displayed should not mislead the user with regard to nomenclature, units of measure, sequence of task steps, or time phasing.

(f) Menu selection

(i) Use

Menu selection interactive control should be used for tasks that involve little or no entry of arbitrary data and where users may have relatively little training. It should also be used when a command set is so large that users are not likely to be able to commit all of the commands to memory.

(ii) Titles

Each page of options (menu) should have a title that clarifies the purpose of that menu.

(iii) Series entry

Users should be provided the capability to stack menu selections, i.e., to make several menu selections without having each menu displayed.

(iv) Sequences

A menu shall not consist of a long list of multi-page options, but shall be logically segmented to allow several sequential selections among a few alternatives.

(v) Active option presentation

The system shall present only menu selections for actions which are currently available.

(vi) Format consistency

Menus shall be presented in a consistent format throughout the system and should be readily available at all times.

(g) Command language

(i) Use

Command language interactive control may be used for tasks involving a wide range of user inputs and where user familiarity with the system can take advantage of the flexibility and speed of the control technique.

(ii) User viewpoint

A command language shall reflect the user's point of view such that the commands are logically related to the user's conception of what is being done.

(iii) Distinctiveness

Command names shall be distinctive from one another.

(iv) Punctuation

The command language shall contain a minimum of punctuation or other special characters.

(v) Abbreviations

The user shall be permitted to enter the full command name or an abbreviation for any command of more than 5 characters.

(vi) Displayed location

Commands shall be entered and displayed in a standard location on the display.

(vii) Command prompts

The user shall be able to request prompts, as necessary, to determine required parameters or available options for an appropriate next command entry.

(viii) Complexity

The command language should be programmed in layers of complexity such that the basic layer will allow the inexperienced user to control a transaction. As this person's skill increases, the command language should allow skipping from basic to more advanced layers to meet the user's current needs.

(ix) Destructive commands

Where a command entry may have destructive consequences, the user shall be required to review and confirm a displayed interpretation of the command before it is executed.

(h) Feedback

(i) Use

Feedback shall be provided which represents status information, confirmation, and verification throughout the interaction.

(ii) Stand-by

When system functioning requires the user to stand-by, WORKING, BUSY, or WAIT messages shall be displayed until user interaction is again possible. Where the delay is likely to exceed 15 seconds, the user should be informed. For delays exceeding 60 seconds, a count-down display shall show delay time remaining.

(iii) Process outcome

When a control process or sequence is completed or aborted by the system, positive indication shall be presented to the user concerning the outcome of the process and the requirements for subsequent user action.

(iv) Input confirmation

Confirmation shall not cause displayed data removal.

(v) Current modes

When multiple modes of operation exist, a means should be provided to remind the user of the current mode.

(vi) Highlighted option selection

When a displayed message or datum is selected as an option or input to the system, the subject item shall be highlighted to indicate acknowledgment by the system.

(vii) User input rejection

If the system rejects a user input, feedback shall be provided to indicate the reason for rejection and the required corrective action. Feedback should be self explanatory.

(viii) Feedback message content

Users shall not be required to translate feedback messages by use of reference system or code sheets. Abbreviations shall not be used unless necessary.

(ix) Time-consuming processes

The system shall give warning information when a command is invoked which will be time consuming or expensive to process.

(i) Prompts

(i) Use

Prompts and help instructions shall be used to explain commands, error messages, system capabilities, display formats, procedures, and sequences and to provide data. Prompting shall conform to the following:

(1) When operating in special modes the system shall display the mode designation and file(s) being processed.

(2) Before processing any user requests which would result in extensive or final changes to existing data, the system shall require user confirmation.

(3) When missing data are detected, the system shall prompt the user.

(4) When data entries or changes will be nullified by an abort action, the user should be requested to confirm the abort.

(5) Neither humour nor admonishment shall be used in structuring messages; the dialogue shall be strictly factual and informative for the user.

(6) Error messages shall appear as close as possible to the user entry that caused the message.

(7) If a user repeats an entry error, the second error message shall be revised to include a noticeable change so that the user may be certain that the computer has processed the attempted correction.

(ii) Standard display

Prompting messages shall be displayed in a standardized area of the displays.

(iii) Explicit prompts

Prompts and help instructions for system controlled dialogue shall be explicit and the user shall not be required to memorize lengthy sequences or refer to secondary written procedural references.

(iv) Prompt clarity

Prompts shall be clear and understandable. They shall not require reference to coding schemes or conventions which may be unfamiliar to occasional users.

(v) Definitions

A dictionary of abbreviations and codes shall be available on-line. Definitions of allowable options and ranges of values should be displayable at the user's request.

(vi) Consistent terminology

On-line documentation, off-line documentation, and help instructions shall use consistent terminology (refer to RS/C6014/12).

(vii) User confirmation

User acceptance of stored data or defaults shall be possible by a single confirming keystroke.

7.6.4 Default

(a) Workload reduction

Default values shall be used to reduce user workload. Currently defined default values should be displayed automatically in their appropriate data fields with the initiation of a data entry transaction and the user shall indicate acceptance of the default.

(b) User selection

The user shall have the option of generating default values based on operational experience if the systems designer cannot predefine appropriate values.

(c) Default substitution

The user shall be able to replace any default value during a given transaction without changing the default definition.

(d) Defaults for sequential entries

Where a series of default values have been defined for a data entry sequence, the user shall be allowed to default all entries or to default until the next required entry. The experienced user may not wish to accept each default value for each data field individually.

7.6.5 Error Management/Data Protection

(a) Error correction

Where users are required to make entries into a system, an easy means shall be provided for correcting erroneous entries. The system shall permit correction of individual errors without requiring re-entry of correctly entered commands or data elements.

(b) Early detection

A capability shall be provided to facilitate detection and correction of errors after keying in, but before entering into the system. While it is

desirable that errors be detected early, error checking shall occur at logical data entry breaks, e.g., at the end of data fields rather than character-by-character, in order to avoid disrupting the user.

(c) Internal software checks

User errors shall be minimized by use of internal software check of user entries for validity of item, sequence of entry, completeness of entry, and range of value.

(d) Critical entries

The system shall require the user to acknowledge critical entries prior to their being implemented by the system. An explicitly labelled CONFIRM function key, different from the ENTER key, should be provided for user confirmation of control and data entries that have been questioned by the computer.

(e) Error message content

Error messages shall be constructive and neutral in tone, avoiding phrases that suggest a judgment of the user's behaviour. The error messages shall reflect the user's view, not that of the programmer. Error messages shall be appropriate to the user's level of training, be as specific as possible to the user's particular application, and describe a way to remedy, recover, or escape from the error situation.

(f) Error recovery and process change

The user shall be able to stop the control process at any point in a sequence as a result of indicated error or as an option. The user shall be able to return easily to previous levels in multi-step processes in order to nullify an error or to effect a desired change.

(g) Diagnostic information

Error messages shall explicitly provide as much diagnostic information and remedial direction as can be inferred reliably from the error condition. Where clear inference is not possible, probable helpful inference(s) may be offered.

(h) Correction entry and confirmation

When the user enters correction of an error, such corrections shall be implemented by an explicit action by the user (e.g., actuation of an

ENTER key.) All error corrections by the user shall be acknowledged by the systems either by indicating a correct entry has been made or by another error message.

(i) Spelling errors

Spelling and other common errors shall not produce valid system commands or initiate transactions different from those intended. When possible, the system shall recognize common misspellings of commands and execute the commands as if spelling had been correct. Computer-corrected commands, values, and spellings shall be displayed and highlighted for user confirmation.

(j) Errors in stacked commands

To prompt for corrections of an error in stacked commands, the system shall display the stacked sequence with the error highlighted. Where possible, a procedure shall be provided to correct the error and salvage the stack.

(k) Display of erroneous entries

A computer-detected error, as well as the error message, shall be continuously displayed until the error is corrected.

(l) Help

In addition to explicit error management aids, (labels, prompts, advisory messages) and implicit aids (cuing), users shall be able to obtain further on-line guidance by requesting HELP. The help messages shall be editable by the maintainer.

7.6.6 Data Security

Data shall be protected from unauthorized use, potential loss from equipment failure, and user errors.

(a) Automated security measures

Automated measures shall be provided to minimize data loss from intruders in a system or from errors by legitimate users.

(b) Warning of threats to security

Computer logic shall be provided that will generate messages and/or alarm signals in order to warn users of attempted intrusion by unauthorized users.

(c) Segregating real from simulated data

When simulated data and system functions are provided (perhaps for user training), real data shall be protected and real system use shall be clearly distinguished from all simulated operations.

(d) Display of simulated data

In applications where either real or simulated data can be displayed, a clear indication of simulated data shall be included as part of the classification label.

(e) Displayed security classification

When displayed data are classified for security purposes, a prominent indication of security classification level shall be labelled in each display.

(f) User identification

User identification procedures shall be as simple as possible, consistent with adequate data protection. For protection of the password, the password shall not be echoed on the display.

(g) Choice of passwords

When passwords are required, users shall be allowed to choose their own passwords since a password chosen by a user will generally be easier for that individual to remember. Guidelines for password selection shall be given so that users will not choose easily guessable ones.

(h) Changing passwords

Users shall be allowed to change passwords whenever they choose; all passwords shall be changed at periodic intervals.

7.6.7 System Response Time

Maximum system response times for real-time systems (e.g., speed control systems) shall not exceed 5 second. Non-real-time systems may permit relaxed response times. If computer response time will exceed 15

seconds, the user shall be given a message indicating that the system is responding.

7.6.8 Functional Integration

Data transmission functions shall be integrated with other information handling functions within a system. A user should be able to transmit data using the same computer system and procedures used for general entry, display and other processing of data.

7.6.9 Consistent Procedures

Procedures for preparing, sending and receiving data and messages shall be consistent from one transaction to another, and consistent with procedures for other information handling tasks.

7.6.10 Minimal Memory Load on Users

The data transmission procedures shall minimize memory load on the users by providing computer aids for automatic insertion of standard information, such as headers and distribution lists.

7.6.11 Interrupt

Users shall be allowed to interrupt message preparation, review, or disposition and then resume any of those tasks from the point of interruption.

7.6.12 Essential Human Computer Interface Development Activities

The equipment development shall involve activities such as HCI requirement analysis, conceptual design and prototyping, user trials and operator workload analysis.

8 Testing Requirements

The testing requirements shall refer to Clause 9.5.4 and 9.5.5 below.

9 System Engineering Management System

9.1 In order to facilitate the operability design development, an Operability Plan (refer to PS 21.2.3) shall be provided according to the requirements specified below.

9.2 The Operability Plan shall be submitted at each stage of SEMP (refer to PS 21.3) to ensure the potential design solutions is able to meet the specified train service, operational, maintenance and training needs.

9.3 Goals and Objectives of Operability Plan

9.3.1 The goals of Operability Plan is to ensure a thorough understanding of the functional relationships between the operational safety and efficiency of operation and control system and the characteristics of the operator as a person, tasks, environments, and technologies; hence to apply the above understanding to:

(a) Enhance system safety by integrating human performance characteristics and technological functions to anticipate (and minimize) the probability and adverse consequences of human or system errors;

(b) Optimize the efficiency of the operation and control system by explicitly assessing and accounting for the capabilities and limitations of the human component.

9.3.2 The objectives of Operability Plan are:

(a) To develop increased knowledge and predictive models of human performance relative to the characteristics of the tasks, environments and technologies in the train operation and control system;

(b) To develop human factor engineering design criteria based on the above knowledge and models.

Note: The human factor engineering design criteria is the summation of available knowledge that defines the nature and limits of human capabilities as they relate to the operation, maintenance or control of systems or equipment, and which may be applied during engineering design to achieve optimum compatibility between equipment and human performance.

9.4 Initial Operability Design

9.4.1 Operability requirements in design shall be derived initially from the operation and control requirements (refer to PS 9), maintenance requirements (refer to PS 26) and training requirement (refer to PS 23).

9.4.2 A description of the system and the mission to be performed shall be provided and constituted in the level 1 design document i.e. the system

requirements document (SRD) (refer to Appendix N Clause 2) as shown in Figure STD14-1.

9.4.3 Based on this SRD, a functional analysis shall be carried out to identify the operator, maintenance and training functions. Individual functions shall be described and expressed in verbal form, such as, acquire, monitor, check, isolate and control. This information shall form part of the basic indication of what needs to occur (in series or in parallel) if the system is to fulfil its mission objective in a satisfactory manner.

9.4.4 Similar to an equipment design which shall be presented in a hierarchical form e.g. subsystem, unit, assembly, subassembly, and component part, it shall also be required to establish a hierarchy of personnel-related activities according to the following contents:

(a) Job operation

Since completion of a job function normally includes a combination of duties and tasks, a job operation shall be determined to identify all related groups of duties and tasks.

(b) Duty

It is defined as a set of related tasks within a given job operation.

(c) Task

It constitutes a composite of related activities performed by an individual in accomplishing a prescribed amount of work in a specified environment.

(d) Subtask

Depending on the complexity of the situation, a task shall be broken down into subtask to cover discrete actions of a limited nature.

(e) Task element

Task element shall be categorized as to the smallest logically definable facet of activity that requires individual behavioral responses in completing a task or a subtask.

9.4.5 The hierarchy outlined above shall constitute a logical division of human activity which serves as a basis in establishing operability requirements.

9.4.6 In addition to the functional analysis result and the basic hierarchy of human activity identified, due consideration shall be given to address the environmental and personnel factors.

9.4.7 The environmental considerations shall comprise of:

(a) all environmental design constraints specified in the GS;
(b) ecological, economical and technological considerations; and
(c) system constraints (such as EMC).

9.4.8 Personnel factors shall comprise of the design factors of:

(a) anthropometric;
(b) human sensory;
(c) physiological; and
(d) psychological.

9.4.9 Within all the design constraints and limits provided, a preliminary system analysis shall be established with the intent of identifying functions/tasks that will be:

(a) accomplished solely by human being;
(b) accomplished automatically by equipment;
(c) accomplished by a combination of the human being and equipment.

9.4.10 All functions shall be evaluated relative to the work required in terms of human capabilities and cost. A trade-off analysis shall be carried out to support the allocation process. This result shall provide the identification of system activities and the allocation of human resources for these activities and record in the level 2 design document i.e. the system specification document (SSD) (refer to Appendix N Clause 2).

9.4.11 The SSD shall specify:

(a) The number of persons required for system operation, maintenance and training. Justification shall be provided.

(b) The personnel job categories and skill levels necessary to perform the designated operation, maintenance and training functions/tasks. Skill level requirements shall be kept to a minimum.

(c) The anthropometric, human sensory, physiological, and psychological parameters that are necessary to facilitate satisfactory human performance in the fulfilment of operation, maintenance and training

functions/tasks. Qualitative and quantitative requirements covering human body dimensions, the environment, and the organization shall be specified as applicable.

9.5 Operability Design Life Cycle

9.5.1 In addition to Clause 9.4 which requires that operability requirements shall be established through a logical breakdown of operation and maintenance functions to the extent feasible during early system design, these operability requirements shall be applied to all stages of the SEMP throughout the operability design life cycle (refer to Figure STD14-2).

9.5.2 SEMP Stage 1

(a) The Contractor shall submit a conceptual design of operability proposal to demonstrate the correct understanding and specification of the user requirements in the context of: the nature of the users, their goals and tasks, and the environment in which the train will be used.

(b) In addition, this conceptual design shall include an explicit construction of the ideas or concepts that an operator needs to learn about what a train is, what it can perform, and how it is intended to be used. It may also address what a train is not, what it cannot perform, and how it is not intended to be used. Conceptual design shall be done from the user's point of view.

(c) In order to facilitate design verification in the SEMP stage 3, a series of qualitative and quantitative targets of operability requirements shall be established at this stage of SEMP.

9.5.3 SEMP Stage 2

(a) The qualitative and quantitative targets provided during SEMP stage 1 shall be allocated to various elements of the system to the extent necessary for design guidance purpose with emphasis on the human element of the system.

(b) The allocation results shall constitute specific parameters to which the system shall be designed.

(c) The context of SEMP stage 2 operability plan shall enable the design team of the Contractor to focus on exactly who is expected to be using the system, for what purpose, and under what circumstances.

(d) Based on the conceptual design, an engineering design proposal shall be produced. In addition, the engineering design proposal shall specify the functional and structural details of how the required operability is implemented.

(e) As a matter of preference, a non-developed product which is a proven design and readily available from the commercial market, shall be used to fulfil the user interface requirements.

(f) The Contractor shall carry out an assessment to identify the risks to the system's overall operational objectives which might arise through the operability design, particularly the human computer interface design.

(g) All feasible engineering design proposal shall be evaluated as part of the iterative system analysis process on the basis of technical performances and man-machine interfaces.

(h) In arriving at a specific recommended approach, the human hierarchy specified in Clause 9.4.4 shall be incorporated to determine the actual personal quantities and skill-level requirements for each engineering design proposal.

(i) As a result of engineering design proposal review, any change from the initial allocation of man-machine requirements shall be implemented through the feedback loop illustrated in Figure STD14-2.

9.5.4 SEMP Stage 3

(a) As the design progresses and data is available, the system analysis shall be re-applied in the form of an ongoing design evaluation process. An error analysis shall also be performed to identify critical activities where operator-induced system failures are likely to occur.

(b) The objective of system analysis at this stage shall be such that the proposed design configuration shall be reviewed from the standpoint of the human being in the system. Any problem areas identified shall initiate design configuration change as required and record according to the requirements of Appendix P - configuration control program.

(c) Towards the end of the SEMP stage 3, prototype equipment shall be developed and tested for the purpose of verifying or demonstrating various system characteristics. All selected hardware and software components of the system shall be verified by actually performing certain operator and maintenance tasks in order to ensure complete human-equipment compatibility.

(d) A feasibility study shall also be carried out by the Contractor to verify the engineering proposals in the context of a comprehensive user study, which shall include:

(i) Scenario-based elicitation of user requirements; and

(ii) Operability assessments - confirmation and refinement of the operability target.

(e) In addition, the Contractor shall produce mock-up and/or prototype of the plausible solutions to validate the design proposal by:

(i) Evaluating the solutions against user requirements;
(ii) Implementation of ergonomic principles and standards; and
(iii) Measure whether operability targets have been achieved.

(f) The above verification of human performance shall be accomplished through a formal personnel test and evaluation program of the Engineer's representatives.

(g) Based on the results of the mock-up, personnel test and evaluation program, a user evaluation report shall be produced by the Contractor to confirm the user-friendliness of the system.

(h) An operability acceptance questionnaire shall be drafted by the Contractor and submitted for Approval. It shall document all the assessment/acceptance activities including demonstrations, prototypes and development rigs for both informal and controlled trials.

(i) The trials may use experts and representative personnel from the user or maintainer of the Engineer. The results of the assessments derived from the use of the questionnaire shall cover the functionally, equipment operability and the performance of the users during agreed scenarios. It may also cover the interoperability between equipments used in close proximity or in relationship to one another.

9.5.5 SEMP Stage 4

(a) The Contractor shall identify and plan the production and installation processes which directly affect quality of the operability performance. As an integral part of the quality system (refer to PS 27), the Contractor shall ensure that the above processes are carried out under controlled conditions.

(b) In order to ensure an effective control of manufacturing quality, the Engineer shall be afforded the right to verify at the Contractor's, subcontractor's and/or supplier's premises that all related products conform to the operability requirements.

(c) The Contractor shall produce a testing plan (refer to PS 22) to ensure that the operability targets can be achieved in the production process

(d) During the later phase of SEMP stage 4, the ongoing system analysis shall constitute manufacturing data collection, updated humanequipment analysis and corrective action as required.

9.5.6 SEMP Stage 5

(a) The Contractor shall produce a test report with complete evidence of conformance of the finished product to the operability targets.

(b) The Contractor shall provide a training plan to ensure the operability targets can be maintained by the user.

TABLE STD14-1 Anthropometric Data for Hong Kong Chinese Adults

				Male		
Anthropometric dimension	**5%ile**	50%ile	95%ile	5%ile	50%ile	**95%ile**
Stature	**1455**	1555	1655	1585	1680	**1775**
Sitting height	**780**	840	900	845	900	**955**
Sitting eye height	**660**	720	780	720	780	**840**
Sitting shoulder height	**510**	560	610	555	605	**655**
Thigh thickness	**105**	130	155	110	135	**160**
Button-knee length	**470**	520	570	505	550	**595**
Buttock-Popliteal length	**385**	435	485	405	450	**495**
Knee height	**410**	455	500	450	495	**540**
Popliteal height	**325**	375	425	365	405	**445**
Shoulder breadth	**335**	385	435	380	425	**470**
Hip breadth	**295**	330	365	300	335	**370**
Foot length	**205**	225	245	235	250	**265**
Forward grip reach	**580**	635	690	640	705	**770**
Hand length	**150**	165	180	165	180	**195**

All dimensions in mm.

Notes:

(a) Anthropometric data sources:

(i) Anthropometric estimates for Hong Kong Chinese adults (age 19-65 years) from Bodyspace, Pheasant S, 1996, Taylor & Francis

(ii) Survey of Chinese industrial workers in Hong Kong, University of Hong Kong

(b) The following shoe corrections shall be used:

(i) + 25 mm for leg height

(ii) + 30 mm for foot length

(c) The ergonomic designs shall take into consideration that 90% of operators are likely to be right handed.

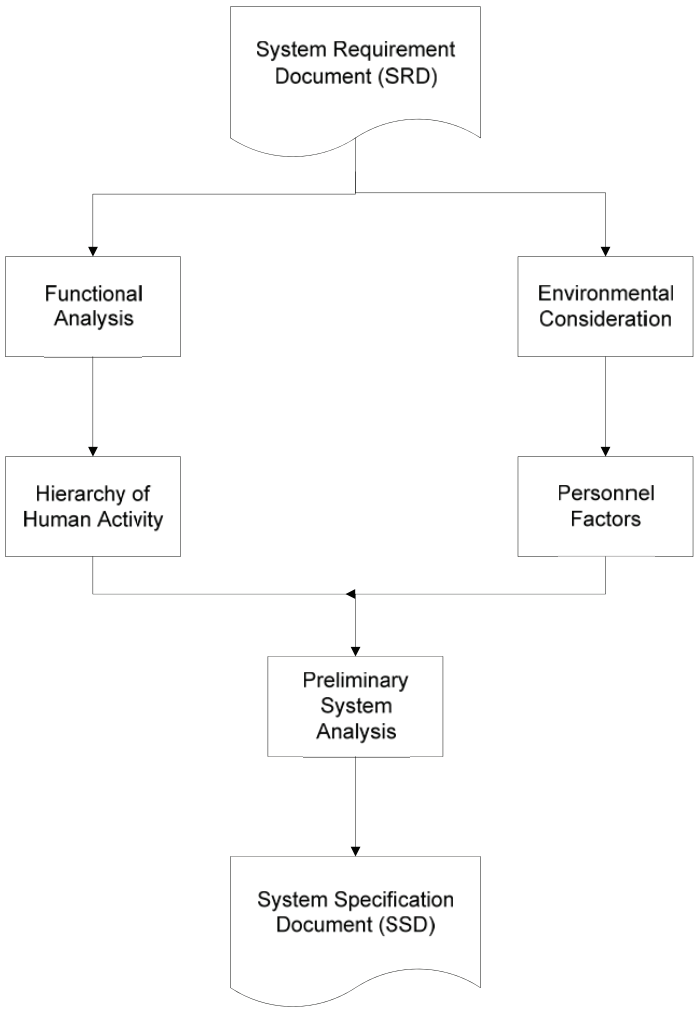


Figure SD14-1 Development of Level 1 and 2 Design Documents with respect to Operability Design

Notes: Detailed explanation of each block shall refer to Clause 9.3 of this Standard.

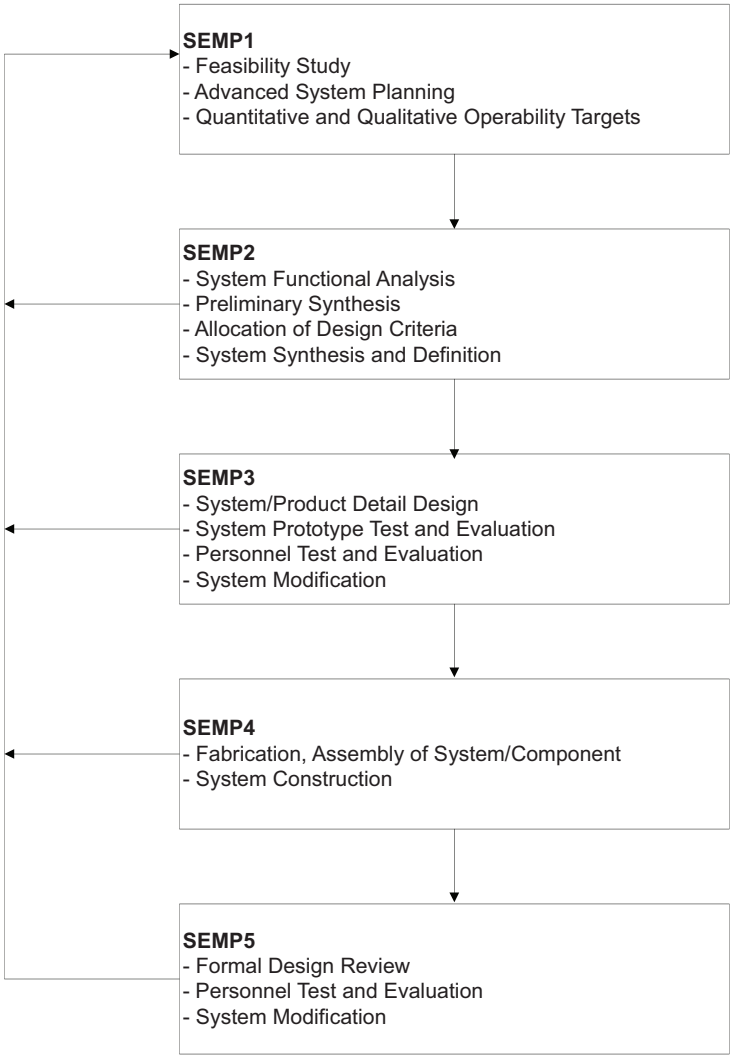


Figure SD14-2 Operability Design Life Cycles

Notes: Detailed explanation of each block shall refer to Clause 9.4 of this Standard.

ROLLING STOCK STANDARD RS/C6014/15
KEYS AND LOCKS

1 Introduction

2 Standards/Reference

3 Definitions / Abbreviations

4 General Requirements

5 Keys and Locks

6 Testing Requirements

7 System Engineering Management System

Figure STD15-1 Locks Design Philosophy

Figure STD15-2 Typical KABA Keys Application

ROLLING STOCK STANDARD RS/C6014/15
KEYS AND LOCKS

1 Introduction

This Standard contains details of standard keys and locks to be used on the trains.

2 Standards/Reference

Not applicable.

3 Definitions / Abbreviations

Not applicable.

4 General Requirements

This Standard specifies the type and detailed requirements of the keys and locks system.

5 Keys and Locks

5.1 A co-ordinated keys and locks system shall be used for the trains.

5.2 The system shall ensure that staff are only allowed to operate or have access to equipment as required in the course of their duties.

5.3 The system shall be designed to allow different levels of access for the staff, for example, the train operator and the maintenance personnel. The levels of access shall be submitted for Approval.

5.4 It shall not be possible for unauthorised staff or passengers to open cubicles or cabinets, or operate equipment, using commonly available tools or implements.

5.5 The keys and locks design shall have male in locks and female in keys as illustrated in Figure STD15-1, while the keys and locks design for Passenger Alarm Emergency Handles (Refer to PS 7.11.4) shall have female in locks and male in keys. The size of the square head shall be 8 mm. The keys provided for resetting the PAEH shall be able to support resetting the PAEH and use for door isolation device on both Urban Lines Train and K Train.

5.6 The Contractor shall submit a schedule of keys and locks, including the requirements as specified in Clause 5.12, 5.13 and 5.14, in accordance with the Configuration Management (refer to PS 21.3.10), specifying the quantity of each type to be supplied and functions of the various types with listing for each type of all cubicles, cabinets and equipment which they will operate.

5.7 The number of different types of keys and locks shall be kept to a minimum.

5.8 Indications shall be provided on locks to show the closed position.

5.9 Keys and locks shall not be able to be broken by normal manual forces.

5.10 Keys and locks shall be designed not to subject to excessive wear such that their ability to continue to function satisfactorily for the life of the train (refer to PS 4.5.5) will be impaired.

5.11 Whenever an approved key is specified in the PS, the key shall form part of the system in accordance with Clause 5.1 and shall be listed as specified in Clause 5.6.

5.12 KABA key level C under master key plan 1636 shall be adopted for maintenance staff access to all equipment. For example, ATP/ATO cubicle, ATP/ ATO relays, event recorder, TMS cubicle and PIS cubicle.

5.13 KABA key level B1 under master key plan 1636 shall be adopted for train operator access to equipment for train operator duties. For example, cab/ saloon partition door, brake isolation cock and hostler cubicle.

5.14 KABA key with key number 6087-0001 shall be adopted for mode selector key switch (refer to PS 9.5.6) and hostler master switch (refer to 9.5.11).

5.15 Typical KABA keys are illustrated in Figure STD15-2.

6 Testing Requirements

6.1 Tests shall be carried out to demonstrate compliance of the requirements as specified in Clause 5.9.

6.2 The Contractor shall submit the testing procedures for Approval.

7 System Engineering Management System

7.1 SEMP Stage 1

The Contractor shall submit a conceptual keys and locks system design to demonstrate correct understanding of the requirements specified in this Standard.

7.2 SEMP Stage 2

The Contractor shall submit a co-ordinated keys and locks system with a schedule of keys and locks in accordance with the Configuration Management.

7.3 SEMP Stage 3

The Contractor shall carry out the tests to verify and validate the strength requirements in accordance with Clause 5.9 before manufacture of panel and equipment case locks.

7.4 SEMP Stage 4

The Contractor shall carry out operational test and inspection with the associate panel or equipment case to check the effectiveness of locking in addition to easy assess.

7.5 SEMP Stage 5

The Contractor shall submit all test results for Approval.

Figure STD15-1: Locks Design Philosophy

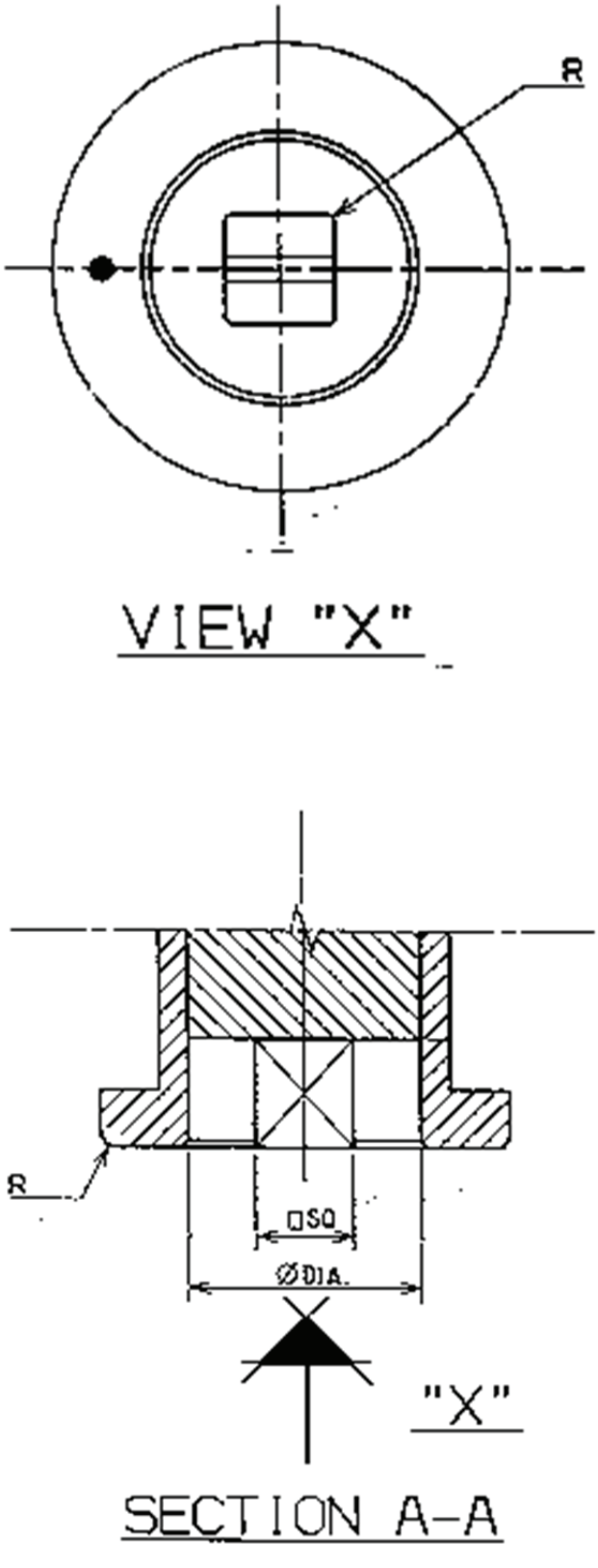
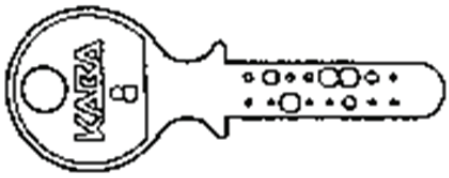
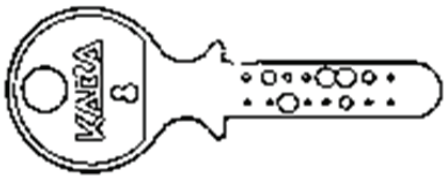


Figure STD15-2: Typical KABA Keys Application

MASTER
CONTROL KEY



ATP KEY



ROLLING STOCK STANDARD RS/C6014/16
LED LIGHTING STANDARD

1 Introduction

2 Standards / Reference

3 Definitions and Abbreviations

4 General Requirements

5 LED Lighting

6 Testing Requirements

7 System Engineering Management System

ROLLING STOCK STANDARD RS/C6014/16
LED LIGHTING STANDARD

1 Introduction

This Standard contains details of standard LED lighting to be used on the trains.

2 Standards / Reference

2.1 The following standards shall apply where appropriate:

Description of Standard	Standard No.
Code of Practice for the Electricity Wiring Regulations issued by EMSD of HKSAR	-
Requirements for electrical installations. IET Wiring Regulations. Seventeenth edition	BS 7671:2008
Railway Applications – Electrical Lighting for Rolling Stock in Public Transport Systems	BS EN 13272:2001
Railway Applications -Electronic Equipment Used on Rolling Stock	BS EN 50155:2007
Limits and method of measurement of radio disturbance characteristics of electrical lighting and similar equipment	BS EN 55015:2006
Degree of Protection of Provided by Enclosures	BS EN 60529:1992
Luminaires – Part 1: General requirements and tests	BS EN 60598-1:2008
Particular requirements – Connectors for LED modules	BS EN 60838-2-2
Low voltage power supplies, d.c. output – Part 3:Electromagnetic compatibility (EMC)	BS EN 61204-3:2001
Particular requirements for DC or AC supplied electronic control gear for LED modules	BS EN 61347-213:2006
Railway Applications – Rolling Stock Equipment – Shock and Vibration Tests	BS EN 61373:2010
Equipment for general lighting purposes – EMC immunity requirements	BS EN 61547:2009
LED modules for general lighting – Safety specifications	BS EN 62031:2008
DC or AC supplied electronic control gear for LED modules – Performance requirements	BS EN 62384:2006
Photobiological safety of lamps and lamp systems	BS EN 62471:2008
Photobiological safety of lamps and lamp systems- Part 2 : Guidance on manufacturing requirements relating to non-laser optical radiation safety	PD IEC / TR 624712:2009

Description of Standard	Standard No.
Approved Method-Electrical and Photometric Measurement of Solid-State Lighting Products	IES LM-79-08
IES Approved Method for Measuring Lumen Maintenance of LED Light Sources	IES LM-80-08
Projecting Long Term Lumen Maintenance of LED Light Sources	IES TM-21-11

2.2 Where equipment complying with other standard are proposed, evidence shall be provided by the Contractor to verify conclusively that the alternative standards proposed are equal to or better than the above standards. Duplicate copies of the alternative standards shall be submitted with the proposal.

2.3 All lighting fittings shall comply with BS 4533 “Specification for general requirements and tests” and BS 5225 “Photometric data for luminaires”. The measurements of the illumination characteristics such as photometric data, intensity, spectral and spatial distribution, colour rendering, etc. of LED luminaires shall be in compliance with the relevant technical reports and recommendations issued by International Commission on Illumination (CIE).

3 Definitions / Abbreviations

Not applicable.

4 General Requirements

4.1 All LED luminaires, control gears and all their accessories provided shall be designed to withstand the maximum stresses under the most severe conditions of service after loss of any corrosion allowance for a lifetime of not less than 50,000hours with the operation pattern of the Employer. The lumen maintenance of the LED shall be not less than 95% and 70% of the initial value after 10,000 and 50,000 operating hours respectively. All control gears and other accessories shall have a design life of at least 25 years.

4.2 The Contractor shall provide evidence that LED chipset manufacturer has the patent right to produce the supplied LED chipsets to avoid infringement of white LED patent. The Contractor shall provide evidence (s), e.g. Certificate of Conformance and letter, to confirm all LED chipsets supplied from the Contractor and chipset manufacturer without mixing any other brands, sub-quality or re-used chipsets by the above Contractor and chipset manufacturer.

4.3 The noise level of all equipment energised for normal service shall not exceed an equivalent continuous sound pressure level of 50 dB (A) at 1 metre away from the equipment.

4.4 All electronic products shall fulfil and comply with the RoHS requirement.

5 LED Lighting

5.1 LED Luminaires

5.1.1 The LED luminaires and control gears shall function at the rated level under the following ambient condition:

(a)	Operating ambient temperature:	0ºC to 40 ºC
(b)	Relative humidity:	up to 98%
(c)	Storage temperature:	-25 ºC to +70 ºC

There will be considerable moisture content in the air throughout the system and the atmosphere will be salt-laden and corrosive. All equipment shall be tropicalized and vermin proof.

5.1.2 Power factor of each LED luminaire shall be 0.9 or above.

5.1.3 Each fitting shall be suitably equipped with its own over-current protection.

5.1.4 Circuit cables shall not be routed through fittings where the cables would be liable to undue temperature rise. All wiring within the light fitting shall be silicone rubber insulated heat resistant cables. All cables shall comply with the requirements of RS/C6014/06.

5.1.5 All components within the luminaires shall preferably be of the same manufacturer to ensure compatibility. All similar items of equipment shall be interchangeable.

5.1.6 MTBF of the control gears shall be minimum 350,000 hours. Test and calculation shall be performed to demonstrate the compliance in accordance with MIL Handbook 217F assuming the ambient temperature and relative humidity are 40°C and 98% respectively.

5.1.7 No force ventilation such as electric fan shall be employed for cooling of LED luminaires and control gears. The luminaires shall have an integrated thermal convection system such that the p-n junction temperature of the LED chipsets shall be less than 80ºC at 30ºC ambient. Laboratory test report to confirm compliance shall be submitted to the Engineer for Approval.

5.1.8 The surface temperature of the luminaires shall not exceed 25ºC temperature rise over 40ºC ambient. The temperature rise due to the heat generated by operation of LED luminaires at steady state shall be within the temperature limits as specified by the manufacturer of the LED modules. Laboratory test report to confirm compliance shall be submitted to the Engineer for Approval.

5.1.9 LED light output shall not cause any hazardous to human eyes in compliance with the requirements of BS EN 62471 and PD IEC/ TR 62471-2. Light output shall be evenly spread on the light diffuser without any light or dark spot/ strip. And flickering shall not be allowed.

5.1.10 Any LED chipset shall not be shut off by any faulty LED chipset in the serial circuit.

5.1.11 Soldering connections of all electronic modules including LEDs, PCBs, heat sinks ,control gears, etc. shall be lead free and comply with the RoHS requirement.

5.1.12 The connections of whole assembly including the LEDs, PCBs, heat sinks, control gears, etc. shall be sufficiently robust and maintain good electrical contacts when subject to vibration in rolling stocks.

5.1.13 Light output shall be evenly spread on the diffuser without any light or dark spot/strip.

5.1.14 An adjustable dip switch with settings of 85%, 100%, 115% and 130% shall be equipped at accessible location of each LED luminaire or control gear to increase driving power for the LEDs. The increased power shall not shorten LED's service life of 50,000 hours. In the first installation, the dip switch shall be preset at 100%.

5.2 Electronic Control Gears

5.2.1 Control gears shall be separated from its corresponding LED lamp and external to the LED luminary assembly.

5.2.2 Control gears shall be electronic switch-mode converter with best sound rating, and the sound rating indicated on the control gears. Control gears found to be unduly noisy shall be replaced without charge.

5.2.3 The control gear shall utilise the latest technology in high current switching transistors and reliable integrated circuits to achieve high efficiency and reliability, and to cope with non-linear loads.

5.2.4 Control gears shall be constant current output type. The current feeding each LED circuit shall be limited to the range of 100% to 110% of the nominal current under all circumstances, including the situation when a number of LED chipsets in the load circuit fail.

5.2.5 The current feeding each LED chipset shall be within the current limit specified by the LED chipset manufacturer.

5.2.6 Energy efficiency of control gear shall be 85% minimum.

5.2.7 Control gears and LED luminaires shall not produce excessive harmonics and shall comply with EN50121-3-2; EN 50155; RS Standard RS/C6014/02 and RS/C6014/03. The design of the equipment shall take account of inrush currents which may occur at the time of switch-on, so that protective devices do not trip and no damage occurs.

5.2.8 Control gear case temperature shall not exceed 25ºC temperature rise over 40ºC ambient.

5.2.9 Control gear shall withstand switching transients without damage due to normal operation and changeover during power interruption. Adequate short circuit and over-current protection devices shall be provided at the input and output of each control gear.

5.2.10 Control gear and wiring assemblies shall be designed to prevent the ingress of water moisture.

5.2.11 Cables interconnecting components shall be heat resisting cables and shall be neatly secured within the fittings to prevent undue looseness and contact with control gear.

5.2.12 Where wiring passes through the edge of any metal section of the fitting, it shall be protected by an Approved grommet. All connections of wires to terminals shall be of Approved types. All wirings shall be concealed from view with the luminary installed.

5.2.13 Each control gear shall be equipped with its over-current protection either using fuse or MCB which can be replaced or re-set externally.

5.2.14 Each control gear shall have identification marking with information to indicate the manufacturer, date of manufacture, serial no., operating voltage, compiled standard, date of maintenance and etc.

6 Testing Requirements

6.1 Tests shall be arranged to comply with the appropriate EN, IEC or BS Standards. Where no reference can be obtained from any relevant EN, IEC or BS Standards for a particular test called for in this clause, the Contractor shall propose and submit the method of test to the Engineer for Approval.

6.2 Accelerated Reliability Tests

6.2.1 The Contractor shall conduct an accelerated reliability test on prototypes to simulate the train operating environment. The test on the prototypes shall employ high stress test methods (e.g. high temperature, high humidity, shock and vibration ,switching transient, voltage variation during train acceleration and deceleration ,and other as appropriate) to shorten the life of LED lamps, their control gears and accessories or quicken the degradation of the product's

performance. Obtaining the test data, the Contractor shall then analyse and estimate the product's life and performance under normal operating conditions.

6.3 The Contractor shall demonstrate by test to prove the electrical characteristic fulfilling the performance requirements of the Standard, and ensure no mal-tripping of MCB / fuse caused by in-rush current.

6.4 Type Tests

6.4.1 Type tests are those tests as specified in Clause 2 which are performed on the first, or subsequent if agreed, equipment or material, carried out in accredited laboratories which have mutual recognition with agreement/ arrangement with HOKLAS/ HKCAS.

6.4.2 If the same type tests have been conducted for the same type and rating of the equipment or materials to be supplied under the Contract, no additional type tests will be required. However, copy of the type test certificates shall be produced for inspection and Approval by the Engineer.

6.5 Routine Tests

6.5.1 Routine tests are defined as those tests which are performed on all equipment or materials in their place of manufacture.

6.5.2 All equipment or materials supplied under the Contract shall undergo the routine tests in accordance with the relevant BS Standards or IEC Recommendations.

6.6 Burnt-in Tests

6.6.1 Prior to delivery, each LED luminary and the associated control gear shall be subject to minimum 48 hours burnt-in test and reach at 40ºC to ensure satisfactory operation. Number of failure units shall be summarised and report to the Engineer before delivery.

6.7 LV Power and Control Cables

6.7.1 The following site tests shall be included:

(a) Continuity and phase/ core identification check for each core.
(b) Continuity test for cable.
(c) Insulation resistance test.
(d) DC high voltage test.

6.7.2 Insulation test on control cables:

(a) Disconnect all associated electronic devices (if any).
(b) Check the insulation resistance of each completed control cable

with a 500V Megger between conductors. The insulation resistance should be not less than 1Mega Ohm.

6.8 LED Lighting System

6.8.1 The following site tests shall be included:

6.8.2 Operation test including ON/OFF switching, emergency power backup, etc.

6.8.3 Voltage, current, power consumption and power factor measurements.

6.8.4 Cable insulation resistance test.

6.8.5 Verification of overall protection and control operations.

6.8.6 Surface temperature of LED luminaires, control gears and ambient temperature.

6.8.7 Illumination levels under normal and emergency power operations.

7 System Engineering Management System

7.1 The LED lighting system shall follow the overall design development of the car Interior according to the System Engineering Management System (SEMS).

7.1.1 Material specification submission for LEDs, PCBs, heat-sinks, control gears, cables, joints, terminations, accessories including the information of input voltages, current, output characteristics, dimensions, technical particulars, drawings, catalogues, etc.

7.1.2 Test record and calculation issued by LED chipset manufacturer and control gear manufacturers to show that the LED and the control gears supplied shall have minimum service life of 50,000 hours with lumen maintenance better than 95 % and 70 % of the initial value after 10,000 and 50,000 operating hours respectively. The MTBF of the control gears shall be 350,000 hours.

7.1.3 Type test certificates for the equipment specified in this Standard.

7.1.4 Design calculation and simulation for LED lighting including photometric data, LED junction temperature and hot spot of the whole lighting assembly and illumination level of the lighting system to prove, to the satisfaction of the Engineer, that the lighting equipment offered is electrically sound for its intended purpose.

7.1.5 Catalogues and job references for lighting and thermal simulation software as stated in item 7.1.4.

7.1.6 CVs of the personnel who undertakes the lighting and thermal simulation so as to demonstrate his/ her competency.

7.1.7 Location specific layout drawings of equipment including operating and maintenance space details.

7.1.8 Design drawings including general layout, system schematic, protection and control arrangement, etc.

7.1.9 Detailed general arrangement drawings for each LED lighting assembly and control gear showing all installation details and interfaces.

7.2 Fabrication/ Shop Drawings for each type of equipment shall be Approved in Principle before manufacturing or construction of the equipment commences. Fabrication/ Shop drawings shall clearly show the fabrication, construction, assembly and fixing arrangements of each element of the equipment which is to be manufactured, constructed and assembled.

MTR CORPORATION LIMITED

CONTRACT C6014-14E

PROCUREMENT OF NEW TRAINS

Particular Specification

Volume 4 of 4

August 2015

MTR CORPORATION LIMITED

CONTRACT C6014-14E

PROCUREMENT OF NEW TRAINS

PARTICULAR SPECIFICATION

WORKING DOCUMENT

VOLUME 4 OF 4

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C6014-14E PARTICULAR SPECIFICATION DRAWINGS

GENERAL

COUPLING ARRANGEMENT

TRAIN EXTERIOR DESIGN

CAB INTERIOR DESIGN

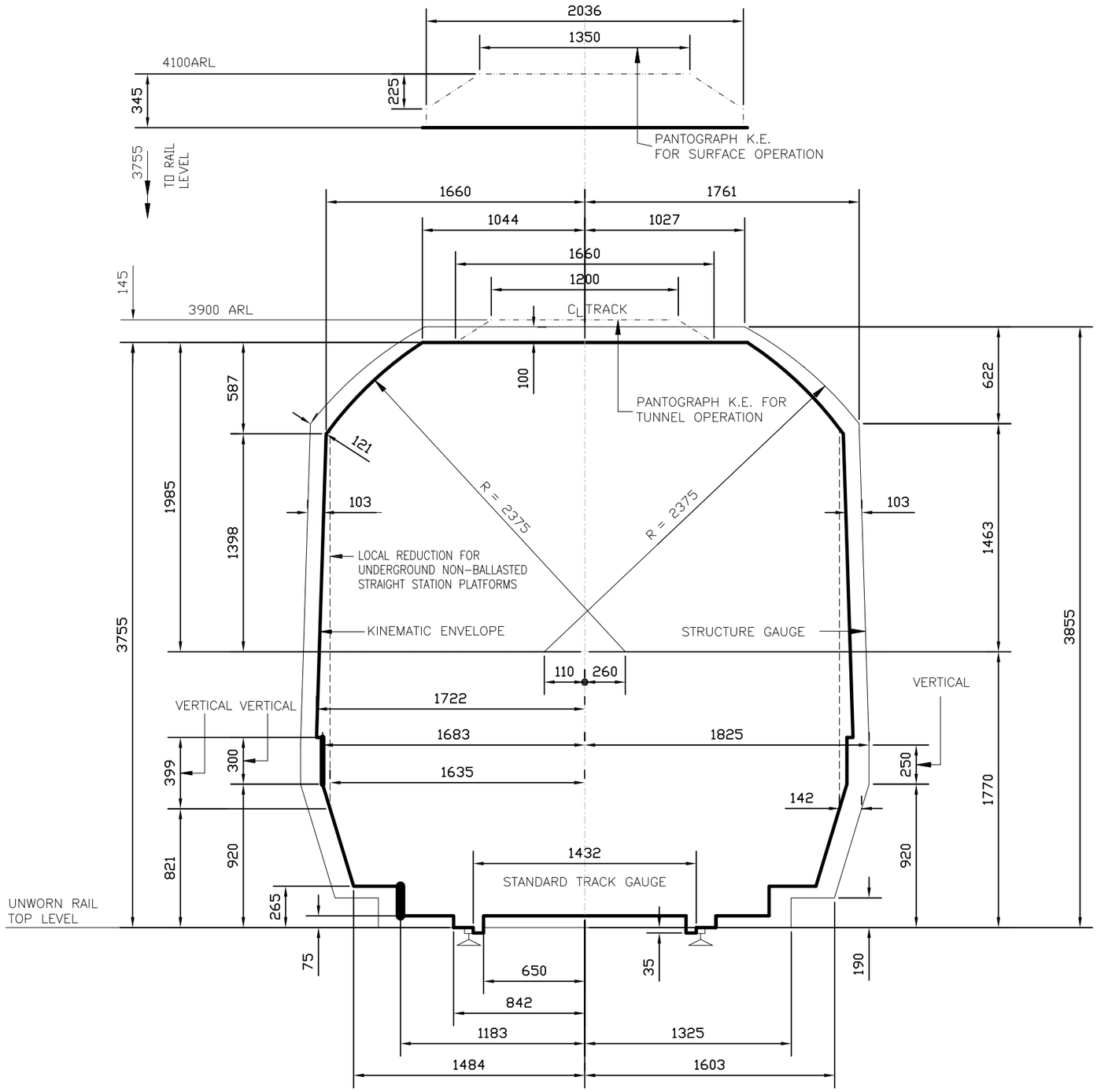
SALOON INTERIOR DESIGN

INTERFACE

DEPOT

TRACK DATA

GENERAL		
Drawing No.	**Title**	**Revision**
C6014-14E/TSEG/010/001	Kinematic Envelope and Structure Gauge	A
C6014-14E/TSEG/010/002	Kinematic Envelope in Depot Maintenance Tracks	A
C6014-14E/TSEG/010/003	Rolling Stock Wheel Tread Profile (P8 Modified)	A
C6014-14E/TSEG/010/004	Track Irregularities	A
C6014-14E/TSEG/010/005	Definition of Vehicle on Track Twist	A
C6014-14E/TSEG/010/006	Vehicle Ride - Acceleration Weighting Characteristic	A
C6014-14E/TSEG/010/007	Explanation of Train Speed Profile w.r.t. Change of Speed Code	A
C6014-14E/TSEG/010/008	Cable Ratings	A
C6014-14E/TSEG/010/009	Train Consist and Car Numbering	A
C6014-14E/TSEG/010/010	Bogie, Axle and Wheel Numbering	A
C6014-14E/TSEG/010/011	Doors and Passenger Alarm Layout and Numbering	A
C6014-14E/TSEG/010/012	General Arrangement of Existing M Train	A
C6014-14E/TSEG/010/013	General Arrangement of Cab and Non-cab End Vehicles	A
C6014-14E/TSEG/010/014	Carbody Contour	A
C6014-14E/TSEG/010/015	In-Saloon CCTV Camera Layout and Numbering	A
C6014-14E/TSEG/010/016	Not used	-
C6014-14E/TSEG/010/017	Train Configuration Arrangement	A



NOTE :

1. THE KINEMATIC ENVELOPE IS THE PROFILE RELATED TO THE NORMAL CO-ORDINATED AXES OF THE TRACK OUTSIDE WHICH NO PART OF ANY VEHICLE, EXCEPT FOR THE PANTOGRAPH IN ITS OPERATING POSITION, MAY PROTRUDE UNDER THE MOST UNFAVOURABLE CONDITIONS OF VEHICLE RUNNING AND TAKING INTO ACCOUNT THE MOST ADVERSE COMBINATION OF VEHICLE AND TRACK MAINTENANCE TOLERANCES AS DEFINED IN THE APPROPRIATE SPECIFICATION.

2. THE STRUCTURE GAUGE IS THE PROFILE RELATED TO THE CO-ORDINATED AXES OF THE TRACK INTO WHICH NO PART OF ANY STRUCTURE OR FIXED EQUIPMENT MAY PENETRATE.

3. THE DIMENSION OF THE KINEMATIC ENVELOPE AND STRUCTURE GAUGE REFER TO STRAIGHT AND LEVEL UNCANTED TRACK. ON HORIZONTAL AND VERTICAL CURVES ALLOWANCES MUST BE MADE IN THE LOCATION OF FIXED EQUIPMENT AND STRUCTURES FOR THE THROW OF VEHICLES AND CANTING OF THE TRACK. BOTH HORIZONTAL AND VERTICAL VEHICLE THROW ALLOWANCES SHOULD BE CALCULATED FROM THE FORMULA :

$$\text{THROW (mm)} = \frac{30500}{\text{CURVE RADIUS (m)}}$$

TO ESTABLISH THE EFFECT OF TRACK CANT REFER TO THE GAUGES AND CLEARANCES STANDARD. PORTIONS OF THE KINEMATIC ENVELOPE WHICH ARE NOT MORE THAN 75mm ABOVE THE RAIL ARE NOT SUBJECT TO ALLOWANCES FOR VEHICLE THROW.

4. THE STRUCTURE GAUGE DOES NOT DEFINE THE MINIMUM PROFILE OF THE CIVIL STRUCTURE. THIS CAN ONLY BE DETERMINED AFTER FIRST ALLOWING SUFFICIENT SPACE OUTSIDE THE STRUCTURE GAUGE AS IS REQUIRED TO ACCOMMODATE E&M CABLES AND PLANT ALSO THE PERMANENT WAY AND ITS SUPPORT SYSTEM FOR GUIDANCE ON THE APPLICATION OF THE VARIOUS ALLOWANCES WHICH HAVE TO BE MADE OUTSIDE THE STRUCTURE GAUGE. REFERENCE SHOULD BE MADE TO THE GAUGES AND CLEARANCES STANDARD.

5. THE MINIMUM CONTRACT WIRE HEIGHT IS 3900mm.
   THE MINIMUM STATIC CLEARANCE BETWEEN LIVE PART OF OHL EQUIPMENT & KINEMATIC ENVELOPE SHALL BE 115mm.

6. TRACK CENTRE LINE TO PLATFORM COPING STONE:
   UNDERGROUND NON-BALLASTED STRAIGHT STATION 1,645 + 5mm − 0mm

7. ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_010_001_A.DWG

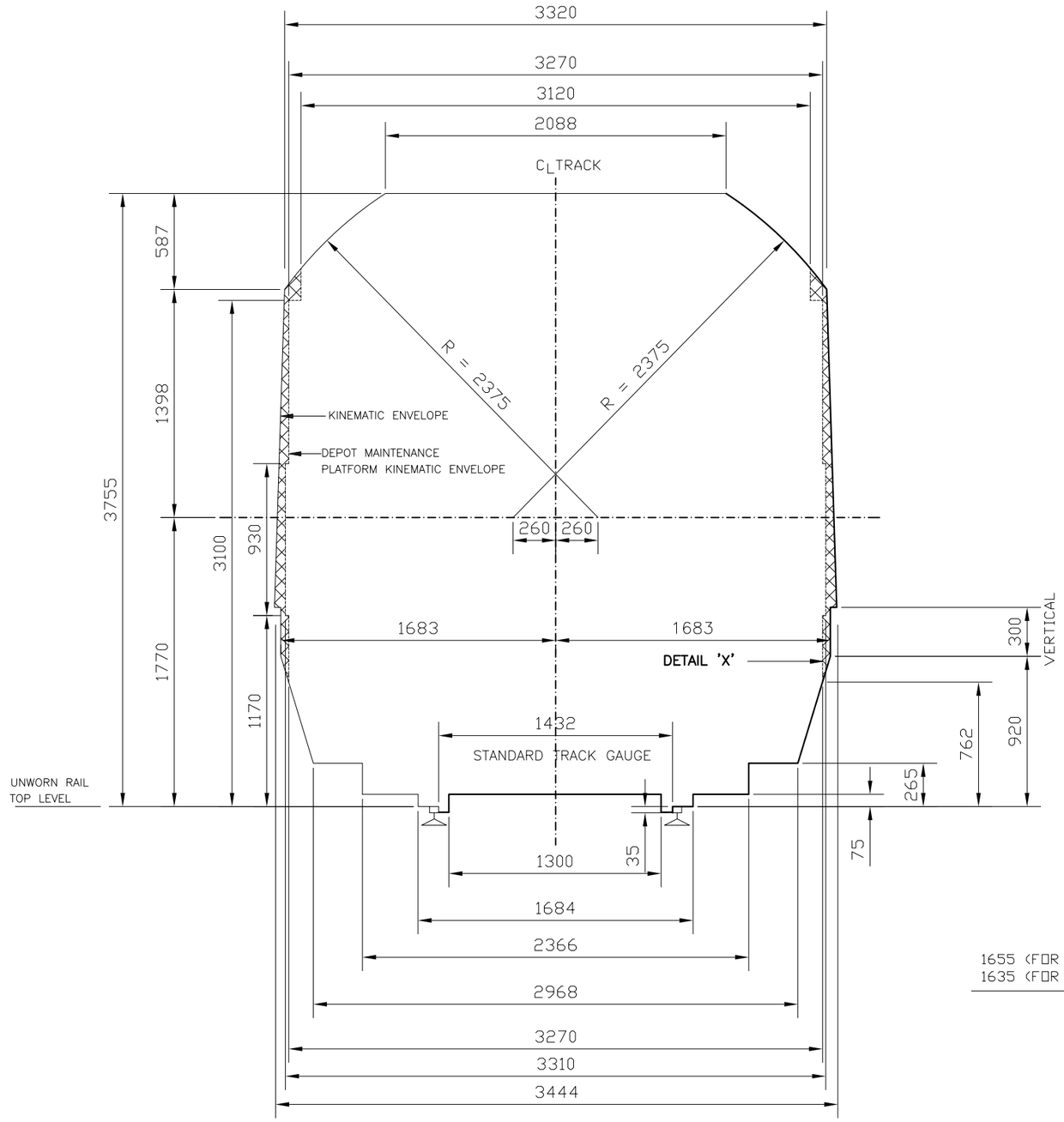
TITLE

C6014-14E

PROCUREMENT OF NEW TRAINS

KINEMATIC ENVELOPE AND STRUCTURE GAUGE

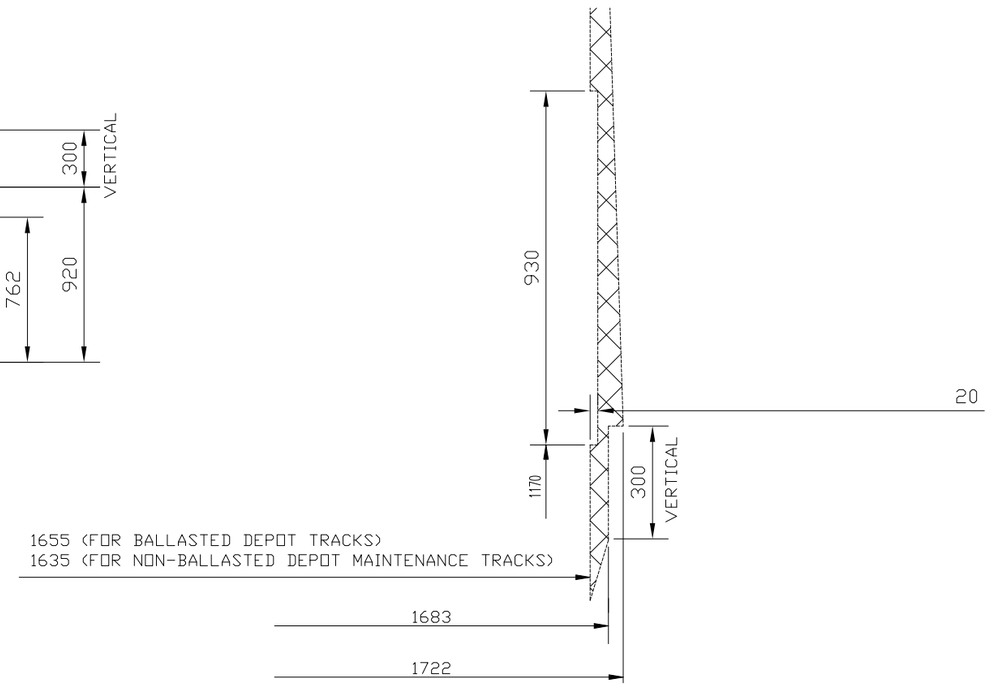
SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/010/001	A



DEPOT MAINTENANCE PLATFORM KINEMATIC ENVELOPE

NOTE :

1. THE DEPOT MAINTENANCE PLATFORM KINEMATIC ENVELOPE IS THE PROFILE RELATED TO THE NORMAL CO-ORDINATED AXES OF THE TRACK OUTSIDE WHICH NO PART OF ANY VEHICLE, EXCEPT FOR THE PANTOGRAPH IN ITS OPERATING POSITION, MAY PROTRUDE UNDER THE MOST UNFAVOURABLE CONDITIONS OF VEHICLE RUNNING AT THE DEPOT MAINTENANCE TRACKS AND TAKING INTO ACCOUNT THE MOST ADVERSE COMBINATION OF VEHICLE AND TRACK MAINTENANCE TOLERANCES AS DEFINED IN MTRC TRAIN SERVICES GROUP DESIGN STANDARD.
2. THE DIMENSION OF THE DEPOT MAINTENANCE PLATFORM KINEMATIC ENVELOPE REFER TO STRAIGHT AND LEVEL UNCANTED TRACK. ON HORIZONTAL AND VERTICAL CURVES ALLOWANCES MUST BE MADE IN THE LOCATION OF FIXED EQUIPMENT AND STRUCTURES FOR THE THROW OF VEHICLES AND CANTING OF THE TRACK.
3. FOR DEFINITION OF DEPOT MAINTENANCE PLATFORM KINEMATIC ENVELOPE AND REQUIREMENTS FOR CHECKING VEHICLE COMPLIANCE REFER TO THE CURRENT ISSUE OF MTRC TRAIN SERVICES GROUP DESIGN STANDARD.
4. THE MINIMUM CONTACT WIRE HEIGHT IS 3900mm. THE MINIMUM STATIC CLEARANCE BETWEEN LIVE PART OF OHL EQUIPMENT & KE SHALL BE 115mm.
5. ALL DIMENSIONS IN MILLIMETRES



DETAIL 'X'

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_010_002_A.DWG

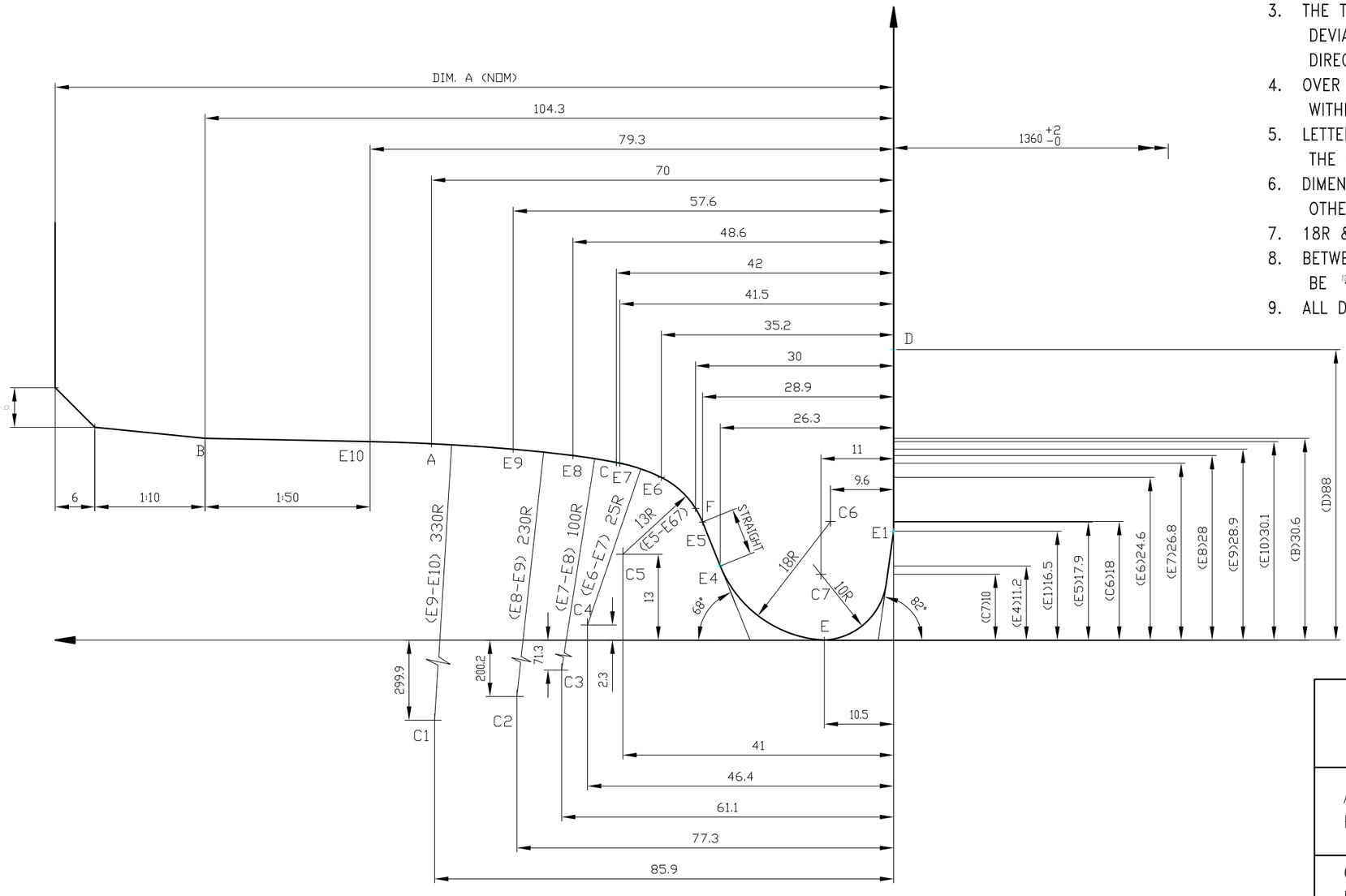
TITLE

C6014-14E
PROCUREMENT OF NEW TRAINS
KINEMATIC ENVELOPE
IN DEPOT MAINTENANCE TRACKS

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/010/002	A

NOTES:

1. DIAMETERS ARE TO BE MEASURED AT POINT 'A'.
2. GAUGING POINT 'C' IS NOT A POINT AT WHICH CURVES ETC. ARE JOINED.
3. THE TYRE PROFILE BETWEEN B & C MUST NOT DEVIATE BY MORE THAN 0.1 IN THE RADIAL DIRECTION FROM THE NOMINAL REQUIREMENTS.
4. OVER SECTION 'C'–'D' THE PROFILE SHALL BE WITHIN 0.25 OF THE NOMINAL.
5. LETTER IN BRACKET INDICATES THE POINT THAT THE DIMENSION REFERS TO.
6. DIMENSIONS TO BE WITHIN +/– 0.25 UNLESS OTHERWISE STATED.
7. 18R & 10R INTERSECT AT POINT 'E'.
8. BETWEEN POINTS 'D' & 'F' SURFACE TEXTURE TO BE 12.5 (CLA) MICROMETERS. (B.S.1134).
9. ALL DIMENSIONS IN MILLIMETRES



VEHICLES	DIM. A (mm)
ALL PASSENGER ROLLING STOCK	127
CASH WAGONS BATTERY LOCOMOTIVES RGU	135

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_010_003_A.DWG

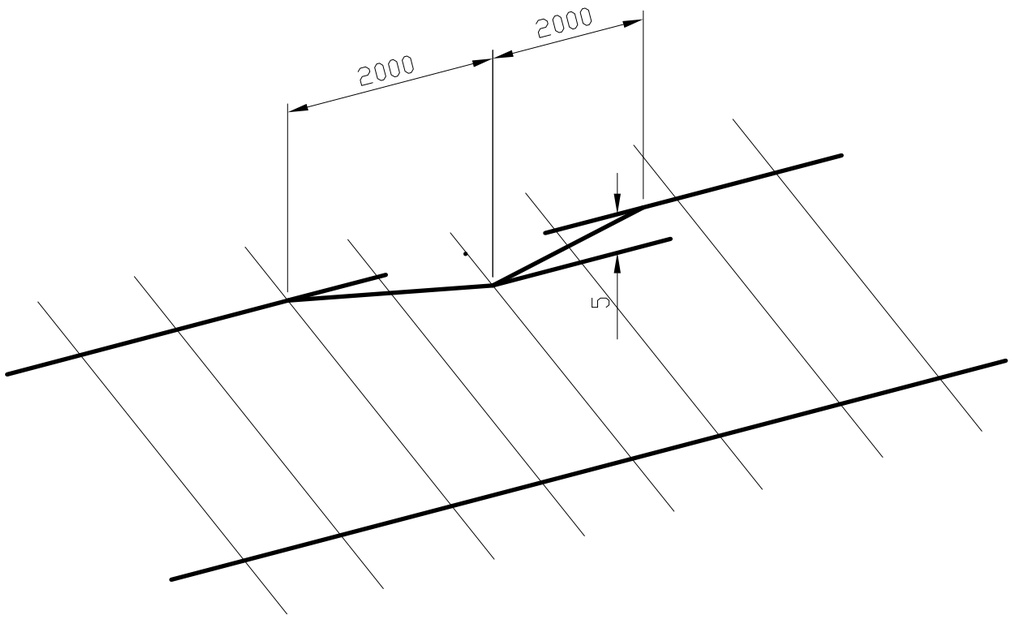
TITLE

C6014-14E

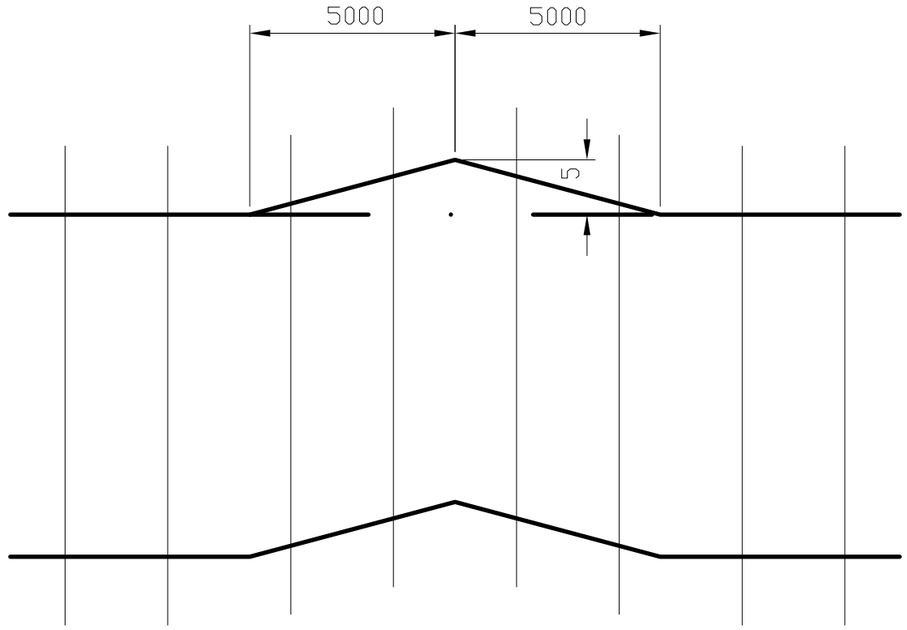
PROCUREMENT OF NEW TRAINS

ROLLING STOCK WHEEL TREAD PROFILE (P8 MODIFIED)

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/010/003	A



TRACK TWIST IRREGULARITY



LATERAL TRACK IRREGULARITY

NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_010_004_A.DWG

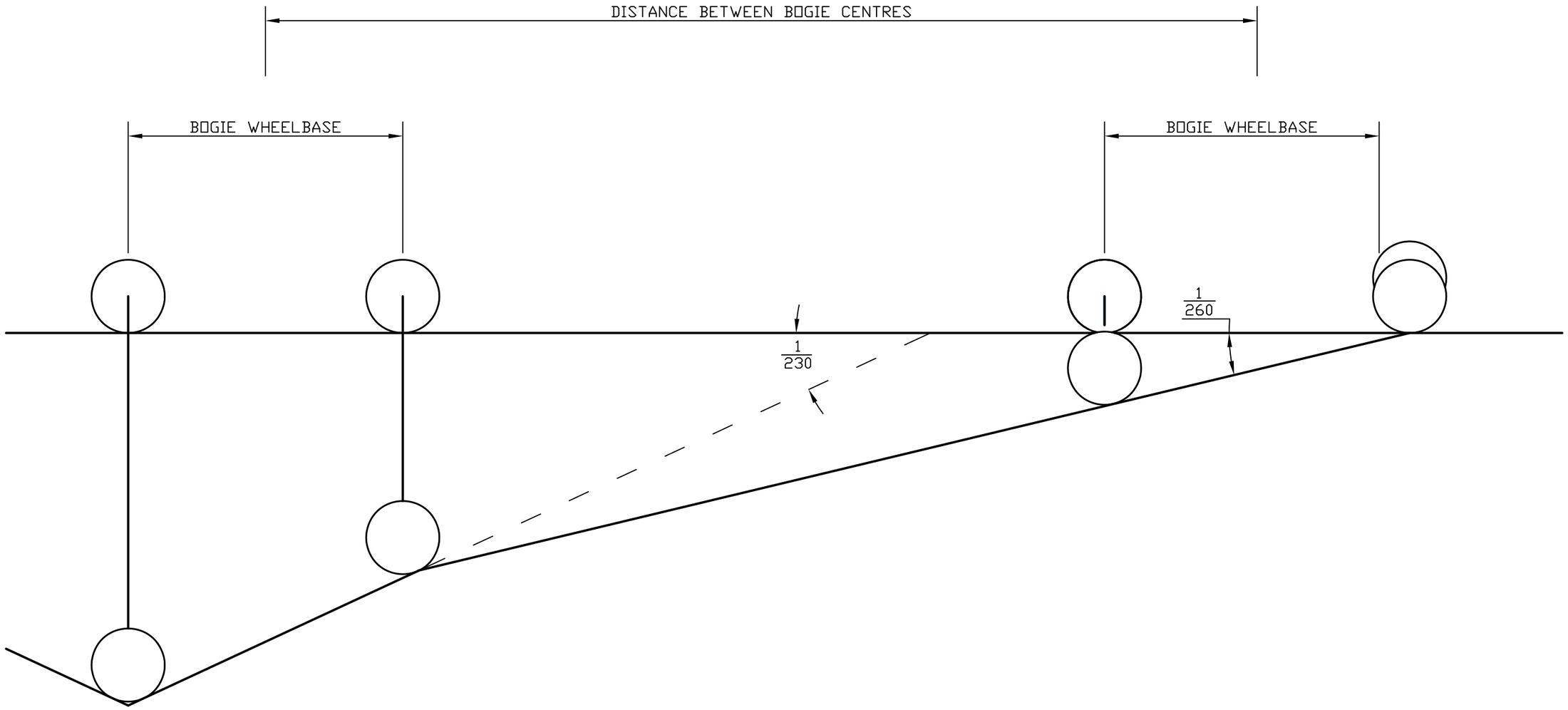
TITLE

C6014-14E

PROCUREMENT OF NEW TRAINS

TRACK IRREGULARITIES

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/010/004	A



NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_010_005_A.DWG

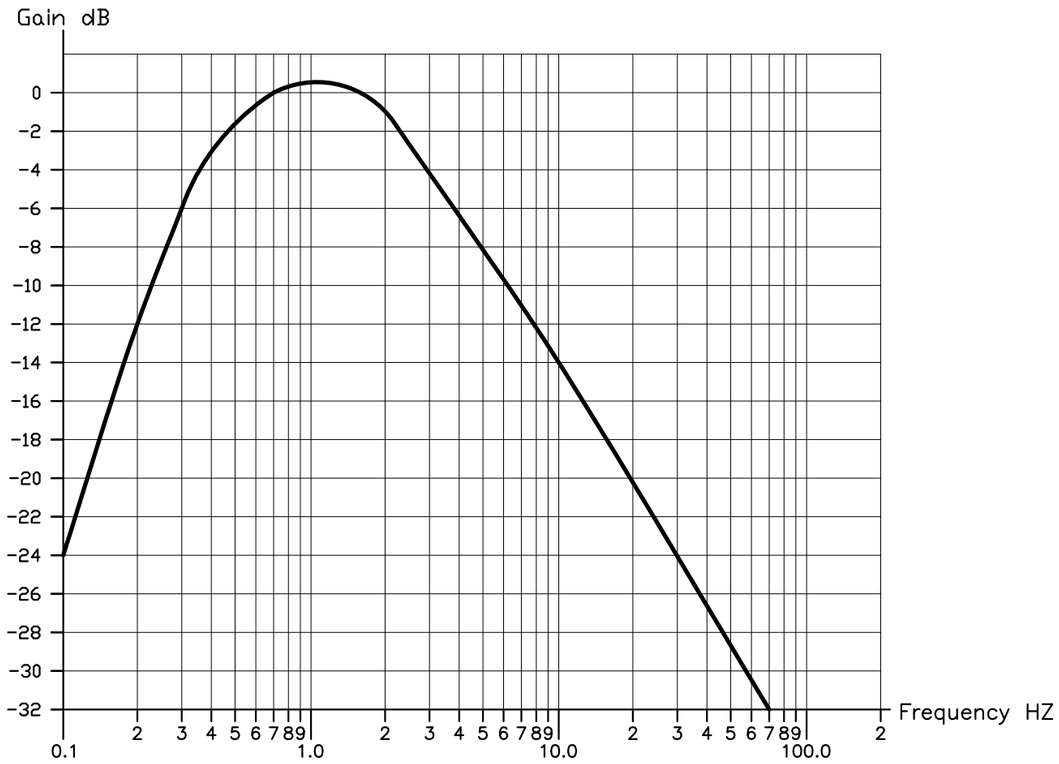
TITLE

C6014-14E

PROCUREMENT OF NEW TRAINS

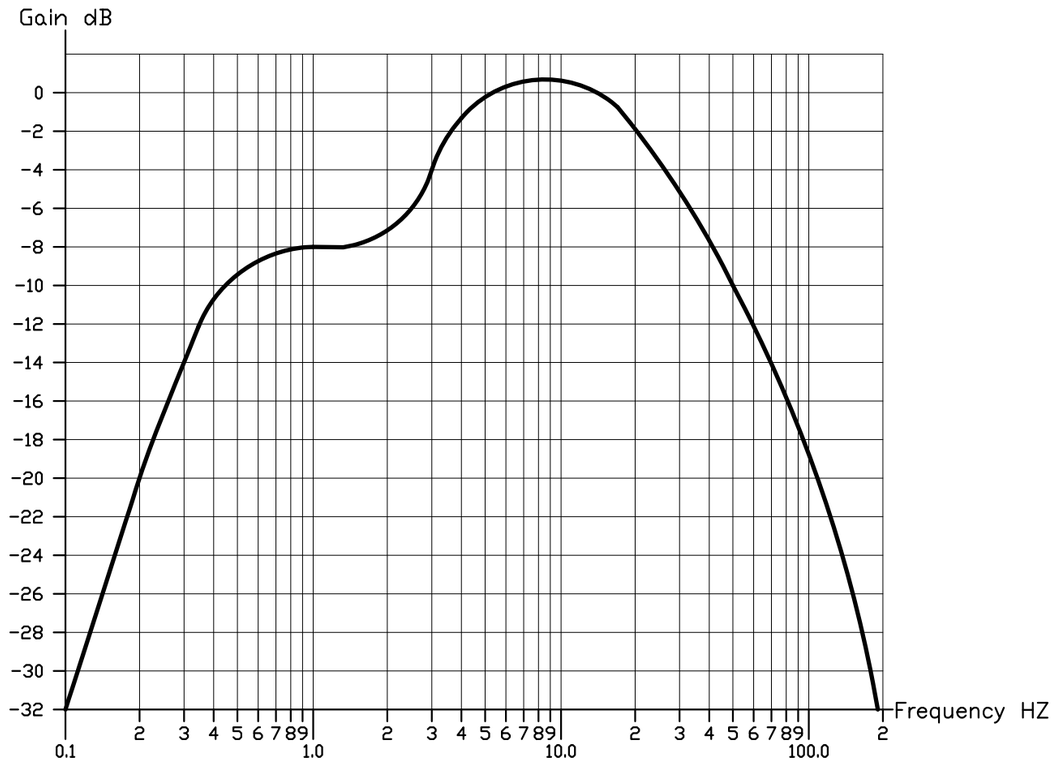
DEFINITION OF VEHICLE ON TRACK TWIST

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/010/005	A



LATERAL ACCELERATION WEIGHTING CHARACTERISIC

ISO 2631 DRAFT 5



VERTICAL ACCELERATION WEIGHTING CHARACTERISIC

ISO 2631 DRAFT 5

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_010_006_A.DWG

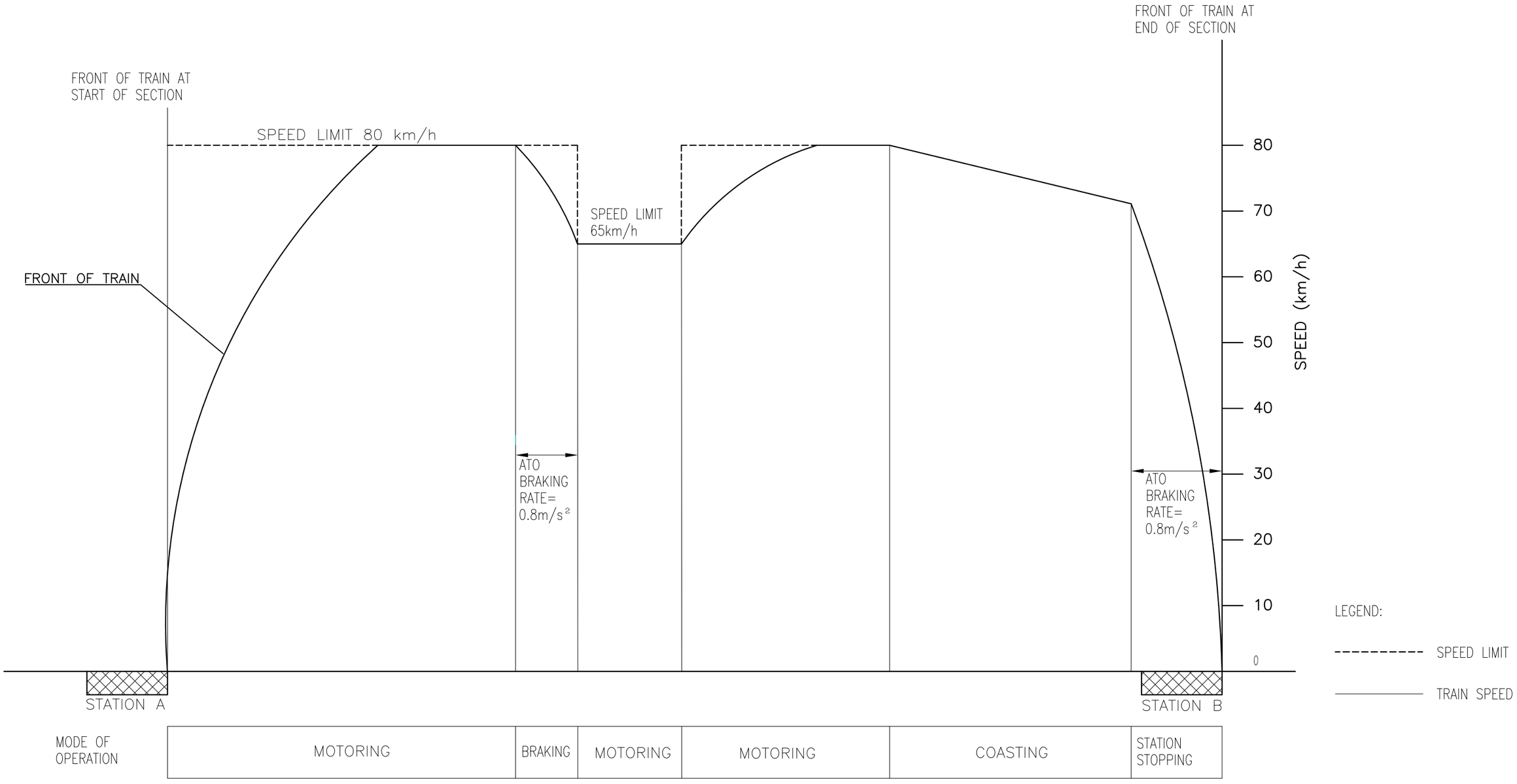
TITLE

C6014-14E

PROCUREMENT OF NEW TRAINS

VEHICLE RIDE – ACCELERATION WEIGHTING CHARACTERISTIC

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/010/006	A



REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_010_007_A.DWG

TITLE

C6014-14E

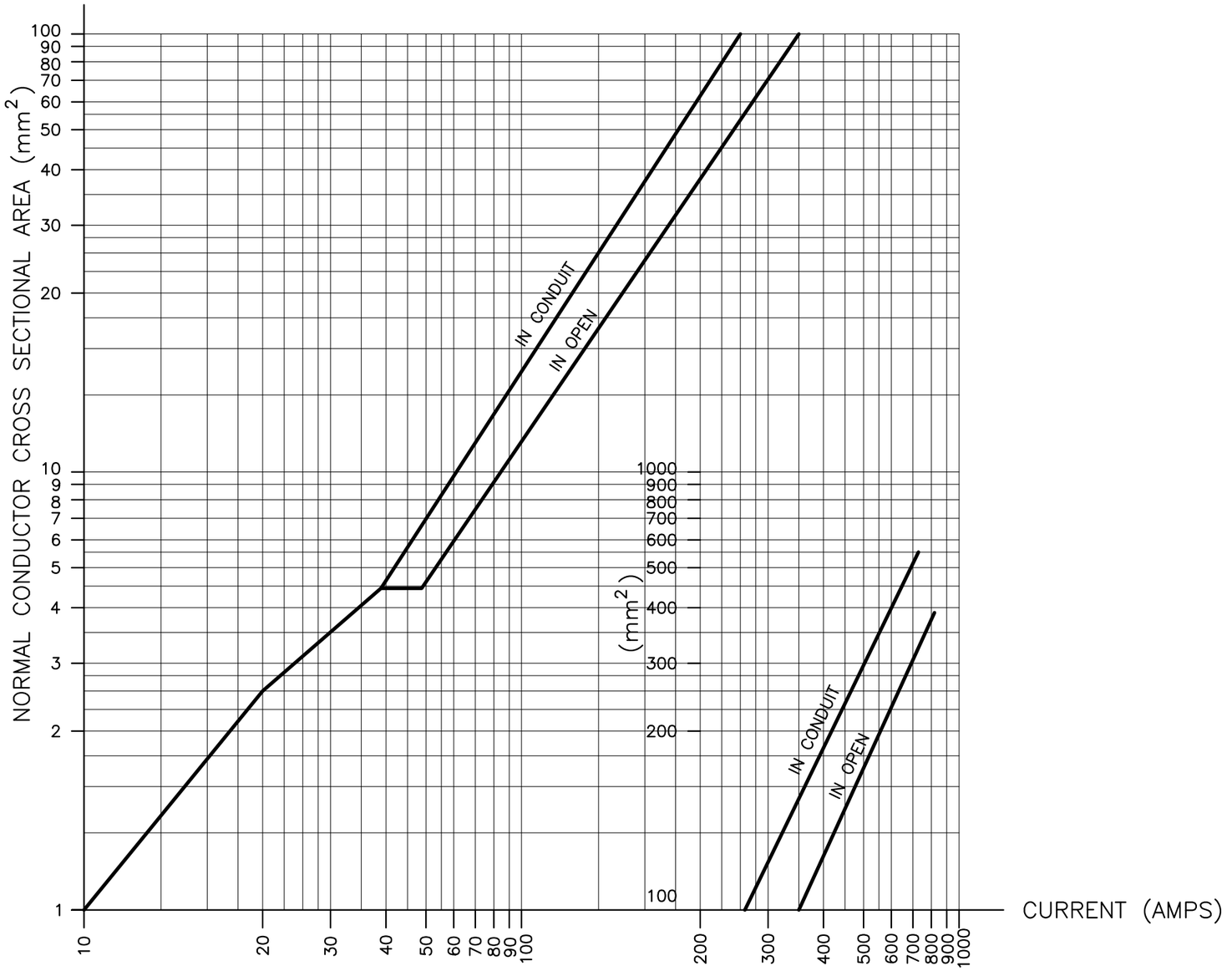
PROCUREMENT OF NEW TRAINS

EXPLANATION OF TRAIN SPEED PROFILE W.R.T. CHANGE OF SPEED CODE

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/010/007	A

NOTE:

CONDUCTOR TEMPERATURE LIMITS MUST NOT BE EXCEED.



MAXIMUM ALLOWABLE CURRENT RATINGS

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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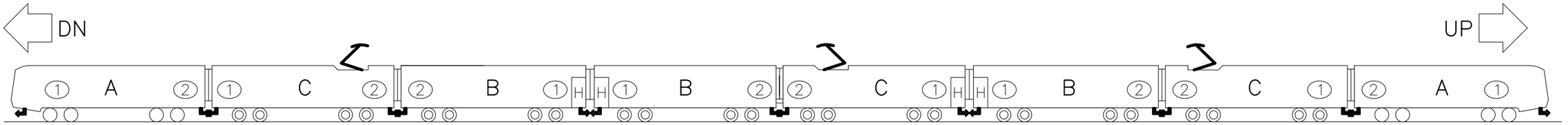
CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_010_008_A.DWG

TITLE

C6014-14E
PROCUREMENT OF NEW TRAINS
CABLE RATINGS

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/010/008	A



ACB UNIT

BC UNIT

ACB UNIT

CAR NUMBERS (ODD)

A
C
B
–

CAR NUMBERS

B
C
–

CAR NUMBERS (EVEN)

A
C
B
–

LEGEND: AUTO COUPLER | SEMI–PERMANENT COUPLER | MOTOR AXLE | TRAILER AXLE | H HOSTLER

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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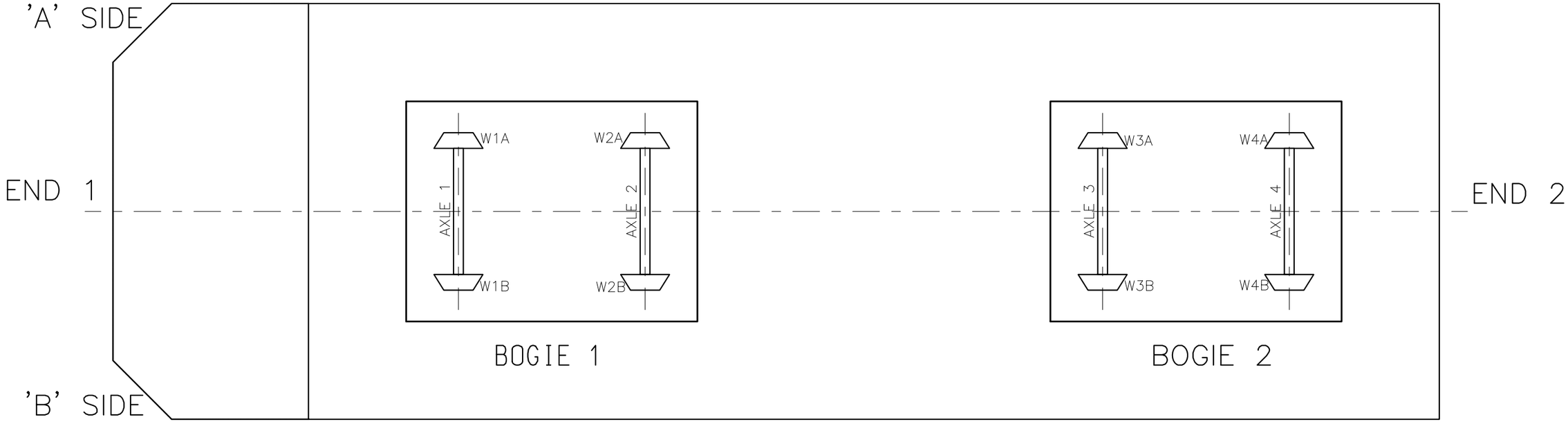
CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_010_009_A.DWG

TITLE

C6014–14E
PROCUREMENT OF NEW TRAINS
TRAIN CONSIST AND CAR NUMBERING

SCALE	DRAWING NO.	REV.
NTS	C6014–14E/TSEG/010/009	A



REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_010_010_A.DWG

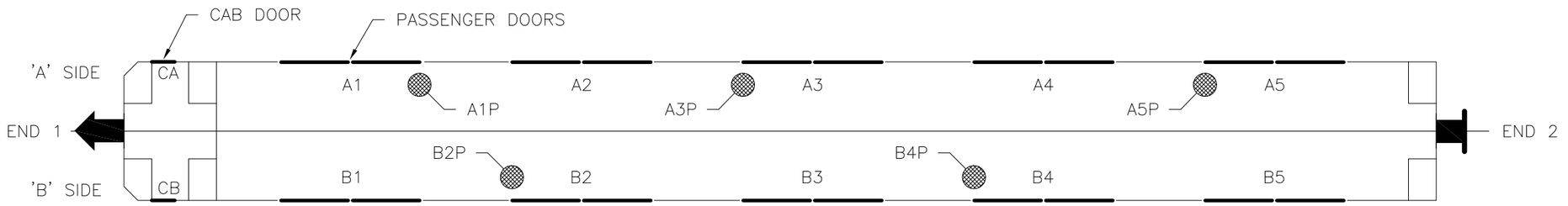
TITLE

C6014-14E

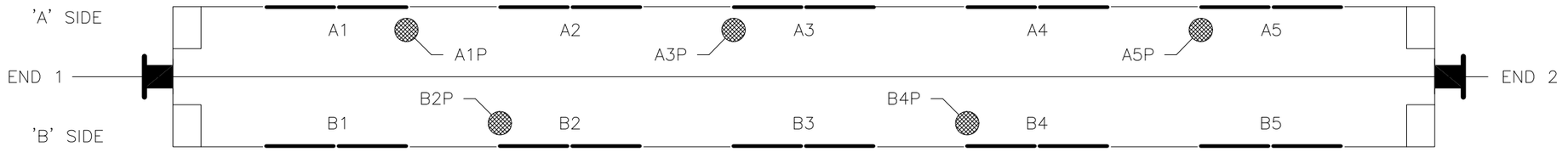
PROCUREMENT OF NEW TRAINS

BOGIE, AXLE AND WHEEL NUMBERING

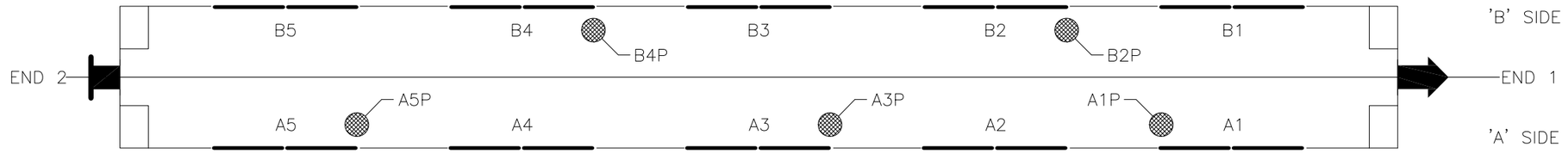
SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/010/010	A



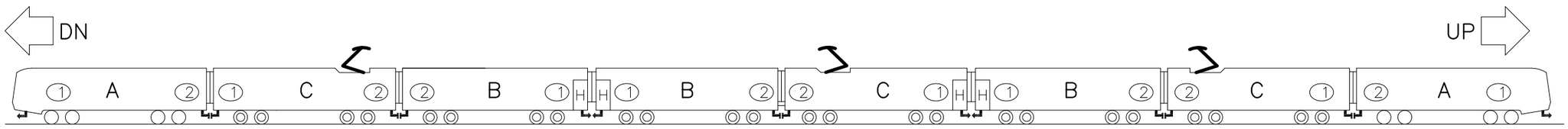
A CAR



C CAR



B CAR



LEGEND : AUTO COUPLER SEMI–PERMANENT COUPLER PASSENGER ALARM (1) END 1 (2) END 2

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_010_011_A.DWG

TITLE

C6014-14E

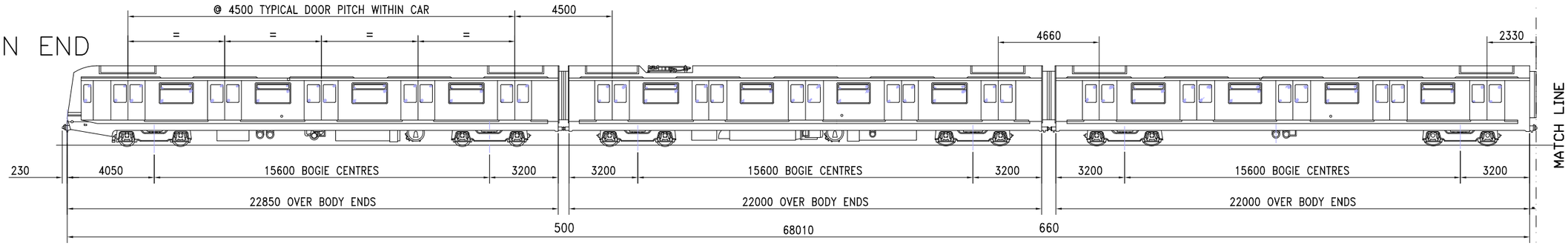
PROCUREMENT OF NEW TRAINS

DOORS AND PASSENGER ALARM

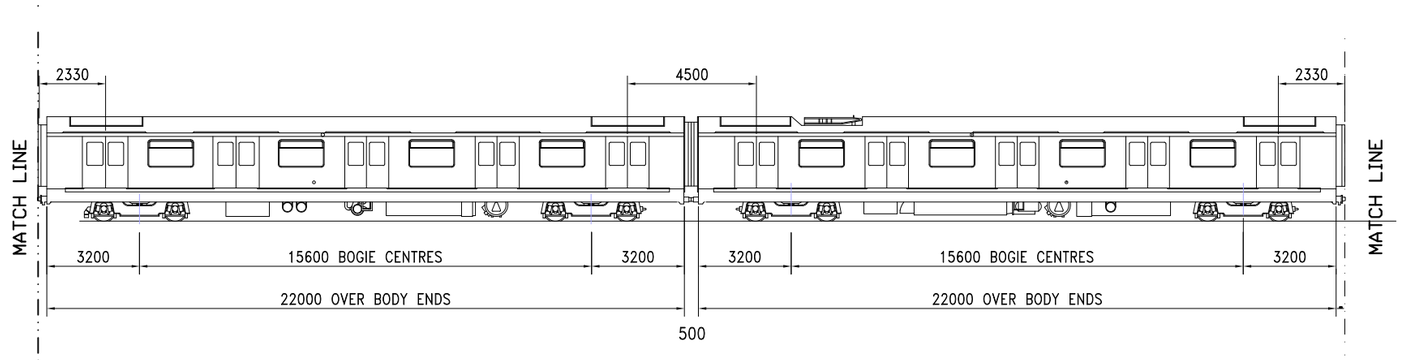
LAYOUT AND NUMBERING

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/010/011	A

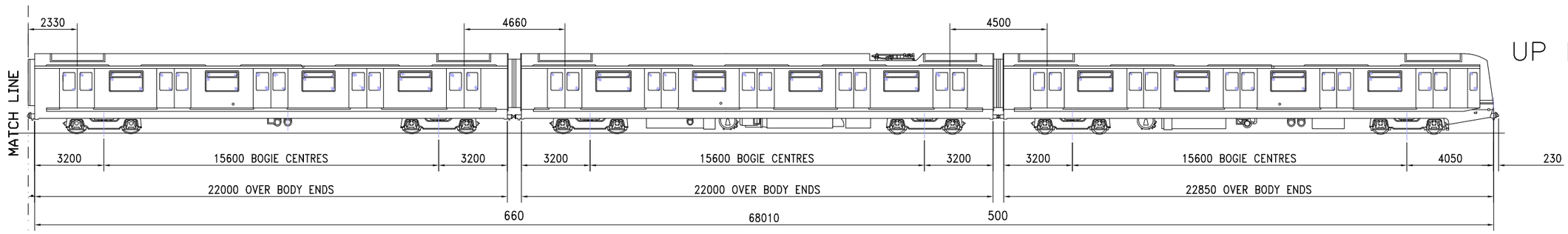
DOWN END



'A' CAR – POWER CAR | 'C_T' CAR – POWER CAR | 'D' CAR – TRAILER CAR



'B' CAR – POWER CAR | 'C' CAR – POWER CAR



UP END

'D' CAR – TRAILER CAR | 'C_T' CAR – POWER CAR | 'A' CAR – POWER CAR

NOTE : 1. ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_010_012_A.DWG

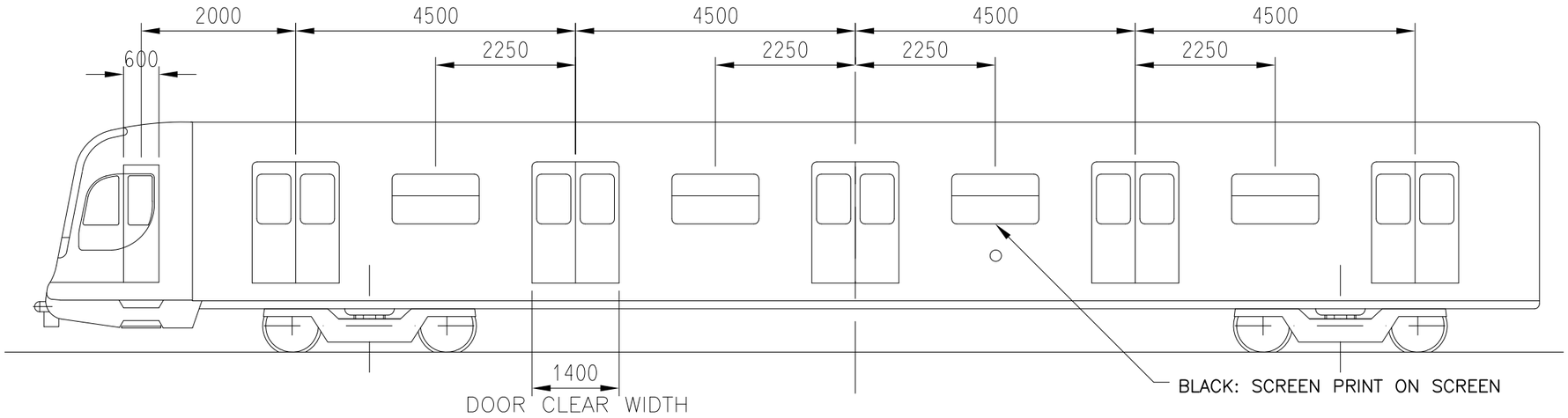
TITLE

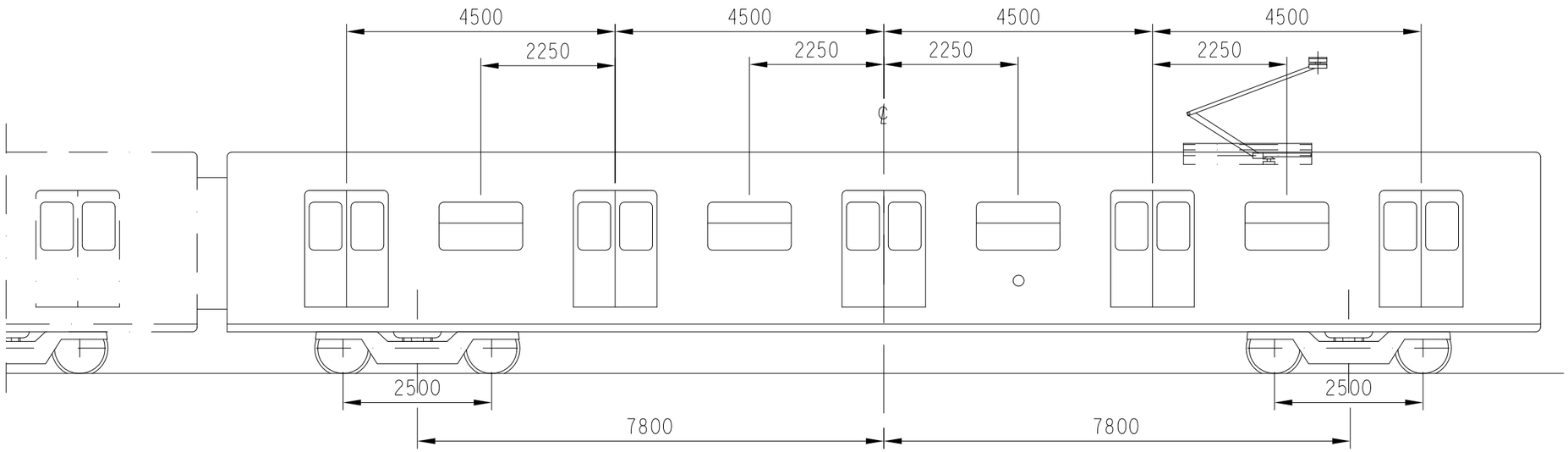
C6014-14E

PROCUREMENT OF NEW TRAINS

GENERAL ARRANGEMENT OF EXISTING M TRAIN

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/010/012	A





NOTE :
1. ALL DIMENSIONS ARE PREFERRED ONLY AND ARE A GUIDE TO THE TYPE OF FORM UNLESS MARKED (*) IN WHICH CASE THE DIMENSIONS IS MANDATORY.
2. ALL DIMENSIONS IN MILLIMETRES.
3. ALL HEIGHTS ABOVE RAIL LEVEL ARE AT TARE.

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_010_013_A.DWG

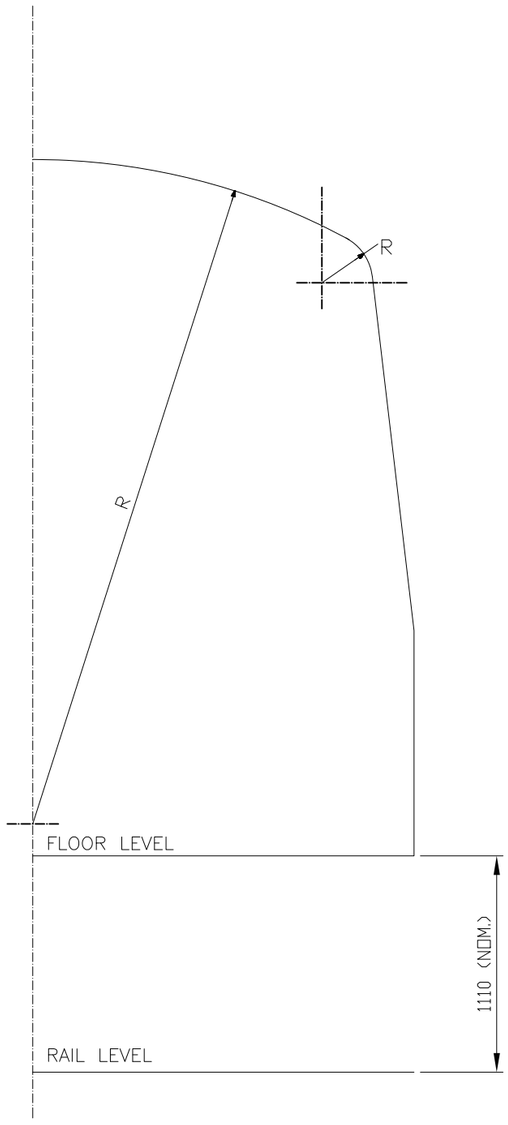
TITLE

C6014-14E

PROCUREMENT OF NEW TRAINS

GENERAL ARRANGEMENT OF CAB AND NON-CAB END VEHICLES

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/010/013	A



NOTE :
ACTUAL DIMENSIONS SUBJECT TO DETAIL DESIGN.

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

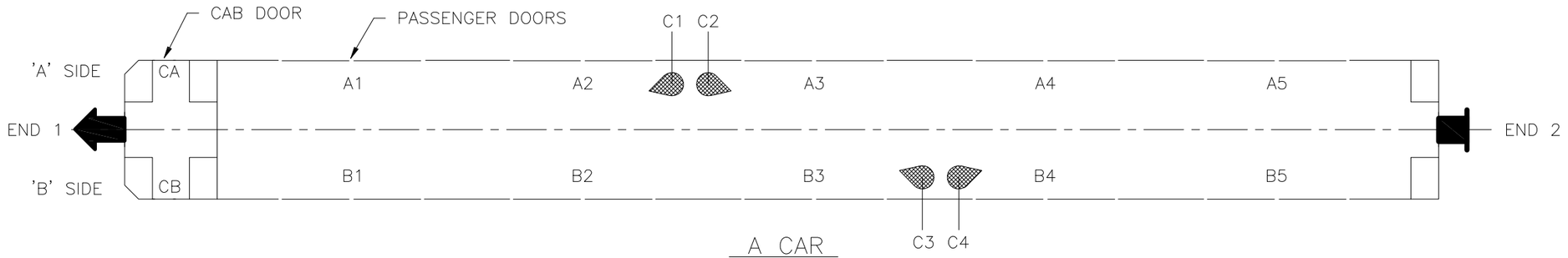
CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_010_014_A.DWG

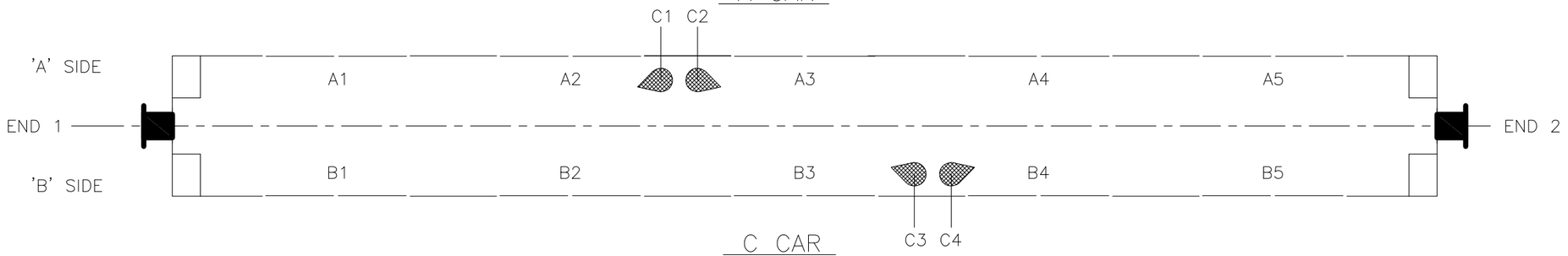
TITLE

C6014-14E
PROCUREMENT OF NEW TRAINS
CARBODY CONTOUR

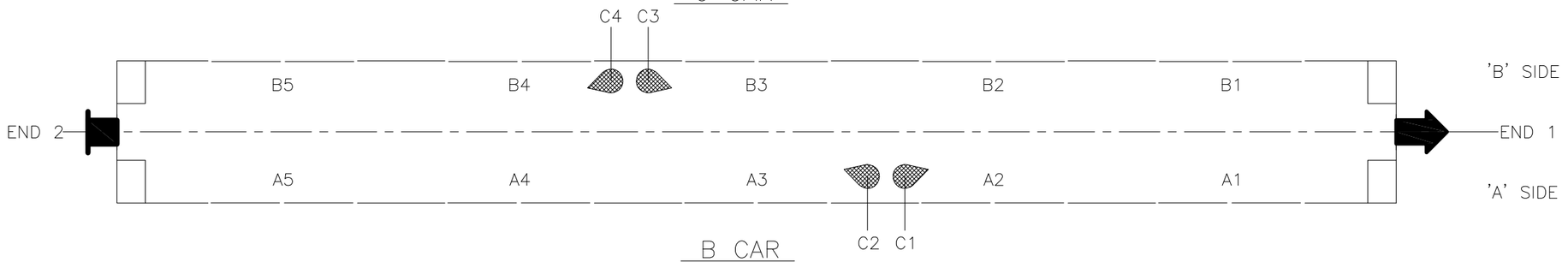
SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/010/014	A



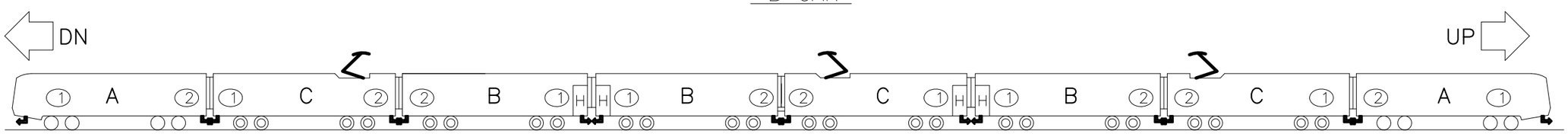
A CAR



C CAR



B CAR



LEGEND : AUTO COUPLER SEMI-PERMANENT COUPLER IN-SALOON CCTV CAMERA (1) END 1 (2) END 2

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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MTR

ORIGINATOR

OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

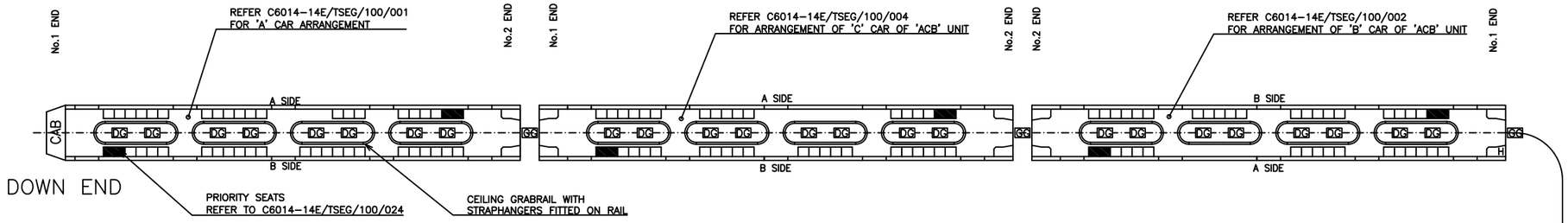
FILE NAME: C6014-14E_TSEG_010_015_A.DWG

TITLE

C6014-14E
PROCUREMENT OF NEW TRAINS
IN-SALOON CCTV CAMERA LAYOUT AND NUMBERING

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/010/015	A

ODD 'ACB' UNIT

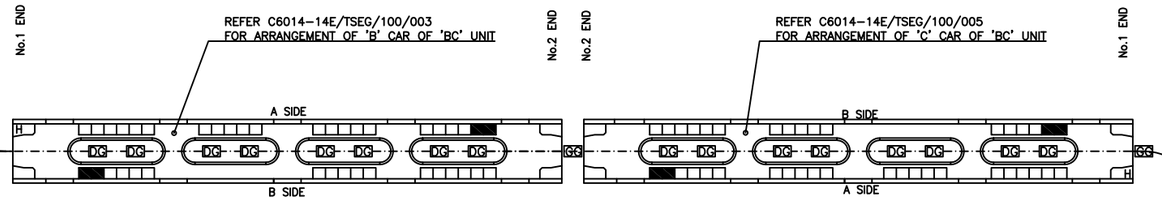


'A' CAR – DRIVING TRAILER CAR

'C' CAR – POWER CAR WITH PANTOGRAPH

'B' CAR – POWER CAR

'BC' UNIT



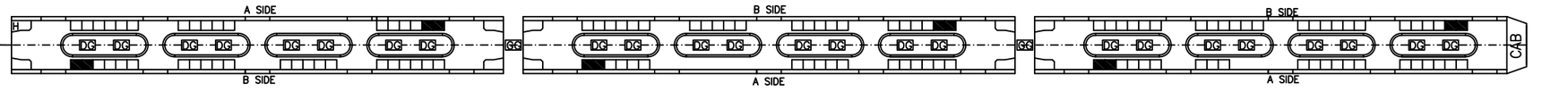
'B' CAR – POWER CAR

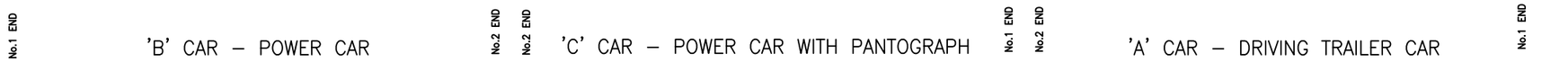
'C' CAR – POWER CAR WITH PANTOGRAPH

LEGEND:

SHADED SEAT – PRIORITY SEAT
H – HOSTLER CUBICLE
DG – SALOON DOUBLE BRANCH GRABPOLE
GG – GANGWAY DOUBLE BRANCH GRABPOLE

EVEN 'ACB' UNIT





'B' CAR – POWER CAR

'C' CAR – POWER CAR WITH PANTOGRAPH

'A' CAR – DRIVING TRAILER CAR

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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ORIGINATOR

OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_010_017_A.DWG

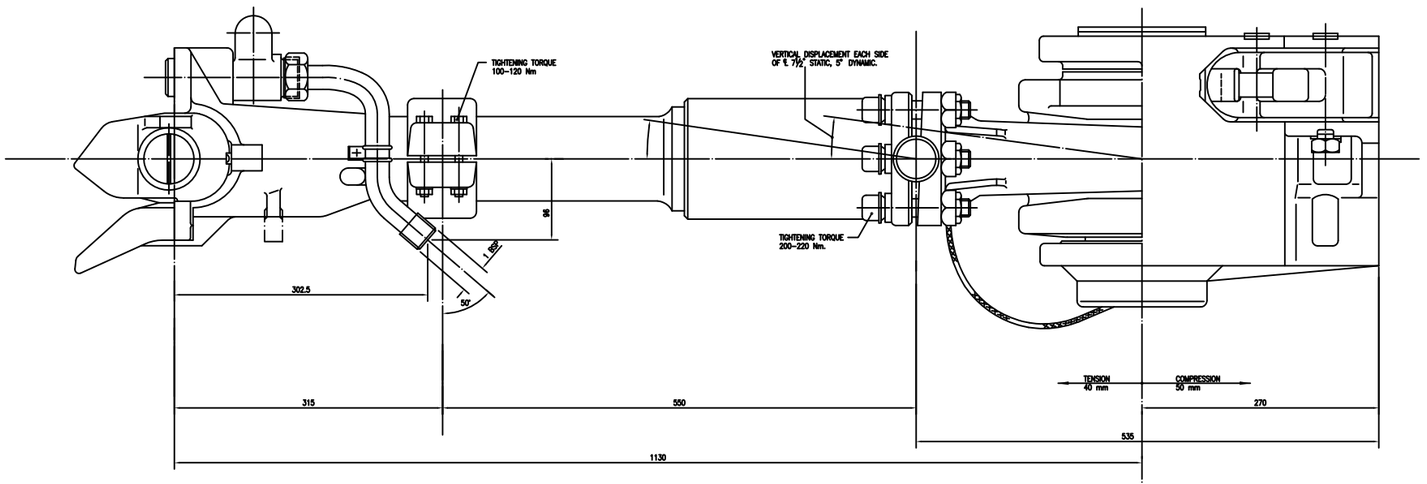
TITLE

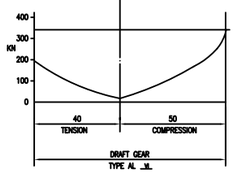
C6014-14E
PROCUREMENT OF NEW TRAINS
TRAIN CONFIGURATION ARRANGEMENT

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/010/017	A

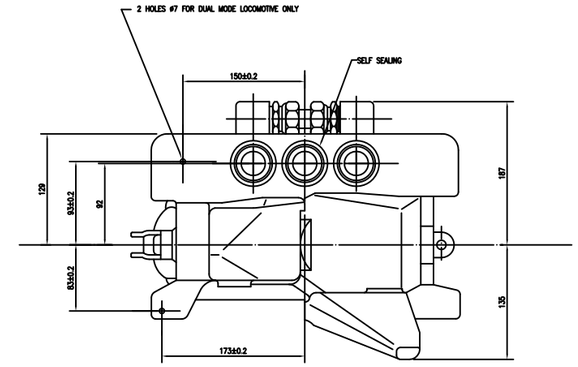
COUPLING ARRANGEMENT		
Drawing No.	**Title**	**Revision**
OD4/311/00001/012	Service Loco. Coupler (ALVI Draftgear)	E
OD4/311/00001/014	General Arrangement of Diesel Locomotive	B
OD4/312/00001/008	BE Loco (MK II) Drawgear Arrangement for Dual Mode Locomotive	B
OD4/312/00001/051	BE Loco (MK I) Drawgear Arrangement Showing AL VI Draftgear	B
OD2/301/00015/001	MTR Standard Automatic Coupler for Passenger Cars	C
OD4/361/00715/0003	Automatic Coupler for Cab End	B
C6014-14E/TSEG/115/001	Automatic Coupler for Cab End of C Train	A

OD4/311/00001/012 E

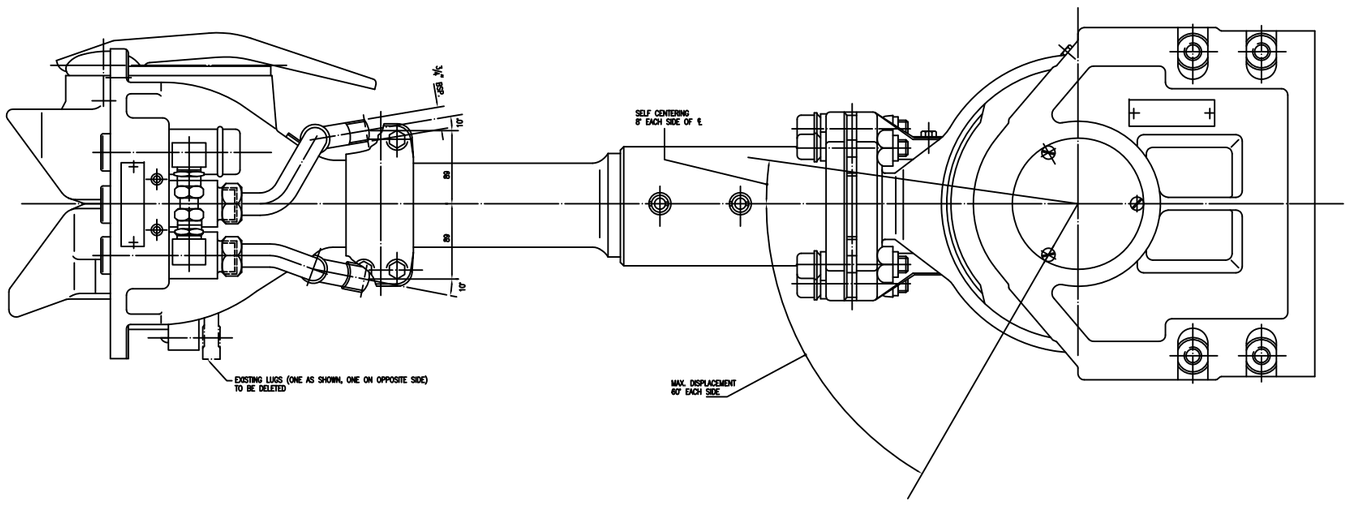


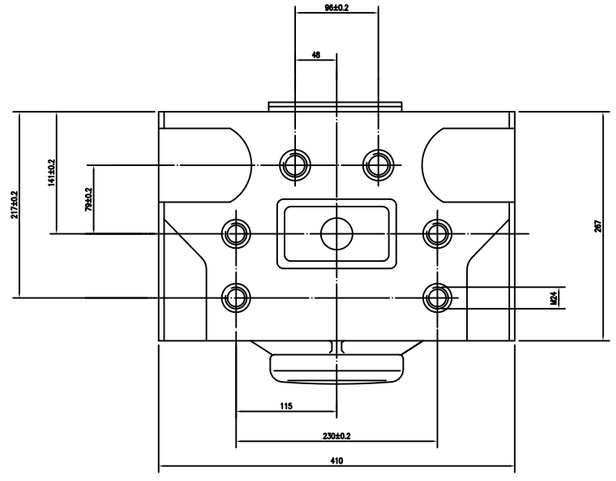


LOAD x STROKE DGM



X





VIEW ON ARROW "X"

REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHECKED	APPROVED	DATE
E	DIGITIZATION	RASON	M.LEUNG	28-3-95
D	LUGS DELETED			17-11-82
C	2 HOLES ⌀7 ADDED			13-10-82
B	AL VI DRAFTGEAR ADDED TO TITLE			06-5-82
A	FIRST ISSUE			20-4-79

REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
M0-00040 (D)

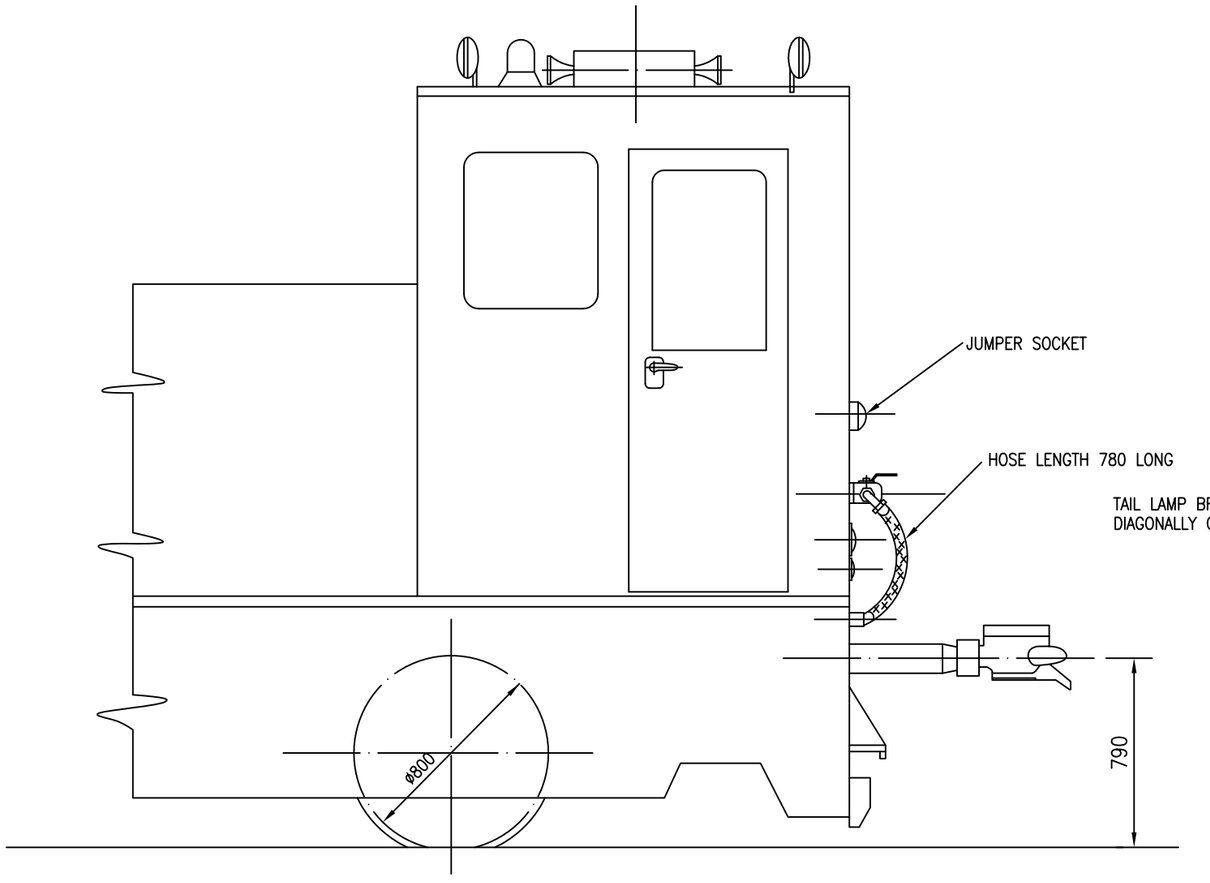
	INITIAL	DESIGNATION	DATE
TRACED BY	Y105	ZESTC	28-3-95
DESIGNED BY			
CHECKED BY			
APPROVED BY			
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.		504133V1	

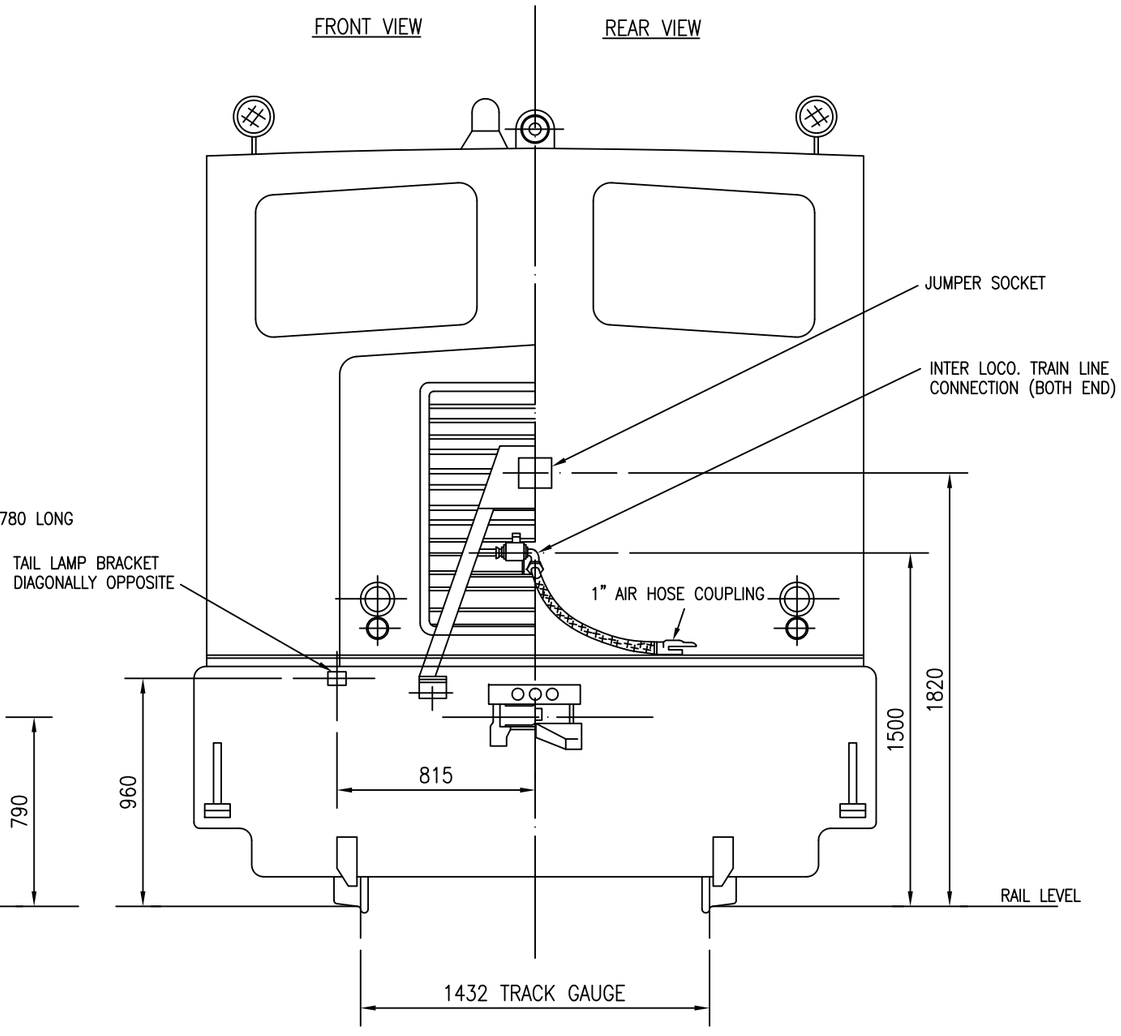
MASS TRANSIT RAILWAY CORPORATION

TITLE
SERVICE LOCO. COUPLER
(AL VI DRAFTGEAR)

SCALE 1:2.5 DWG NO. OD4/311/00001/012 E

A0 SIZE, 1189 x 841mm, TYPE 2





REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE
B	DIGITIZATION	RASON	M.LEUNG	30-3-95

REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
M3-00049 (A)

	INITIAL	DESIGNATION	DATE
TRACED BY	Y87	ZESTC	30-3-95
DESIGNED BY			
CHECKED BY			
APPROVED BY			
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.		504135V1	

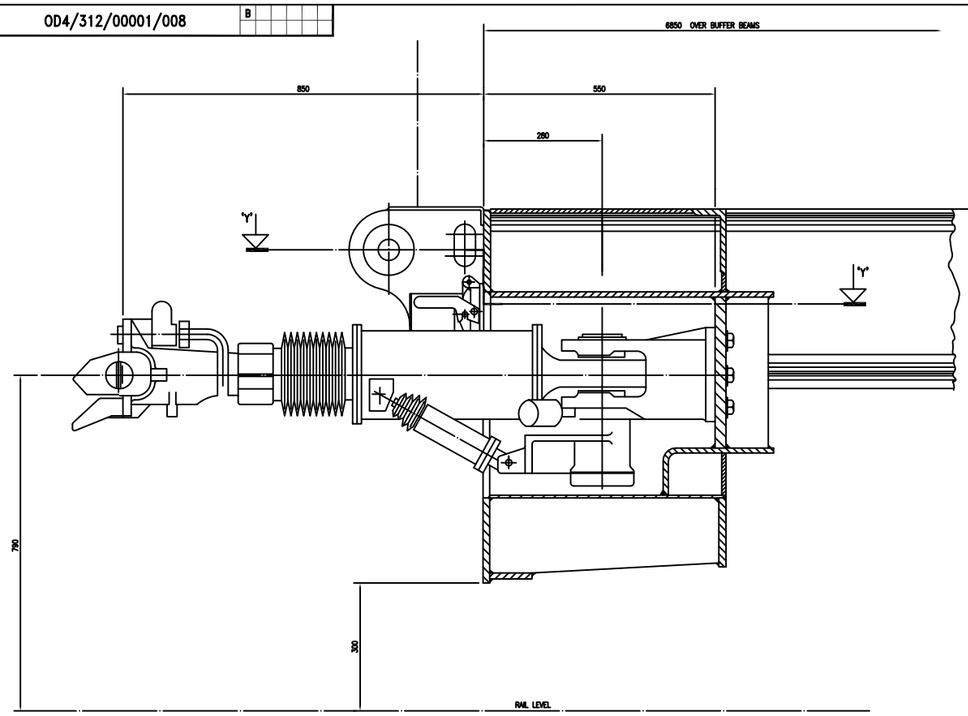
MASS TRANSIT RAILWAY CORPORATION

TITLE
GENERAL ARRANGEMENT OF DIESEL LOCO.

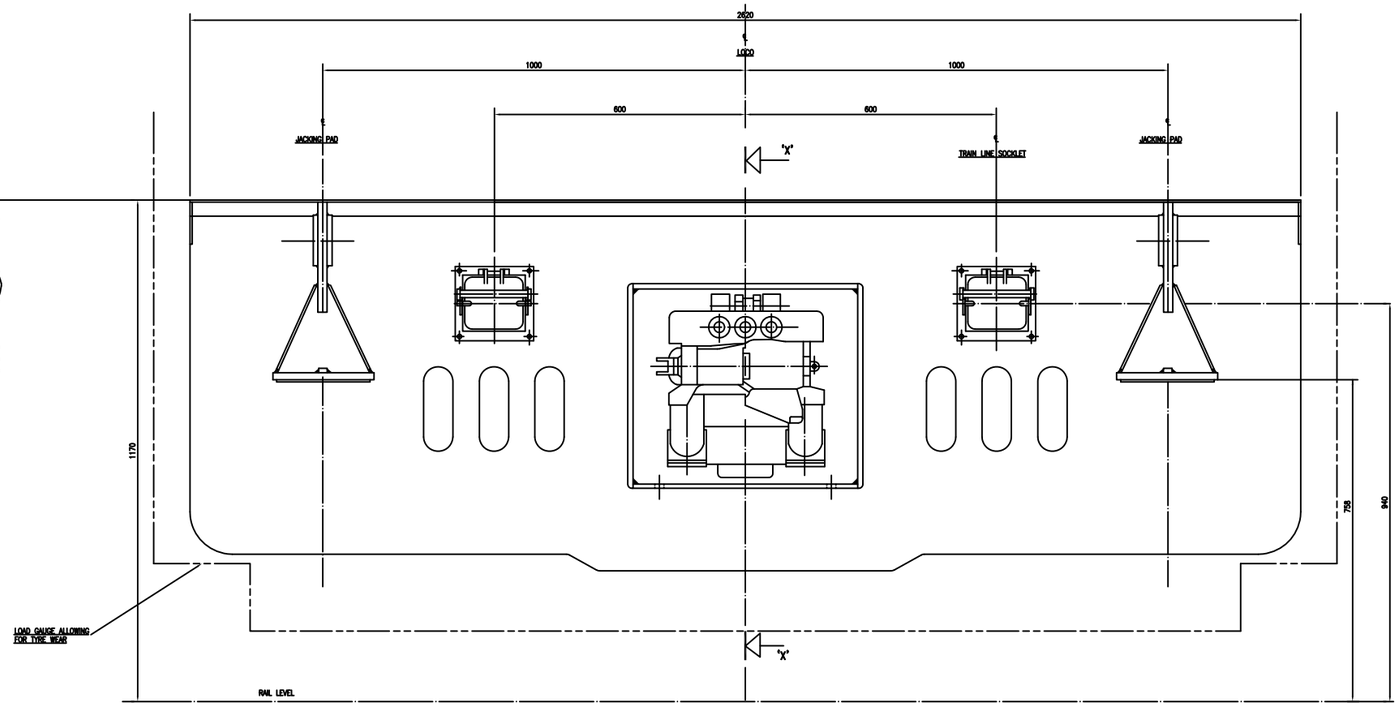
SCALE 1:25 | DWG NO. OD4/311/00001/014 B

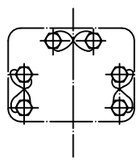
A3 SIZE, 420 x 297mm, TYPE 2

OD4/312/00001/008 B



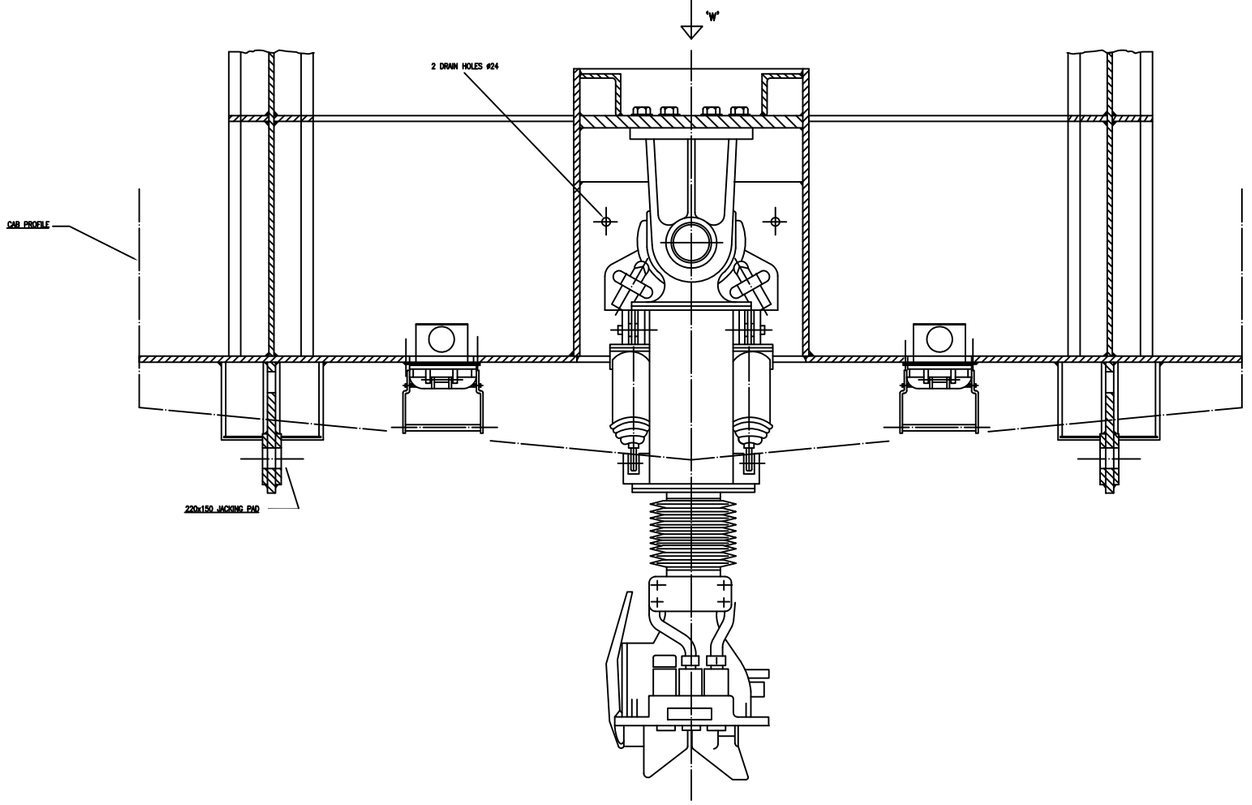
SECTION 'X-X'





BOLT HEADS OF COUPLER MOUNTING BOLTS TO BE DRILLED ø4 AND WIRE LOCKED IN PAIRS WITH ø 1/16 STEEL LOCKING WIRE. AS SHOWN.

PART VIEW ON 'W'



SECTION 'Y-Y'

B	DIGITIZATION	RASON	M.LEUNG	27-7-94
REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHECKED	APPROVED	DATE

REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
A04010227 (A)

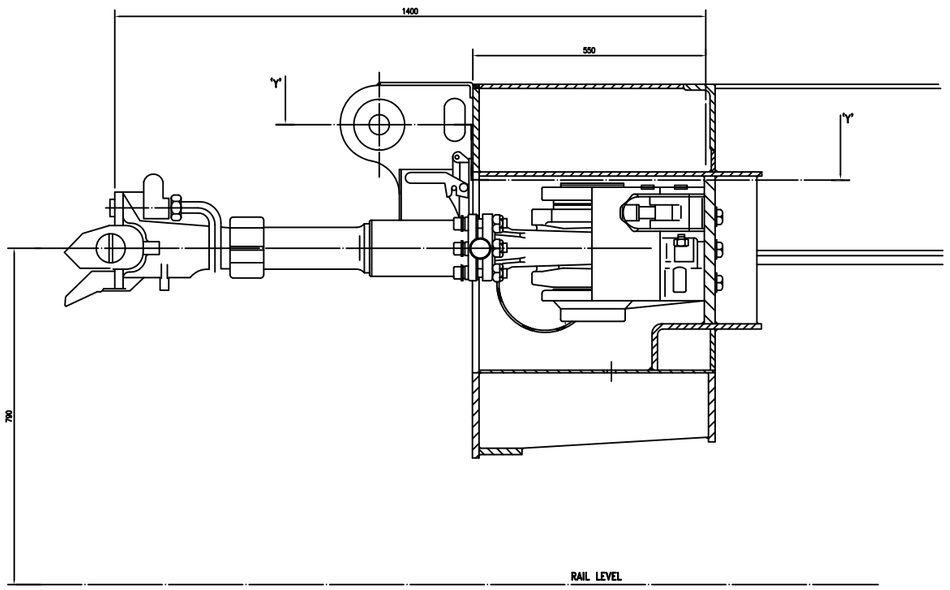
	INITIAL	DESIGNATION	DATE
TRACED BY	Y119	ZESTC	27-7-94
DESIGNED BY		MTRC	
CHECKED BY		MTRC	
APPROVED BY		MTRC	
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.		413008V1	

MASS TRANSIT RAILWAY CORPORATION

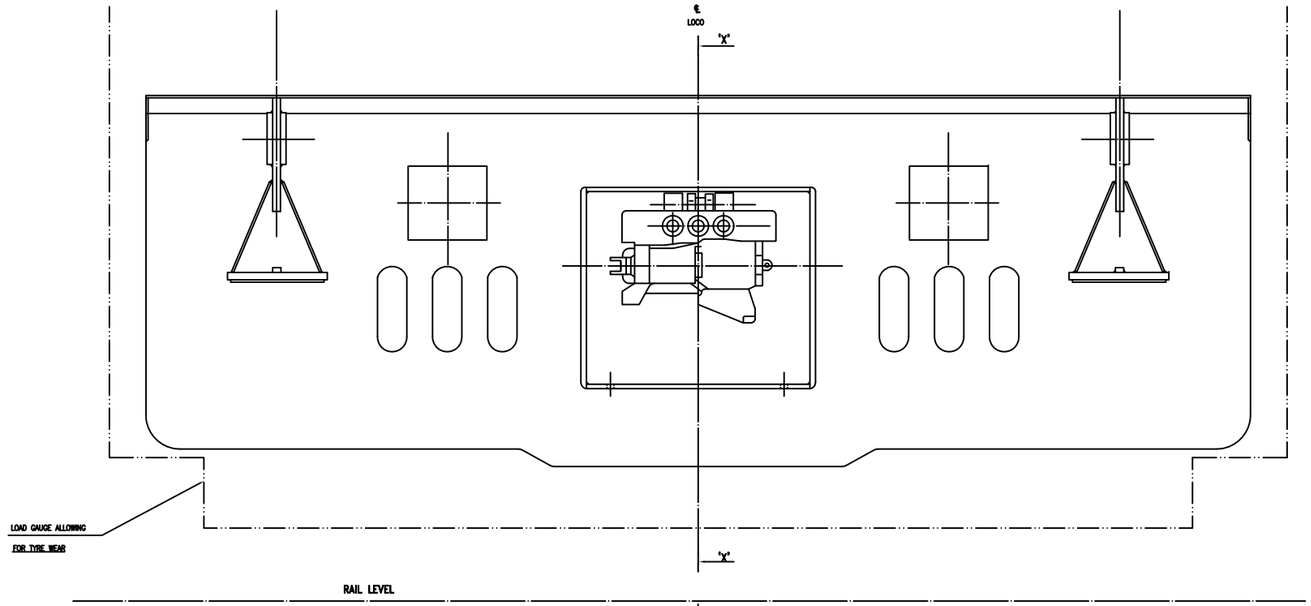
TITLE
BE LOCO (MKII)
DRAWGEAR ARRANGEMENT FOR DUAL MODE LOCOMOTIVE

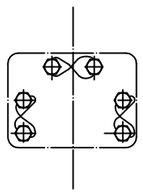
SCALE 1:5 DWG NO. OD4/312/00001/008 B

A0 SIZE, 1189 x 841mm, TYPE 2



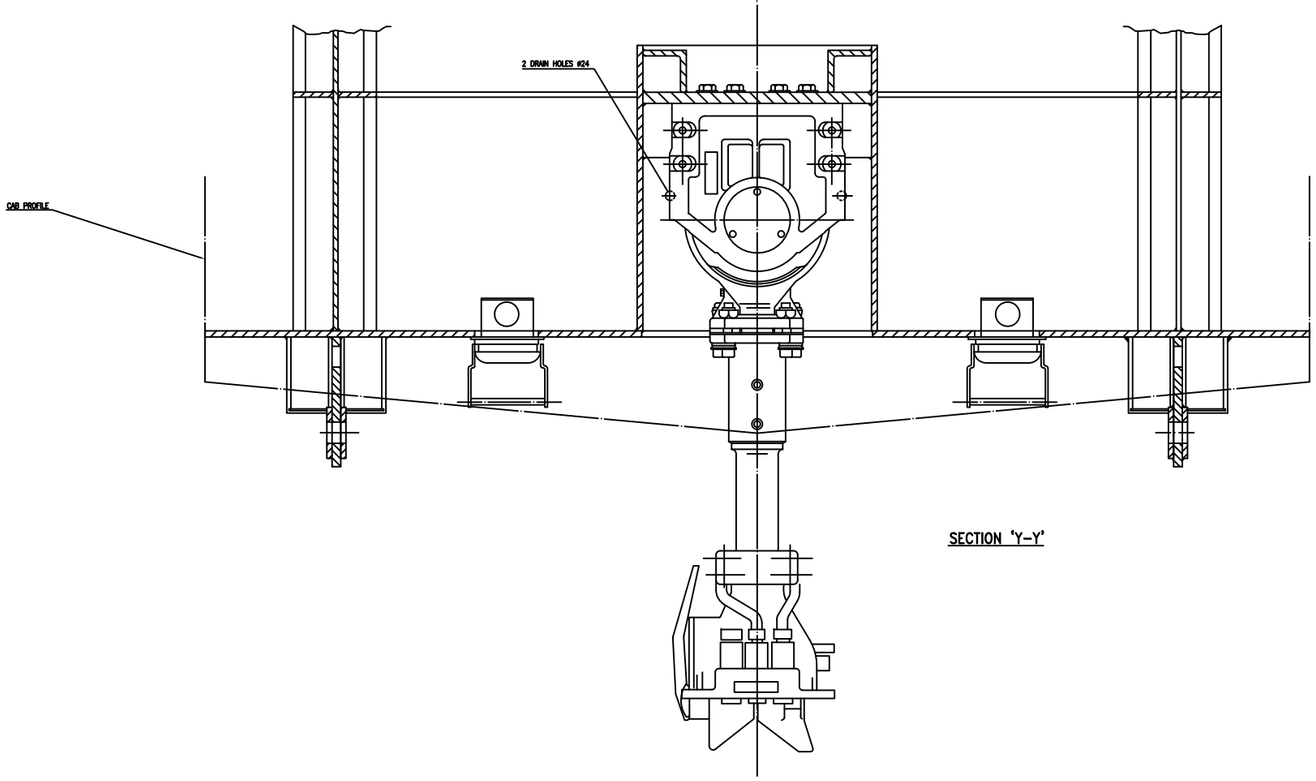
SECTION 'X-X'





BOLT HEADS OF COUPLER MOUNTING BOLTS TO BE DRILLED ⌀4 AND WIRE LOCKED IN PAIRS WITH #16 STEEL LOCKING WIRE. AS SHOWN.

PART VIEW ON 'W'



SECTION 'Y-Y'

REV	DESCRIPTION	BY	CHECKED	APPROVED	DATE
B	DIGITIZATION	RASON	M.LEUNG		28-7-94

REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
A04010314 (A)

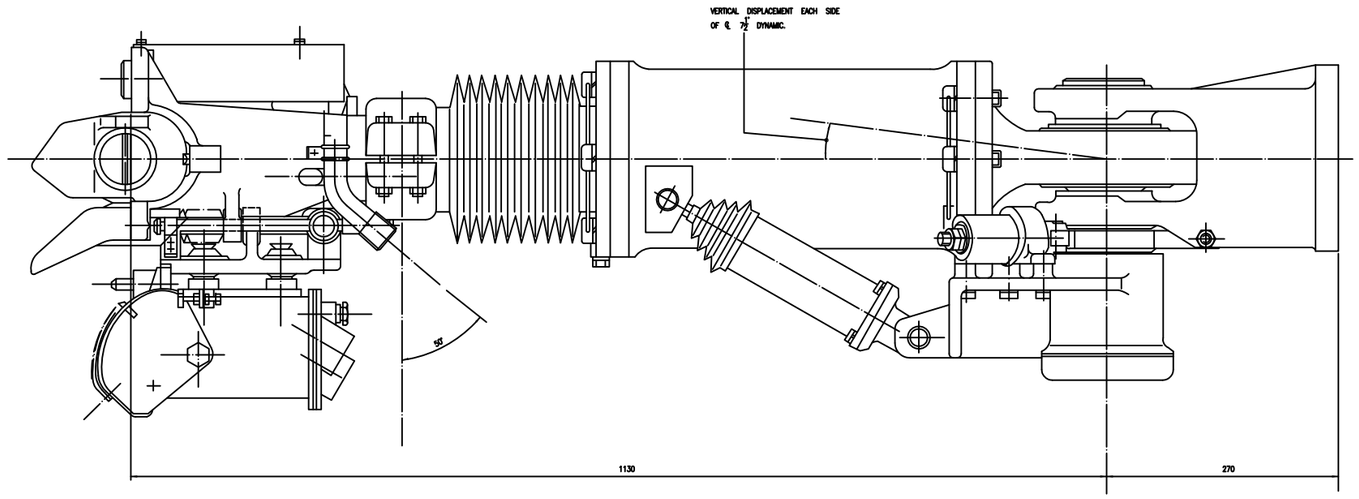
	INITIAL	DESIGNATION	DATE
TRACED BY	Y120	ZESTC	28-7-94
DESIGNED BY		MTRC	
CHECKED BY		MTRC	
APPROVED BY		MTRC	
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.		413049V1	

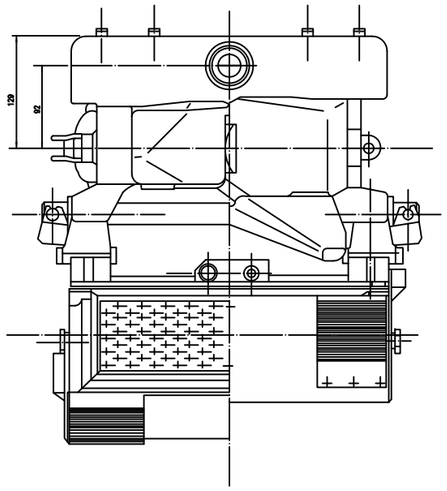
MASS TRANSIT RAILWAY CORPORATION

TITLE
BE LOCO (MKI)
DRAWGEAR ARRANGEMENT SHOWING
AL VI DRAFTGEAR

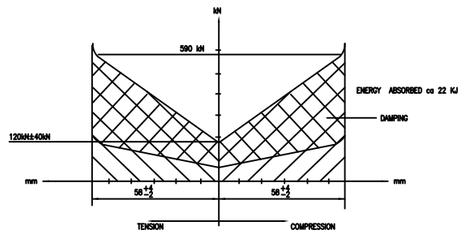
SCALE 1:5 | DWG NO. OD4/312/00001/051 B

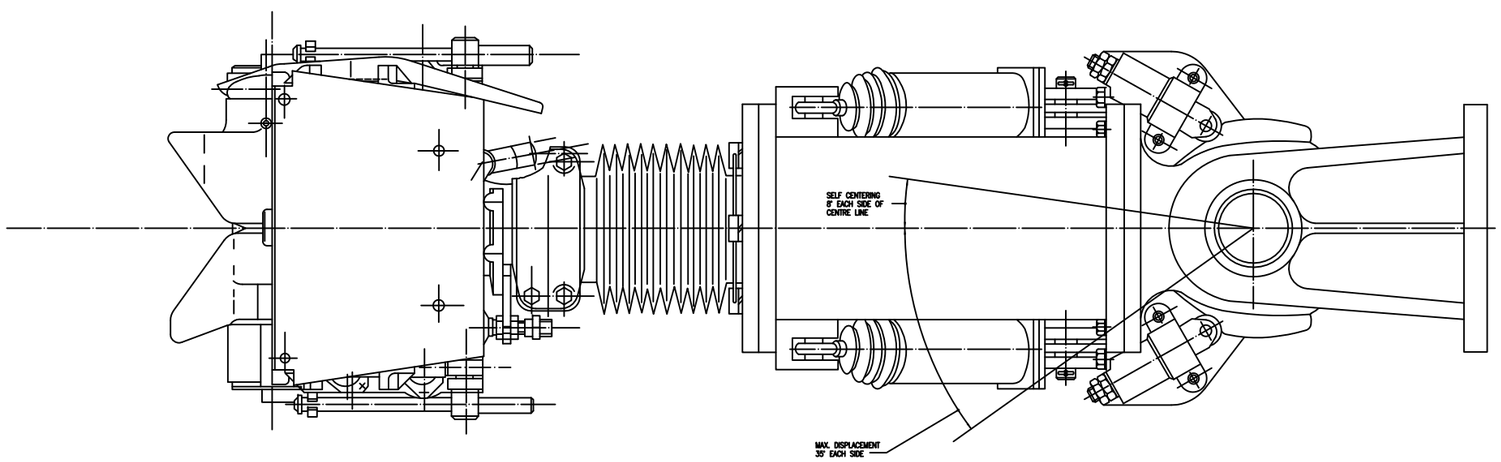
A0 SIZE, 1189 x 841mm, TYPE 2

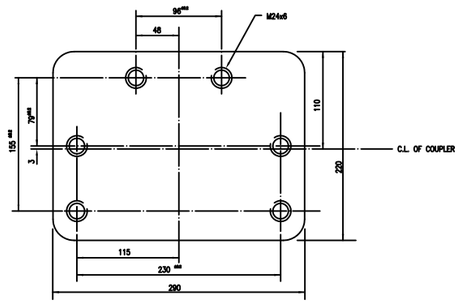




X







VIEW ON ARROW 'X'

FIRST ANGLE PROJECTION

REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHECKED	APPROVED	DATE
C	DIGITIZATION	RASON	W.H.YUEN	26-2-94
B	LOCATION OF TAPPED HOLES ON COUPLER MOUNTING FACE SHIFTED			07-5-86

REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
M0-00104

	INITIAL	DESIGNATION	DATE
TRACED BY	Y5	ZESTC	26-2-94
DESIGNED BY		MTRC	
CHECKED BY		MTRC	
APPROVED BY		MTRC	
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.		320044V1	

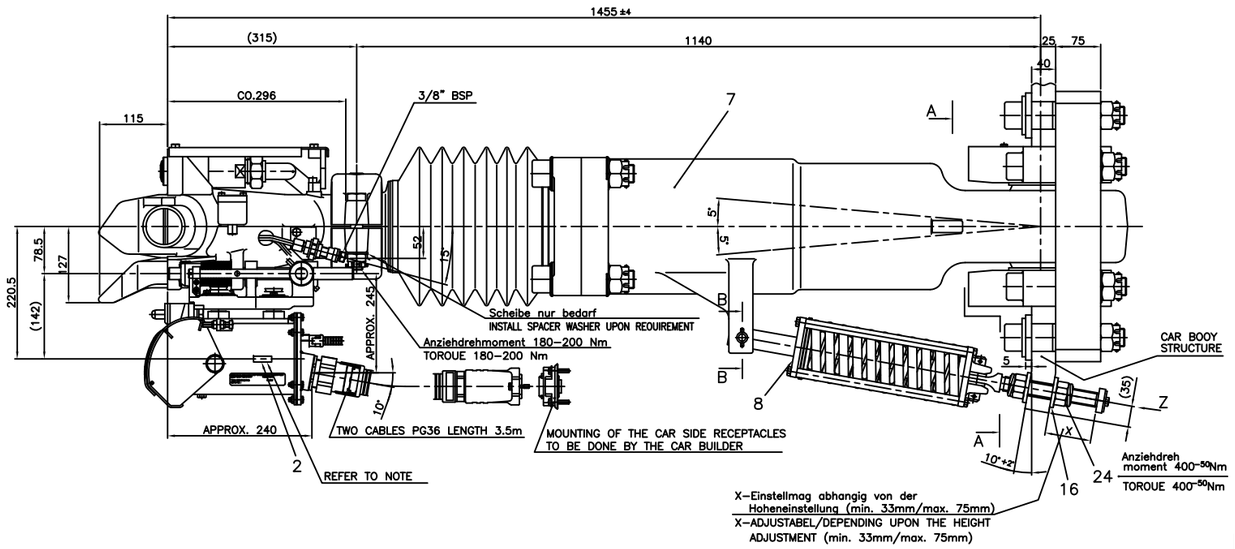
MASS TRANSIT RAILWAY CORPORATION

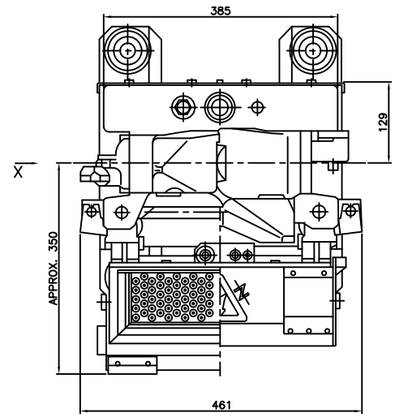
TITLE
MTR STANDARD AUTOMATIC
COUPLER FOR PASSENGER CARS

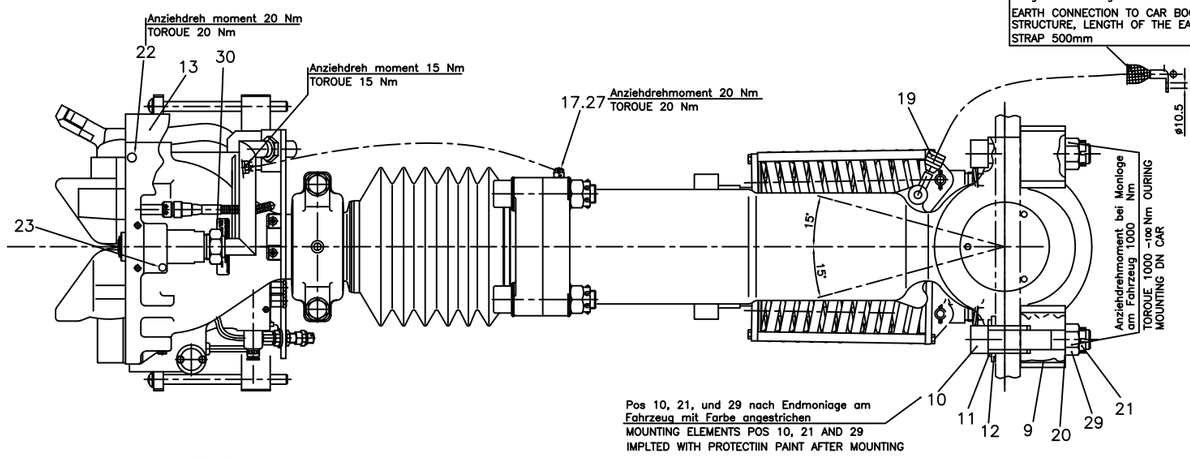
SCALE 1:2.5 | DWG NO. 0D2/301/00015/001 | C

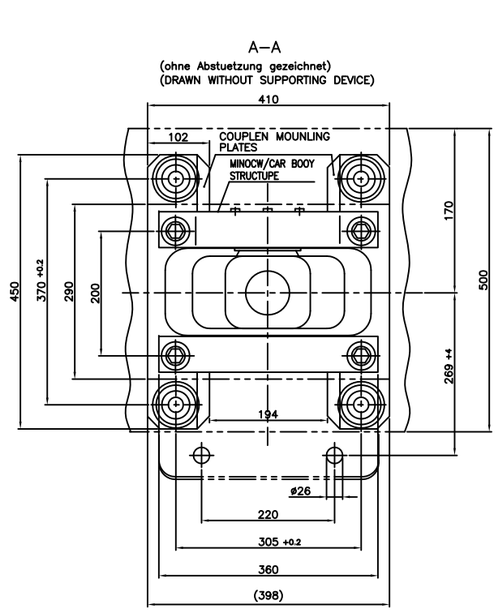
A0 SIZE, 1189 x 841mm, TYPE 2

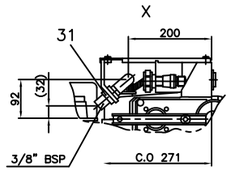
OD4/361/00715/0003 _B

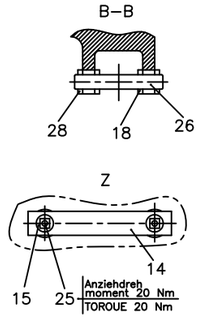


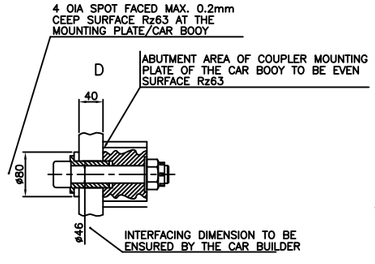


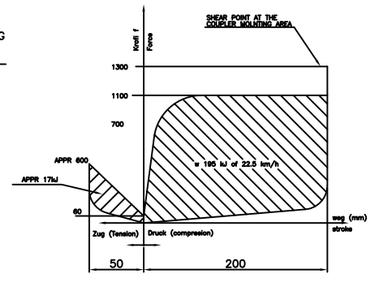












Note

1. Bar Code Label
   1) Bar code specification: refer to KOROS's Doc. No. E-1-4-1047
   2) Bar code dimension (excluding readable characters): L37.9xH15mm
   3) Bar code standard: Code 39
   4) Bar code numbering: from 142210A000 to 142210A025

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	Note Added (Bar Code Location)	CH Choi 31.03.2004	CH Choi 31.03.2004	GH Yeom 31.03.2004

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
EB22010-000

	INITIAL	DESIGNATION	DATE
DRAWN			
DESIGNED	OH Kim		23.04.2002
CHECKED	KT Kim		23.04.2002
APPROVED	GH Yeom		23.04.2002
CAD FILE NAME	OD4_361_00715_0003_B		

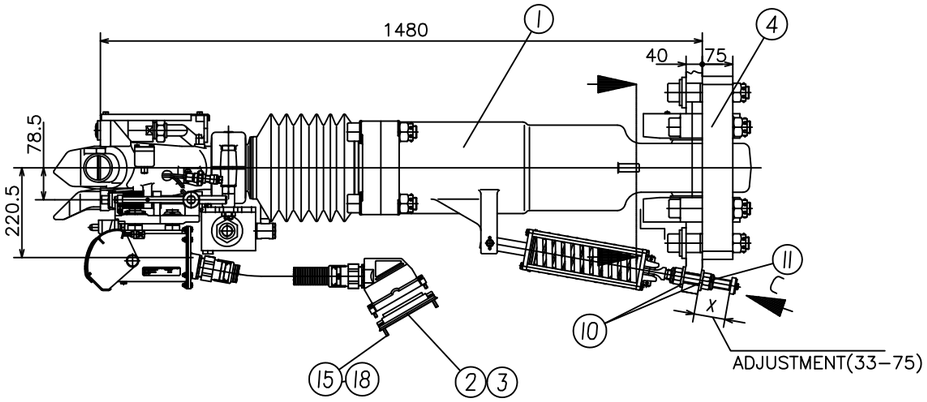
地鐵公司 MTR Corporation

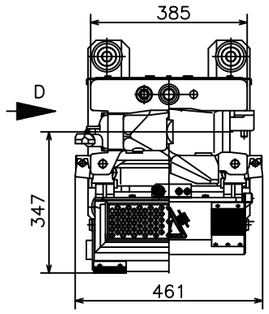
TITLE AUTOMATIC COUPLER FOR CAB END

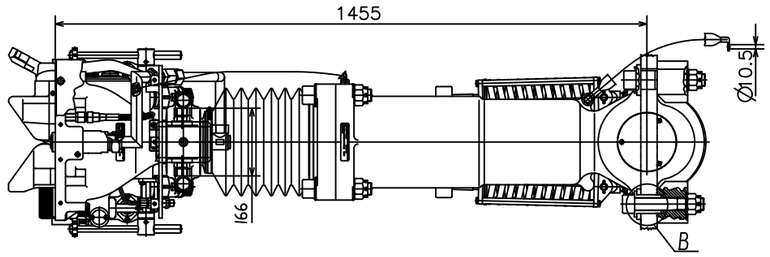
SCALE 1/5

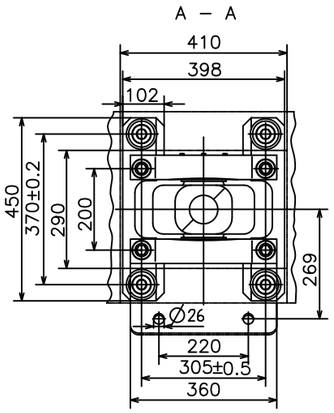
OED DRAWING NO. OD4/361/00715/0003 _B

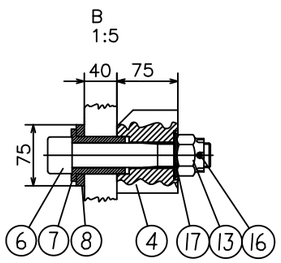
A1 SIZE, 841 x 594mm, TYPE 3

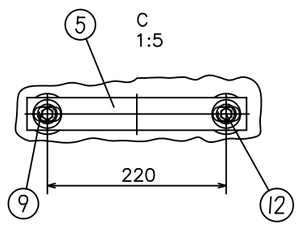


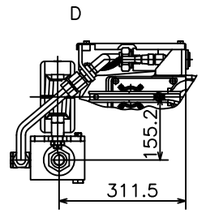












NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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ORIGINATOR

OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_115_001_A.DWG

TITLE

C6014-14E

PROCUREMENT FOR NEW TRAINS

AUTOMATIC COUPLER FOR CAB END OF C TRAIN

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/115/001	A

TRAIN EXTERIOR DESIGN		
Drawing No.	**Title**	**Revision**
C6014-14E/TSEG/060/001	Train Exterior – Cab Perspective View	A
C6014-14E/TSEG/060/002	Not Used	-
C6014-14E/TSEG/060/003	Train Exterior – Colour Scheme	A
C6014-14E/TSEG/060/004	Cab Exterior – General Arrangement	A
C6014-14E/TSEG/060/005	Train Exterior – General Arrangement	A
C6014-14E/TSEG/060/006	Cab – Vertical Cross Section	A
C6014-14E/TSEG/060/007	Cab – Horizontal Cross Section	A
C6014-14E/TSEG/060/008	Destination and Special Messages For Electronic Destination Display	A
OD1/307/00009/001	General Arrangement of Mock-Up Emergency Cab Door in Deployed Ramp Position	A
OD1/307/00009/002	General Arrangement of Mock-Up Emergency Cab Door in Plug Door Position	A
OD1/307/00009/003	Mock-Up Emergency Cab Door in Ramp Deployment Sequence	A

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_060_001_A.DWG

TITLE

C6014-14E
PROCUREMENT OF NEW TRAINS
TRAIN EXTERIOR
CAB PERSPECTIVE VIEW

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/060/001	A

Black PMS Process Black C

3M <<CONTROLTAC>> MTR Red 180-2249

MTR Corporate logo

3M <<CONTROLTAC>> Grey Metallic 180-221

3M <<CONTROLTAC>> Black 180-12

Silver Colour to match 3M <<CONTROLTAC>> Satin Aluminium 180-120

MTR Corporate Rex PMS 201 C

3M <<CONTROLTAC>> Satin Aluminium 180-120

Silver Colour to match 3M <<CONTROLTAC>> Satin Aluminium 180-120

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION

TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_060_003_A.DWG

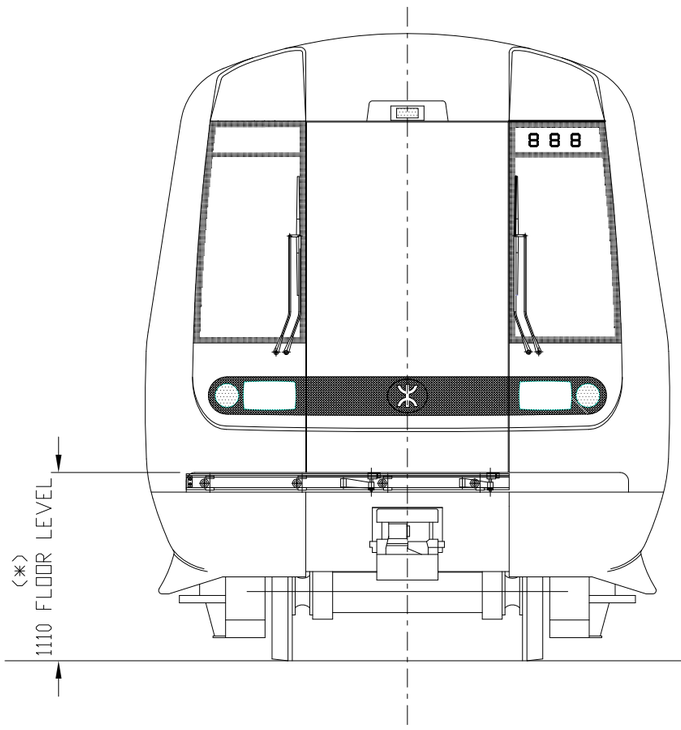
TITLE

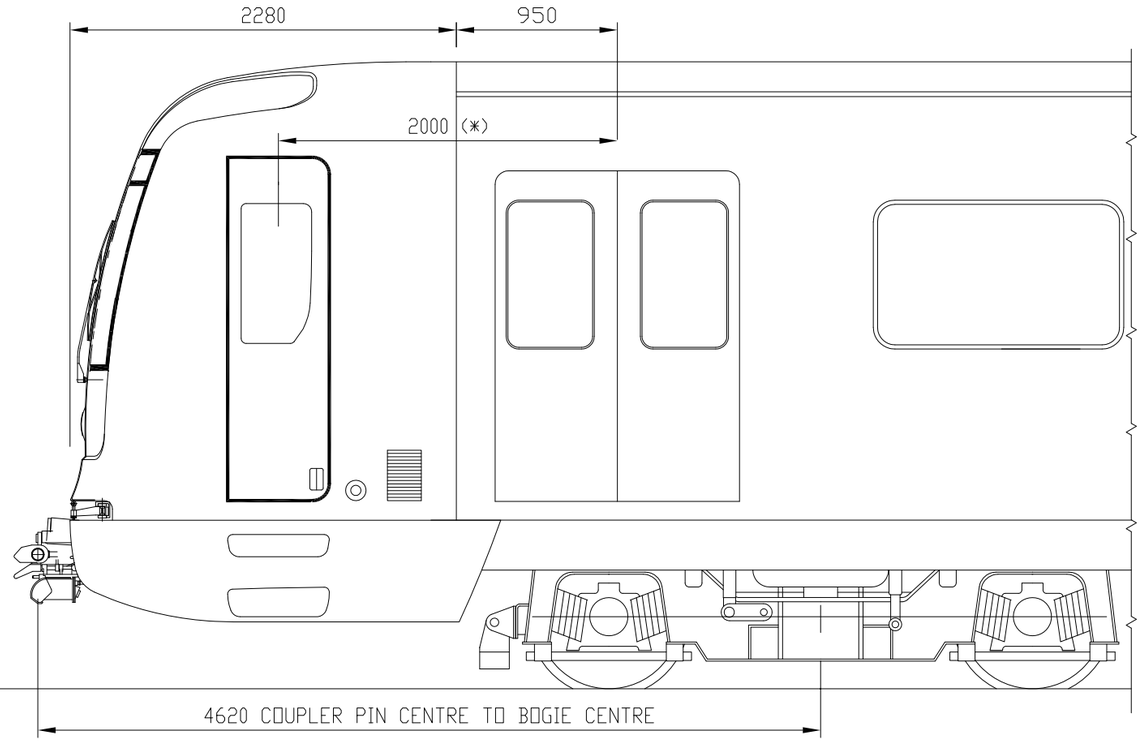
C6014-14E

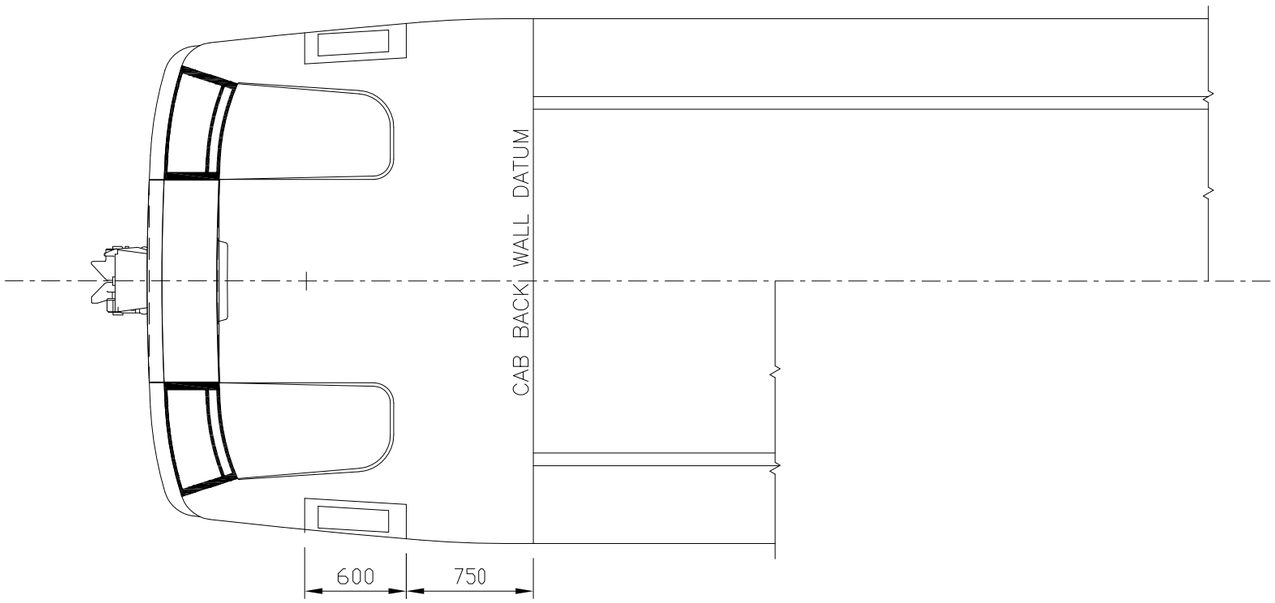
PROCUREMENT OF NEW TRAINS

TRAIN EXTERIOR COLOUR SCHEME

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/060/003	A







NOTES:

1. ALL DIMENSIONS ARE PREFERRED ONLY AND ARE A GUIDE TO THE TYPE OF FORM UNLESS MARKED (*) IN WHICH CASE THE DIMENSION IS MANDATORY.
2. ALL DIMENSIONS IN MILLIMETRES.
3. ALL HEIGHTS ABOVE RAIL LEVEL ARE AT TARE.

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
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APPROVED	ML
DATE	15/10/2014

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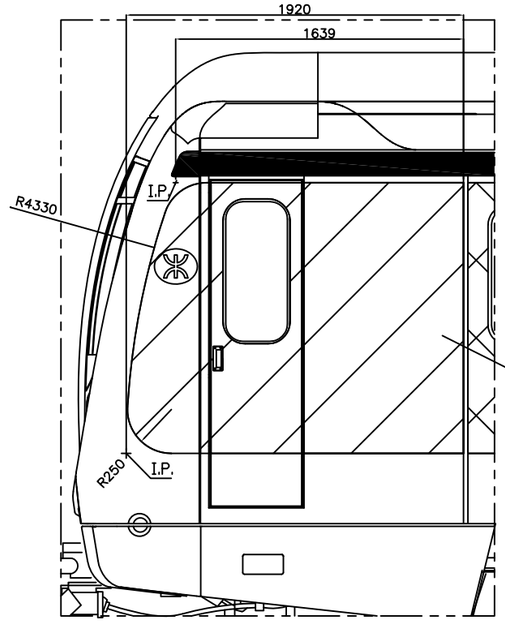
CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_060_004_A.DWG

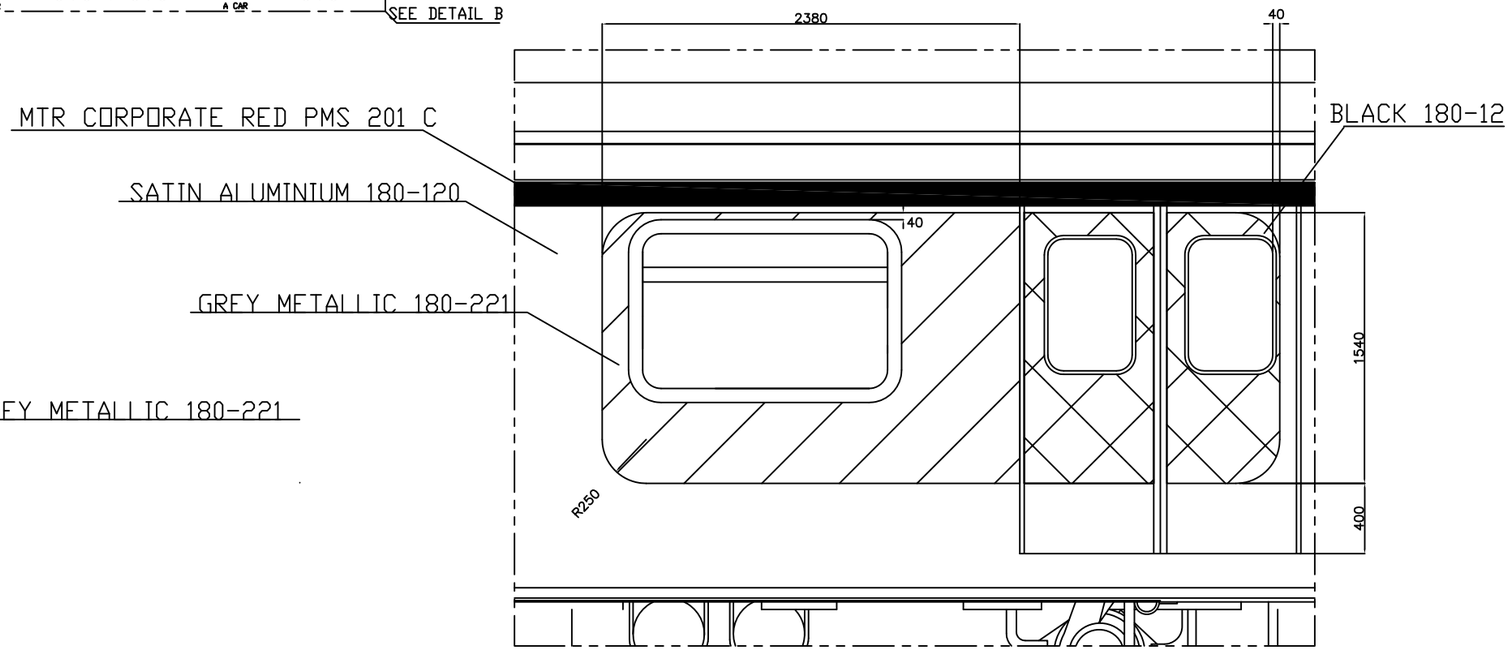
TITLE

C6014-14E
PROCUREMENT OF NEW TRAINS
CAB EXTERIOR
GENERAL ARRANGEMENT

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/060/004	A



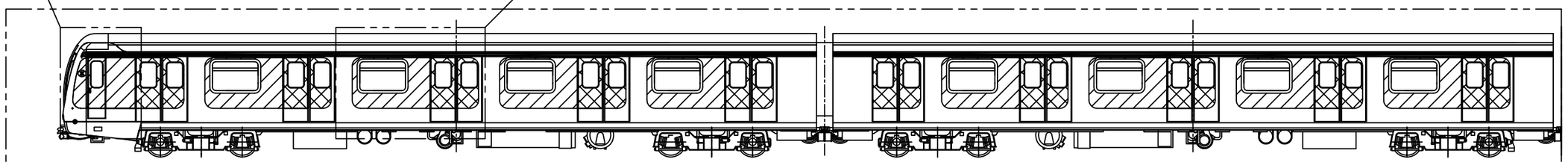
DETAIL C



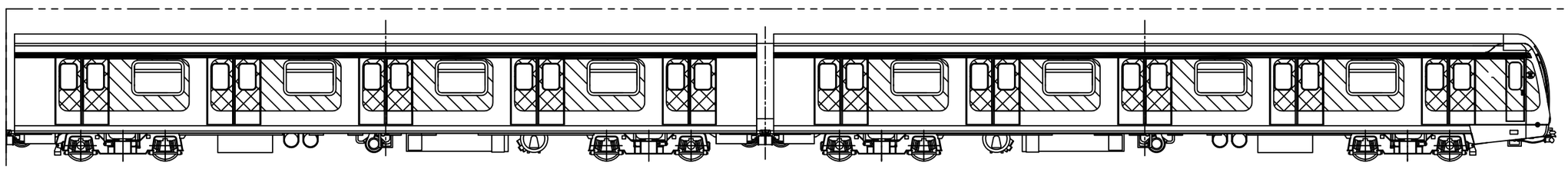
DETAIL D

SEE DETAIL C

SEE DETAIL D



DETAIL A



UP END

DETAIL B

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	EF
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_060_005_A.DWG

TITLE

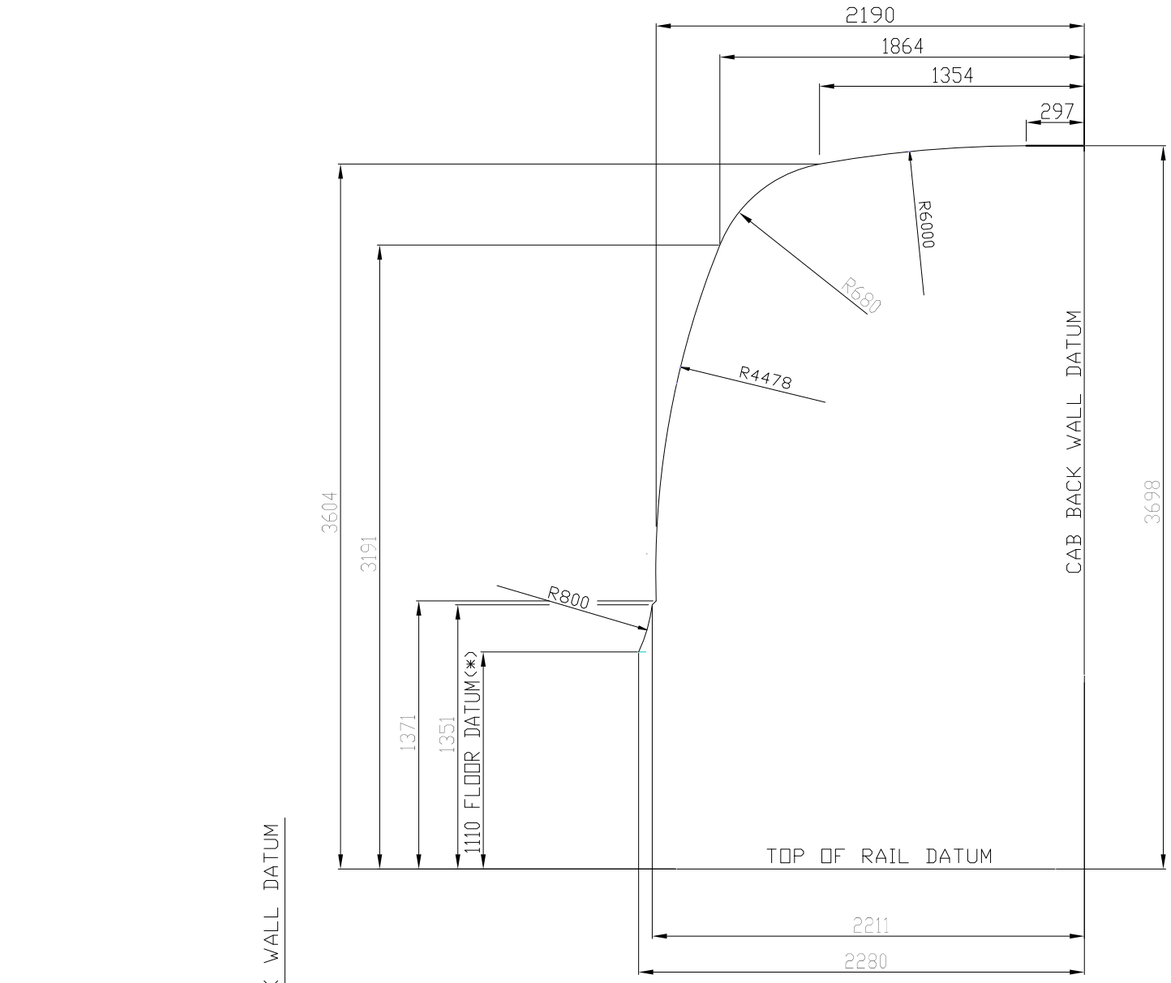
C6014-14E

PROCUREMENT OF NEW TRAINS

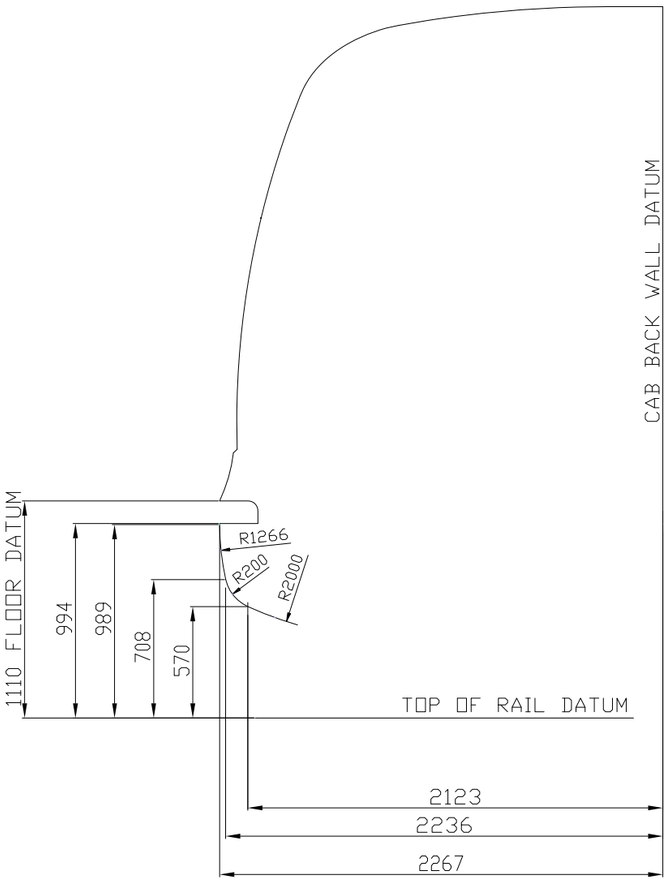
TRAIN EXTERIOR

GENERAL ARRANGEMENT

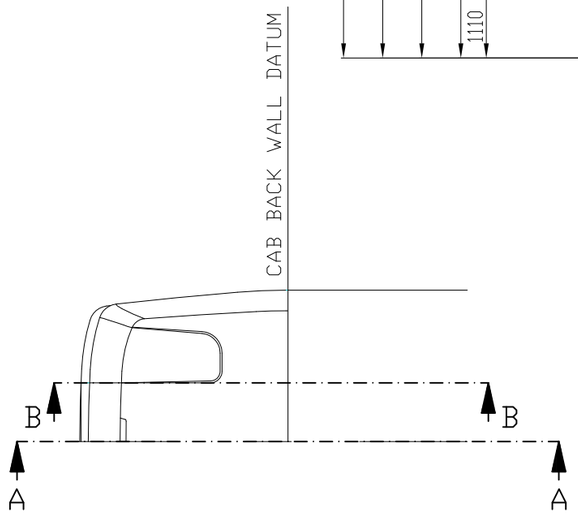
SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/060/005	A



SECTION A-A



SECTION B-B



NOTES:

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2. ALL DIMENSIONS IN MILLIMETRES.
3. ALL HEIGHT ABOVE RAIL LEVEL ARE AT TARE.

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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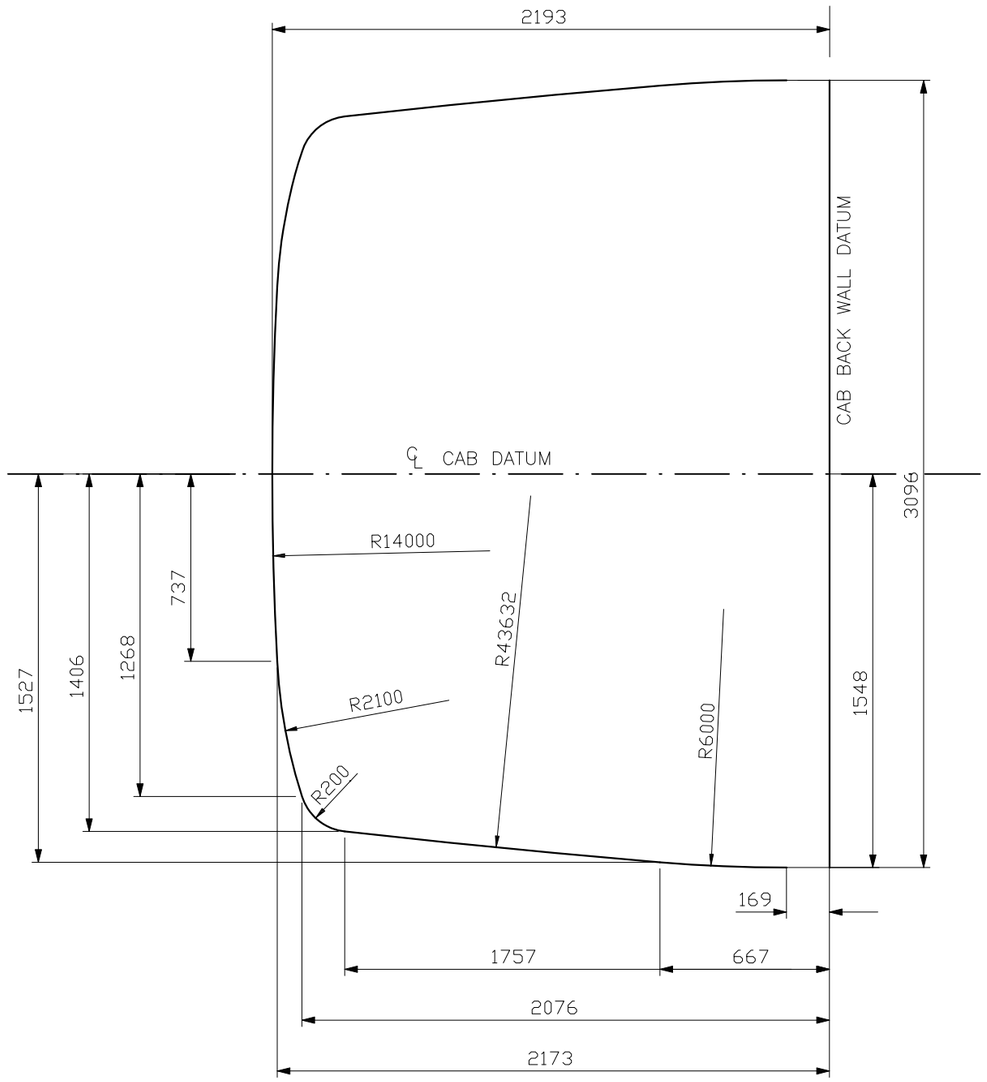
CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_060_006_A.DWG

TITLE
C6014-14E
PROCUREMENT OF NEW TRAINS
CAB -
VERTICAL CROSS SECTION

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/060/006	A



HORIZONTAL SECTION AT 1520 ABOVE RAIL DATUM

NOTES:

1. ALL DIMENSIONS ARE PREFERRED ONLY AND ARE A GUIDE TO THE TYPE OF FORM UNLESS MARKED (*) IN WHICH CASE THE DIMENSION IS MANDATORY.

2. ALL DIMENSIONS IN MILLIMETRES.

3. ALL HEIGHT ABOVE RAIL LEVEL ARE AT TARE.

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_060_007_A.DWG

TITLE

C6014-14E
PROCUREMENT OF NEW TRAINS
CAB -
HORIZONTAL CROSS SECTION

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/060/007	A

PICTURE NO.	DISPLAY MESSAGE	PICTURE NO.	DISPLAY MESSAGE	PICTURE NO.	DISPLAY MESSAGE	PICTURE NO.	DISPLAY MESSAGE	PICTURE NO.	DISPLAY MESSAGE	PICTURE NO.	DISPLAY MESSAGE
00	In Service 載客	15	Tin Hau 天后	30	Tsuen Wan 荃灣	45		60	Kowloon Tong 九龍塘	75	
01	Not in Service 不載客	16	Fortress Hill 炮台山	31	Tai Wo Hau 大窩口	46		61	Shek Kip Mei 石硤尾	76	
02	For Depot 回廠	17	North Point 北角	32	Kwai Hing 葵興	47		62		77	
03	Test 試車	18	Quarry Bay 鰂魚涌	33	Kwai Fong 葵芳	48		63		78	
04	Special 專用	19	Tai Koo 太古	34	Lai King 荔景	49		64		79	
05	Special 專用	20	Sai Wan Ho 西灣河	35	Mei Foo 美孚	50	FOR FUTURE RAILWAY EXTENSION OF KTE	65	Ho Man Tin 何文田	80	
06	Special 專用	21	Shau Kei Wan 筲箕灣	36	Lai Chi Kok 荔枝角	51		66	Whampoa 黃埔	81	LOHAS Park 康城
07	Kennedy Town 堅尼地城	22	Heng Fa Chuen 杏花邨	37	Cheung Sha Wan 長沙灣	52	Lam Tin 藍田	67		82	Po Lam 寶琳
08	HKU 香港大學	23	Chai Wan 柴灣	38	Sham Shui Po 深水埗	53	Kwun Tong 觀塘	68		83	Hang Hau 坑口
09	Sai ying Pun 西營盤	24		39	Prince Edward 太子	54	Ngau Tau Kok 牛頭角	69		84	Tseung Kwan O 將軍澳
10	Sheung Wan 上環	25		40	Mong Kok 旺角	55	Kowloon Bay 九龍灣	70		85	Tiu Keng Leng 調景嶺
11	Central 中環	26		41	Yau Ma Tei 油麻地	56	Choi Hung 彩虹	71		86	Yau Tong 油塘
12	Admiralty 金鐘	27		42	Jordan 佐敦	57	Diamond Hill 鑽石山	72		87	
13	Wan Chai 灣仔	28		43	Tsim Sha Tsui 尖沙咀	58	Wong Tai Sin 黃大仙	73		88	
14	Causeway Bay 銅鑼灣	29		44		59	Lok Fu 樂富	74		89	

FOR FUTURE RAILWAY EXTENSION OF WIL

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_060_008_A.DWG

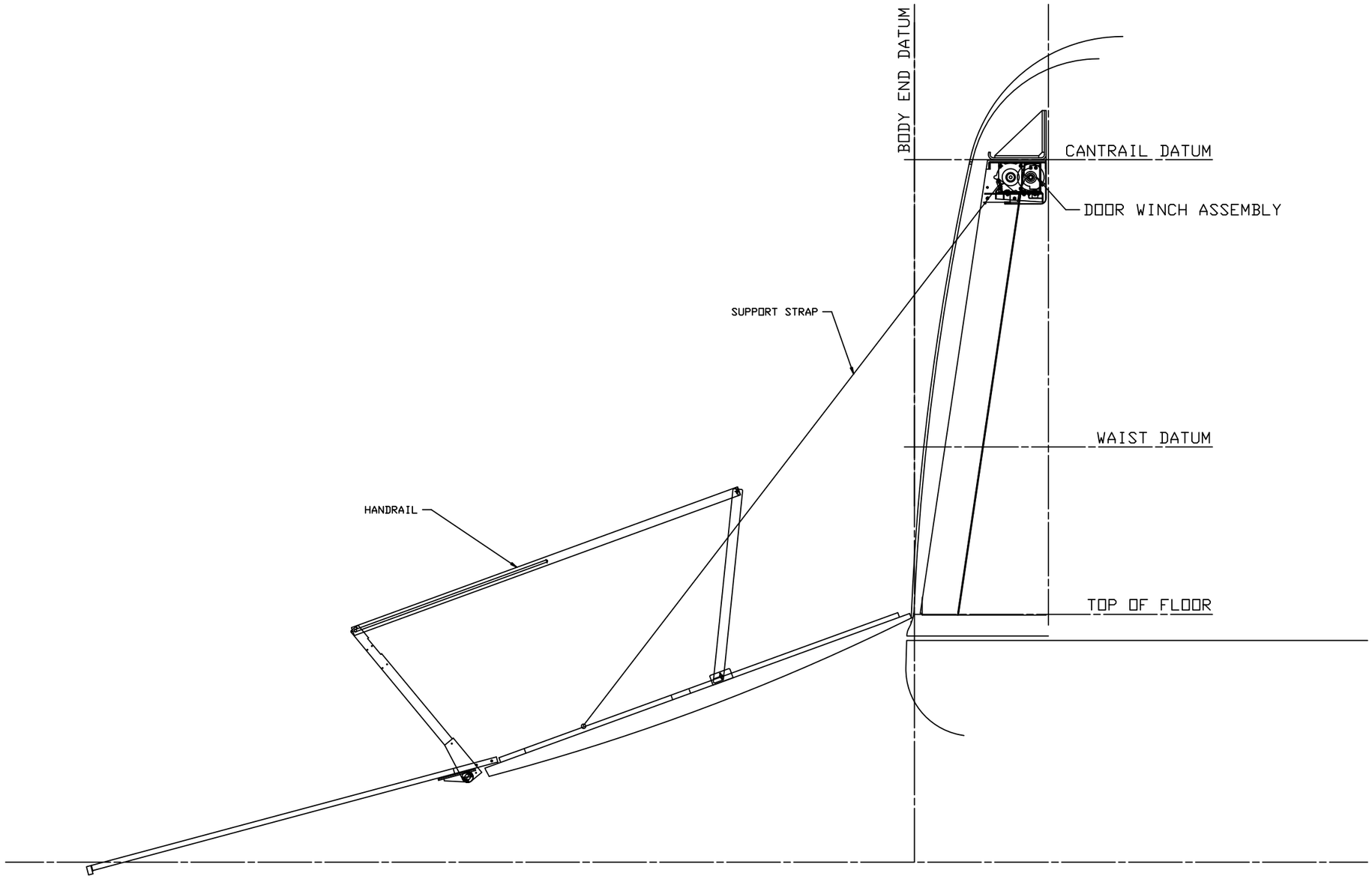
TITLE

C6014-14E

PROCUREMENT OF NEW TRAINS

DESTINATION AND SPECIAL MESSAGES FOR ELECTRONIC DESTINATION DISPLAY

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/060/008	A



REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE

REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
T157/023

	INITIAL	DESIGNATION	DATE
DRAWN BY	JOSEPH TSUI	D'MAN	27/2/97
DESIGNED BY			
CHECKED BY	RASON LAW	DA(RS)	28/2/97
APPROVED BY	W.H.YUEN	ME&SM	28/2/97
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.		157/023	

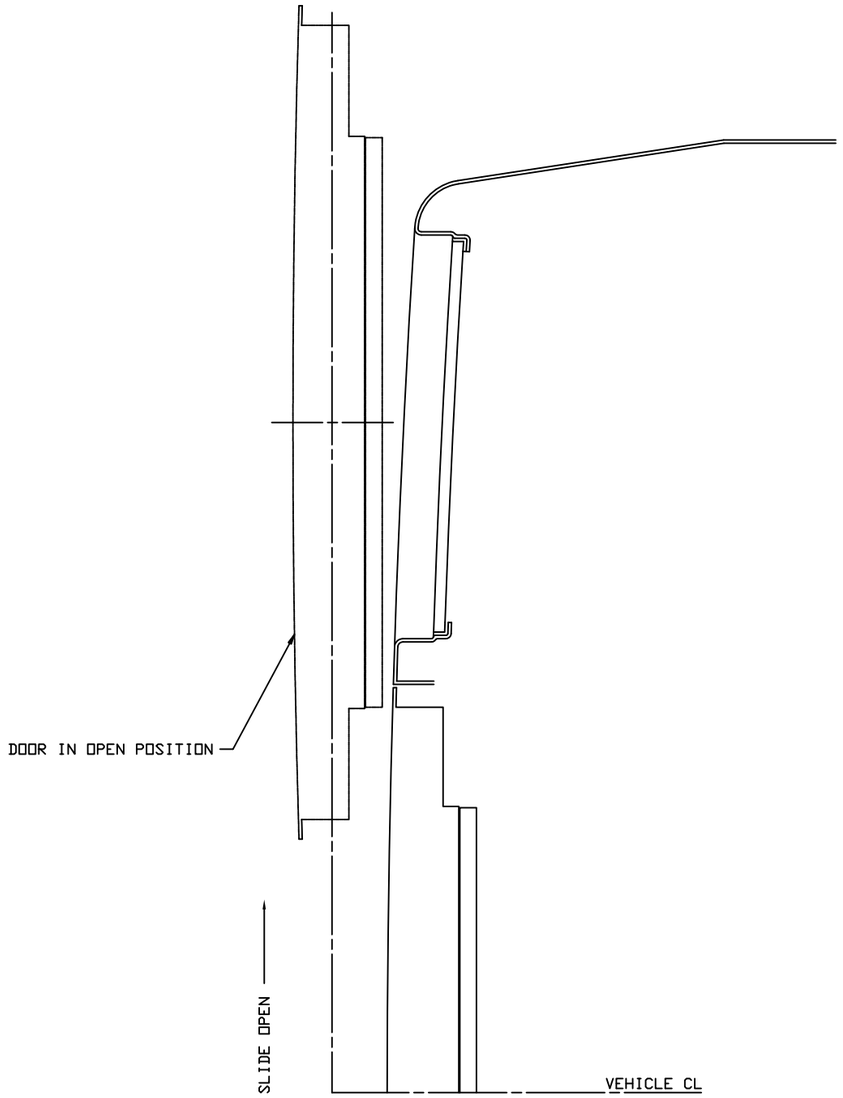
MASS TRANSIT RAILWAY CORPORATION

TITLE
GENERAL ARRANGEMENT OF MOCK-UP EMERGENCY CAB DOOR IN DEPLOYED RAMP POSITION

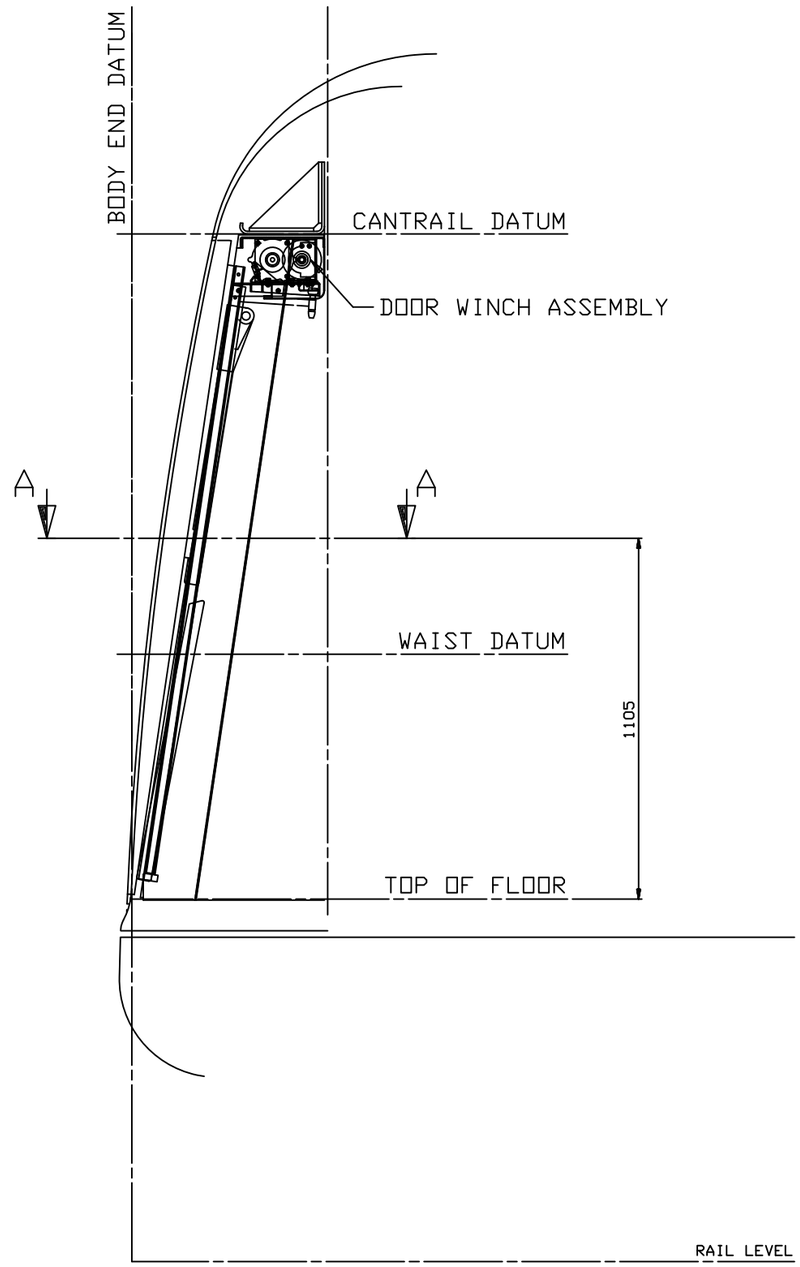
SCALE NTS | DWG NO. OD1/307/00009/001 A

A2 SIZE, 594 x 420mm, TYPE 2

OD1/307/00009/002 A



SECTION A-A
SCALE 1:5



REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE

REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
T157/024

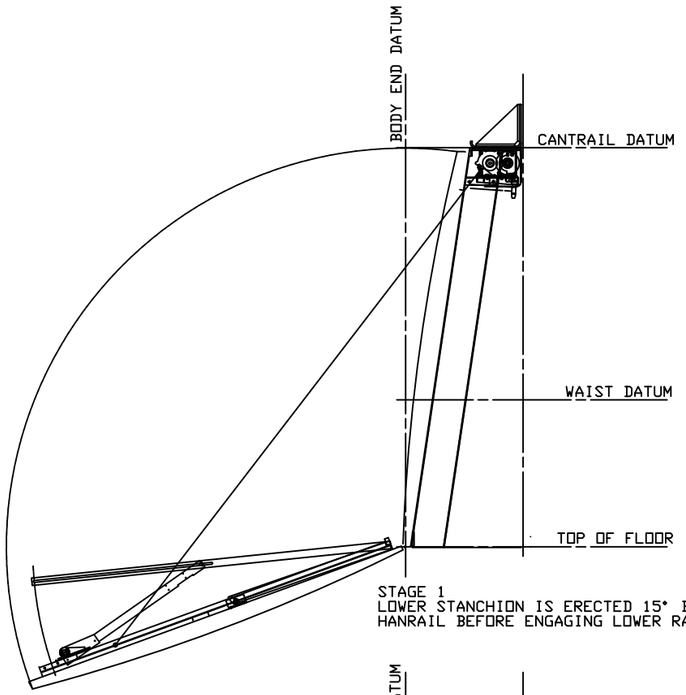
	INITIAL	DESIGNATION	DATE
DRAWN BY	JOSEPH TSUI	D'MAN	27/2/97
DESIGNED BY			
CHECKED BY	RASON LAW	DA(RS)	28/2/97
APPROVED BY	W.H.YUEN	ME&SM	28/2/97
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.		157/024	

MASS TRANSIT RAILWAY CORPORATION

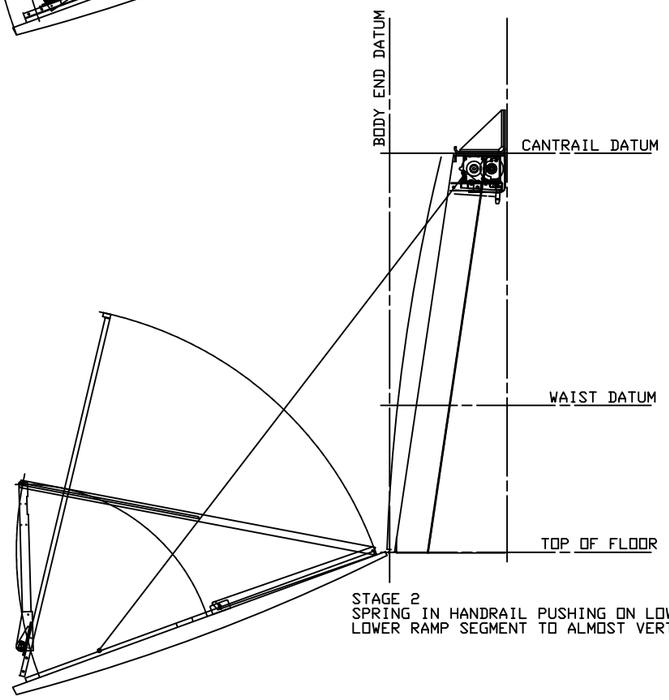
TITLE
GENERAL ARRANGEMENT OF MOCK-UP EMERGENCY CAB DOOR IN PLUG DOOR POSITION

SCALE NTS | DWG NO. OD1/307/00009/002 A

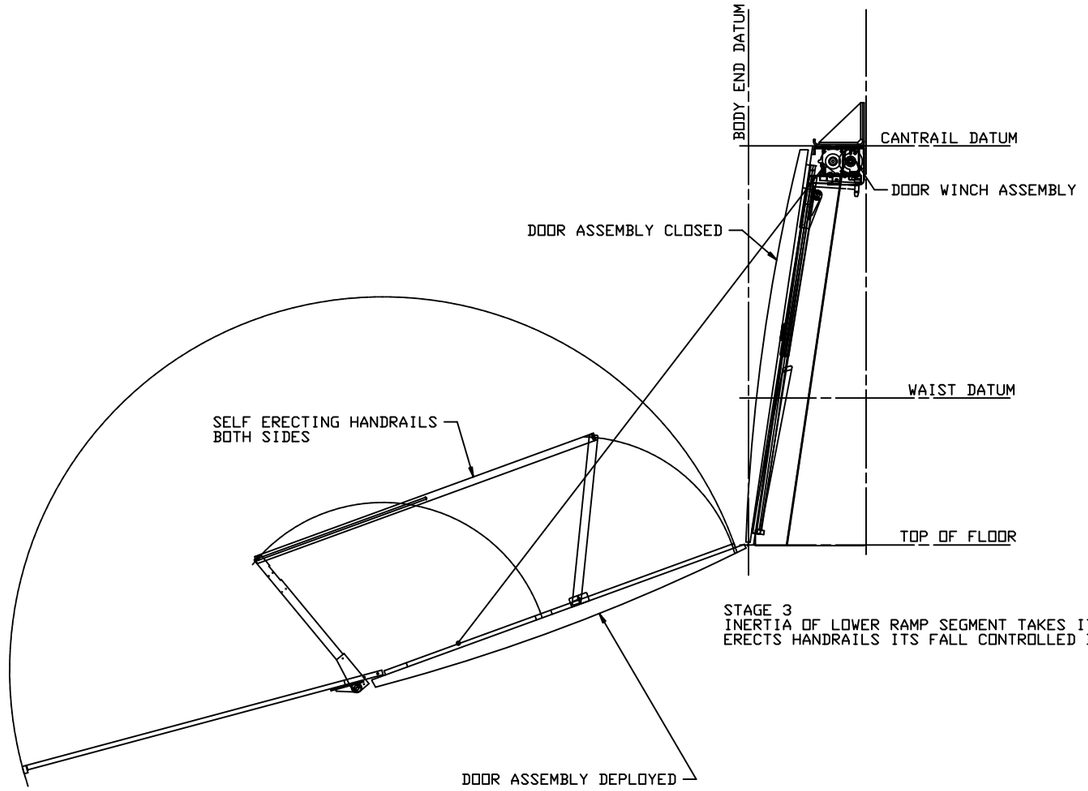
A2 SIZE, 594 x 420mm, TYPE 2



STAGE 1
LOWER STANCHION IS ERECTED 15° BY SPRING IN HANRAIL BEFORE ENGAGING LOWER RAMP SEGMENT



STAGE 2
SPRING IN HANDRAIL PUSHING ON LOWER STANCHIONLEVERS
LOWER RAMP SEGMENT TO ALMOST VERTICAL POSITION



STAGE 3
INERTIA OF LOWER RAMP SEGMENT TAKES IT OVER VERTICAL AND ERECTS HANDRAILS ITS FALL CONTROLLED BY EXISTING DAMPER

REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE

REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
T157/026

	INITIAL	DESIGNATION	DATE
DRAWN BY	JOSEPH TSUI	D'MAN	27/2/97
DESIGNED BY			
CHECKED BY	RASON LAW	DA(RS)	28/2/97
APPROVED BY	W.H.YUEN	ME&SM	28/2/97
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.		157/026	

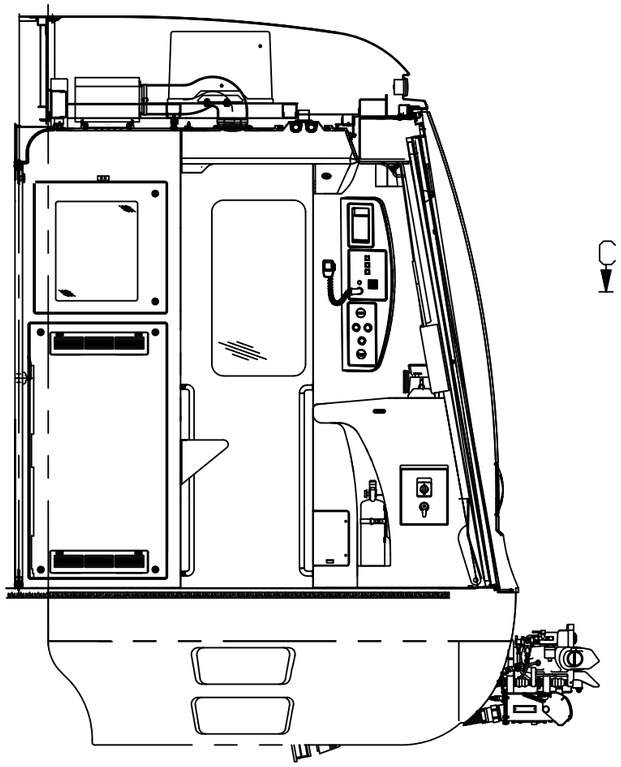
MASS TRANSIT RAILWAY CORPORATION

TITLE
MOCK-UP EMERGENCY CAB DOOR RAMP DEPLOYMENT SEQUENCE

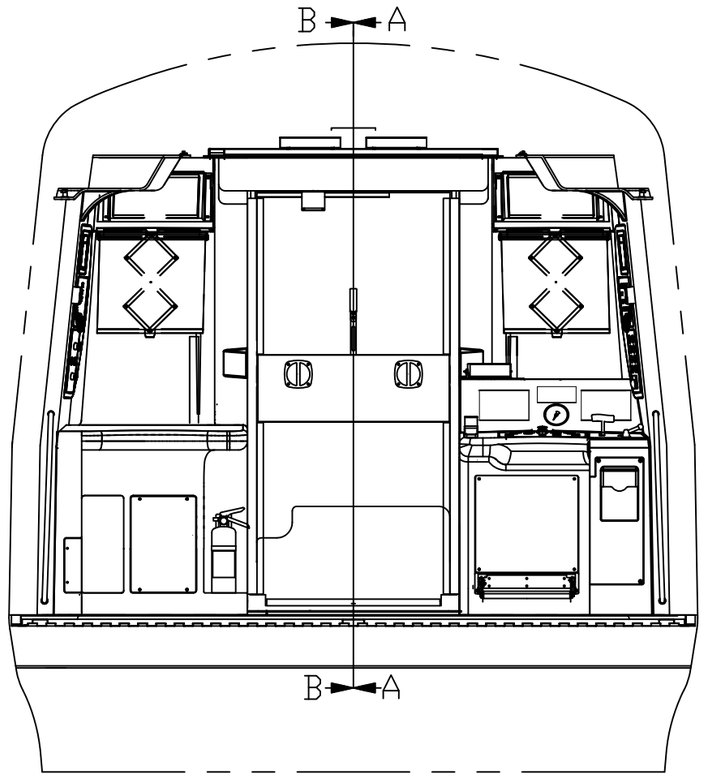
SCALE NTS DWG NO. 0D1/307/00009/003 A

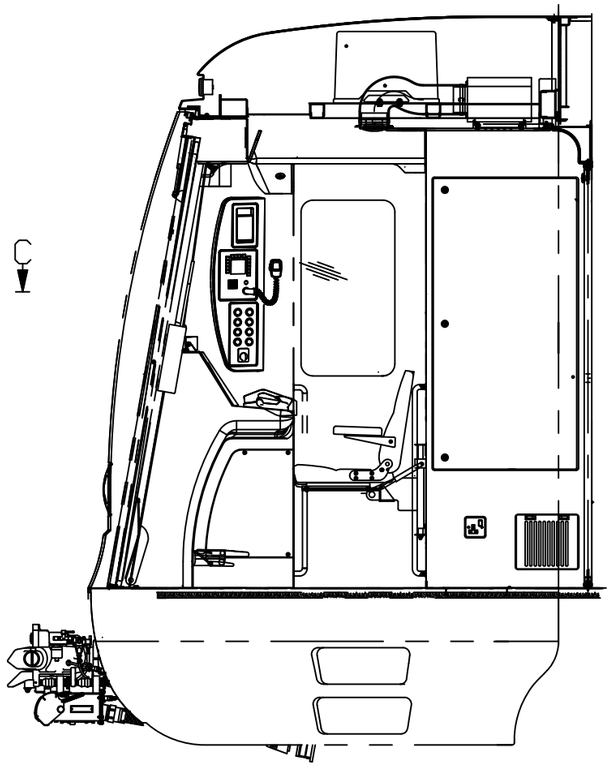
A2 SIZE, 594 x 420mm, TYPE 2

CAB INTERIOR DESIGN		
Drawing No.	**Title**	**Revision**
C6014-14E/TSEG/110/001	Cab Interior General Arrangement	A
C6014-14E/TSEG/110/002	Train Operator's Console and Window - Zone A	A
C6014-14E/TSEG/110/003	Auxiliary Console and Window - Zone B	A
C6014-14E/TSEG/110/004	A Side Cab Back Wall - Zone C	A
C6014-14E/TSEG/110/005	B Side Cab Back Wall - Zone D	A
C6014-14E/TSEG/110/006	Cab Ceiling - Zone E	A
C6014-14E/TSEG/110/007	Bardic Signal Lamp	A
C6014-14E/TSEG/110/008	Not Used	-
C6014-14E/TSEG/110/009	Train Operator's Seat	A



SECTION A–A





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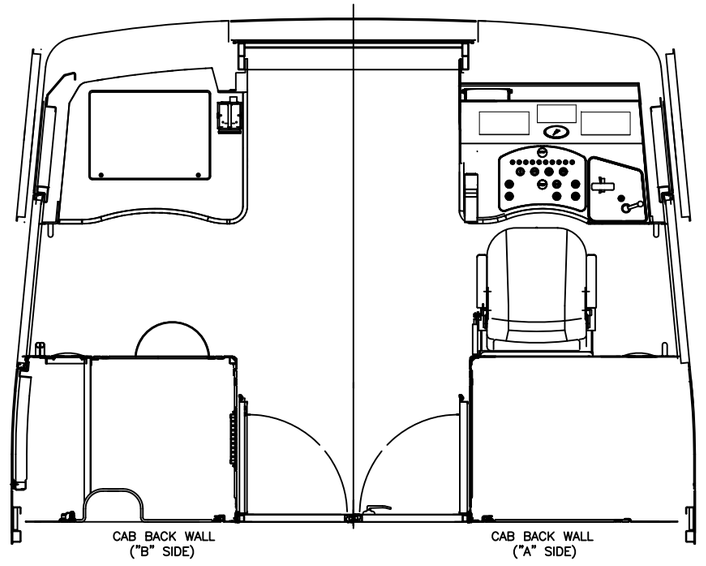

SECTION C–C

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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ORIGINATOR

OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

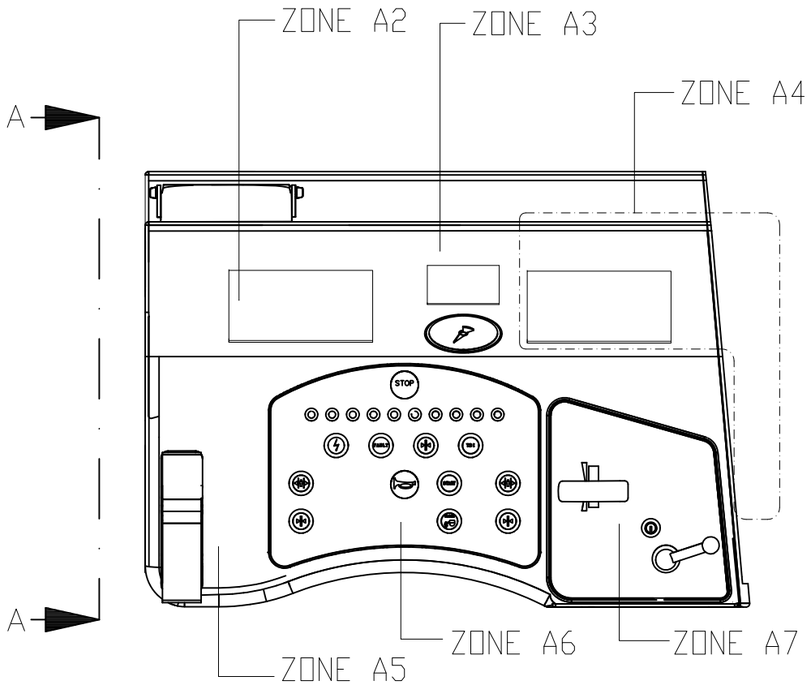
CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_110_001_A.DWG

TITLE

C6014–14E
PROCUREMENT OF NEW TRAINS
CAB INTERIOR
GENERAL ARRANGEMENT

SCALE	DRAWING NO.	REV.
NTS	C6014–14E/TSEG/110/001	A



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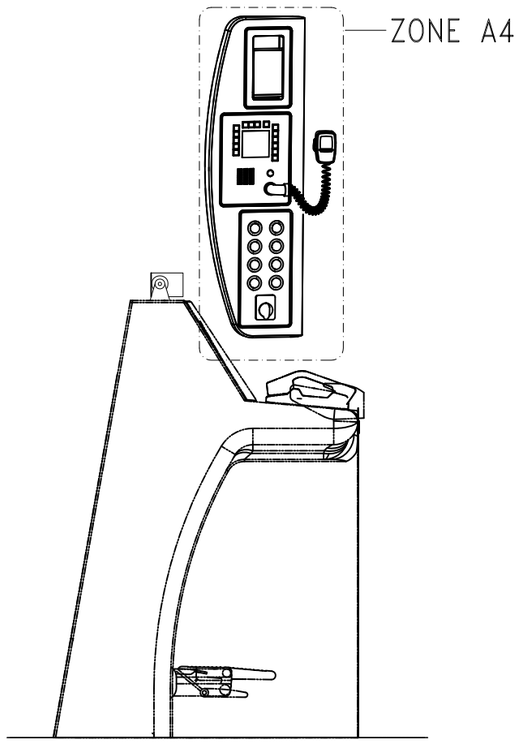
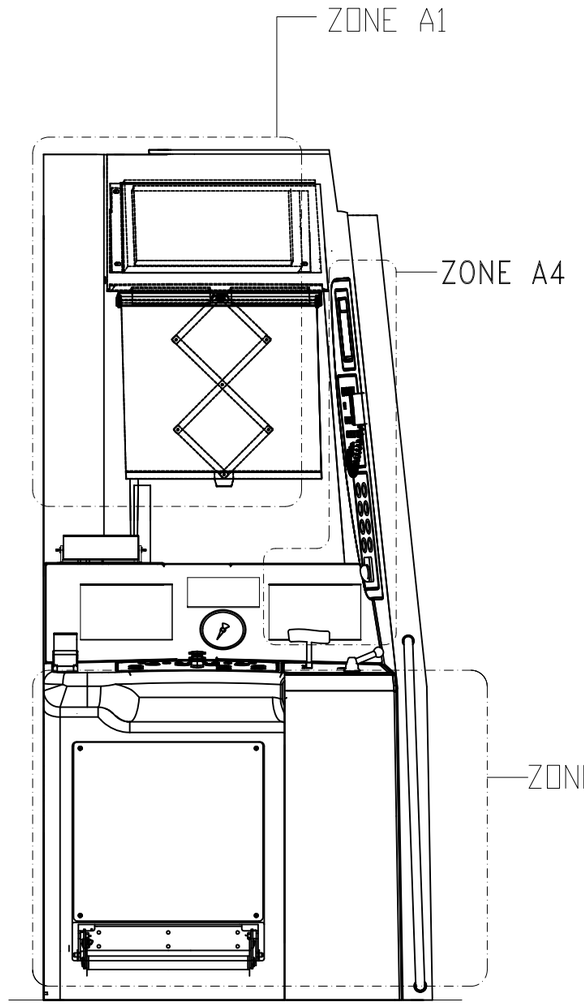


VIEW A–A



VIEW B–B

NOTE: REFER TO PS 8.8.10
FOR SUMMARY OF CONTROLS AND FACILITIES

REV	BY	DATE	APPROVED	REV	DESCRIPTION	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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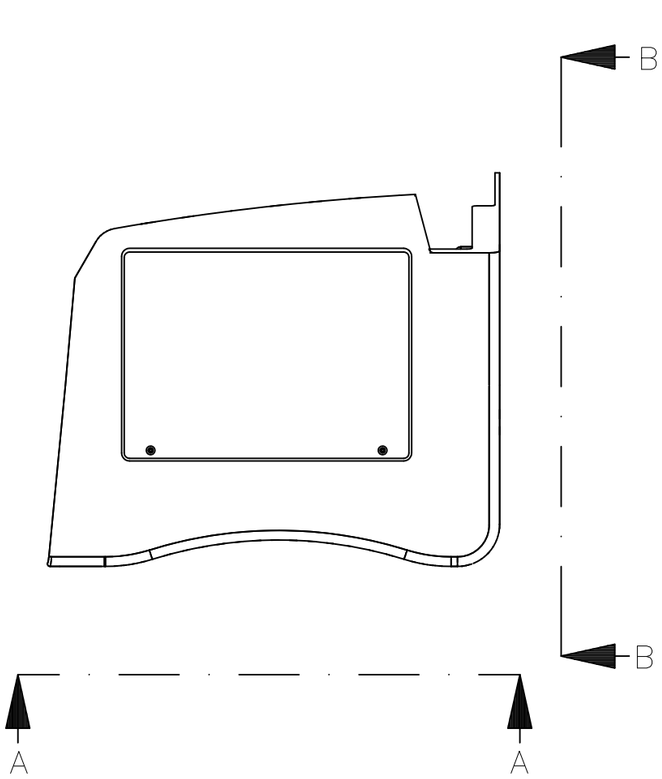
ORIGINATOR
OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

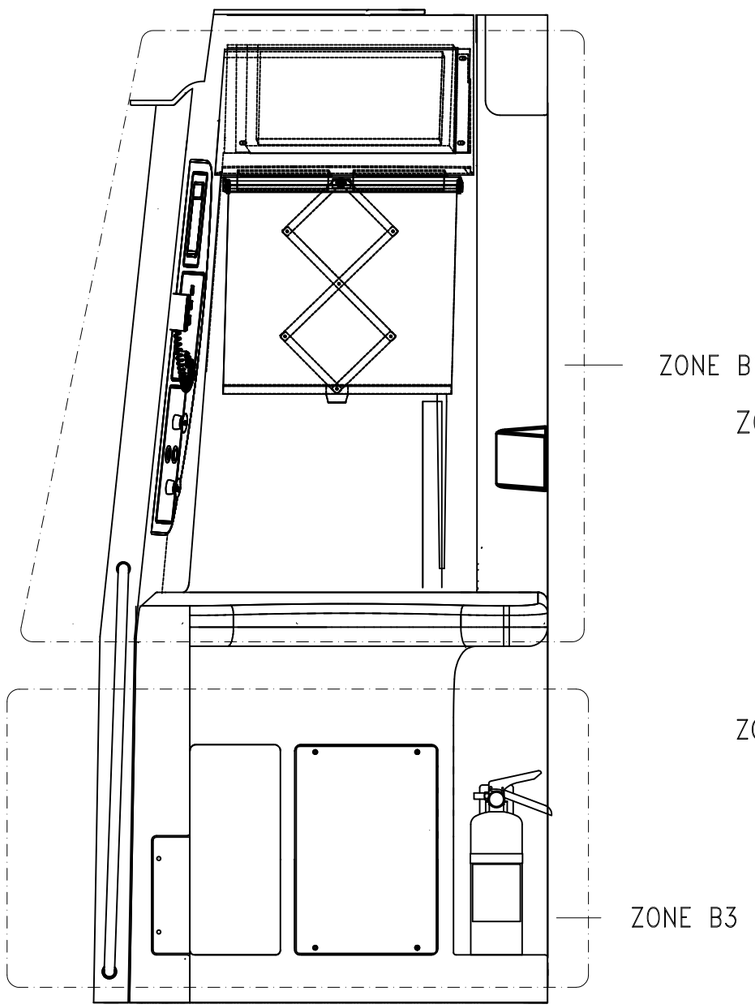
CONTRACTOR REFERENCE NO.

FILE NAME: C6014–14E_TSEG_110_002_A.DWG

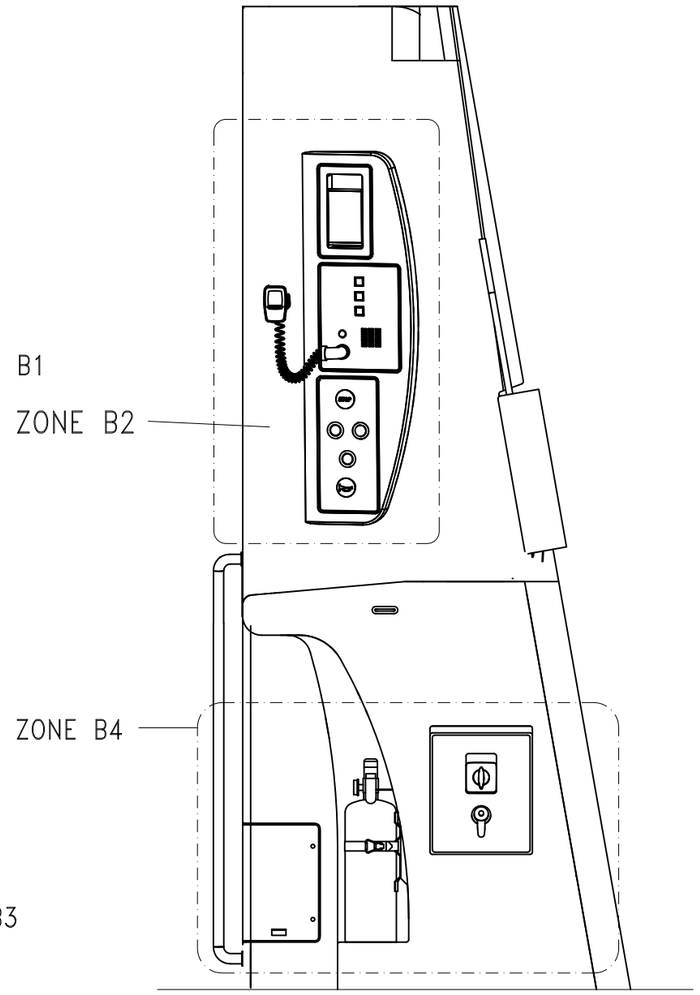
TITLE
C6014–14E
PROCUREMENT OF NEW TRAINS
TRAIN OPERATOR'S
CONSOLE AND WINDOW – ZONE A

SCALE	DRAWING NO.	REV.
NTS	C6014–14E/TSEG/110/002	A





VIEW A–A



VIEW B–B

NOTE: REFER TO PS 8.9.6
FOR SUMMARY OF CONTROLS AND FACILITIES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

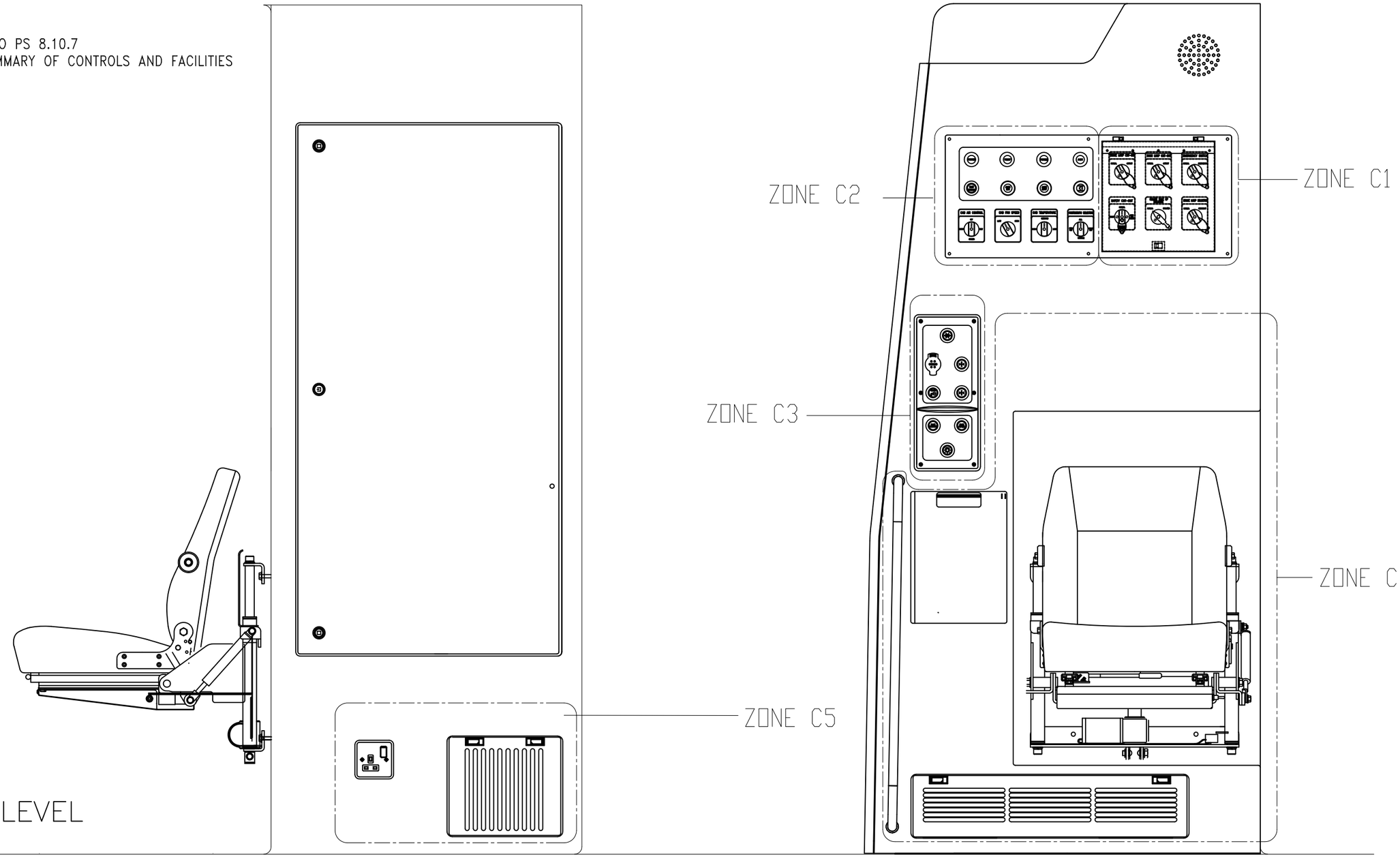
CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_110_003_A.DWG

TITLE
C6014-14E
PROCUREMENT OF NEW TRAINS
AUXILIARY CONSOLE
AND WINDOW – ZONE B

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/110/003	A

NOTE: REFER TO PS 8.10.7
FOR SUMMARY OF CONTROLS AND FACILITIES



REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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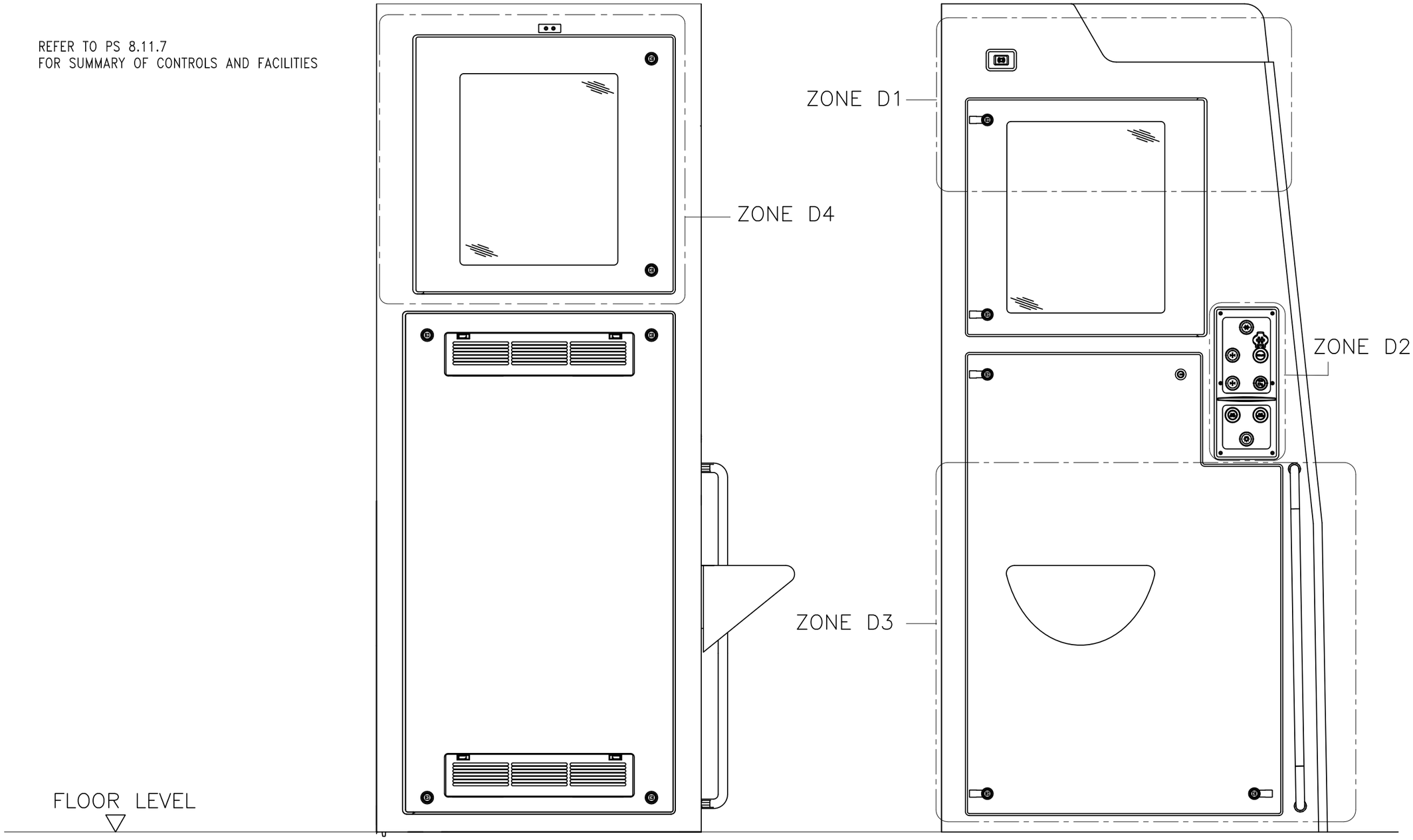
CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_110_004_A.DWG

TITLE
C6014-14E
ROLLING STOCK FOR MTR LINES
A SIDE CAB BACK WALL
– ZONE C

SCALE	DRAWING NO.	REV.
NTS	**C6014-14E/TSEG/110/004**	A

NOTE: REFER TO PS 8.11.7
FOR SUMMARY OF CONTROLS AND FACILITIES



REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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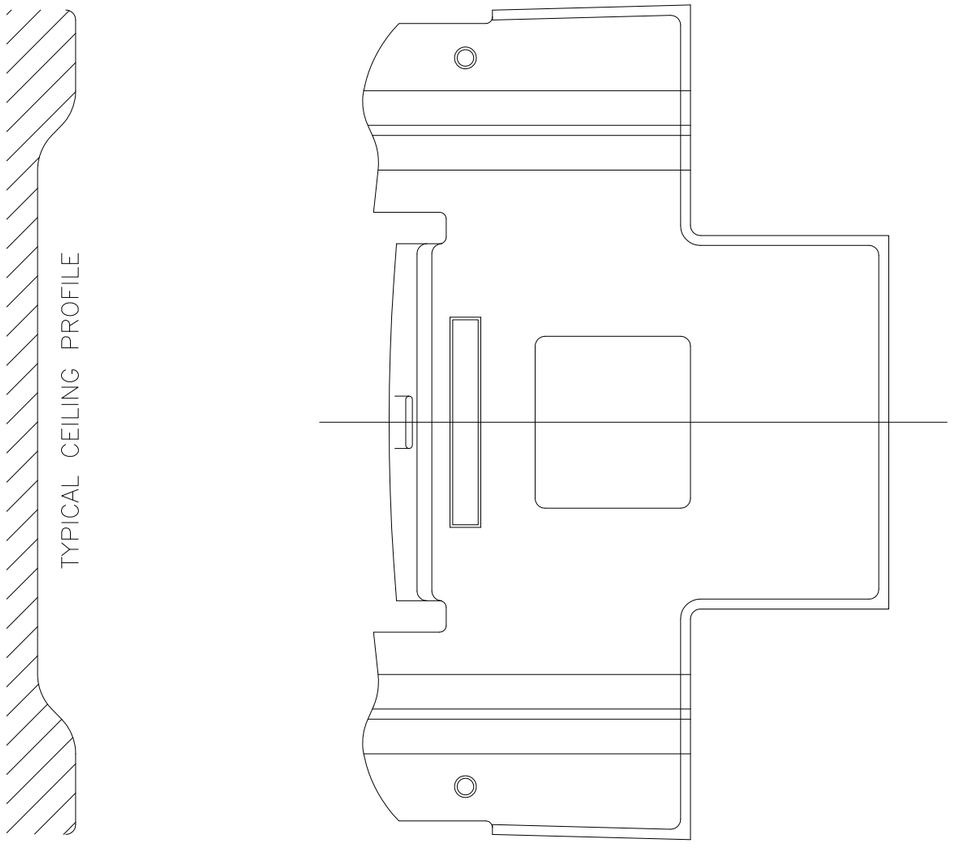
OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_110_005_A.DWG

TITLE
C6014-14E
PROCUREMENT OF NEW TRAINS
B SIDE CAB BACK WALL
– ZONE D

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/110/005	A



NOTE: REFER TO PS 8.12.6
FOR SUMMARY OF CONTROLS AND FACILITIES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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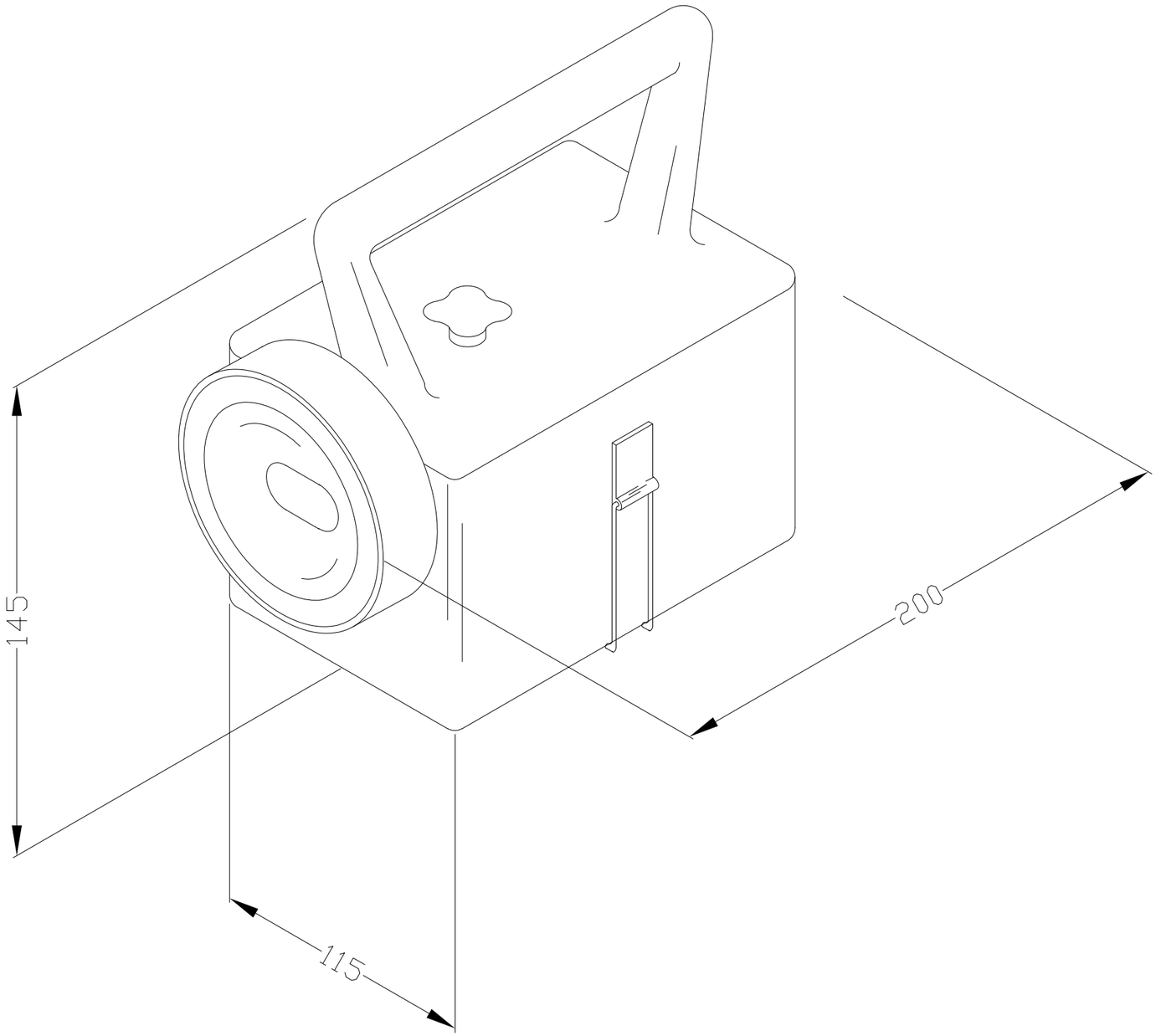
OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_110_006_A.DWG

TITLE
C6014-14E
PROCUREMENT OF NEW TRAINS
CAB CEILING – ZONE E

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/110/006	A



NOTE: ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED
REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_110_007_A.DWG

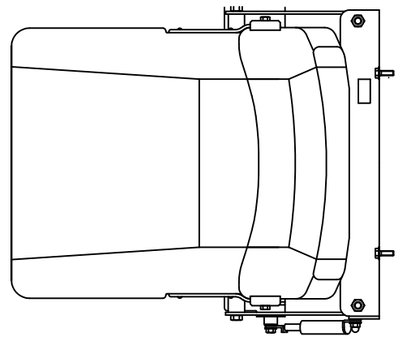
TITLE

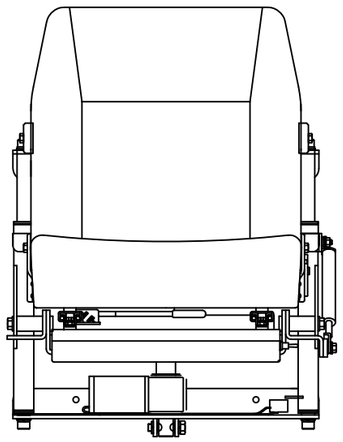
C6014-14E

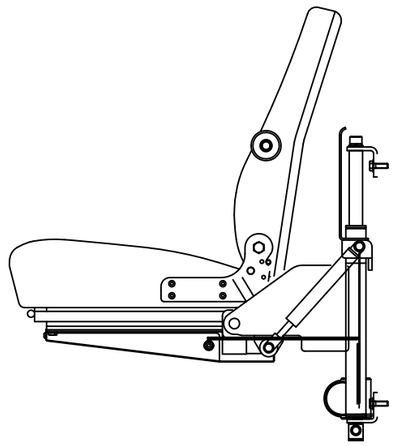
PROCUREMENT OF NEW TRAINS

BARDIC SIGNAL LAMP

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/110/007	A







REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_110_009_A.DWG

TITLE

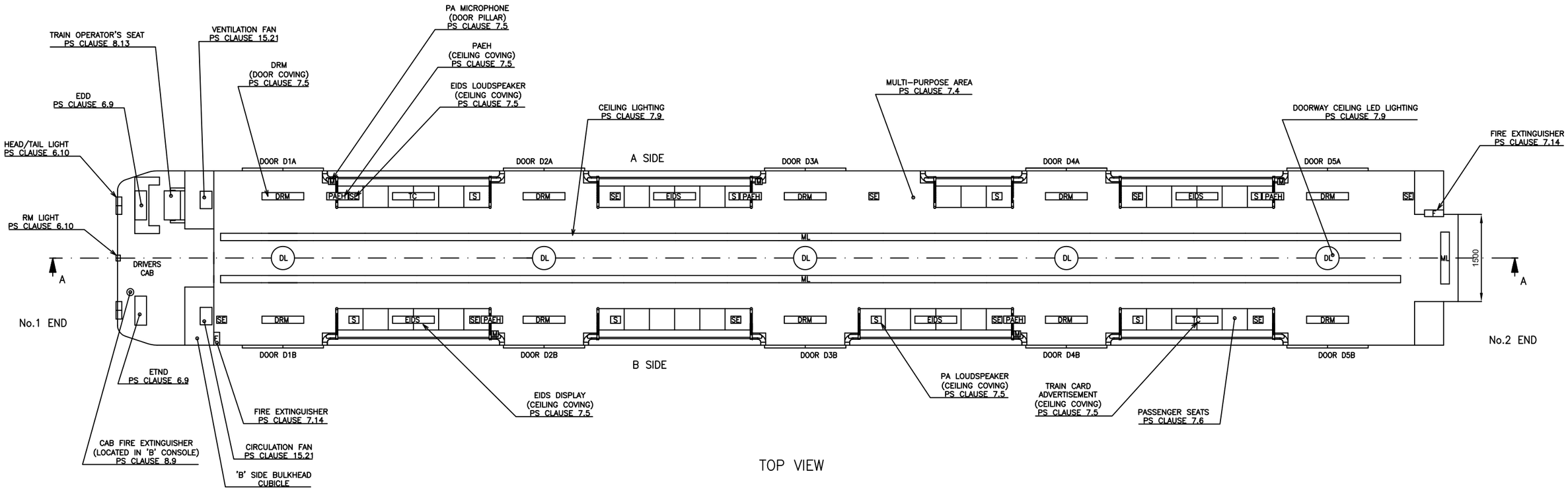
C6014-14E

PROCUREMENT OF NEW TRAINS

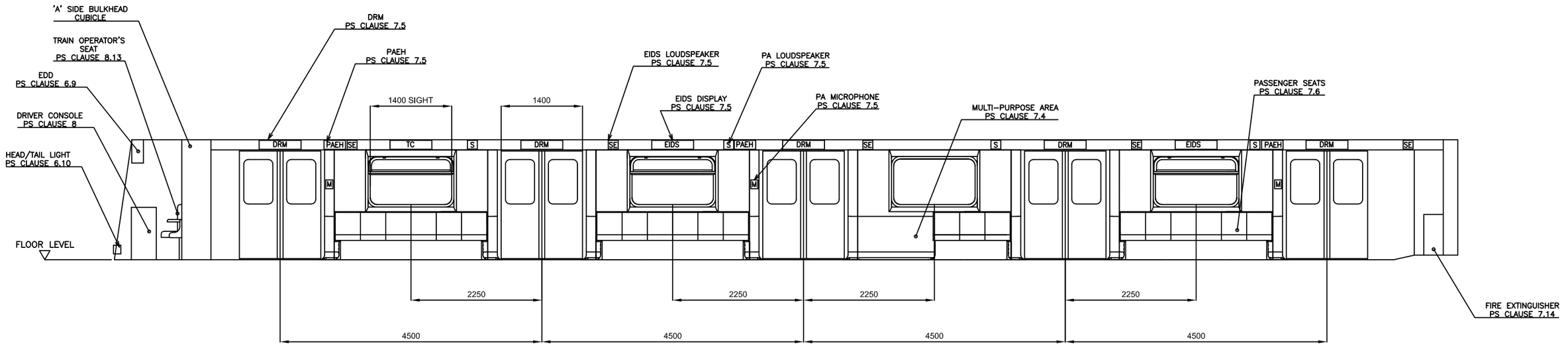
TRAIN OPERATOR'S SEAT

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/110/009	A

SALOON INTERIOR DESIGN		
Drawing No.	**Title**	**Revision**
C6014-14E/TSEG/100/001	General Saloon Interior Arrangement – A car	A
C6014-14E/TSEG/100/002	General Saloon Interior Arrangement – B car in 'ACB' Unit	A
C6014-14E/TSEG/100/003	General Saloon Interior Arrangement – B car in 'BC' Unit	A
C6014-14E/TSEG/100/004	General Saloon Interior Arrangement – C car in 'ACB' Unit	A
C6014-14E/TSEG/100/005	General Saloon Interior Arrangement – C car in 'BC' Unit	A
C6014-14E/TSEG/100/006	Saloon Interior – Overall Perspective View	A
C6014-14E/TSEG/100/007	Saloon Interior – Perspective View at Seat Bench Sh 1 of 2	A
C6014-14E/TSEG/100/007	Saloon Interior – Perspective View at Seat Bench Sh 2 of 2	A
C6014-14E/TSEG/100/008	Saloon Interior – Perspective View at Multi-purpose Area	A
C6014-14E/TSEG/100/009	Saloon Interior – Perspective View at Enlarged Multi-purpose Area	A
C6014-14E/TSEG/100/010	Saloon Interior – Perspective View at Cab End Bulkhead	A
C6014-14E/TSEG/100/011	Saloon Interior – Perspective View at Intercar Gangway	A
C6014-14E/TSEG/100/012	Saloon Interior – Colour Scheme	A
C6014-14E/TSEG/100/013	Multi-Purpose Area General Arrangement	A
C6014-14E/TSEG/100/014	Enlarged Multi-Purpose Area General Arrangement	A
C6014-14E/TSEG/100/015	Bodyside Interior Trim General Arrangement Sh 1 of 2	A
C6014-14E/TSEG/100/015	Bodyside Interior Trim General Arrangement Sh 2 of 2	A
C6014-14E/TSEG/100/016	Bodyside Door General Arrangement	A
C6014-14E/TSEG/100/017	Cab End Bulkhead General Arrangement	A
C6014-14E/TSEG/100/018	Intercar Gangway General Arrangement	A
C6014-14E/TSEG/100/019	Vestibule Interior Cross-Section General Arrangement	A
C6014-14E/TSEG/100/020	Ceiling General Arrangement	A
C6014-14E/TSEG/100/021	Seating	A
C6014-14E/TSEG/100/022	Not Used	-
C6014-14E/TSEG/100/023	Floor Covering Arrangement	A
C6014-14E/TSEG/100/024	Priority Seat Graphics General Arrangement	A
C6014-14E/TSEG/100/025	Straphanger	A
C6014-14E/TSEG/100/026	Door Gap Gauge	A
C6014-14E/TSEG/100/027	Door Obstacle Gauge	A
OD4/362/00510/0261	Fire Extinguisher	A



TOP VIEW



SECTION A–A

NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_001_A.DWG

TITLE

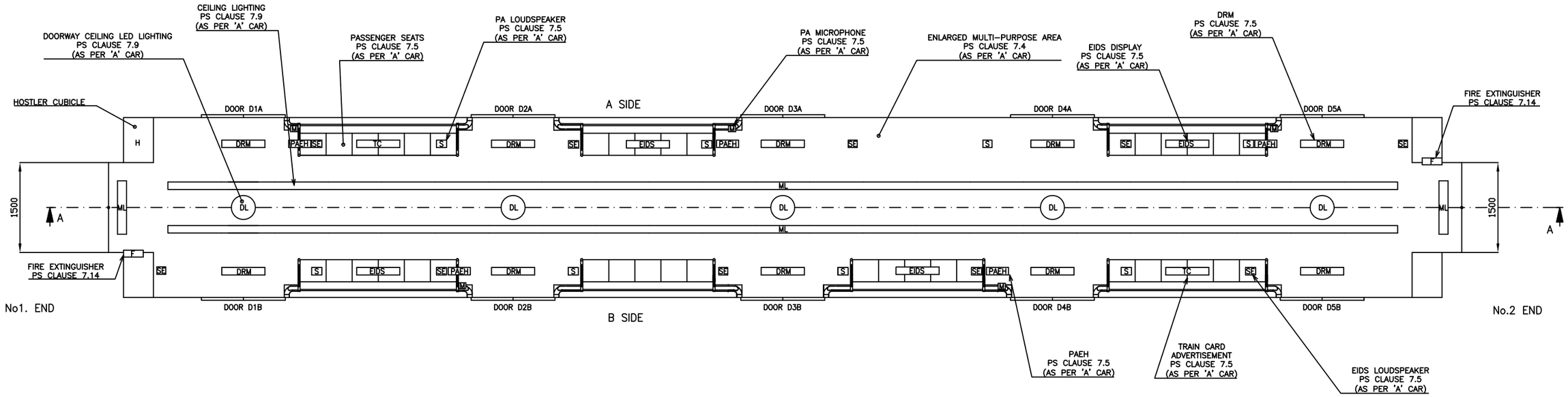
C6014-14E

PROCUREMENT OF NEW TRAINS

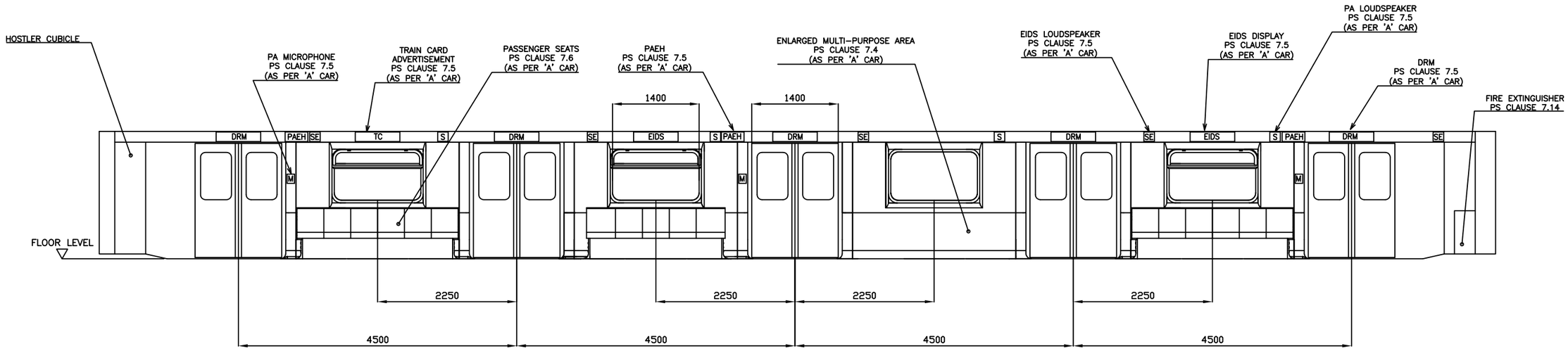
GENERAL SALOON INTERIOR ARRANGEMENT

A CAR

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/001	A



TOP VIEW



SECTION A–A

NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_002.DWG

TITLE

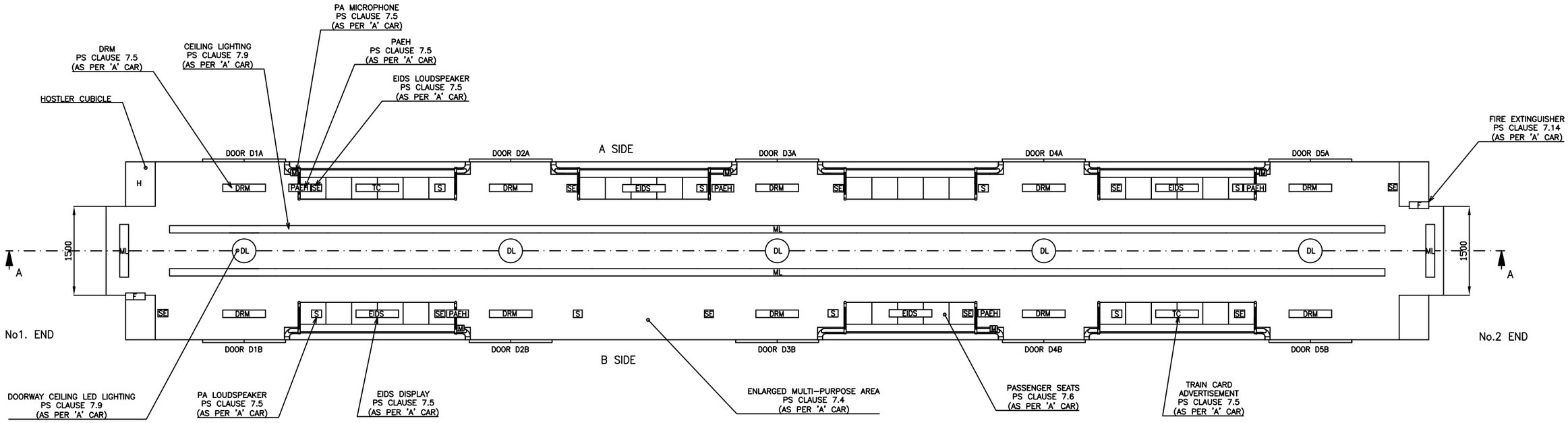
C6014-14E

PROCUREMENT OF NEW TRAINS

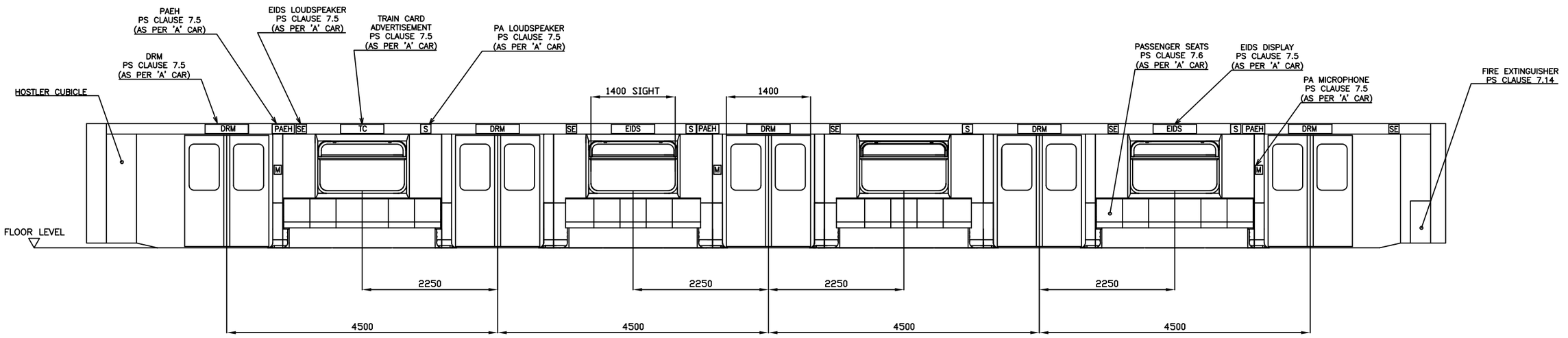
GENERAL SALOON INTERIOR ARRANGEMENT

B CAR IN 'ACB' UNIT

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/002	A



TOP VIEW



SECTION A–A

NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED
REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_003_A.DWG

TITLE

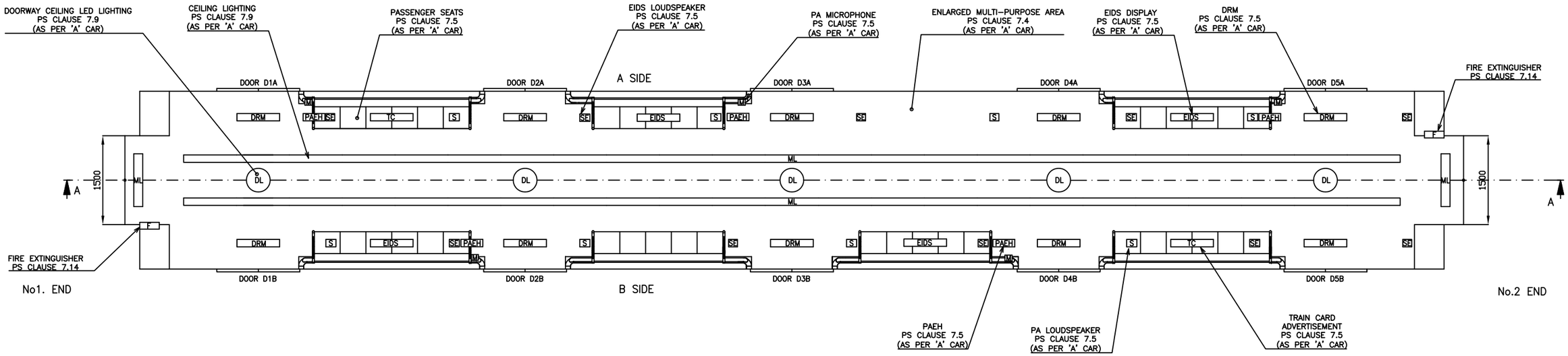
C6014-14E

PROCUREMENT OF NEW TRAINS

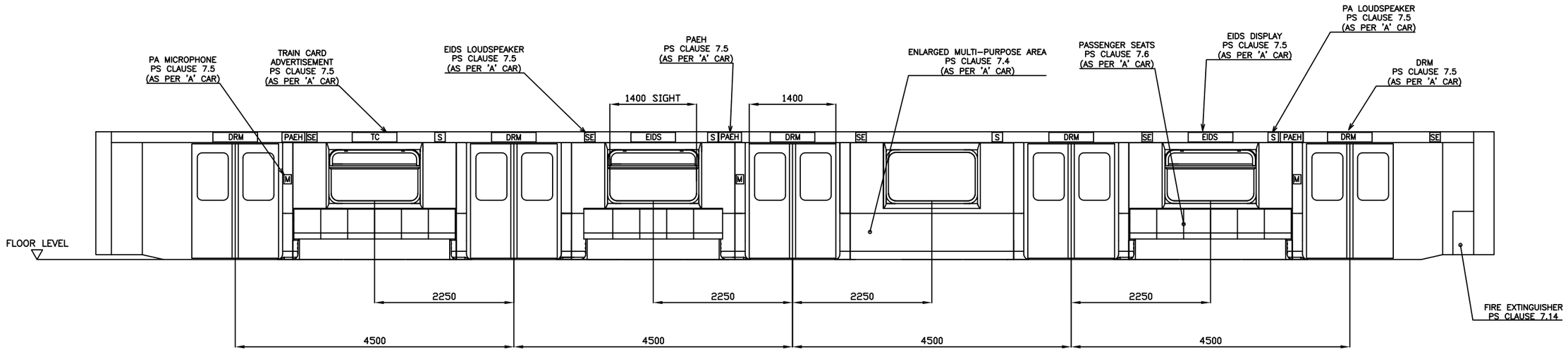
GENERAL SALOON INTERIOR ARRANGEMENT

B CAR IN 'BC' UNIT

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/003	A



TOP VIEW



SECTION A–A

NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_004.DWG

TITLE

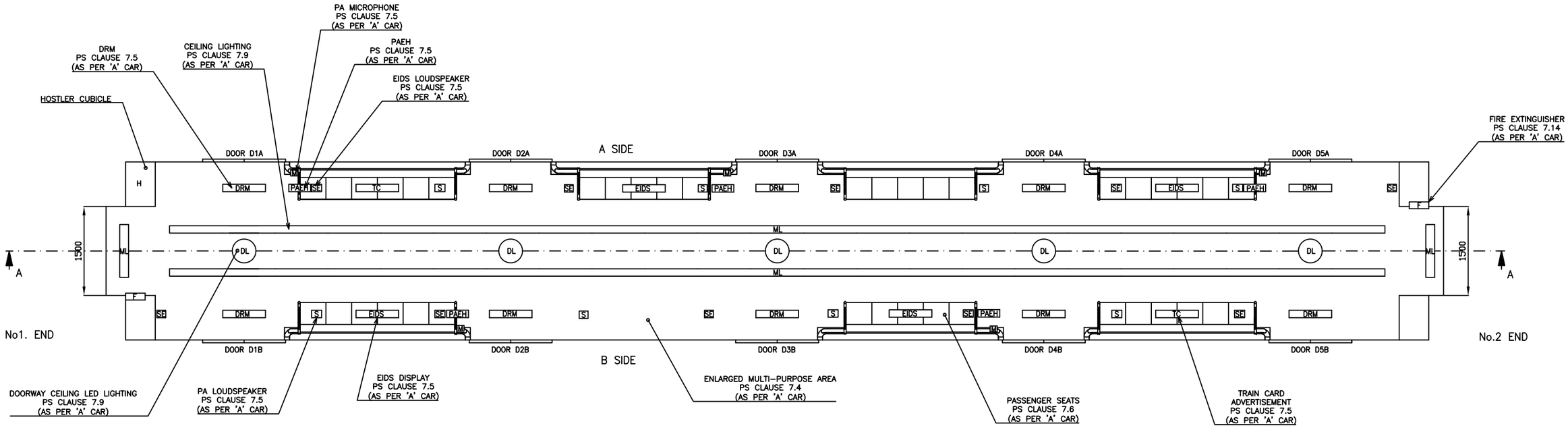
C6014-14E

PROCUREMENT OF NEW TRAINS

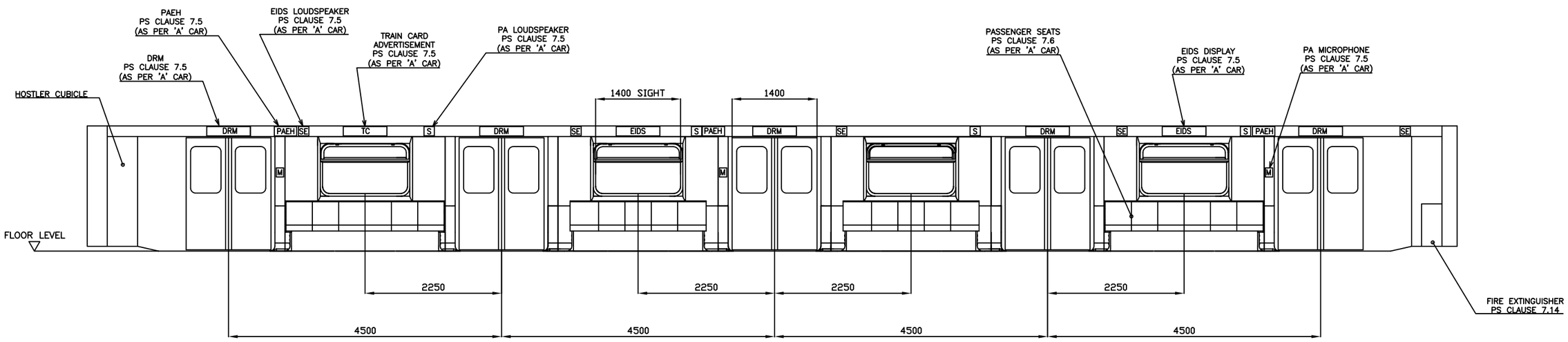
GENERAL SALOON INTERIOR ARRANGEMENT

C CAR IN 'ACB' UNIT

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/004	A



TOP VIEW



SECTION A-A

NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_005_A.DWG

TITLE

C6014-14E

PROCUREMENT OF NEW TRAINS

GENERAL SALOON INTERIOR ARRANGEMENT

C CAR IN 'BC' UNIT

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/005	A

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	---
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_006_A.DWG

TITLE

C6014-14E

PROCUREMENT OF NEW TRAINS

SALOON INTERIOR

OVERALL PERSPECTIVE VIEW

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/006	A

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	___
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_007_SH1_OF_2_A.DWG

TITLE

C6014-14E

PROCUREMENT OF NEW TRAINS

SALOON INTERIOR

PERSPECTIVE VIEW AT SEAT BENCH SH 1 OF 2

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/007	A

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
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DATE	15/10/2014

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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_007_SH2_OF_2_A.DWG

TITLE

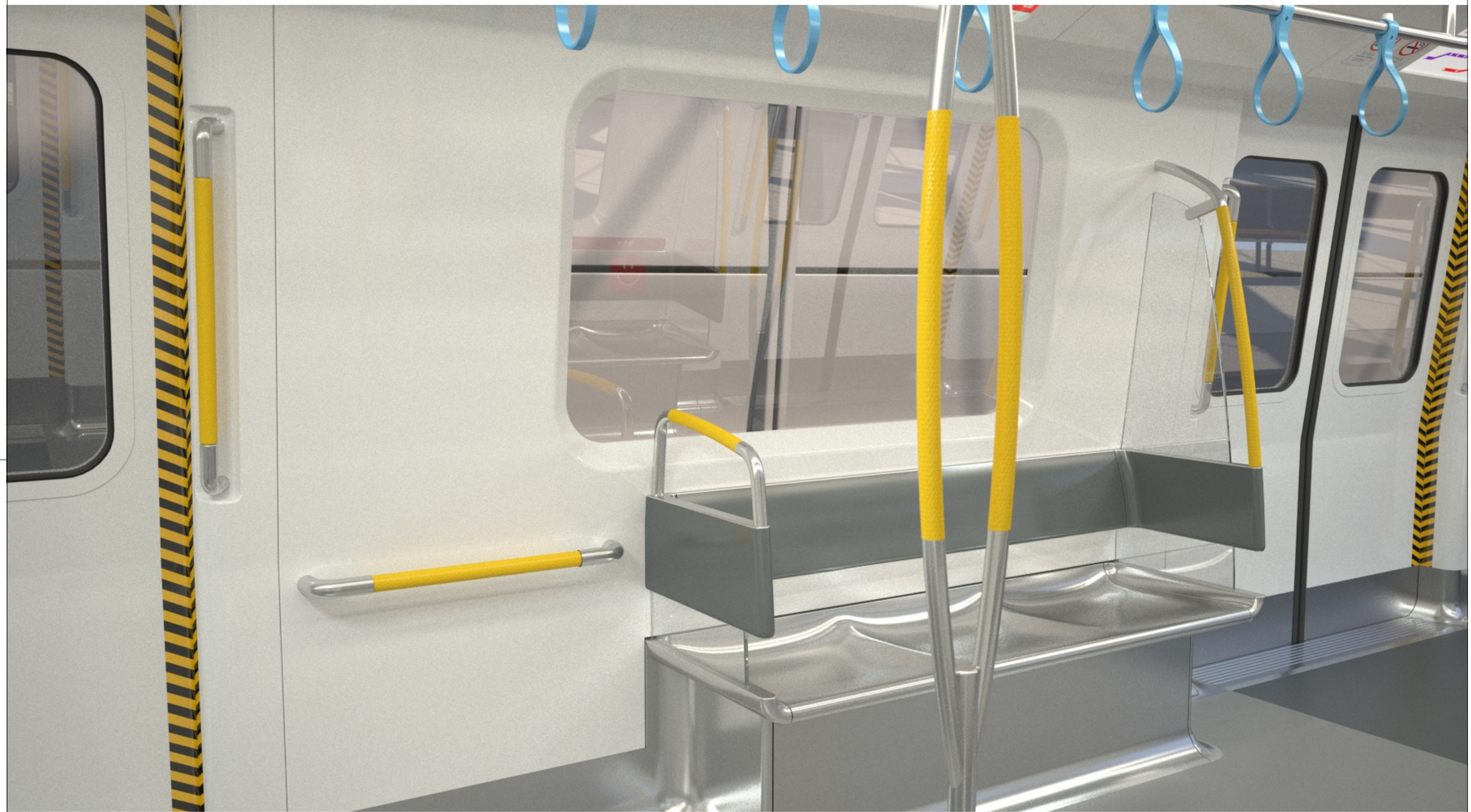
C6014-14E

PROCUREMENT OF NEW TRAINS

SALOON INTERIOR

PERSPECTIVE VIEW AT SEAT BENCH SH 2 OF 2

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/007	A



REV	DESCRIPTION	BY	DATE	APPROVED

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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_008_A.DWG

TITLE

C6014-14E

PROCUREMENT OF NEW TRAINS

SALOON INTERIOR

PERSPECTIVE VIEW AT MULTI-PURPOSE AREA

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/008	A

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
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DATE	15/10/2014

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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_009_A.DWG

TITLE

C6014-14E

PROCUREMENT OF NEW TRAINS

SALOON INTERIOR

PERSPECTIVE VIEW AT ENLARGED MULTI-PURPOSE AREA

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/009	A

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
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DATE	15/10/2014

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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_010_A.DWG

TITLE

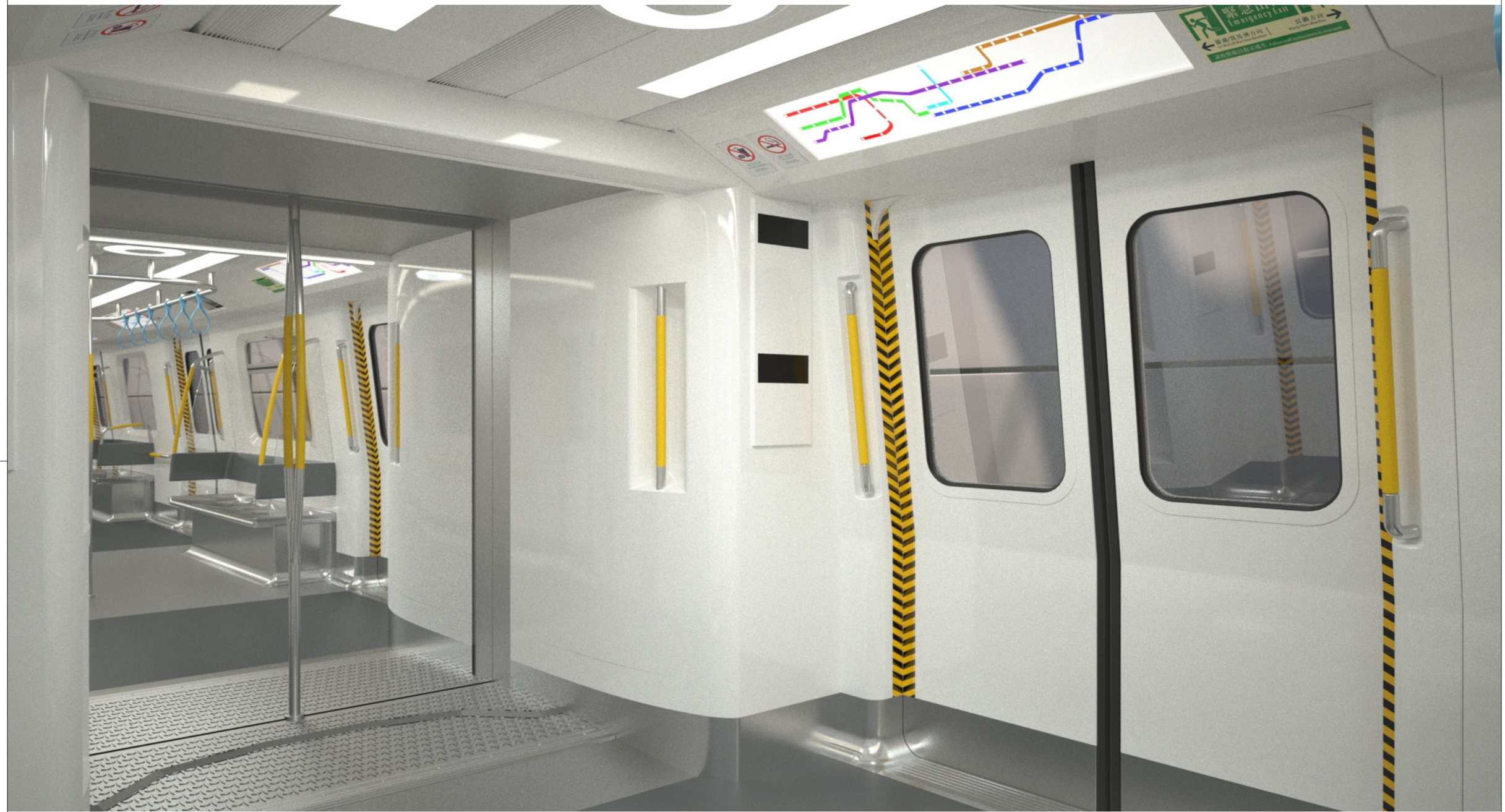
C6014-14E

PROCUREMENT OF NEW TRAINS

SALOON INTERIOR

PERSPECTIVE VIEW AT CAB END BULKHEAD

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/010	A



REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_011_A.DWG

TITLE

C6014-14E

PROCUREMENT OF NEW TRAINS

SALOON INTERIOR

PERSPECTIVE VIEW AT INTERCAR GANGWAY

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/011	A

Air grille RAL 000 90 00

Ceiling RAL 000 90 00

Straphangers RAL 5024

Coving Panel RAL 000 90 00

Doorway lighting RAL 000 90 00

Sidewall RAL 000 90 00

Clear Glass

Grabpole/grabhandle RAL 1023

Seat Back RAL 00 55 00

Door pillar flooring coving stainless steel bead blast finish

Draughtscreen panel RAL 000 55 00

Doorway flooring dark grey (Fig App-L-2)

Seat plinth Stainless steel bead blast finish

Seat bay flooring light grey (Fig App-L-3)

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	---
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DATE	15/10/2014

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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_012_A.DWG

TITLE

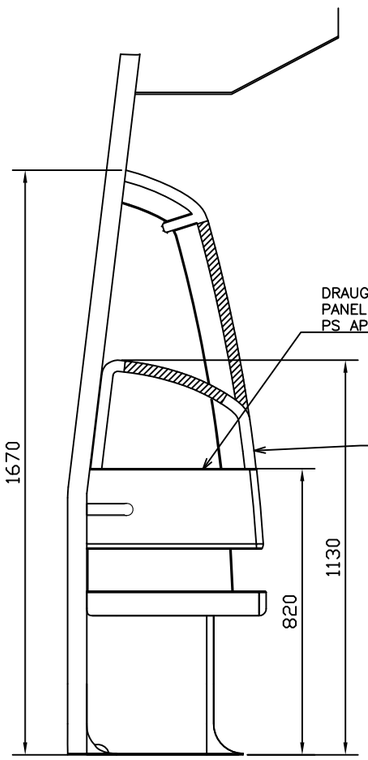
C6014-14E

PROCUREMENT OF NEW TRAINS

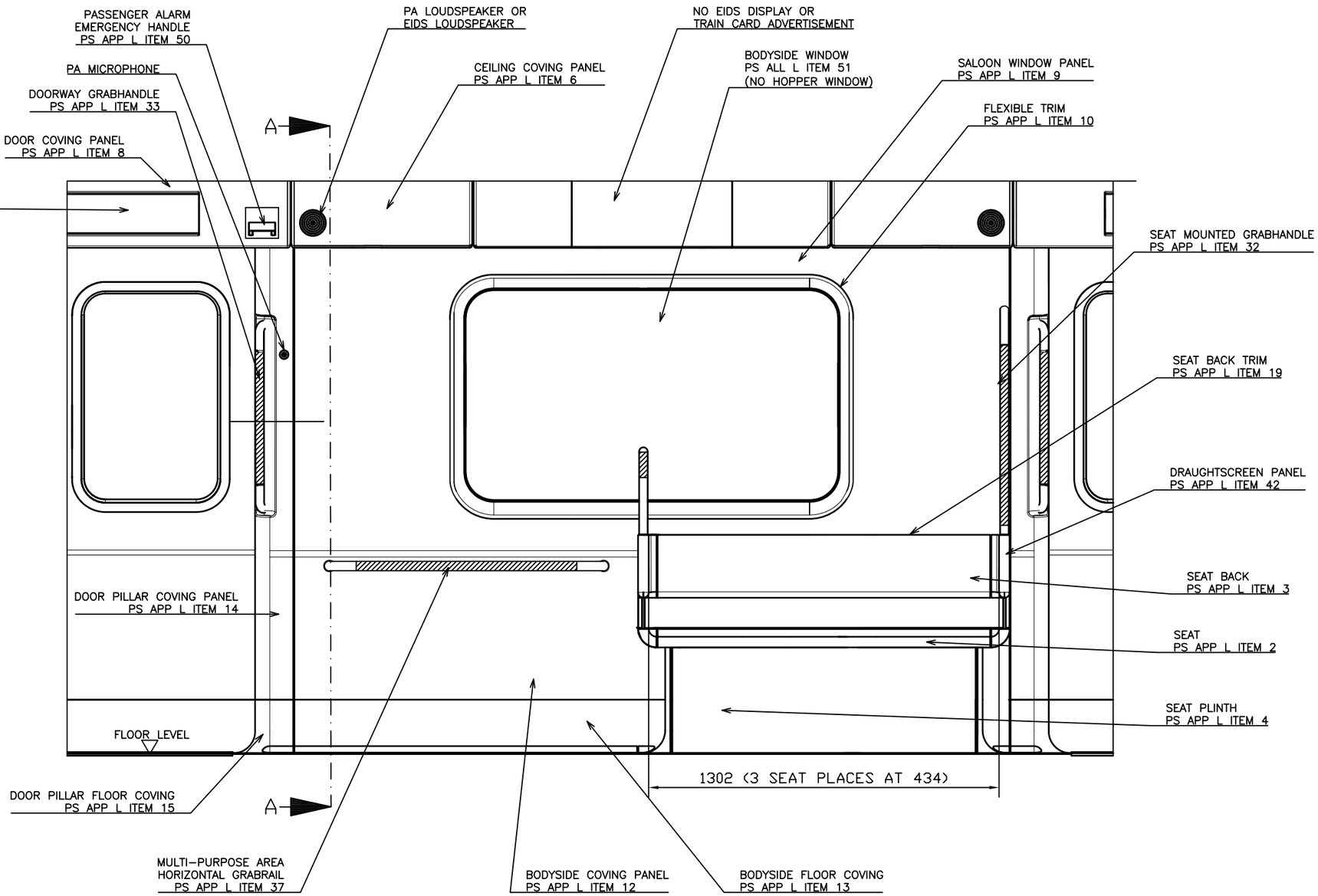
SALOON INTERIOR

COLOUR SCHEME

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/012	A



SECTION A-A



NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
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APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION

TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_013_A.DWG

TITLE

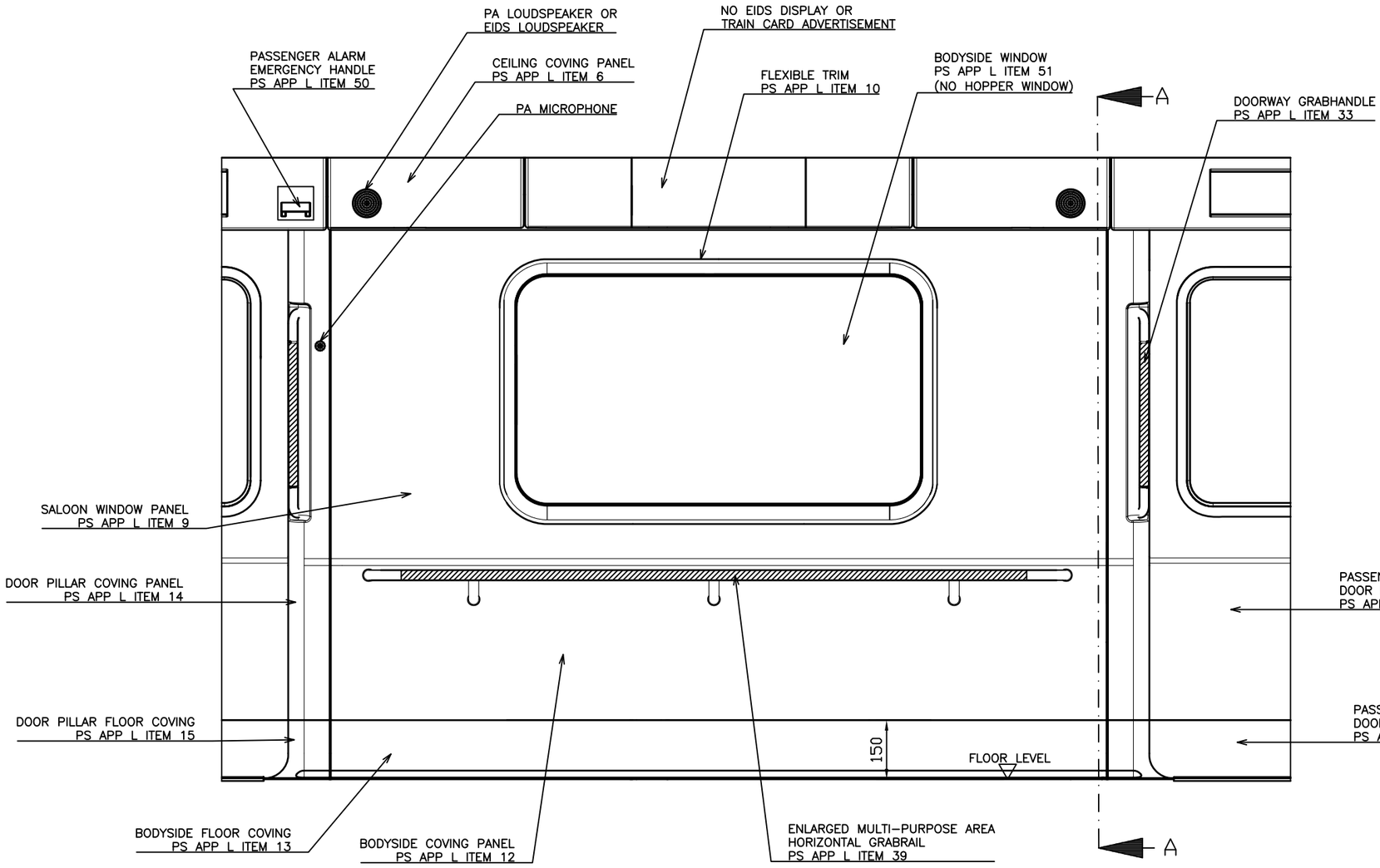
C6014-14E

PROCUREMENT OF NEW TRAINS

MULTI-PURPOSE AREA

GENERAL ARRANGEMENT

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/013	A



SECTION A-A

NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_014_A.DWG

TITLE

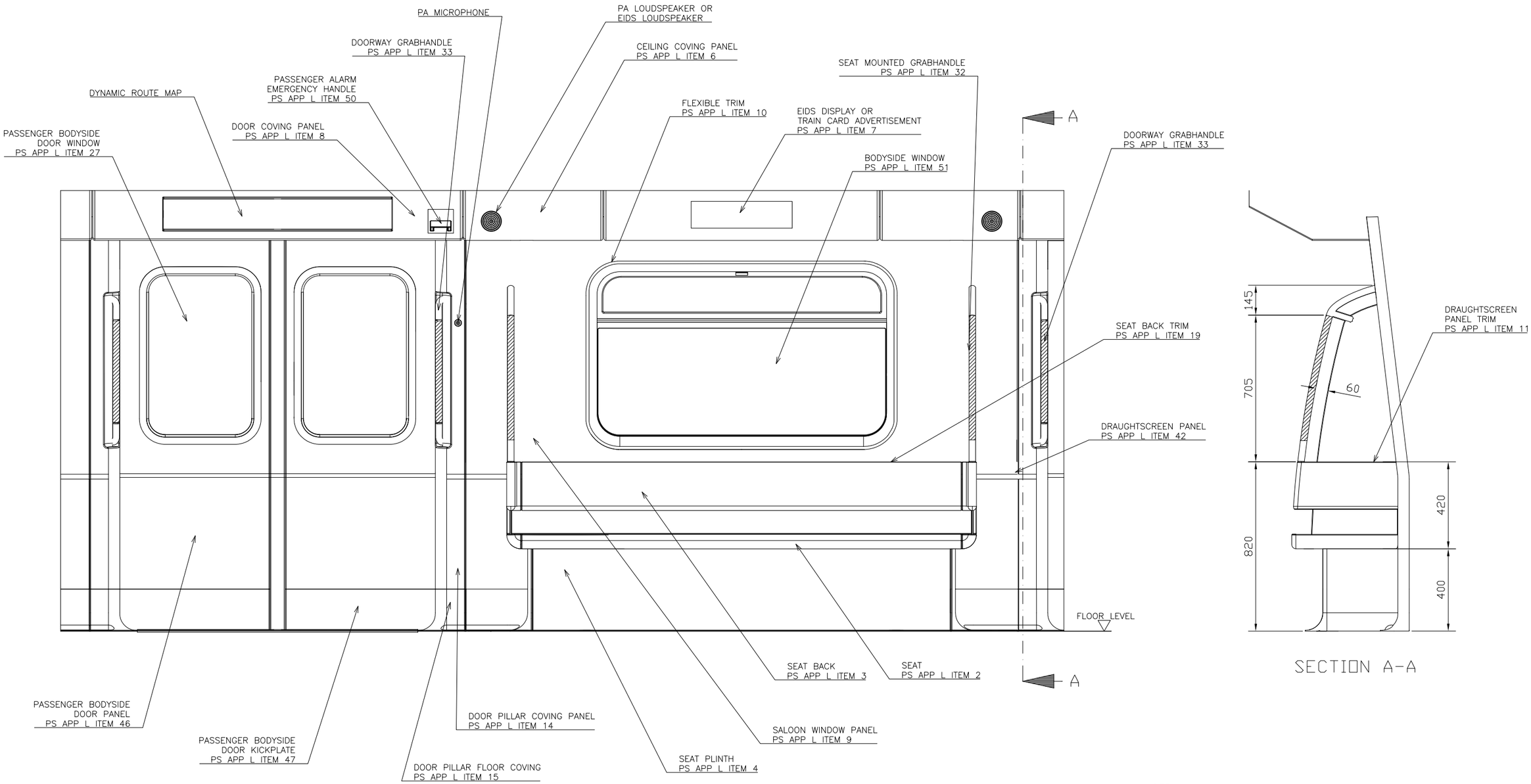
C6014-14E

PROCUREMENT OF NEW TRAINS

ENLARGED MULTI-PURPOSE AREA

GENERAL ARRANGEMENT

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/014	A



SECTION A-A

GENERAL ARRANGEMENT OF 5-SEATER

NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	---
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_015_SH_1_OF_2_A.DWG

TITLE

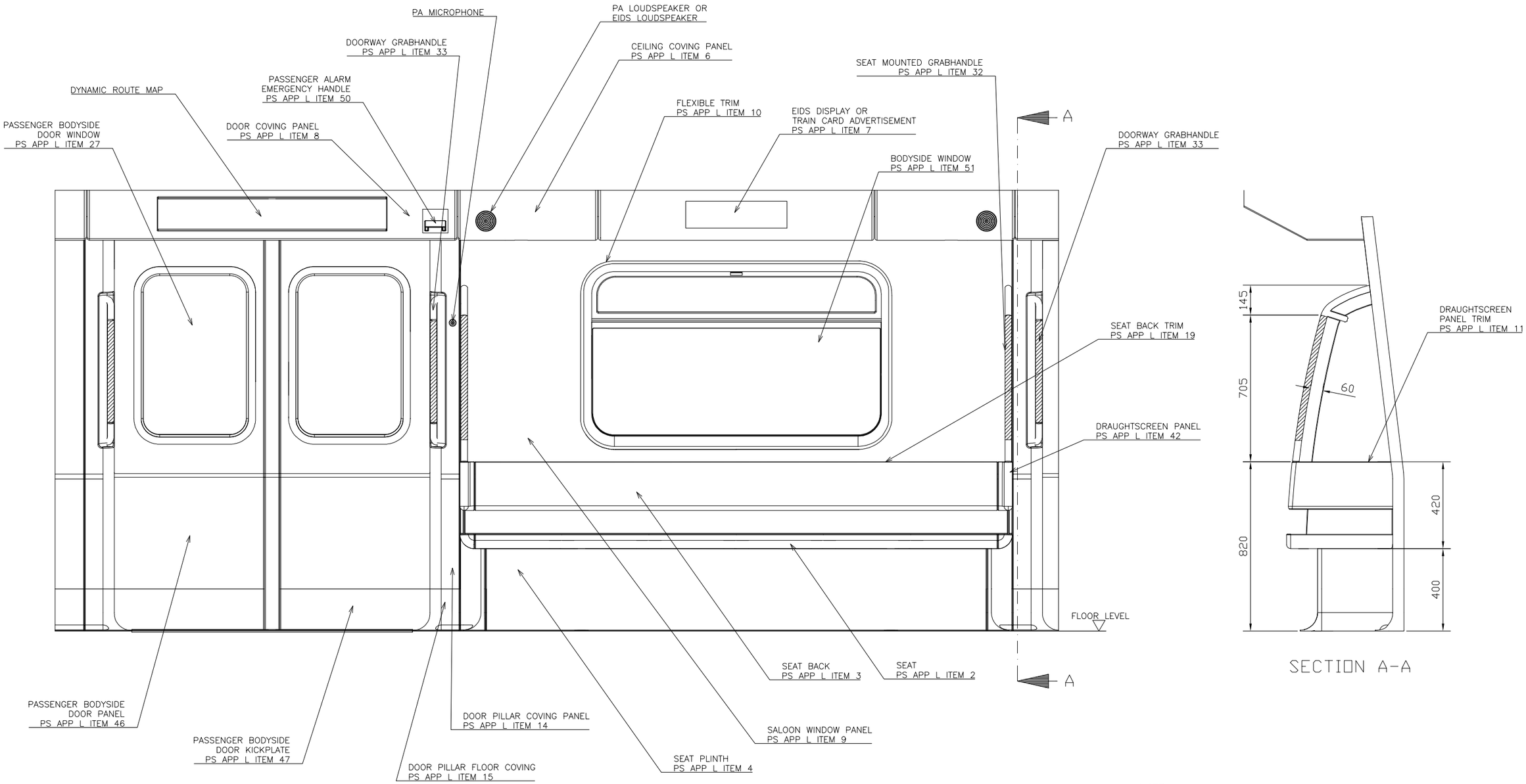
C6014-14E

PROCUREMENT OF NEW TRAINS

BODYSIDE INTERIOR TRIM

GENERAL ARRANGEMENT SH 1 OF 2

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/015	A



GENERAL ARRANGEMENT OF 6-SEATER

SECTION A-A

NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_015_SH_2_OF_2_A.DWG

TITLE

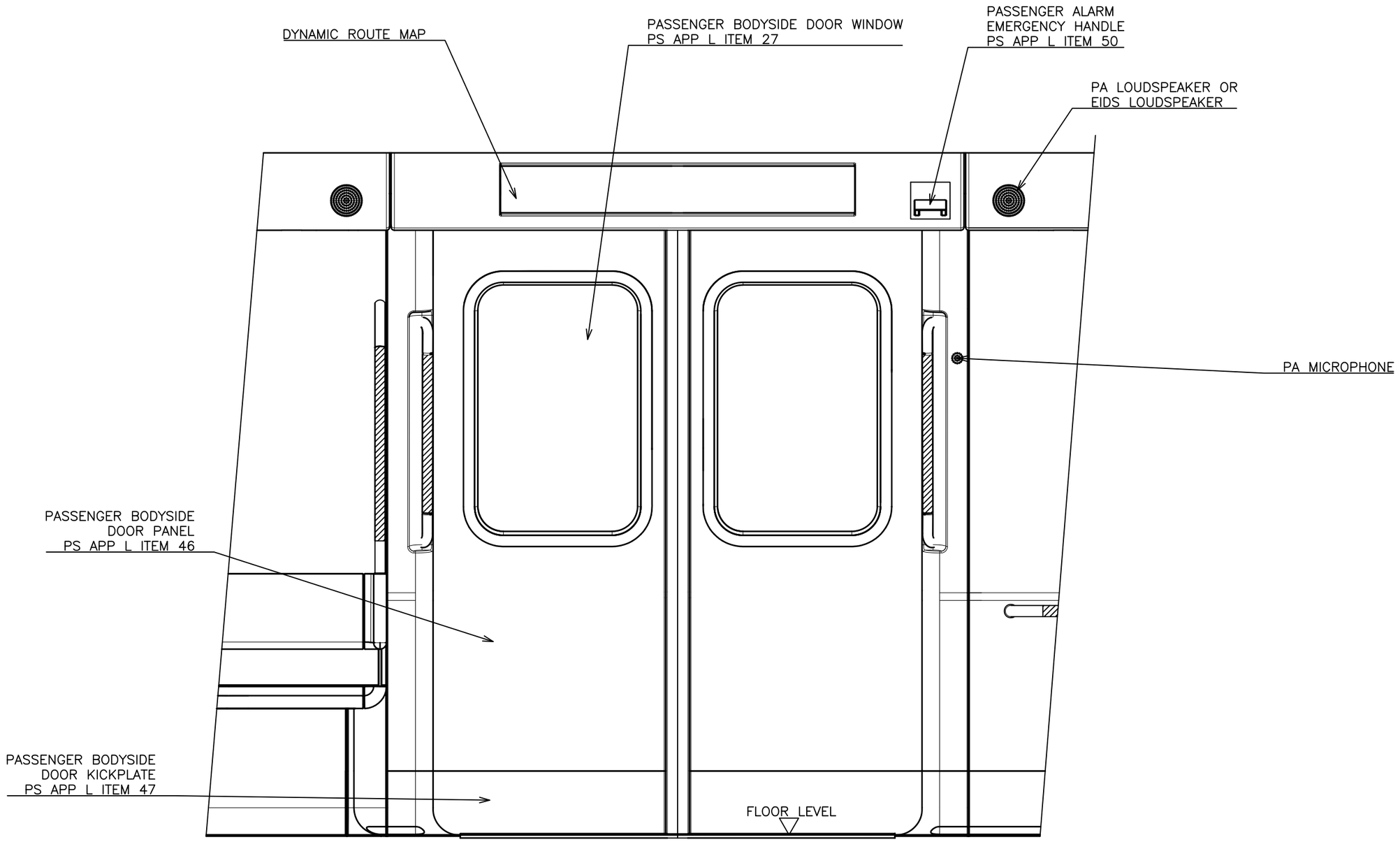
C6014-14E

PROCUREMENT OF NEW TRAINS

BODYSIDE INTERIOR TRIM

GENERAL ARRANGEMENT SH 2 OF 2

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/015	A



NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
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DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_016_A.DWG

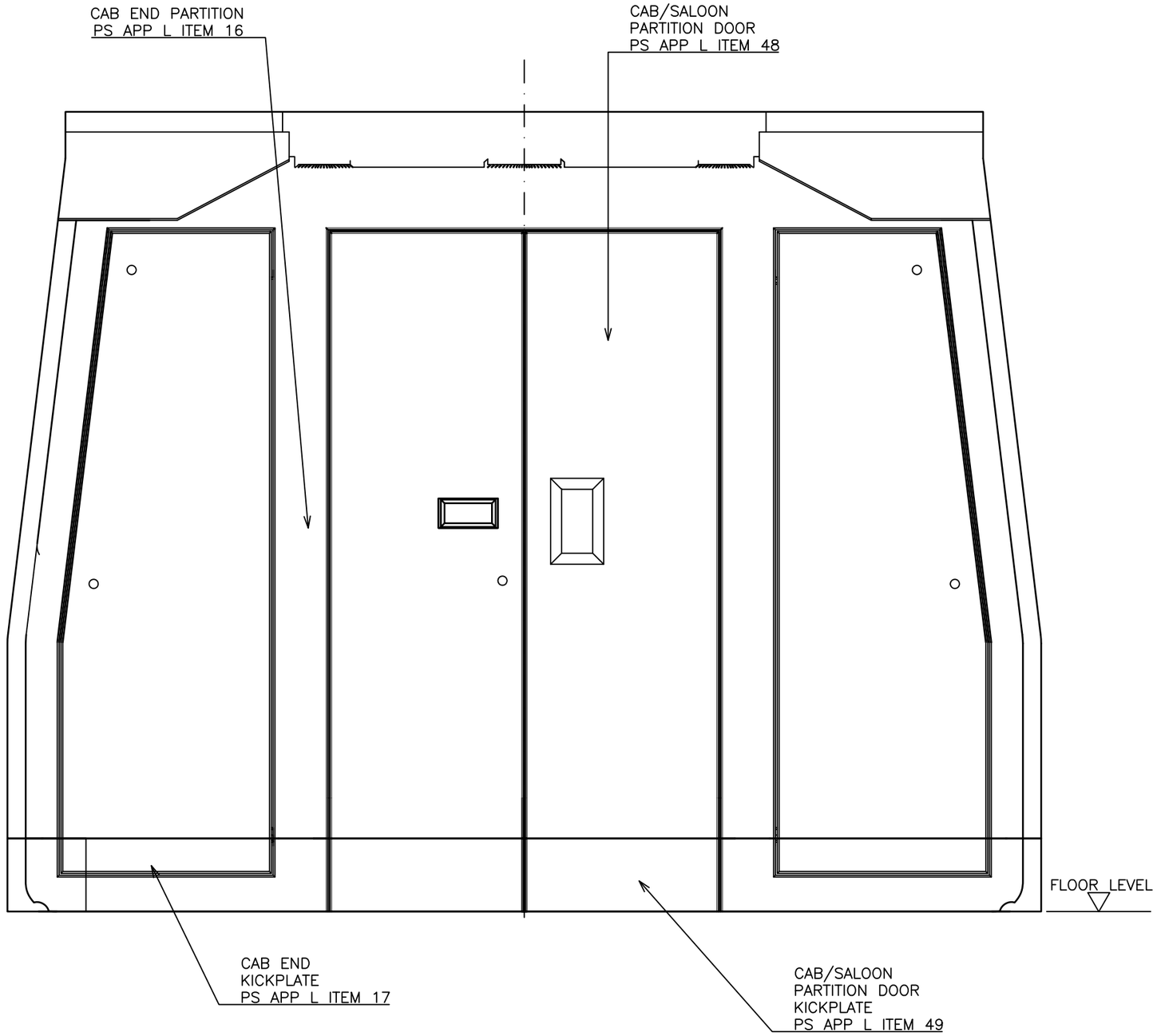
TITLE

C6014-14E

PROCUREMENT OF NEW TRAINS

BODYSIDE DOOR
GENERAL ARRANGEMENT

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/016	A



NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED
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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_017_A.DWG

TITLE

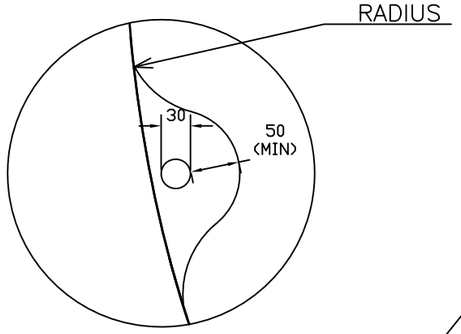
C6014-14E

PROCUREMENT OF NEW TRAINS

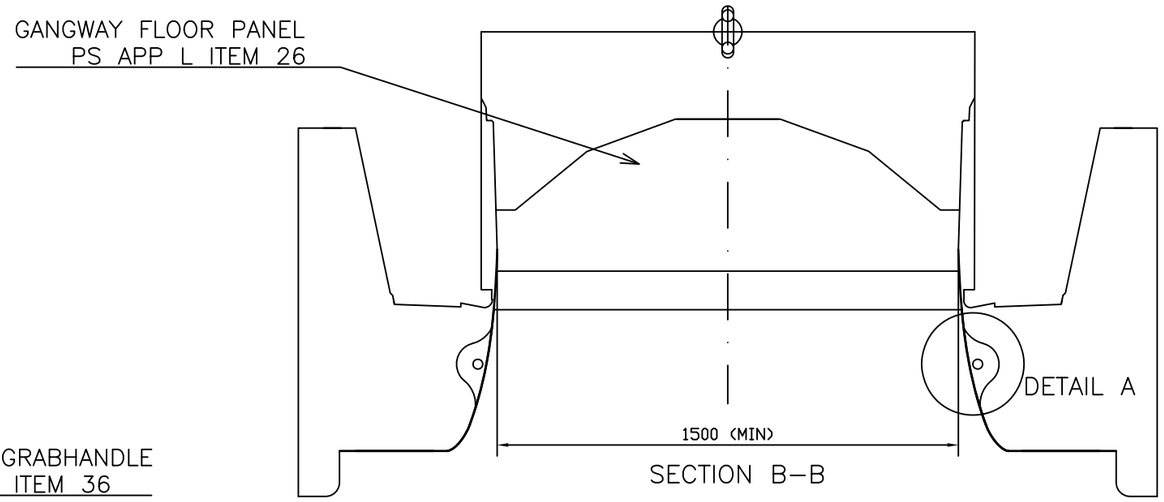
CAB END BULKHEAD

GENERAL ARRANGEMENT

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/017	A



DETAIL A



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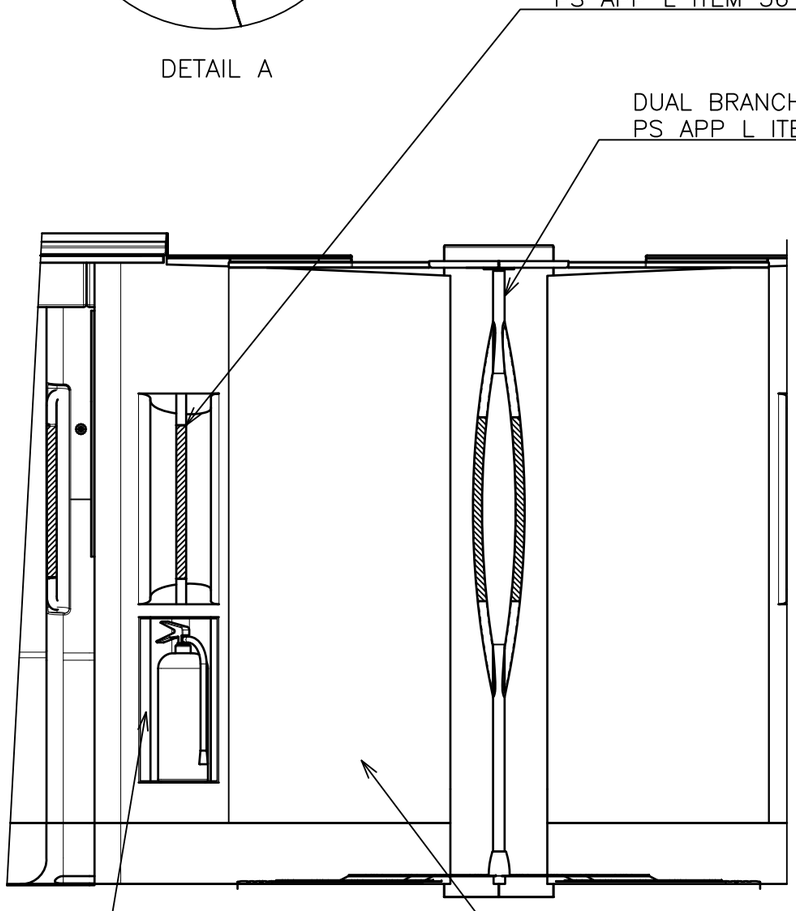
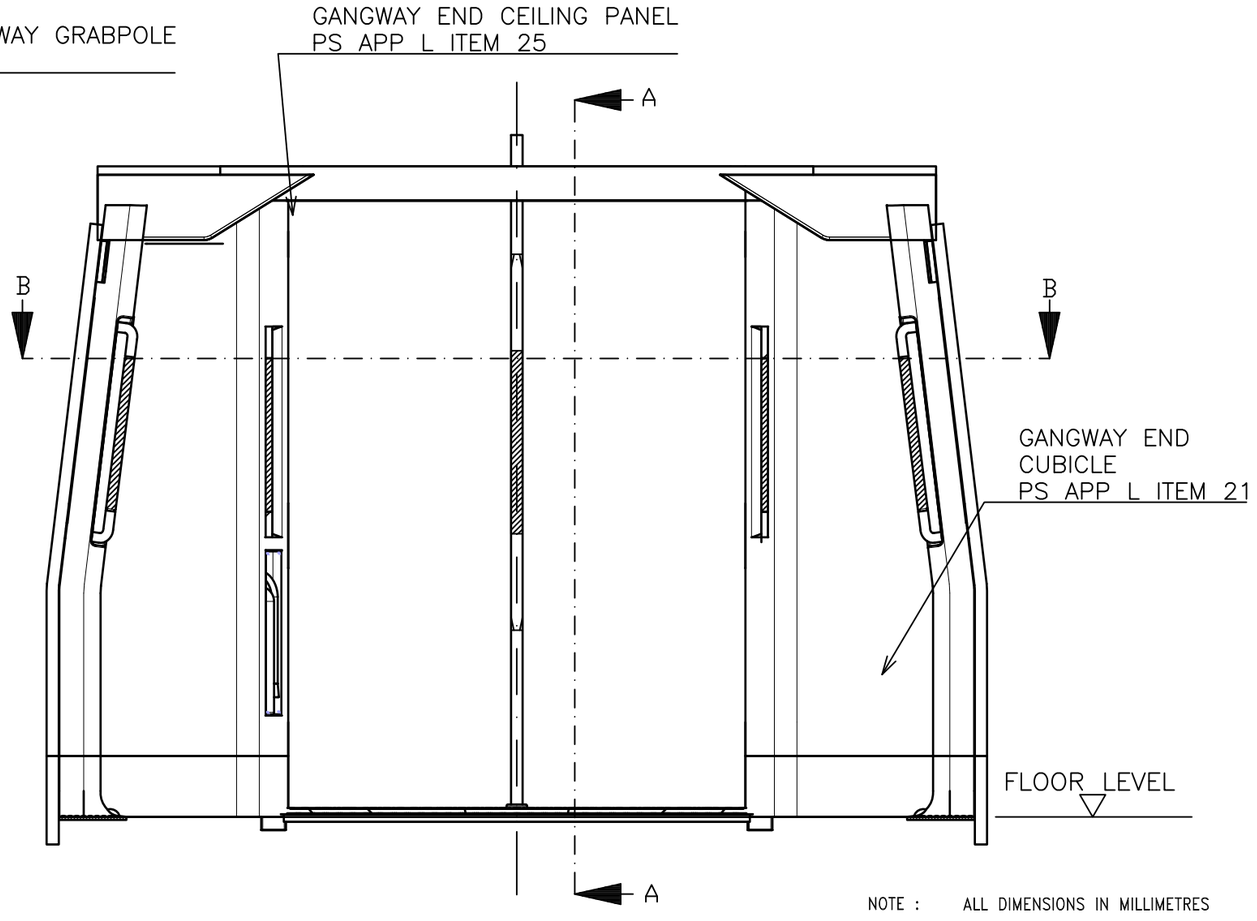


SECTION A–A



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REV	DESCRIPTION	BY	DATE	APPROVED
REV	DESCRIPTION	BY	DATE	APPROVED

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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_018_A.DWG

TITLE

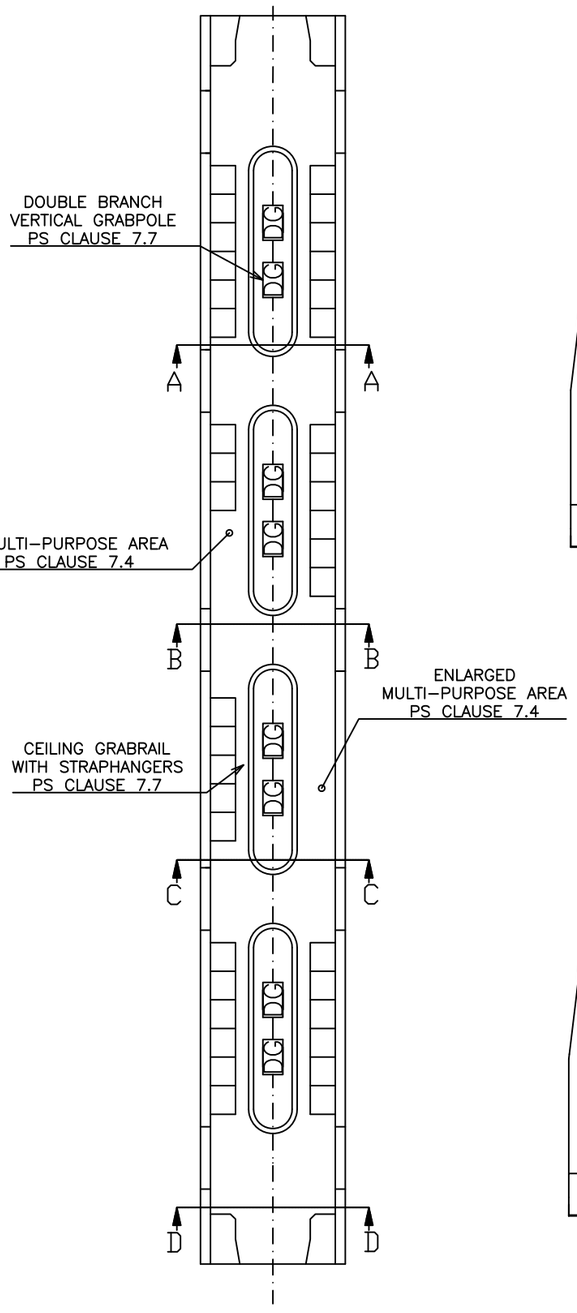
C6014-14E

PROCUREMENT OF NEW TRAINS

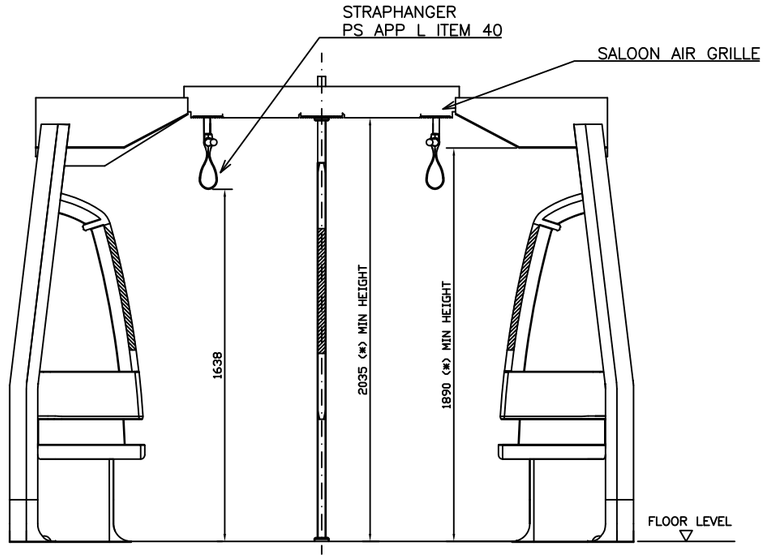
INTERCAR GANGWAY

GENERAL ARRANGEMENT

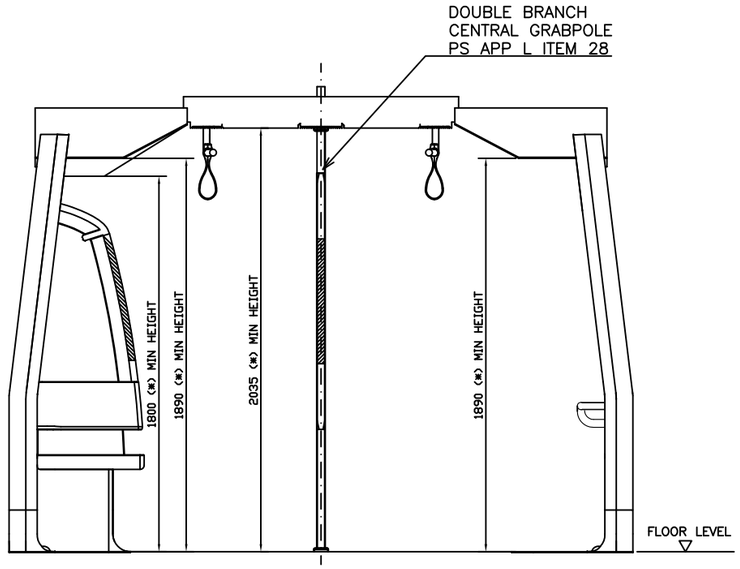
SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/018	A



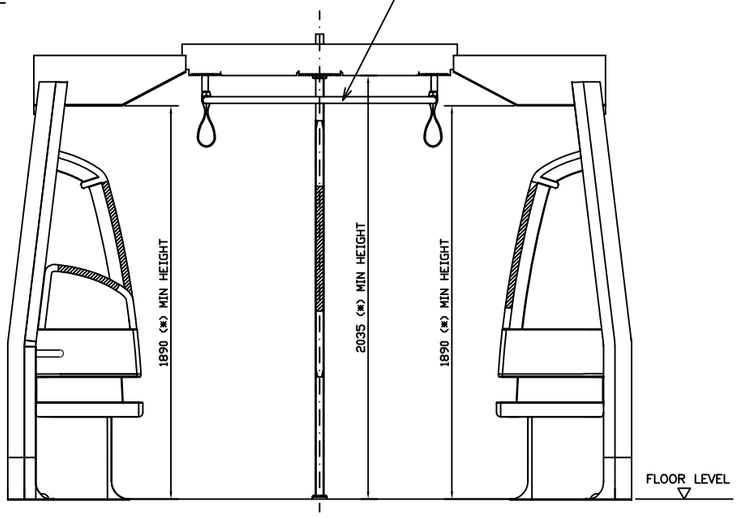
PLAN



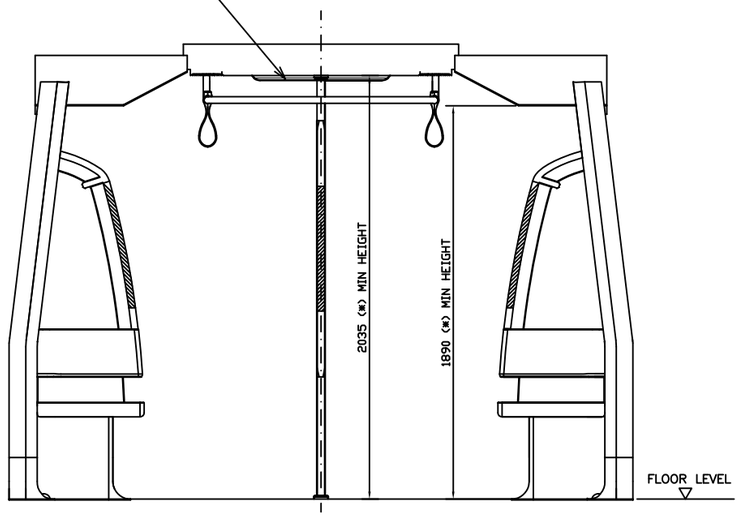
SECTION A–A



SECTION C–C



SECTION B–B



SECTION D–D

NOTE : 1. ALL DIMENSIONS IN MILLIMETRES
2. PLAN NOT REPRESENTING ACTUAL GENERAL ARRANGEMENT OF ANY CAR

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

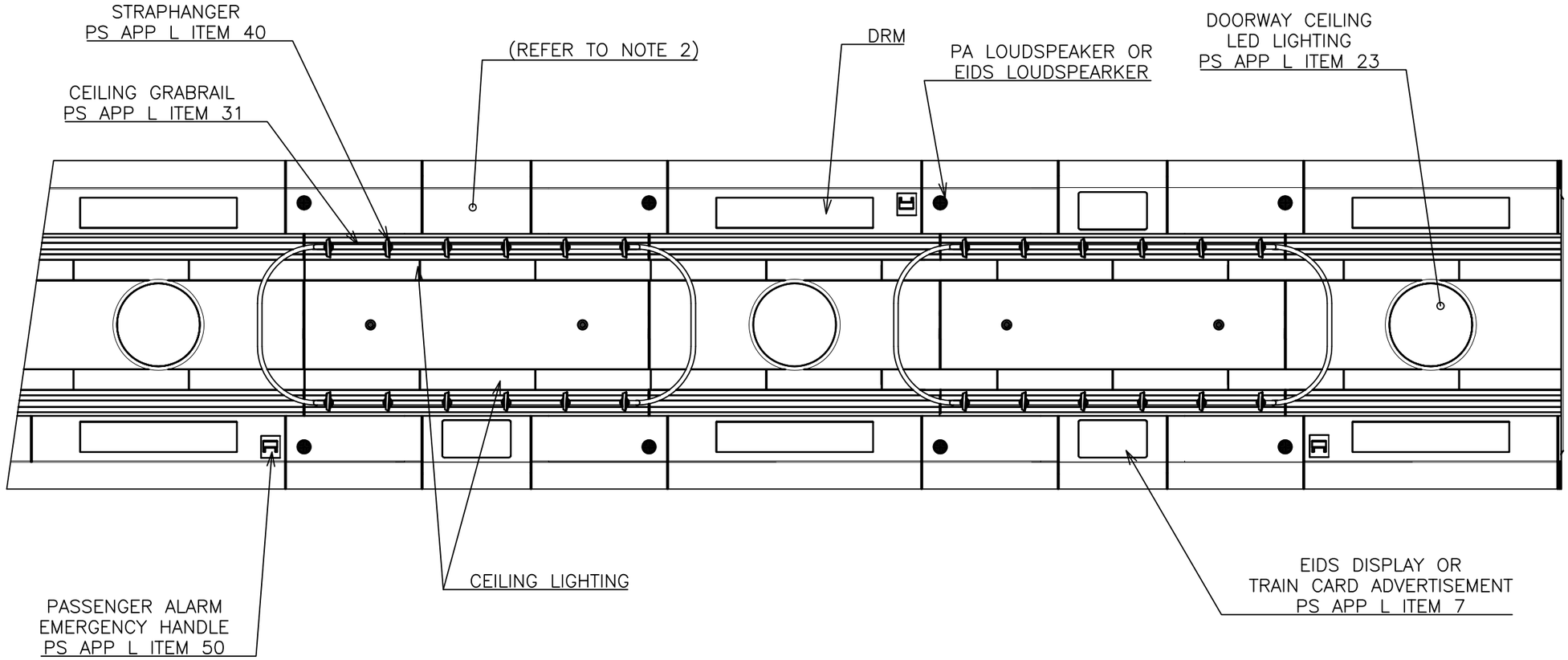
CONTRACTOR REFERENCE NO.

FILE NAME: C6014–14E_TSEG_100_019_A.DWG

TITLE

C6014–14E
PROCUREMENT OF NEW TRAINS
VESTIBULE INTERIOR CROSS–SECTION
GENERAL ARRANGEMENT

SCALE	DRAWING NO.	REV.
NTS	C6014–14E/TSEG/100/019	A



NOTE:

1 REFER TO DRG. NOS. C6014-14E/TSEG/100/001-005 FOR SPECIFIC LOCATION OF EQUIPMENT OF EACH CAR TYPE
2 NO EIDS DISPLAY NOR TRAIN CARD ADVERTISEMENT ON CEILING COVING PANEL AT MULTI-PURPOSE AREA OR ENLARGED MULTI-PURPOSE AREA
3 ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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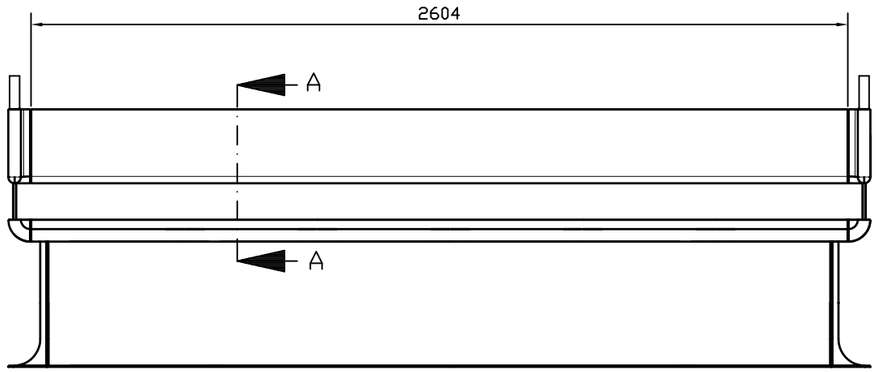
CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_020_A.DWG

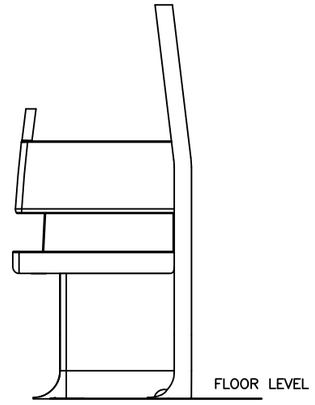
TITLE

C6014-14E
PROCUREMENT OF NEW TRAINS
CEILING GENERAL ARRANGEMENT

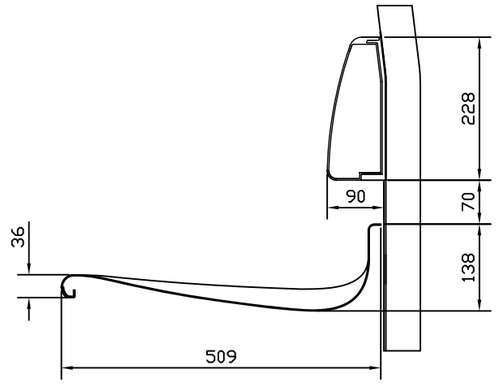
SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/020	A



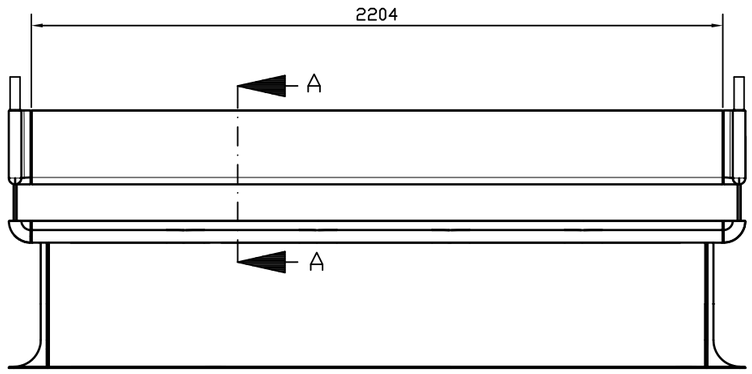
6–PLACE BENCH SEAT



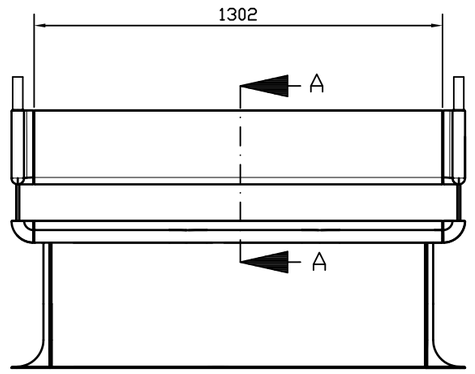
SIDE VIEW



SECTION A–A



5–PLACE BENCH SEAT



3–PLACE BENCH SEAT

NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	MP
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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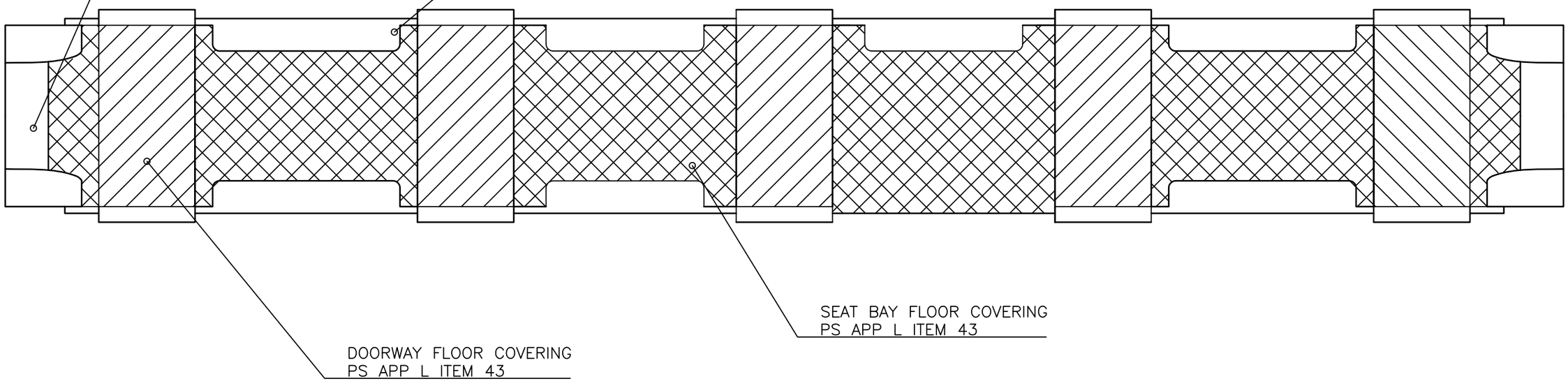
CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_021_A.DWG

TITLE

C6014–14E
PROCUREMENT OF NEW TRAINS
SEATING

SCALE	DRAWING NO.	REV.
NTS	C6014–14E/TSEG/100/021	A



NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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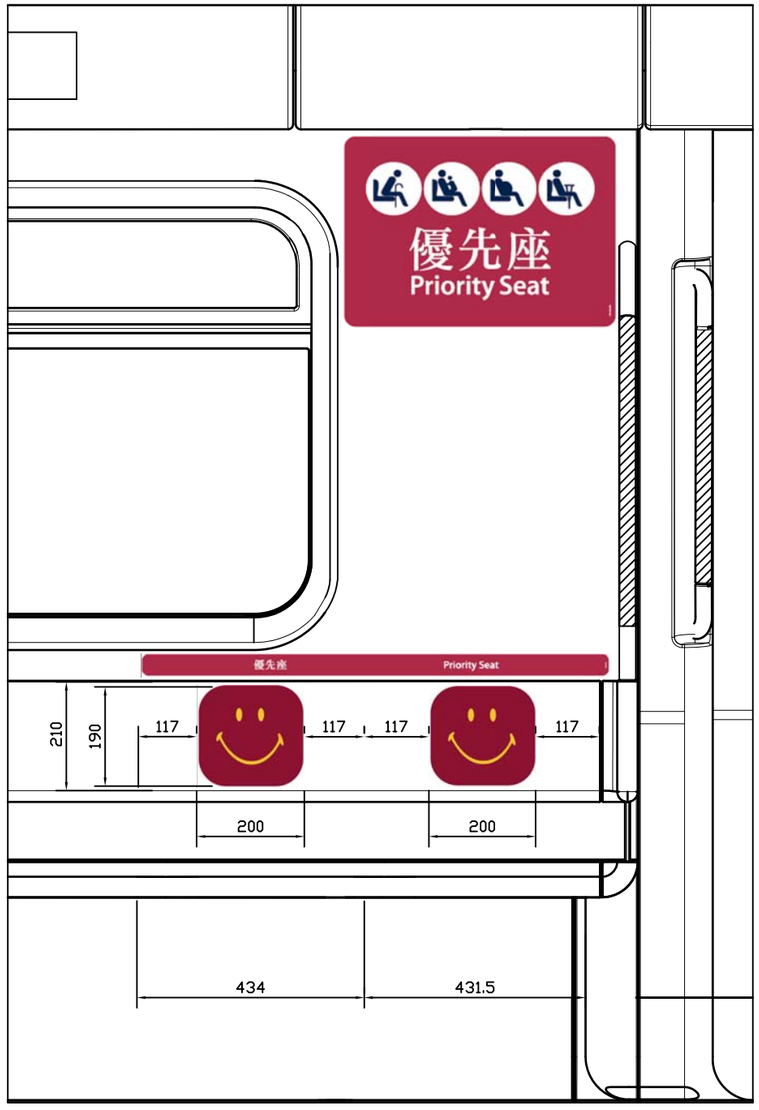
CONTRACTOR REFERENCE NO.

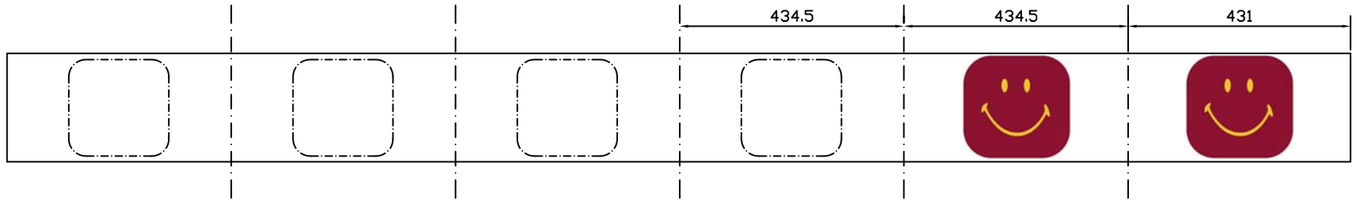
FILE NAME: C6014-14E_TSEG_100_023_A.DWG

TITLE

C6014-14E
PROCUREMENT OF NEW TRAINS
FLOOR COVERING ARRANGEMENT

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/023	A





Artwork no. : NIL
Description : Smiley face of saloon seat
Size : 200(W) x190(H)mm
Corner radius: 100mm
Colour : 2 colours
Pantone® 123C
Pantone® 201C
Material : NIL
Printing : NIL
Finishing : NIL

NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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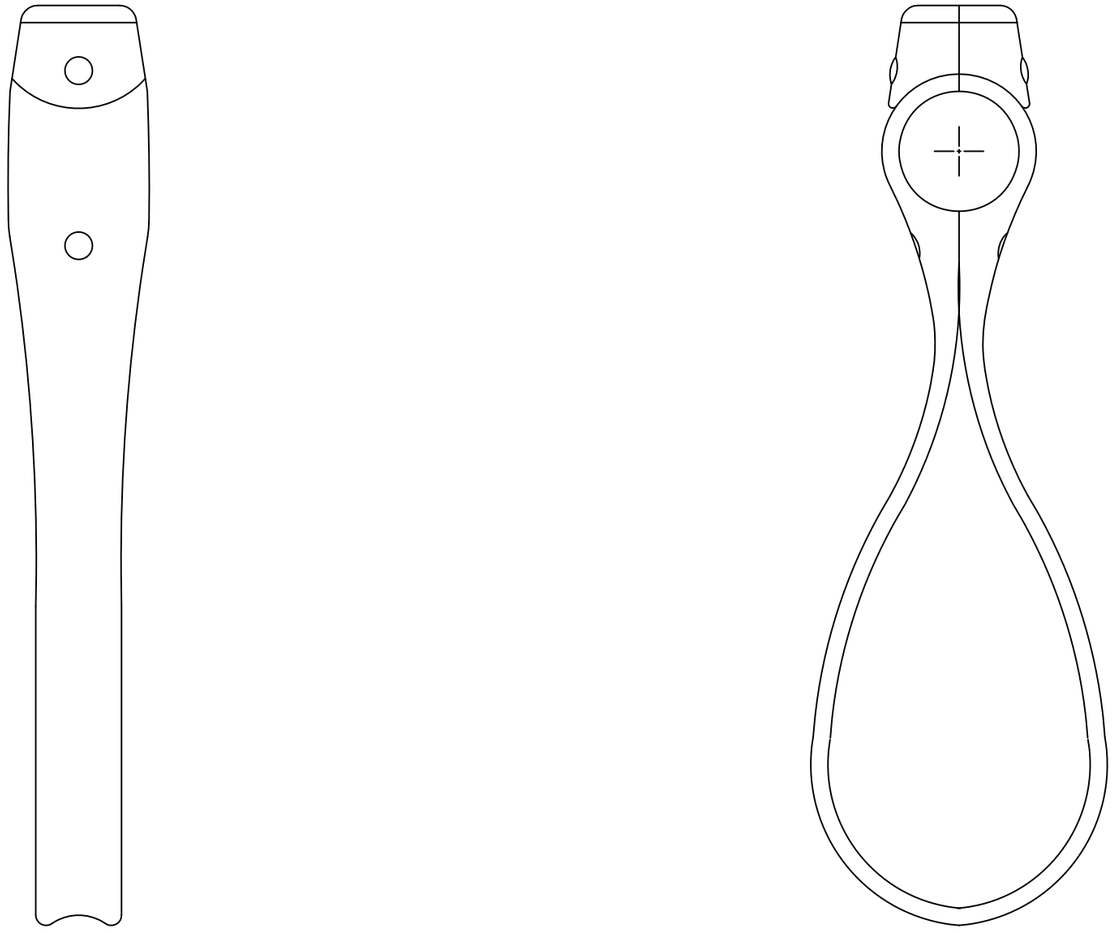
TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_024_A.DWG

TITLE
C6014-14E
PROCUREMENT OF NEW TRAINS
PRIORITY SEAT GRAPHICS
GENERAL ARRANGEMENT

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/024	A



TopAdstrap STRAPHANGER [COLOUR – RAL 5024 BLUE]

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	EF
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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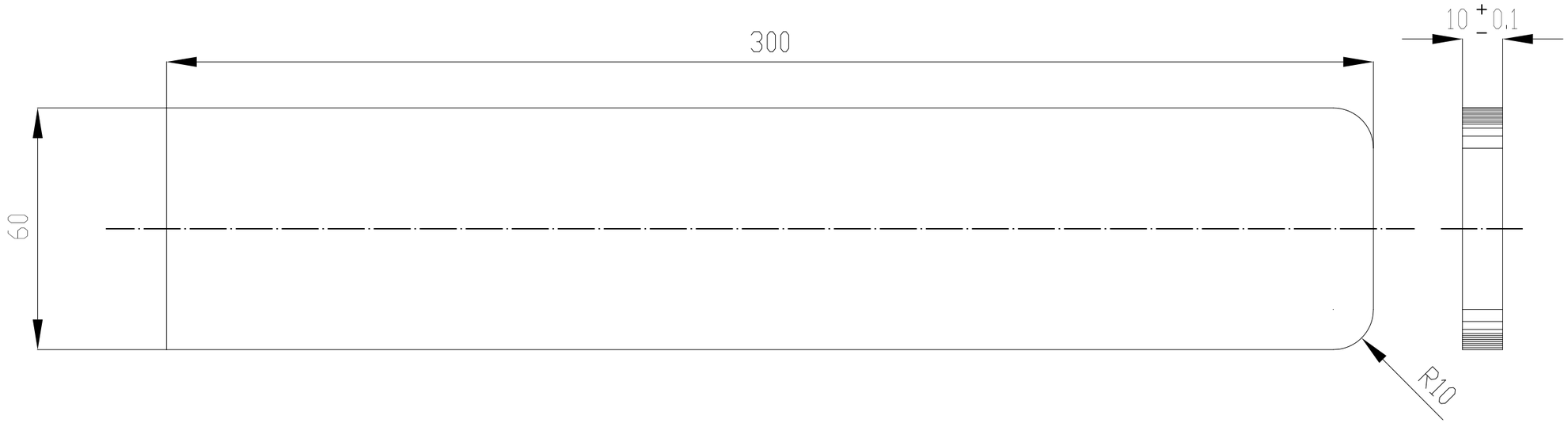
CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_025_A.DWG

TITLE

C6014-14E
PROCUREMENT OF NEW TRAINS
STRAPHANGER

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/025	A



NOTES:

1. MATERIAL : ALUMINIUM.
2. UNLESS OTHERWISE SPECIFIED.
   ALL DIMENSIONS IN MILLIMETRES.
   ALL ROUND CORNERS ARE R2.
   GENERAL TOLERANCE : ± 0.5mm.
3. REMOVE ALL BURRS AND SHARP EDGES.

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

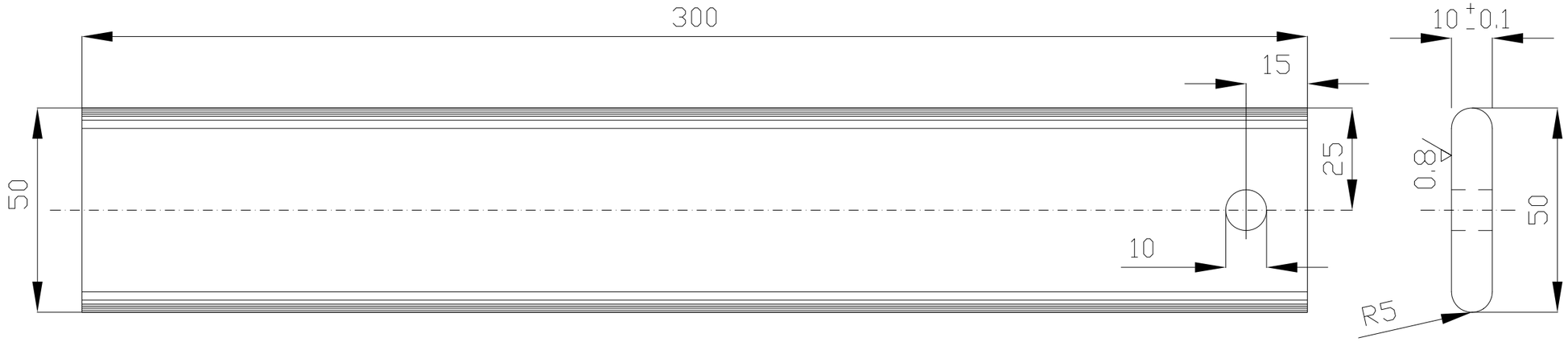
CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_026_A.DWG

TITLE

C6014-14E
PROCUREMENT OF NEW TRAINS
DOOR GAP GAUGE

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/026	A



NOTES:

1. MATERIAL : ALUMINIUM.
2. UNLESS OTHERWISE SPECIFIED.
   ALL DIMENSIONS IN MILLIMETRES.
   ALL ROUND CORNERS ARE R2.
   GENERAL TOLERANCE : ±0.5mm.
3. REMOVE ALL BURRS AND SHARP EDGES.
4. THICKNESS DIMENSIONS TO BE ENGRAVED ON THE GAUGE

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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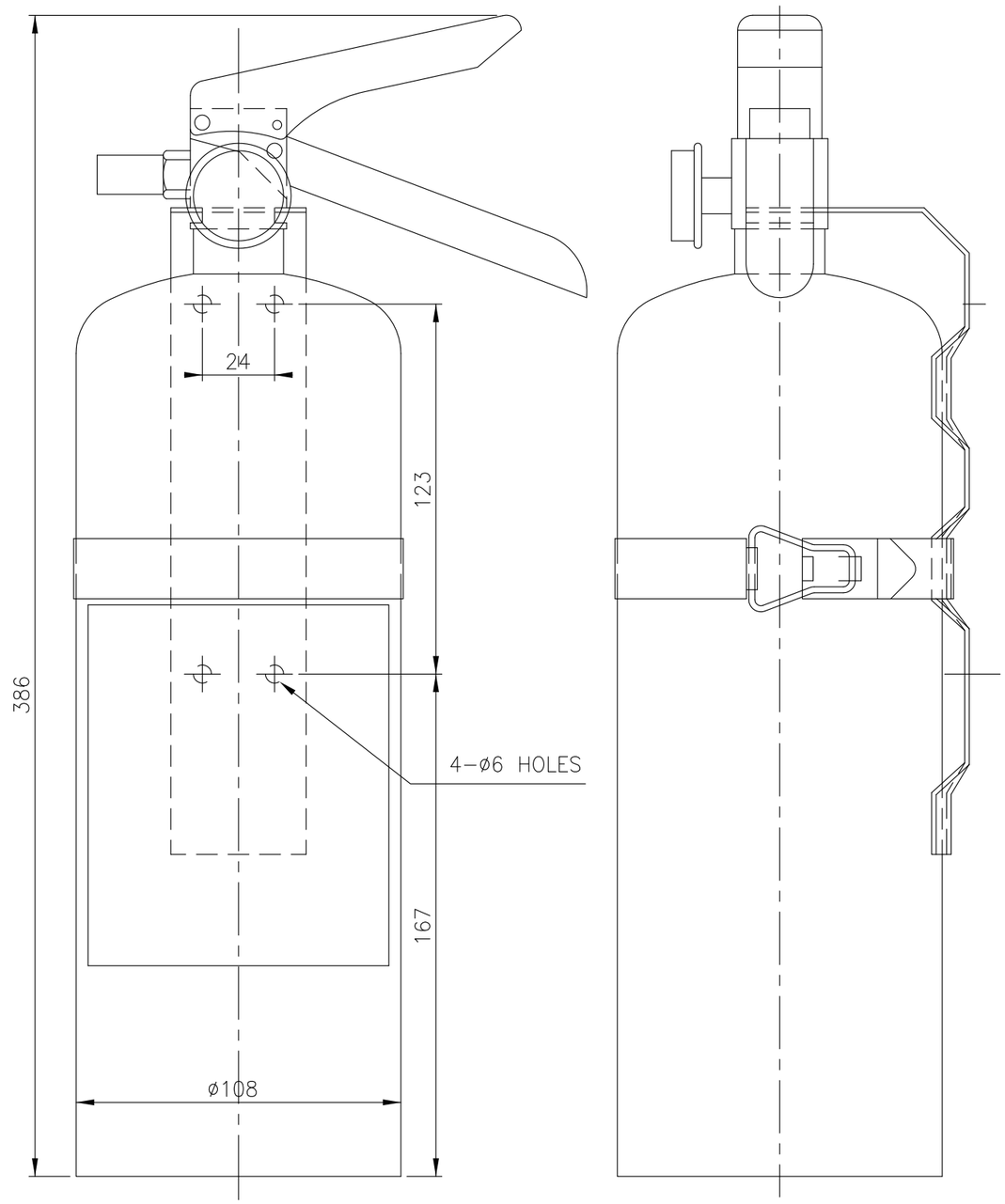
CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_100_027_A.DWG

TITLE

C6014-14E
PROCUREMENT OF NEW TRAINS
DOOR OBSTACLE GAUGE

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/100/027	A



SPECIFICATION	
Name	AMEREX
Model No.	425T
Capacity(kg)	2.26
Fire Rating	8A:55B
Operating Pressure(psi)	195
Min Discharge Time(secs.)	9
DTI Marine Approval	YES
Height(ins.)	15.25
Width(ins.)	5.5
Diameter(ins.)	4.25

NEXT ASSY
EC50027
EC50028
EC21816–000

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
EC21330–000

	INITIAL	DESIGNATION	DATE
DRAWN	SB Lee		27.03.2006
DESIGNED	SB Lee		27.03.2006
CHECKED	GH Yeom		27.03.2006
APPROVED	GH Yeom		27.03.2006
CAD FILE NAME	OD4_362_00510_0261_A.DWG		

地鐵公司 MTR Corporation

TITLE FIRE EXTINGUISHER

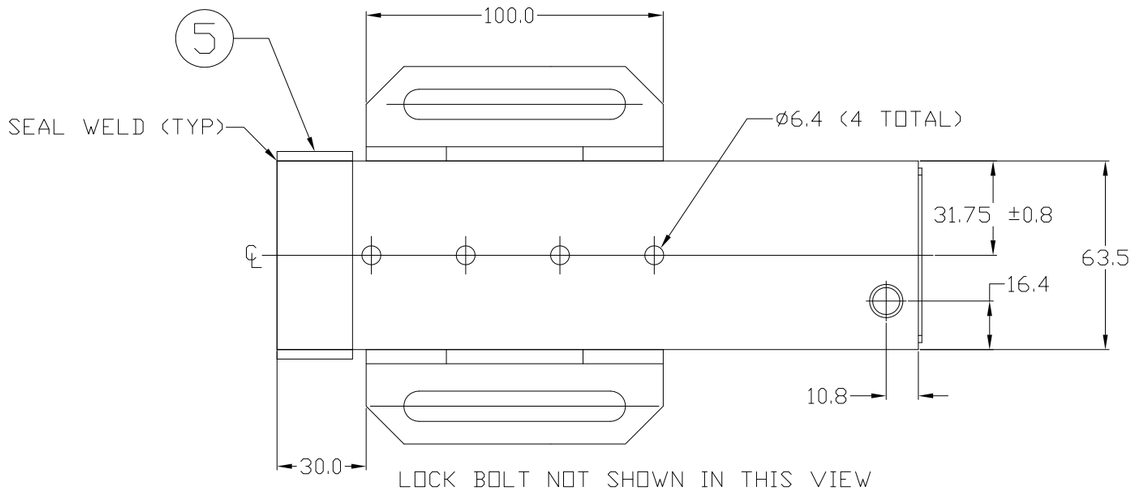
SCALE 1/2 | OED DRAWING NO. OD4/362/00510/0261 | A

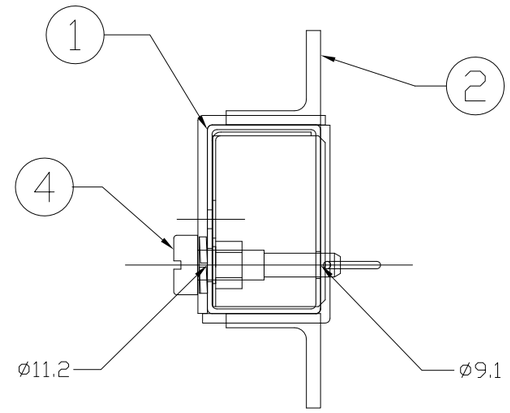
A3 SIZE, 420 x 297mm, TYPE 3

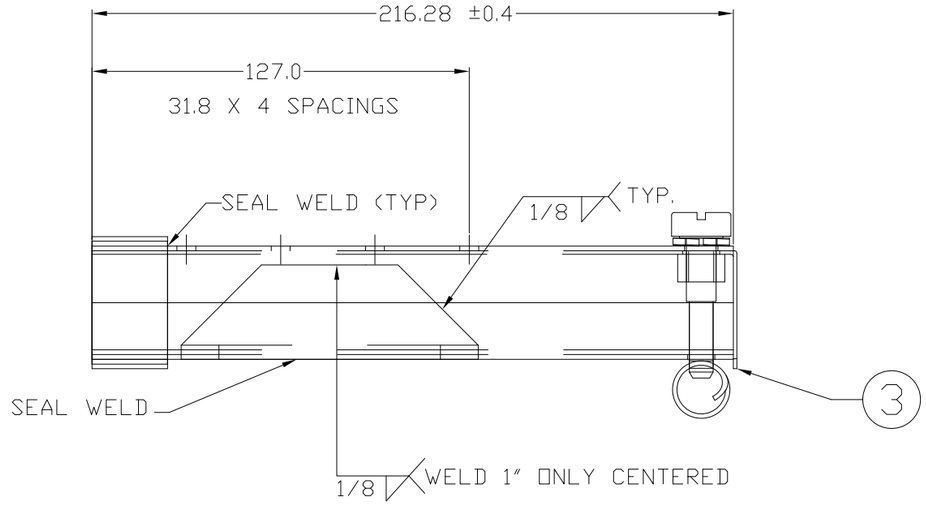
INTERFACE		
Drawing No.	**Title**	**Revision**
C6014-14E/TSEG/077/001	Platform Interface with Vehicle K.E.	A
C6014-14E/TSEG/077/002	Train / PSD Door Opening Scenario	A
C6014-14E/TSEG/077/003	Train / PSD Door Closing Scenario	A
C6014-14E/TSEG/077/004	Platform Screen Door Section for Interface Arrangement	A
C6014-14E/TSEG/157/001	Urban Lines Trains Cab End Coupler Electrical Box Pin Arrangement	A
C6014-14E/TSEG/417/001	Train Conceptual Safety Proving Circuit	A
C6014-14E/TSEG/497/001	Conceptual Architecture of TMS	A
C6014-14E/TSEG/497/002	ATC / Communications System / DRM Interface with TMS	A
C6014-14E/TSEG/497/003	ATC/DVAS/EIDS/DRM Conceptual Data Flow	A
C6014-14E/TSEG/667/008	CCTV Trainborne Equipment Connection Schematics	A
C6014-14E/TSEG/687/001	HPF Applicator	A
OD4/302/00003/0011	Schematic Diagram Of Power Circuit	C
OD4/302/00303/0002	'I' Stock Melco Chopper (248-256) Auxiliary Circuit Diagram “A”, “C” & “D” Cars	L
OD4/303/00042/027	Power Circuit Diagram For EMU Cars Chopper/Aux. Inverter	B
OD4/303/00042/108	Circuit Diagram Of Static Auxiliary Inverter Chopper/Aux. Inverter	B
OD4/303/00063/0011	'G' Stock Auxiliary Circuit Diagram., EMU Cars A-CT-D, Chopper/Aux. Inverter (Sheet 1 of 1)	E
OD4/305/00141/001	'M' Stock Chopper Conversion Power Circuit Diagram For EMU Cars	C
OD4/305/00141/0009	'M' Stock 'A'-Car Auxiliary & Control Wiring Diagram (Sheet No.1) Chopper Conversion	E
OD4/305/00162/0001	'M' Stock Chopper Conversion Auxiliary Circuit Diagram A-CT-D Cars	G
OD4/305/00241/004	'T' Stock Chopper Conversion Power Circuit Diagram For EMU Cars	C
OD4/305/00262/0001	'T' Stock Chopper Conversion Auxiliary Circuit Diagram A-CT-D Cars	G
OD4/306/00041/001	Power Circuit Diagram For EMU Cars Additional Rolling Stock	N
OD4/306/00063/003	Circuit Diagram Of Static Auxiliary Converter	B
OD4/306/00063/0004	'H' Stock Auxiliary Circuit Diagram EMU Cars A-CT-D Additional Rolling Stock (1/1)	E
C6014-14E/TSEG/637/001	Schematic Diagram of SIV Power Circuit (Sheet 1 of 2)	A
C6014-14E/TSEG/637/002	Schematic Diagram of SIV Power Circuit (Sheet 2 of 2)	A
C6014-14E/TSEG/637/003	Power Circuit Diagram For EMU Cars	A
C6014-14E/TSEG/637/004	Circuit Diagram Of Auxiliary Static Inverter	A
OD4/312/00005/0001	BE Loco (MK I & II) Power Circuit Diagram Battery Electric Locomotive	D
OD4/312/00005/0002	Dual Mode Locomotive (MK I & II) Auxiliary Circuit Diagram	G
OD4/313/00005/0026	BE Loco (MK III) Power Circuit Diagram	B
OD4/313/00005/0027	BE Loco (MK III) Power Circuit Diagram	B
OD4/313/00005/0028	BE Loco (MK III) Power Circuit Diagram	B
OD4/313/00005/049	BE Loco (MK III) Auxiliary Circuit Diagram	A
OD4/306/00041/0002	H Stock Control Circuit Diagram “A-C_T-D” Cars (SHT. 1 OF 3)	N
OD4/306/00063/0005	H Stock Auxiliary Circuit Diagram EMU Cars “B-C” Additional Rolling Stock	C
OD4/361/00742/0034	Schematic Diagram of Power Circuit	A
OD4/361/00741/9731	SIV Control (C, B, B1, C1 Car)	A

C6014-14E/TSEG/687/001 | A

1	1	HSS 2-1/2" x 1-1/2" x 0.083" S/S (304)	-01
2	2	MOUNT COMPONENT	G0210000/A
3	1	INSERT	RA094H0100/A
4	1	SCREW WITH LOCK WASHER AND RING COTTER	G0080000/A
5	2	COLLAR	RA094H0200/A







NOTES:
1) BREAK SHARP EDGES.
2) MTL: SEE BOM
3) QTY: 1 ONLY
4) WEIGHT: 1.49kg
5) LOCK BOLT IS NOT SHOWN IN TOP VIEW
6) NOT ALL HIDDEN LINES SHOWN

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	RH
DESIGNED	---
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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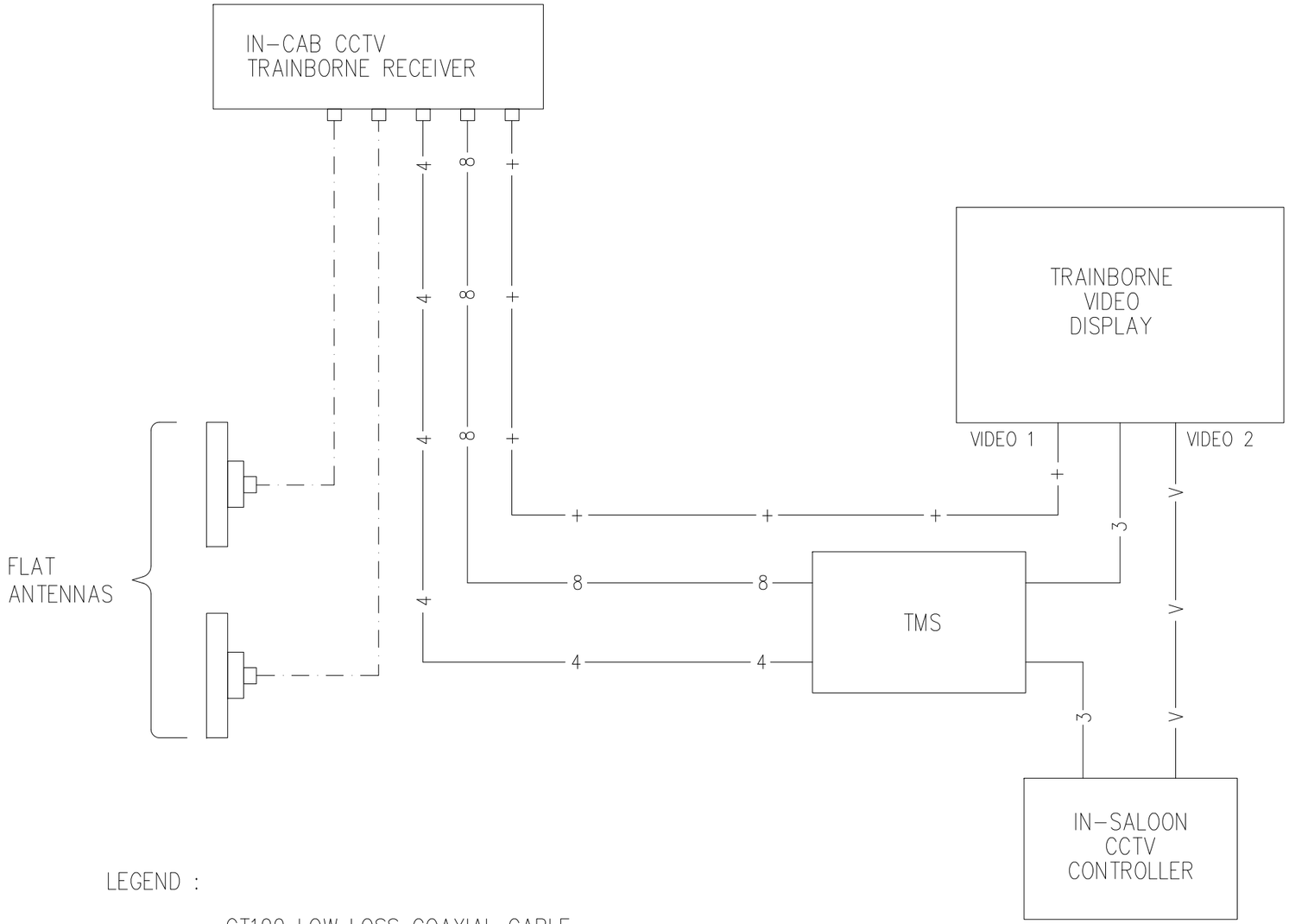
OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_687_001_A.DWG

TITLE
C6014-14E
PROCUREMENT OF NEW TRAINS
HPF APPLICATOR

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/687/001	A



LEGEND :

— · — · — CT100 LOW LOSS COAXIAL CABLE

—— + —— LSOH COAXIAL CABLE

—— 8 —— 8 CORE LSOH CABLE

—— 4 —— 4 CORE LSOH CABLE

—— 3 —— 3 CORE LSOH CABLE

—— V —— VGA CABLE

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	RH
DESIGNED	---
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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ORIGINATOR

OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_667_008_A.DWG

TITLE

C6014-14E

PROCUREMENT OF NEW TRAINS

CCTV TRAINBORNE EQUIPMENT

CONNECTION SCHEMATICS

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/667/008	A

NOTE: K.E. FROM 'X' TO 'Y' IS THE LOCAL REDUCTION FOR UNDERGROUND NON-BALLASTED STRAIGHT STATION PLATFORMS WITHOUT SIDE WIND.

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	RH
DESIGNED	___
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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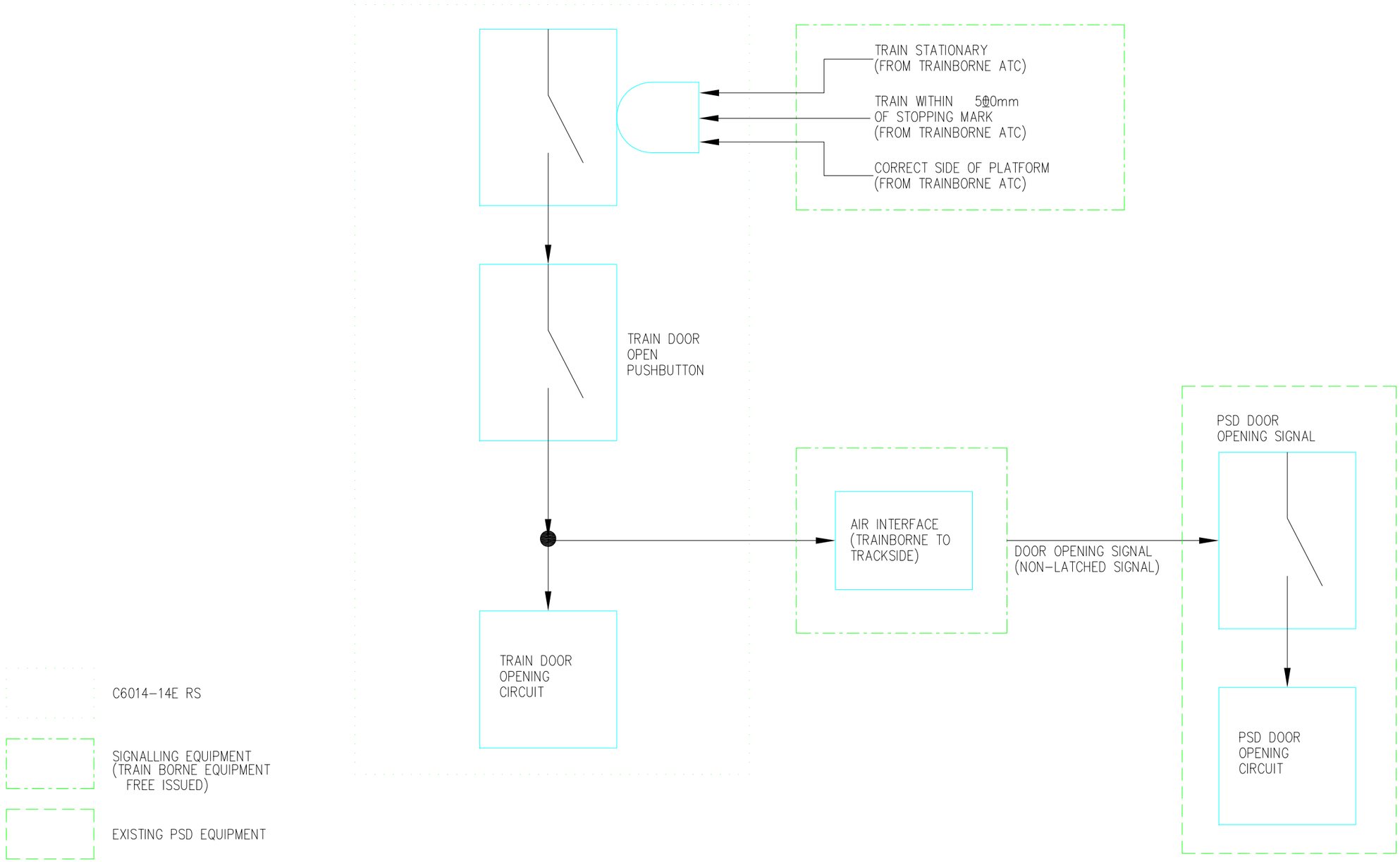
CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_077_001_A.DWG

TITLE

C6014-14E
PROCUREMENT OF NEW TRAINS
PLATFORM INTERFACE
WITH VEHICLE K.E.

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/077/001	A



REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	RH
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DATE	15/10/2014

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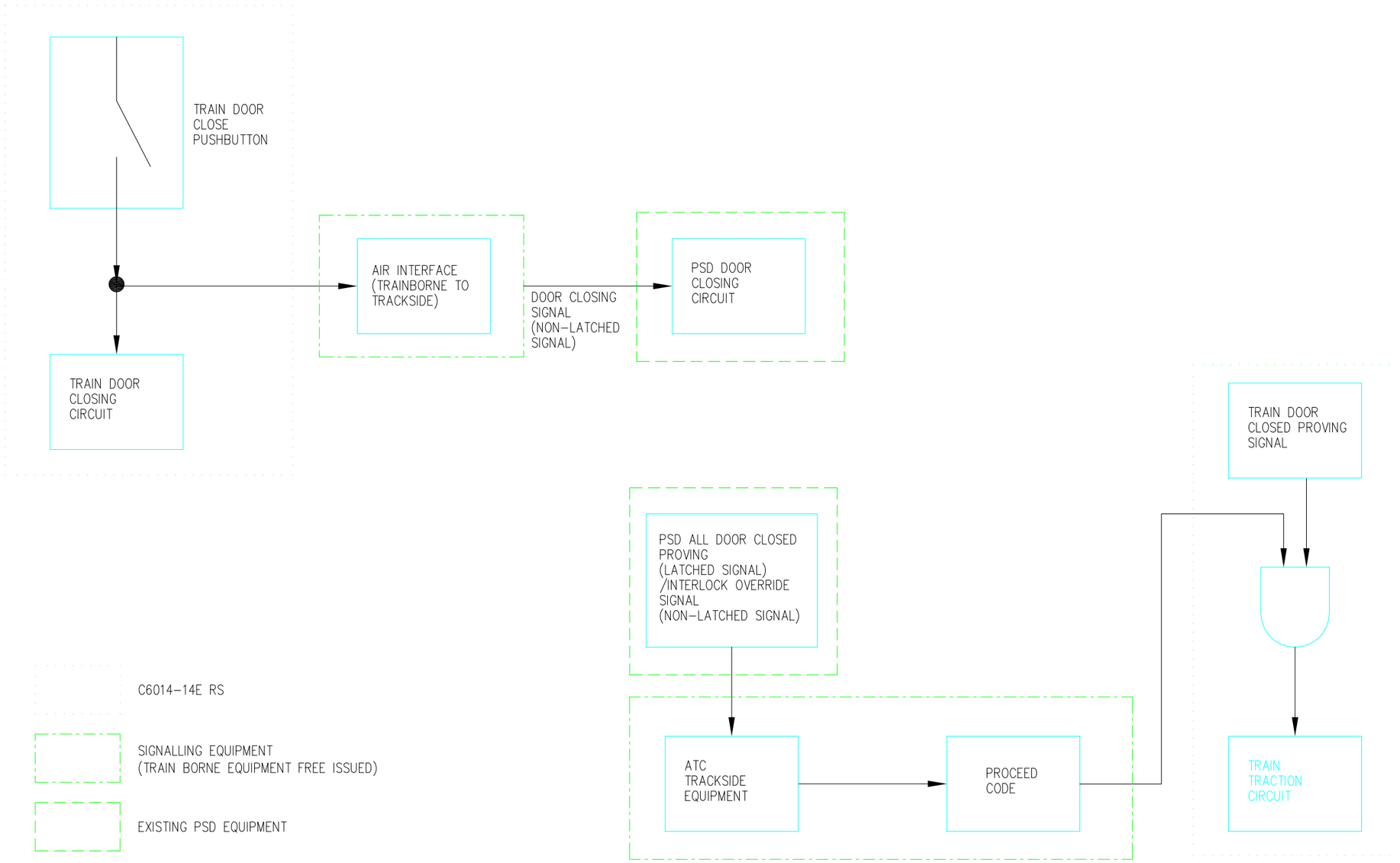
CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_077_002_A.DWG

TITLE
C6014-14E
PROCUREMENT OF NEW TRAINS
TRAIN / PSD DOOR
OPENING SCENARIO

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/077/002	A

C6014-14E/TSEG/077/003 A



REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	RH
DESIGNED	___
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_077_003_A.DWG

TITLE

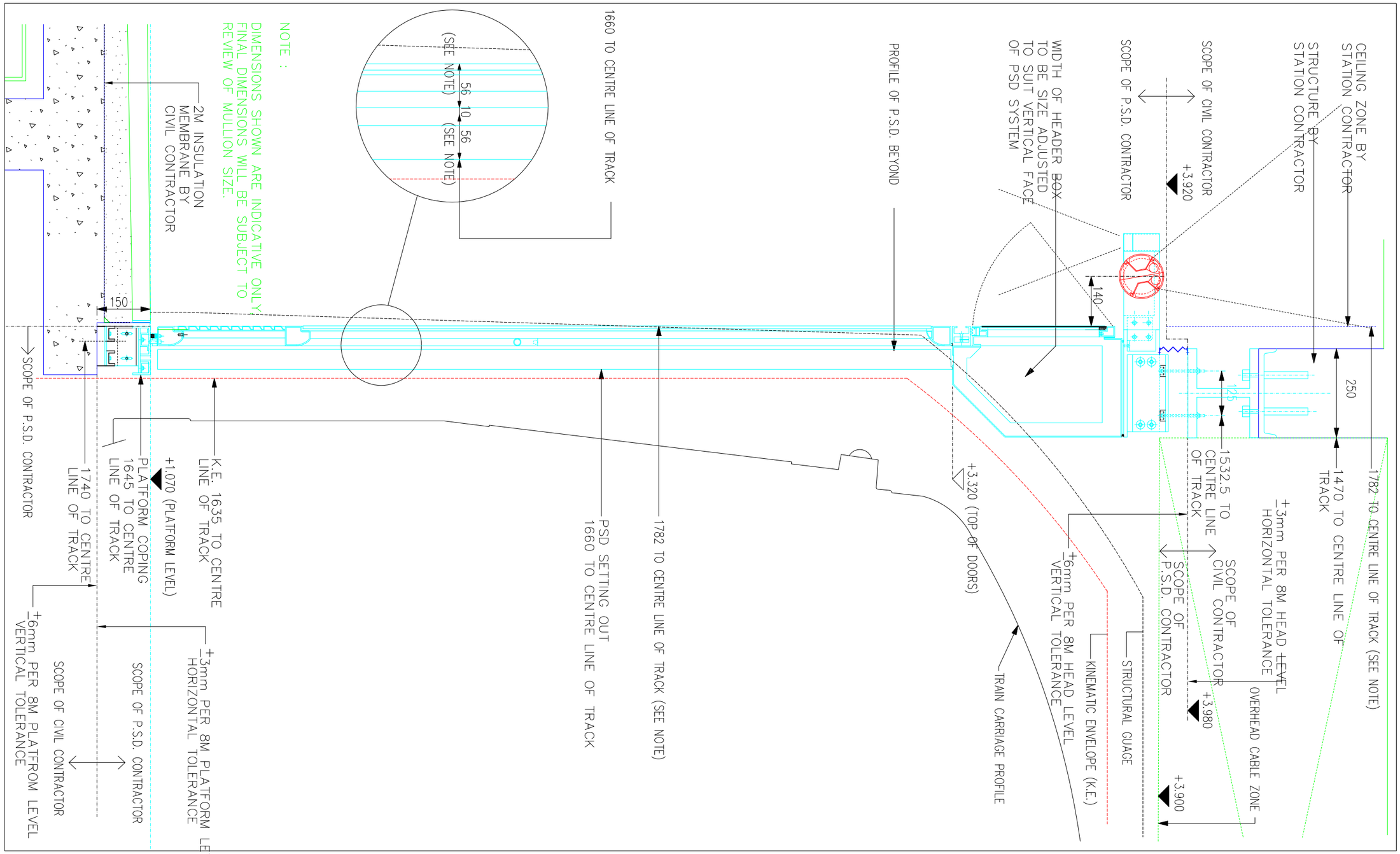
C6014-14E

PROCUREMENT OF NEW TRAINS

TRAIN / PSD DOOR CLOSING SCENARIO

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/077/003	A

C6014-14E/TSEG/077/004 A



REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	RH
DESIGNED	---
CHECKED	JA/KYL
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DATE	15/10/2014

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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_077_004_A.DWG

TITLE
C6014-14E
PROCUREMENT OF NEW TRAINS
PLATFORM SCREEN DOOR SECTION FOR INTERFACE ARRANGEMENT

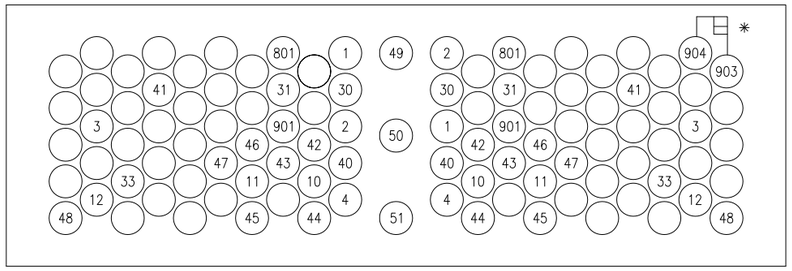
SCALE: NTS

DRAWING NO.: C6014-14E/TSEG/077/004

REV.: A

URL M-TRAIN
CAB-END AUTOCOUPLER PIN Arrangement

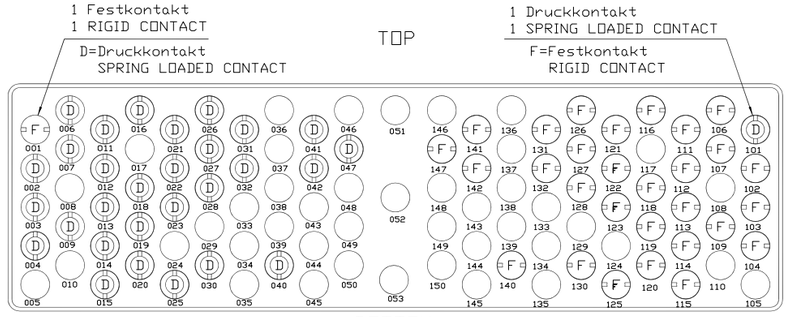
LIST OF TRAIN LINES	
No.	FUNCTION
1	FORWARD
2	REVERSE
3	SHUNT
4	SERIES
801	SAFETY BRAKE
901	SAFETY BRAKE RETURN
10	BRAKE LEVEL
11	BRAKE LEVEL
12	BRAKE AND INDICATION SUPPLY
903	N/C CONTACT-OPEN WHEN COUPLED
904	N/C CONTACT-OPEN WHEN COUPLED RETURN
30	TRAIN LINE -VE
31	TRAIN LINE -VE
33	TRAIN LINE +VE
40	TELECOMMUNICATION (EMERGENCY CALL)
41	SPARE
42	TELECOMMUNICATION (CAB/CAB CONTROL)
43	TELECOMMUNICATION (P.A.CONTROL)
44	TRAIN DIVIDED INDICATION
45	TELECOMMUNICATION (P.A.+VE)
46	TELECOMMUNICATION (100V BUS LINE)
47	TELECOMMUNICATION (100V BUS LINE)
48	PUBLIC ADDRESS -VE
49	BATTERY CHARGING FAULT
50	FLASHING LIGHT
51	PWM SCREENS



SPRING CONTACTS | AUTO-COUPLER (FRONT VIEW) | FIXED CONTACTS

URL K-Train
CAB-END AUTOCOUPLER PIN Arrangement

No.	FUNCTION	No.	FUNCTION
001	AUTO COUPLER COUPLED	101	AUTO COUPLER COUPLED
002	BRAKE LOOP2 RETURN	102	BRAKE LOOP2 RETURN
003	PWM SIGNAL(1)	103	PWM SIGNAL(1)
004	PWM SIGNAL(2)	104	PWM SIGNAL(2)
005		105	
006	AUTO COUPLER COUPLED	106	AUTO COUPLER COUPLED
007	FAULT INDICATION CONTROL	107	FAULT INDICATION CONTROL
008		108	
009	Spare	109	Spare
010		110	
011	PA AUDIO BUS	111	PA AUDIO BUS
012	PA AUDIO BUS	112	PA AUDIO BUS
013	PA AUDIO BUS	113	PA AUDIO BUS
014	EMV CONTROL POWER	114	EMV CONTROL POWER
015	BRAKE LOOP2 CONTROL	115	BRAKE LOOP2 CONTROL
016	BRAKE LOOP1 RETURN	116	BRAKE LOOP1 RETURN
017		117	
018	BRAKING	118	BRAKING
019	PA COM BUS	119	PA COM BUS
020	PA COM BUS	120	PA COM BUS
021	PA COM BUS	121	PA COM BUS
022	Spare	122	Spare
023	Spare	123	Spare
024		124	
025	BRAKE LOOP1 CONTROL	125	BRAKE LOOP1 CONTROL
026	REVERSE	126	FORWARD
027	FORWARD	127	REVERSE
028	MOTORING	128	MOTORING
029		129	
030	EMERGENCY PANTO DOWN	130	EMERGENCY PANTO DOWN
031	DOOR PROVING LOOP	131	DOOR PROVING LOOP
032	DOOR PROVING LOOP	132	DOOR PROVING LOOP
033		133	
034		134	
035		135	
036		136	
037		137	
038		138	
039		139	
040	GROUND RETURN 1	140	GROUND RETURN 1
041	TRAIN DIVIDED CONTROL 2	141	TRAIN DIVIDED CONTROL 2
042	TRAIN DIVIDED RETURN	142	TRAIN DIVIDED RETURN
043		143	
044		144	
045		145	
046		146	
047	EMV CONTROL GROUND RETURN	147	EMV CONTROL GROUND RETURN
048		148	
049		149	
050		150	
051			
052			
053			



REV	DESCRIPTION	BY	DATE	APPROVED
REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	RH
DESIGNED	---
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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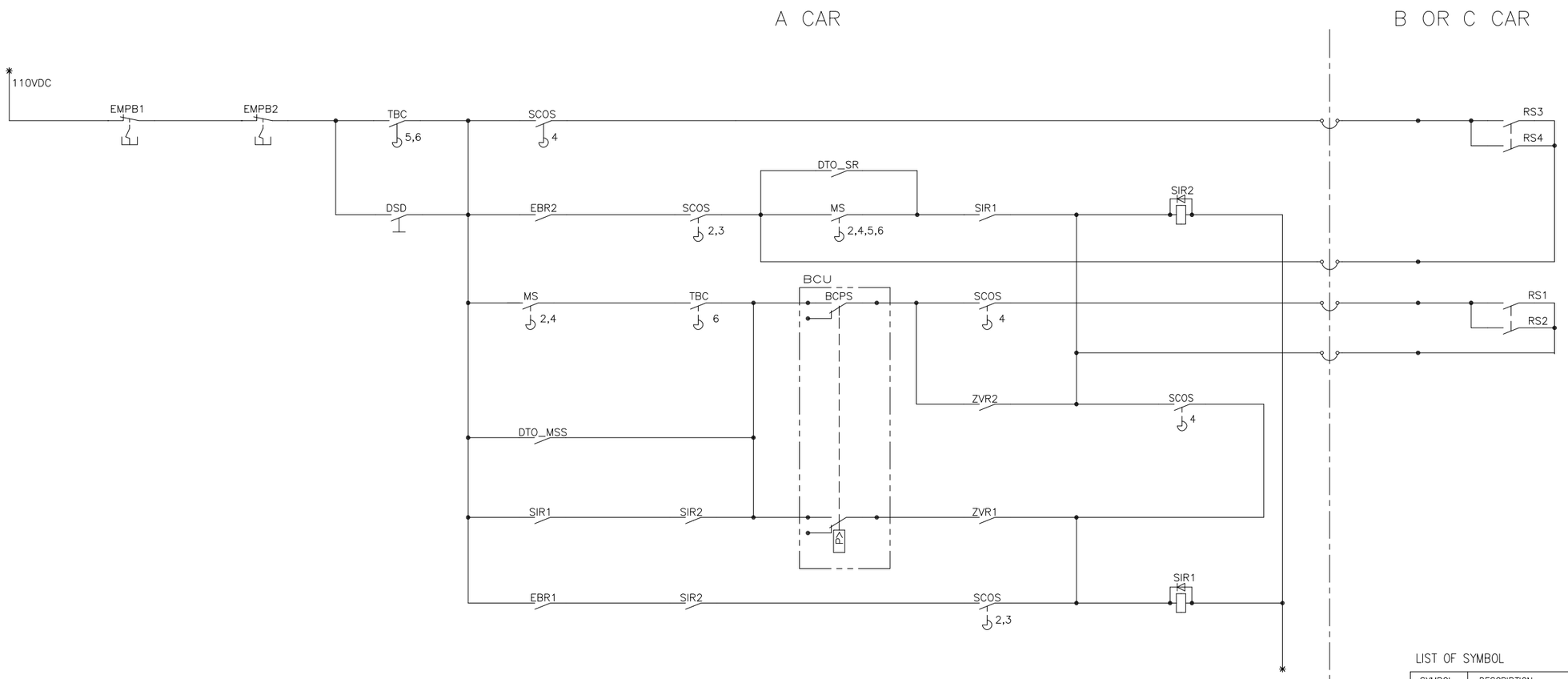
ORIGINATOR: OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

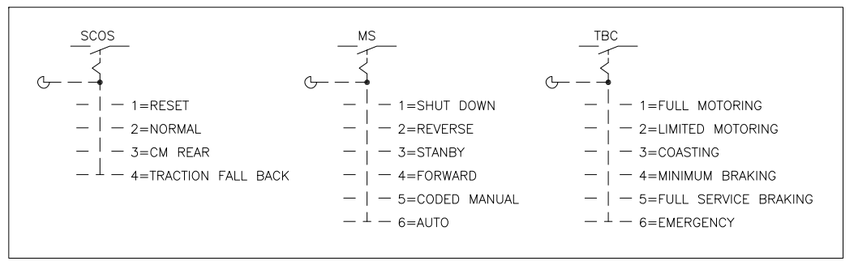
FILE NAME: C6014-14E_TSEG_157_001_A.DWG

TITLE: C6014-14E
PROCUREMENT OF NEW TRAINS
URBAN LINES TRAINS CAB END COUPLER
ELECTRICAL BOX PIN ARRANGEMENT

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/157/001	A



CAM POSITIONS



LIST OF SYMBOL

SYMBOL	DESCRIPTION
BCPS	BRAKE CYLINDER PRESSURE SWITCH
BCU	BRAKE CONTROL UNIT
DSD	DRIVERS SAFETY DEVICE
DTO_MSS, DTO_SR	DRIVERLESS TURNAROUND CONTROLS
EBR1-2	EMERGENCY BRAKE RELAYS
EMPB1-2	EMERGENCY PUSH BUTTONS
MS	MODE SELECTOR
SCOS	SAFETY CUT OUT SWITCH
SIR1-2	SAFETY INTERLOCK RELAYS
TBC	TRACTION BRAKE CONTROLLER
RS3, RS4	TRACTION - OVERSPEED CONTACTS
RS1, RS2	TRACTION - ZERO VELOCITY CONTACTS
ZVR1-2	ZERO VELOCITY RELAYS

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	RH
DESIGNED	---
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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_417_001_A.DWG

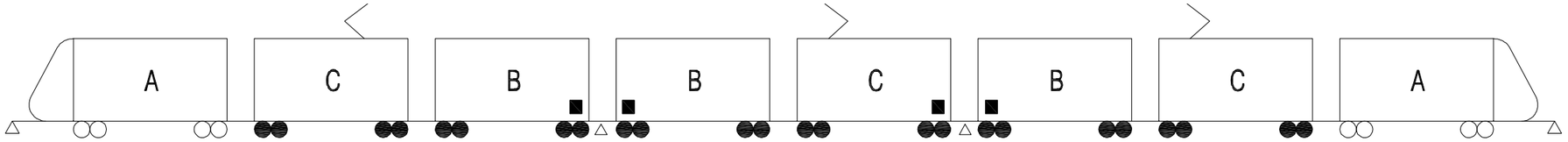
TITLE

C6014-14E

PROCUREMENT OF NEW TRAINS

TRAIN CONCEPTUAL SAFETY PROVING CIRCUIT

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/417/001	A



REFER TO
C6554-07E/TSEG/497/002

ATC/COMMS SYSTEM INTERFACE

REFER TO
C6554-07E/TSEG/497/002

ATC/COMMS SYSTEM INTERFACE

TRAIN BUS

AUTO-COUPLER

AUTO-COUPLER

DISPLAY

CPU+ REAL TIME CLOCK

GATEWAY

EVENT RECORDER

GATEWAY

GATEWAY

CPU+ REAL TIME CLOCK

DISPLAY

VEHICLE BUS

VEHICLE BUS

VEHICLE BUS

LPU

LPU

LPU

LPU

LPU

LPU

LPU

LPU

DOOR

A/C

SUSPENSION

CONTROL INTERFACE

DRM

EDD

ETND

DOOR

A/C

SUSPENSION

AUXILIARY CONVERTER

DRM

DOOR

A/C

SUSPENSION

AUXILIARY CONVERTER

CONTROL INTERFACE

DRM

DOOR

A/C

SUSPENSION

AUXILIARY CONVERTER

CONTROL INTERFACE

DRM

DOOR

A/C

SUSPENSION

AUXILIARY CONVERTER

CONTROL INTERFACE

DRM

DOOR

A/C

SUSPENSION

AUXILIARY CONVERTER

CONTROL INTERFACE

DRM

DOOR

A/C

SUSPENSION

AUXILIARY CONVERTER

DRM

DOOR

A/C

SUSPENSION

CONTROL INTERFACE

DRM

EDD

ETND

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	LC
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TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

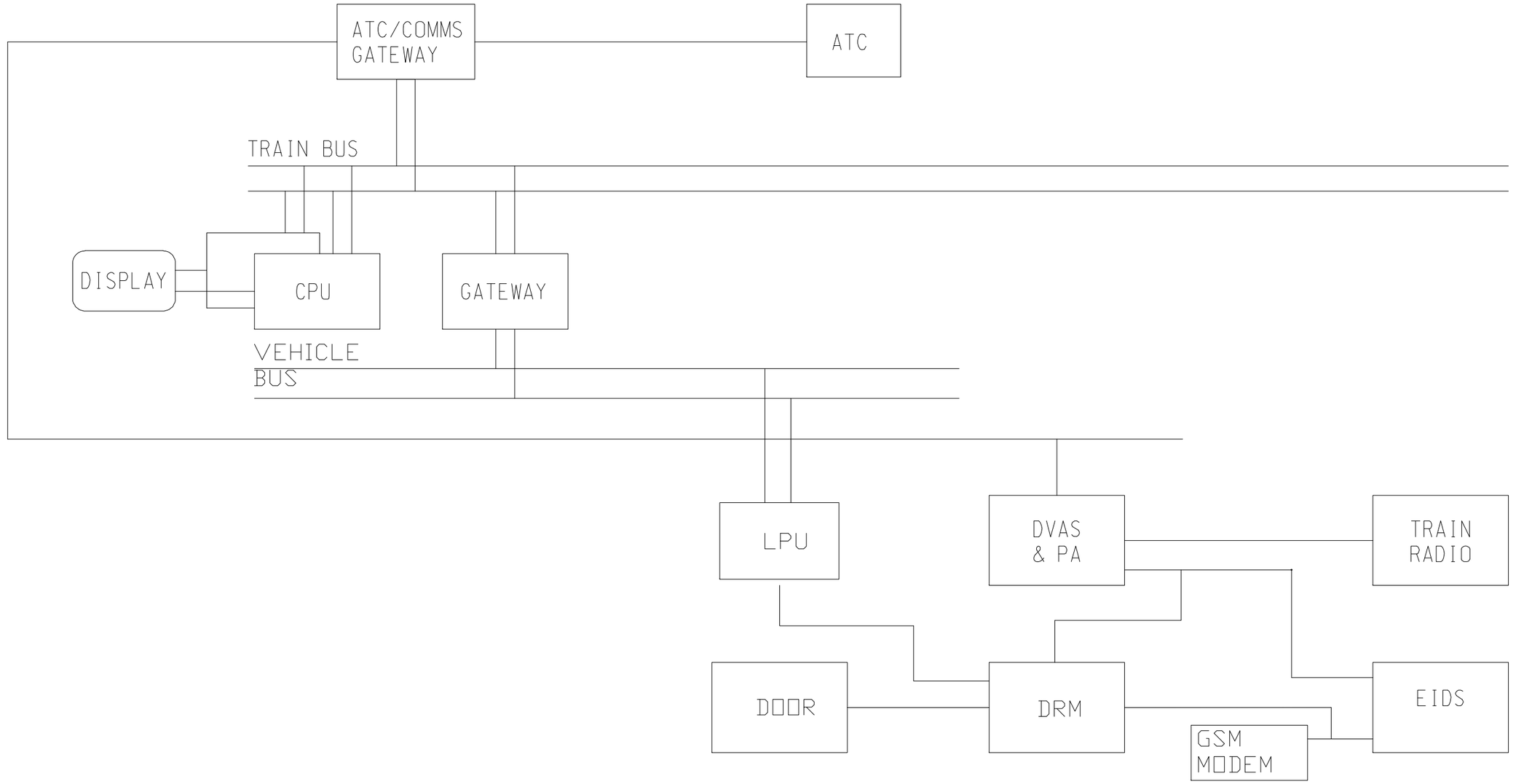
CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_497_001_A.DWG

TITLE

C6014-14E
PROCUREMENT OF NEW TRAINS
CONCEPTUAL ARCHITECTURE OF TMS

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/497/001	A



REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	LC
DESIGNED	—
CHECKED	JA/KYL
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DATE	15/10/2014

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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_497_002_A.DWG

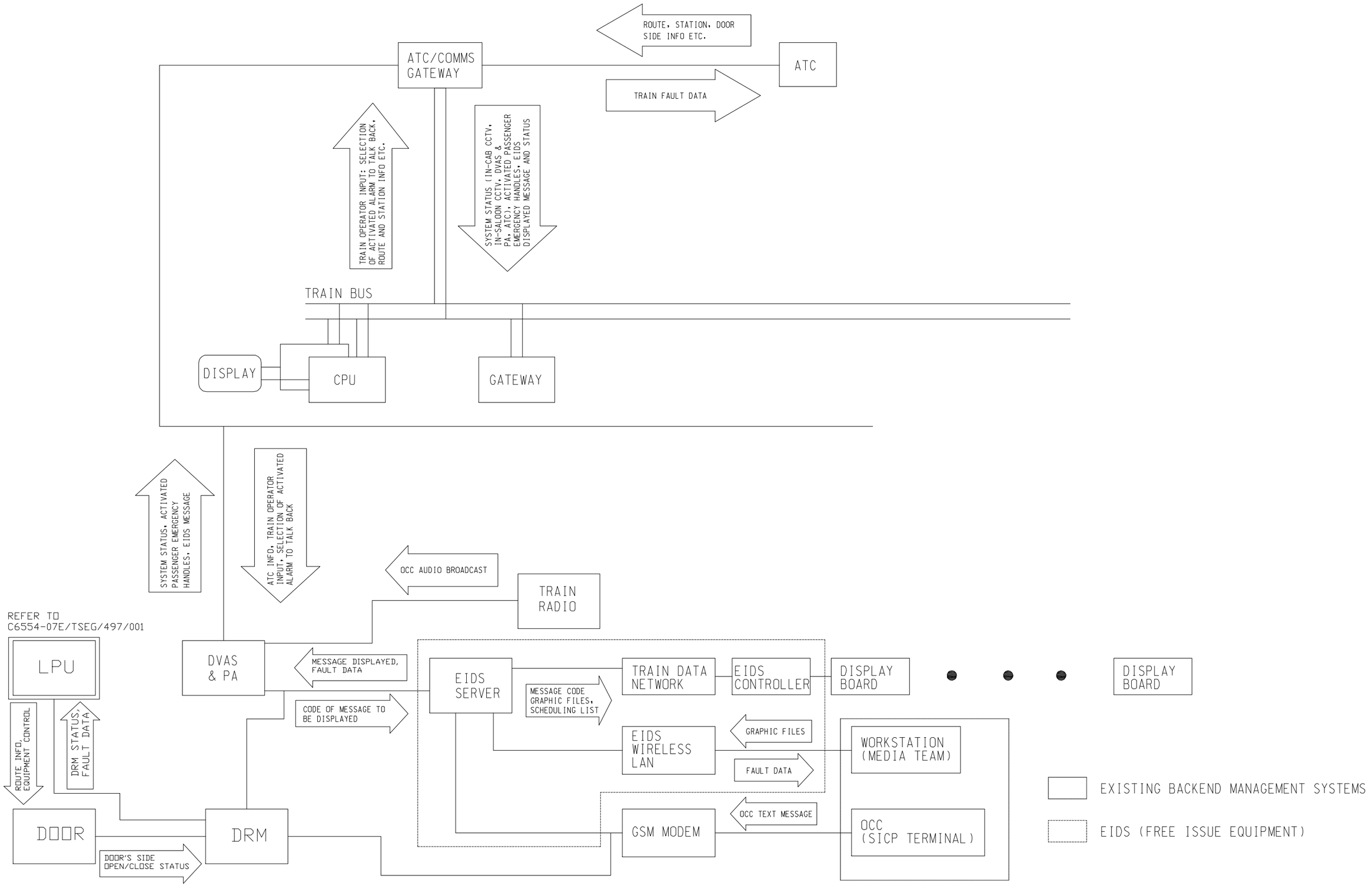
TITLE

C6014-14E

PROCUREMENT OF NEW TRAINS

ATC / COMMUNICATION SYSTEM / DRM INTERFACE WITH TMS

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/497/002	A



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REV	DESCRIPTION	BY	DATE	APPROVED

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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_497_003_A.DWG

TITLE

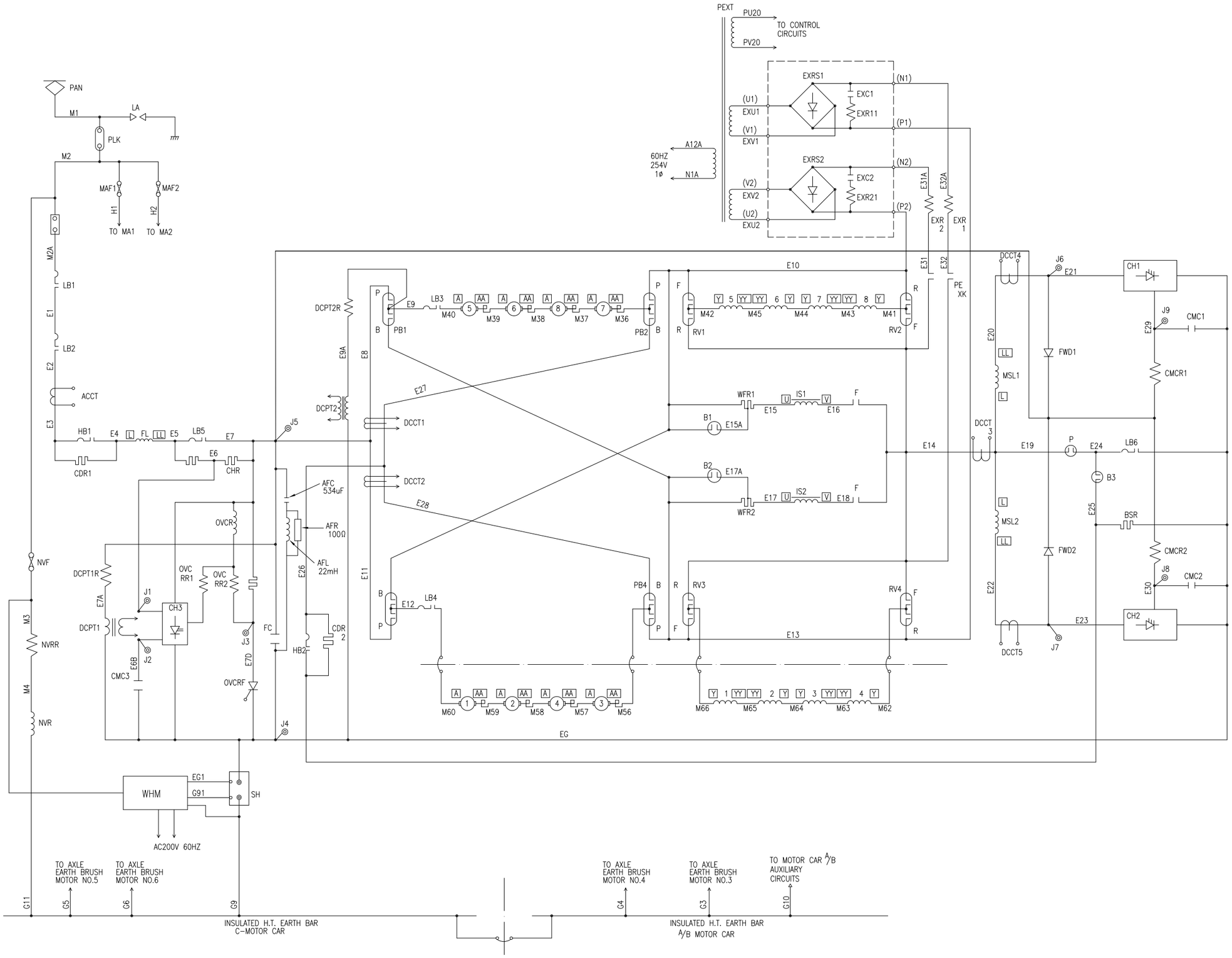
C6014-14E

PROCUREMENT OF NEW TRAINS

ATC/DVAS/EIDS/DRM

CONCEPTUAL DATA FLOW

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/497/003	A



ABBREVIATION LIST	
SYMBOL	DESCRIPTION
ACCT	A.C. CURRENT TRANSFORMER
B	BRAKING CONTACTOR
BSR	BRAKE SIRIES RESISTOR
CH	CHOPPING PART
CHR	CHARGING RESISTOR
CMC	COMMUTATING CONDENSER
CMCR	CMC RESISTOR
DCCT	D.C. CURRENT TRANSFORMER
DCPT	D.C. POTENTIAL TRANSFORMER
DCPTR	DCPT RESISTOR
EXR	EXCITER RESISTOR
EXRS	EXCITER RECTIFIER STACK
F	FIELD SHUNT CONTACTOR
FC/AFC	FILTER CONDENSER / AUX. FC
FL/AFL	FILTER REACTOR / AUX. FL
FWD	FREE WHEELING DIODE
HB	HIGH SPEED CIRCUIT BREAKER
IS	INDUCTIVE SHUNT
LA	LIGHTNING ARRESTER
LB	LINE BREAKER
MAF	MOTOR ALTERNATOR FUSE
MSL	MAIN SMOOTHING REACTOR
NVF	NO VOLT FUSE
NVR	NO VOLT RESISTOR
NVRR	NVR RESISTOR
OVCRF	OVER VOLT CONTROL RECTIFIER
OVCR	OVCR RELAY
OVCRR	OVCR RESISTOR
P	POWERING CONTACTOR
PAN	PANTOGRAPH
PB	POWER AND BRAKING CHANGEOVER SWITCH
PEXK	PRE-EXCITATION CONTACTOR
PEXT	PRE-EXCITATION TRANSFORMER
PLK	PANTOGRAPH LINK
RV	REVERSER
SH	SHUNT
WFR	WEAK FIELD RESISTOR
WHM	WATT FIELD RESISTOR
AFR	AUX. FIILTER RESISTOR (100Ω)

△C

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
C	ABBREVIATION LIST WAS MISSING	J.TSUI 08-11-01	J.C.KIU 14-11-01	E.YEUNG 16-11-01
B	DIGITIZATION		J.C.KIU 26-2-94	E.YEUNG 26-2-94
A	ARC, AFR & AFL ADDED ON GRID 4f			31-10-86

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MTRC REFERENCE NO.

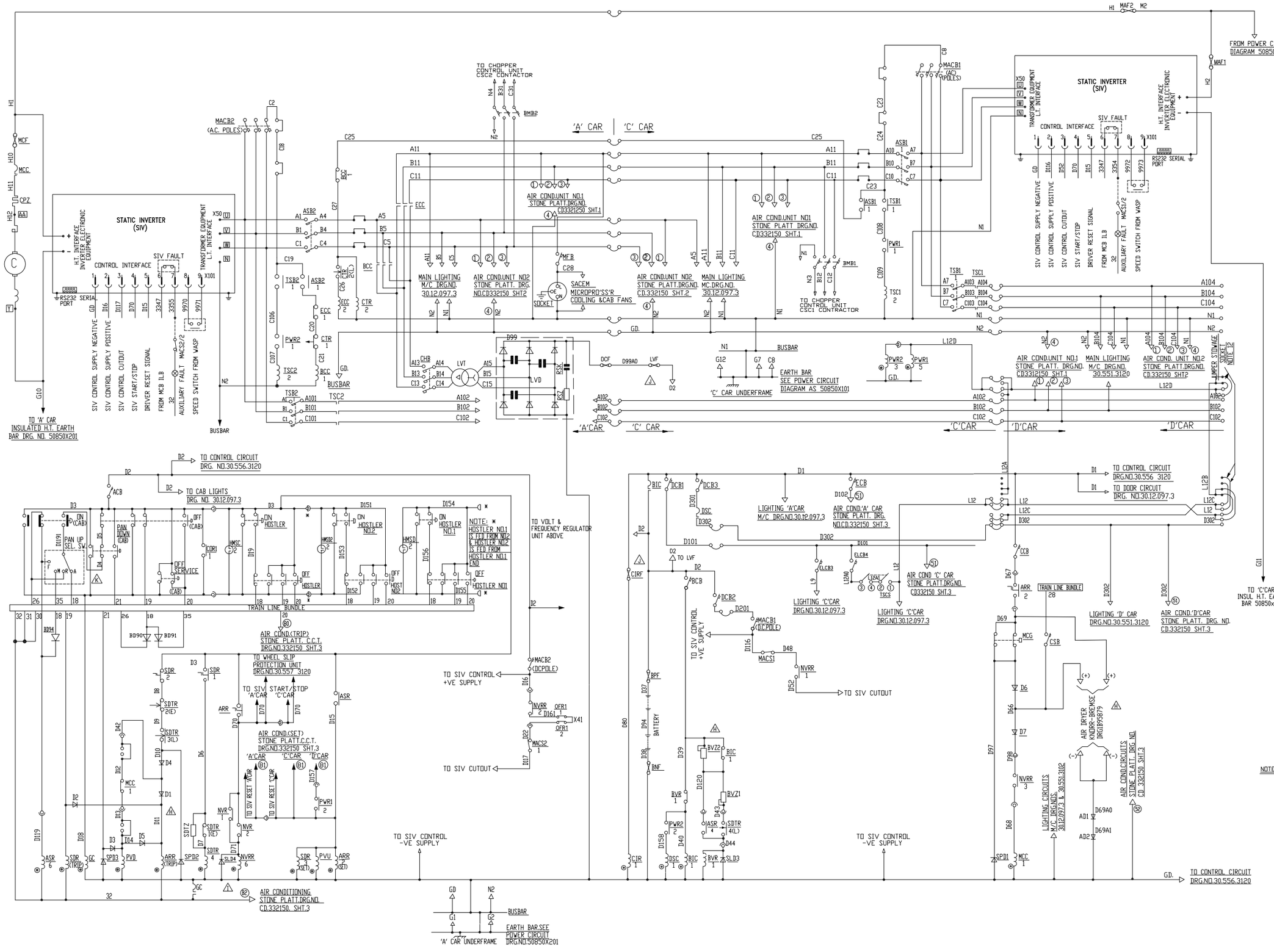
CONTRACTOR REFERENCE NO.
HK16486

	INITIAL	DESIGNATION	DATE
DRAWN	Y38	ZESTC	26-2-94
DESIGNED			
CHECKED			
APPROVED			
CAD FILE NAME	320145V1		

地鐵公司 MTR Corporation

TITLE
SCHEMATIC DIAGRAM OF POWER CIRCUIT

SCALE NTS | OED DRAWING NO. OD4/302/00003/0011 | C



LIST OF SYMBOLS

SYMBOL	DESCRIPTION	LOCATION REF.CARS A	CT	D
ACB	AUXILIARY CONTROL M.C.B	2		
ARR	AUXILIARIES RUN RELAY		7	
ASB2-1	3-PHASE SUPPLY M.C.B.S	6	7	
ASR	AUXILIARY START RELAY		7	
AD1-2	AIR DRYER DIODES	6		
BCB	BATTERY CONTROL M.C.B.	2		
BCC	BATTERY CHARGE & L.V.SUPPLY CONTACTOR	6		
BIC	BATTERY ISOLATING CONTACTOR	6		
BD90-91	BLOCKING DIODES	2		
BNF	BATTERY NEGATIVE FUSE	11		
BPF	BATTERY POSITIVE FUSE	11		
BVR	BATTERY VOLTAGE RELAY	6		
BVZ2-1	BALLAST FOR BVR	6		
CCB	COMPRESSOR M.C.B.	2		
CHB	BATTERY CHARGE & L.V.SUPPLY M.C.B.	6		
CIR	CHARGING INDICATION RELAY	6		
CIRF	CHARGING INDICATION RELAY FUSE	6		
CIRZ	CHARGING INDICATION RELAY RESISTOR	6		
COR1	CAB OCCUPIED RELAY	13		
CPZ	COMPRESSOR MOTOR PROTECTIVE RESISTOR	11		
CSB	COMPRESSOR SYNCHRONISING M.C.B.	2		
CTR	CHARGING C/O TIME DELAY RELAY	6		
DCB1	'C' CAR CONTROL POSITIVE M.C.B.	2		
DCB2	'C' CAR BATTERY POSITIVE M.C.B.	2		
DCB3	'D' CAR CONTROL POSITIVE M.C.B.	18		
DCF	D.C. SUPPLY FUSE	6		
D1-7	BLOCKING DIODES	2		
DSC	'D' CAR SUPPLY CONTACTOR	18		
ECB	'A' CAR AIR CONDITIONING SUPPLY M.C.B.	2		
ECC	EMERGENCY CHARGING CONTACTOR	6		
ELCB3-4	'C' CAR EMERGENCY LIGHTING M.C.B.S		10	
GC	GROUND CONTACTOR	6		
HMSC	HOSTLER MASTER SWITCH		10	
HMSD1-2	HOSTLER MASTER SWITCHES			16-17
LVD	BATTERY CHARGE & L.V.SUPPLY RECTIFIER	6		
LVF	L.V. RECTIFIER OUTPUT FUSE	6		
LVT	BATTERY CHARGE & L.V. SUPPLY TRANSFORMER	11		
MACB2-1	M.A. CONTROL M.C.B.S	6	7	
MACS2-1	M.A. SET CUT OUT SWITCHES	2	10	
MAF2-1	M.A. FUSES		22	
MCC	MAIN COMPRESSOR CONTACTOR	6		
MCF	COMPRESSOR FUSE	6		
MCG	MAIN COMPRESSOR GOVERNOR	6		
MFB	MICROPROCESSOR FAN BREAKER	2		
NVF	NO VOLT FUSE		22	
NVR	NO VOLT RELAY *		7	
NVRR	NO VOLT REPEATER RELAY		7	
NVZ	NO VOLT RESISTOR		7	
OFR2-1	OFF SERVICE RELAY (AIR CONDITIONING)		7	
PVD	PANTOGRAPH DOWN VALVE		14	
PVU	PANTOGRAPH UP VALVE		14	
PWR2-1	PILOT WIRE RELAYS	18	19	
RSK	RECTIFIER SUPPRESSION CAPACITOR	6		
RSZ	SERIES RESISTOR FOR RSK	6		
SDR	SHUT DOWN RELAY		7	
SDTR	SHUT DOWN TIME DELAY RELAY		7	
SDTZ	BALLAST FOR SDTR		7	
SLD1-4	SLUGGING DIODES	6	7	
SPD1-3	SUPPRESSION DIODES	6	7	
TSB2-1	TRAILER A.C. SUPPLIES M.C.B.S	18	19	
TSC2-1	TRAILER A.C. SUPPLIES CONTACTORS	18	19	
TSCS	TRAILER SUPPLY CUT-OUT SWITCH		10	

NOTES:
1. * COIL IN POWER CIRCUIT DIAGRAM DRG. NO.50850X201
2. ** CENTRIFUGAL SWITCHES
3. FOR LOCATION REF. NOS. SEE DRG.NO.30.555.3120
4. 'A' CAR SIDE — 'C' CAR SIDE
5. 'C' CAR SIDE — 'D' CAR SIDE
6. CIR/1 CONTACT ON CONTROL CIRCUIT DIAGRAM NO.30.556.3120
7. NVRR/4 CONTACT ON CONTROL CIRCUIT DIAGRAM NO.30.556.3120
8. CORI COIL ON CONTROL CIRCUIT DIAGRAM NO.30.556.3120
9. (2) DENOTES STONE PLATT TERMINAL NOS.
10. ⊖ DENOTES SUPPRESSION UNIT FITTED ACCROSS COIL E.G.
11. TO ENSURE FAIL SAFE OF 'D' CAR A.C.SUPPLY, JUMPERS MUST BE CORRECTLY COUPLED TO 'C' CAR AND AT UNCOUPLED END CORRECTLY COUPLED TO STDWAGE SOCKETS 'D' CAR
12. FIELD FORCING TRANSFORMER SECONDARY CONNECTION: 785 TYPE MA--STAR CONNECTED 788 TYPE MA--DELTA CONNECTED
13. JUNPER ACROSS BIC/2 N.C., REFER TO MOD ZML2772.
14. SUPPRESSOR FOR CIR COIL IS V150LA10A (SCN 46-64-44028)

FIRST ANGLE PROJECTION

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
L	REVISED AS PER EDOC NO. ZML5862	2048 23-01-07	J.C.KIU 9-3-07	9-3-07
K	REVISED AS PER EDOC NO. ZML5094	2012 10-5-02	M.C. YIP 17-10-02	E. YEUNG 17-10-02
J	REVISED AS PER EDOC ZML4369 DRAWING UPDATING	W.H.CHENG 20-08-98	N.LEE 13-11-98	E.YEUNG 13-11-98
I	REVISED AS PER EDOC ZML4030 DRAWING UPDATING		M.C.YIP 11-03-97	E.YEUNG 11-03-97
H	REVISED AS PER EDOC ZML2811, ZML3545 & ZML3784 DRAWING UPDATING		F.NGAI 06-11-95	E.YEUNG 06-11-95
G	REVISED AS PER EDOC ZML2772, ZML3066, ZML3126 & ZML3265 DRAWING UPDATING			07-12-92 07-12-92
F	SUPPLY FOR MFB CONNECTED TO WIRE A11 ZML2746 UPDATED			23-06-92 23-06-92
E	D2 DIODE RELOCATED BETWEEN SDR (TRIP) COIL AND ARR (TRIP) COIL ZML2529 UPDATED			03-08-90 03-08-90
D	LVT CHANGED FROM Y CONNECTION TO △ CONNECTION			10-08-87 10-08-87
C	AMENDED D80, BCC/1 AND OFF SERVICE ON GRID 3A, 5E & 2E, SDR/3 WAS SDR/2 ON GRID 3G			
B	ADDED TO TER2/3 & TER1/3 ON GRID B4 & B6, OFR/1 & OFR/2 ADDED ON LINE D22 ON GRID E4, MAOR2/1 & MAOR1/1 SHORTED ON GRID F4 & F6			
A	FIRST ISSUE			22-08-83 22-08-83

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MTR REFERENCE NO.

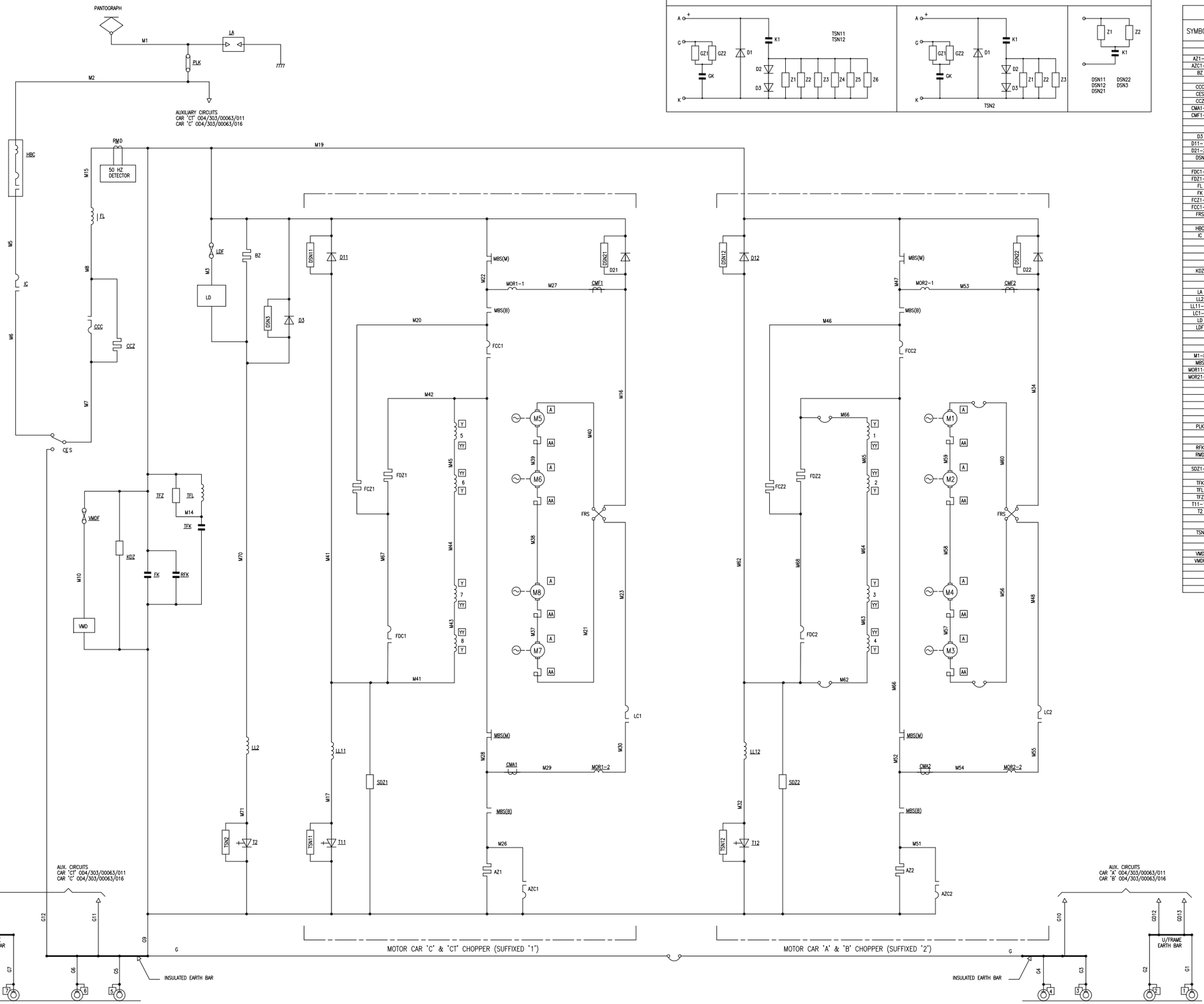
CONTRACTOR REFERENCE NO. 30.553.3120

	INITIAL	DESIGNATION	DATE
DRAWN		D'MAN	07-04-93
DESIGNED			
CHECKED		TO(RS)	
APPROVED		T&EE(RS)	
CAD FILE NAME		00303002	

地鐵公司 MTR Corporation

TITLE 'I' STOCK MELCO CHOPPER (248-256)
AUXILIARY CIRCUIT DIAGRAM
'A' 'C' & 'D' CARS

SCALE NTS | OED DRAWING NO. 0D4/302/00303/0002 | L



LIST OF SYMBOLS

SYMBOL	DESCRIPTION	LOCATION No'S CAR REF. A	CT	D	B	C
AZ1-2	ARMATURE RESISTOR	22				22
AZC1-2	ARMATURE RESISTOR CONTATOR	5				5
BZ	BRAKING RESISTOR	22				22
CCC	CAPACITOR CHARGING CONTACTOR	5				5
CES	CAPACITOR EARTHING SWITCH	5				5
CCZ	CAPACITOR CHARGING RESISTOR	5				5
CMA1-2	CURRENT MONITORING DEVICE (ARM)	5				5
CMF1-2	CURRENT MONITORING DEVICE (FIELD)	5				5
D3	RESISTOR FREEWHEEL DIODE	4				4
D11-12	MOTOR FREEWHEEL DIODE	4				4
D21-22	BRAKING DIODE	4				4
DSN	DIODE SNUBBER NETWORK	4				4
FDC1-2	WEAKFIELD CONTACTORS	5				5
FDZ1-2	WEAKFIELD RESISTORS	22				22
FL	LINE FILTER INDUCTOR	11				11
FK	LINE FILTER CAPACITOR	21				21
FCZ1-2	FIELD CONTROL RESISTOR	22				22
FCC1-2	FIELD CONTROL RESISTOR CONTACTOR	5				5
FRS	FORWARD REVERSE SWITCH	5				5
HBC	HIGH SPEED CIRCUIT BREAKER	8				8
IC	ISOLATING CONTACTOR	5				5
KDZ	FILTER CAPACITOR DISCHARGE RESISTOR	21				21
LA	LIGHTNING ARRESTOR	23				23
LL2	DI/DT CHOKE	4				4
LL11-12	DI/DT CHOKE	4				4
LC1-2	LOOP CONTACTORS	5				5
LD	LOCK ON DETECTOR	9				9
LDF	LOCK ON DETECTOR FUSE	9				9
M1-8	TRACTION MOTORS	11				11
MBS	MOTOR BRAKE SWITCH	5				5
MOR11-12	MOTOR OVERLOAD RELAY	5				5
MOR21-22	MOTOR OVERLOAD RELAY	5				5
PLK	PANTOGRAPH LINK	23				23
RFK	R.F. INT. SUPPRESSOR CAPACITOR	21				21
RMD	RIPPLE MONITOR DETECTOR	9				9
SDZ1-2	SNUBBER DISCHARGE RESISTOR	5				5
TFK	TUNED FILTER CAPACITOR	21				21
TFL	TUNED FILTER INDUCTOR	21				21
TFZ	TUNED FILTER RESISTOR	21				21
T11-12	MAIN THYRISTOR	4				4
T2	RHEOSTATIC BRAKE THYRISTOR	4				4
TSN	THYRISTOR SNUBBER NETWORK	4				4
VMD	LINE VOLT MONITORING DEVICE	9				9
VMDF	VMD FUSE	9				9

LOCATION REF. NUMBERS

REF	LOCATION
1	CAB
2	CAB CUPBOARD ("A" SIDE)
3	CAB CUPBOARD ("B" SIDE)
4	CHOPPER EQUIPMENT CASE
5	CONTACTOR CASE
6	AUX. EQUIPMENT CASE
7	INVERTER POWER EQUIPMENT CASE
8	HIGH SPEED CONTACTOR CASE
9	ELECTRONICS & H.V.AUX.CASE
10	HOSTLER CAB
11	MOUNTED ON UNDERFRAME
12	INVERTER POWER EQUIPMENT FRAME
13	
14	PANTOGRAPH EQUIPT. CUPBOARD
15	
16	HOSTLER CAB NO.1 END("A" SIDE)
17	HOSTLER CAB NO.2 END("B" SIDE)
18	BODY
19	LT PANEL
20	
21	CAPACITOR FRAME
22	MAIN RESISTOR FRAME
23	ROOF
24	

NOTES
1/FORWARD/REVERSE SWITCH (FRS) IS SHOWN IN FORWARD POSITION
2/MOTOR/BRAKE SWITCH MBS IS SHOWN IN MOTORING POSITION
3/ONLY MOTORS 1 TO 4 INC. ARE MOUNTED ON "A"/"B" CARS
REMAINDER OF EQUIPMENT IS MOUNTED ON THE "C" & "CT" CARS
4/THE CHOPPER GROUP FOR THE "C" & "CT" CAR MOTORS IS SUFFIXED '1'
AND FOR THE 'A'/'B' CAR MOTORS IS SUFFIXED '2'

REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHECKED	APPROVED	DATE
B	DIGITIZATION	F.NGAI	E.YEUNG	11/1/96

REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
50897X201 G

	INITIAL	DESIGNATION	DATE
TRACED BY	Y56	ZESTC	18-2-94
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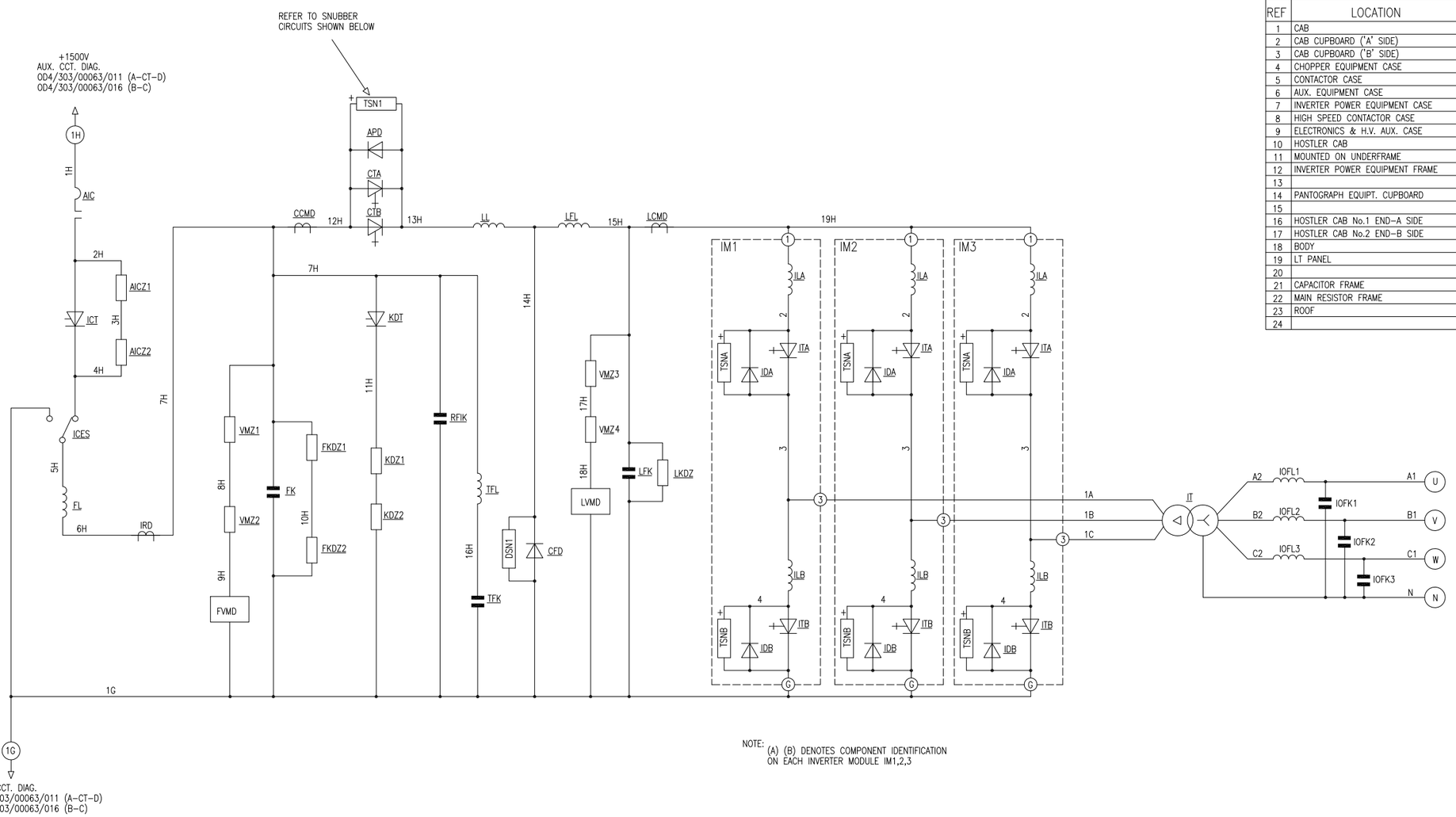
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.		320356V1	

MASS TRANSIT RAILWAY CORPORATION

TITLE
POWER CIRCUIT DIAGRAM FOR E.M.U.
CARS CHOPPER/AUX. INVERTER

SCALE NTS DWG NO. 0D4/303/00042/027 B



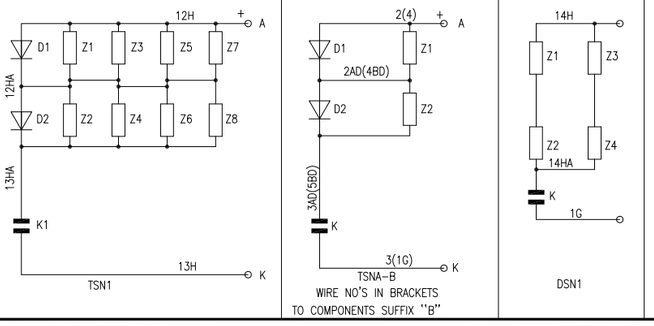
LOCATION REF. NUMBERS

REF	LOCATION
1	CAB
2	CAB CUPBOARD ('A' SIDE)
3	CAB CUPBOARD ('B' SIDE)
4	CHOPPER EQUIPMENT CASE
5	CONTACTOR CASE
6	AUX. EQUIPMENT CASE
7	INVERTER POWER EQUIPMENT CASE
8	HIGH SPEED CONTACTOR CASE
9	ELECTRONICS & H.V. AUX. CASE
10	HOSTLER CAB
11	MOUNTED ON UNDERFRAME
12	INVERTER POWER EQUIPMENT FRAME
13	
14	PANTOGRAPH EQUIPT. CUPBOARD
15	
16	HOSTLER CAB No.1 END-A SIDE
17	HOSTLER CAB No.2 END-B SIDE
18	BODY
19	LT PANEL
20	
21	CAPACITOR FRAME
22	MAIN RESISTOR FRAME
23	ROOF
24	

LIST OF SYMBOLS

SYMBOL	DESCRIPTION	LOCATION REF.CARS A	CT	B	C
AIC	AUXILIARY SUPPLY INVERTER CONTACTOR	7	7	7	7
AICZ1-2	AUXILIARY INVERTER CHARGING RESISTOR	7	7	7	7
APD	ANTI PARALLEL DIODE	7	7	7	7
CCMD	CHOPPER CURRENT MONITORING DEVICE	7	7	7	7
CFD	CHOPPER FREEWHEEL DIODE	7	7	7	7
CTA-B	CHOPPER THYRISTOR	7	7	7	7
D1	CHOPPER FREEWHEEL DIODE	7	7	7	7
DSN	DIODE SNUBBER CIRCUIT	7	7	7	7
FK	FILTER CAPACITOR (LINE)	12	12	12	12
FKDZ1-2	CAPACITOR PERMANENT DISCHARGE RESISTOR	12	12	12	12
FL	FILTER INDUCTOR (LINE)	12	12	12	12
FVMD	FILTER VOLTAGE MONITORING DEVICE	7	7	7	7
ICES	INVERTER CAPACITOR EARTHING SWITCH	12	12	12	12
ICT	INVERTER CHARGING THYRISTOR	7	7	7	7
IDA-B	INVERTER DIODE	7	7	7	7
IOFL1-3	INVERTER OUTPUT FILTER INDUCTOR	12	12	12	12
IOFK1-3	INVERTER OUTPUT FILTER CAPACITOR	12	12	12	12
ILA-B	INVERTER INDUCTOR	7	7	7	7
IM1-3	INVERTER MODULES	7	7	7	7
IRD	INVERTER RIPPLE DETECTION CT	7	7	7	7
IT	INVERTER OUTPUT TRANSFORMER	11	11	11	11
ITA-B	INVERTER THYRISTOR	7	7	7	7
KDT	CAPACITOR DISCHARGE THYRISTOR	7	7	7	7
KDZ1-2	CAPACITOR DISCHARGE RESISTOR	12	12	12	12
LCMD	LINK CURRENT MONITORING DEVICE	7	7	7	7
LKDZ	CAPACITOR PERMANENT DISCHARGE RESISTOR	12	12	12	12
LFK	LINK FILTER CAPACITOR	12	12	12	12
LFL	LINK FILTER INDUCTOR	12	12	12	12
LL	DI/DT LIMITING INDUCTOR	7	7	7	7
LVMD	LINK VOLTAGE MONITORING DEVICE	7	7	7	7
RFIK	RADIO FREQUENCY INTERFERENCE CAPACITOR	7	7	7	7
TSN	THYRISTOR SNUBBER CIRCUIT	7	7	7	7
TFK	TUNED FILTER CAPACITOR	12	12	12	12
TFL	TUNED FILTER INDUCTOR	12	12	12	12
VMZ1-4	VOLTAGE MONITORING RESISTOR	7	7	7	7

SNUBBER CIRCUITS



REV				
B	DIGITIZATION	F.NGAI	E.YEUNG	11/1/96
REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHECKED	APPROVED	DATE

REFERENCE DWGS

CONTRACTOR'S DWG. NO. 50897L202 F

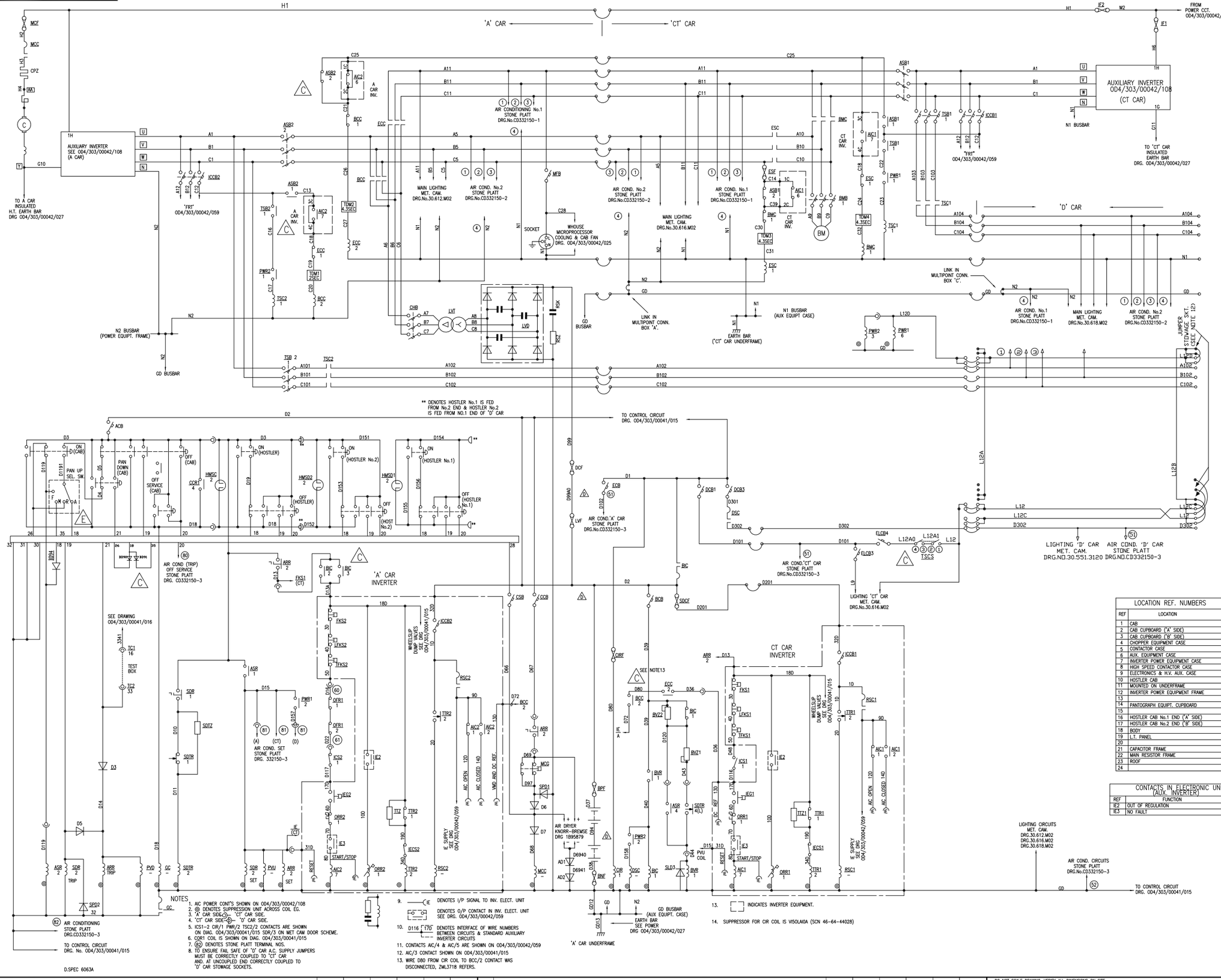
	INITIAL	DESIGNATION	DATE
TRACED BY	Y56	ZESTC	16-2-94
DESIGNED BY		GEC	
CHECKED BY		GEC	
APPROVED BY		GEC	
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.		320435V1	

MASS TRANSIT RAILWAY CORPORATION

TITLE

CIRCUIT DIAGRAM OF STATIC AUXILIARY INVERTER CHOPPER/AUX. INVERTER

SCALE NTS | DWG NO. 0D4/303/00042/108 B



NOTES

1. AIC POWER CONT'S SHOWN ON OD4/303/00042/108
2. ⓔ DENOTES SUPPRESSION UNIT ACROSS COIL EG.
3. "A" CAR SIDE⊖ "CT" CAR SIDE.
4. "CT" CAR SIDE⊕ "D" CAR SIDE.
5. ICS1-2 CIR/1 PWR/2 TSC2/2 CONTACTS ARE SHOWN ON DIAG. OD4/303/00041/015 SDR/3 ON MET CAM DOOR SCHEME.
6. COR1 COIL IS SHOWN ON DIAG. OD4/303/00041/015
7. (82) DENOTES STONE PLATT TERMINAL NOS.
8. TO ENSURE FAIL SAFE OF "D" CAR A.C. SUPPLY JUMPERS MUST BE CORRECTLY COUPLED TO "CT" CAR AND. AT UNCOUPLED END CORRECTLY COUPLED TO "D" CAR STOWAGE SOCKETS.
9. ⓘE DENOTES I/P SIGNAL TO INV. ELECT. UNIT
   ⓘE DENOTES O/P CONTACT IN INV. ELECT. UNIT SEE DRG. OD4/303/00042/059
10. D116 | 170 DENOTES INTERFACE OF WIRE NUMBERS BETWEEN CIRCUITS & STANDARD AUXILIARY INVERTER CIRCUITS
11. CONTACTS AIC/4 & AIC/5 ARE SHOWN ON OD4/303/00042/059
12. AIC/3 CONTACT SHOWN ON OD4/303/00041/015
13. WIRE D80 FROM CIR COIL TO BCC/2 CONTACT WAS DISCONNECTED, ZML3718 REFERS.
13. ⬚ INDICATES INVERTER EQUIPMENT.
14. SUPPRESSOR FOR CIR COIL IS V150LA40A (SCN 46-64-44028)

LIST OF SYMBOLS

SYMBOLS	DESCRIPTION	LOCATION REF.CARS A	CT	D
ACB	AUXILIARY CONTROL M.C.B	2		
AIC 1–2	AUXILIARY SUPPLY INVERTER CONTACTOR	7	7	
AD 1–2	AIR DRYER DIODES	6		
ARR	AUXILIARIES RUN RELAY		6	
ASB2–1	3–PHASE SUPPLY M.C.B.S	6	6	
ASR	AUXILIARY START RELAY		6	
BMC	BLOWER MOTOR CONTACTOR		6	
BCB	BATTERY CONTROL M.C.B.	2		
BCC	BATTERY CHARGE & L.V.SUPPLY CONTACTOR	6		
BIC	BATTERY ISOLATING CONTACTOR	6		
BM	CHOPPER BLOWER MOTOR		4	
BMB	BLOWER MOTOR M.C.B.		6	
BNF	BATTERY NEGATIVE FUSE	11		
BPF	BATTERY POSITIVE FUSE	11		
BVR	BATTERY VOLTAGE RELAY	6		
BVZ2–1	BALLAST FOR BVR	6		
BD9091	BLOCKING DIODES	3		
C	COMPRESSOR MOTOR	11		
CCB	COMPRESSOR M.C.B.	2		
CHB	BATTERY CHARGE & L.V.SUPPLY M.C.B.	6		
CIR	CHARGING INDICATION RELAY	6		
CIRF	CHARGING INDICATION RELAY FUSE	6		
COR1	CAB OCCUPIED RELAY	6		
CPZ	COMPRESSOR MOTOR PROTECTIVE RESISTOR	11		
CSB	COMPRESSOR SYNCHRONISING M.C.B.	2		
CECS	CHOPPER ELECTRONICS CUT–OUT SWITCH		9	
DCB1	"CT" CAR CONTROL POSITIVE M.C.B.	2		
DCB3	"D" CAR CONTROL POSITIVE M.C.B.	6		
DCF	D.C. SUPPLY FUSE	6		
D3.5	BLOCKING DIODES		6	
D6–7	BLOCKING DIODES	6		
DSC	"D" CAR SUPPLY CONTACTOR	6		
ECB	"A" CAR AIR CONDITIONING SUPPLY M.C.B.	2		
ECC	EMERGENCY CHARGING CONTACTOR	6		
ESC	EMERGENCY SUPPLY CONTACTOR		6	
ELCB3–4	"CT" CAR EMERGENCY LIGHTING M.C.B.S		10	
ESF	EMERGENCY SUPPLY FUSE		6	
FKS 1–2	FILTER CAPACITOR PRESSURE SWITCH	12	12	
FRT 1–2	FEEDBACK REFERENCE TRANSFORMER	7	7	
GC	GROUND CONTACTOR	6		
HMSC	HOSTLER MASTER SWITCH		10	
HMSD1	HOSTLER MASTER SWITCH			16
HMSD2	HOSTLER MASTER SWITCH			17
IE	AUXILIARY INVERTER ELECTRONIC UNIT	7	7	
ICCB 1–2	INVERTER CONTROL CIRCUIT BREAKER	7	7	
ICS2–1	INVERTER CUT OUT SWITCH	2	10	
IEG 1–2	INVERTER EQUIPMENT GOVERNOR	7	7	
IF1,2	INVERTER FUSE		9	
IECS 1–2	INVERTER ELECTRONICS CUT–OUT SWITCH	7	7	
LFKS 1–2	LINK FILTER CAPACITOR PRESSURE SWITCH	12	12	
LVD	BATTERY CHARGE & L.V.SUPPLY RECTIFIER	6		
LVF	L.V. RECTIFIER OUTPUT FUSE	6		
LVT	BATTERY CHARGING TRANSFORMER	11		
MCC	MAIN COMPRESSOR CONTACTOR	6		
MCF	COMPRESSOR FUSE	6		
MCG	MAIN COMPRESSOR GOVERNOR	6		
MFB	MICROPROCESSOR FAN BREAKER (W'HOUSE)	2		
OFR1–2	OFF SERVICE RELAY (AIR COND.)		18	
ORR 1–2	OUT OF REGULATION RELAY	7	7	
PVD	PANTOGRAPH DOWN VALVE		14	
PVU	PANTOGRAPH UP VALVE		14	
PWR2–1	PILOT WIRE RELAYS	6	6	
RSC 1–2	REGULATOR SUPPLY CONTACTOR	7	7	
RSK	RECTIFIER SUPPRESSION CAPACITOR	6		
RSZ	RECTIFIER SUPPRESSION RESISTOR	6		
SDCF	SECURE DC FUSE	2		
SDR	SHUT DOWN RELAY		6	
SDTR	SHUT DOWN DELAY RELAY		6	
SDTZ	SHUT DOWN DELAY RELAY RESISTOR		6	
SLD3	SLUGGING DIODE	6		
SPD1–2	SUPPRESSION DIODES	6	6	
TSB 2–1	TRAILER A.C. SUPPLIES M.C.B.S	6	6	
TSC 2–1	TRAILER A.C. SUPPLIES CONTACTORS	6	6	
TTR 1–2	TRIP TIME DELAY RELAYS	7	7	
TTZ 1–2	BALLAST FOR TTR	7	7	
TDM1–2	TIME DELAY MODULE	6		
TDM3–4	TIME DELAY MODULE		6	
TFKS 1–2	TUNED FILTER CAP. PRESSURE SWITCH	12	12	

LOCATION REF. NUMBERS

REF	LOCATION
1	CAB
2	CAB CUPBOARD ("A" SIDE)
3	CAB CUPBOARD ("B" SIDE)
4	CHOPPER EQUIPMENT CASE
5	CONTACTOR CASE
6	AUX. EQUIPMENT CASE
7	INVERTER POWER EQUIPMENT CASE
8	HIGH SPEED CONTACTOR CASE
9	ELECTRONICS & H.V. AUX. CASE
10	HOSTLER CAB
11	MOUNTED ON UNDERFRAME
12	INVERTER POWER EQUIPMENT FRAME
13	
14	PANTOGRAPH EQUIPT. CUPBOARD
15	
16	HOSTLER CAB No.1 END ("A" SIDE)
17	HOSTLER CAB No.2 END ("B" SIDE)
18	BODY
19	L.T. PANEL
20	
21	CAPACITOR FRAME
22	MAIN RESISTOR FRAME
23	ROOF
24	

CONTACTS IN ELECTRONIC UNIT (AUX. INVERTER)

REF	FUNCTION
IE2	OUT OF REGULATION
IE3	NO FAULT

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
E	REVISED AS PER EDOC NO. ZML5094	Z012 10–5–02	M.C. YIP 17–10–02	E. YEUNG 17–10–02
D	REVISED AS PER EDOC ZML4369 DRAWING UPDATING	W.H.CHENG 20–08–98	N.LEE 13–11–98	E.YEUNG 13–11–98
C	REVISED AS PER EDOC ZML3066, ZML3067, ZML3126, ZML3453, ZML3545 & ZML3718 DRAWING UPDATING		F.NGAI 06–11–95	E.YEUNG 06–11–95
B	DIGITIZATION		J.C.KIU 18–02–94	E.YEUNG 18–02–94

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MTRC REFERENCE NO.

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	INITIAL	DESIGNATION	DATE
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地鐵公司 MTR Corporation

TITLE 'G' STOCK
AUXILIARY CIRCUIT DIAGRAM, EMU CARS 'A'–'CT'–'D',
CHOPPER / AUXILIARY INVERTER (SHEET 1 OF 1)

SCALE NTS | OED DRAWING NO. OD4/303/00063/0011 | E

0D4/305/00141/001 C

PANTOGRAPH

LA

PLK

AUXILIARY CIRCUITS
CAR 'CT' 0D4/305/00162/001
CAR 'C' 0D4/305/00162/002

HBC

RMD

50 HZ DETECTOR

FL

LDF

BZ

LD

DSN3

D3

CCC

CCZ

CES

VMDF

KDZ

TFZ

TFL

TFK

FFWD

FK

RFK

VMD

D11

FDC1

FDZ1

FCZ1

LL2

LL11

SDZ1

TSN2

T2

TSN11

T11

MBS(M)

MBS(B)

MOR1-1

CMF 1

DSN21

D21

FCC1

M1

M2

M3

M4

M5

M6

M7

M8

FRS

LC1

CMA1

MOR1-2

AZ1

AZC1

D12

FDC2

FDZ2

FCZ2

LL12

SDZ2

TSN12

T12

MOR2-1

CMF2

DSN22

D22

FCC2

LC2

CMA2

MOR2-2

AZ2

AZC2

SNUBBER CIRCUITS

TSN11
TSN12

DSN21
DSN22

SEE NOTE 6

DSN3

TSN2

AUX. CIRCUITS
CARS 'A' & 'CT' 0D4/305/00162/001
CARS 'B' & 'C' 0D4/305/00162/002

U/FRAME EARTH BAR

INSULATED EARTH BAR

MOTOR CAR 'C' & 'CT' CHOPPER (SUFFIXED '1')

MOTOR CAR 'A' & 'B' CHOPPER (SUFFIXED '2')

D.S.6989A

LIST OF SYMBOLS

SYMBOL	DESCRIPTION	LOCATION Nos. CAR REF. A	CT	D	B	C
APD	ANTI-PARALLEL DIODE		4			4
AZ1-2	ARMATURE RESISTOR		22			22
AZC1-2	ARMATURE RESISTOR CONTACTOR		5			5
BZ	BRAKING RESISTOR		22			22
CI	ENERGY TRANSFER CAPACITOR (SNUBBER)		4			4
CCC	CAPACITOR CHARGING CONTACTOR		5			5
CES	CAPACITOR EARTHING SWITCH		5			5
CCZ	CAPACITOR CHARGING RESISTOR		5			5
CMA1-2	CURRENT MONITORING DEVICE (ARM)		5			5
CMF1-2	CURRENT MONITORING DEVICE (FIELD)		5			5
CS	SNUBBER CAPACITOR		4			4
D1-D2	SNUBBER DIODE		4			4
D3	RESISTOR FREEWHEEL DIODE		4			4
D11-D12	MOTOR FREEWHEEL DIODE		4			4
D21-D22	BRAKING DIODE		4			4
DI	ENERGY TRANSFER SNUBBER DIODE		4			4
DR	SNUBBER DIODE		4			4
DS	SNUBBER DIODE		4			4
DSN	DIODE SNUBBER NETWORK		4			4
FCC1-2	FIELD CONTROL RESISTOR CONTACTOR		5			5
FCZ1-2	FIELD CONTROL RESISTOR		22			22
FDC1-2	WEAKFIELD CONTACTORS		5			5
FDZ1-2	WEAKFIELD RESISTORS		22			22
FL	LINE FILTER INDUCTOR		11			11
FK	LINE FILTER CAPACITOR		21			21
FRS	FORWARD REVERSE SWITCH		5			5
FFWD	FILTER FREEWHEEL DIODE		21			21
HBC	HIGH SPEED CONTACTOR		8			8
K1-K4	SNUBBER CAPACITOR		4			4
KDZ	FILTER CAPACITOR DISCHARGE RESISTOR		21			21
LA	LIGHTNING ARRESTOR		23			23
LL2	DI/DT CHOKE		4			4
LL11-12	DI/DT CHOKE		4			4
LC1-2	LOOP CONTACTORS		5			5
LD	LOCK ON DETECTOR		9			9
LDF	LOCK ON DETECTOR FUSE		9			9
M1-4	TRACTION MOTORS	11			11	
M5-8	TRACTION MOTORS		11			11
MBS	MOTOR BRAKE SWITCH		5			5
MOR11-12	MOTOR OVERLOAD RELAY		5			5
MOR21-22	MOTOR OVERLOAD RELAY		5			5
PLK	PANTOGRAPH LINK		23			23
RFK	R.F. INT. SUPPRESSOR CAPACITOR		21			21
RMD	RIPPLE MONITOR DETECTOR		9			9
RR	RECOVERY SNUBBER RESISTOR		4			4
SDZ1-2	SNUBBER DISCHARGE RESISTOR		5			5
TFK	TUNED FILTER CAPACITOR		21			21
TFL	TUNED FILTER INDUCTOR		21			21
TFZ	TUNED FILTER RESISTOR		21			21
T11-12	MAIN THYRISTOR		4			4
T2	RHEOSTATIC BRAKE THYRISTOR		4			4
TSN	THYRISTOR SNUBBER NETWORK		4			4
VMD	LINE VOLT MONITORING DEVICE		9			9
VMDF	VMD FUSE		9			9
Z1-Z5	SNUBBER RESISTORS		4			4

LOCATION REF. NUMBERS

REF	LOCATION
1	CAB
2	CAB CUPBOARD ('A' SIDE)
3	CAB CUPBOARD ('B' SIDE)
4	CHOPPER EQUIPMENT CASE
5	CONTACTOR CASE
6	AUX. EQUIPMENT CASE
7	INVERTER POWER EQUIPMENT CASE
8	HIGH SPEED CONTACTOR CASE
9	ELECTRONICS & H.V.AUX.CASE
10	HOSTLER CAB
11	MOUNTED ON UNDERFRAME
12	INVERTER POWER EQUIPMENT FRAME
13	
14	PANTOGRAPH EQUIPT. CUPBOARD
15	
16	HOSTLER CAB No.1 END('A' SIDE)
17	HOSTLER CAB No.2 END('B' SIDE)
18	BODY
19	LT PANEL
20	
21	CAPACITOR FRAME
22	MAIN RESISTOR FRAME
23	ROOF
24	

NOTES

1/ FORWARD/REVERSE SWITCH (FRS) IS SHOWN IN FORWARD POSITION

2/ MOTOR/BRAKE SWITCH MBS IS SHOWN IN MOTORING POSITION

3/ ONLY MOTORS 1 TO 4 INC. ARE MOUNTED ON "A"/"B" CARS
REMAINDER OF EQUIPMENT IS MOUNTED ON THE "C" & "CT" CARS

4/ THE CHOPPER GROUP FOR THE "C" & "CT" CAR MOTORS IS SUFFIXED "1"
AND FOR THE "A"/"B" CAR MOTORS IS SUFFIXED "2".

5/ FOR LABELLING PURPOSES, THE CHOPPER EQUIPMENT GROUPS ARE
GIVEN A SINGLE REFERENCE.
E.G. FOR T11 & D11 REFER TO T1 & D1 ON CH11 RESPECTIVELY.
" T12 & D12 " " " " CH12 " " .

6/ WHERE WIRE NUMBERS ARE SHOWN IN BRACKETS THIS INDICATES
THAT THEY ARE INTERNAL TO THE HEATSINK ASSEMBLY &
THAT EXTERNALLY THE WIRE NUMBERS DIFFER.

THIRD ANGLE PROJECTION

REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHECKED	APPROVED	DATE
C	REVISED PER GEC MOD.86	F.NGAI	E.YEUNG	26-1-96
B	DIGITIZATION			

REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
51808X0255 D

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TRACED BY	Y30	ZESTC	24-12-93
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APPROVED BY			
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.	318350V1		

MASS TRANSIT RAILWAY CORPORATION

TITLE
'M' STOCK CHOPPER CONVERSION
POWER CIRCUIT DIAGRAM FOR E.M.U. CARS

SCALE NTS

DWG NO. 0D4/305/00141/001 C

TAIL LIGHT
HEAD LIGHT
HEAD LIGHT RESISTOR
HORN
MAGNET VALVE
* 32 CORE RADIO CABLE
DRIVERS DESK (INTERNAL WIRING DIAGRAM 0D4/301/00148/0001)
'A'-SIDE
AXLE 1 'A' SIDE DISCONNECTION BOX
RIGHT CT SENSOR
SKS(SURAHU) CONNECTOR
A SIDE CAB PARTITION FOR INTERNAL WIRING DIAGRAM SEE 0D4/301/00148/003
CAB DOOR MAGNET VALVE
CAB DOOR INTERLOCK
CAB FAN
CAB LIGHT
CAB LIGHT INVERTER
GEAR PROBE JUNCTION BOX
PARKING BRAKE MAGNET VALVE
AMMETER CONNECTION BOX
EARTH BAR
SEE DRG. 0D4/305/00141/0007
GEAR PROBE JUNCTION BOX
CJ4/A & CJ4A/A CONNECTION BOX
RAYCHEM
C J 4/A
C J 4A/A
C J 3/A
C J 2/A
C J 1/A
CJ1/A, CJ2/A, CJ3/A ARE CONNECTED TO COMPRESSOR CONTROL CASE
THROUGH CONNECTION BOX
COMPRESSOR CONTROL CASE
CONTINUED ON SHEET No.2 DWG.No.0D4/305/00141/010
No.1 END
32 CORE RADIO CABLE
SEE NOTE 1
SEE NOTE 2
SPRING CONTACTS
FIXED CONTACTS
AUTO-COUPLER (FRONT END)
* N/C CONTACT-OPEN WHEN COUPLED.
A.T.P. ANTENNAE
A.T.O. ANTENNAE
TO DESK
TO 'B' SIDE PARTITION
AXLE 1 'B' SIDE DISCONNECTION BOX
ALL SACEM CABLE TYPE 'H'
FOR INTERNAL WIRING DIAGRAM SEE 0D4/301/00148/002
B SIDE CAB PARTITION
DOOR SWITCH
SEE NOTE 1
CONTROL MULTIPOINT CONNECTION BOX
THROUGH CRIMPED WIRES
DEMISTER TERM BOARD
HEADLIGHT
HEADLIGHT RESISTOR
UNCOUPLER MAGNET VALVE
BRAKE PROVING GOVERNOR
WHEELSLIDE BLOWDOWN VALVE
'B'-SIDE
D.SPEC-7038A

NOTES:-

1. SPARE WIRES TO CONN.BOXES TO BE LEFT LONG ENOUGH TO REACH ALL TERMINALS. TAPE ENDS & COIL UP.
2. THE FOLLOWING ARE SPARE WIRES FROM COMPRESSOR CONTROL CASE. 3304SP, 3335SP, 3351SP, 3366SP, 3360SP, 3444SP, SP66, 1201SP, 23SP, 24SP
   3338SP, 3347SP, 3348SP, 3355SP, 3357SP, 3361SP, 3367SP, 3385SP, 3386SP, 3389SP, 3391SP, 3392SP, 3394SP, 3399SP, 3427SP, 3431SP, 3437SP, 3438SP, 3452SP, SPS3, SPS4.
4. SPARE WIRES FROM DECODER PL1
   9935SP 9944SP (TO BRAKE ANALOGUE UNIT)
   9930SP 9931SP (TO MULTIPOINT CONNECTION BOX 'B')
5. ALL SPARE WIRES ARE LABELLED ___SP BUT (SP) CABLE IDENT IS TO BE ADDED AT CONNECTION BOX END ONLY OF THE WIRE.
6. FOR SACEM ATC SPARE WIRES & CASLE SCHEDULE, SEE 0D4/301/00148/0002

THIRD ANGLE PROJECTION

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
E	REVISED AS PER SACEM ATC AS BUILT DRAWING INTERFACE	Y112	05-02-99 J.C.KIU	23-02-99 E.YEUNG 23-02-99
D	REVISED AS PER EDOC ZML4369 DRAWING UPDATING	W.H.CHENG	18-08-98 J.KIU	07-10-98 E.YEUNG 09-10-98
C	REVISED AS PER EDOC ZML3784 & ZML3811 DRAWING UPDATING	Y143	26-03-98 F.NGAI	17-04-98 E.YEUNG 17-04-98
B	DIGITIZATION		F.NGAI	02-10-96 E.YEUNG 02-10-96

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO. 51808X266 (E)

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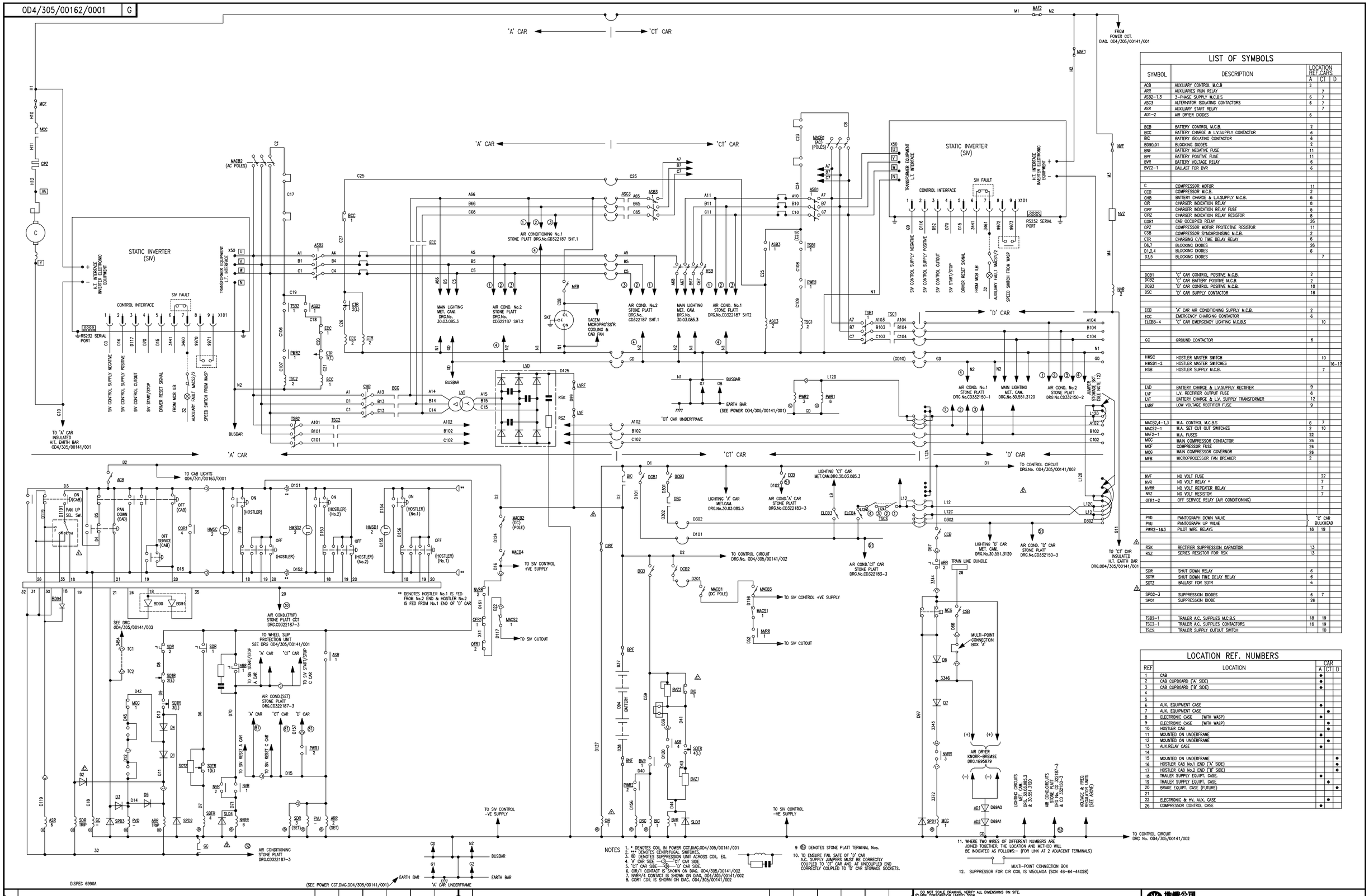
地鐵公司 MTR Corporation

TITLE 'M' STOCK
'A'-CAR AUXILIARY & CONTROL WIRING DIAGRAM
(SHEET No.1) CHOPPER CONVERSION

SCALE NTS | OED DRAWING NO. 0D4/305/00141/0009 | E



LIST OF SYMBOLS

SYMBOL	DESCRIPTION	LOCATION REF.CARS A	CT	D
ACB	AUXILIARY CONTROL M.C.B	2		
ARR	AUXILIARIES RUN RELAY		7	
ASR2-1,3	3-PHASE SUPPLY M.C.B.S	6	7	
ASC3	ALTERNATOR ISOLATING CONTACTORS	6	7	
ASR	AUXILIARY START RELAY		7	
AD1-2	AIR DRYER DIODES	6		
BCB	BATTERY CONTROL M.C.B.	2		
BCC	BATTERY CHARGE & L.V.SUPPLY CONTACTOR	6		
BIC	BATTERY ISOLATING CONTACTOR	6		
BD90,91	BLOCKING DIODES	2		
BNF	BATTERY NEGATIVE FUSE	11		
BPF	BATTERY POSITIVE FUSE	11		
BVR	BATTERY VOLTAGE RELAY	6		
BVZ2-1	BALLAST FOR BVR	6		
C	COMPRESSOR MOTOR	11		
CCB	COMPRESSOR M.C.B.	2		
CHB	BATTERY CHARGE & L.V.SUPPLY M.C.B.	6		
CIR	CHARGER INDICATION RELAY	8		
CIRF	CHARGER INDICATION RELAY FUSE	8		
CIRZ	CHARGER INDICATION RELAY RESISTOR	8		
COR1	CAB OCCUPIED RELAY	26		
CPZ	COMPRESSOR MOTOR PROTECTIVE RESISTOR	11		
CSB	COMPRESSOR SYNCHRONISING M.C.B.	2		
CTR	CHARGING C/O TIME DELAY RELAY	6		
D6,7	BLOCKING DIODES	26		
D1,2,4	BLOCKING DIODES	6		
D3,5	BLOCKING DIODES		7	
DCB1	'C' CAR CONTROL POSITIVE M.C.B.	2		
DCB2	'C' CAR BATTERY POSITIVE M.C.B.	2		
DCB3	'D' CAR CONTROL POSITIVE M.C.B.	18		
DSC	'D' CAR SUPPLY CONTACTOR	18		
ECB	'A' CAR AIR CONDITIONING SUPPLY M.C.B.	2		
ECC	EMERGENCY CHARGING CONTACTOR	6		
ELCB3-4	'C' CAR EMERGENCY LIGHTING M.C.B.S		10	
GC	GROUND CONTACTOR	6		
HMSC	HOSTLER MASTER SWITCH		10	
HMSD1-2	HOSTLER MASTER SWITCHES			16-17
HSB	HOSTLER SUPPLY M.C.B.		7	
LVD	BATTERY CHARGE & L.V.SUPPLY RECTIFIER	9		
LVF	L.V. RECTIFIER OUTPUT FUSE	6		
LVT	BATTERY CHARGE & L.V. SUPPLY TRANSFORMER	12		
LVRF	LOW VOLTAGE RECTIFIER FUSE	9		
MACB2,4-1,3	M.A. CONTROL M.C.B.S	6	7	
MACS2-1	M.A. SET CUT OUT SWITCHES	2	10	
MAF2-1	M.A. FUSES	22		
MCC	MAIN COMPRESSOR CONTACTOR	26		
MCF	COMPRESSOR FUSE	26		
MCG	MAIN COMPRESSOR GOVERNOR	26		
MFB	MICROPROCESSOR FAN BREAKER	2		
NVF	NO VOLT FUSE		22	
NVR	NO VOLT RELAY *		7	
NVRR	NO VOLT REPEATER RELAY		7	
NVZ	NO VOLT RESISTOR		7	
OFR1-2	OFF SERVICE RELAY (AIR CONDITIONING)			
PVD	PANTOGRAPH DOWN VALVE	"C" CAR BULKHEAD		
PVU	PANTOGRAPH UP VALVE			
PWR2-1&3	PILOT WIRE RELAYS	18	19	
RSK	RECTIFIER SUPPRESSION CAPACITOR	13		
RSZ	SERIES RESISTOR FOR RSK	13		
SDR	SHUT DOWN RELAY	6		
SDTR	SHUT DOWN TIME DELAY RELAY	6		
SDTZ	BALLAST FOR SDTR	6		
SPD2-3	SUPPRESSION DIODES	6	7	
SPD1	SUPPRESSION DIODE	26		
TSB2-1	TRAILER A.C. SUPPLIES M.C.B.S	18	19	
TSC2-1	TRAILER A.C. SUPPLIES CONTACTORS	18	19	
TSCS	TRAILER SUPPLY CUTOUT SWITCH		10	

LOCATION REF. NUMBERS

REF	LOCATION	CAR A	CT	D
1	CAB	●		
2	CAB CUPBOARD ('A' SIDE)	●		
3	CAB CUPBOARD ('B' SIDE)	●		
4				
5				
6	AUX. EQUIPMENT CASE	●		
7	AUX. EQUIPMENT CASE			●
8	ELECTRONIC CASE (WITH WASP)	●		
9	ELECTRONIC CASE (WITH WASP)			●
10	HOSTLER CAB			●
11	MOUNTED ON UNDERFRAME	●		
12	MOUNTED ON UNDERFRAME			●
13	AUX.RELAY CASE	●		
14				
15	MOUNTED ON UNDERFRAME			●
16	HOSTLER CAB No.1 END ('A' SIDE)			●
17	HOSTLER CAB No.2 END ('B' SIDE)			●
18	TRAILER SUPPLY EQUIPT. CASE.	●		
19	TRAILER SUPPLY EQUIPT. CASE		●	
20	BRAKE EQUIPT. CASE (FUTURE)			●
21				
22	ELECTRONIC & HV. AUX. CASE		●	
26	COMPRESSOR CONTROL CASE	●		

NOTES
1. * DENOTES COIL IN POWER CCT.DIAG.004/305/00141/001
2. *** DENOTES CENTRIFUGAL SWITCHES.
3. ⑩ DENOTES SUPPRESSION UNIT ACROSS COIL EG.
4. 'A' CAR SIDE ⑤ 'CT' CAR SIDE.
5. 'CT' CAR SIDE ⑤ 'D' CAR SIDE.
6. CIR/1 CONTACT IS SHOWN ON DIAG. 004/305/00141/002
7. NVRR/4 CONTACT IS SHOWN ON DIAG. 004/305/00141/002 & CORY COIL IS SHOWN ON DIAG. 004/305/00141/002
9. ⑫ DENOTES STONE PLATT TERMINAL Nos.
10. TO ENSURE FAIL SAFE OF 'D' CAR A.C. SUPPLY JUMPERS MUST BE CORRECTLY COUPLED TO 'CT' CAR AND, A' UNCOUPLED END CORRECTLY COUPLED TO 'D' CAR STOWAGE SOCKETS.
11. WHERE TWO WIRES OF DIFFERENT NUMBERS ARE JOINED TOGETHER, THE LOCATION AND METHOD WILL BE INDICATED AS FOLLOWS:- (FOR LINK AT 2 ADJACENT TERMINALS)
12. SUPPRESSOR FOR CIR COIL IS VISOLAIOA (SCN 46-64-44028)

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
G	REVISED AS PER EDOC NO. ZML5862	2049 23-01-07	J.C.KIU 9-3-07	E.YEUNG 9-3-07
F	REVISED AS PER EDOC NO. ZML5094	2012 10-5-02	M.C. YIP 17-10-02	E. YEUNG 17-10-02
E	REVISED AS PER EDOC ZML4369 DRAWING UPDATING	W.H.CHENG 20-08-98	N.LEE 13-11-98	E.YEUNG 13-11-98
D	REVISED AS PER EDOC ZML4030 DRAWING UPDATING		M.C.YIP 18-03-97	E.YEUNG 18-03-97
C	REVISED AS PER EDOC ZML3545 & ZML3784 DRAWING UPDATING		F.NGAI 06-11-95	E.YEUNG 06-11-95
B	DIGITIZATION		05-01-94	05-01-94

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CAD FILE NAME	00162001		

地鐵公司 MTR Corporation

TITLE 'M' STOCK CHOPPER CONVERSION
AUXILIARY CIRCUIT DIAGRAM
'A'-'CT'-'D' CARS

SCALE NTS | OED DRAWING NO. 0D4/305/00162/0001 | G

A0 SIZE, 1189 x 841mm, TYPE 2

PANTOGRAPH

LA

PLK

M1

M2

AUXILIARY CIRCUITS
CAR 'CT' 0D4/305/00262/001
CAR 'C' 0D4/305/00262/002

RMD

50 HZ DETECTOR

M19

HBC

M15

M5

FL

M8

CCC

CCZ

M7

CES

LDF

BZ

M13

LD

DSN3

D3

TFZ

TFL

M14

VMDF

KDZ

TFK

FFWD

FK

RFK

M10

VMD

MBS(M)

DSN21

D21

MOR1-1

M27

CMF1

M22

MBS(B)

M20

FCC1

M5

M6

M8

M7

A

AA

Y

5

YY

M39

M40

M16

FRS

M42

FDZ1

FCZ1

M45

6

M44

7

M43

8

M67

FDC1

M41

M70

D11

LL2

LL11

M71

M17

TSN2

T2

TSN11

T11

SDZ1

MBS(M)

LC1

M28

M30

CMA1

M29

MOR1-2

MBS(B)

M26

AZ1

AZC1

M19

MBS(M)

DSN22

D22

MOR2-1

M53

CMF2

M47

MBS(B)

M46

FCC2

M60

M1

M2

M3

M4

M66

M65

1

2

3

4

M64

M63

M59

M58

M57

M56

M54

M60

FRS

FDZ2

FCZ2

M68

FDC2

D12

M62

LL12

M32

TSN12

T12

SDZ2

MBS(M)

LC2

M52

M55

CMA2

M54

MOR2-2

MBS(B)

M51

AZ2

AZC2

M66

M48

SNUBBER CIRCUITS

TSN11
TSN12

K2 Z2 DR RR K4 Z4 Z5 DS APD CI Z3 K3 DI CS

TSN2

D1 D2 Z1 M121 K1

DSN21
DSN22

(M111) Z1 M108 K1 (M110)

SEE NOTE 6

M120

DSN3

LIST OF SYMBOLS

SYMBOL	DESCRIPTION	LOCATION Nos. CAR REF. A	CT	D	B	C
APD	ANTI-PARALLEL DIODE		4			4
AZ1-2	ARMATURE RESISTOR		22			22
AZC1-2	ARMATURE RESISTOR CONTACTOR		5			5
BZ	BRAKING RESISTOR		22			22
CI	ENERGY TRANSFER CAPACITOR (SNUBBER)		4			4
CCC	CAPACITOR CHARGING CONTACTOR		5			5
CES	CAPACITOR EARTHING SWITCH		5			5
CCZ	CAPACITOR CHARGING RESISTOR		5			5
CMA1-2	CURRENT MONITORING DEVICE (ARM)		5			5
CMF1-2	CURRENT MONITORING DEVICE (FIELD)		5			5
CS	SNUBBER CAPACITOR		4			4
D1-D2	SNUBBER DIODE		4			4
D3	RESISTOR FREEWHEEL DIODE		4			4
D11-D12	MOTOR FREEWHEEL DIODE		4			4
D21-D22	BRAKING DIODE		4			4
DI	ENERGY TRANSFER SNUBBER DIODE		4			4
DR	SNUBBER DIODE		4			4
DS	SNUBBER DIODE		4			4
DSN	DIODE SNUBBER NETWORK		4			4
FCC1-2	FIELD CONTROL RESISTOR CONTACTOR		5			5
FCZ1-2	FIELD CONTROL RESISTOR		22			22
FDC1-2	WEAKFIELD CONTACTORS		5			5
FDZ1-2	WEAKFIELD RESISTORS		22			22
FL	LINE FILTER INDUCTOR		11			11
FK	LINE FILTER CAPACITOR		21			21
FRS	FORWARD REVERSE SWITCH		5			5
FFWD	FILTER FREEWHEEL DIODE		21			21
HBC	HIGH SPEED CONTACTOR		8			8
K1-K4	SNUBBER CAPACITOR		4			4
KDZ	FILTER CAPACITOR DISCHARGE RESISTOR		21			21
LA	LIGHTNING ARRESTOR		23			23
LL2	DI/DT CHOKE		4			4
LL11-12	DI/DT CHOKE		4			4
LC1-2	LOOP CONTACTORS		5			5
LD	LOCK ON DETECTOR		9			9
LDF	LOCK ON DETECTOR FUSE		9			9
M1-4	TRACTION MOTORS	11			11	
M5-8	TRACTION MOTORS		11			11
MBS	MOTOR BRAKE SWITCH		5			5
MOR11-12	MOTOR OVERLOAD RELAY		5			5
MOR21-22	MOTOR OVERLOAD RELAY		5			5
PLK	PANTOGRAPH LINK		23			23
RFK	R.F. INT. SUPPRESSOR CAPACITOR		21			21
RMD	RIPPLE MONITOR DETECTOR		9			9
RR	RECOVERY SNUBBER RESISTOR		4			4
SDZ1-2	SNUBBER DISCHARGE RESISTOR		5			5
TFK	TUNED FILTER CAPACITOR		21			21
TFL	TUNED FILTER INDUCTOR		21			21
TFZ	TUNED FILTER RESISTOR		21			21
T11-12	MAIN THYRISTOR		4			4
T2	RHEOSTATIC BRAKE THYRISTOR		4			4
TSN	THYRISTOR SNUBBER NETWORK		4			4
VMD	LINE VOLT MONITORING DEVICE		9			9
VMDF	VMD FUSE		9			9
Z1-Z5	SNUBBER RESISTORS		4			4

LOCATION REF. NUMBERS

REF	LOCATION
1	CAB
2	CAB CUPBOARD ('A' SIDE)
3	CAB CUPBOARD ('B' SIDE)
4	CHOPPER EQUIPMENT CASE
5	CONTACTOR CASE
6	AUX. EQUIPMENT CASE
7	INVERTER POWER EQUIPMENT CASE
8	HIGH SPEED CONTACTOR CASE
9	ELECTRONICS & H.V.AUX.CASE
10	HOSTLER CAB
11	MOUNTED ON UNDERFRAME
12	INVERTER POWER EQUIPMENT FRAME
13	
14	PANTOGRAPH EQUIPT. CUPBOARD
15	
16	HOSTLER CAB NO.1 END('A' SIDE)
17	HOSTLER CAB NO.2 END('B' SIDE)
18	BODY
19	LT PANEL
20	
21	CAPACITOR FRAME
22	MAIN RESISTOR FRAME
23	ROOF
24	

AUX. CIRCUITS
CARS 'A'&'CT' 0D4/305/00262/001
CARS 'B'&'C' 0D4/305/00262/002

N1 U/FRAME EARTH BAR G8 G7

G12 G11 G9 G6 G5

INSULATED EARTH BAR

MOTOR CAR 'C' & 'CT' CHOPPER (SUFFIXED '1')

MOTOR CAR 'A' & 'B' CHOPPER (SUFFIXED '2')

AUX. CIRCUITS
CARS 'A' & 'CT' 0D4/305/00262/001
CARS 'B' & 'C' 0D4/305/00262/002

G10 G12 G13 U/FRAME EARTH BAR G4 G3 G2 G1

INSULATED EARTH BAR

NOTES

1/ FORWARD/REVERSE SWITCH (FRS) IS SHOWN IN FORWARD POSITION

2/ MOTOR/BRAKE SWITCH MBS IS SHOWN IN MOTORING POSITION

3/ ONLY MOTORS 1 TO 4 INC. ARE MOUNTED ON "A"/"B" CARS
REMAINDER OF EQUIPMENT IS MOUNTED ON THE "C" & "CT" CARS

4/ THE CHOPPER GROUP FOR THE "C" & "CT" CAR MOTORS IS SUFFIXED "1"
AND FOR THE "A"/"B" CAR MOTORS IS SUFFIXED "2".

5/ FOR LABELLING PURPOSES, THE CHOPPER EQUIPMENT GROUPS ARE
GIVEN A SINGLE REFERENCE.
E.G. FOR T11 & D11 REFER TO T1 & D1 ON CH11 RESPECTIVELY.
" T12 & D12 " " " " CH12 " "

6/ WHERE WIRE NUMBERS ARE SHOWN IN BRACKETS THIS INDICATES
THAT THEY ARE INTERNAL TO THE HEATSINK ASSEMBLY &
THAT EXTERNALLY THE WIRE NUMBERS DIFFER.

REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHECKED	APPROVED	DATE
C	REVISED PER GEC MOD.86	F.NGAI	E.YEUNG	26-1-96
B	DIGITIZATION			

REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
51808X0285 D

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TRACED BY	Y39	ZESTC	24-12-93
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CAD REF NO.	318398V1		

MASS TRANSIT RAILWAY CORPORATION

TITLE 'T' STOCK CHOPPER CONVERSION
POWER CIRCUIT DIAGRAM FOR E.M.U. CARS

SCALE NTS DWG NO. 0D4/305/00241/004 C

'A' CAR ⟷ 'CT' CAR

FROM POWER CCT. DIAG.OD4/305/00241/004

STATIC INVERTER (SIV)

H.T. INTERFACE INVERTER ELECTRONIC EQUIPMENT

TRANSFORMER EQUIPMENT L.T. INTERFACE

CONTROL INTERFACE

SIV FAULT

RS232 SERIAL PORT

SIV CONTROL SUPPLY NEGATIVE
SIV CONTROL SUPPLY POSITIVE
SIV CONTROL CUTOUT
SIV START/STOP
DRIVER RESET SIGNAL
FROM MCB ILB
AUXILIARY FAULT MACS1/2
SPEED SWITCH FROM WASP

'D' CAR

'D' CAR TO CONTROL CIRCUIT DRG.NO.51808X0288

TO 'A' CAR INSULATED H.T. EARTH BAR OD4/305/00241/004

TO 'CT' CAR INSULATED H.T. EARTH BAR DRG. OD4/305/00241/004

TO CONTROL CIRCUIT DRG. No. OD4/305/00241/005

TO CAB LIGHTS MET CAM. DRG.30.12.097.3.

AIR CONDITIONING NO.1 STONE PLATT DRG.NO.CD326085 SH.1

AIR CONDITIONING NO.2 STONE PLATT DRG.NO.CD326085 SHT.2

AIR CONDITIONING NO.1 STONE PLATT DRG.NO.CD326085-3

AIR CONDITIONING NO.2 STONE PLATT DRG.NO.CD326085-1

MAIN LIGHTING MET. CAM. DRG.NO.30.12.097.3

AIR COND.NO.1 STONE PLATT DRG.NO.CD332150-2

AIR COND.NO.2 STONE PLATT DRG.NO.CD332150-1

MAIN LIGHTING MET. CAM. DRG.NO.30.551.3120

JUMPER STONE SKT. (SEE NOTE 12)

LIGHTING 'A' CAR MET.CAM. DRG.NO.30.12.097.3

LIGHTING 'CT' CAR MET. CAM.DRG.30.03.085.3

AIR COND.'A' CAR STONE PLATT DRG.NO.CD326085-3

AIR COND.'CT' CAR STONE PLATT DRG.NO.CD322183-3

LIGHTING 'D' CAR MET. CAM. DRG.NO.30.551.3120

AIR COND.'D' CAR STONE PLATT DRG.NO.CD332150-3

TO SIV CONTROL +VE SUPPLY

TO SIV CUTOUT

TO SIV CONTROL -VE SUPPLY

TO WHEELSLIP PROTECTION UNIT SEE DRG.51808X0289

TO SIV START/STOP

AIR COND.(SET) STONE PLATT DRG.CD326085-3

AIR CONDITIONING STONE PLATT DRG.CD326085-3

AIR COND.(TRIP) STONE PLATT CCT DRG.CD326085-3

SEE DRAWING OD4/305/00241/006

TRAIN LINE BUNDLE

AIR DRYER KNORR-BREMSE DRG. 1895879

LIGHTING CIRCUITS MET.CAM. DRG'S 30.12.097.3 & 30.551

AIR COND. CIRCUITS STONE PLATT (DRG No. CD326085-3)

VOLT & FREQ. REG. UNITS (SEE ABOVE)

EARTH BAR (SEE POWER CCT.DIAG. OD4/305/00241/004)

'A' CAR UNDERFRAME

'CT' CAR UNDERFRAME

'A' CAR U/FRAME EARTH BAR.

BUSBAR

EARTH BAR (SEE POWER DRG. 004/305/00241/004)

D,SPEC 699.3A

LIST OF SYMBOLS

SYMBOL	DESCRIPTION	LOCATION REF.CARS A	CT	D
ACB	AUXILIARY CONTROL M.C.B	2		
ARR	AUXILIARIES RUN RELAY		7	
ASB2-1	3-PHASE SUPPLY M.C.B.S	6	7	
ASR	AUXILIARY START RELAY		7	
AD1-2	AIR DRYER DIODES	6		
BCB	BATTERY CONTROL M.C.B.	2		
BCC	BATTERY CHARGE & L.V.SUPPLY CONTACTOR	6		
BIC	BATTERY ISOLATING CONTACTOR	6		
BD90-91	BLOCKING DIODES	2		
BNF	BATTERY NEGATIVE FUSE	11		
BPF	BATTERY POSITIVE FUSE	11		
BVR	BATTERY VOLTAGE RELAY	6		
BVZ2-1	BALLAST FOR BVR	6		
CCB	COMPRESSOR M.C.B.	2		
CHB	BATTERY CHARGE & L.V.SUPPLY M.C.B.	6		
CIR	CHARGING INDICATION RELAY	6		
CIRF	CHARGING INDICATION RELAY FUSE	6		
CIRZ	CHARGING INDICATION RELAY RESISTOR	6		
COR1	CAB OCCUPIED RELAY	13		
CPZ	COMPRESSOR MOTOR PROTECTIVE RESISTOR	11		
CSB	COMPRESSOR SYNCHRONISING M.C.B.	2		
CTR	CHARGING C/O TIME DELAY RELAY	6		
DCB1	'C' CAR CONTROL POSITIVE M.C.B.	2		
DCB2	'C' CAR BATTERY POSITIVE M.C.B.	2		
DCB3	'D' CAR CONTROL POSITIVE M.C.B.	18		
DCF	D.C. SUPPLY FUSE	6		
D1-7	BLOCKING DIODES			
DSC	'D' CAR SUPPLY CONTACTOR	18		
ECB	'A' CAR AIR CONDITIONING SUPPLY M.C.B.	2		
ECC	EMERGENCY CHARGING CONTACTOR	6		
ELCB3-4	'C' CAR EMERGENCY LIGHTING M.C.B.S		10	
GC	GROUND CONTACTOR	6		
HMSC	HOSTLER MASTER SWITCH		10	
HMSD1-2	HOSTLER MASTER SWITCHES			16-17
LVD	BATTERY CHARGE & L.V.SUPPLY RECTIFIER	6		
LVF	L.V. RECTIFIER OUTPUT FUSE	6		
LVT	BATTERY CHARGE & L.V. SUPPLY TRANSFORMER	11		
MACB2-1	M.A. CONTROL M.C.B.S	6	7	
MACS2-1	M.A. SET CUT OUT SWITCHES	2	10	
MAF2-1	M.A. FUSES		22	
MCC	MAIN COMPRESSOR CONTACTOR	6		
MCF	COMPRESSOR FUSE	6		
MCG	MAIN COMPRESSOR GOVERNOR	6		
MFB	MICROPROCESSOR FAN BREAKER	2		
NVF	NO VOLT FUSE		22	
NVR	NO VOLT RELAY *		7	
NVRR	NO VOLT REPEATER RELAY		7	
NVZ	NO VOLT RESISTOR		7	
OFR2-1	OFF SERVICE RELAY (AIR CONDITIONING)			
PVD	PANTOGRAPH DOWN VALVE		14	
PVU	PANTOGRAPH UP VALVE		14	
PWR2-1	PILOT WIRE RELAYS	18	19	
RSK	RECTIFIER SUPPRESSION CAPACITOR	6		
RSZ	SERIES RESISTOR FOR RSK	6		
SDR	SHUT DOWN RELAY		7	
SDTR	SHUT DOWN TIME DELAY RELAY		7	
SDTZ	BALLAST FOR SDTR		7	
SLD1-4	SLUGGING DIODES	6	7	
SPD1-3	SUPPRESSION DIODES	6	7	
TSB2-1	TRAILER A.C. SUPPLIES M.C.B.S	18	19	
TSC2-1	TRAILER A.C. SUPPLIES CONTACTORS	18	19	
TSCS	TRAILER SUPPLY CUT-OUT SWITCH		10	

LOCATION REF. NUMBERS

REF	LOCATION	CAR A	CT	D
1	CAB	•		
2	CAB CUPBOARD ('A' SIDE)	•		
3	CAB CUPBOARD ('B' SIDE)	•		
4				
5				
6	AUX. EQUIPMENT CASE (WITH WASP)	•		
7	AUX. EQUIPMENT CASE (WITH WASP)			•
8				
9				
10	HOSTLER CAB			•
11	MOUNTED ON UNDERFRAME	•		
12	MOUNTED ON UNDERFRAME			•
13	AUXILIARY RELAY CASE	•		
14	PANTOGRAPH EQUIPT. CUPBOARD		•	
15	MOUNTED ON UNDERFRAME			•
16	HOSTLER CAB NO.1 END ('A' SIDE)			•
17	HOSTLER CAB NO.2 END ('B' SIDE)			•
18	TRAILER SUPPLY EQUIPT. CASE	•		
19	TRAILER SUPPLY EQUIPT. CASE		•	
20				
21				
22	ELEC.AND H.V. AUX. CASE		•	

NOTES

1. * DENOTES COIL IN POWER CCT.DIAG. OD4/305/00241/004
2. ▭ DENOTES CENTRIFUGAL SWITCHES.
3. ⊙ DENOTES SUPPRESSION UNIT ACROSS COIL.EG.
4. 'A' CAR SIDE ⊣⊢ 'CT' CAR SIDE
5. 'CT' CAR SIDE ⊣⊢ 'D' CAR SIDE.
6. CIR/1 CONTACT IS SHOWN ON DIAG. OD4/305/00241/005
7. NVRR/4 CONTACT IS SHOWN ON DIAG. OD4/305/00241/005
8. COR1 COIL IS SHOWN ON DIAG. OD4/305/00241/005
9. (82) DENOTES STONE PLATT TERMINAL NO.S.
10. TO ENSURE FAIL SAFE OF 'D' CAR A.C. SUPPLY JUMPERS MUST BE CORRECTLY COUPLED TO 'CT' CAR AND, AT UNCOUPLED END CORRECTLY COUPLED TO 'D' CAR STOWAGE SOCKETS.
11. SUPPRESSOR FOR CIR COIL IS VI50LA10A (SCN 46-64-44028)

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
G	REVISED AS PER EDOC NO. ZML5862	Z051 23-01-07	J.C.KIU 9-3-07	E.YEUNG 9-3-07
F	REVISED AS PER EDOC NO. ZML5094	Z012 10-5-02	M.C. YIP 17-10-02	E. YEUNG 17-10-02
E	REVISED AS PER EDOC ZML4369 DRAWING UPDATING	W.H.CHENG 20-08-98	N.LEE 13-11-98	E.YEUNG 13-11-98
D	REVISED AS PER EDOC ZML4030 DRAWING UPDATING		M.C.YIP 18-03-97	E.YEUNG 18-03-97
C	REVISED AS PER EDOC ZML2513, ZML2529, ZML3126, ZML3545 & ZML3784 DRAWING UPDATING		F.NGAI 06-11-95	E.YEUNG 06-11-95
B	DIGITIZATION		09-01-94	09-01-94

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MTR REFERENCE NO.

CONTRACTOR REFERENCE NO. 51808X0286 B

	INITIAL	DESIGNATION	DATE
DRAWN	Y32	ZESTC	09-01-94
DESIGNED			
CHECKED			
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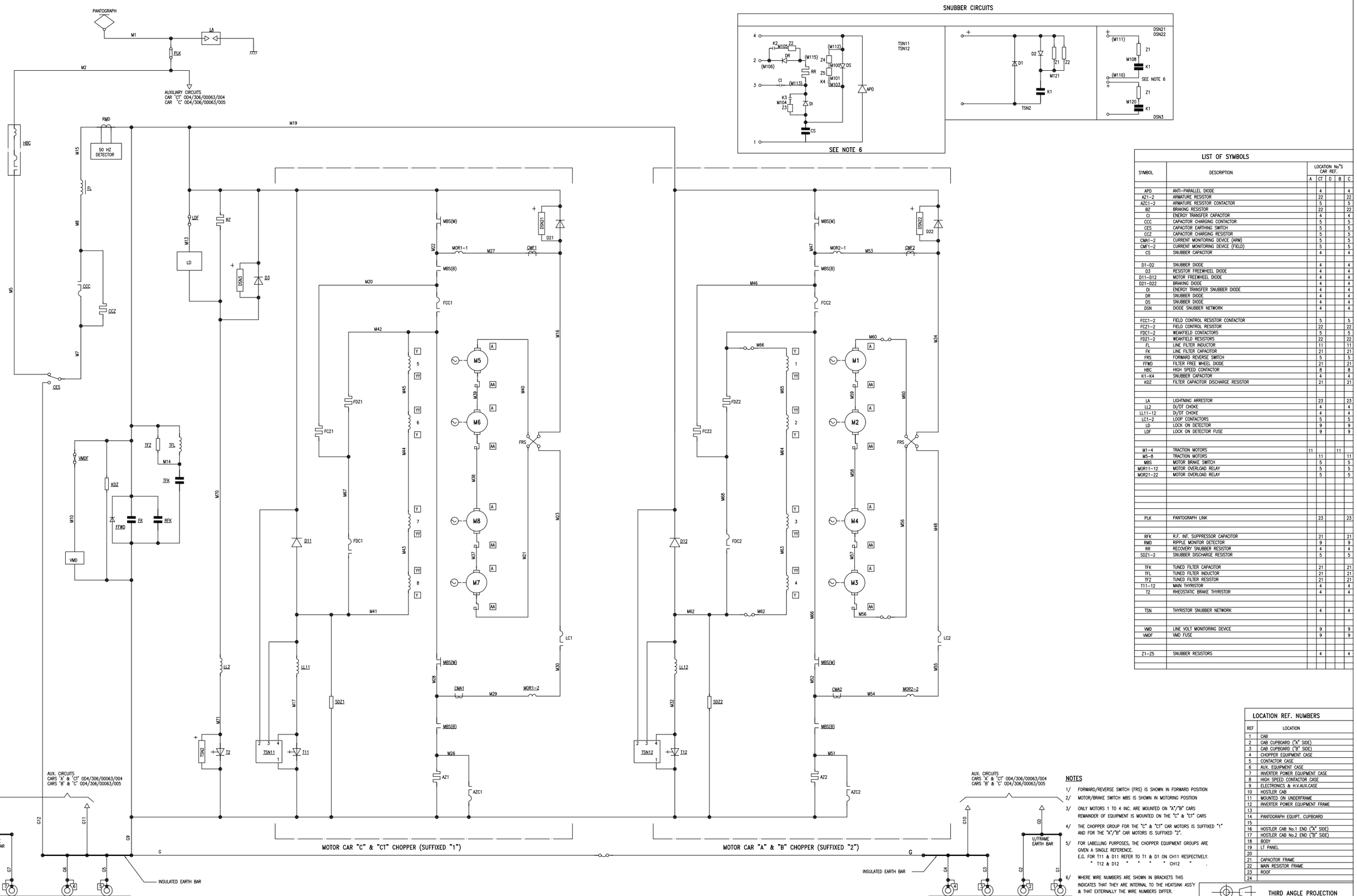
CAD FILE NAME	00262001		

地鐵公司 MTR Corporation

TITLE 'T' STOCK CHOPPER CONVERSION
AUXILIARY CIRCUIT DIAGRAM
'A'-'CT'-'D' CARS

SCALE NTS | OED DRAWING NO. OD4/305/00262/0001 | G



SNUBBER CIRCUITS

LIST OF SYMBOLS

SYMBOL	DESCRIPTION	LOCATION No'S CAR REF. A	CT	D	B	C
APD	ANTI-PARALLEL DIODE		4			4
AZ1-2	ARMATURE RESISTOR		22			22
AZC1-2	ARMATURE RESISTOR CONTACTOR		5			5
BZ	BRAKING RESISTOR		22			22
CI	ENERGY TRANSFER CAPACITOR		4			4
CCC	CAPACITOR CHARGING CONTACTOR		5			5
CES	CAPACITOR EARTHING SWITCH		5			5
CCZ	CAPACITOR CHARGING RESISTOR		5			5
CMA1-2	CURRENT MONITORING DEVICE (ARM)		5			5
CMF1-2	CURRENT MONITORING DEVICE (FIELD)		5			5
CS	SNUBBER CAPACITOR		4			4
D1-D2	SNUBBER DIODE		4			4
D3	RESISTOR FREEWHEEL DIODE		4			4
D11-D12	MOTOR FREEWHEEL DIODE		4			4
D21-D22	BRAKING DIODE		4			4
DI	ENERGY TRANSFER SNUBBER DIODE		4			4
DR	SNUBBER DIODE		4			4
DS	SNUBBER DIODE		4			4
DSN	DIODE SNUBBER NETWORK		4			4
FCC1-2	FIELD CONTROL RESISTOR CONTACTOR		5			5
FCZ1-2	FIELD CONTROL RESISTOR		22			22
FDC1-2	WEAKFIELD CONTACTORS		5			5
FDZ1-2	WEAKFIELD RESISTORS		22			22
FL	LINE FILTER INDUCTOR		11			11
FK	LINE FILTER CAPACITOR		21			21
FRS	FORWARD REVERSE SWITCH		5			5
FFWD	FILTER FREE WHEEL DIODE		21			21
HBC	HIGH SPEED CONTACTOR		8			8
K1-K4	SNUBBER CAPACITOR		4			4
KDZ	FILTER CAPACITOR DISCHARGE RESISTOR		21			21
LA	LIGHTNING ARRESTOR		23			23
LL2	DI/DT CHOKE		4			4
LL11-12	DI/DT CHOKE		4			4
LC1-2	LOOP CONTACTORS		5			5
LD	LOCK ON DETECTOR		9			9
LDF	LOCK ON DETECTOR FUSE		9			9
M1-4	TRACTION MOTORS	11			11	
M5-8	TRACTION MOTORS		11			11
MBS	MOTOR BRAKE SWITCH		5			5
MOR11-12	MOTOR OVERLOAD RELAY		5			5
MOR21-22	MOTOR OVERLOAD RELAY		5			5
PLK	PANTOGRAPH LINK		23			23
RFK	R.F. INT. SUPPRESSOR CAPACITOR		21			21
RMD	RIPPLE MONITOR DETECTOR		9			9
RR	RECOVERY SNUBBER RESISTOR		4			4
SD21-2	SNUBBER DISCHARGE RESISTOR		5			5
TFK	TUNED FILTER CAPACITOR		21			21
TFL	TUNED FILTER INDUCTOR		21			21
TFZ	TUNED FILTER RESISTOR		21			21
T11-12	MAIN THYRISTOR		4			4
T2	RHEOSTATIC BRAKE THYRISTOR		4			4
TSN	THYRISTOR SNUBBER NETWORK		4			4
VMD	LINE VOLT MONITORING DEVICE		9			9
VMDF	VMD FUSE		9			9
Z1-Z5	SNUBBER RESISTORS		4			4

LOCATION REF. NUMBERS

REF	LOCATION
1	CAB
2	CAB CUPBOARD ("A" SIDE)
3	CAB CUPBOARD ("B" SIDE)
4	CHOPPER EQUIPMENT CASE
5	CONTACTOR CASE
6	AUX. EQUIPMENT CASE
7	INVERTER POWER EQUIPMENT CASE
8	HIGH SPEED CONTACTOR CASE
9	ELECTRONICS & H.V.AUX.CASE
10	HOSTLER CAB
11	MOUNTED ON UNDERFRAME
12	INVERTER POWER EQUIPMENT FRAME
13	
14	PANTOGRAPH EQUIPT. CUPBOARD
15	
16	HOSTLER CAB No.1 END ("A" SIDE)
17	HOSTLER CAB No.2 END ("B" SIDE)
18	BODY
19	LT PANEL
20	
21	CAPACITOR FRAME
22	MAIN RESISTOR FRAME
23	ROOF
24	

NOTES

1/ FORWARD/REVERSE SWITCH (FRS) IS SHOWN IN FORWARD POSITION

2/ MOTOR/BRAKE SWITCH MBS IS SHOWN IN MOTORING POSITION

3/ ONLY MOTORS 1 TO 4 INC. ARE MOUNTED ON "A"/"B" CARS
REMAINDER OF EQUIPMENT IS MOUNTED ON THE "C" & "CT" CARS

4/ THE CHOPPER GROUP FOR THE "C" & "CT" CAR MOTORS IS SUFFIXED "1"
AND FOR THE "A"/"B" CAR MOTORS IS SUFFIXED "2".

5/ FOR LABELLING PURPOSES, THE CHOPPER EQUIPMENT GROUPS ARE
GIVEN A SINGLE REFERENCE.
E.G. FOR T11 & D11 REFER TO T1 & D1 ON CH11 RESPECTIVELY.
" T12 & D12 " " " " CH12 " .

6/ WHERE WIRE NUMBERS ARE SHOWN IN BRACKETS THIS
INDICATES THAT THEY ARE INTERNAL TO THE HEATSINK ASS'Y
& THAT EXTERNALLY THE WIRE NUMBERS DIFFER.

THIRD ANGLE PROJECTION

REV	DESCRIPTION	CHECKED	APPROVED	DATE
B	DIGITIZATION	F.NGAI	E.YEUNG	11/1/96

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CONTRACTOR'S DRAWING NO. 51809X0201B

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CAD REF NO.	511424V1		

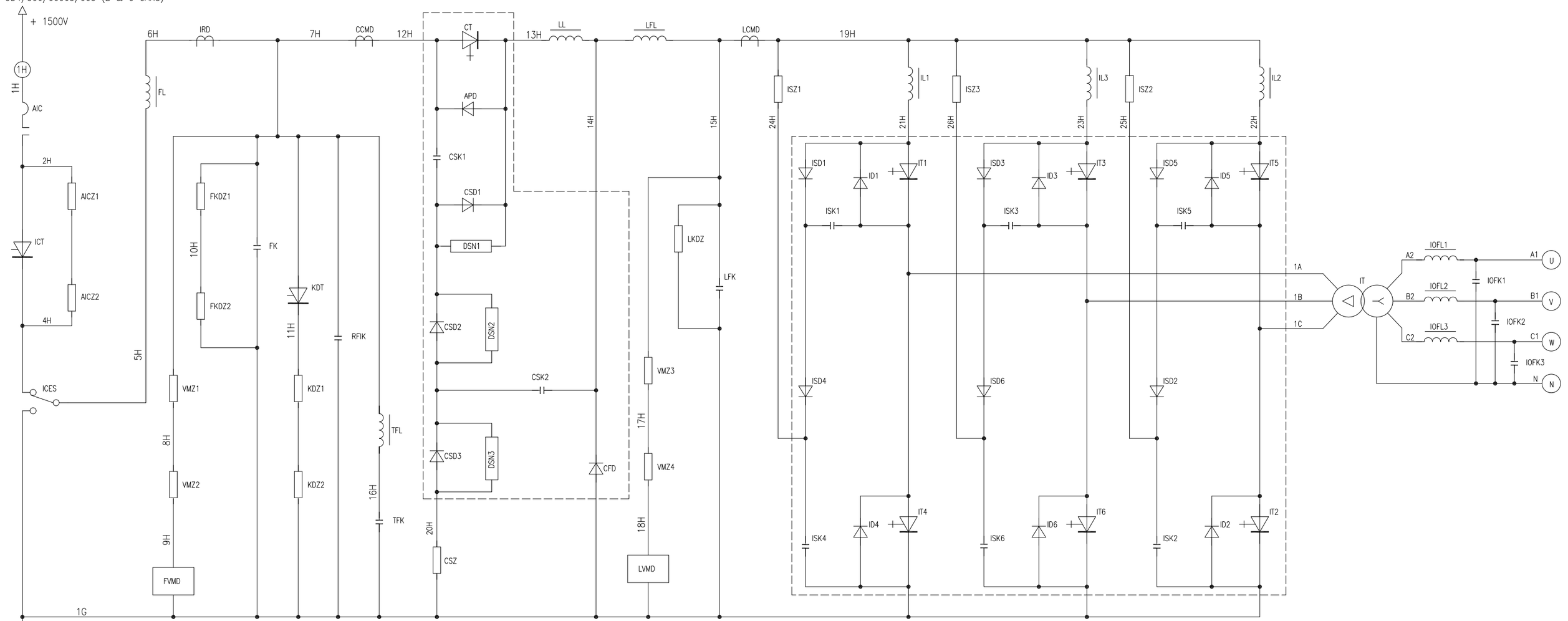
MASS TRANSIT RAILWAY CORPORATION

TITLE

POWER CIRCUIT DIAGRAM FOR E.M.U. CARS
ADDITIONAL ROLLING STOCK

SCALE NTS DWG NO. 0D4/306/00041/001 B

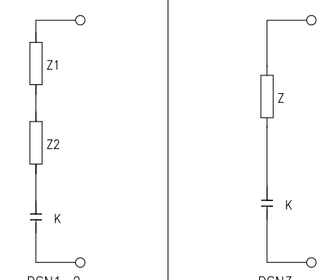
AUX.CCT.DIAG
OD4/306/00063/004 (A & CT CARS)
OD4/306/00063/005 (B & C CARS)



AUX.CCT.DIAG
OD4/306/00063/004 (A & CT CARS)
OD4/306/00063/005 (B & C CARS)

REFER TO OD4/306/00063/007 FOR SYMBOL LIST

SNUBBER CIRCUITS



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B	DIGITIZATION	F.NGAI	E.YEUNG	11/1/96

REFERENCE DWGS

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PEN SET		PRINT DATE	
CAD REF NO.		511433V1	

MASS TRANSIT RAILWAY CORPORATION

TITLE
CIRCUIT DIAGRAM OF STATIC
AUXILIARY CONVERTER

SCALE NTS | DWG NO. OD4/306/00063/003 B

OD4/306/00063/0004 | E

'A' CAR ← → 'CT' CAR → 'D' CAR

1H AUXILIARY CONVERTER SEE OD4/306/00063/006 ('A' CAR)

1G

TO 'A' CAR INSULATED H.T. EARTH BAR DRG. OD4/306/00041/001

'A' CAR AUX. CONV.

'FRT' DRG. OD4/306/00063/011

MAIN LIGHTING MET. CAM. DRG.No.30.406.M06

AIR CONDITIONING No. 1 STONE PLATT DRG. No.CD332150-1

AIR CONDITIONING No. 2 STONE PLATT DRG.No.CD332150-2

CAB AIR COND. STONE PLATT DRG. No. CD341622

CAB COOLING FAN

LINK IN MULTIPOINT CONN. BOX 'A'

LINK IN MULTIPOINT CONN. BOX 'C'

N2 BUSBAR (POWER EQUIPT. FRAME)

GD BUSBAR

N1 BUSBAR (AUX EQUIP. CASE)

EARTH BAR ('CT' CAR UNDERFRAME)

FROM POWER CCT DRG. OD4/306/00041/001

1H AUXILIARY CONVERTER SEE OD4/306/00063/006 ('CT' CAR)

1G

N1 BUSBAR

TO 'CT' CAR INSULATED EARTH BAR DRG. OD4/306/00041/001

'FRT' DRG. OD4/306/00063/011

MAIN LIGHTING MET. CAM. DRG.No.30.412.M06

AIR CONDITIONING No. 2 STONE PLATT DRG. No. CD332150-2

AIR CONDITIONING No. 1 STONE PLATT DRG.No.CD332150-1

MAIN LIGHTING MET. CAM. DRG.No.30.406.M06

AIR CONDITIONING No. 2 STONE PLATT DRG.No.CD332150-2

** DENOTES HOSTLER No. 1 IS FED FROM No. 2 END & HOSTLER No. 2 IS FED FROM No. 1 END OF 'D' CAR

TO CONTROL CIRCUIT DRG. OD4/306/00041/002

⊠JUMPER STOWAGE SKT. (SEE NOTE 6)

AIR CONDITIONING STONE PLATT DRG.No.CD332150-3 TO CONTROL CIRCUIT DRG. No. OD4/306/00041/002

AIR COND. (TRIP) OFF SERVICE STONE PLATT DRG. CD332150-3

SEE DRG. OD4/306/00041/006

AIR COND. SET STONE PLATT DRG.332150-3

AIR COND. 'CT' CAR STONE PLATT DRG.No.CD332150-3

CAB AIR COND. STONE PLATT DRG.No.CD341622

AIR COND. 'D' CAR STONE PLATT DRG.No.CD332150-3

LIGHTING 'D' CAR MET. CAM. DRG.No.30.412.M06

LIGHTING 'CT' CAR MET. CAM. DRG.No.30.412.M06

'A' CAR AUX CONVERTER

'CT' CAR AUX CONVERTER

'A' CAR UNDERFRAME

AIR DRYER KNORR-BREMSE DRG.No.1895879

TEST BOX

WHEEL SLIP DUMP VALVES SEE DRG. OD4/306/00041/002

E SUPPLY SEE OD4/306/00063/012

AC OPEN

AC CLOSED

DC REF.

AUX. EQPT. CASE 'A' SEE NOTE 14.

CAB. AIR COND. STONE PLATT DRG. No. CD341622

LIGHTING CIRCUITS MET.CAM. DRG.30.406.M06 DRG.30.410.M06 DRG.30.412.M06

AIR COND. CIRCUITS STONE PLATT DRG. No. CD332150-3

TO CONTROL CIRCUIT DRG. OD4/306/00041/002

LIST OF SYMBOLS

SYMBOLS	DESCRIPTION	LOCATION REF. CARS A	CT	D
AC	AUXILIARY COMPRESSOR		11	
ACB	AUXILIARY CONTROL M.C.B.	2		
ACCB	AUXILIARY COMPRESSOR CIRCUIT BREAKER	2		
ACD	AUXILIARY COMPRESSOR DIODE		14	
ACG	AUXILIARY COMPRESSOR GOVERNOR		14	
ACK	AUXILIARY COMP. SNUBBER CAPACITOR		14	
ACZ	AUXILIARY COMP. SNUBBER RESISTOR		14	
AD1,2	AIR DRYER DIODE	6		
AIC1–2	AUXILIARY CONVERTER SUPPLY CONTACTOR	7	7	
ARR	AUXILIARY RUN RELAY		6	
ASR	AUXILIARY STARY RELAY		6	
ASB2–1	3–PHASE SUPPLY M.C.B.S.	6	6	
BCB	BATTERY CONTROL M.C.B.	2		
BCC	BATTERY CHARGE & L.V. SUPPLY CONTACTOR	6		
BD90–91	BLOCKING DIODES.	2		
BIC	BATTERY ISOLATING CONTACTOR	6		
BNF	BATTERY NEGATIVE FUSE	11		
BPF	BATTERY POSITIVE FUSE	11		
BVR	BATTERY VOLTAGE RELAY	6		
BVZ2–1	BALLAST FOR BVR	6		
C	COMPRESSOR MOTOR	11		
CAF	CAB AIR CONDITIONING FUSE	6		
CAR	CAB AIR COND CONTROL	1		
CCB	COMPRESSOR M.C.B.	2		
CHB	BATTERY CHARGE & L.V. SUPPLY M.C.B.	6		
CIR	CHARGING INDICATION RELAY	6		
CIRF	CHARGING INDICATION RELAY FUSE	6		
COR1	CAB OCCUPIED RELAY	6		
CPZ	COMPRESSOR MOTOR PROTECTIVE RESISTOR	11		
CSB	COMPRESSOR SYNCHRONISING M.C.B.	2		
CECS	CHOPPER ELECTRONICS CUT–OUT SWITCH		9	
DCB1	"CT" CAR CONTROL ROSITIVE M.C.B.	2		
DCB3	"D" CAR CONTROL POSITIVE M.C.B.	6		
DCF	D.C. SUPPLY FUSE	6		
D3,5	BLOCKING DIODE		6	
D6–7	BLOCKING DIODES	6		
DSC	"D" CAR SUPPLY CONTACTOR	6		
ECB	"A" CAR AIR CONDITIONING SUPPLY M.C.B.	2		
ECC	EMERGENCY CHARGING CONTACTOR	6		
ELCB3–4	"CT" CAR EMERGENCY LIGHTING M.C.B.S.		10	
FKS1–2	FILTER CAPACITOR PRESSURE SWITCH	12	12	
FRT	FEEDBACK REFERENCE TRANSFORMER	7	7	
GC	GROUND CONTACTOR	6		
HMSC	HOSTLER MASTER SWITCH		10	
HMSD1	HOSTLER MASTER SWITCH			16
HMSD2	HOSTLER MASTER SWITCH			17
IE	AUX. CONVERTER ELECTRONIC UNIT	7	7	
ICCB1–2	AUX. CONVERTER CONTROL CIRCUIT BREAKER	7	7	
ICS2–1	AUX. CONVERTER CUT–OUT SWITCH	2	10	
IEG1–2	AUX. CONVERTER EQUIPMENT GOVERNOR	7	7	
IECS1–2	AUX. CONVERTER ELECTRONICS CUT–OUT SWITCH	7	7	
LFKS1–2	LINK FILTER CAPACITOR PRESSURE SWITCH	12	12	
LVD	BATTERY CHARGE & L.V. SUPPLY RECTIFIER	6		
LVF	L.V. RECTIFIER OUTPUT FUSE	6		
LVT	BATTERY CHARGING TRANSFORMER	11		
MAF1,2	MAIN AUXILIARY FUSES		9	
MCC	MAIN COMPRESSOR CONTACTOR	6		
MCF	MAIN COMPRESSOR FUSE	6		
MCG	MAIN COMPRESSOR GOVERNOR	6		
MFB	MICROPROCESSOR FAN BREAKER (W'HOUSE)	2		
OFR1–2	OFF SERVICE RELAY (AIR COND.)		18	
ORR1–2	OUT OF REGULATION RELAY	7	7	
PVD	PANTOGRAPH DOWN VALVE		14	
PVU	PANTOGRAPH UP VALVE		14	
PWR2–1	PILOT WIRE RELAYS	6	6	
RSR1–2	REGULATOR SUPPLY RELAY	7	7	
RSK	RECTIFIER SUPPRESSION CAPACITOR	6		
RSZ	RECTIFIER SUPPRESSION RESISTOR	6		
SDCF	SECURE DC FUSE	6		
SDR	SHUT DOWN RELAY		6	
SDTR	SHUT DOWN DELAY RELAY		6	
SDTZ	SHUT DOWN DELAY RELAY RESISTOR		6	
SLD3	SLUGGING DIODE	6		
SPD1–2	SUPPRESSION DIODES	6	6	
TSB2–1	TRAILER A.C. SUPPLIES M.C.B.S.	6	6	
TSC2–1	TRAILER A.C. SUPPLIES CONTACTORS	6	6	
TTR1–2	TRIP TIME DELAY RELAYS	7	7	
TTZ1–2	BALLAST FOR TTR	7	7	
TDM1–2	TIME DELAY MODULE	6		
TFKS1–2	TUNED FILTER CAP. PRESSURE SWITCH	12	12	
TSCS	TRAILER SUPPLY CUT–OUT SWITCH		10	

LOCATION REF. NUMBERS

REF.	LOCATION
1	CAR
2	CAB CUPBOARD ('A' SIDE)
3	CAB CUPBOARD ('B' SIDE)
4	CHOPPER EQUIPMENT CASE
5	CONTACTOR CASE
6	AUX. EQUIPMENT CASE
7	AUX. CONVERTER POWER EQUIPMENT CASE
8	HIGH SPEED CONTACTOR CASE
9	ELECTRONICS & H.V. AUX. CASE
10	HOSTLER CAB
11	MOUNTED ON UNDERFRAME
12	AUX. CONVERTER POWER EQUIPMENT FRAME
13	
14	PANTOGRAPH EQUIP. CUPBOARD
15	
16	HOSTLER CAB No. 1 END ['A' SIDE]
17	HOSTLER CAB No. 2 END ['B' SIDE]
18	BODY
19	L.T. PANEL
20	
21	CAPACITOR FRAME
22	MAIN RESISTOR FRAME
23	ROOF
24	

CONTACTS IN ELECTRONIC UNIT [AUX. CONVERTER]

REF.	FUNCTION
IE2	OUT OF REGULATION
IE3	NO FAULT

NOTES:–

1. AIC POWER CONTACTS SHOWN ON OD4/306/00063/006
2. ⓞ DENOTES SUPPRESSION UNIT ACROSS COIL EG.
3. 'A' CAR SIDE —○— 'CT' CAR SIDE
4. 'CT' CAR SIDE —○— 'D' CAR SIDE
5. ICS1–2 C9/1 PWR2/3 TSC2/2 CONTACTS ARE SHOWN ON DIAG. 51809X205 SDR/3 ON MET CAM DOOR SCHEME
6. COR1 COIL IS SHOWN ON OD4/306/00041/002
7. (82) DENOTES STONE PLATT TERMINAL Nos.
8. TO ENSURE FAIL SAFE OF 'D' CAR A.C. SUPPLY JUMPERS MUST BE CORRECTLY COUPLED TO "CT" CAR AND AT UNCOUPLED END CORRECTLY COUPLED TO "D" CAR STOWAGE SOCKETS
9. —○— IE DENOTES I/P SIGNAL TO AUX. CONV. ELECT. UNIT —○— DENOTES O/P CONTACT IN AUX. CONV. ELECT. UNIT SEE DRG. OD4/306/00063/009
10. D116 17D DENOTES INTERFACE OF WIRE NUMBERS BETWEEN CIRCUITS & STANDARD AUXILIARY CONVERTER CIRCUITS
11. CONTACTS AIC/4 & AIC/5 ARE USED ON "A" CAR AUX. CONV. ONLY
12. AIC/3 CONTACT SHOWN ON OD4/306/00041/002
13. INDICATES AUX. CONVERTER EQUIPMENT
14. FOR REGULATION OF BATTERY TERMINAL VOLTAGE FIT LINK. FOR REGULATION OF CONVERTER A.C. OUTPUT OMIT LINK.
15. WHERE TWO WIRES OF DIFFERENT NUMBERS ARE JOINED TOGETHER THE LOCATION AND METHOD WILL BE INDICATED AS FOLLOWS:– FOR LINK AT TWO ADJACENT TERMINALS e.g. GD —○— N2 MULTIPOINT CONNECTION BOX 'A'
16. OFR COIL SHOWN ON STONE PLATT DRG. No. CD332150-3.
17. SUPPRESSOR FOR CIR COIL IS V50LA40A (SCN 46–64–44028)

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
E	REVISED AS PER EDOC NO. ZML5094	Z012	10–5–02 M.C. YIP	17–10–02 E. YEUNG	17–10–02
D	REVISED AS PER GECA MOD. NO. 41 DRAWING UPDATING	K.W.TSUI	28–04–99 J.C.KIU	03–05–99 E.YEUNG	03–05–99
C	REVISED AS PER EDOC ZML4369 DRAWING UPDATING	W.H.CHENG	20–08–98 N.LEE	13–11–98 E.YEUNG	13–11–98
B	DIGITIZATION		R.NGAI	06–11–95 E.YEUNG	06–11–95

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO. 51809X0203 E

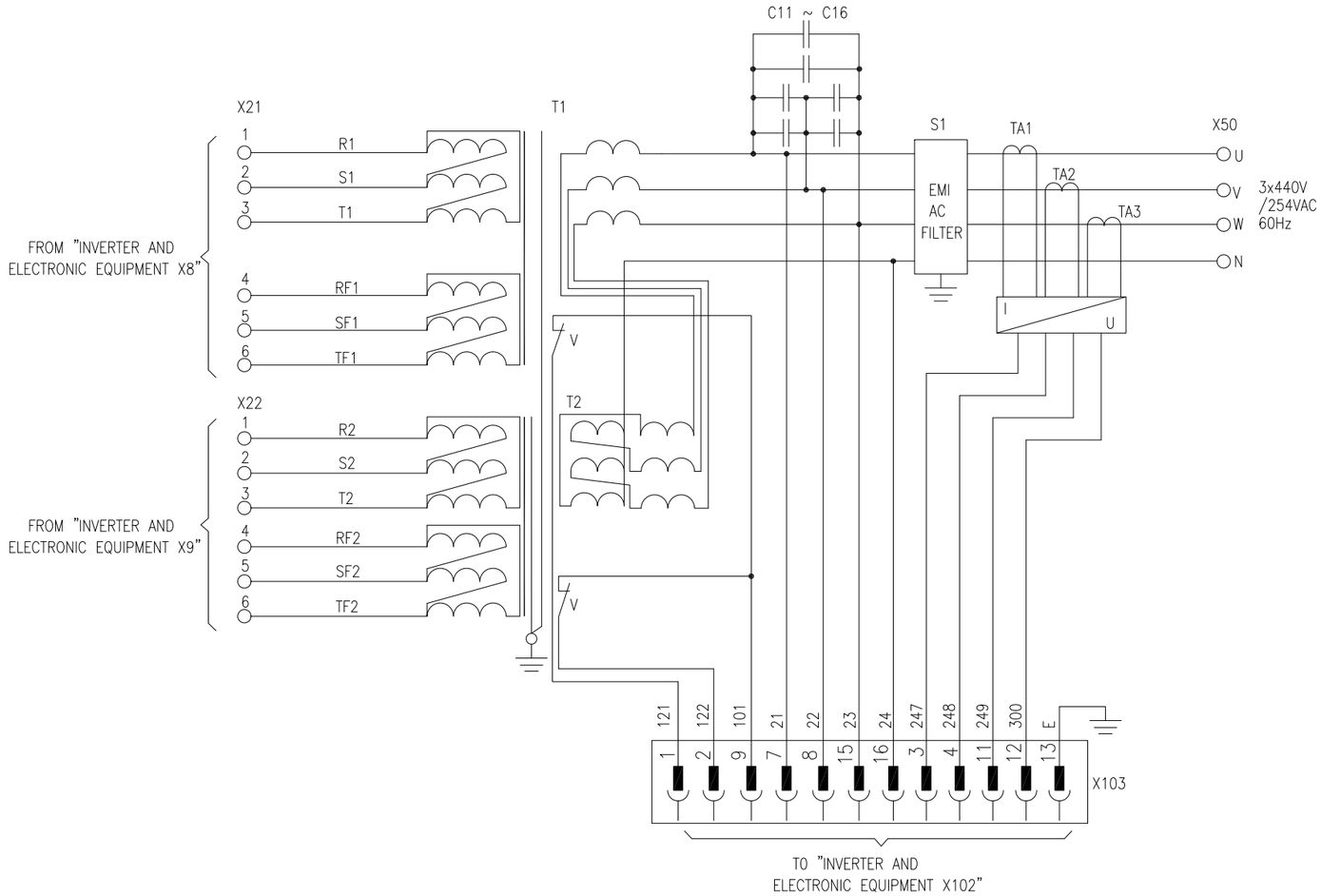
	INITIAL	DESIGNATION	DATE
DRAWN	Y152	ZESTC	28–07–95
DESIGNED			
CHECKED			
APPROVED			
CAD FILE NAME	00063004		

地鐵公司 MTR Corporation

TITLE 'H' STOCK
AUXILIARY CIRCUIT DIAGRAM EMU CARS
'A'–'CT'–'D' ADDITIONAL ROLLING STOCK [1/1]

SCALE NTS | OED DRAWING NO. OD4/306/00063/0004 | E

TRANSFORMER EQUIPMENT



LIST OF SYMBOLS	
SYMBOL	DESCRIPTION
X1 ~ X50	TERMINAL PLATE
X101 ~ X103	HARTING CONNECTOR
KM1	H.V. CONTACTOR
UA1 ~ UA5	CURRENT SENSOR
UV1 ~ UV3	VOLTAGE SENSOR
L1	INDUCTOR
V1, V4, V6	THYRISTOR
V5	DIODE MODULE
V7, V8	RECTIFIER BRIDGE
C1, C2	DC FILTER CAPACITOR
C11 ~ C16	AC FILTER CAPACITOR
T1	DY TRANSFORMER
T2	DZ TRANSFORMER
S1	AC EMI FILTER
S2	DC EMI FILTER
V	TEMPERATURE RELAY
TA1 ~ TA3	CURRENT TRANSDUCER
A5, A6	IGBT INVERTER MODULE
A7	VOLTAGE FEEDBACK BOARD
A8	VOLTAGE TRANSDUCERS ASSEMBLY
A100	CONTROL UNIT

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	RH
DESIGNED	---
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_637_001_A.DWG

TITLE

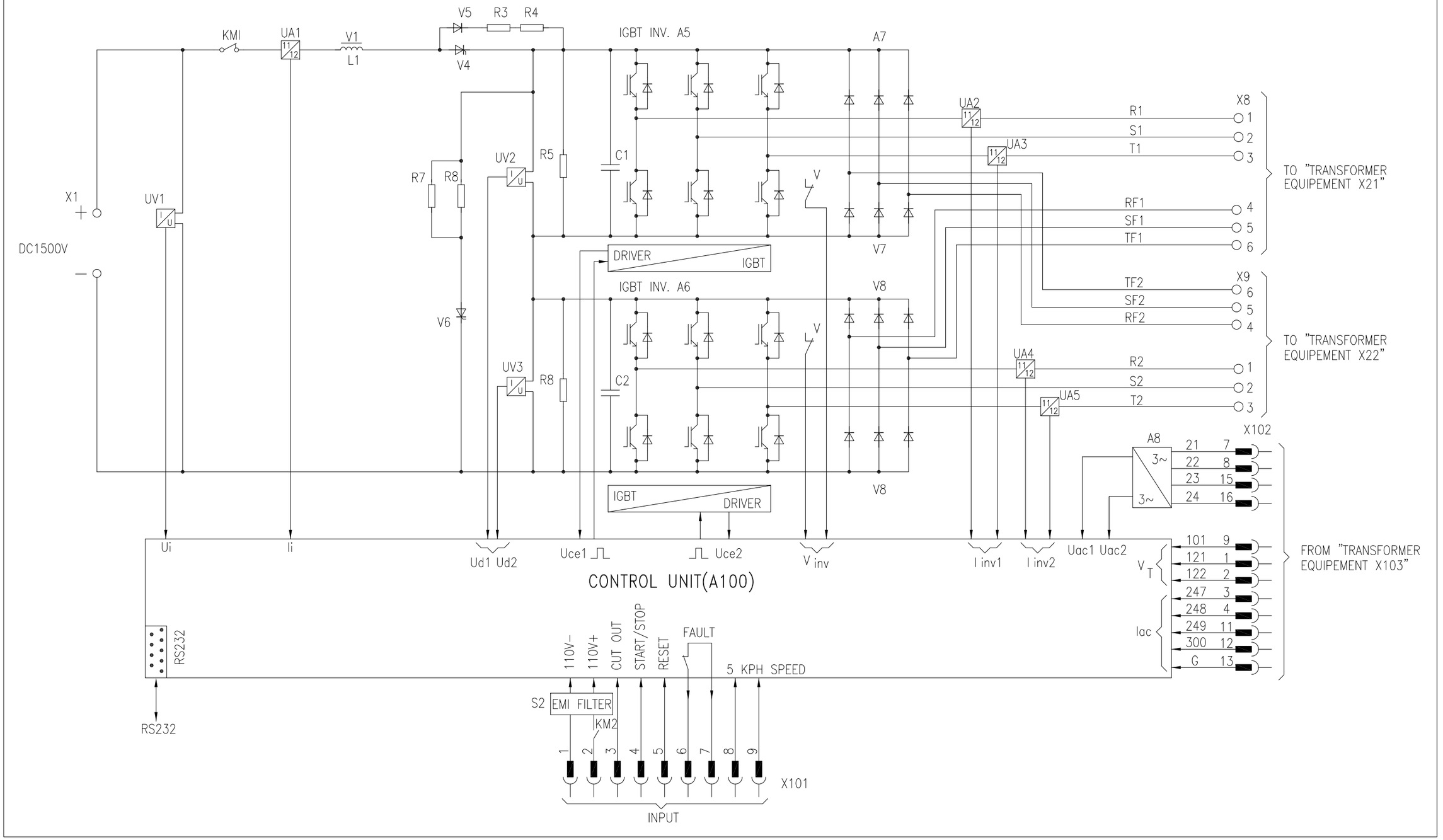
C6014-14E

PROCUREMENT OF NEW TRAINS

SCHEMATIC DIAGRAM OF SIV POWER CIRCUIT (SHEET 1 OF 2)

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/637/001	A

INVERTER & ELECTRONIC EQUIPMENT



REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	RH
DESIGNED	___
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_637_002_A.DWG

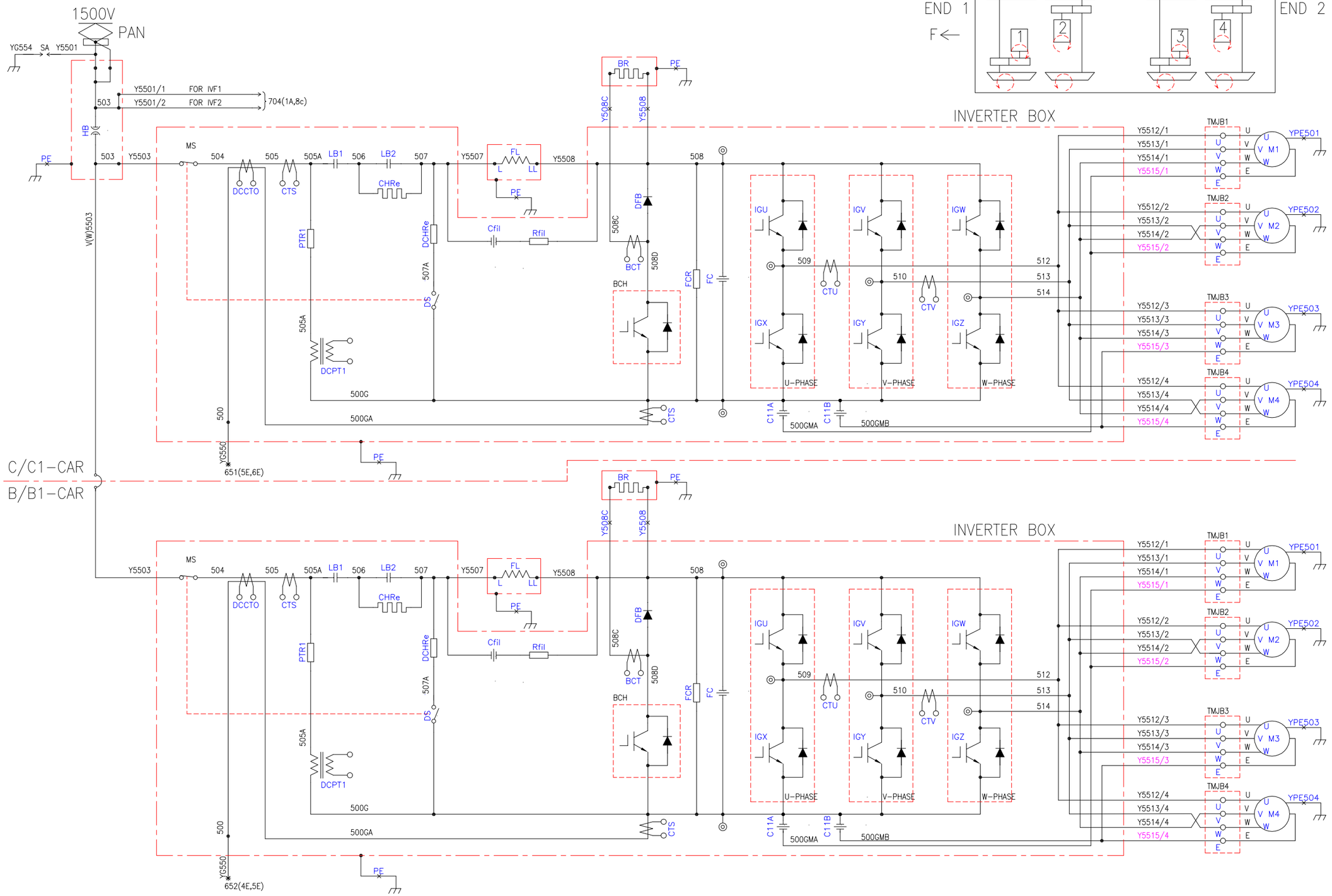
TITLE

C6014-14E

PROCUREMENT OF NEW TRAINS

SCHEMATIC DIAGRAM OF SIV POWER CIRCUIT (SHEET 2 OF 2)

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/637/002	A



REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_637_003_A.DWG

TITLE
C6014-14E
ROLLING STOCK FOR MTR LINES
POWER CIRCUIT DIAGRAM FOR EMU CARS

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/637/003	A

C,B,B1,C1 CAR

STATIC INVERTER

Car Type	C-car	B-car	B1-car	C1-car
Wire No.	T5502	W5502	V5502	K5502

704(3B,3D, 6B,6D) — 801 — IVS — 802 — IVK — 803 — FL — 804

TO TCN1, RC, RB, CB, TO TCN1, RD, BTH, GUB

812, HK, 800G

709(4D,7D) 710(4D,7D) — Y7007 — CN1 (g) IVSON1 — MONP — From *5

704(3B,6B,3E,6E) — YG551 — 800G — HCT3 — 800GA — TO TCN1

H.T.SENSOR

INVERTER UNIT

IVP2, CT1, FC1, FC2, CT2, IV01

Q1U, Q1V, Q1W, Q2U, Q2V, Q2W, Q3U, Q3V, Q3W, Q4U, Q4V, Q4W

GUDPU, GUDPV, GUDPW, FDPU, FDPV, FDPW, GUDNU, GUDNV, GUDNW, FDNU, FDNV, FDNW

TO TCN1 — UL, VL, WL — HCT11, HCT12 — UL1, VL1 — TR1

IA1U1, IA1V1

PWB-UNIT

PROTECTION CIRCIT

CONVERTER — IA1U1, IA1V1, IA1W1 — Iref* — C.C.

Limitter — *IA* — V.C.

IT1U1, IT1V1, IT1W1 — U2,V2,W2

Current Command, Voltage Command, ACC current Command

CPU, MEMORY, TRACE MEMORY, A/D CONVERTER, CARRIER MEMORY, INTER FACE, MONITOR, PARAMETER MEMORY

PROCESS I/O, INV.Start/ Stop,CONT, DISPLAY, I/O, INTER FACE

PB, MI03, DSC

P5, PSC1, PSP, PSC, PSN, DSP, DSC — +5V, +/-15V, +24V — PS1

MI04, MI05, MI06, MI07, MI08, MI09, MI10 — I/F PCB

U48, V48, BP3, SVGG, FR2, FID2, FIC1, FR1, FID1, NF

DC110P, DC110E, IVF2, EPD, AOFF, AON, GR71, DCFA, DCKFA

MI01, MI02, N.V.TEST SW, TCN1, DSC — 804, IVP2, 800GA, UL, IV01

SIVKXR, SDR, SDRAR, SSK, SIVK

TO *2 *1

TMS I/F PCB — 485S1, 485S2, 485S3, MNS

BCV1, BCV1E, BCV1G, BCV2E, BCV2, BCV2G

RCH8, RCH9 — DC PT

ACC, IT1U1, IT1V1, IT1W1, U00, V00, W00, T14

U2, V2, W2

TU, TV, TW — HCT21, HCT22, HCT23 — U00, V00, W00 — SIVK

TR3

SSK, SIVK, B1A, B2, A2, B2, C2, N, B1

SHORE SUPPLY AC415V 3Phase, 50Hz 100A

	C-	B-	B1-	C1- CAR	
B1A	W7057	W7054	H7054	V7057	TO BCG 705(5D)
B2	W7058	W7055	H7055	V7058	
A3	W7407	R7407	H7407	K7407	220VAC 50Hz 3kVA 703
B3	W7408	R7408	H7408	K7408	
A1	H7414				B1 CAR ONLY
B1	H7415				3ø 415VAC 50Hz TO BCG;705
C1	H7416				
A1	W7401	W7404	V7404	V7401	3ø 415VAC 50Hz 703
B1	W7402	W7405	V7405	V7402	
C1	W7403	W7406	V7406	V7403	
N	WG741	WG742	VG742	VG741	
A1	W7401	W7404	V7404	V7401	3ø 415VAC 50Hz 703
B1	W7402	W7405	V7405	V7402	
C1	W7403	W7406	V7406	V7403	
N	WG741	WG742	VG742	VG741	

CN1 (C) — T7113, W7123, V7123, K7113 — 709(4C,7C),710(4C,7C)

(D) — T7114, R7114, H7114, K7114 — 708(3B,6B)

(A) — T7033, W7033, V7033, K7033 — 709(4C,7C),710(4C,7C)

(G) — T7104, W7104, V7104, K7104 — 708(3C,6C)

(H) — 1002, 1002, 1002, 1002 — 708(3C,6C)

(J) — 1006, 1006, 1007, 1007 — 709(4D,7D),710(4D,7D)

(K) — TGR71, RGR71, HGR71, KGR71 — 709(4D,7D),710(4D,7D)

(R) — W7036, W7037, H7037, V7036 — 709(4C,7C),710(4C,7C)

(U) — W7059, W7056, H7056, V7059 — 709,710

CN2 (E) — Y7051, (F) — Y7052, (S) — Y7053, (T) — Y7055 — 709(4E,7E) 710(4E,7E)

CN1 (S) — W7041, W7081, H7081, V7041

(T) — W7042, W7082, H7082, V7042

(X) — W7071, W7091, H7091, V7071

(Z) — W7072, W7092, H7092, V7072 — 709,710

107(3C),108(3C) 109(3C),110(3C) — Y1061 — CN1 (M) MFR1 — SIVMFR; Y1072 — (N) MFR2

709,710 — C- T5005 W5007 V5007 K5005 / T5006 R5006 H5006 K5006 — (f) IVK1, IVK — (f) IVK2

709,710 — Y7101 — (b) ACR1 — SIVACR; Y7110 — (c) ACR2

709,710 — C- T7113 W7123 V7123 K7113 / W7075 W7076 V7076 V7075 — (e) MONP; (L) ACR3 — SIVACR

709(4E,7E),710(4E,7E) — Y7005 — (P) ACR5 — TO *5

C,B CAR ONLY — 107(3B),108(3B) — T1078 for C-car, W1078 for B-car — From *1 DC110P — (B) TSAS — TSAR — DC110P

IVKXR, HKXR, SIVMFR, SIVACR, TSAR, SIVKXR, SDRAR

DC110P, HK, IVK, HK — DC110E From *2

TO TMS 709,710 — Y7003 — CN1 (V) SSKA — SSK; YB111 — (W) SSKB

107,108,109,110,511,512,704,708,709,710,703,711,712

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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ORIGINATOR: OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

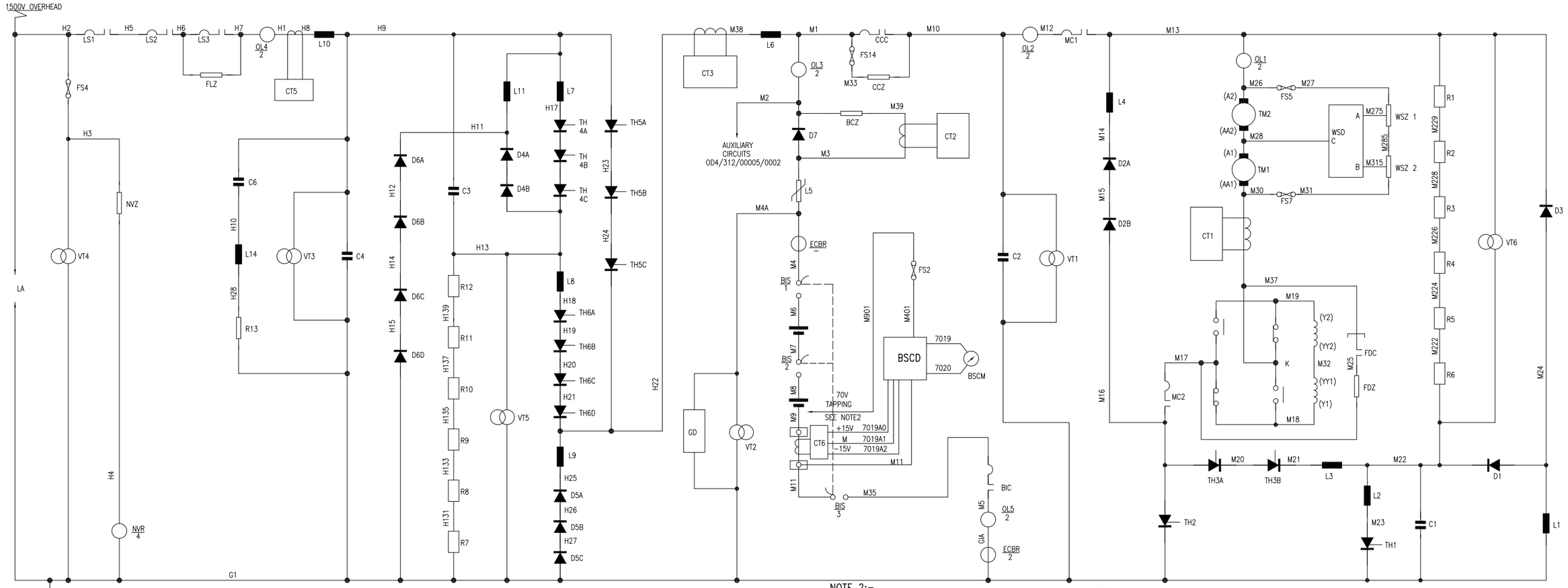
FILE NAME: C6014-14E_TSEG_637_004_A.DWG

TITLE: C6014-14E
ROLLING STOCK FOR MTR LINES
CIRCUIT DIAGRAM OF AUXILIARY STATIC INVERTER

SCALE: NTS

DRAWING NO.: C6014-14E/TSEG/637/004

REV.: A



REFERENCE	DESCRIPTION	DRG ZONE
BCZ	BATTERY CHARGING RESISTOR	D1
BIS	BATTERY ISOLATING SWITCH	C2,C3
BIC	BATTERY ISOLATING CONTACTOR	D2
BSCD	BATTERY STATE OF CHARGE DETECTOR	D2
BSCM	BATTERY STATE OF CHARGE METER	D2
C1	MOTOR CHOPPER COMMUTATION CAPACITOR	F3
C2	MOTOR CHOPPER FILTER CAPACITOR	D2
C3	LINE CHOPPER COMMUTATION CAPACITOR	B1
C4	LINE CHOPPER FILTER CAPACITOR	B2
C6	50Hz FILTER CAPACITOR	A1
CCC	CAPACITOR CHARGING CONTACTOR	D1
CCZ	CAPACITOR CHARGING RESISTOR	D1
CT1	MOTOR CURRENT TRANSDUCER	E1/E2
CT2	BATTERY CHARGE CURRENT TRANSDUCER	D2
CT3	LINE CHOPPER OUTPUT CURRENT TRANSDUCER	C1
CT5	LINE CURRENT RIPPLE TRANSDUCER	B1
CT6	BATTERY CURRENT TRANSDUCER	D2
D1	MOTOR CHOPPER COMMUTATION DIODE	F2
D2A,B	MOTOR CHOPPER FREEWHEEL DIODES	E1,E2

D3	MOTOR CHOPPER OVERCHARGE DIODE	F2
D4A,B	LINE CHOPPER RING-DOWN DIODES	B1
D5A-C	LINE CHOPPER FREEWHEEL DIODES	C2,C3
D6A-D	LINE CHOPPER OVERCHARGE DIODES	B1,B2
D7	BATTERY DISCHARGE DIODE	C1
ECBR	ELECTRONIC CURRENT BALANCE RELAY	D3
FDC	FIELD DIVERT CONTACTOR	E2
FDZ	FIELD DIVERT RESISTOR	E2
FLZ	FILTER INRUSH CURRENT LIMITING RESISTOR	A1
FS2	BATTERY STATE OF CHARGE DETECTOR FUSE	D2
FS4	NO VOLT RELAY FUSE	A1
FS5&7	WHEELSPIN FUSES	E1
FS14	FUSE	D1
GD	GASSING DETECTOR	C2
K	REVERSER	E2
L1	MOTOR CHOPPER RING-DOWN INDUCTOR	F3
L2	MOTOR CHOPPER RING-UP INDUCTOR	E2
L3	MOTOR CHOPPER dI/dt INDUCTOR	E2
L4	MOTOR CHOPPER dI/dt INDUCTOR	E1
L5	BATTERY CHARGE SMOOTHING INDUCTOR	C1

NOTE 2:- BSCD IS CONNECTED ACROSS ONE BATTERY TRAY ONLY (35 CELLS)

L6	MOTOR CHOPPER FILTER INDUCTOR	C1
L7	LINE CHOPPER RING -UP INDUCTOR	C1
L8	LINE CHOPPER dI/dt INDUCTOR	C2
L9	LINE CHOPPER dI/dt INDUCTOR	C2
L10	LINE CHOPPER FILTER INDUCTOR	B1
L11	LINE CHOPPER RING-DOWN INDUCTOR	B1
L14	50Hz FILTER INDUCTOR	B2
LS1-3	LINE SWITCHES	A1
LA	LIGHTNING ARRESTOR	A2
MC1,2	MOTOR CONTACTORS	D1,E2
NVR	NO VOLT RELAY	A3
NVZ	NO VOLT RELAY RESISTOR	A1
OL1	MOTOR OVERLOAD RELAY	E1
OL2	MOTOR SUPPLY OVERLOAD RELAY	D1
OL3	BATTERY OVERLOAD RELAY	C1
OL4	LINE OVERLOAD RELAY	B1
OL5	OVERLOAD RELAY	D2
R1-6	MOTOR CHOPPER TAIL RESISTORS	F2
R7-12	LINE CHOPPER TAIL RESISTORS	B2
R13	50Hz FILTER DAMPING RESISTOR	A2

NOTE1- REVERSER SHOWN IN "FORWARD" (CAB END LEADING) POSITION.

TH1	MOTOR CHOPPER COMMUTATION THYRISTOR	E3
TH2	MOTOR CHOPPER MAIN THYRISTOR	E3
TH3 A,B	MOTOR CHOPPER SERIES THYRISTORS	E2
TH4 A,B,C	LINE CHOPPER COMMUTATION THYRISTORS	C1
TH5 A,B,C	LINE CHOPPER MAIN THYRISTORS	C1,C2
TH6 A,B,C,D	LINE CHOPPER SERIES THYRISTORS	C2
VT1	MOTOR FILTER CAPACITOR VOLTAGE TRANSDUCER	D2
VT2	BATTERY VOLTAGE TRANSDUCER	C2
VT3	LINE FILTER CAPACITOR VOLTAGE TRANSDUCER	B2
VT4	LINE VOLTAGE TRANSDUCER	A2
VT5	LINE CHOPPER COMMUTATION VOLTAGE TRANSDUCER	B2
VT6	MOTOR CHOPPER COMMUTATION VOLTAGE TRANSDUCER	F2
WSD	WHEELSPIN DETECTOR	E1

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
D	REVISED AS PER ZMK6798 UPDATING	Z022 19-5-05	LUN CHAI 26-5-05	E.YEUNG 26-5-05
C	GENERAL REVISION	J.L. 09/05/00	LUN CHAI 09/06/00	E.YEUNG 09/06/00

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MTRC REFERENCE NO.

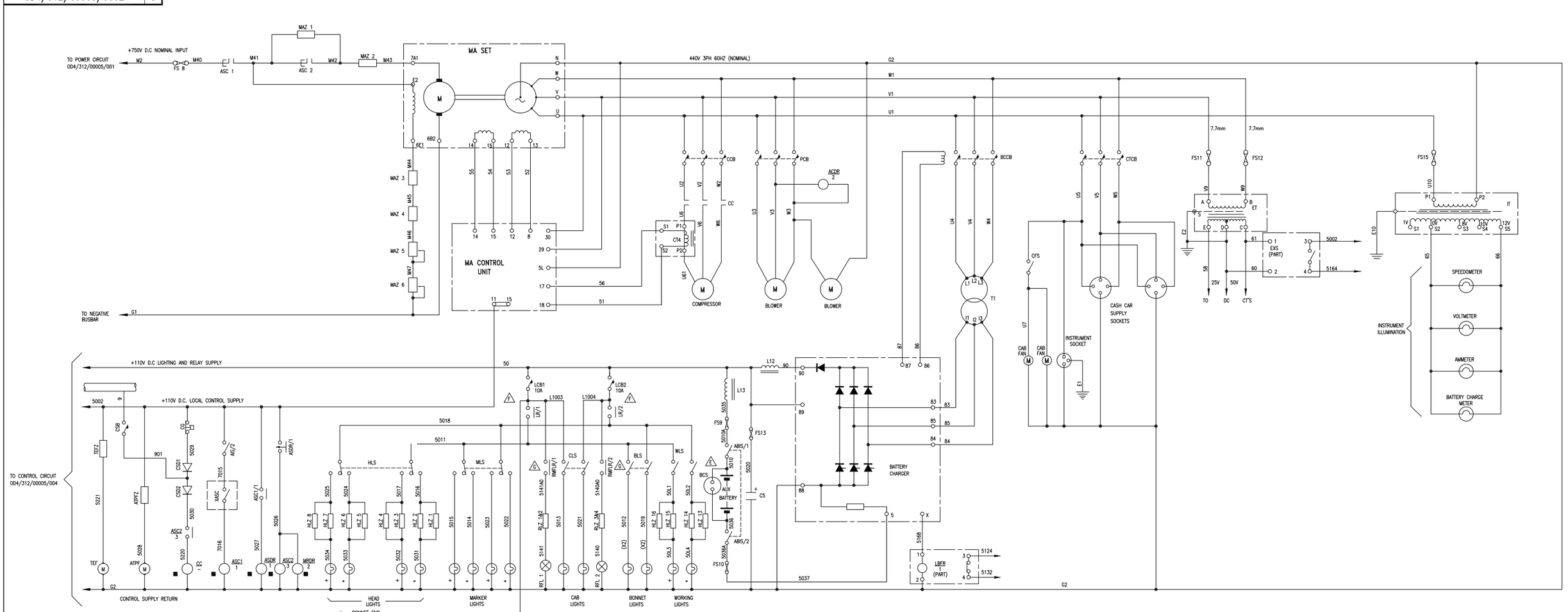
CONTRACTOR REFERENCE NO. B2040016G

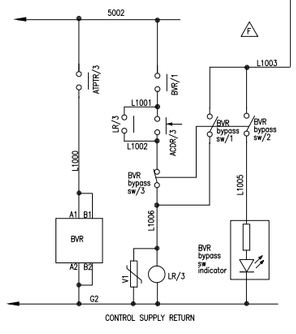
	INITIAL	DESIGNATION	DATE
DRAWN	Y48	ZESTC	01/08/94
DESIGNED	-	-	-
CHECKED	LUN CHAI	T.O.	26-5-2005
APPROVED	E. YEUNG	EEM	26-5-2005
CAD FILE NAME	413296V1		

地鐵公司 MTR Corporation

TITLE
BE LOCO (MK I & II)
POWER CIRCUIT DIAGRAM BATTERY
ELETRIC LOCOMOTIVE

SCALE NTS | OED DRAWING NO. OD4/312/00005/0001 | D





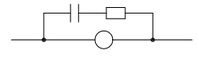
REF	DESCRIPTION
ACDR	AC DELAY RELAY
AIS	AUXILIARY FAULT ISOLATION SWITCH
ASC 1–2	AUXILIARY SUPPLY CONTACTOR
ASDR	AUXILIARY SUPPLY DELAY RELAY
ATPF	ATP FAN
ATPFZ	ATP FAN DROPPER RESISTOR
BCCB	BATTERY CHARGER CIRCUIT BREAKER
E BCS	BATTERY CHARGING SOCKET
BLS	BONNET LAMP SWITCH
F BVR	BATTERY VOLTAGE RELAY
F BVRBS	BVR BYPASS SWITCH
F BVRBSI	BVR BYPASS SWITCH INDICATOR
C5	BATTERY CHARGER CAPACITOR
CC	COMPRESSOR CONTACTOR
CCB	COMPRESSOR CIRCUIT BREAKER
CFS	CAB FAN SWITCH
CG	COMPRESSOR GOVERNOR
CLS	CAB LIGHT SWITCH
CSB	COMPRESSOR SYNCHRONISING BREAKER
CSD 1–2	COMPRESSOR SYNCHRONISING DIODE
CT4	MA SET COMPOUNDING C.T.
CTCB	CASH TRAIN SUPPLY CIRCUIT BREAKER

REF	DESCRIPTION
ET	DCCT EXCITATION TRANSFORMER
EXS	EXCITATION RELAY PCB
FS 8	MOTOR ALTERNATOR FUSE
FS 9–10	L.T. BATTERY FUSE
FS 11–12	EXCITATION TRANSFORMER FUSE
FS 13	L.T. BATTERY CHARGER CAPACITOR FUSE
FS 15	INSTRUMENT TRANSFORMER FUSE
HLZ 13–16	HEADLAMP DROPPER RESISTOR
HLS	HEADLAMP SWITCH
HLZ 1–8	HEADLAMP DROPPER RESISTOR
IT	INSTRUMENT TRANSFORMER
L12	L.T. BATTERY CHARGER CHOKE
L13	L.T. BATTERY CHARGER CHOKE
LCB 1–2	LIGHTING CIRCUIT BREAKER
LBFR	LOW TENSION BATLERY CHARGER FAULT RELAY
F LR	LIGHTING RELAY

REF	DESCRIPTION
MAZ 1	MOTOR ALTERNATOR STARTING RESISTOR
MAZ 2	MOTOR ALTERNATOR SET SERIES RESISTOR
MAZ 3–6	MOTOR ALTERNATOR SET FIELD BALLAST RESISTOR
MLS	MARKER LAMP SWITCH
MRDR	MAIN RESERVOIR DELAY RELAY
PCB	POWER CIRCUIT BLOWER CIRCUIT BREAKER
TI	BATTERY CHARGER TRANSFORMER
TEF	TRACTION ELECTRONICS FAN
TEFZ	TRACTION ELECTRONICS FAN DROPPER RESISTOR
WLS	WORKING LIGHT SWITCH
XASC	AUXILIARY SUPPLY CONTACTOR RELAY (ELECTRONIC)

NOTE:–

SYMBOL ■ REPRESENTS THE FOLLOWING SUPPRESSION CIRCUIT AROUND MARKED SWITCHGEAR COILS



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
G	REVISED AS PER AMK 6457 DRAWING UPDATING	P K NG 22–11–04	LUN CHAI 10–3–04	E.YEUNG 10–3–04
F		P K NG 24–2–04		
E	REVISED AS PER E"DOC NO. ZMK5226 DRAWING UPDATING	K.W.TSUI 27–08–02	LUN CHAI 28–08–02	E.YEUNG 28–08–02
D	WLS AND CABLE SIZE ADDED	J.L. 09/05/00	LUN CHAI 09/06/00	E.YEUNG 09/06/00
C	REVISED AS PER EDOC ZMK4189 DRAWING UPDATING	– –	D CHEUNG 27/08/97	E. YEUNG 27/05/97
B	DIGITIZATION	– –	F. NGAI 02/08/94	WH YUEN 02/08/94

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CONTRACTOR REFERENCE NO. A02010716H

	INITIAL	DESIGNATION	DATE
DRAWN	Y44	ZESTC	02/08/94
DESIGNED	–	–	–
CHECKED	–	–	–
APPROVED	–	–	–
CAD FILE NAME	413297V1		

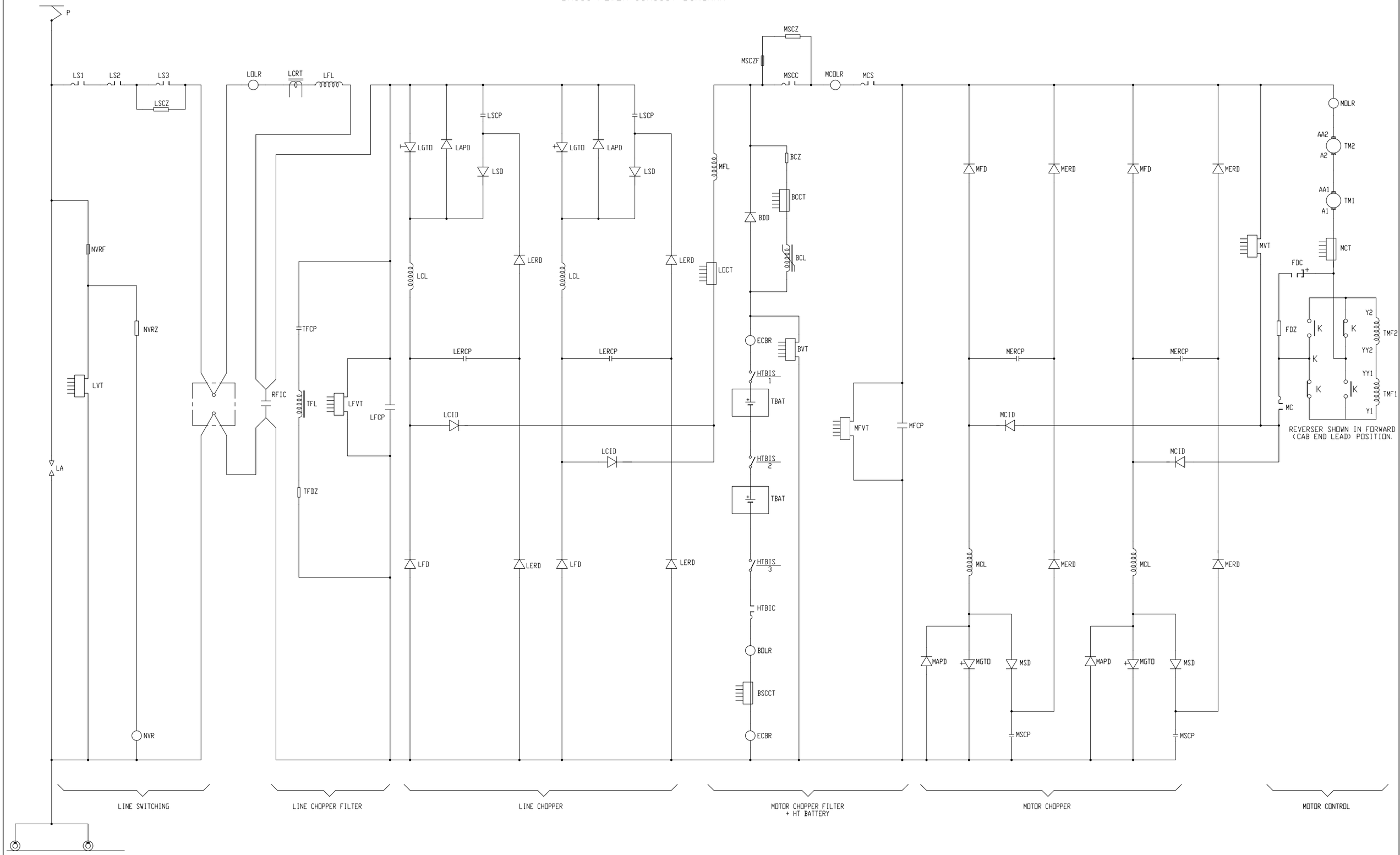
地鐵公司 MTR Corporation

TITLE: DUAL MODE LOCOMOTIVE (MARK I & II)
AUXILIARY CIRCUIT DIAGRAM

SCALE: NTS | OED DRAWING NO. 0D4/312/00005/0002 | G

QTY	REF	PART No	DESCRIPTION	MATL	SPEC	CODE No	MATL SIZE

HONG KONG MK III BATTERY ELECTRIC LOCOMOTIVE
BASIC POWER CIRCUIT DIAGRAM



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	CONTRACTOR DRAWING REVISED	J.L. 11.04.01	LUN CHAI 27.04.01	E. YEUNG 27.04.01

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
A02512100F (2 OF 5)

	INITIAL	DESIGNATION	DATE
DRAWN	J. TSUI	D'MAN	04.12.96
DESIGNED	–	–	–
CHECKED	JC KIU	TO (RS)	29.09.98
APPROVED	E. YEUNG	EEM (RS)	29.09.98
CAD FILE NAME		00005026	

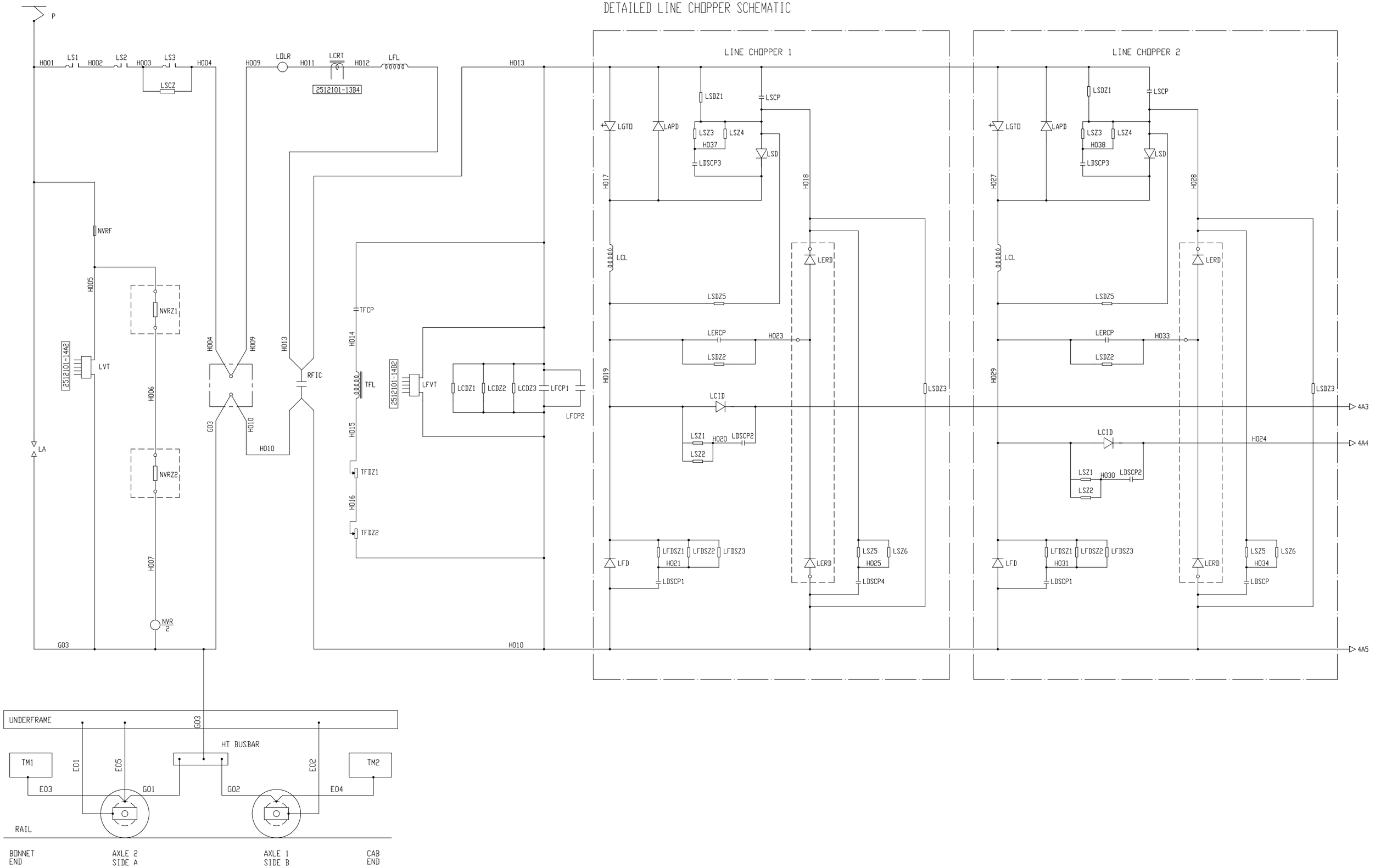
地鐵公司 MTR Corporation

TITLE: BE LOCO (MK III)
POWER CIRCUIT DIAGRAM

SCALE: NTS
OED DRAWING NO. OD4/313/00005/0026 B

QTY	REF	PART No	DESCRIPTION	MATL	SPEC	CODE No	MATL SIZE

DETAILED LINE CHOPPER SCHEMATIC



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	CONTRACTOR DRAWING REVISED	J.L. 11.04.01	LUN CHAI 27.04.01	E. YEUNG 27.04.01

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CONTRACTOR REFERENCE NO.
A02512100F (3 OF 5)

	INITIAL	DESIGNATION	DATE
DRAWN	J. TSUI	D'MAN	04.12.96
DESIGNED	–	–	–
CHECKED	JC KIU	TO (RS)	29.09.98
APPROVED	E. YEUNG	EEM (RS)	29.09.98

CAD FILE NAME 00005027

地鐵公司 MTR Corporation

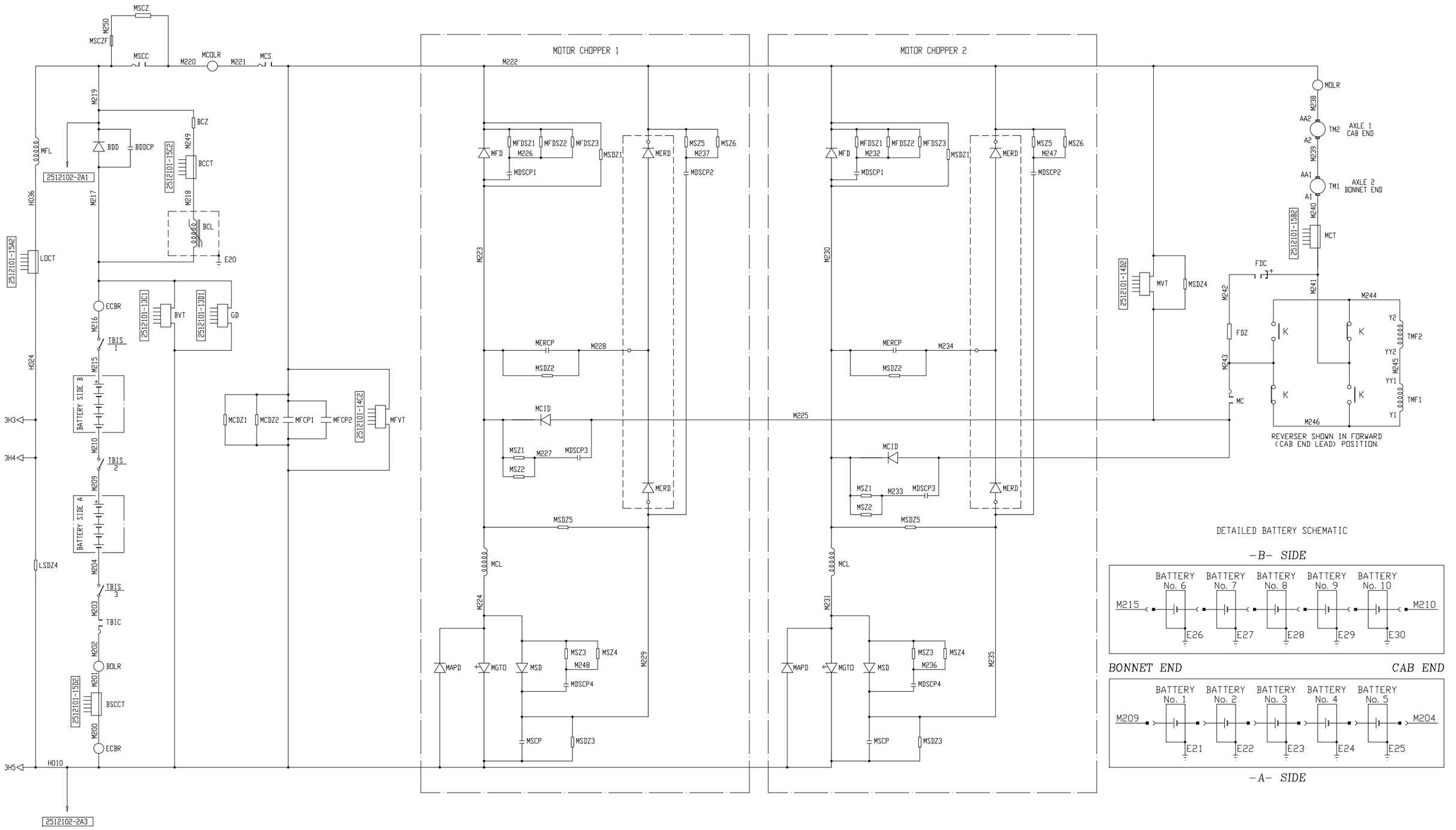
TITLE
BE LOCO (MK III)
POWER CIRCUIT DIAGRAM

SCALE NTS

OED DRAWING NO. 0D4/313/00005/0027 B

QTY	REF	PART No	DESCRIPTION	MATL	SPEC	CODE No	MATL SIZE

DETAILED MOTOR CHOPPER SCHEMATIC



DETAILED BATTERY SCHEMATIC

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	CONTRACTOR DRAWING REVISED	J.L. 11.04.01	LUN CHAI 27.04.01	E. YEUNG 27.04.01

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CONTRACTOR REFERENCE NO.
A025121 00F (4 OF 5)

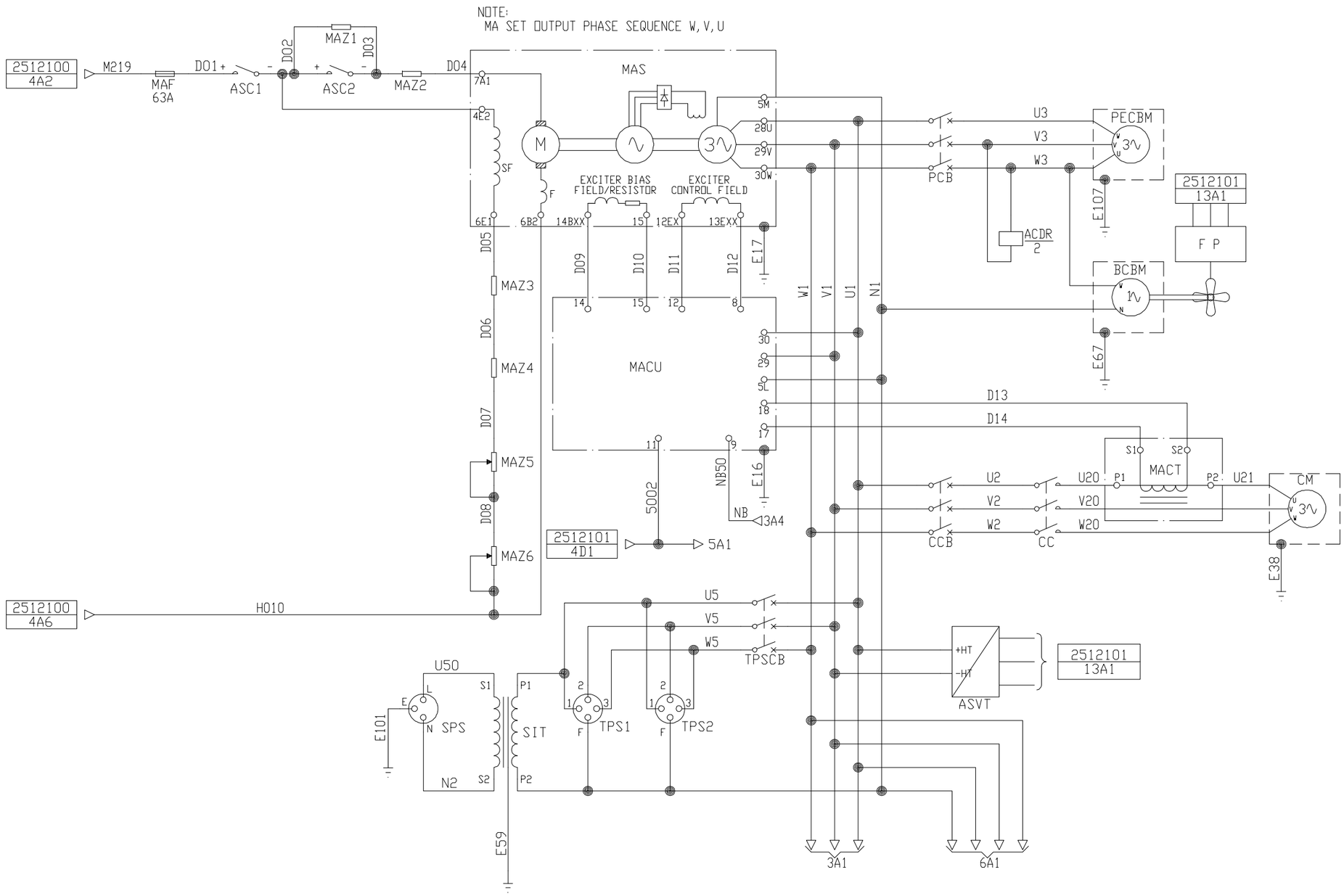
	INITIAL	DESIGNATION	DATE
DRAWN	J. TSUI	D'MAN	14.12.96
DESIGNED	–	–	–
CHECKED	JC KIU	TO (RS)	29.09.98
APPROVED	E. YEUNG	EEM (RS)	29.09.98

CAD FILE NAME 00005028

地鐵公司 MTR Corporation

TITLE BE LOCO (MK III)
POWER CIRCUIT DIAGRAM

SCALE NTS | OED DRAWING NO. 0D4/313/00005/0028 | B



3 PHASE GENERATION AND AUXILIARY MACHINES

REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHECKED	APPROVED	DATE

REFERENCE DWGS

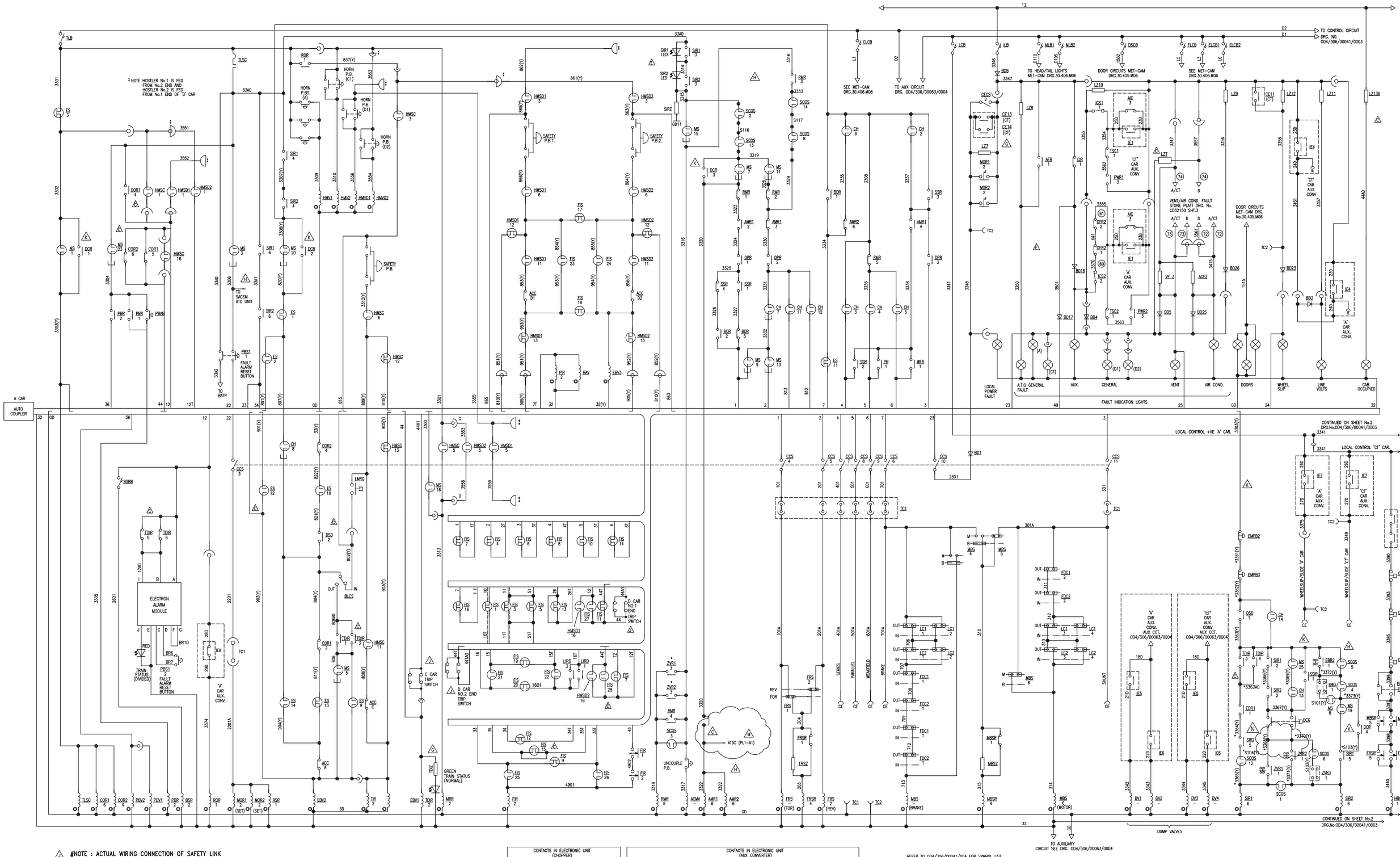
CONTRACTOR'S DWG. NO.
D2512102F (SHT 2/7)

	INITIAL	DESIGNATION	DATE
DRAWN BY	JOSEPH TSUI	D'MAN	10-12-96
DESIGNED BY			
CHECKED BY	J. KIN	T.O.(RS)	30-10-97
APPROVED BY	E.YEUNG	EEM(RS)	30-10-97
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.		00005049	

MASS TRANSIT RAILWAY CORPORATION

TITLE
BE LOCO (MK III)
AUXILIARY CIRCUIT DIAGRAM

SCALE NTS | DWG NO. 0D4/313/00005/049 A



△1 #NOTE : ACTUAL WIRING CONNECTION OF SAFETY LINK TRIP SWITCH IS DETERMINATED BY THE CAR END TO BE COUPLED

CONTACTS IN ELECTRONIC UNIT (CHOPPER)			
REF	FUNCTION		
CE11	SLIP/SLIDE (CT CAR)		
CE12	FAULT INDICATION		
CE13	NO OVERLOAD		

CONTACTS IN ELECTRONIC UNIT (AUX CONVERTER)			
REF	FUNCTION	REF	FUNCTION
IE1	AUXILIARY FAULT INDICATION	IE8	SPEED < 22KPH
IE4	LINE VOLTS		
IE5	DUMP VALVE		
IE6	DUMP VALVE		
IE7	WHEEL SLIP/SLIDE		

REFER TO 0D4/306/00041/004 FOR SYMBOL LIST SEQUENCE CHARTS & NOTES

REV	REVISION DESCRIPTION	REVISED/DATE		CHECKED/DATE		APPROVED/DATE	
N	REVISED AS PER EDOC ZML7774	AME	29.10.07	KIU JC	22.11.07	E YEUNG	22.11.07
M	REVISED AS PER EDOC ZML7447 DRAWING UPDATE	Z051	01-02-07	N.LEE	3-4-07	E.YEUNG	3-4-07
L	REVISED AS PER EDOC ZML6533 DRAWING UPDATING	Z044	20-1-05	NELSON LEE	8-02-05	E.YEUNG	8-02-05
K	REVISED AS PER AT PROJECT DRAWING UPDATING	J.TSUI	18-04-02				
J	REVISED AS PER EDOC ZML4220 DRAWING UPDATING	K.W.TSUI	12-05-99	W.K.LEE	10-11-99	E.YEUNG	10-11-99
H	REVISED AS PER SACEM ATC AS BUILT DRAWING INTERFACE	Y87	05-01-99	J.C.KIU	19-01-99	E.YEUNG	19-01-99
G	REVISED AS PER EDOC ZML3903, & GEC MOD. NO. 47 DRAWING UPDATING	W.H.CHENG	26-05-98	F.NGAI	09-06-98	E.YEUNG	10-06-98
F	REVISED AS PER EDOC ZML4173 DRAWING UPDATING			F.NGAI	27-06-97	E.YEUNG	27-06-97
E	REVISED AS PER EDOC ZML3978, ZML4064 DRAWING UPDATING			Y.C.HO	04-11-96	E.YEUNG	04-11-96
D	REVISED AS PER EDOC ZML3941 DRAWING UPDATING			T.S.PANG	21-08-96	C.S.CHAN	21-08-96
C	REVISED AS PER EDOC ZML3575, ZML3637, ZML3714, ZML3811, ZML3467			F.NGAI	26-01-96	E.YEUNG	26-01-96
B	DIGITIZATION			F.NGAI	02-08-95	E.YEUNG	02-08-95

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
51809 X 0205 D

	INITIAL	DESIGNATION	DATE
DRAWN	Y113	ZESTC	02-08-95
DESIGNED			
CHECKED			
APPROVED			
CAD FILE NAME	0D4_306_00041_0002_N.DWG		

地鐵公司 MTR Corporation

TITLE
'H' STOCK
CONTROL CIRCUIT DIAGRAM 'A'-'CT'-'D' CARS
(SHT. 1 OF 3)

SCALE NTS

OED DRAWING NO. 0D4/306/00041/0002 N

'B' CAR ← → 'C' CAR

FROM POWER CCT DIAG. 0D4/306/00041/001

TO 'B' CAR INSULATED H.T. EARTH BAR DRG. 0D4/306/00041/001

TO 'C' CAR INSULATED H.T. EARTH BAR DRG. 0D4/306/00041/001

1H AUXILIARY CONVERTER SEE 0D4/306/00063/006 ['B' CAR]

1H AUXILIARY CONVERTER SEE 0D4/306/00063/006 ['C' CAR]

'B' CAR AUXILIARY CONVERTER

'FRT' DRG. 0D4/306/00063/011

AIR CONDITIONING No. 1 STONE PLATT DRG. No.CD332150-1

MAIN LIGHTING MET. CAM. DRG.No.30.419.M06

AIR CONDITIONING No. 2 STONE PLATT DRG.No.CD332150-2

MAIN LIGHTING MET. CAM. DRG.No.30.410.M06

LINK IN MULTIPOINT CONN. BOX 'A'

GD BUSBAR

N2 BUSBAR (POWER EQUIPT. FRAME)

N1 BUSBAR (AUX EQUIP. CASE)

EARTH BAR

'C' CAR UNDERFRAME

SEE POWER DRG. 0D4/306/00041/001

TO CONTROL CIRCUIT DRG.No. 0D4/306/00041/005

'B' CAR AUX CONVERTER

'C' CAR AUX CONVERTER

AIR COND. 'B' CAR STONE PLATT DRG.No.CD332150-3

AIR COND. 'C' CAR STONE PLATT DRG.No.CD332150-3

LIGHTING 'C' CAR MET. CAM. DRG.No.30.419.M06

AIR COND. SET STONE PLATT DRG.332150-3

AIR COND (TRIP) OFF SERVICE STONE PLATT DRG. CD332150-3

SEE DRG. 0D4/306/00041/006

AIR CONDITIONING STONE PLATT DRG.No.CD332150-3 TO CONTROL CIRCUIT DRG. No. 0D4/306/00041/005

AIR DRYER KNORR-BREMSE DRG.No 1B95879

AUX. EQPT. CASE 'B' SEE NOTE 12.

IE SUPPLY SEE DRG. 0D4/306/00063/012

WHEEL SLIP DUMP VALVES SEE DRG. 0D4/306/00041/005

LIGHTING CIRCUITS MET.CAM. DRG.30.408.M06 DRG.30.419.M06

AIR COND. CIRCUITS STONE PLATT DRG. No. CD332150-3

GD BUSBAR [AUX. EQUIP. CASE]

EARTH BAR

SEE POWER DRG.51809X0201

LIST OF SYMBOLS

SYMBOLS	DESCRIPTION	LOCATION REF. CARS B	C	–
AC	AUXILIARY COMPRESSOR		11	
ACB	AUXILIARY CONTROL M.C.B.	19		
ACCB	AUXILIARY COMPRESSOR CIRCUIT BREAKER	19		
ACD	AUXILIARY COMPRESSOR DIODE		14	
ACG	AUXILIARY COMPRESSOR GOVERNOR		14	
ACK	AUXILIARY COMP. SNUBBER CAPACITOR		14	
ACZ	AUXILIARY COMP. SNUBBER RESISTOR		14	
AD1,2	AIR DRYER DIODE	6		
AIC1–2	AUXILIARY CONVERTER SUPPLY CONTACTOR	7	7	
ARR	AUXILIARY RUN RELAY		6	
ASR	AUXILIARY START RELAY		6	
ASB2–1	3–PHASE SUPPLY M.C.B.S.	6	6	
BCB	BATTERY CONTROL M.C.B.	19		
BCC	BATTERY CHARGE & L.V. SUPPLY CONTACTOR	6		
BD90–91	BLOCKING DIODES.	19		
BIC	BATTERY ISOLATING CONTACTOR	6		
BNF	BATTERY NEGATIVE FUSE	11		
BPF	BATTERY POSITIVE FUSE	11		
BVR	BATTERY VOLTAGE RELAY	6		
BVZ1–2	BALLAST FOR BVR	6		
C	COMPRESSOR MOTOR	11		
CCB	COMPRESSOR M.C.B.	19		
CHB	BATTERY CHARGE & L.V. SUPPLY M.C.B.	6		
CIR	CHARGING INDICATION RELAY	6		
CIRF	CHARGING INDICATION RELAY FUSE	6		
CPZ	COMPRESSOR MOTOR PROTECTIVE RESISTOR	11		
CSB	COMPRESSOR SYNCHRONISING M.C.B.	19		
DCB1	'B' CAR CONTROL POSITIVE M.C.B.	19		
DCF	D.C. SUPPLY FUSE	6		
D3,5	BLOCKING DIODES		6	
D6–7	BLOCKING DIODES	6		
ECB	'B' CAR AIR CONDITIONING SUPPLY M.C.B.	19		
ECC	EMERGENCY CHARGING CONTACTOR	6		
ELCB3–4	EMERGENCY LIGHTING M.C.B.S.		10	
FKS1–2	FILTER CAPACITOR SWITCH	12	12	
FRT1–2	FEEDBACK REFERENCE TRANSFORMER	7	7	
GC	GROUND CONTACTOR	6		
HMSB/C	HOSTLER MASTER SWITCHES	10	10	
IE	AUX. CONVERTER ELECTRONIC UNIT	7	7	
ICCB1–2	AUX. CONVERTER CONTROL CIRCUIT BREAKER	7	7	
ICS2–1	AUX. CONVERTER CONTROL CUT–OUT SWITCH	10	10	
IEG1–2	AUX. CONVERTER EQUIPMENT GOVERNOR	7	7	
IECS1–2	AUX. CONVERTER ELECTRONICS CUT–OUT SWITCH	7	7	
LFKS1–2	LINK FILTER CAPACITOR PRESSURE SWITCH	12	12	
LVD	LOW VOLTAGE RECTIFIER	6		
LVF	L.V. RECTIFIER OUTPUT FUSE	6		
LVT	BATTERY CHARGING TRANSFORMER	11		
MAF1,2	MAIN AUXILIARY FUSES			9
MCC	MAIN COMPRESSOR CONTACTOR	6		
MCF	COMPRESSOR FUSE	6		
MCG	MAIN COMPRESSOR GOVERNOR	6		
OFR1–2	OFF SERVICE RELAY (AIR CONDITIONING)			18
ORR1–2	OUT OF REGULATION RELAY	7	7	
PBS1	FAULT RESET PUSHBUTTON	19		
PVD	PANTOGRAPH DOWN VALVE		14	
PVU	PANTOGRAPH UP VALVE		14	
RSR1–2	REGULATOR SUPPLY RELAY	7	7	
RSK	RECTIFIER SUPPRESSION CAPACITOR	6		
RSZ	RECTIFIER SUPPRESSION RESISTOR	6		
SDCF	SECURE DC FUSE	6		
SDR	SHUT DOWN RELAY		6	
SDTR	SHUT DOWN TIME DELAY RELAY		6	
SDTZ	BALLAST FOR SDTR		6	
SLD3	SLUGGING DIODE	6		
SPD1–2	SUPPRESSION DIODES	6	6	
TTR1–2	TRIP TIME DELAY RELAY	7	7	
TTZ1–2	BALLAST FOR TTR	7	7	
TDM1–2	TIME DELAY MODULE	6		
TFKS1–2	TUNED FILTER CAPACITOR SWITCH	12	12	

LOCATION REF. NUMBERS

REF.	LOCATION
1	CAB
2	CAB CUPBOARD ('A' SIDE)
3	CAB CUPBOARD ('B' SIDE)
4	CHOPPER EQUIPMENT CASE
5	CONTACTOR CASE
6	AUX. EQUIPMENT CASE
7	AUX. CONVERTER POWER EQUIPMENT CASE
8	HIGH SPEED CONTACTOR CASE
9	ELECTRONICS & H.V. AUX. CASE
10	HOSTLER CAB
11	MOUNTED ON UNDERFRAME
12	AUX. CONVERTER POWER EQUIPMENT FRAME
13	
14	PANTOGRAPH EQUIP. CUPBOARD
15	
16	HOSTLER CAB No. 1 END ('A'SIDE)
17	HOSTLER CAB No. 2 END ('B'SIDE)
18	BODY
19	L.T. PANEL
20	
21	CAPACITOR FRAME
22	MAIN RESISTOR FRAME
23	ROOF
24	

CONTACTS IN ELECTRONIC UNIT [AUX. CONVERTER]

REF.	FUNCTION
IE2	OUT OF REGULATION
IE3	NO FAULT

NOTES:–

1. AIC POWER CONTACTS SHOWN ON 0D4/306/00063/006
2. ⓞ DENOTES SUPPRESSION UNIT ACROSS COIL e.g.:
3. 'B' CAR SIDE —⊖— 'C' CAR SIDE
4. COR1 COIL IS SHOWN ON DIAG. 0D4/306/00041/005
5. (82) DENOTES STONE PLATT TERMINAL Nos.
6. —(IE DENOTES I/P SIGNAL TO AUX. CONV. ELECT. UNIT
   —⊖— DENOTES O/P CONTACT IN AUX. CONV. ELECT. UNIT
   SEE DRG. 0D4/306/00063/009
7. D116 17D DENOTES INTERFACE OF WIRE NUMBERS BETWEEN CIRCUITS & STANDARD AUXILIARY CONVERTER CIRCUITS
8. AIC/3 CONTACT SHOWN ON 0D4/306/00041/005
9. AIC/4 & AIC/5 ARE USED ON 'B' CAR AUX. CONV. ONLY
10. [ ] INDICATES AUX. CONVERTER EQUIPMENT
11. FAULT RESET PUSH BUTTON ALSO SHOWN ON DRG. 0D4/306/00041/005
12. FOR REGULATION OF BATTERY TERMINAL VOLTAGE FIT LINK.
    FOR REGULATION OF CONVERTER A.C. OUTPUT OMIT LINK.
13. WHERE TWO WIRES OF DIFFERENT NUMBERS ARE JOINED TOGETHER THE LOCATION AND METHOD WILL BE INDICATED AS FOLLOWS:–
    FOR LINK AT TWO ADJACENT TERMINALS e.g.:–
    GD — N2 MULTIPOINT CONNECTION BOX 'A'
14. SUPPRESSOR FOR CIR COIL IS V150LA10A (SCN 46–64–44028)

FIRST ANGLE PROJECTION

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
C	REVISED AS PER EDOC ZML4369 DRAWING UPDATING	W.H.CHENG 20–08–98	N.LEE 13–11–98	E.YEUNG 13–11–98
B	DIGITIZATION		F.NGAI 06–11–95	E.YEUNG 06–11–95

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO. 51809X0204 E

	INITIAL	DESIGNATION	DATE
DRAWN	Y10	ZESTC	28–07–95
DESIGNED			
CHECKED			
APPROVED			
CAD FILE NAME	00063005		

地鐵公司 MTR Corporation

TITLE 'H' STOCK
AUXILIARY CIRCUIT DIAGRAM EMU CARS
'B'–'C' ADDITIONAL ROLLING STOCK

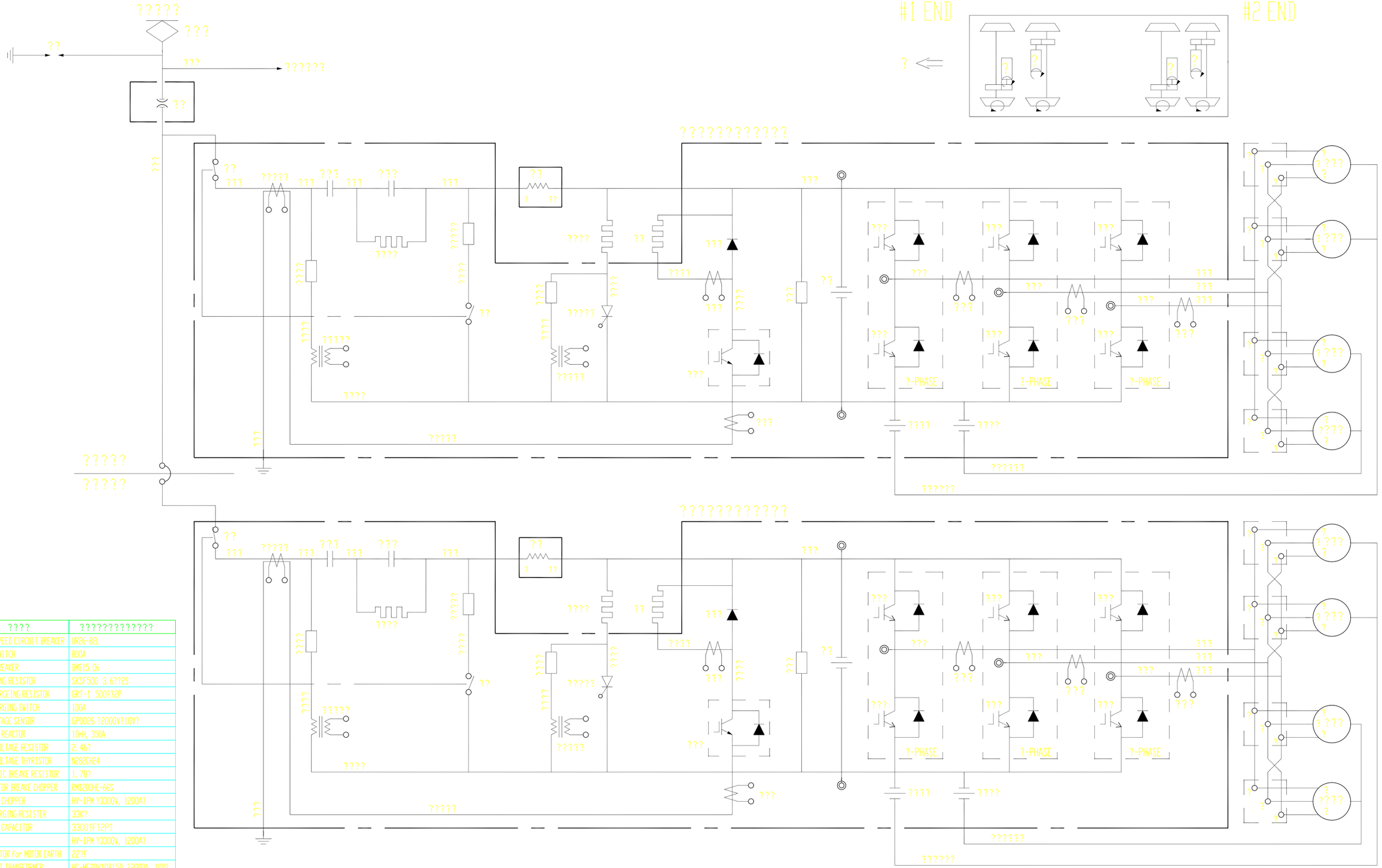
SCALE NTS

OED DRAWING NO. 0D4/306/00063/0005 C

OD4/361/00742/0034 A

#1 END

#2 END



??????	????	??????????????
??	HIGH SPEED CIRCUIT BREAKER	UR26-82L
??	MAIN SWITCH	800A
???????	LINE BREAKER	BMS15.06
????	CHARGING RESISTOR	SKSF500 3.6??2S
?????	DISCHARGEING RESISTOR	GRT-1 500??2P
??	DISCHARGING SWITCH	100A
?????,?	DC VOLTAGE SENSOR	GP0026 ?2000V?10V?
??	FILTER REACTOR	10mH, 350A
????	OVER VOLTAGE RESISTOR	2.4&?
?????	OVER VOLTAGE THYRISTOR	N282CH24
??	DAINAMIC BREAKE RESISTOR	1.7&?
???	DIODE FOR BREAKE CHOPPER	RM1200HE-66S
???	BREAKE CHOPPER	HV-IPM ?3300V, 1200A?
???	DISCHARGING RESISTER	33K?
??	FILTER CAPACITOR	33002F?2P?
???????	IGBT	HV-IPM ?3300V, 1200A?
????, ???	CAPACITOR For MOTOR EARTH	22?F
????? ???, ??? ???????	CURRENT TRANSFORMER	HC-ME20V10B15D ?2000A, 10V?

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
H2M5669

	INITIAL	DESIGNATION	DATE
DRAWN			
DESIGNED	HG Moon		23.04.2002
CHECKED	SH Chun		23.04.2002
APPROVED	KC Lee		23.04.2002
CAD FILE NAME	7420034A		

地鐵公司 MTR Corporation

TITLE: Schematic Diagram of Power Circuit

SCALE: N/S

OED DRAWING NO.: OD4/361/00742/0034

A

C,B,B1,C1 CAR

STATIC INVERTER

INVERTER UNIT

730(3B,3D, 6B,6D)

Car Type	C-car	B-car	B1-car	C1-car
Wire No.	T5502	W5502	V5502	K5502

801 IVS 802 IVK 803 FL 804

TO TCN1 RC RB CB BTH GUB RD

812 HK 800G

IVP2 CT1 FC1 FC2 CT2 IVO1

Q1U Q1V Q1W Q2U Q2V Q2W Q3U Q3V Q3W Q4U Q4V Q4W

GUDPU GUDPV GUDPW FDPU FDPV FDPW GUDNU GUDNV GUDNW FDNU FDNV FDNW

H.T.SENSOR

TO TCN1 UL VL WL HCT11 HCT12 TR1 VL1

TU TV TW HCT21 HCT22 HCT23 U00 V00 W00 SIVK

ACC T14 IT1U1 IT1V1 IT1W1 M1U1 M1V1

742(4D,7D) 743(4D,7D) Y7007 CN1 (g) IVSON1 MONP From *5

YG551 800G HCT3 800GA TO TCN1

730(3B,6B,3E,6E)

586(3C),587(3C) 588(3C),589(3C) Y1061 CN1 (M) MFR1 SIVMFR Y1072 (N) MFR2

742,743

C-	B-	B1-	C1-CAR
T5005	W5007	V5007	K5005
T5006	R5006	H5006	K5006

(f) IVK1 IVK (f) IVK2

742,743 Y7101 (b) ACR1 SIVACR Y7110 (c) ACR2

C-	B-	B1-	C1-CAR
T7113	W7123	V7123	K7113
W7075	W7076	V7076	V7075

(e) MONP (L) ACR3 SIVACR (P) ACR5

742(4E,7E),743(4E,7E) Y7005 TO *5

C,B CAR ONLY

586(3B),587(3B) T1078 for C-car W1078 for B-car

From *1 DC110P (B) TSAS TSAR DC110P IVKXR HKXR DC110P HK IVK HK DC110E From *2

TO TMS 742,743 Y7003 CN1 (V) SSKA SSK YB111 (W) SSKB

IVKXR HKXR SIVMFR SIVACR TSAR SIVKXR SDRAR

MI03 PB DSC

PROTECTION CIRCIT

CONVERTER IA1U1, IA1V1, IA1W1 -HA* Limitter V.C. Iref* C.C.

IT1U1, IT1V1, IT1W1 U2,V2,W2

Current Command Voltage Command ACC current Command

PWB-UNIT

CPU MEMORY TRACE MEMORY A/D CONVERTER INTER FACE MONITOR PARAMETER MEMORY PROCESS I/O INV.Start/ Stop,CONT CARRIER MEMORY DISPLAY I/O INTER FACE

P5 PSC1 PSP PSC PSN DSP DSC +5V +/-15V +24V PS1 U48 V48 BP3 SVGG

MI04 MI05 MI06 MI07 MI08 MI09 MI10 I/F PCB

DC110P DC110E IVF2 EPD AOFF AON GR71 DCFA DCKFA

FR2 FID2 FIC1 FR1 FID1 NF

MI01 MI02 TCN1 DSC N.V.TEST SW 804 IVP2 800GA UL IV01

SIVKXR SDR SDRAR SSK SIVK

TMS I/F PCB 485S1 485S2 485S3 MNS

BCV1 BCV1E BCV1G BCV2E BCV2 BCV2G RCH8 RCH9 DC

SSK SIVK B1A B2 A2 B2 C2 N A3 B3 A1 B1 C1 N

SHORE SUPPLY AC415V 3Phase, 50Hz 100A

TR3

C-	B-	B1-	C1- CAR	
W7057	W7054	H7054	V7057	TO BCG 760(5D)
W7058	W7055	H7055	V7058	
W7407	R7407	H7407	K7407	220VAC 50Hz 3kVA 745
W7408	R7408	H7408	K7408	
H7414				3ø 415VAC 50Hz TO BCG;760 — B1 CAR ONLY
H7415				
H7416				
W7401	W7404	V7404	V7401	3ø 415VAC 50Hz 745
W7402	W7405	V7405	V7402	
W7403	W7406	V7406	V7403	
WG741	WG742	VG742	VG741	
W7401	W7404	V7404	V7401	3ø 415VAC 50Hz 745
W7402	W7405	V7405	V7402	
W7403	W7406	V7406	V7403	
WG741	WG742	VG742	VG741	

CN1 (C) (D) (A) (G) (H) (J) (K) (R) (U)

C-	B-	B1-	C1- CAR	
T7113	W7123	V7123	K7113	742(4C,7C),743(4C,7C)
T7114	R7114	H7114	K7114	741(3B,6B)
T7033	W7033	V7033	K7033	742(4C,7C),743(4C,7C)
T7104	W7104	V7104	K7104	741(3C,6C)
1002	1002	1002	1002	741(3C,6C)
1006	1006	1007	1007	742(4D,7D),743(4D,7D)
TGR71	RGR71	HGR71	KGR71	742(4D,7D),743(4D,7D)
W7036	W7037	H7037	V7036	742(4C,7C),743(4C,7C)
W7059	W7056	H7056	V7059	742,743

CN2 (E) (F) (S) (T) Y7051 Y7052 Y7053 Y7055 — 742(4E,7E) 743(4E,7E)

CN1 (S) (T) (X) (Z)

C-	B-	B1-	C1- CAR	
W7041	W7081	H7081	V7041	742,743
W7042	W7082	H7082	V7042	
W7071	W7091	H7091	V7071	
W7072	W7092	H7092	V7072	

586,587,588,589,625,626,730,741,742,743,745,755,756

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO. ED23731

	INITIAL	DESIGNATION	DATE
DRAWN	JS Koo		23.04.2002
DESIGNED	DI Kim		23.04.2002
CHECKED	CC Park		23.04.2002
APPROVED	KC Lee		23.04.2002

CAD FILE NAME 7419731A

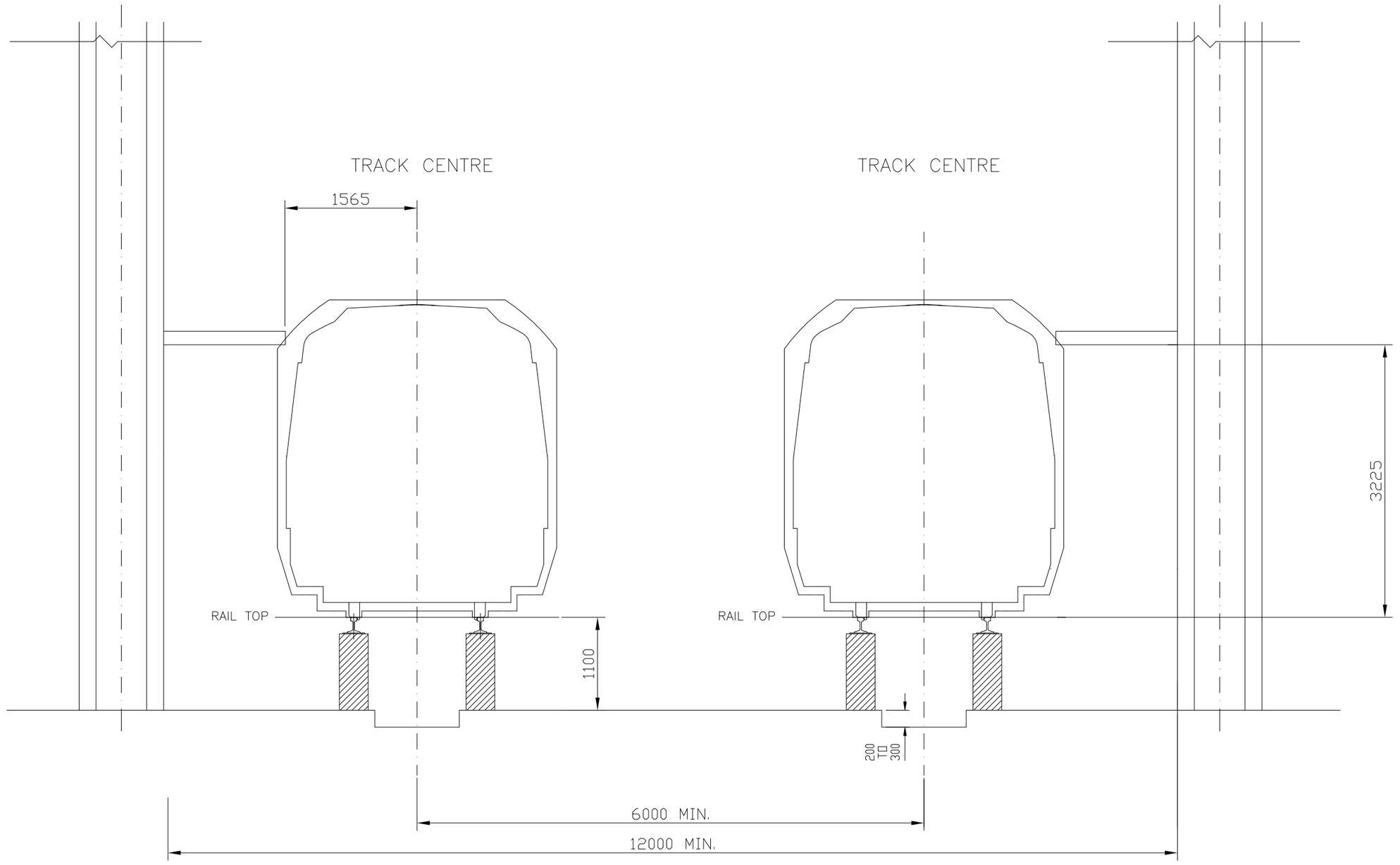
地鐵公司 MTR Corporation

TITLE SIV CONTROL (C,B,B1,C1 CAR)

SCALE N/S

OED DRAWING NO. OD4/361/00741/9731 A

DEPOT		
Drawing No.	**Title**	**Revision**
C6014-14E/TSEG/990/001	Typical Cross Section of Running Maintenance Area in Existing Depots	A
C6014-14E/TSEG/990/002	Typical Cross Section of Heavy Maintenance Area	A
C6014-14E/TSEG/990/003	Position of Jacking Points for Existing URL Train	A
C6014-14E/TSEG/990/004	Typical Dimensions of Lifting Claws of Lifting Jacks	A
C6014-14E/TSEG/990/005	Conceptual Sketch of Underfloor Jacks	A
C6014-14E/TSEG/990/006	Existing Accommodation Bogie at KBD	A
C6014-14E/TSEG/990/007	Typical Arrangement and Details of Towing Points of Existing M Trains	A
C6014-14E/TSEG/990/008	Details of Hold Down Device for Underfloor Wheel Lathe	A
C6014-14E/TSEG/990/009	Not Used	-
C6014-14E/TSEG/990/010	Typical Details of Target	A
C6014-14E/TSEG/990/011	Details of Target Holder	A
C6014-14E/TSEG/990/012	Pneumatic Connector Plug Schrader Plug 1/8"	A
C6014-14E/TSEG/990/013	Typical Recovery Procedure for EMU De-railment	A
C6014-14E/TSEG/990/014	Existing Wheel Skate of Operating Railway	A
C6014-14E/TSEG/990/015	Stripe Pattern For Identification of Jacking Point on Rolling Stock Vehicle	A
C6014-14E/TSEG/990/016	KBD Ground Floor Level Plan	A
520/Z/00/PWY/C30/362	Siu Ho Wan Depot General Arrangement	A
EMS/C3202.A/AFA/02-07	Chai Wan Depot Layout at G/F	-
USP/M/TKD3/XXX/A00/XXX	Tseung Kwan O Depot (TKD) Ground Level (+5.400) Arch- Depot Layout Plan	B
USP/TWD1/A12/001	Tsuen Wan Depot (TWD) Ground Floor Level Architectural Layout- Updated Station Plan	A1



NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_990_001_A.DWG

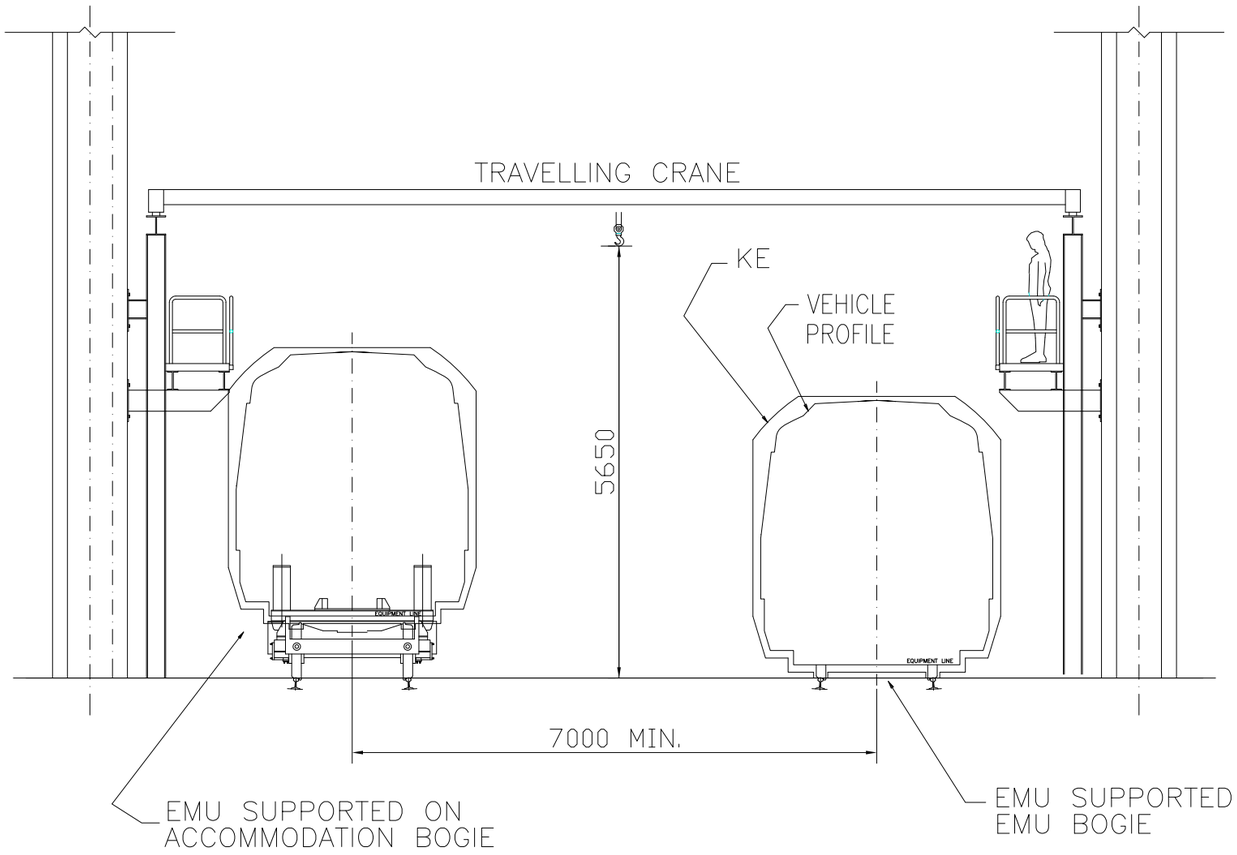
TITLE

C6014-14E

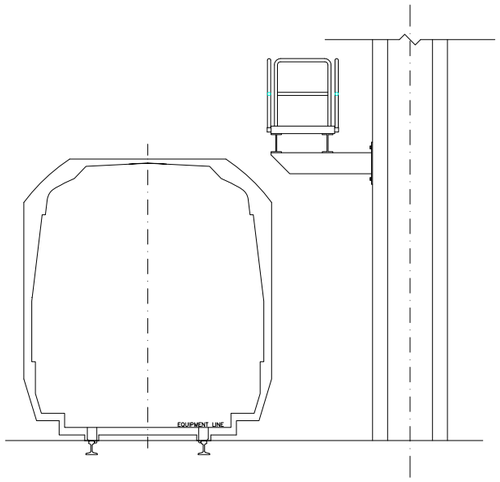
PROCUREMENT OF NEW TRAINS

TYPICAL CROSS SECTION OF RUNNING MAINTENANCE AREA IN EXISTING DEPOTS

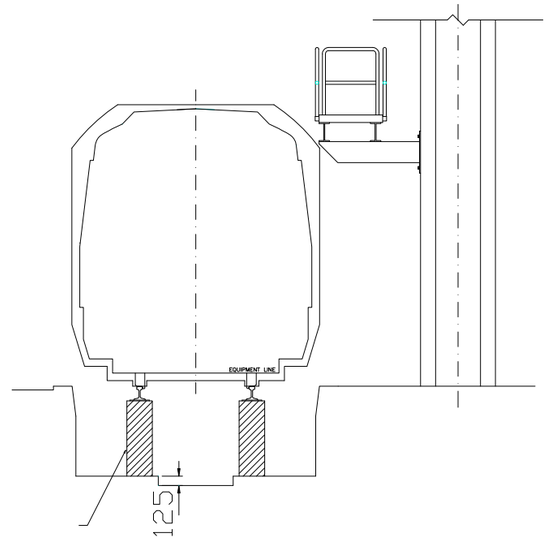
SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/990/001	A



CROSS SECTION AT CONCRETE FLOOR AREA



CROSS SECTION AT LIFTING AREA



COLUMN SPACING ALONG TRACK: 1100±20

CROSS SECTION AT PIT

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DESIGNED	—
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CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_990_002_A.DWG

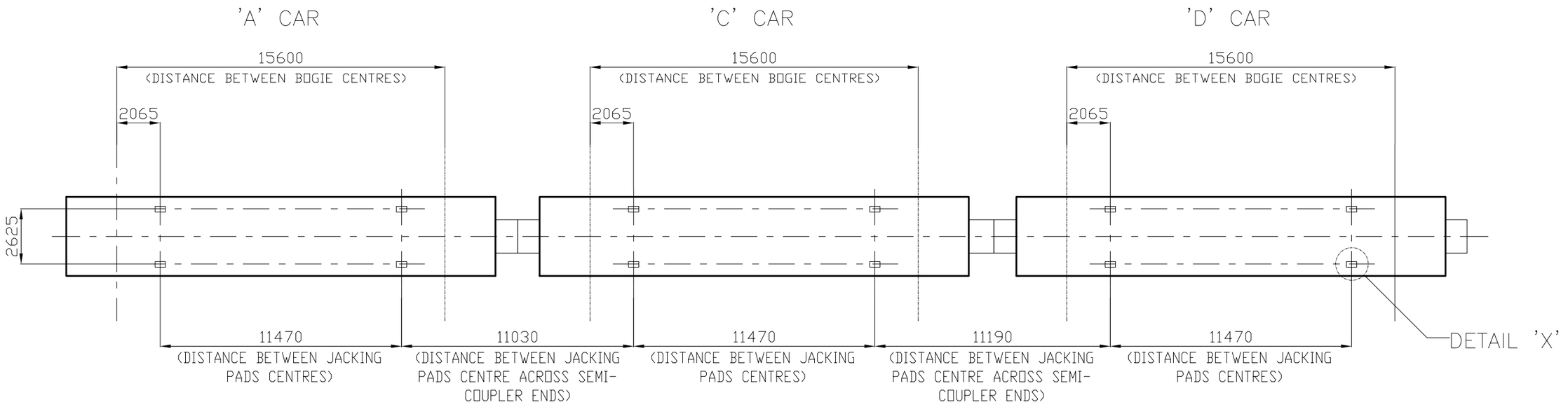
TITLE

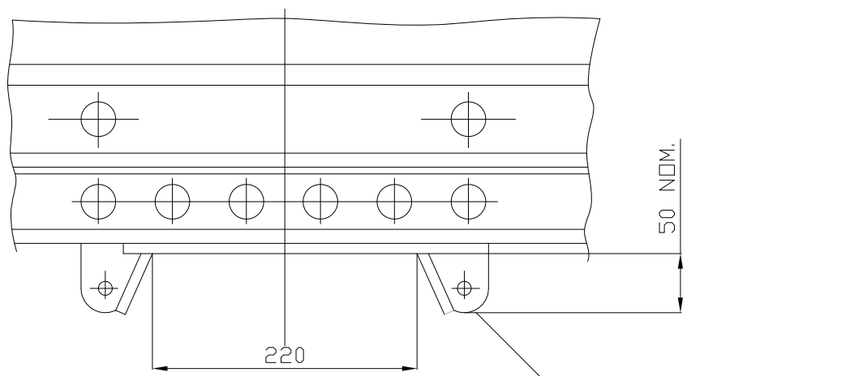
C6014-14E

PROCUREMENT OF NEW TRAINS

TYPICAL CROSS-SECTION OF HEAVY MAINTENANCE AREA

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/990/002	A





DETAIL "X" – JACKING PAD

NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
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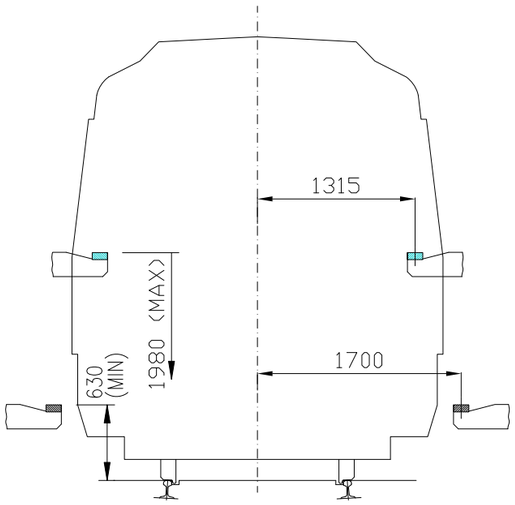
CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_990_003_A.DWG

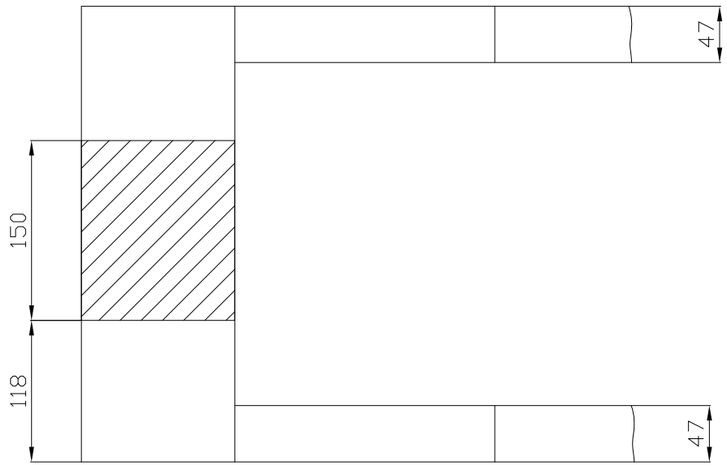
TITLE
C6014-14E
PROCUREMENT OF NEW TRAINS
POSITION OF JACKING POINT FOR EXISTING URL TRAIN

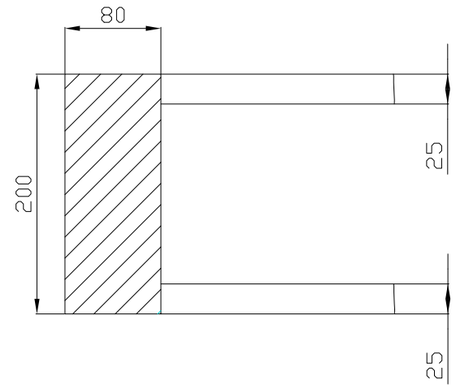
SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/990/003	A

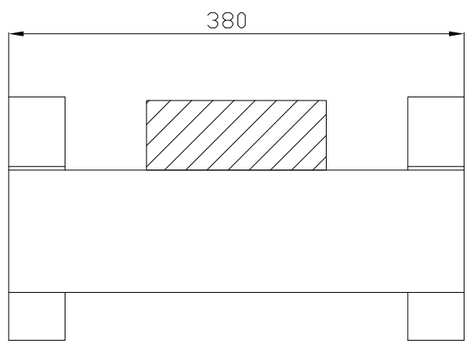


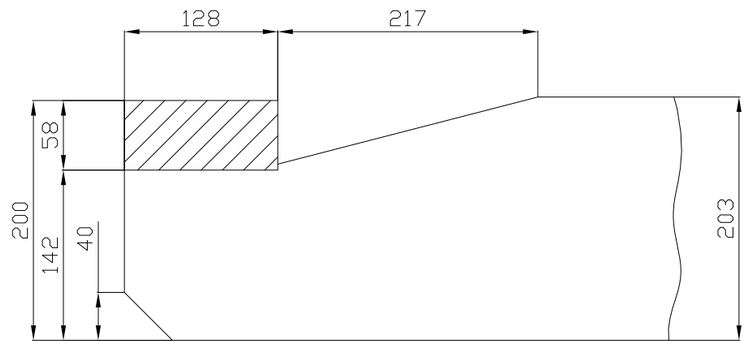
SCALE 1 : 50

OPERATING RANGE OF LIFTING CLAWS:
OF ATLAS 12.5T FIXED JACKS

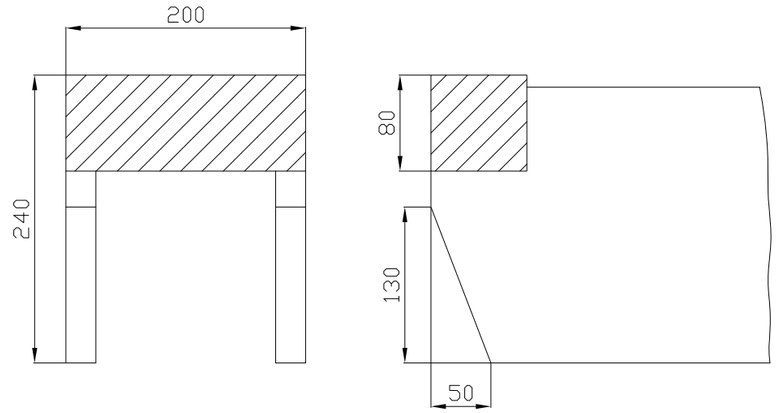








LIFTING CLAW OF ATLAS 12.5T FIXED JACKS



JACKS OPERATING RANGE:
530MM TO 1900MM
MEASURED FROM GROUND LEVEL

LIFTING CLAW OF GEDI 12.5t MOBILE JACKS

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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ORIGINATOR

OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

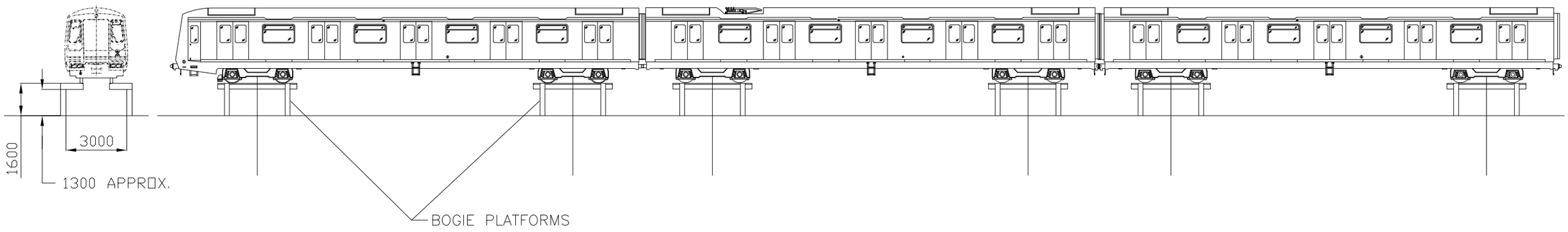
CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_990_004_A.DWG

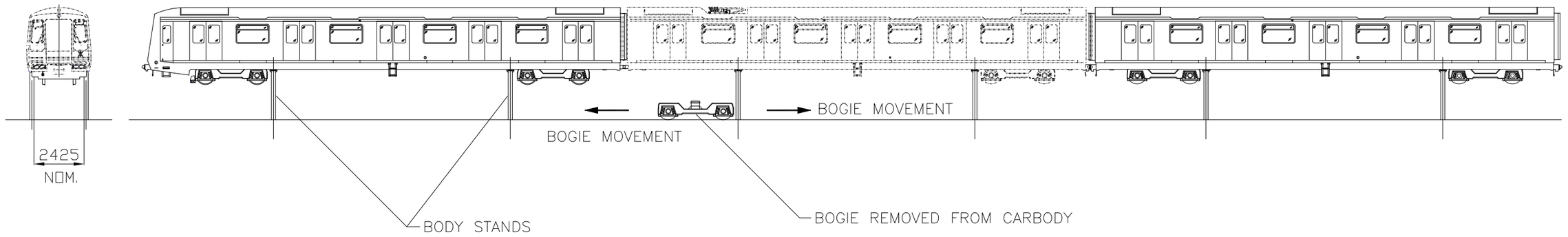
TITLE
C6014-14E
PROCUREMENT OF NEW TRAINS
TYPICAL DIMENSION OF
LIFTING CLAWS OF LIFTING JACKS

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/990/004	A

UNIT LIFTING WITH BOGIE PLATFORMS



UNIT SUPPORT WITH BODY STANDS



NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED
REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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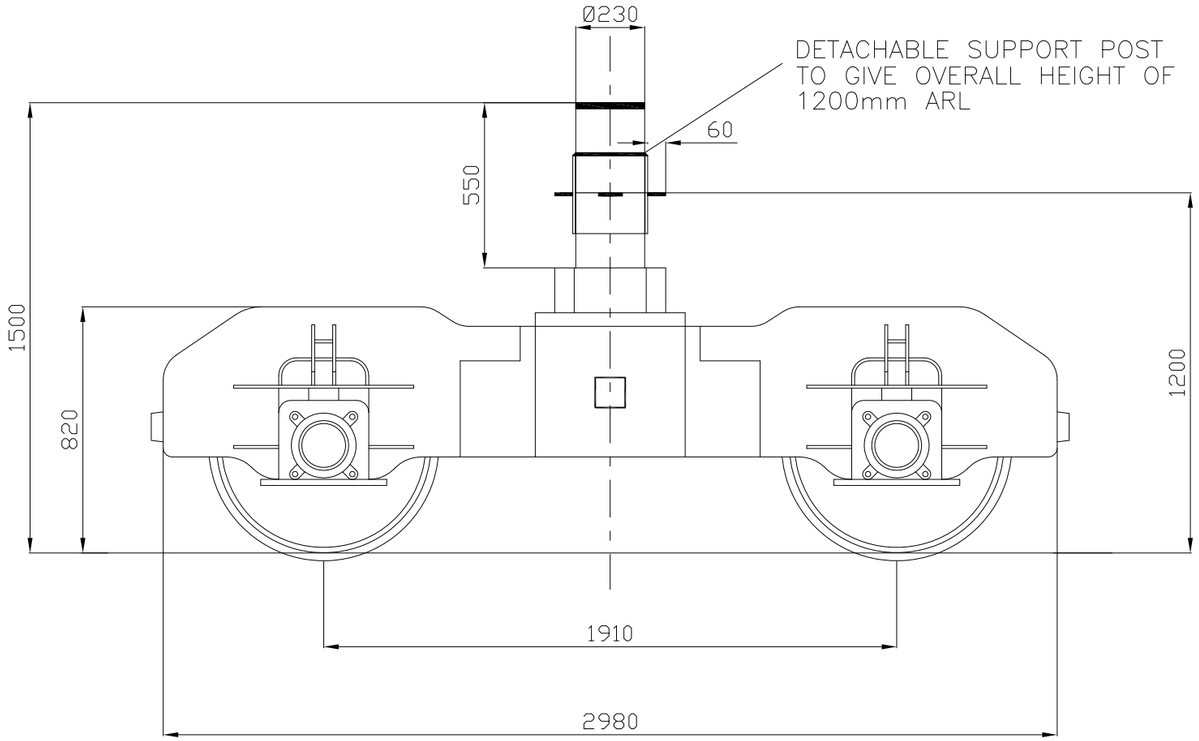
OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

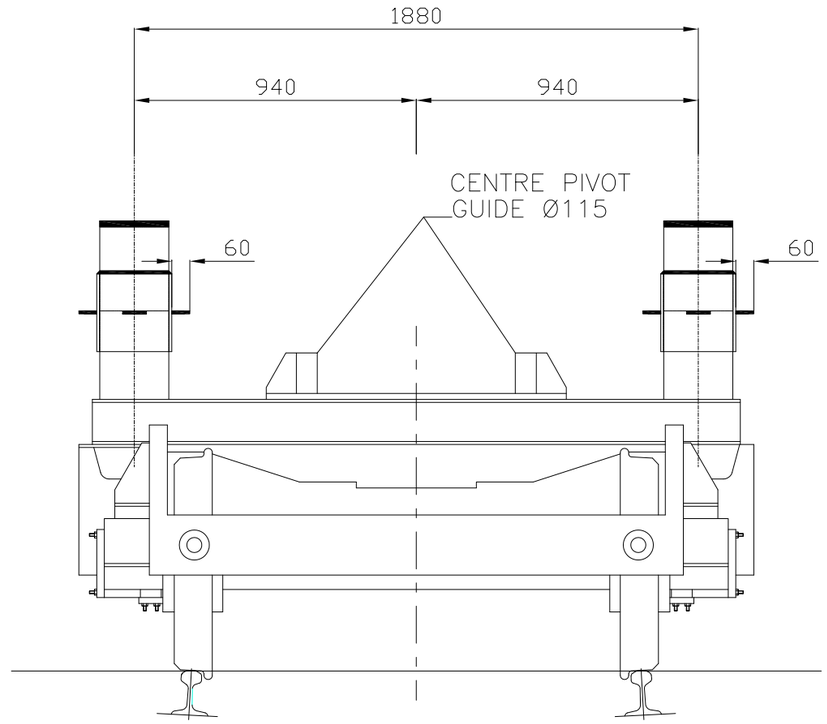
FILE NAME: C6014-14E_TSEG_990_005_A.DWG

TITLE
C6014-14E
PROCUREMENT OF NEW TRAINS
CONCEPTUAL SKETCH OF
UNDERFLOOR JACKS

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/990/005	A



FRONT VIEW



END VIEW

NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

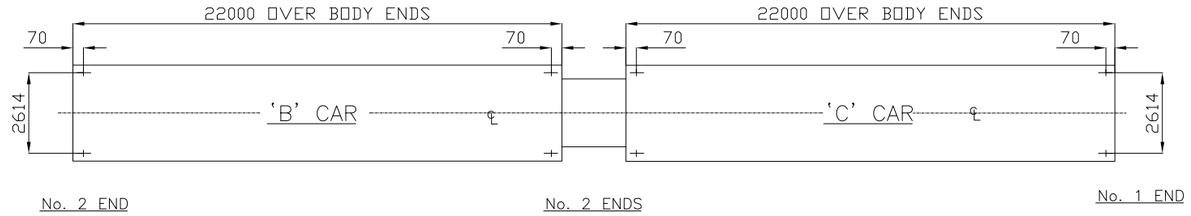
CONTRACTOR REFERENCE NO.

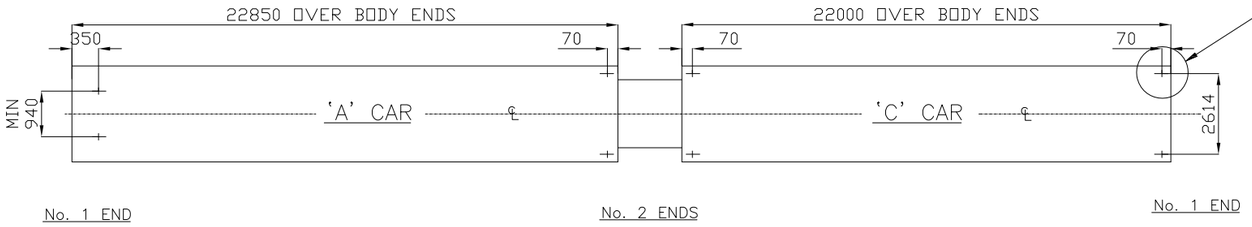
FILE NAME: C6014-14E_TSEG_990_006_A.DWG

TITLE

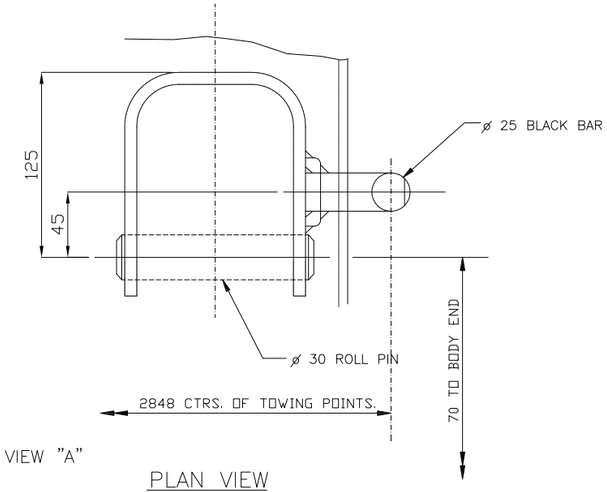
C6014-14E
PROCUREMENT OF NEW TRAINS
EXISTING ACCODMODATION BOGIE
AT KBD

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/990/006	A

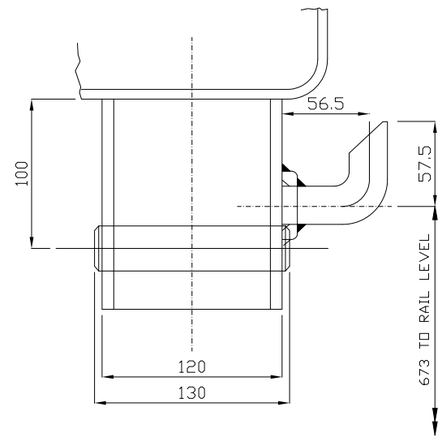




POSITIONS OF TOWING BRACKETS



PLAN VIEW



VIEW A (FROM CAR END)

POSITIONS OF D CAR TOWING BRACKETS THE SAME AS THOSE ON B AND C CARS OF EXISTING MODERNISED TRAINS

NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_990_007_A.DWG

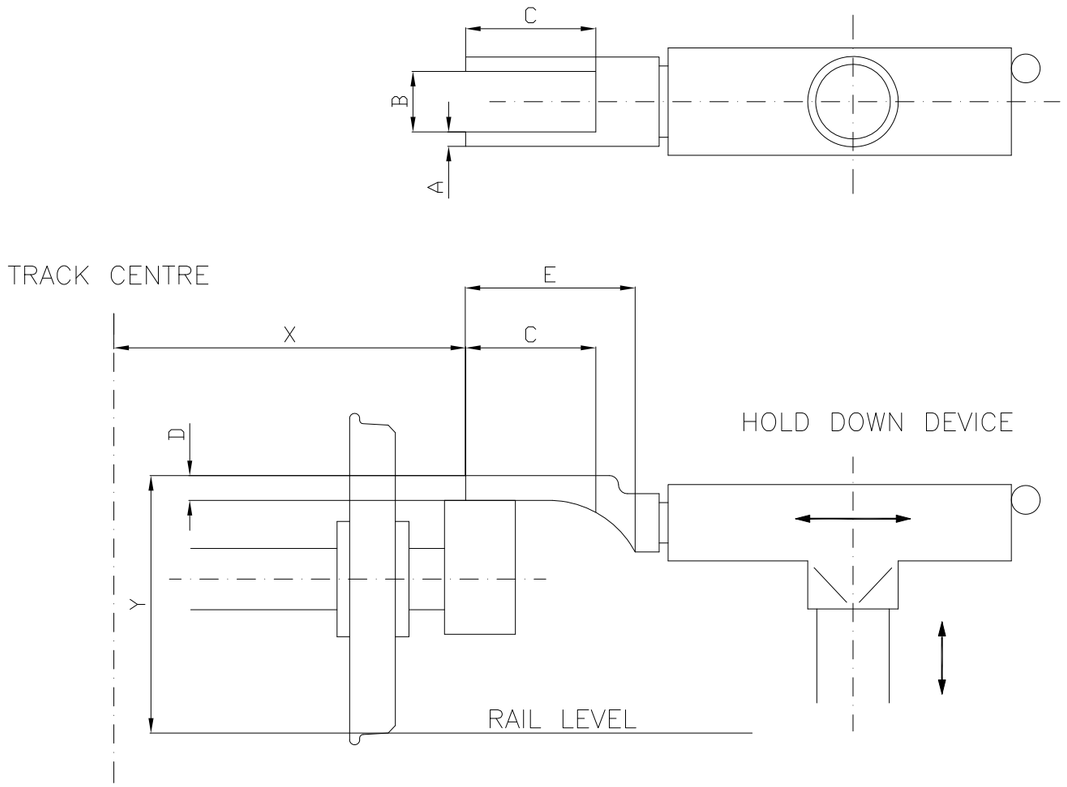
TITLE

C6014-14E

PROCUREMENT OF NEW TRAINS

TYPICAL ARRANGEMENT AND DETAILS OF TOWING POINTS OF EXISTING M TRAINS

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/990/007	A



X		Y	
MIN	MAX	MIN	MAX
466	1086	450	1050

TYPE	A	B	C	D	E
EMU	30	160	335	60	380
LOCO AND WAGON	40	165	190	40	150

NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_990_008_A.DWG

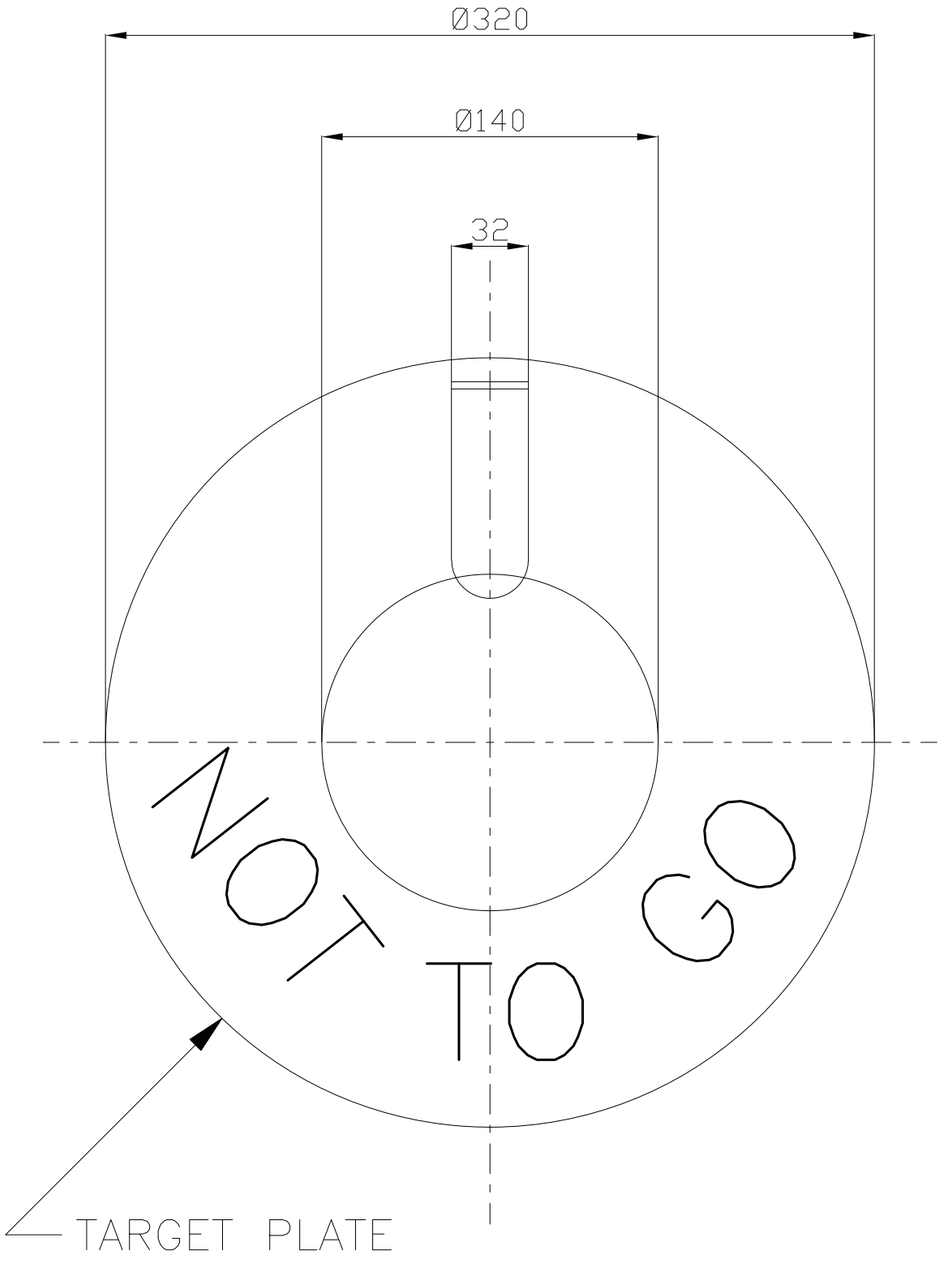
TITLE

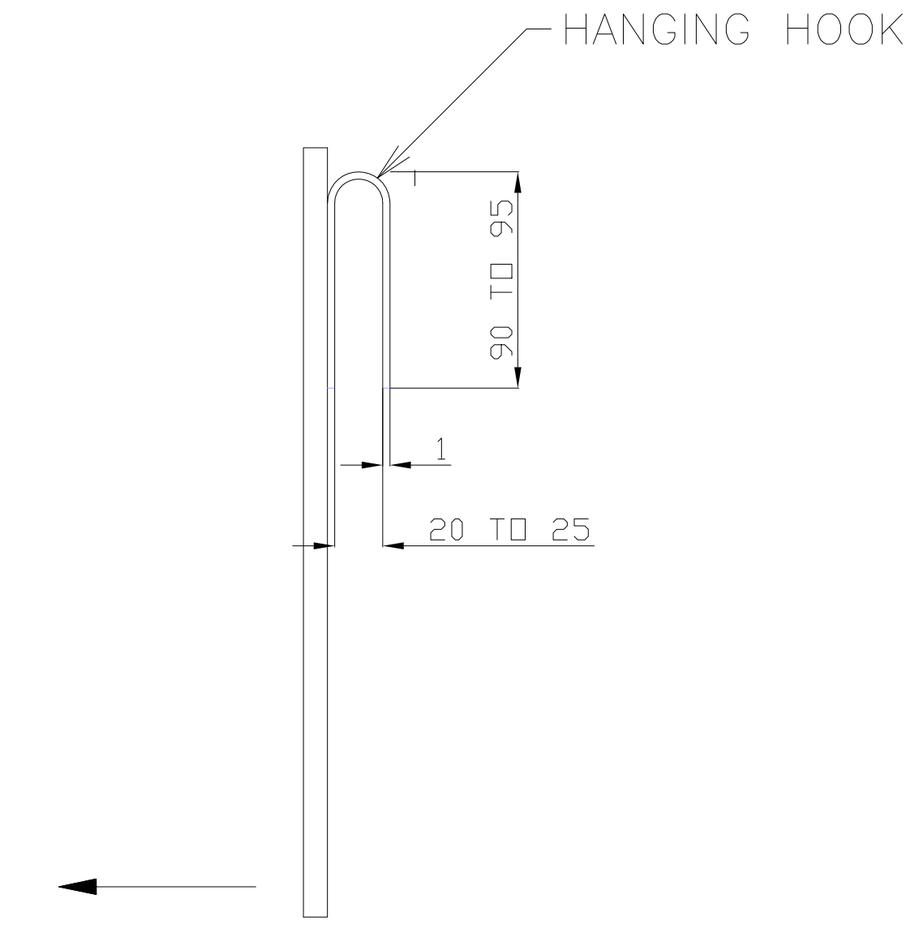
C6014-14E

PROCUREMENT OF NEW TRAINS

DETAILS OF HOLD DOWN DEVICE FOR UNDERFLOOR WHEEL LATHE

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/990/008	A





NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION **TECHNICAL AND ENGINEERING SERVICES DEPARTMENT**

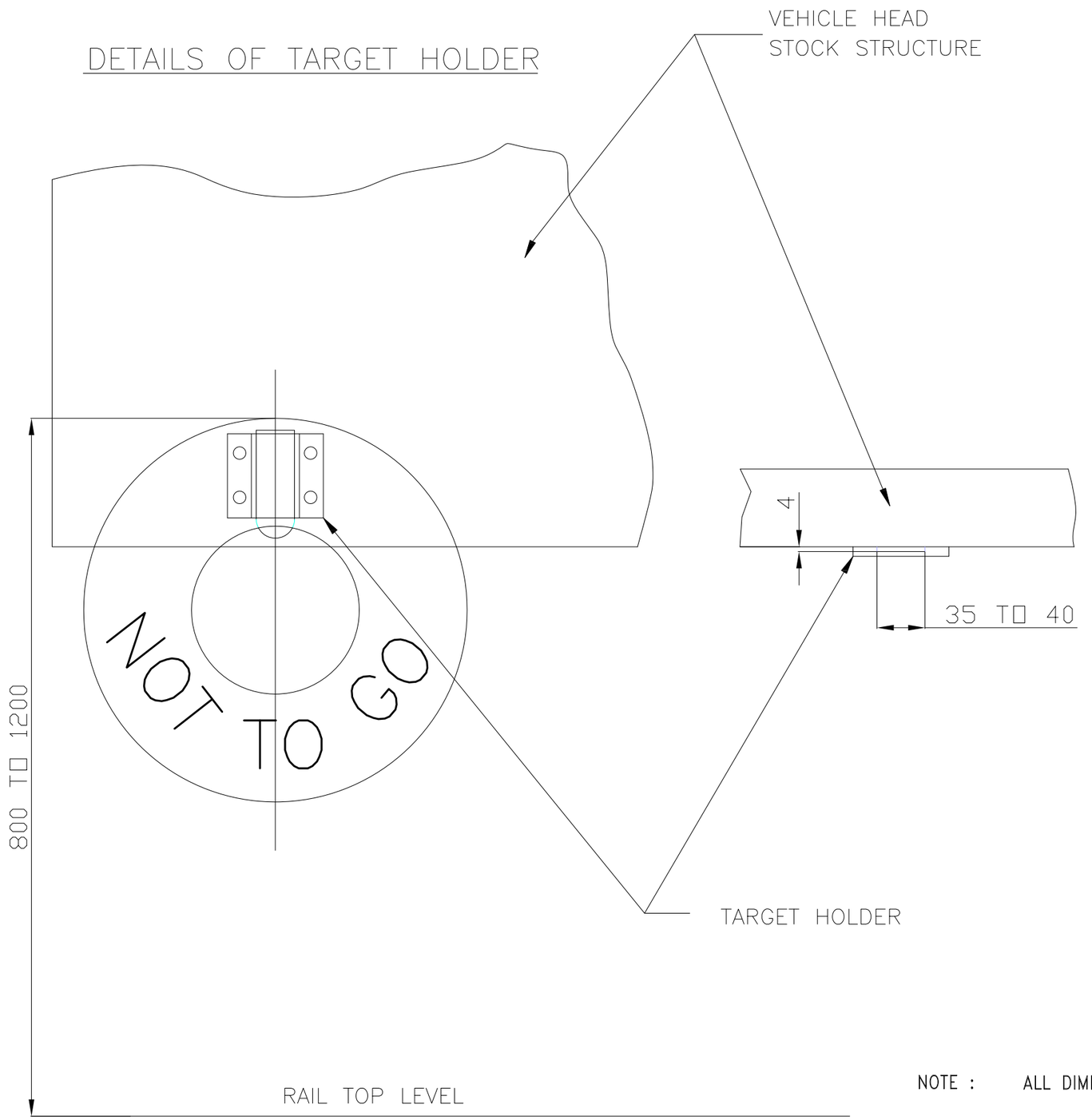
CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_990_010_A.DWG

TITLE
C6014-14E
PROCUREMENT OF NEW TRAINS
TYPICAL DETAILS OF TARGET

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/990/010	A

DETAILS OF TARGET HOLDER



NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
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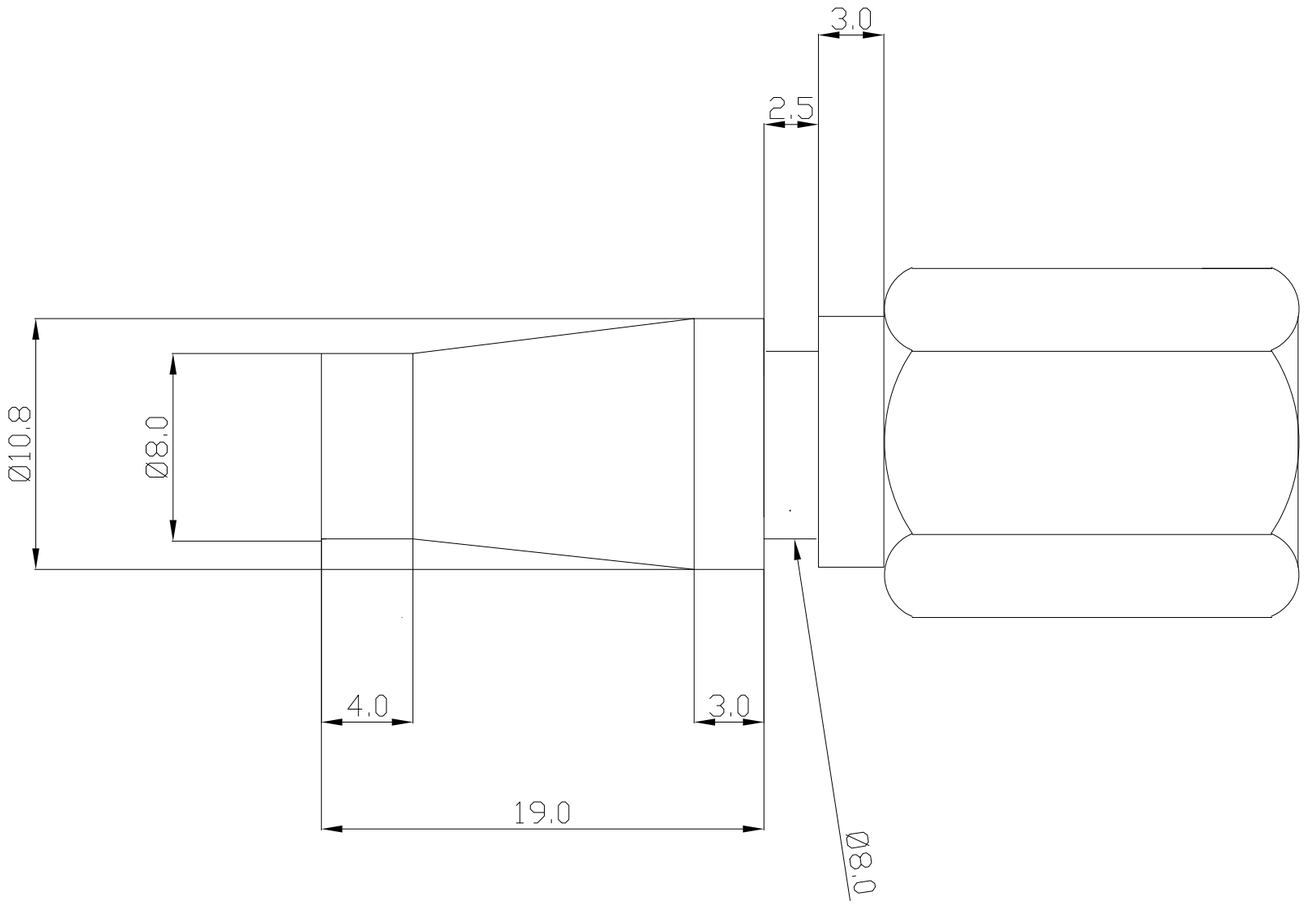
OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_990_011_A.DWG

TITLE
C6014-14E
PROCUREMENT OF NEW TRAINS
DETAILS OF TARGET HOLDER

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/990/011	A



NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

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DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_990_012_A.DWG

TITLE

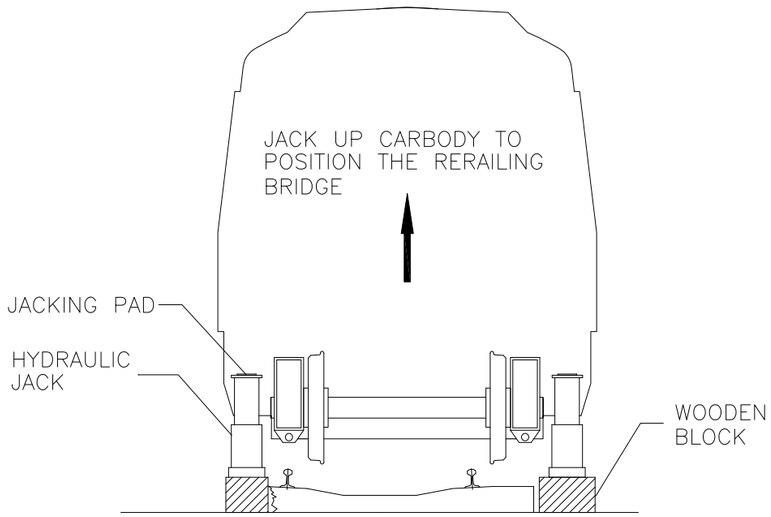
C6014-14E

PROCUREMENT OF NEW TRAINS

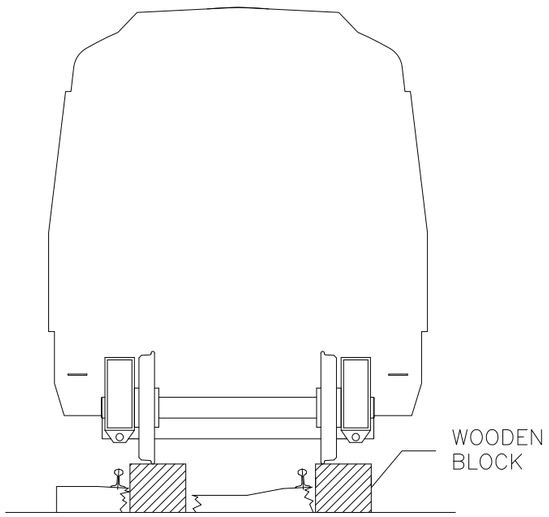
PNEUMATIC CONNECTOR PLUG SCHRADER PLUG 1/8"

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/990/012	A

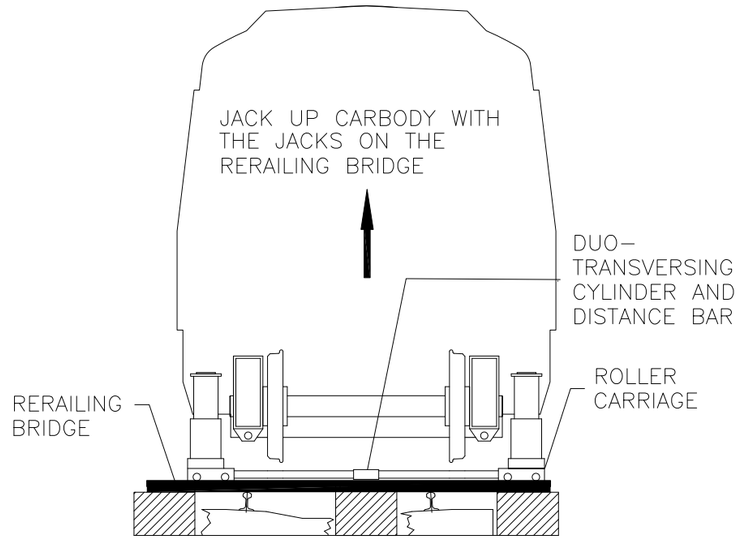
1. JACK UP CARBODY



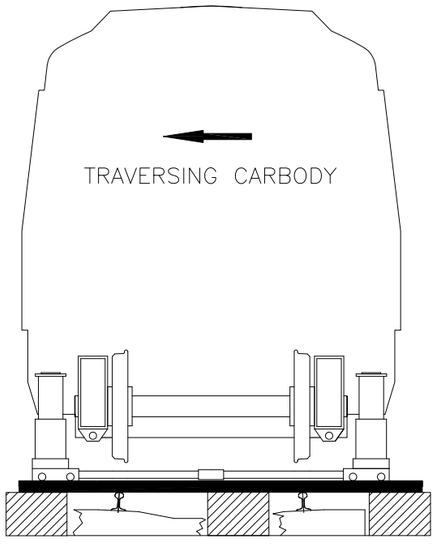
2. SUPPORT WHEELS WITH WOODEN BLOCKS AND INSTALL RERAILING BRIDGE



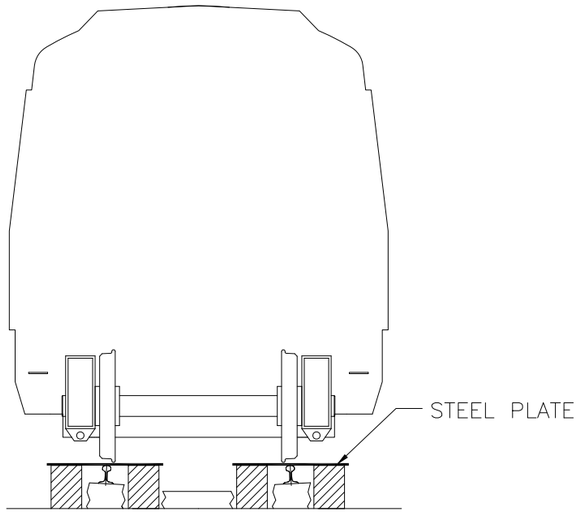
3. ALIGN CARBODY WITH TRACK USING TRANSVERSING SYSTEM



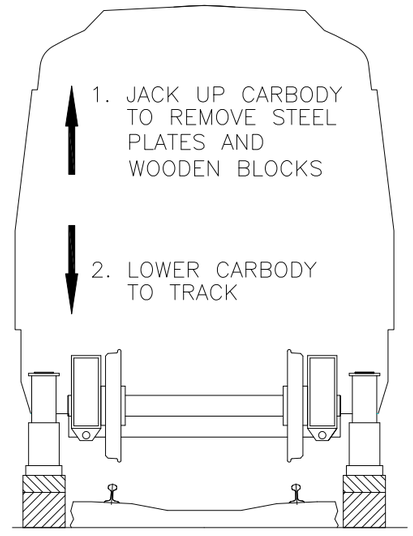
4. TRAVERSE CARBODY TO ALIGN WITH TRACK



5. SUPPORT WHEELS WITH STEEL PLATES AND WOODEN BLOCK



6. JACK UP CARBODY AND LOWER ONTO TRACK



LIST OF ESSENTIAL RE-RAILING EQUIPMENT

1. 20T, 152mm AND 305mm HYDRAULIC JACKS.
2. RERAILING BRIDGE, L=3300mm AND H=95mm.
3. TRAVERSING SYSTEM CONSISTS OF DUO-TRAVERSING CYLINDERS, DISTANCE BARS AND ROLLER CARRIAGES.

NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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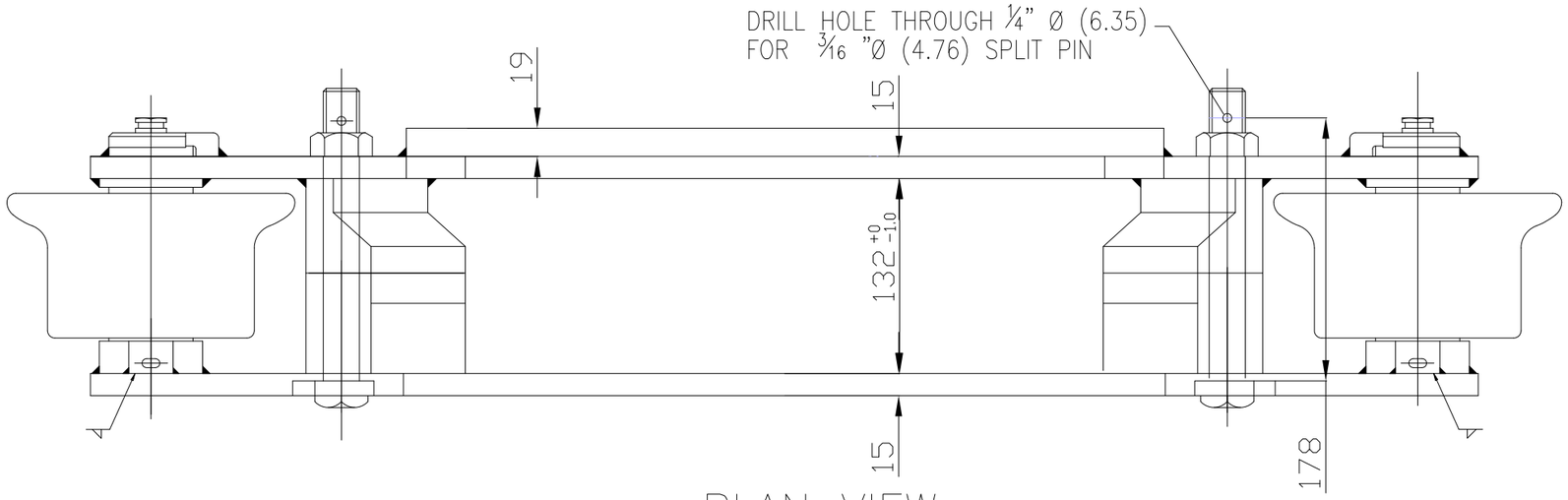
OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

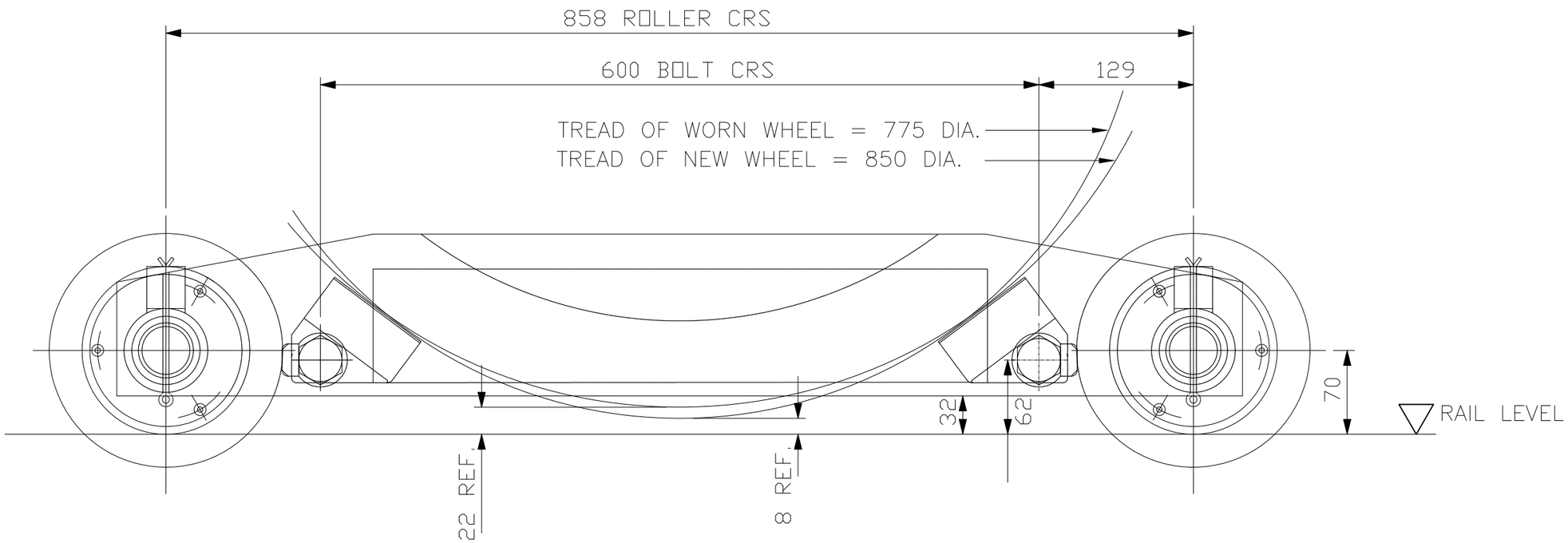
FILE NAME: C6014-14E_TSEG_990_013_A.DWG

TITLE
C6014-14E
PROCUREMENT OF NEW TRAINS
TYPICAL RECOVERY PROCEDURES FOR EMU DERAILMENT

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/990/013	A



PLAN VIEW



FRONT VIEW

NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
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DATE	15/10/2014

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OPERATIONS DIVISION **TECHNICAL AND ENGINEERING SERVICES DEPARTMENT**

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_990_014_A.DWG

TITLE

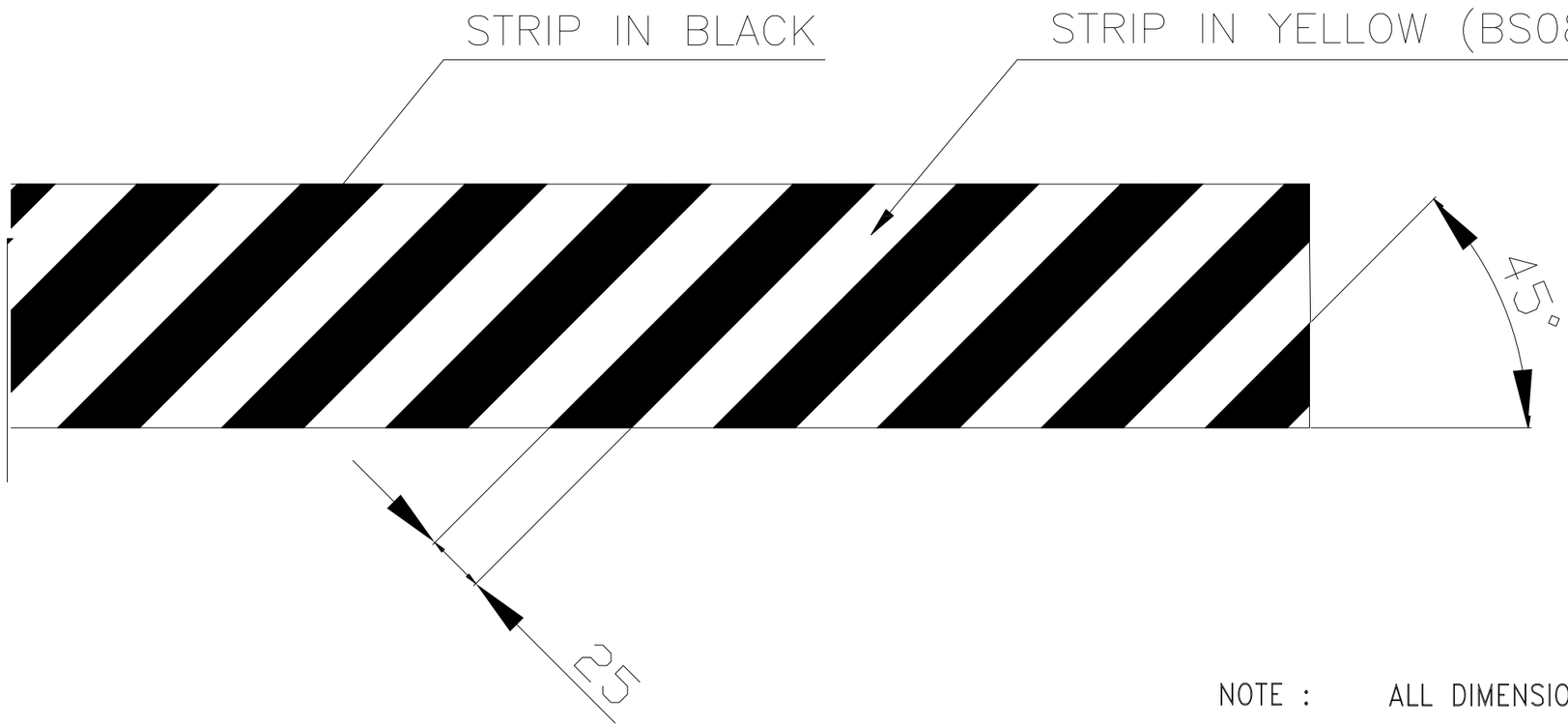
C6014-14E

PROCUREMENT OF NEW TRAINS

EXISTING RAIL SKATE OF OPERATING RAILWAY

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/990/014	A

STRIPE PATTERN FOR IDENTIFICATION OF JACKING POINT ON ROLLING STOCK VEHICLE



NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	—
CHECKED	JA/KYL
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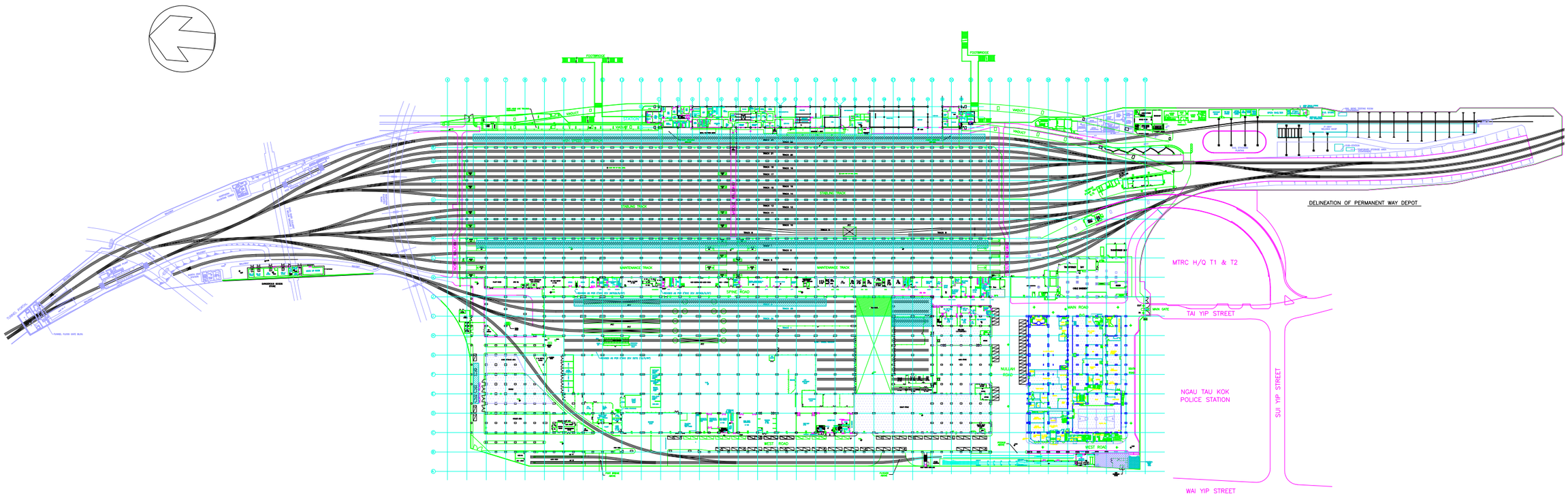
OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_990_015_A.DWG

TITLE
C6014-14E
PROCUREMENT OF NEW TRAINS
STRIPE PATTERN FOR IDENTIFICATION OF JACKING POINT OF ROLLING STOCK VEHICLE

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/990/015	A



KOWLOON BAY DEPOT GROUND FLOOR PLAN

SCALE
0 40 80 120 160 200

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	GN
DESIGNED	— —
CHECKED	JA/KYL
APPROVED	ML
DATE	15/10/2014

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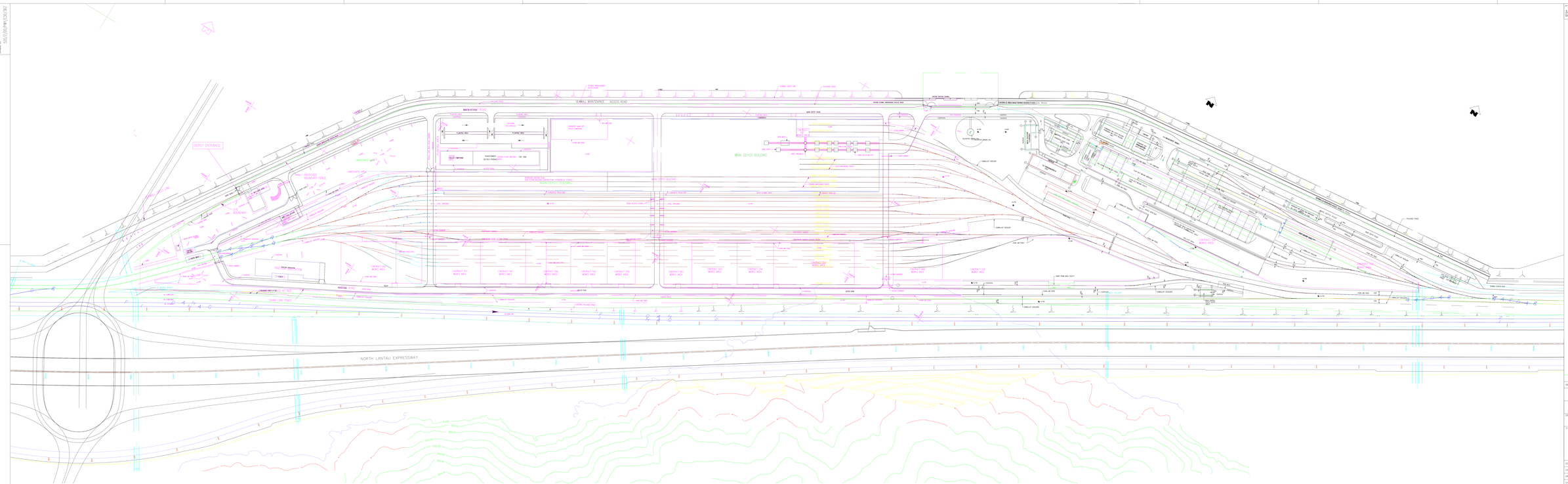
OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_990_016_A.DWG

TITLE
C6014-14E
PROCUREMENT OF NEW TRAINS
KBD
GROUND LEVEL FLOOR PLAN

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/990/016	A



DRAWING No. 520/Z/00/PWY/C30/001

1:1000 ON ORIGINAL

NOTES :

1. FOR GENERAL NOTES REFER TO DRAWING No. 520/Z/00/PWY/C30/001

LEGEND :

PHASE 2 CONSTRUCTION NOT UNDER 520D CONTRACT

MTR Corporation

APPROVED AS-BUILT DRAWING

Signed _____ Date _____

REVISION	DESCRIPTION	BY	DATE	APPROVED
A	AS BUILT DRAWING CHANGED BY MTRC ON 3 SEPTEMBER 2020	SF	SEPTEMBER 2020	

地鐵公司 MTR Corporation

MTR TOWER, TELFORD PLAZA, 11 HOK LOK STREET, KOWLOON BAY, HONG KONG
TEL: 2993 2111 FAX: 2798 8822

LANTAU AND AIRPORT RAILWAY

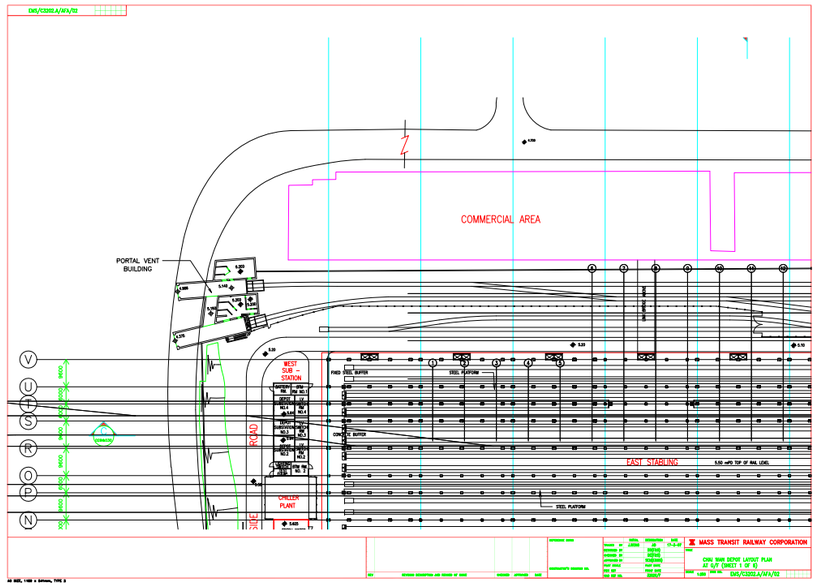
ORIGINATOR: MTR Corporation | CVE, ENGINEERING DEPARTMENT PROJECT DIVISION

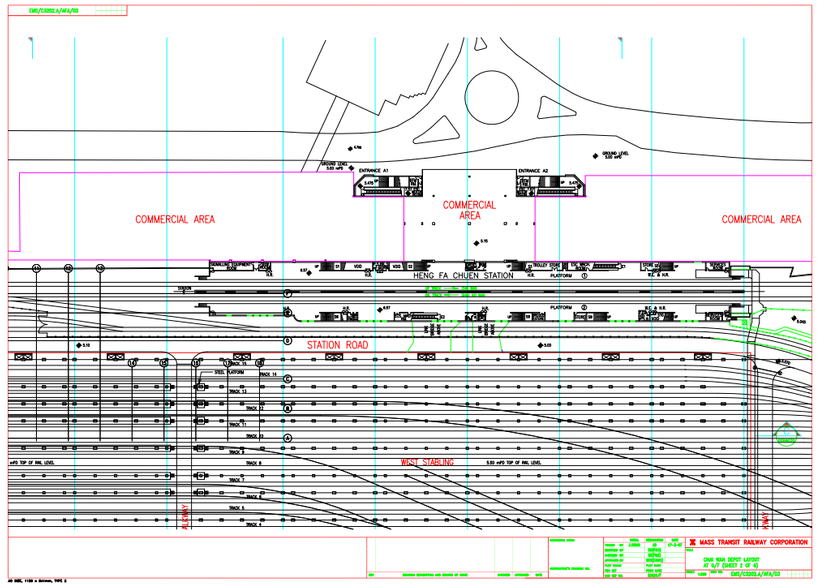
TITLE

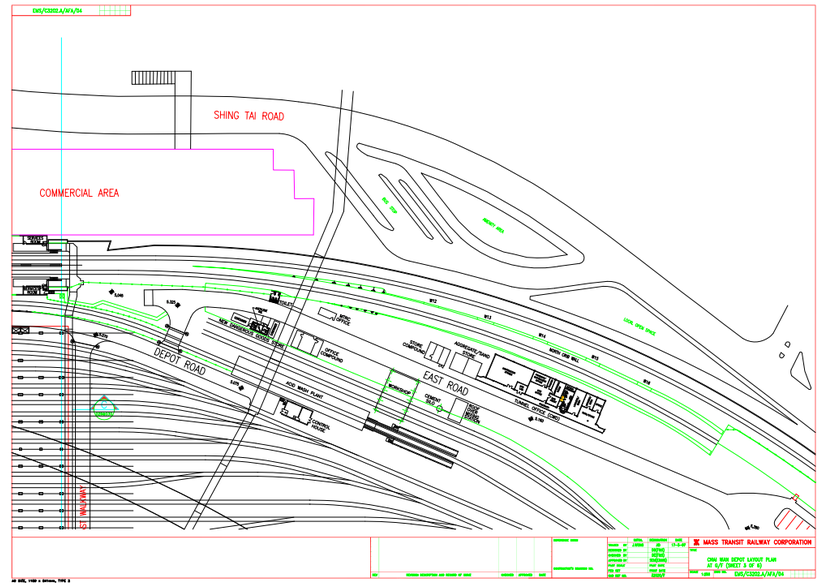
CONTRACT 520
ALIGNMENTS
SIU HO WAN DEPOT
GENERAL ARRANGEMENT

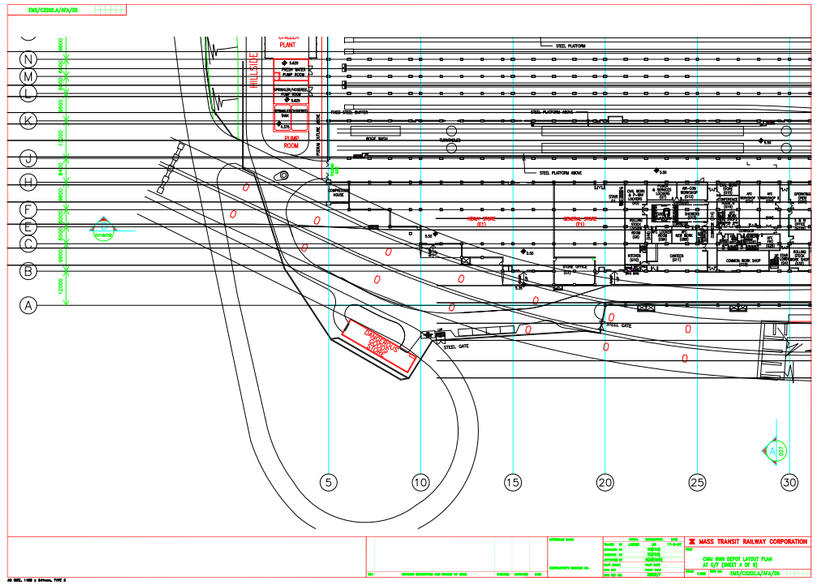
SCALE	1 : 1000 (A1)	CAD REF	C30_362.DGN		
DATE	23.09.98	AS BUILT DWG NO			
DRAWN	CHM	SIGNED	DRAWING NO.	520/Z/00/PWY/C30/362	REV. A
CHECKED	FTC	APPROVED	DE		

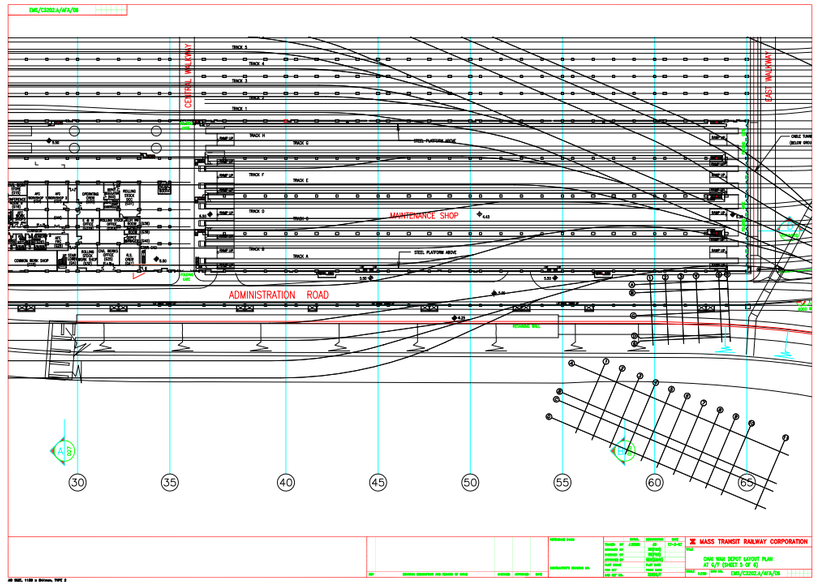
LEGO REF : XXXX

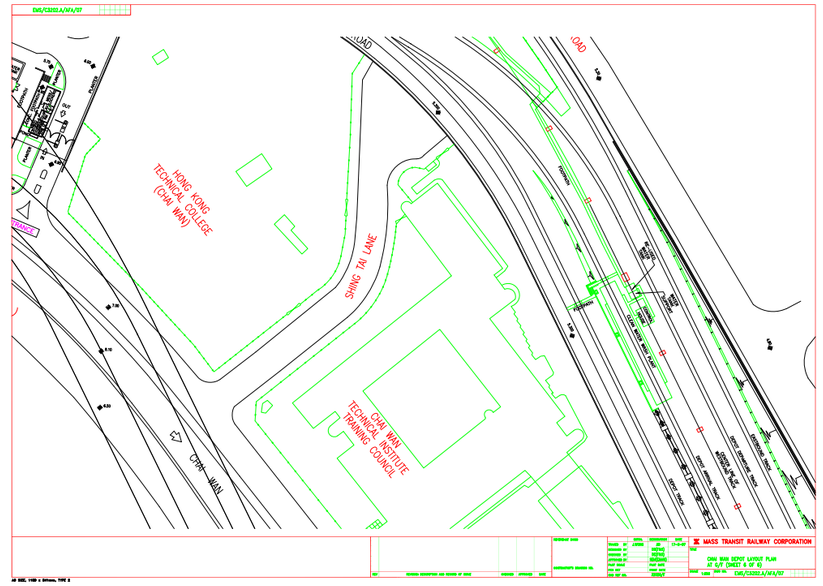

COMMERCIAL AREA
PORTAL VENT BUILDING
WEST SUB - STATION
ROAD
FIRE SERVICE
CHILLER PLANT
EAST STABLING
STEEL PLATFORM
V
U
T
S
R
O
P
N


COMMERCIAL AREA
COMMERCIAL AREA
COMMERCIAL AREA
HENG FA CHUEN STATION
STATION ROAD
WEST STABLING
RAILWAY
RAILWAY

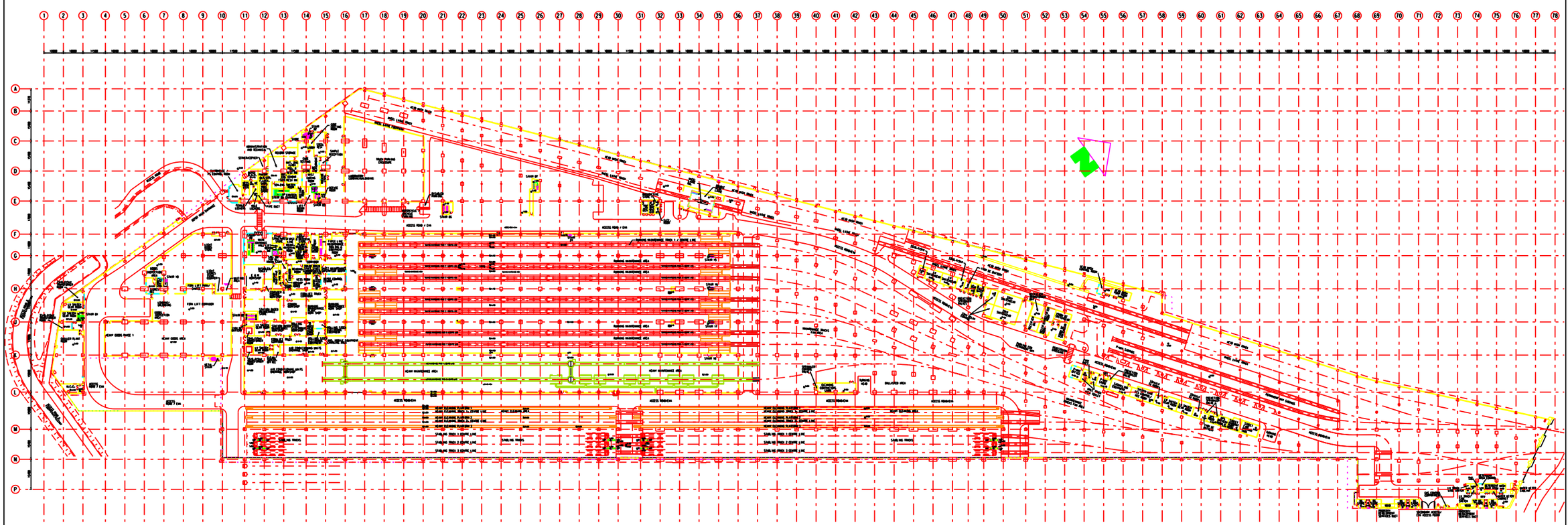

SHING TAI ROAD
COMMERCIAL AREA
DEPOT ROAD
EAST ROAD
RAILWAY


PLANT
FIRE SERVICE PUMP ROOM
SWITCH ROOM
TRANSFORMER ROOM
FLOOD ROOM
RAILSIDE
ROAD
STEEL PLATFORM
FIXED STEEL BUFFER
ROCK MASS
STEEL PLATFORM ABOVE
CHAN SHAN ST.
KOWLOON - CANTON RAILWAY
STEEL GATE
N
A
B
5
10
15
20
25
30


CENTRAL RAILWAY
TRACK 13
TRACK 12
TRACK 11
TRACK 10
TRACK 9
TRACK 8
TRACK 7
TRACK 6
TRACK 5
TRACK 4
TRACK 3
TRACK 2
TRACK 1
MAINTENANCE SHOP
ADMINISTRATION ROAD
EAST RAILWAY
30
35
40
45
50
55
60
65


ROAD
HONG KONG TECHNICAL COLLEGE (TSUEN WAN)
SHING TAI LANE
CHUN WAN TECHNICAL INSTITUTE TRAINING COUNCIL
CHUN WAN
RAILWAY

USP/M/TKD3/XXX/A00/XXX | B



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	MINOR AMENDMENT	JACKSON 22-10-07		
A	FIRST ISSUE	ZO12 09-7-07		

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MTR REFERENCE NO.

CONTRACTOR REFERENCE NO.

	INITIAL	DESIGNATION	DATE
DRAWN	ZO12	ZST	09-7-07
DESIGNED			
CHECKED			
APPROVED			

CAD FILE NAME USP_M_TKD3_XXX_A00_XXX_B.dgn

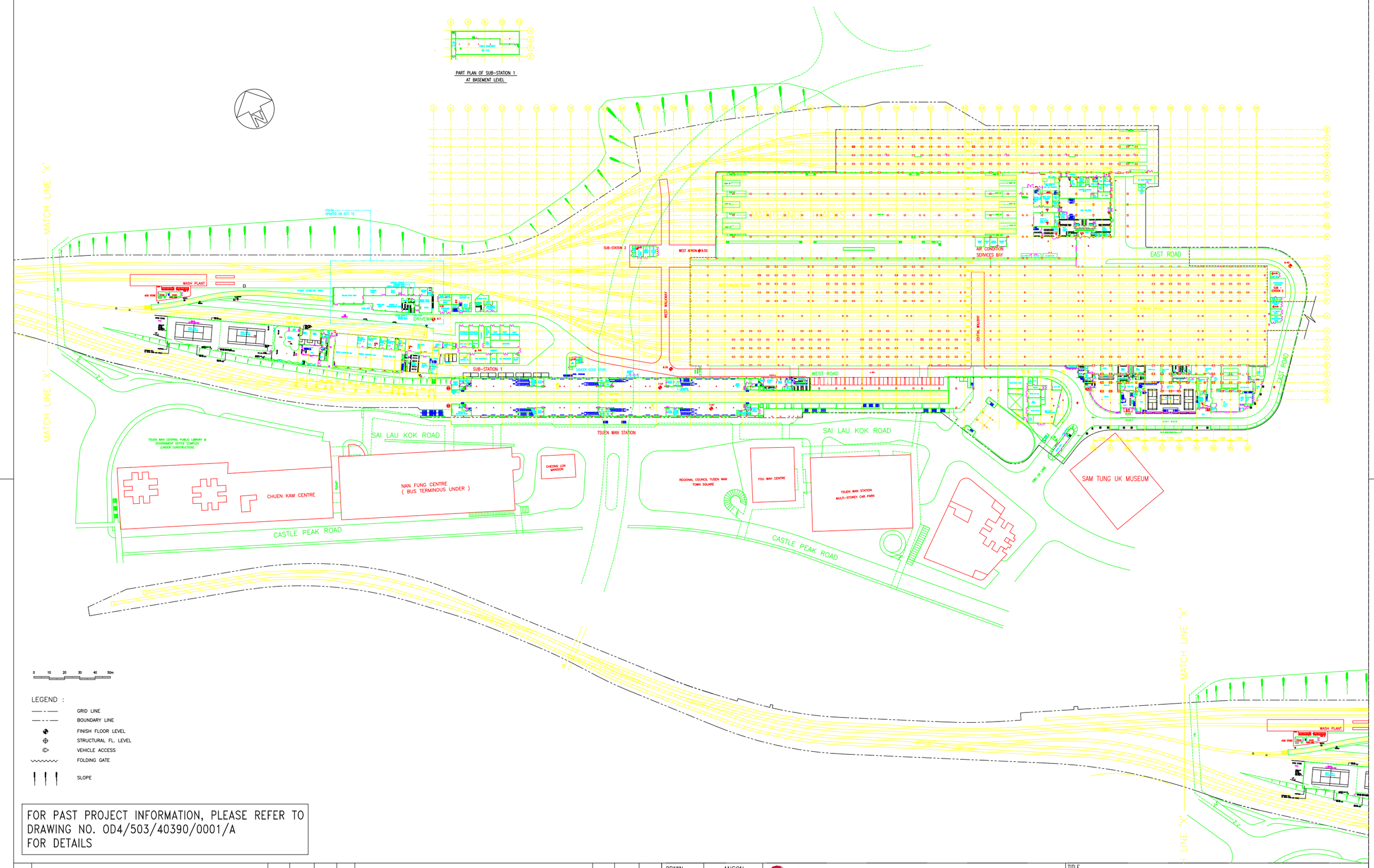
地鐵公司 MTR Corporation
MTR TOWER
TELFORD PLAZA - KOWLOON BAY
HONG KONG
TEL : 2993 2111 FAX : 2798 8822

TITLE TSEUNG KWAN O DEPOT (TKD)
GROUND LEVEL (+5.400)
ARCH - DEPOT LAYOUT PLAN

SCALE 1:1200(A1)

OED DRAWING NO. USP/M/TKD3/XXX/A00/XXX | B

A1 SIZE. 841 x 594mm. TYPE 3 $PLTDRVLS



REV	DESCRIPTION	BY	DATE	APPROVED
A1	FIRST ISSUE (INCLUDED C5434 UPDATING)	ANSON	10OCT12	___

DRAWN	ANSON
DESIGNED	___
CHECKED	___
APPROVED	___
DATE	10/OCT/2012

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MTR

ORIGINATOR

OPERATION DIVISION | TECHNICAL & ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

CADD REF. USP_TWD1_A12_001_A1.DWG

TITLE

TSUEN WAN DEPOT (TWD)

GROUND FLOOR LEVEL

ARCHITECTURAL LAYOUT – UPDATED STATION PLAN

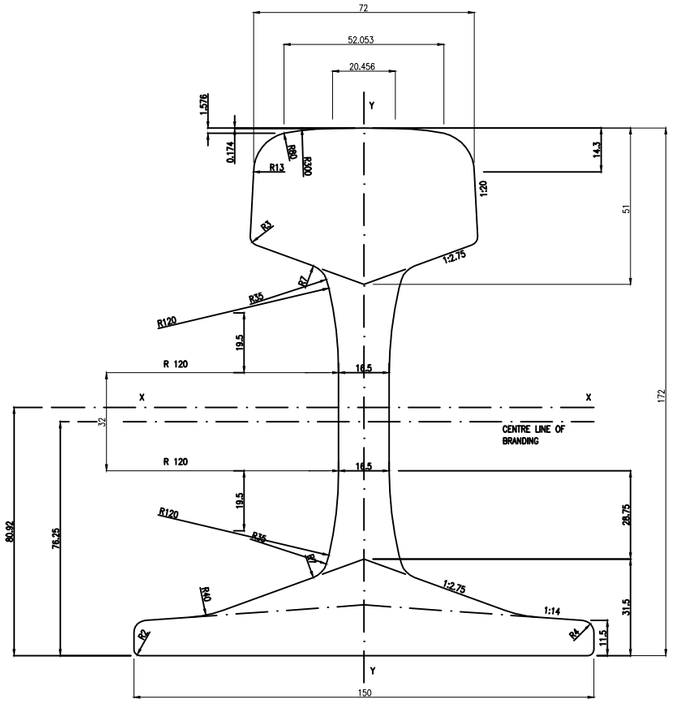
SCALE	DRAWING NO.	REV.
1 : 1100 (A1)	USP/TWD1/A12/001	A1

TRACK DATA		
Drawing No.	**Title**	**Revision**
OD8/501/00001/0057	Rail Profile of 60E1, UIC60 and BS 90A(M) Section	D
KTL/M/SQ/W02/301	Yau Ma Tei Station Track Diagrams Volume 1	A
KTL/M/SQ/W02/302	Mong Kok Station – Prince Edward Station Track Diagrams Volume 1	A
OD4/900/00105/0003	Shek Kip Mei Station Track Diagrams Volume 1	E
OD4/900/00105/0004	Kowloon Tong Station – Lok Fu Station Track Diagrams Volume 1	E
OD4/900/00105/0005	Wong Tai Sin Station – Diamond Hill Station Track Diagrams Volume 1	C
KTL/M/SQ/W02/306	Choi Hung Station Track Diagrams Volume 1	A
KTL/SQ/TD1/R38/307	Kowloon Bay Station – Ngau Tau Kok Station Track Diagrams Volume 1	A
OD4/900/00105/0008	Kwun Tong Station Track Diagrams Volume 1	E
KTL/M/SQ/W02/309	Lam Tin Station Track Diagrams Volume 1	A
OD4/900/00105/1031	Yau Tong Station (Kwun Tong Line) Track Diagrams Volume 1	A
KTL/M/SQ/W02/311	Tiu Keng Leng Station and Crossover Track Diagrams Volume 1	A
OD4/501/00104/0003	YMT Sidings – YMT Line Diagram - KTL	B
OD4/501/00104/0004	YMT – MOK Line Diagram - KTL	B
OD4/501/00104/005	MOK Line Diagram - KTL	A
OD4/501/00104/0006	MOK – PRE Line Diagram - KTL	B
OD4/501/00104/0007	PRE – SKM Line Diagram - KTL	B
OD4/501/00104/0008	SKM– KOT Line Diagram - KTL	B
OD4/501/00104/0009	KOT– LOF Line Diagram - KTL	B
OD4/501/00104/0010	LOF – WTS Line Diagram - KTL	B
OD4/501/00104/0011	WTS – DIH Line Diagram - KTL	B
OD4/501/00104/0012	DIH – CHH Line Diagram - KTL	C
OD4/501/00104/013	CHH – KOB Line Diagram - KTL	A
OD4/501/00104/014	CHH – RT1 & 2 Line Diagram - KTL	A
OD4/501/00104/0015	KOB – NTK Line Diagram - KTL	B
OD4/501/00104/0016	Line Diagram - KTL Dep & Reception TK - NTK	A
OD4/501/00104/0017	NTK – KWT Line Diagram - KTL	D
OD4/501/00104/0018	KWT – LAT Line Diagram - KTL	D
OD4/501/00104/0019	LAT – YAT Line Diagram - KTL	C
OD4/501/00104/0020	YAT – TIK Line Diagram - KTL	C
OD4/501/00104/0021	TIK – Overrun Line Diagram - KTL	C
OD4/501/00104/0022	LAT – CVB Line Diagram - KTL LAT Service Connection	A
TWL/M/SQ/W02/201	Central Station – Admiralty Station Track Diagrams Volume 1	A
OD4/900/00205/0002	Immersed Tube Track Diagrams Volume 1	D
OD4/900/00205/0003	Tsim Sha Tsui Station – Jordon Station Track Diagrams Volume 1	D
TWL/M/SQ/W02/204	Yau Ma Tei Station – Mong Kok Station Track Diagrams Volume 1	A
OD4/900/00205/0005	Prince Edward Station – Sham Shui Po Station Track Diagrams Volume 1	D
OD4/900/00205/0006	Cheung Sha Wan Station – Lai Chi Kok Station Track Diagrams Volume 1	C
OD4/900/00205/0007	Mei Foo Station Track Diagrams Volume 1	C
OD4/900/00205/0008	Lai King Station Track Diagrams Volume 1	F
TWL/SQ/TD1/R38/209	Kwai Fong Station Track Diagrams Volume 1	A
OD4/900/00205/0010	Kwai Hing Station – Tai Wo Hau Station Track Diagrams Volume 1	C
TWL/SQ/TD1/R38/211	Tsuen Wan Station Track Diagrams Volume 1	A
OD4/501/00204/0002	CEN – ADM Line Diagram – TWL	D
OD4/501/00204/0003	ADM – SVB Line Diagram – TWL	B
OD4/501/00204/0004	SVB – TST Line Diagram – TWL	B
OD4/501/00204/0005	TST – JOR Line Diagram – TWL	B
OD4/501/00204/006	JOR – YMT Line Diagram – TWL	A
OD4/501/00204/007	YMT – MOK Line Diagram – TWL	A
OD4/501/00204/008	MOK – PRE Line Diagram – TWL	A
OD4/501/00204/009	PRE – SSP Line Diagram – TWL	A
OD4/501/00204/0010	SSP – CSW Line Diagram – TWL	B

TRACK DATA		
Drawing No.	**Title**	**Revision**
OD4/501/00204/011	CSW – LCK Line Diagram – TWL	A
OD4/501/00204/012	LCK – MEF Line Diagram – TWL	A
OD4/501/00204/0013	MEF – LAK Line Diagram – TWL	D
OD4/501/00204/0014	LAK – KWF Line Diagram – TWL	C
OD4/501/00204/0015	KWF – KWH Line Diagram – TWL	B
OD4/501/00204/0016	KWH – TWH Line Diagram – TWL	B
OD4/501/00204/017	TWH – TSW Line Diagram – TWL	A
OD4/501/00204/0018	TSW – H/S Line Diagram – TWL	B
OD4/900/00305/0001	Sheung Wan Station – Central Station Track Diagrams Volume 1	F
ISL/M/SQ/W02/102	Admiralty Station– Wan Chai Station Track Diagrams Volume 1	A
ISL/M/SQ/W02/103	Causeway Bay Station Track Diagrams Volume 1	A
OD4/900/00305/0004	Tin Hau Station – Fortress Hill Station Track Diagrams Volume 1	C
OD4/900/00305/0005	North Point Station – Quarry Bay Station Track Diagrams Volume 1	D
OD4/900/00305/0006	Tai Koo Station Track Diagrams Volume 1	F
OD4/900/00305/0007	Sai Wan Ho Station – Shau Kei Wan Station Track Diagrams Volume 1	C
OD4/900/00305/0008	Heng Fa Chuen Station Track Diagrams Volume 1	G
OD4/900/00305/0009	Chai Wan Station Track Diagrams Volume 1	F
OD4/501/00304/002	Overrun – SHW Line Diagram – ISL	A
OD4/501/00304/003	SHW – CEN Line Diagram – ISL	A
OD4/501/00304/004	CEN – ADM Line Diagram – ISL	A
OD4/501/00304/005	ADM – WAC Line Diagram – ISL	A
OD4/501/00304/006	WAC – CAB Line Diagram – ISL	A
OD4/501/00304/007	CAB – TIH Line Diagram – ISL	A
OD4/501/00304/008	TIH – FOH Line Diagram – ISL	A
OD4/501/00304/009	FOH – NOP Line Diagram – ISL	A
OD4/501/00304/0010	NOP – QUB Line Diagram – ISL	B
OD4/501/00304/0011	QUB – TAK Line Diagram – ISL	B
OD4/501/00304/012	TAK – SWH Line Diagram – ISL	A
OD4/501/00304/0013	SWH – SKW Line Diagram – ISL	B
OD4/501/00304/014	SKW – HFC Line Diagram – ISL	A
OD4/501/00304/015	HFC – CHW Line Diagram – ISL	A
TKL/M/SQ/W02/401	North Point Station Track Diagrams Volume 1	A
TKL/M/SQ/W02/402	Quarry Bay Station Track Diagrams Volume 1	A
TKL/M/SQ/W02/403	Eastern Immersed Tube Track Diagrams Volume 1	A
TKL/M/SQ/W02/404	Yau Tong Station (Tseung Kwan O Line) Track Diagrams Volume 1	A
TKL/M/SQ/W02/405	Tiu Keng Leng Station Track Diagrams Volume 1	A
TKL/M/SQ/W02/406	Tseung Kwan O Station Track Diagrams Volume 1	A
TKL/M/SQ/W02/407	Hang Hau Station Track Diagrams Volume 1	A
TKL/M/SQ/W02/408	Po Lam Station Track Diagrams Volume 1	A
TKL/SQ/TD1/R38/451	LOHAS Park Station Track Diagrams Volume 1	B1
OD4/501/00704/0030	NOP Sidings – NOP Line Diagram – TKL	-
OD4/501/00704/0031	NOP – QVB Line Diagram – TKL	-
OD4/501/00704/0032	QVB – CVB Line Diagram – TKL	-
OD4/501/00704/0033	CVB – YAT Line Diagram – TKL	-
OD4/501/00704/0034	YAT – TIK Line Diagram – TKL	-
OD4/501/00704/0035	TIK – TKO Line Diagram – TKL	-
OD4/501/00704/0036	TKO – HAH Line Diagram – TKL	-
OD4/501/00704/0037	HAH – POA Line Diagram – TKL	-
OD4/501/00704/0038	TKO – PSK Line Diagram - TKL	-
OD4/501/00704/0039	PSK – LHP Line Diagram – TKL	A
715/W/WIL/MTR/C01/001	General Notes	A
715/W/WIL/MTR/C01/002	Legend	A
715/W/WIL/MTR/C01/003	Site Location Plan	A

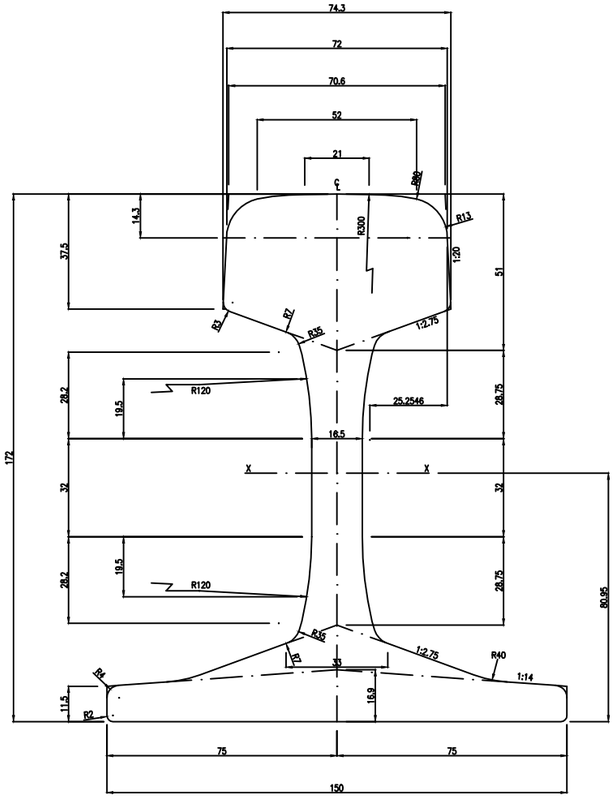
TRACK DATA		
Drawing No.	**Title**	**Revision**
715/W/WIL/MTR/C01/004	Overall Track Schematic Diagram	A
715/W/WIL/MTR/C01/005	Permanent Speed Restriction Diagram	B
715/W/WIL/MTR/C31/001	Track Schematics – Sheung Wan To Sai Ying Pun	B
715/W/WIL/MTR/C31/002	Track Schematics - Hong Kong University To Kennedy Town	A
715/W/WIL/MTR/C31/003	Track Schematics – Turnback Siding	A
715/W/WIL/MTR/C31/004	Interface Schedule and Buffer Stop Schedule	B
715/W/WIL/MTR/C31/005	Stage Opening of Refuge Siding at SHW	A
715/W/WIL/MTR/C30/001	Alignment - Sheung Wan Station To Sai Ying Pun Station Sheet 1 of 2	A
715/W/WIL/MTR/C30/002	Alignment - Sheung Wan Station To Sai Ying Pun Station Sheet 2 of 2	A
715/W/WIL/MTR/C30/003	Alignment – Sai Ying Pun Station to Hong Kong University Station	A
715/W/WIL/MTR/C30/004	Alignment – Hong Kong University Station to Kennedy Town Sheet 1 of 2	A
715/W/WIL/MTR/C30/005	Alignment – Hong Kong University Station to Kennedy Town Sheet 2 of 2	A
715/W/WIL/MTR/C30/006	Alignment – Kennedy Town Station to Track End Sheet 1 of 2	A
715/W/WIL/MTR/C30/007	Alignment – Kennedy Town Station to Track End Sheet 2 of 2	A
715/W/WIL/MTR/C30/008	Alignment – Sheung Wan Station Crossover Track	A
715/W/WIL/MTR/C30/009	Alignment Data Sheet	A
715/W/WIL/MTR/C33/001	Junction Layouts Track End to KET T 181	A
715/W/WIL/MTR/C32/001	Circular Tunnel Non-Ballasted BCT Trackform (MAB)	A
715/W/WIL/MTR/C32/002	Circular Tunnel Non-Ballasted BCT Trackform (HAB)	A
715/W/WIL/MTR/C32/003	Horseshoe Tunnel Non-Ballasted BCT Trackform (HAB)	A
715/W/WIL/MTR/C32/004	Horseshoe Tunnel Non-Ballasted BCT Trackform (MAB)	A
715/W/WIL/MTR/C33/001	Track End to Kennedy Town Station T 181	A
1020/W/KTE/MTR/C01/005	Permanent Speed Restriction Diagram	B
1020/W/KTE/MTR/C30/001	Yau Ma Tei Station to Ho Man Tin Station Sheet 1 of 4	A
1020/W/KTE/MTR/C30/002	Yau Ma Tei Station to Ho Man Tin Station Sheet 2 of 4	A
1020/W/KTE/MTR/C30/003	Yau Ma Tei Station to Ho Man Tin Station Sheet 3 of 4	A
1020/W/KTE/MTR/C30/004	Yau Ma Tei Station to Ho Man Tin Station Sheet 4 of 4	C
1020/W/KTE/MTR/C30/005	Ho Man Tin Station to Whampoa Station Sheet 1 of 2	A
1020/W/KTE/MTR/C30/006	Ho Man Tin Station to Whampoa Station Sheet 2 of 2	A
1020/W/KTE/MTR/C30/007	Crossover East of HOM	A
1020/W/KTE/MTR/C30/008	Alignment Data Sheet Horizontal Alignment	A
1020/W/KTE/MTR/C30/009	Alignment Data Sheet Vertical Alignment	A
752/DRW/0083	Final Scheme Plan	B
OD1/411/00129/0002	KTL Pre Scheme Plan Sacem Sectors Stopping Points	H
OD1/411/00229/002	TWL Pre Scheme Plan Sacem Sectors Stopping Points	J1
OD1/411/00329/002	ISL Pre Scheme Plan Sacem Sectors Stopping Points	-
752/DRW/1019	Contract No. 752 Final Scheme Plan	B
NOP->QUB->EHJ TKL Line	Contract 652 Track Layout NOP->QUB->EHJ TKL Line	-
EHJ->YAT->TIK->TKO->HAH->POA TKL Line	Contract 652 Track Layout EHJ->YAT->TIK->TKO->HAH->POA	-
TKO->TKS TKL Line	Contract 652 Track Layout TKO->TKS TKL Line	-
LAT->YAT->TIK KTL Line	Contract 652 Track Layout LAT->YAT->TIK KTL Line	-
LAT->EHJ->QUB KTL/TKL Line	Contract 652 Track Layout LAT->EHJ->QUB KTL/TKL Line	-
Depot TKL Line	Contract 652 Track Layout Depot TKL Line	-
C6014-14E/TSEG/080/001	ISL Dwell Time Requirement	A
C6014-14E/TSEG/080/002	KTL Dwell Time Requirement	A
C6014-14E/TSEG/080/003	TKL Dwell Time Requirement	A
C6014-14E/TSEG/080/004	TWL Dwell Time Requirement	A

NOTES :
1. ALL DIMENSIONS IN MM
2. MANUFACTURING DETAILS SHALL BE IN ACCORDANCE WITH P'WAY STANDARDS – S/PWY/MW/008



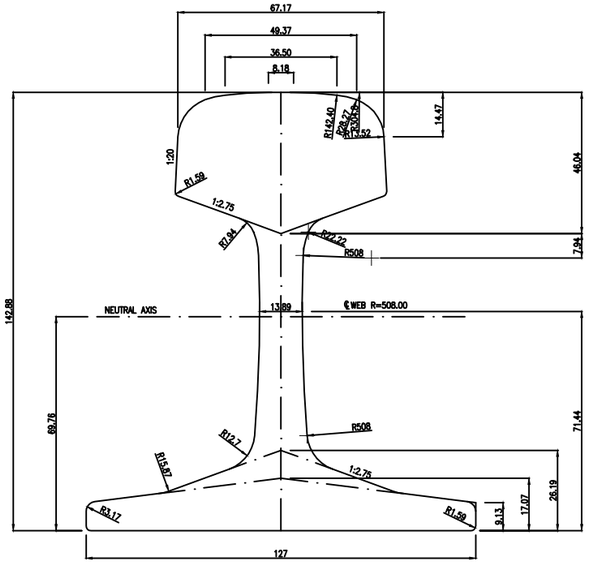
CROSS SECTIONAL AREA	: 76.70 cm^2
MASS PER METRE	: 60.21 kg/m
MOMENT OF INERTIA X–X AXIS	: 3038.3 cm^4
SECTION MODULUS–HEAD	: 333.6 cm^3
SECTION MODULUS–BASE	: 375.5 cm^3
MOMENT OF INERTIA Y–Y AXIS	: 512.3 cm^4
SECTION MODULUS Y–Y AXIS	: 68.3 cm^3

60E1 RAIL PROFILE (D)



CROSS SECTIONAL AREA	: 76.86 cm^2
MASS PER METRE	: 60.34 kg/m
MOMENT OF INERTIA X–X AXIS	: 3055 cm^4
SECTION MODULUS–HEAD	: 335.5 cm^3
SECTION MODULUS–BASE	: 377.4 cm^3
MOMENT OF INERTIA Y–Y AXIS	: 512.9 cm^4
SECTION MODULUS Y–Y AXIS	: 68.4 cm^3
RAKE	: 1.15
THERMAL BALANCE (a/b)	: 1.68

STANDARD UIC60 RAIL PROFILE



CROSS SECTIONAL AREA	: 57.21 cm^2
MASS PER METRE	: 44.91 kg/m
MOMENT OF INERTIA X–X AXIS	: 1550 cm^4
SECTION MODULUS–HEAD	: 212.1 cm^3
SECTION MODULUS–BASE	: 222.2 cm^3
MOMENT OF INERTIA Y–Y AXIS	: 283.5 cm^4
SECTION MODULUS Y–Y AXIS	: 44.6 cm^3

MODIFIED BS90A(M) RAIL PROFILE (C)

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
D	RAIL PROFILE 60E1 ADDED	P.S.CHUNG 23-09-05	W.TSE 23-09-05	ZOE TSE 23-09-05
C	BS90A(M) PROFILE UPDATED & MODIFIED UIC60 PROFILE (NOT USED) DELETED	W.Y.LI 13-05-03	K.HUNG 13-05-03	ZOE TSE 13-05-03
B	STANDARD UIC60 RAIL PROFILE ADDED	P.S.CHUNG 16-08-00	P.S.CHUNG 16-08-00	Z.TSE 16-08-00
A	DRAWING TITLE CHANGED	C.YU 02-01-98	T.TONG 02-01-98	T.WONG 02-01-98

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PWM/SK/265
PWM/SK/270
CONTRACTOR REFERENCE NO.

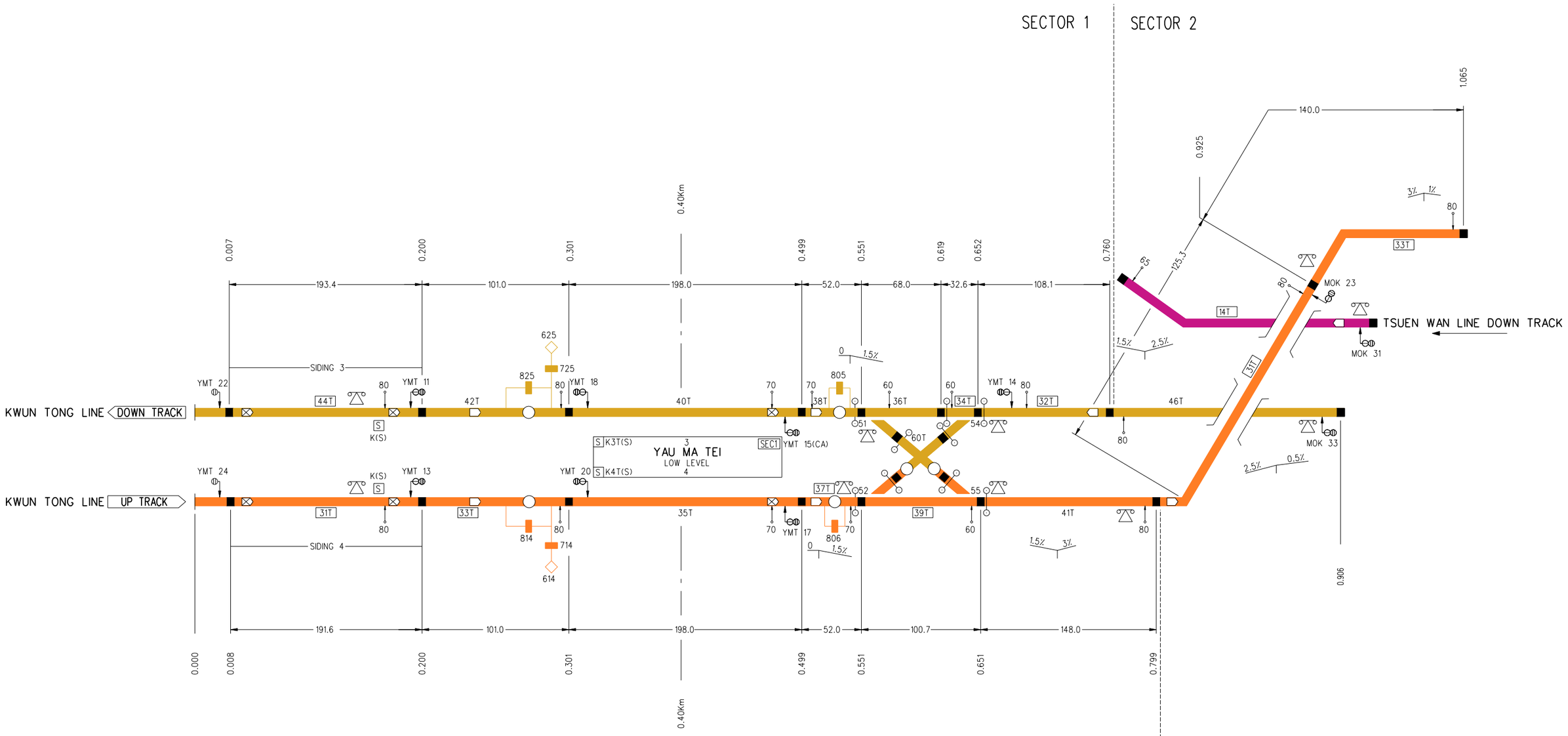
	INITIAL	DESIGNATION	DATE
DRAWN	P.S.CHUNG	PWA	28–10–1997
DESIGNED	MTRC	MTRC	28–10–1997
CHECKED	T.TONG	PWO(D)	28–10–1997
APPROVED	TERRY WONG	SE(PW)	28–10–1997
CAD FILE NAME	OD8_501_00001_0057_D		

地鐵公司 MTR Corporation

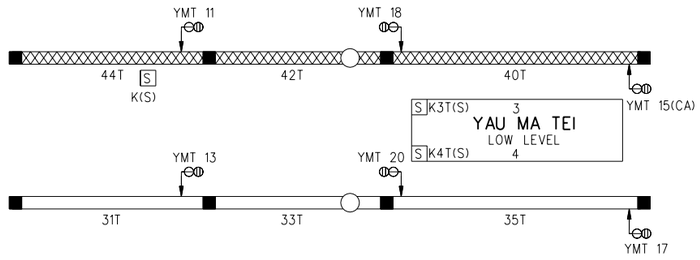
TITLE
RAIL PROFILE OF 60E1, UIC60 AND BS90A(M) SECTION

SCALE N.T.S. | OED DRAWING NO. OD8/501/00001/0057 | D

Yau Ma Tei Station



When Co-operative Keyswitch K(S) near signal YMT 11 or K3T(S) is operated:



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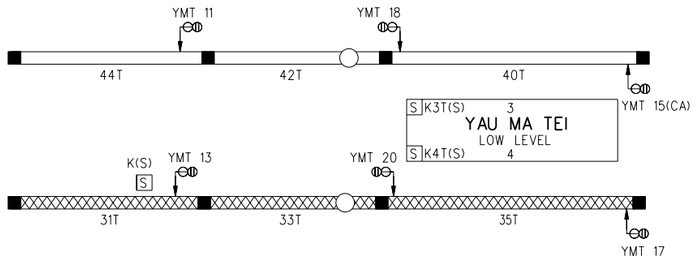


SECTOR 1 SECTOR 2

地鐵公司 MTR Corporation

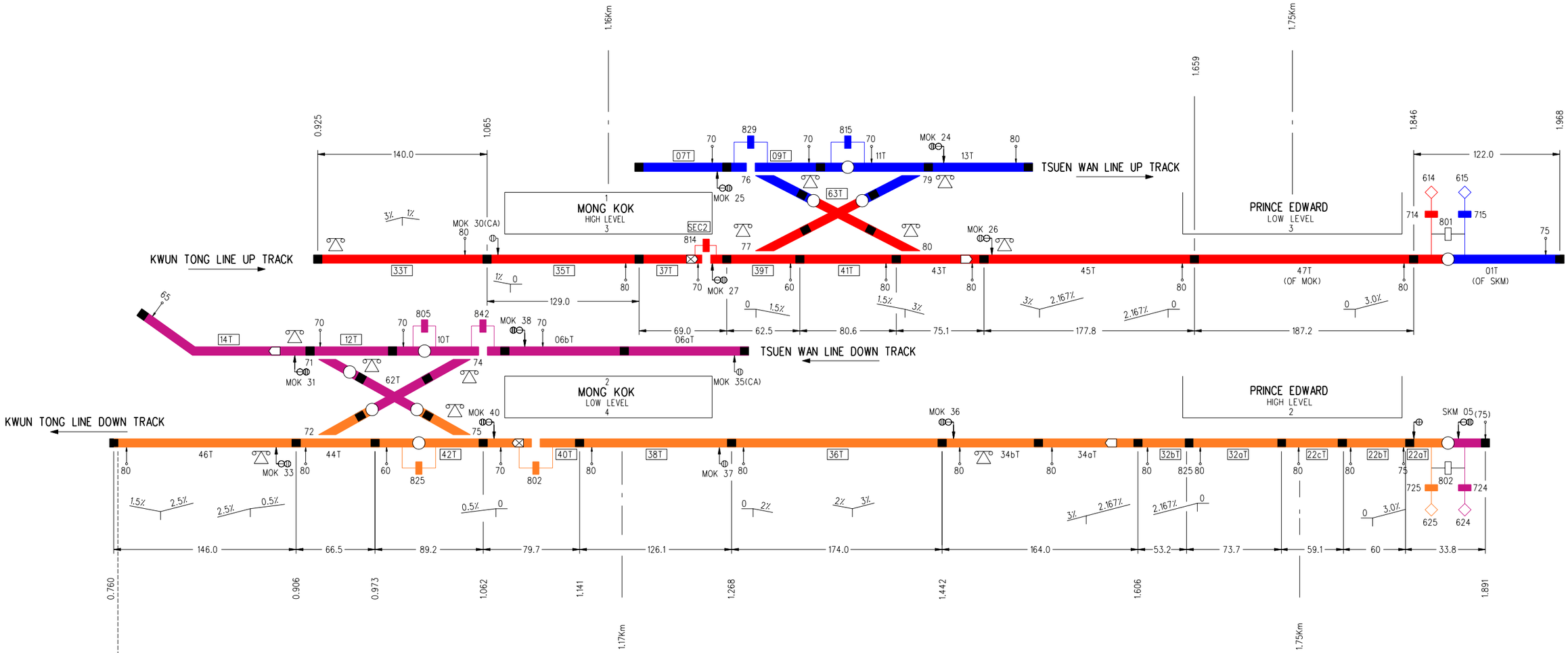
Title Yau Ma Tei Station
Track Diagrams Volume 1

(Issue/Rev: 0.9 September 2004)

DIN TD(1)-02-C1	Page 2	DWG NO. KTL/M/SQ/W02/301	A

Mong Kok Station – Prince Edward Station

SECTOR 2



DEVIATED STIB

Track Circuit	Deviation
MOK37T	+1.7m from CL
MOK40T	+1.7m from CL

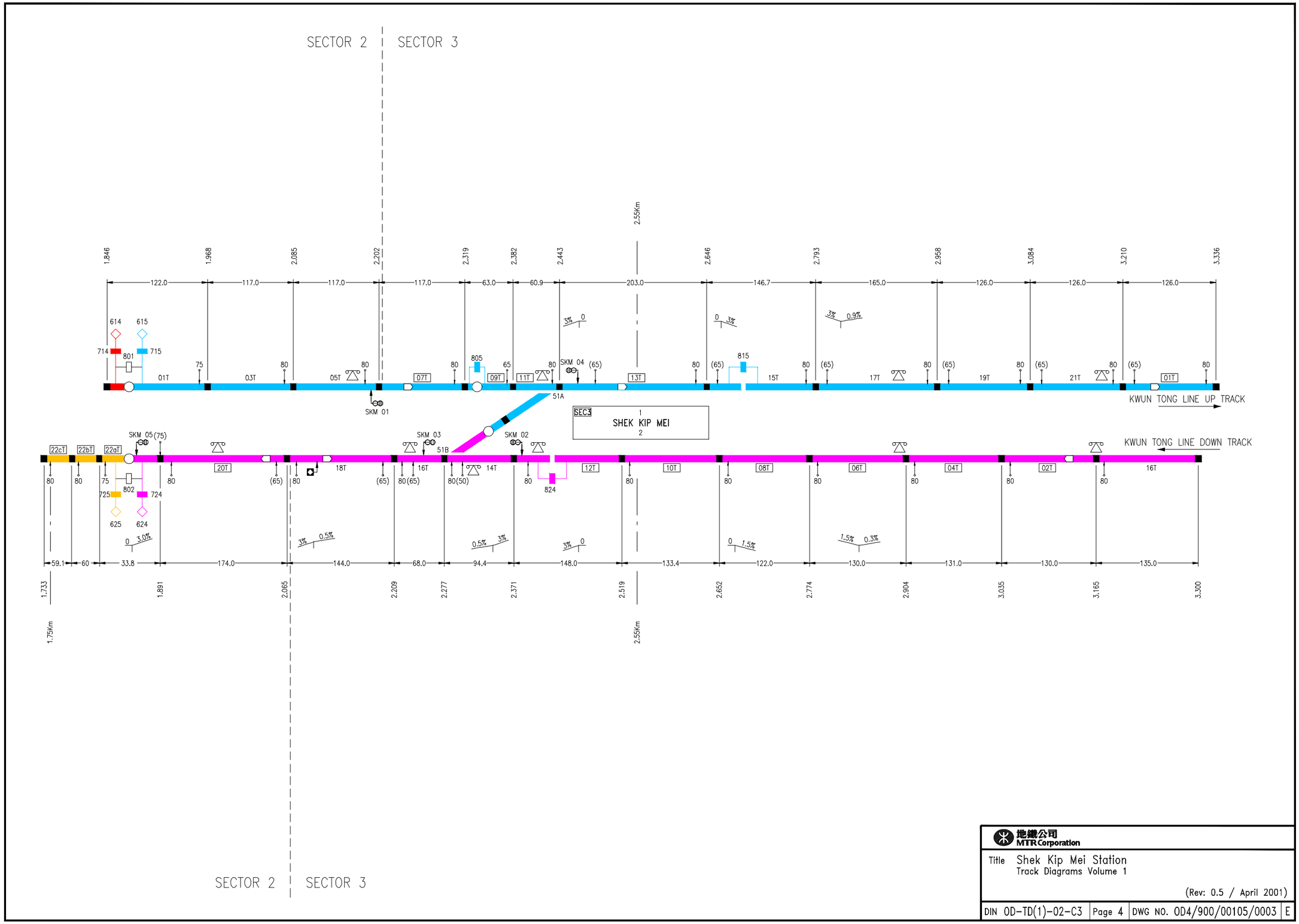
地鐵公司 MTR Corporation

Title Mong Kok Station - Prince Edward Station
Track Diagrams Volume 1

(Issue/Rev: 0.9 / September 2004)

DIN	TD(1)-02-C2	Page 3	DWG NO.	KTL/M/SQ/W02/302	A

Shek Kip Mei Station



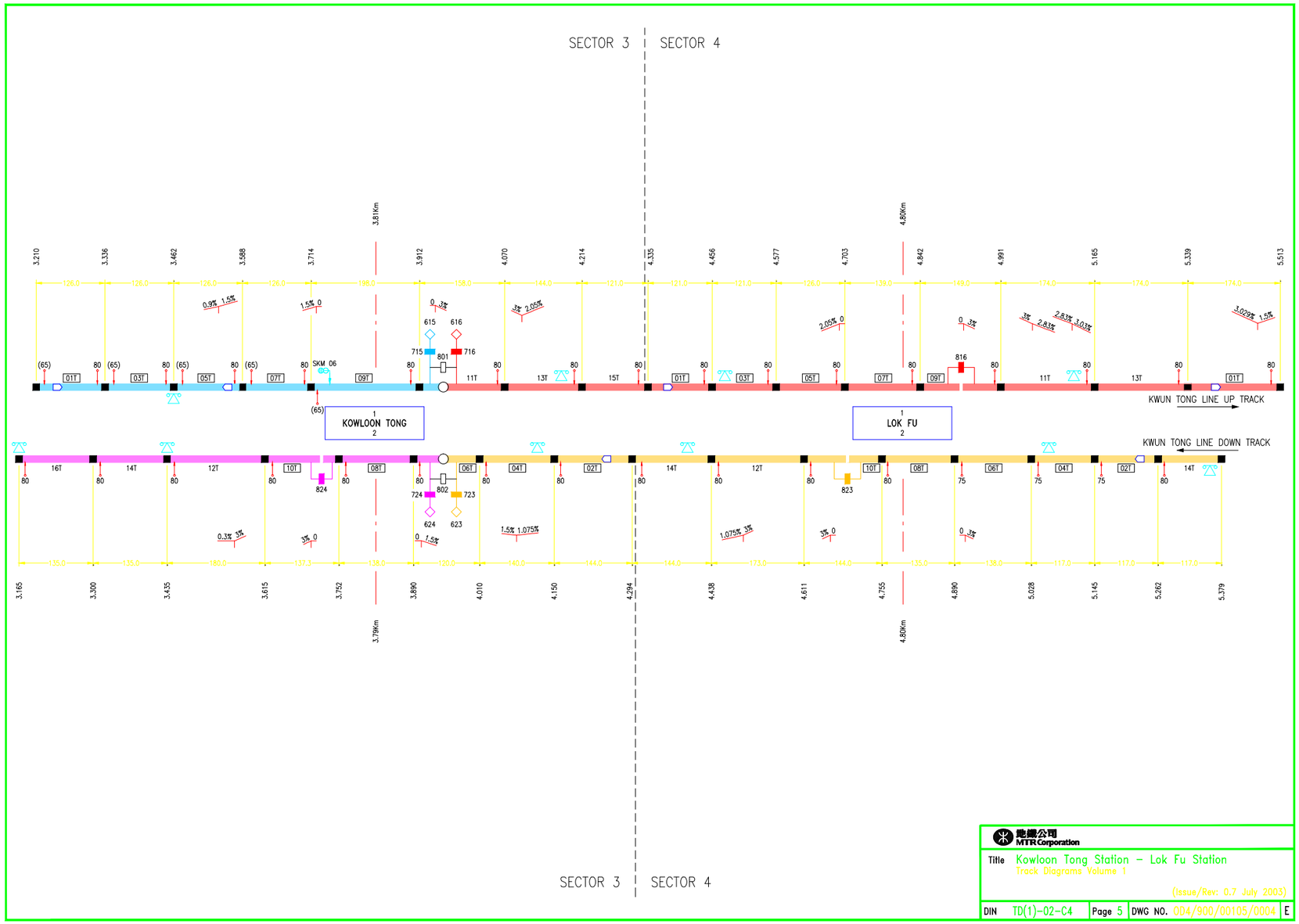
地鐵公司 MTR Corporation

Title Shek Kip Mei Station
Track Diagrams Volume 1

(Rev: 0.5 / April 2001)

DIN OD-TD(1)-02-C3	Page 4	DWG NO. OD4/900/00105/0003	E

Unregistered Version - http://www.anydwg.com



地鐵公司 MTR Corporation

Title Kowloon Tong Station – Lok Fu Station
Track Diagrams Volume 1

(Issue/Rev: 0.7 July 2003)

DIN TD(1)-02-C4 | Page 5 | DWG NO. 0D4/900/00105/0004 | E

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
E	MTIB AT KOT07T IS LOCATED AT KOT05T INSTEAD	KSK 08-07-03	K. MARK 08-07-03	
D	ADDITIONAL & UPDATED INFORMATION (101044)	DIXON K. 11-11-99	KEVIN LO 11-11-99	STANLEY S. 11-11-99
C	ADDITIONAL & UPDATED INFORMATION	DIXON K. 6-11-98	JENNY C. 20-11-98	STANLEY S. 20-11-98

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MTRC REFERENCE NO.
TD(1)-02-C4

CONTRACTOR REFERENCE NO.

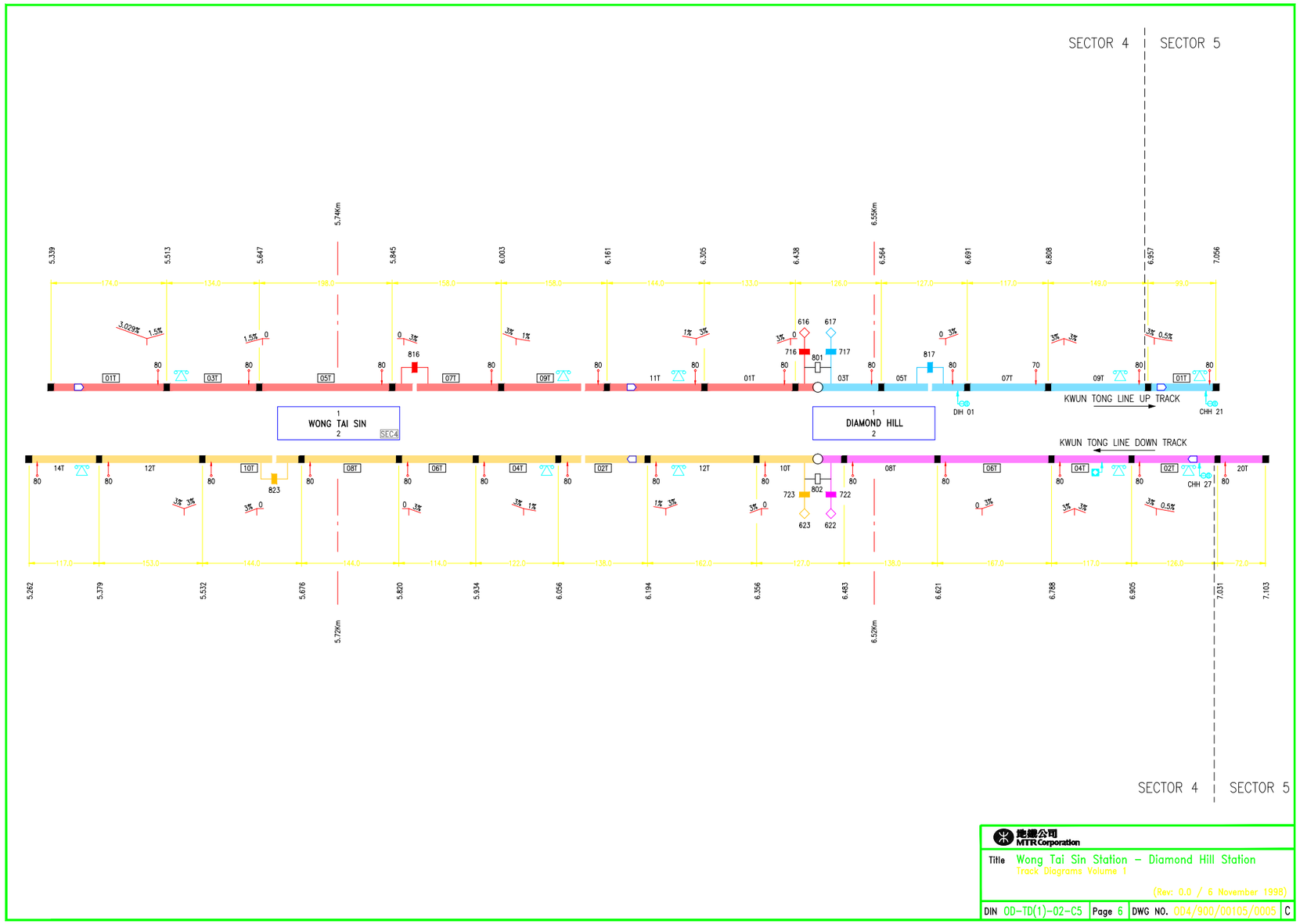
	INITIAL	DESIGNATION	DATE
DRAWN	C.M.YIU	D'MAN	23-5-90
DESIGNED			
CHECKED			
APPROVED			

CAD FILE NAME 00105004

地鐵公司 MTR Corporation

TITLE KOWLOON TONG STATION – LOK FU STATION
TRACK DIAGRAMS VOLUME 1

SCALE NTS | OED DRAWING NO. 0D4/900/00105/0004 | E



地鐵公司 MTR Corporation

Title Wong Tai Sin Station – Diamond Hill Station
Track Diagrams Volume 1

(Rev: 0.0 / 6 November 1998)

DIN OD-TD(1)-02-C5 | Page 6 | DWG NO. OD4/900/00105/0005 | C

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
C	ADDITIONAL & UPDATED INFORMATION	DIXON K. 6-11-98	JENNY C. 20-11-98	STANLEY S. 20-11-98

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MTRC REFERENCE NO.
OD-TD(1)-02-C5

CONTRACTOR REFERENCE NO.

	INITIAL	DESIGNATION	DATE
DRAWN	C.M.YIU	D'MAN	23-5-90
DESIGNED			
CHECKED			
APPROVED			

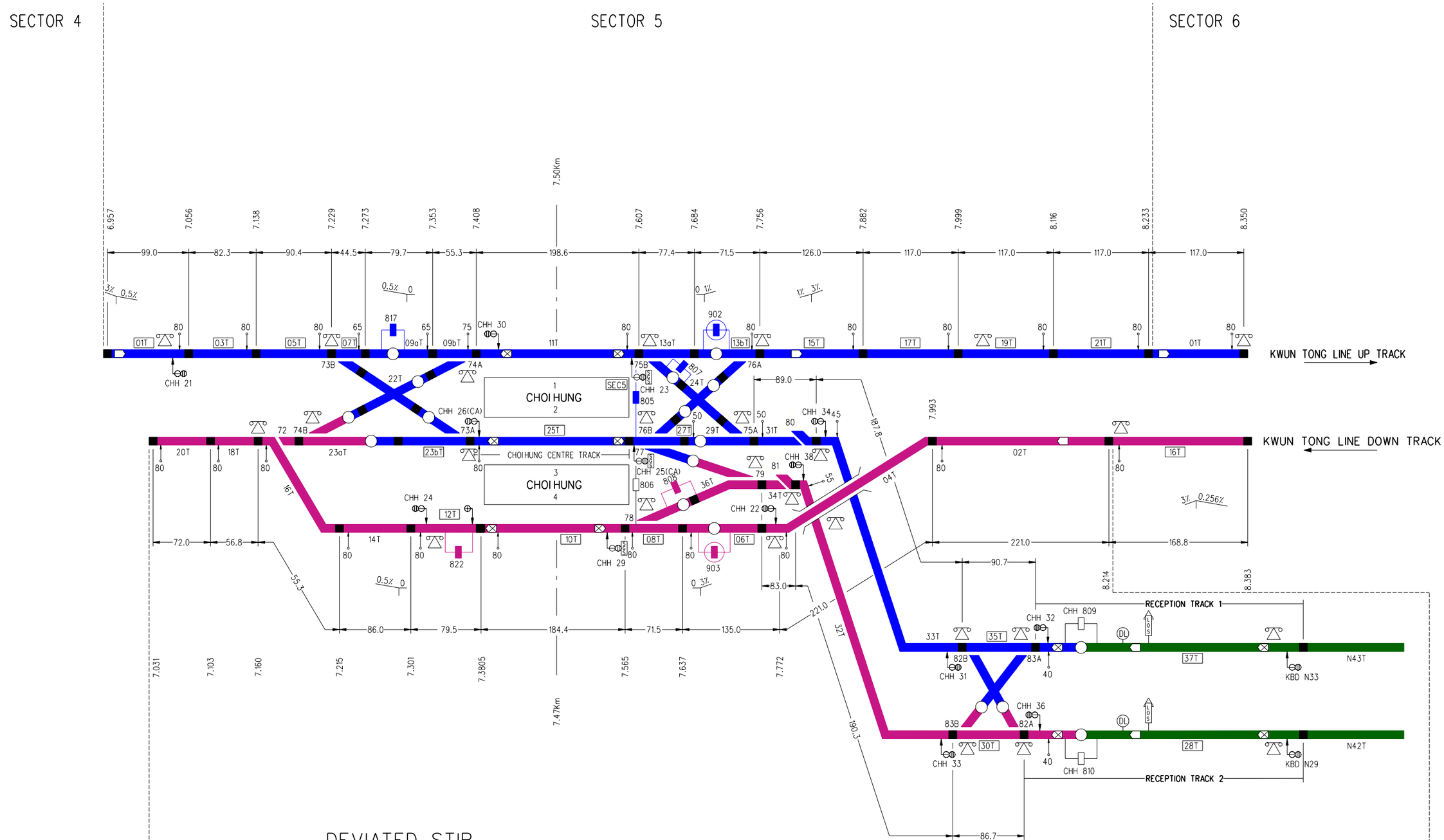
CAD FILE NAME 00105005

地鐵公司 MTR Corporation

TITLE WONG TAI SIN STATION – DIAMOND HILL STATION
TRACK DIAGRAMS VOLUME 1

SCALE NTS | OED DRAWING NO. OD4/900/00105/0005 | C

Choi Hung Station



DEVIATED STIB

Track Circuit	Deviation
CHH11T	+1.4m from CL
CHH25T (UP)	+1.3m from CL
CHH25T (DN)	+1.1m from CL

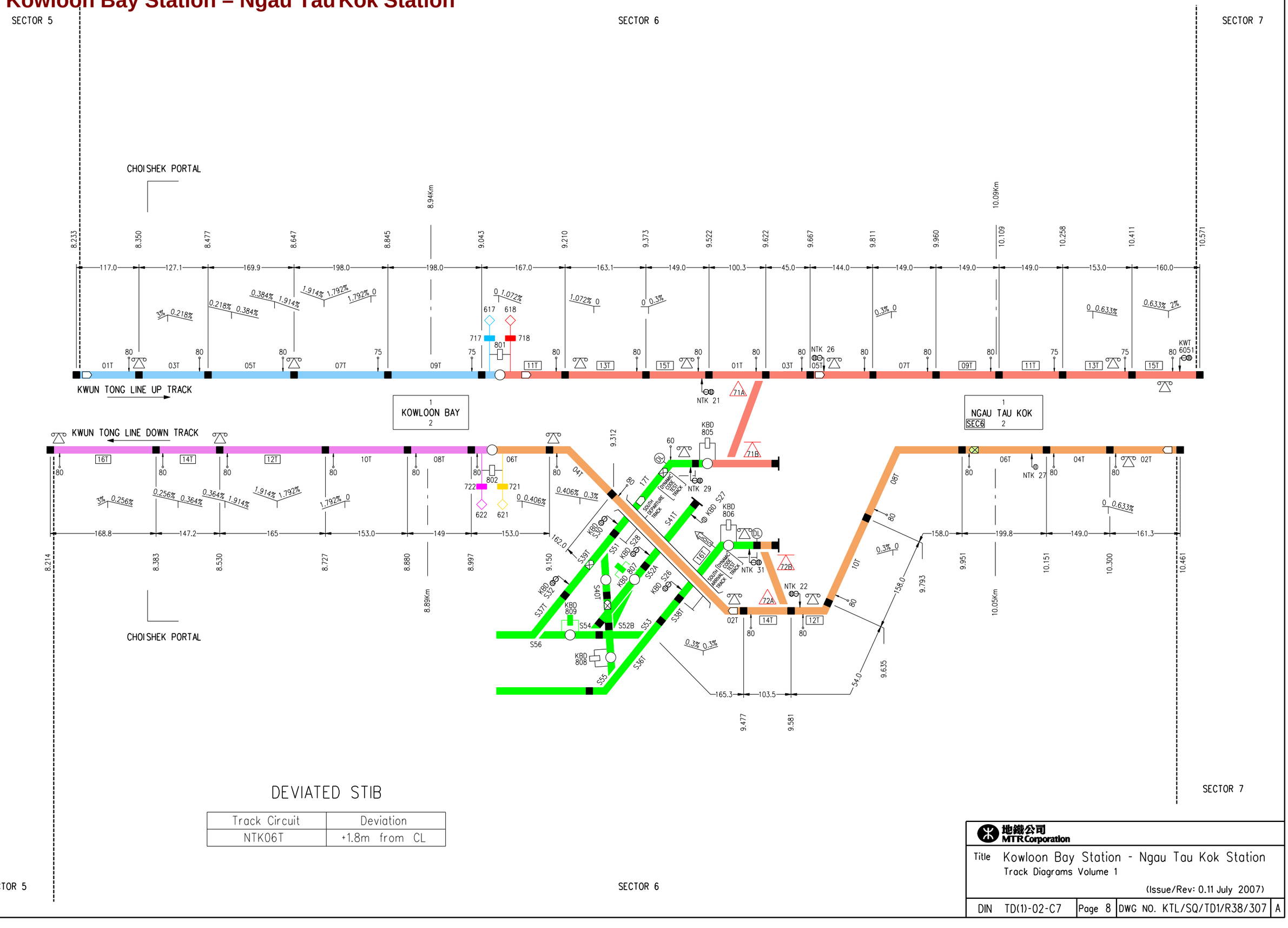
地鐵公司 MTR Corporation

Title Choi Hung Station
Track Diagrams Volume 1

(Issue/Rev: 0.9 / September 2004)

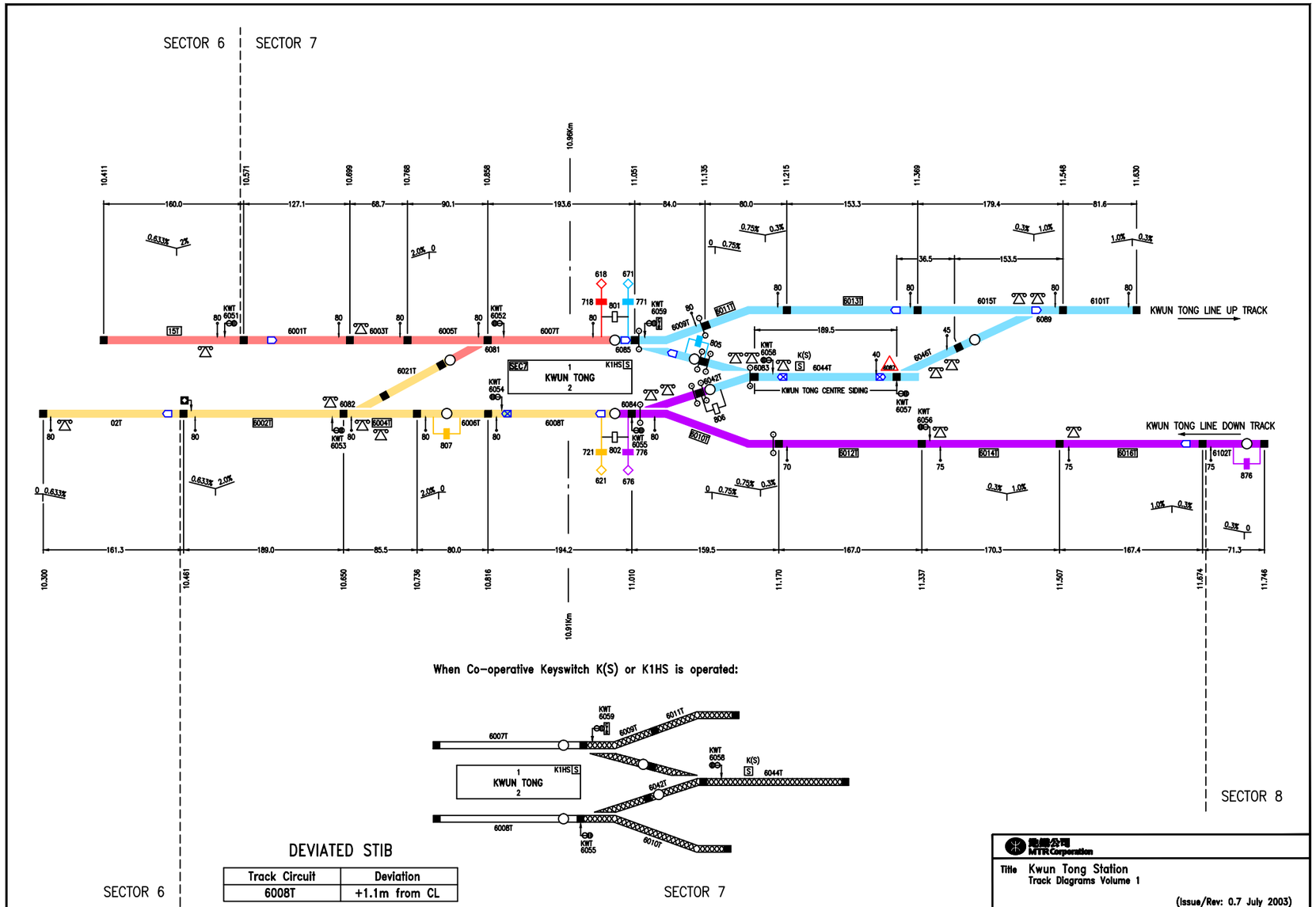
DIN	TD(1)-02-C6	Page 7	DWG NO. KTL/M/SQ/W02/306	A

Kowloon Bay Station – Ngau Tau Kok Station



DEVIATED STIB

Track Circuit	Deviation
NTK06T	+1.8m from CL



DEVIATED STIB

Track Circuit	Deviation
6008T	+1.1m from CL

Title	Kwun Tong Station Track Diagrams Volume 1
	(Issue/Rev: 0.7 July 2003)
DIN	TD(1)-02-C8
Page	9
DWG NO.	0D4/900/00105/0008 E

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
E	DEVIATED STIB SPECIFIED, MTB ADDED TO KWT6007T	KSK 08-07-03	K. MARK 08-07-03	
D	ADDITIONAL & UPDATED INFORMATION	P.C.YU 03-08-99	JENNY C. 09-08-99	STANLEY S. 09-08-99
C	ADDITIONAL & UPDATED INFORMATION	DIXON K. 6-11-98	JENNY C. 20-11-98	STANLEY S. 20-11-98

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MTRC REFERENCE NO. TD(1)-02-C8

CONTRACTOR REFERENCE NO.

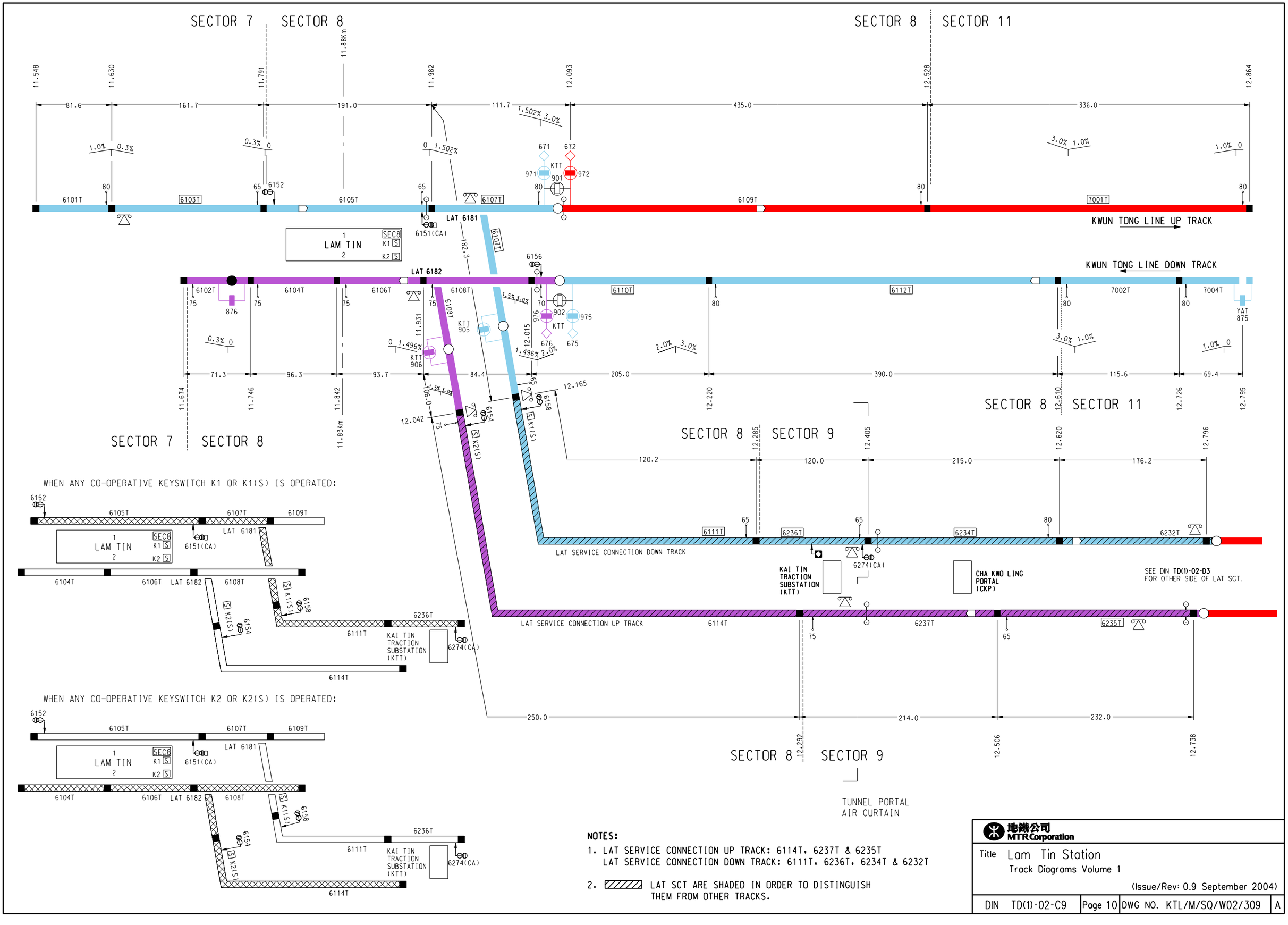
	INITIAL	DESIGNATION	DATE
DRAWN	C.M.YIU	D'MAN	23-5-90
DESIGNED			
CHECKED			
APPROVED			
CAD FILE NAME	00105008		

地鐵公司 MTR Corporation

TITLE KWUN TONG STATION
TRACK DIAGRAMS VOLUME 1

SCALE NTS | OED DRAWING NO. 0D4/900/00105/0008 | E

Lam Tin Station



WHEN ANY CO-OPERATIVE KEYSWITCH K1 OR K1(S) IS OPERATED:

WHEN ANY CO-OPERATIVE KEYSWITCH K2 OR K2(S) IS OPERATED:

NOTES:

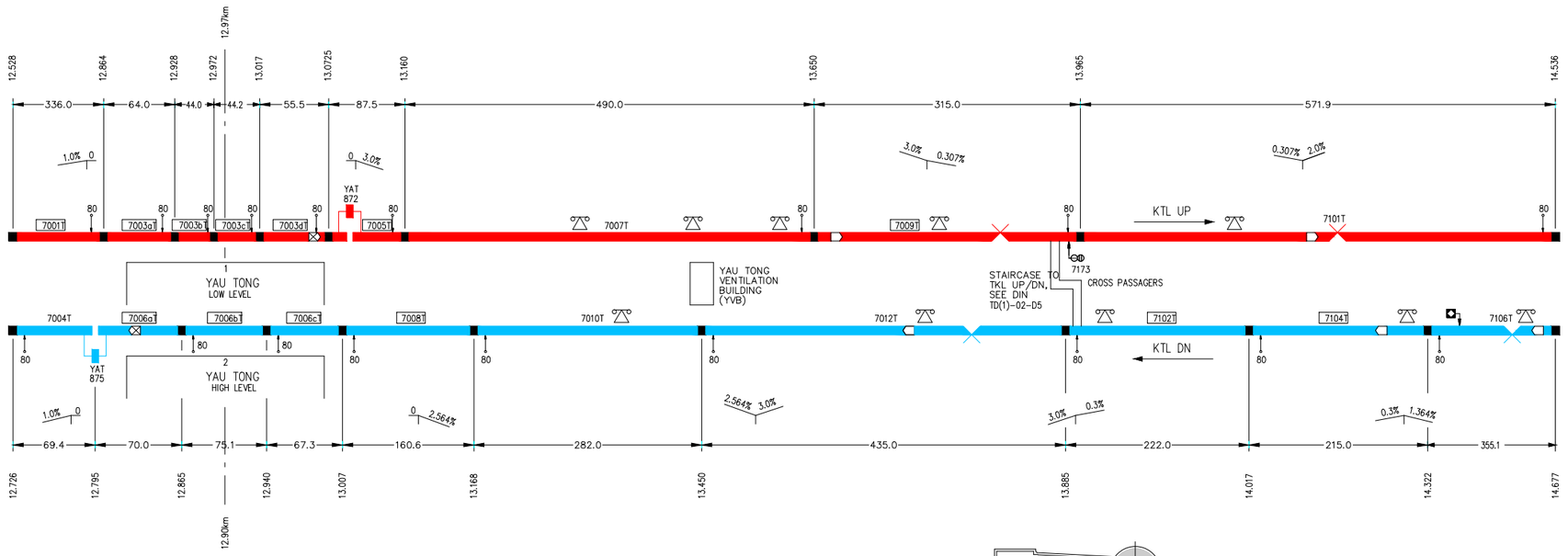
1. LAT SERVICE CONNECTION UP TRACK: 6114T, 6237T & 6235T
   LAT SERVICE CONNECTION DOWN TRACK: 6111T, 6236T, 6234T & 6232T

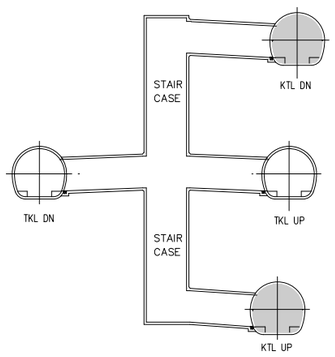
2. ▨ LAT SCT ARE SHADED IN ORDER TO DISTINGUISH THEM FROM OTHER TRACKS.

地鐵公司 MTR Corporation

Title Lam Tin Station
Track Diagrams Volume 1
(Issue/Rev: 0.9 September 2004)

SECTOR 11





SECTOR 11

SECTION OF SUB-SHAFT OF CROSS PASSAGES

地鐵公司 MTR Corporation

Title Yau Tong Station (Kwun Tong Line)
Track Diagrams Volume 1

(Issue/Rev: 0.7 July 2003)

DIN TD(1)-02-C10 Page 11 DWG NO. OD4/900/00105/1031A

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
A	TKE ADDED - YAT OF KTL	KSK 08-07-03	K. MARK 08-07-03	

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MTRC REFERENCE NO.
TD(1)-02-C10

CONTRACTOR REFERENCE NO.

	INITIAL	DESIGNATION	DATE
DRAWN			
DESIGNED			
CHECKED			
APPROVED			

CAD FILE NAME 00105031.DGN

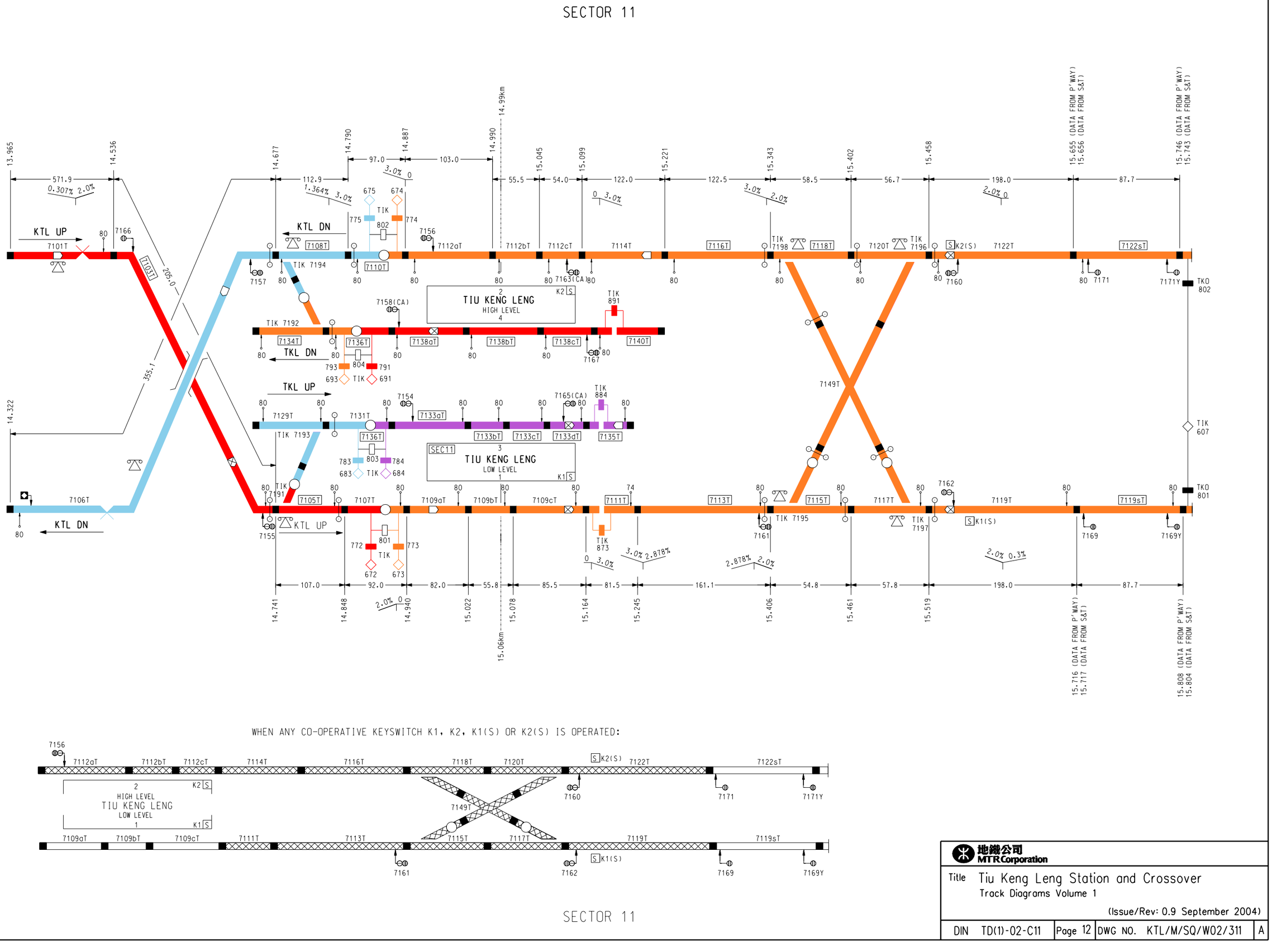
地鐵公司 MTR Corporation

TITLE YAU TONG STATION (KWUN TONG LINE)
TRACK DIAGRAMS VOLUME 1

SCALE NIL

OED DRAWING NO. OD4/900/00105/1031 A

Tiu Keng Leng Station and Crossover

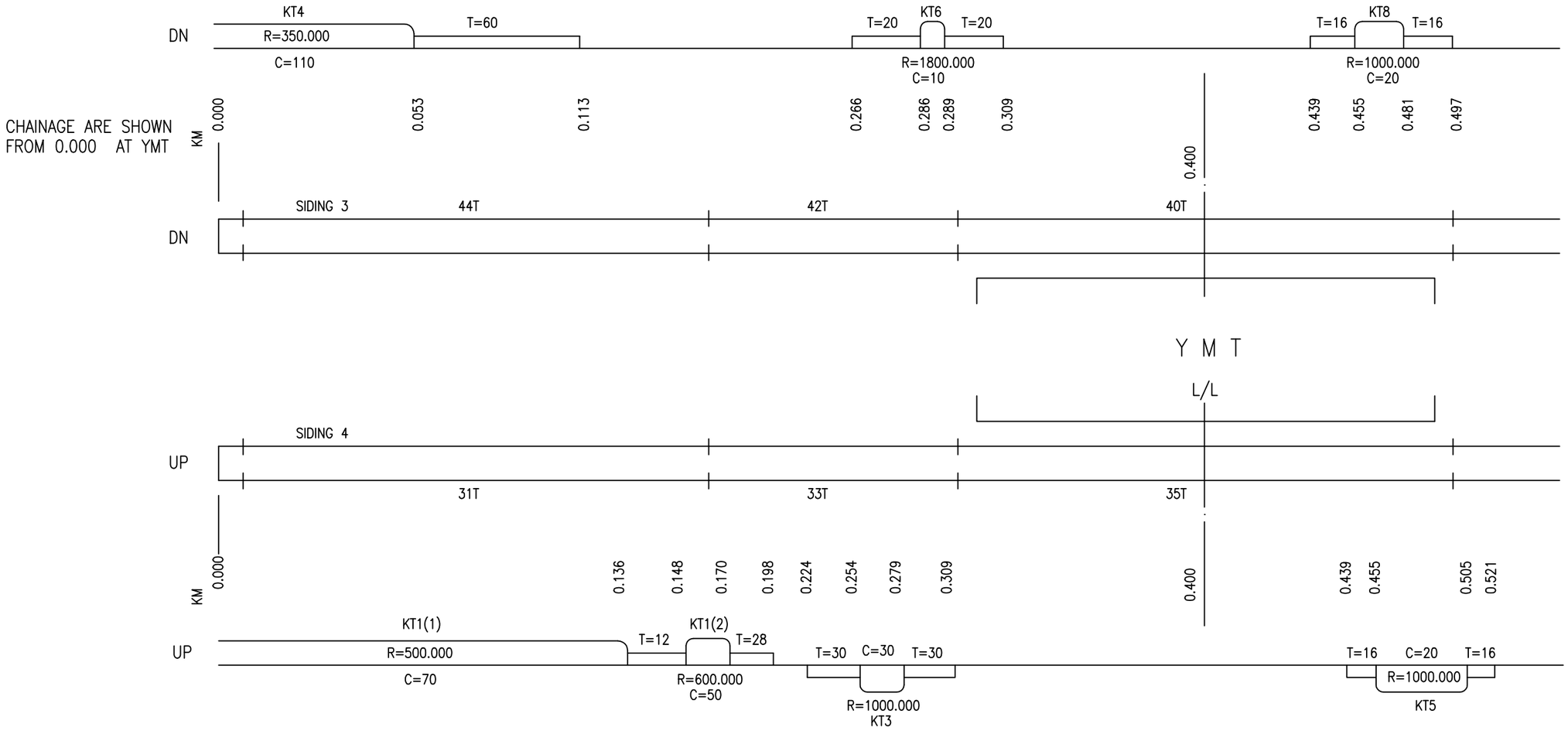


地鐵公司 MTR Corporation

Title Tiu Keng Leng Station and Crossover
Track Diagrams Volume 1

(Issue/Rev: 0.9 September 2004)

DIN TD(1)-02-C11 | Page 12 | DWG NO. KTL/M/SQ/W02/311 | A



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	CHAINAGE UPDATED TO THE NEAREST METER	P.S.CHUNG 02-08-06	P.S.CHUNG 02-08-06	K.HUNG 02-08-06
A	DIGITIZATION	Y32 15-12-93	T.TONG 04-01-95	R.KEEFE 04-01-95

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/KTL/001

	INITIAL	DESIGNATION	DATE
DRAWN	Y32	ZESTC	15-12-1993
DESIGNED			
CHECKED			
APPROVED			

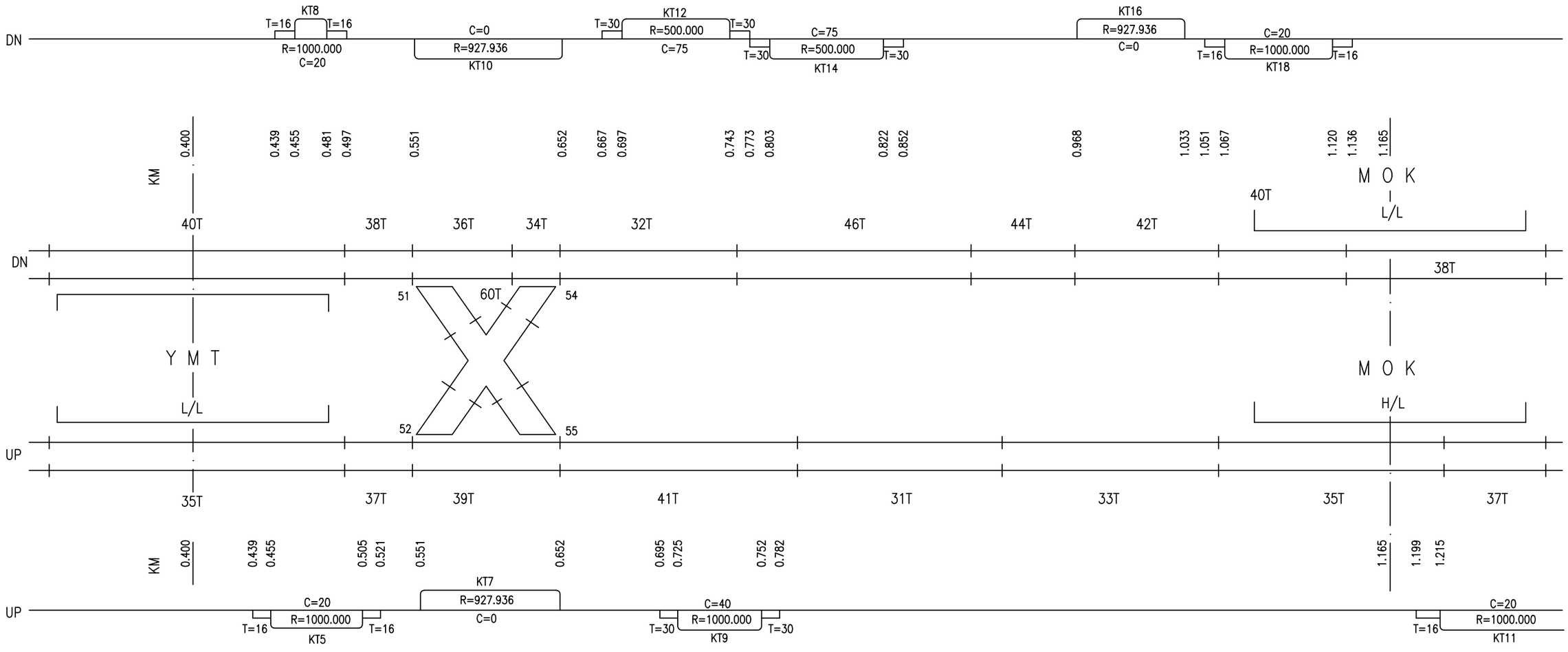
CAD FILE NAME 0D4_501_00104_0003_B

地鐵公司 MTR Corporation

TITLE
YMT SIDINGS – YMT
LINE DIAGRAM – KTL

SCALE N.T.S.

OED DRAWING NO. 0D4/501/00104/0003 B



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	CURVE KT10, KT12, KT14 & KT18 AMENDED	P.S.CHUNG 15-08-06	P.S.CHUNG 15-08-06	K.HUNG 15-08-06
A	DIGITIZATION	Y46 04-01-95	T.TONG 04-01-95	R.KEEFE 04-01-95

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/KTL/002

	INITIAL	DESIGNATION	DATE
DRAWN	Y46	ZESTC	11-12-1993
DESIGNED			
CHECKED			
APPROVED			
CAD FILE NAME	0D4_501_00104_0004_B		

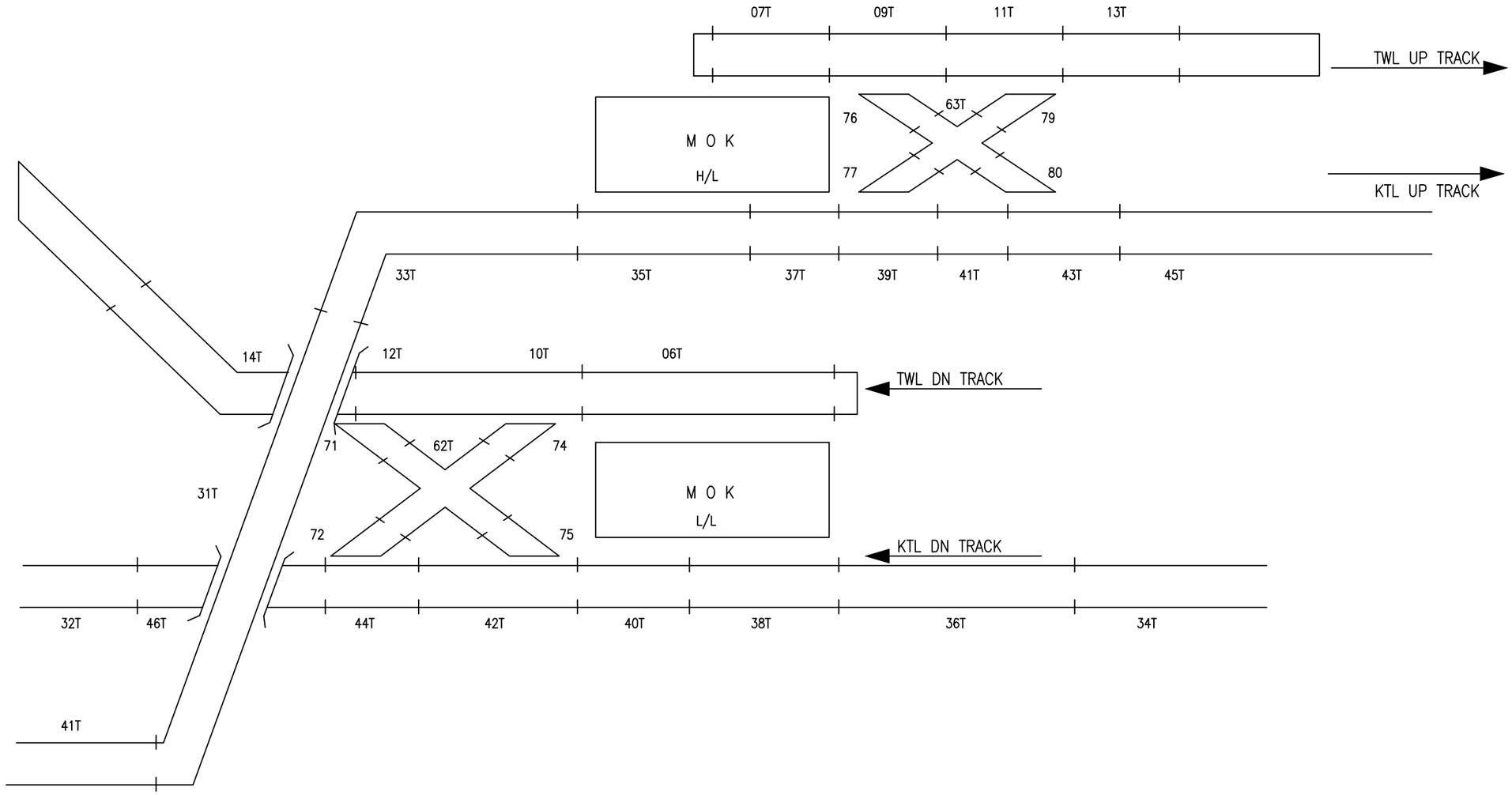
地鐵公司 MTR Corporation

TITLE
YMT – MOK
LINE DIAGRAM – KTL

SCALE N.T.S.

OED DRAWING NO. 0D4/501/00104/0004 | B

OD4/501/00104/005 A



REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE
A	DIGITIZATION	TONG	TM(PW)	10-12-93

REFERENCE DWGS

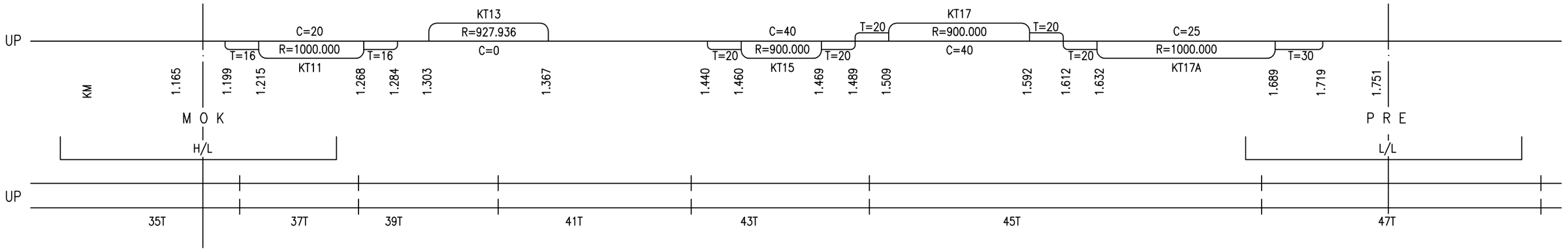
CONTRACTOR'S DRAWING NO.
PWM/KTL/003

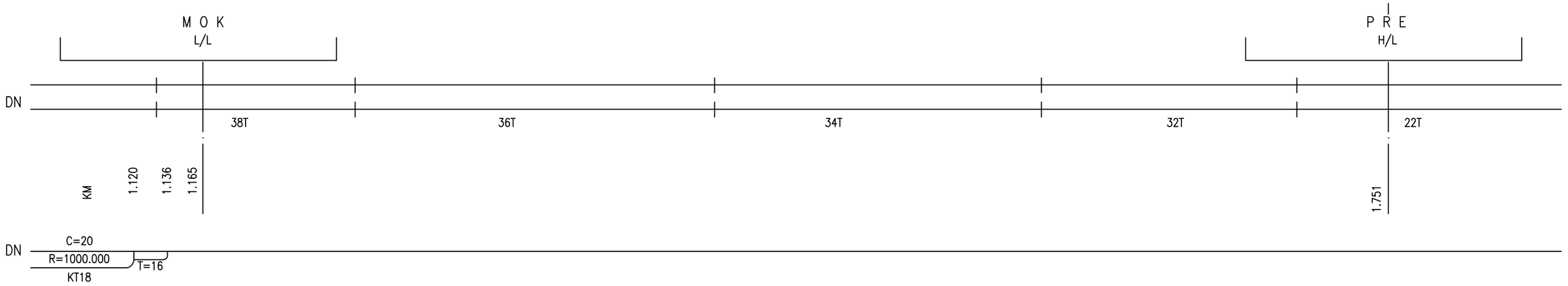
	INITIAL	DESIGNATION	DATE
TRACED BY	Y42	ZESTC	10-12-93
DESIGNED BY			
CHECKED BY	T. HO	PWO	13-1-95
APPROVED BY	R. KEEFE	TM(PW)	13-1-95
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.	317344V1		

MASS TRANSIT RAILWAY CORPORATION

TITLE
MOK
LINE DIAGRAM – KTL

SCALE NTS | DWG NO. OD4/501/00104/005 A





REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	CURVE KT11, 15, 17, 17A AMENDED	P.S.CHUNG 15-08-06	P.S.CHUNG 15-08-06	K.HUNG 15-08-06
A	DIGITIZATION	Y44 16-12-93	T.TONG 04-01-95	R.KEEFE 04-01-95

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/KTL/004

	INITIAL	DESIGNATION	DATE
DRAWN	Y44	ZESTC	16-12-1993
DESIGNED			
CHECKED			
APPROVED			

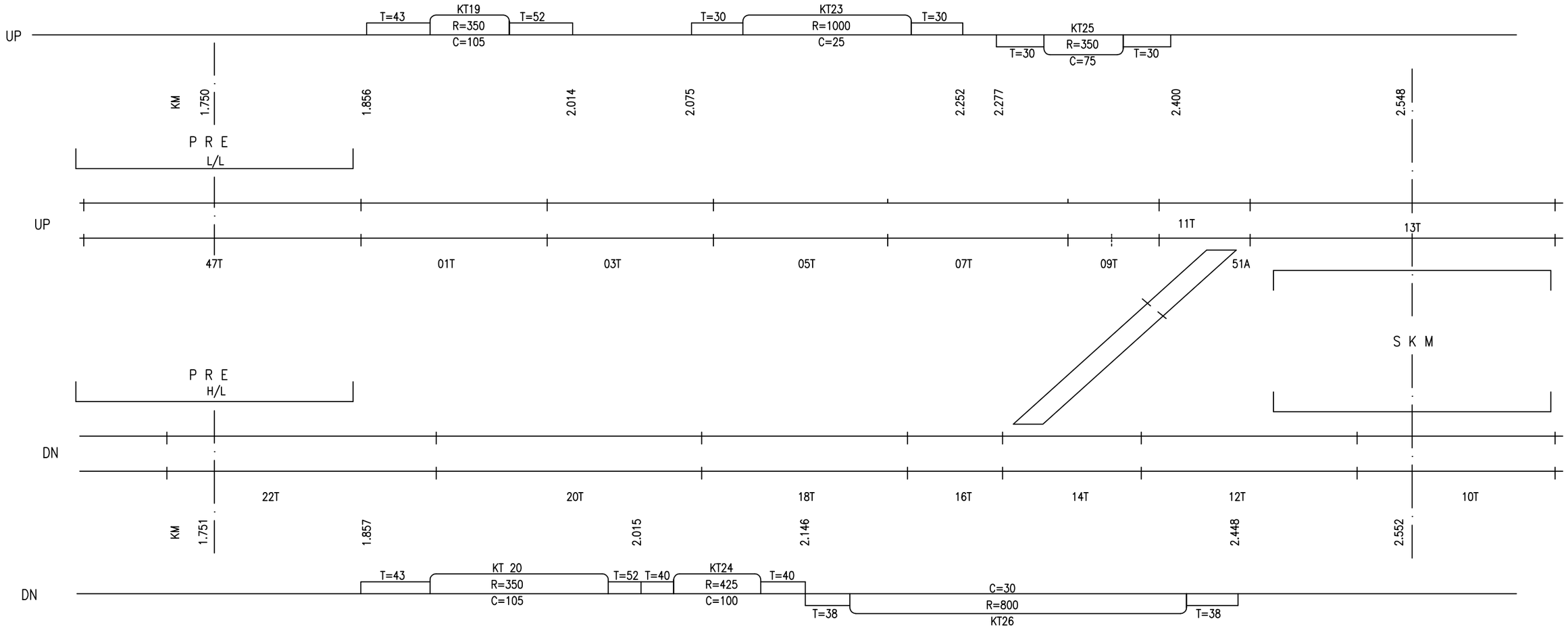
CAD FILE NAME 0D4_501_00104_0006_B

地鐵公司 MTR Corporation

TITLE
MOK – PRE
LINE DIAGRAM – KTL

SCALE N.T.S.

OED DRAWING NO. 0D4/501/00104/0006 B



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	ALIGNMENT DATA FOR CURVE KT19, KT20, KT26 AMENDED	P.S.CHUNG 05-06-01	P.S.CHUNG 05-06-01	M.T.WONG 05-06-01
A	DIGITIZATION	Y41 11-12-93	T.TONG 04-01-95	R.KEEFE 04-01-95

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MTRC REFERENCE NO.

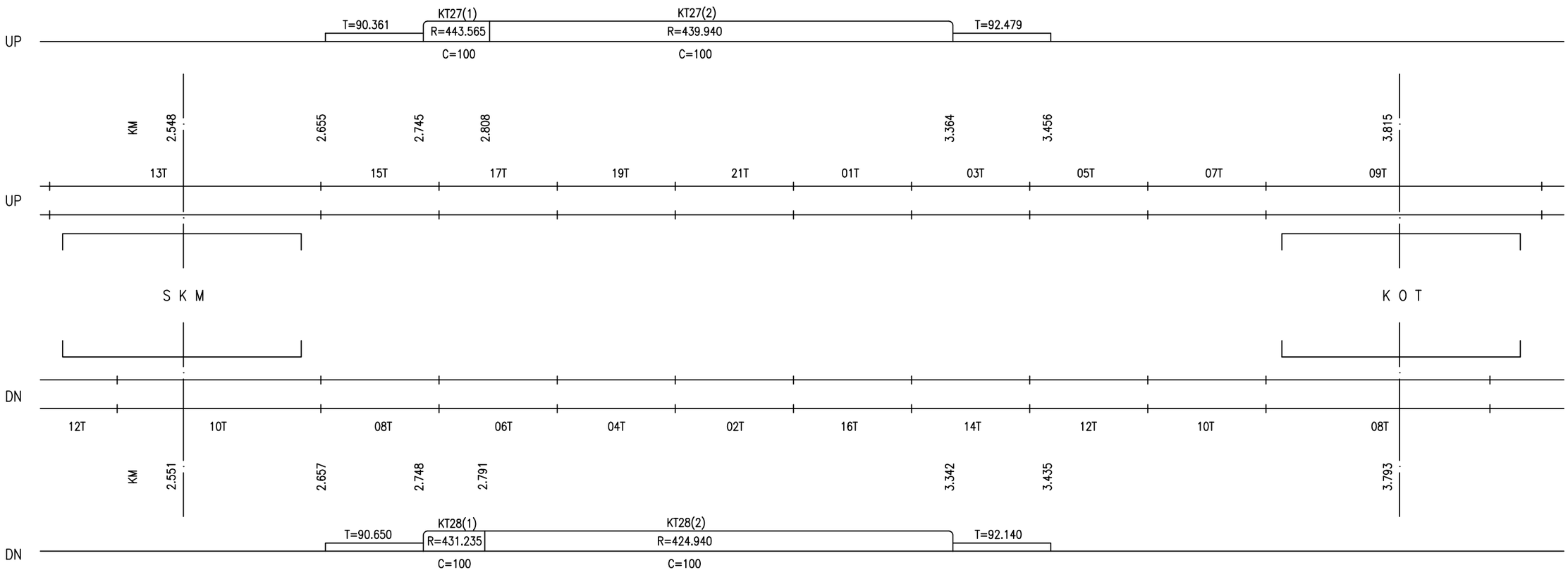
CONTRACTOR REFERENCE NO.
PWM/KTL/005

	INITIAL	DESIGNATION	DATE
DRAWN	Y41	ZESTC	11-12-1993
DESIGNED			
CHECKED			
APPROVED			
CAD FILE NAME	317346V1		

地鐵公司 MTR Corporation

TITLE
PRE-SKM
LINE DIAGRAM - KTL

SCALE N.T.S.
OED DRAWING NO. OD4/501/00104/0007 B



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	TRANSITION LENGTH FOR KT28(1) AMENDED	P.S.CHUNG 15-08-06	P.S.CHUNG 15-08-06	K.HUNG 15-08-06
A	DIGITIZATION	Y49 11-12-93	TIM HO 04-01-95	R.KEEFE 04-01-95

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/KTL/006

	INITIAL	DESIGNATION	DATE
DRAWN	Y48	ZESTC	11-12-1993
DESIGNED			
CHECKED			
APPROVED			

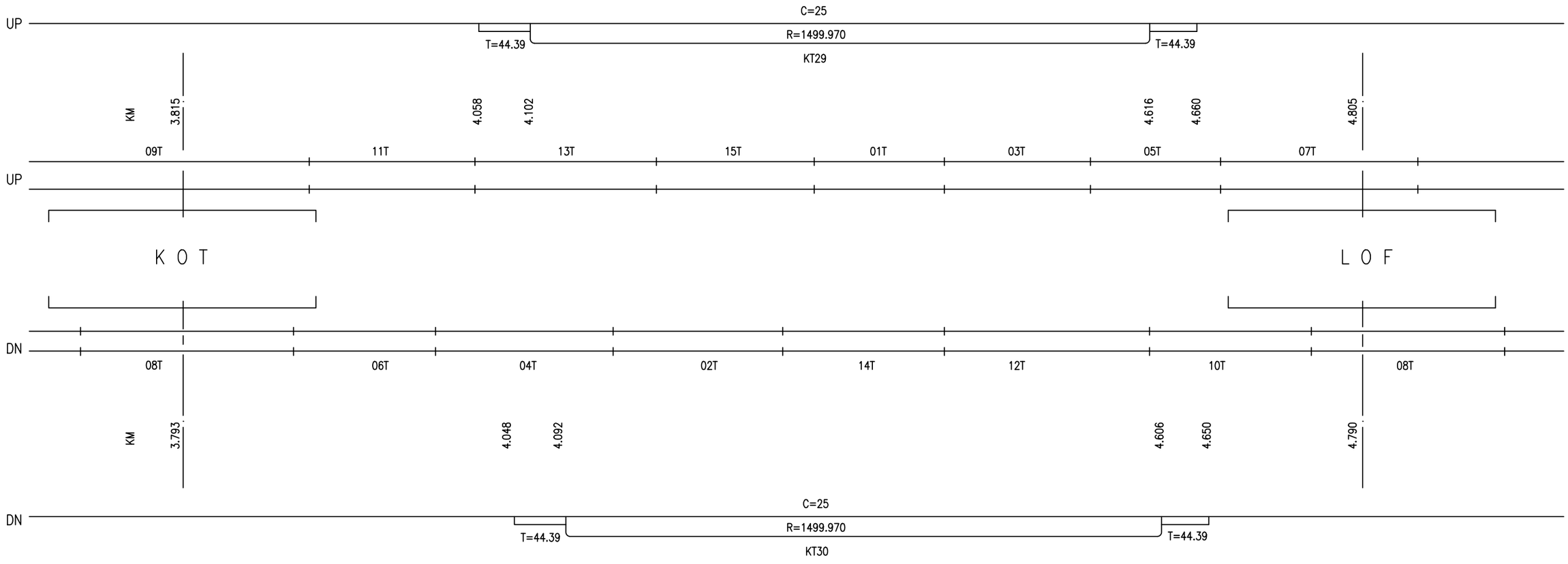
CAD FILE NAME 0D4_501_00104_0008_B

地鐵公司 MTR Corporation

TITLE
SKM – KOT
LINE DIAGRAM – KTL

SCALE N.T.S.

OED DRAWING NO. 0D4/501/00104/0008 B



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	CHAINAGE UPDATED TO THE NEAREST METER	P.S.CHUNG 02-08-06	P.S.CHUNG 02-08-06	K.HUNG 02-08-06
A	DIGITIZATION	Y27 13-12-95	T.TONG 04-01-95	R.KEEFE 04-01-95

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/KTL/007

	INITIAL	DESIGNATION	DATE
DRAWN	Y27	ZESTC	13-12-1993
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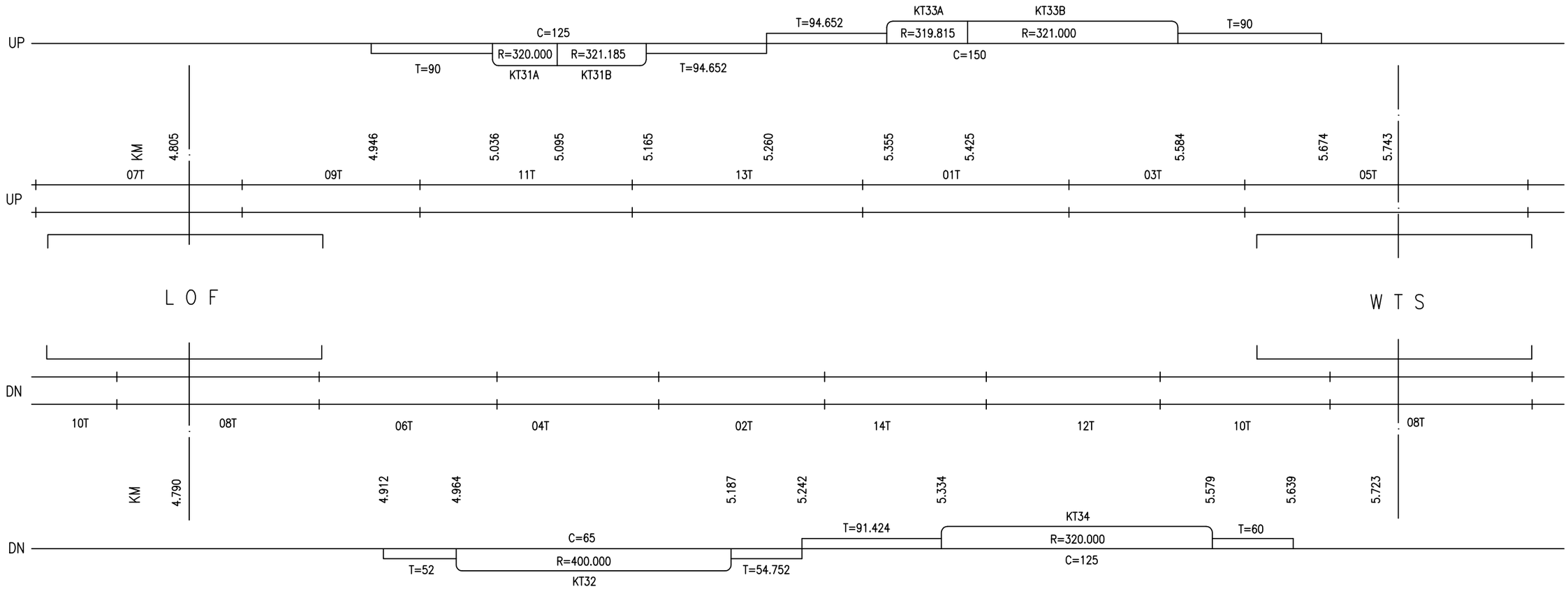
CHECKED			
APPROVED			
CAD FILE NAME	0D4_501_00104_0009_B		

地鐵公司 MTR Corporation

TITLE
KOT – LOF
LINE DIAGRAM – KTL

SCALE N.T.S.

OED DRAWING NO. 0D4/501/00104/0009 | B



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	CHAINAGE UPDATED TO THE NEAREST METER	P.S.CHUNG 02-08-06	P.S.CHUNG 02-08-06	K.HUNG 02-08-06
A	DIGITIZATION	Y4 15-12-93	T.TONG 13-01-95	R.KEEFE 13-01-95

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/KTL/008

	INITIAL	DESIGNATION	DATE
DRAWN	Y4	ZESTC	14-12-1993
DESIGNED			
CHECKED			
APPROVED			

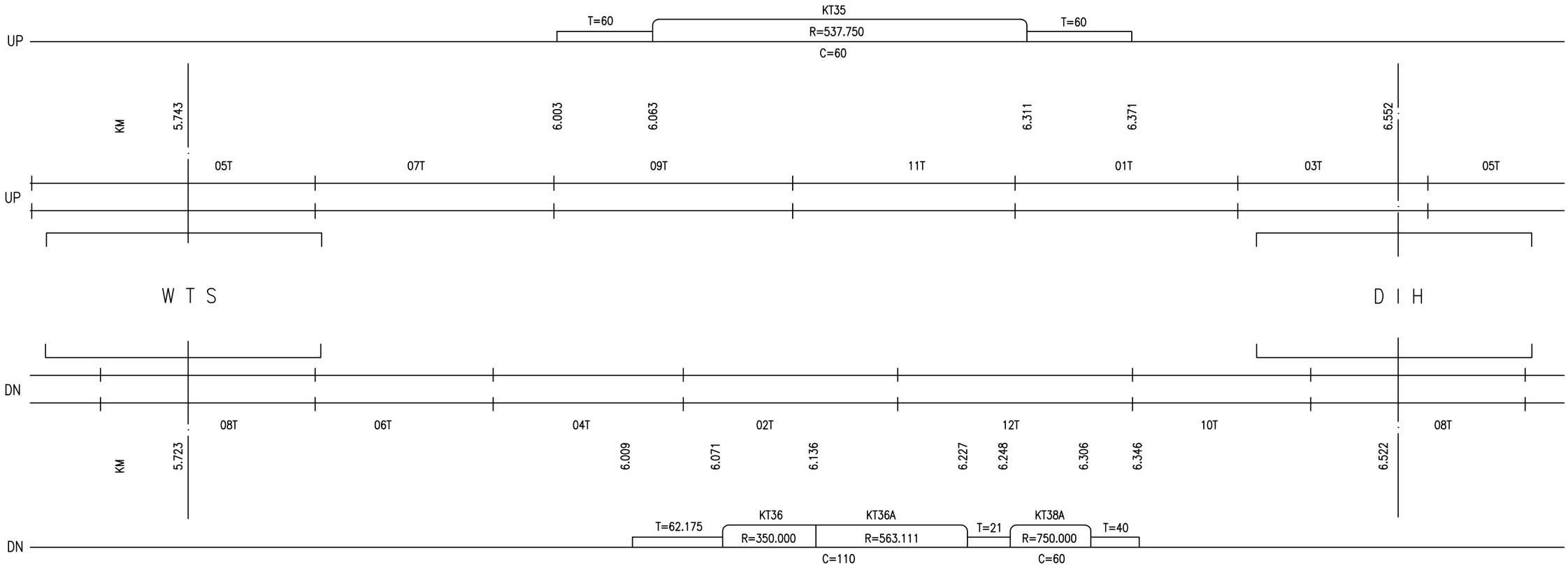
CAD FILE NAME 0D4_501_00104_0010_B

地鐵公司 MTR Corporation

TITLE
LOF – WTS
LINE DIAGRAM – KTL

SCALE N.T.S.

OED DRAWING NO. 0D4/501/00104/0010 B



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	KM UPDATED TO THE NEAREST METER	P.S.CHUNG 25-08-06	P.S.CHUNG 25-08-06	K.HUNG 25-08-06
A	DIGITIZATION	Y38 14-12-93	T.TONG 04-01-95	R.KEEFE 04-01-95

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CONTRACTOR REFERENCE NO.
PWM/KTL/009

	INITIAL	DESIGNATION	DATE
DRAWN	Y38	ZESTC	14-12-1993
DESIGNED			
CHECKED			
APPROVED			

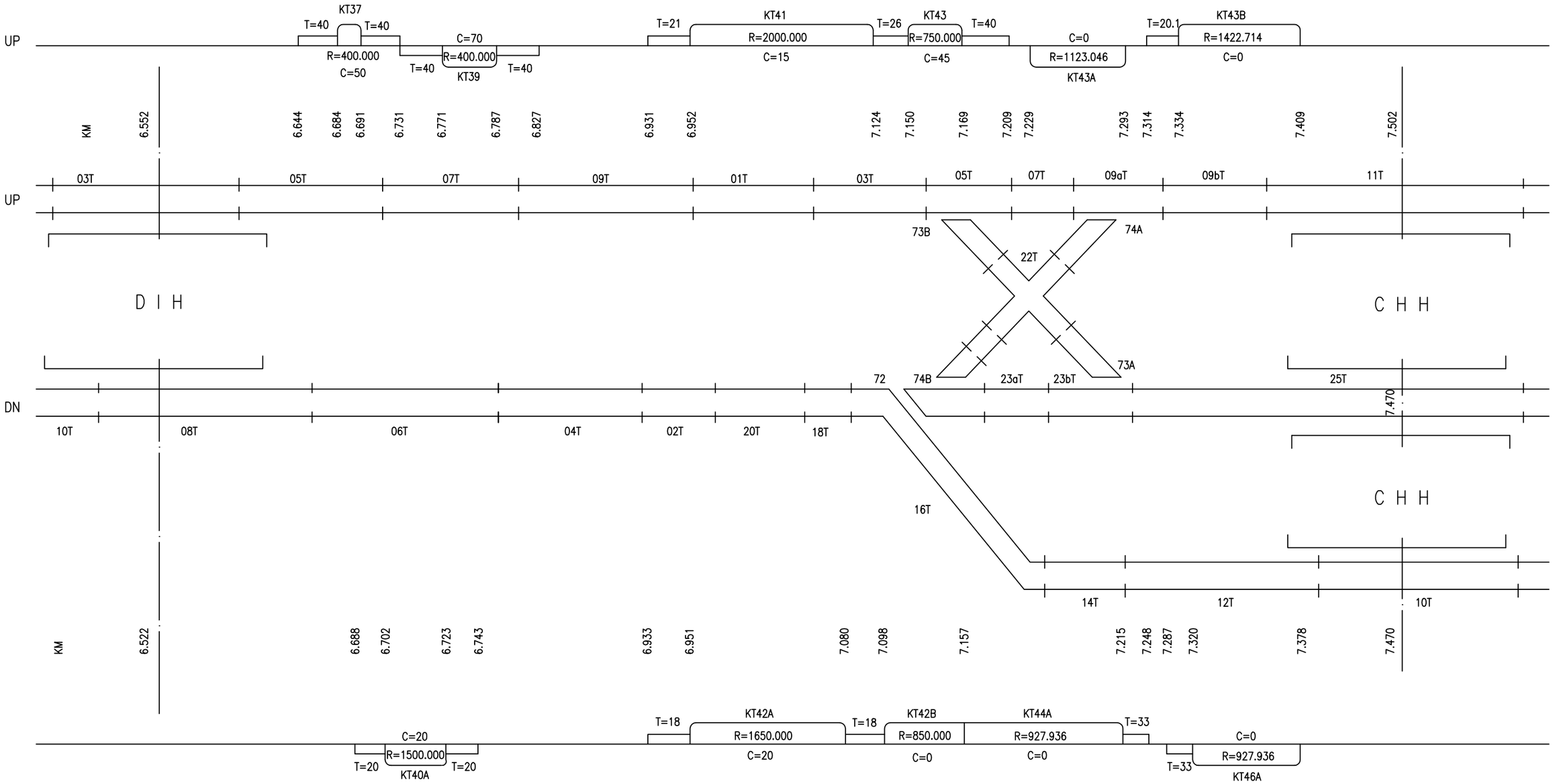
CAD FILE NAME 0D4_501_00104_0011_B

地鐵公司 MTR Corporation

TITLE
WTS – DIH
LINE DIAGRAM – KTL

SCALE N.T.S.

OED DRAWING NO. 0D4/501/00104/0011 B



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
C	CURVE KT43B & KT46A AMENDED	P.S.CHUNG 15-08-06	P.S.CHUNG 15-08-06	K.HUNG 15-08-06
B	CURVE KT43B AMENDED	P.S.CHUNG 21-09-99	T.TONG 21-09-99	T.WONG 21-09-99
A	DIGITIZATION	Y4 17-12-93	T.TONG 04-01-95	R.KEEFE 04-01-95

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CONTRACTOR REFERENCE NO.
PWM/KTL/010

	INITIAL	DESIGNATION	DATE
DRAWN	Y4	ZESTC	17-12-1993
DESIGNED			
CHECKED			
APPROVED			
CAD FILE NAME	OD4_501_00104_0012_C		

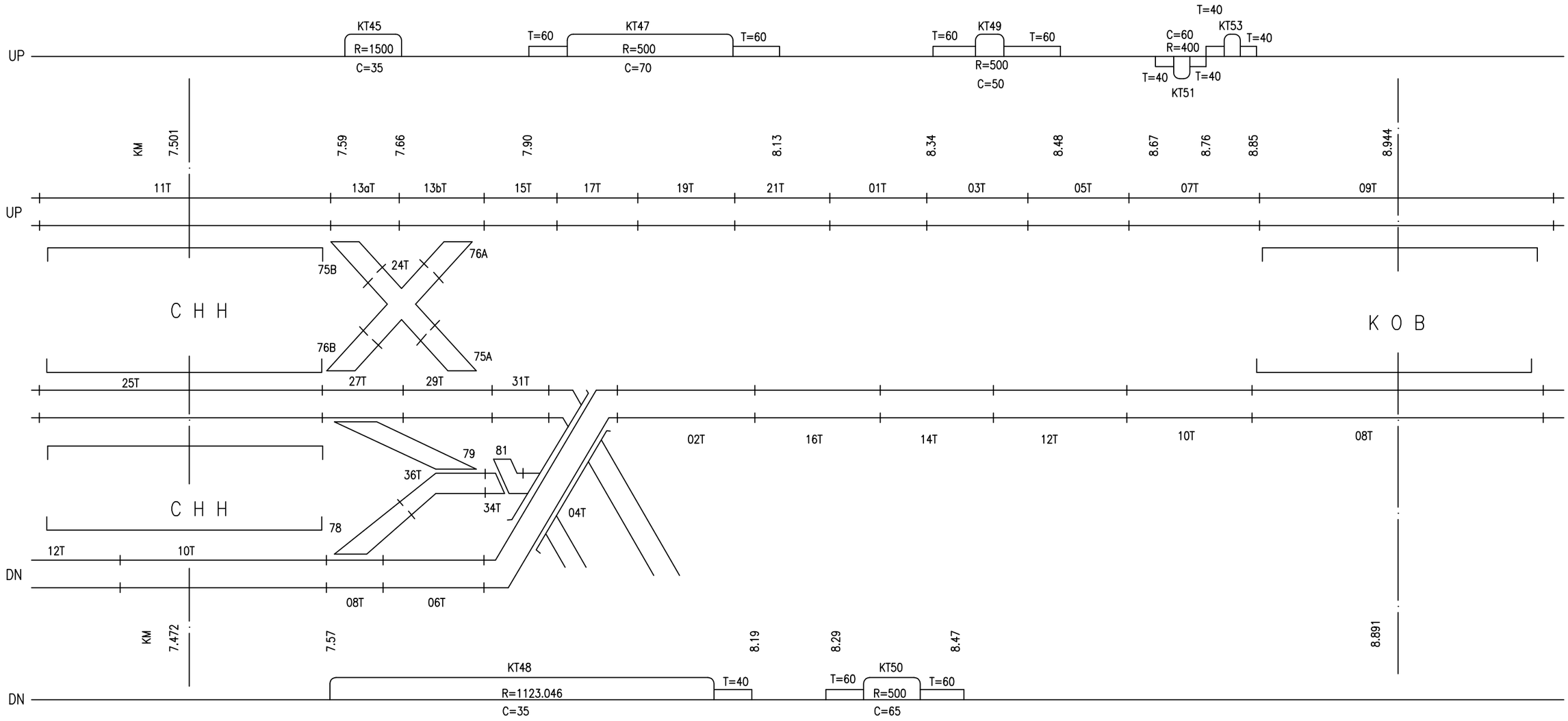
地鐵公司 MTR Corporation

TITLE
DIH – CHH
LINE DIAGRAM – KTL

SCALE N.T.S.

OED DRAWING NO. OD4/501/00104/0012 C

OD4/501/00104/013 A



REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE
A	DIGITIZATION	TONG	TM(PW)	16-12-93

REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
PWM/KTL/011

	INITIAL	DESIGNATION	DATE
TRACED BY	Y4	ZESTC	16-12-93
DESIGNED BY			
CHECKED BY	T. HO	PWO	04-1-95
APPROVED BY	R. KEEFE	TM(PW)	04-1-95
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.		317352V1	

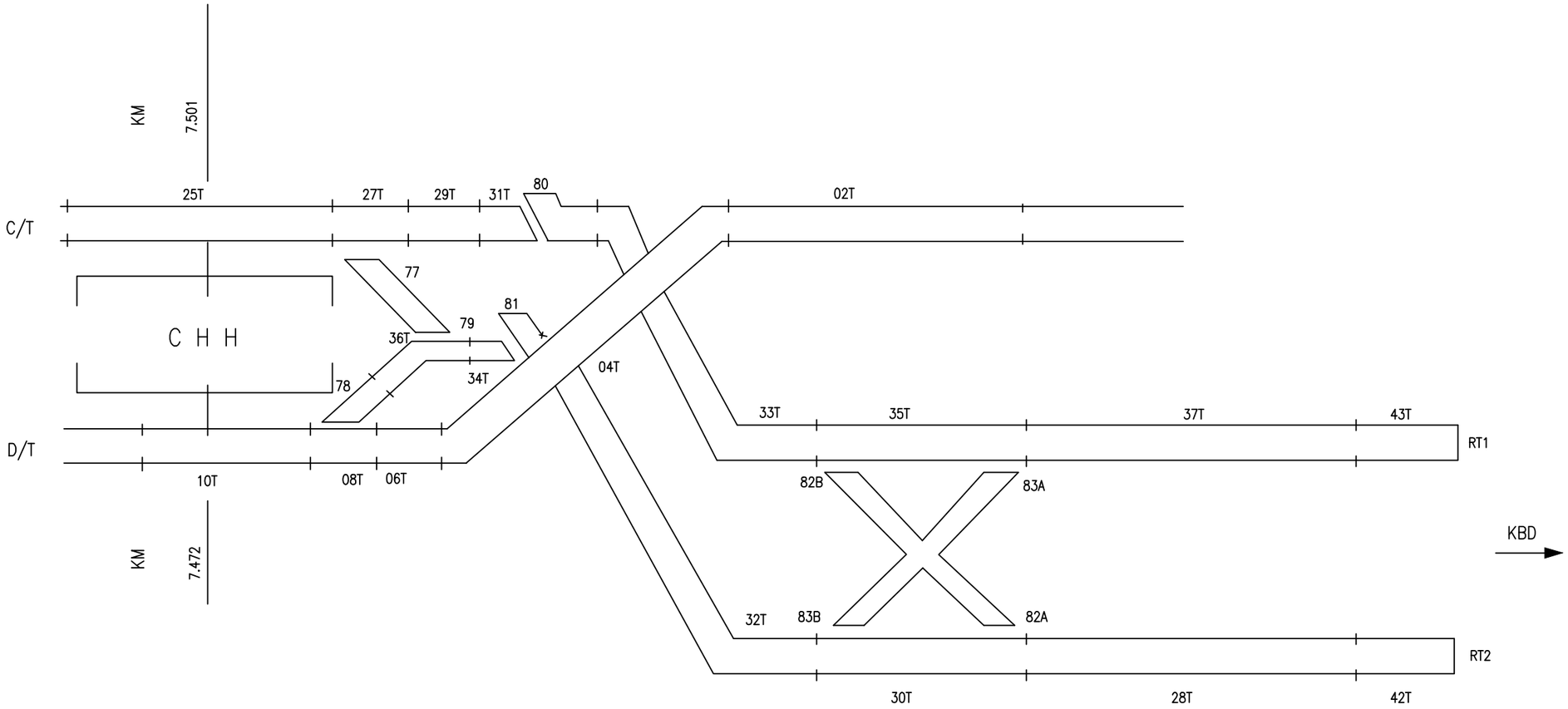
MASS TRANSIT RAILWAY CORPORATION

TITLE
CHH-KOB
LINE DIAGRAM - KTL

SCALE NTS

DWG NO. OD4/501/00104/013 A

OD4/501/00104/014 A



REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE
A	DIGITIZATION	TONG	TM(PW)	14-12-93

REFERENCE DWGS

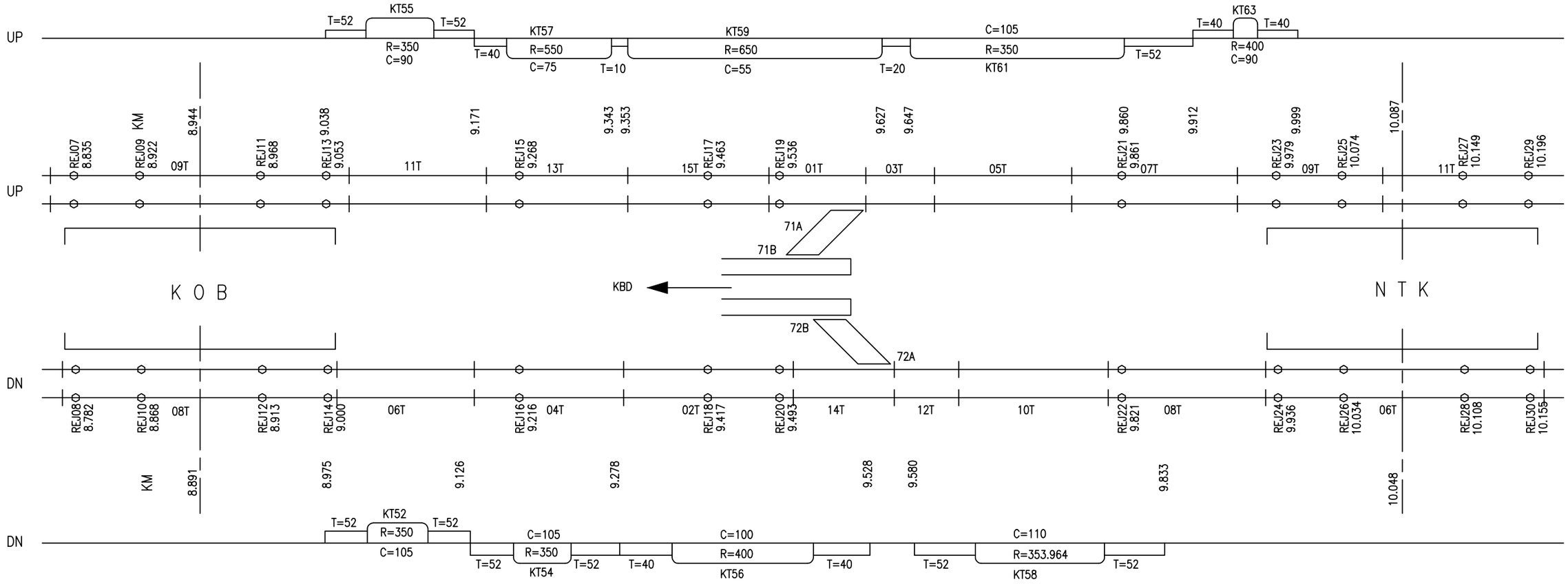
CONTRACTOR'S DRAWING NO.
PWM/KTL/012

	INITIAL	DESIGNATION	DATE
TRACED BY	Y2	ZESTC	14-12-93
DESIGNED BY			
CHECKED BY	T. HO	PWO	13-1-95
APPROVED BY	R. KEEFE	TM(PW)	13-1-95
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.	317353V1		

MASS TRANSIT RAILWAY CORPORATION

TITLE
CHH-RT 1 & 2
LINE DIAGRAM-KTL

SCALE NTS | DWG NO. OD4/501/00104/014 A



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	CURVE KT52 & KT58 AMENDED	P.S.CHUNG 19-02-02	P.S.CHUNG 19-02-02	Z.TSE 19-02-02
A	DIGITIZATION	Y6 14-12-93	T.TONG 04-01-95	R.KEEFE 04-01-95

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MTRC REFERENCE NO.

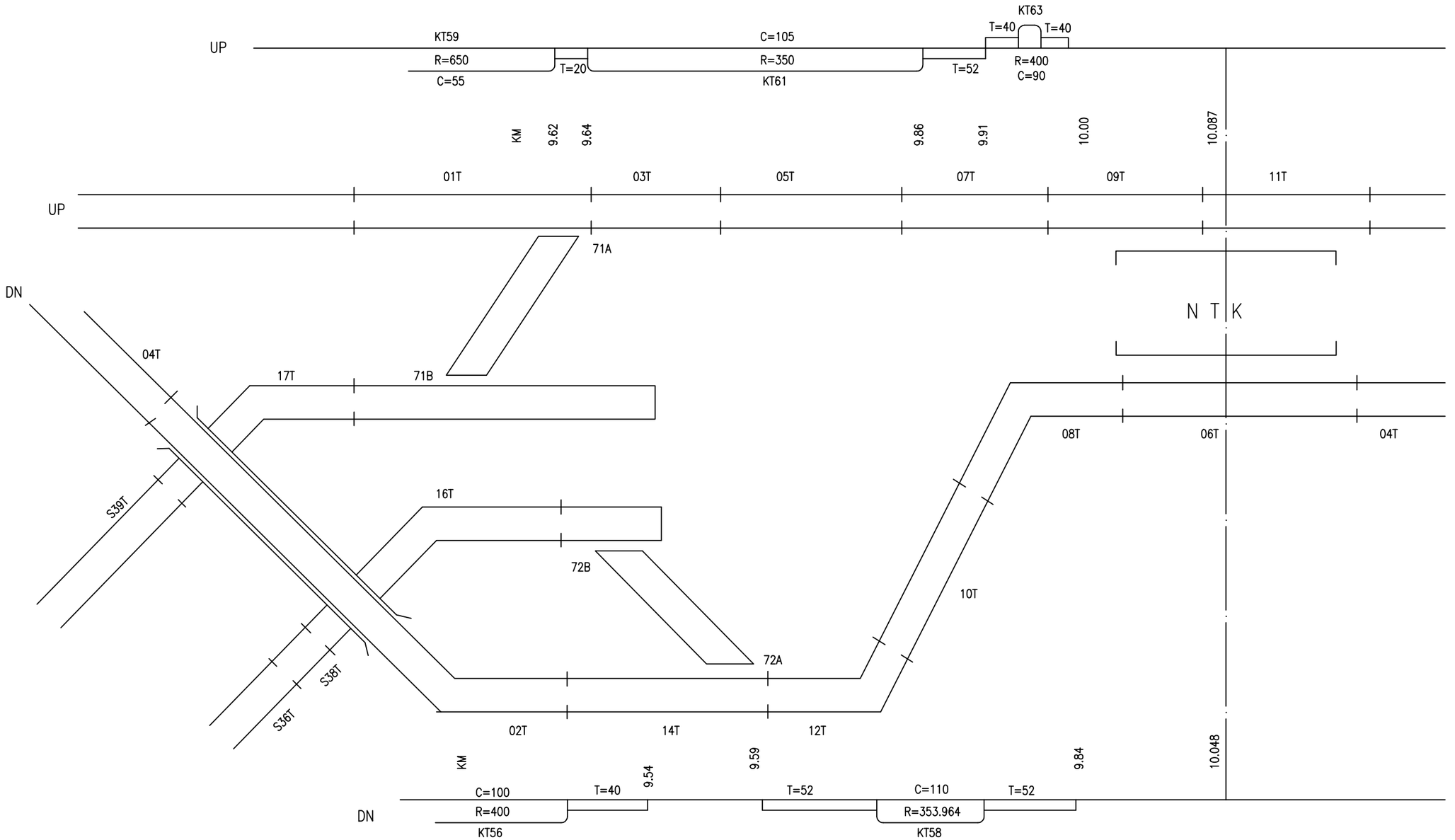
CONTRACTOR REFERENCE NO.
PWM/KTL/013

	INITIAL	DESIGNATION	DATE
DRAWN	Y6	ZESTC	14-12-93
DESIGNED			
CHECKED			
APPROVED			
CAD FILE NAME	317354V1		

地鐵公司 MTR Corporation

TITLE
KOB – NTK
LINE DIAGRAM – KTL

SCALE N.T.S.
OED DRAWING NO. OD4/501/00104/0015 B



REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE
A	DIGITIZATION	TONG	TM(PW)	14-12-93

REFERENCE DWGS

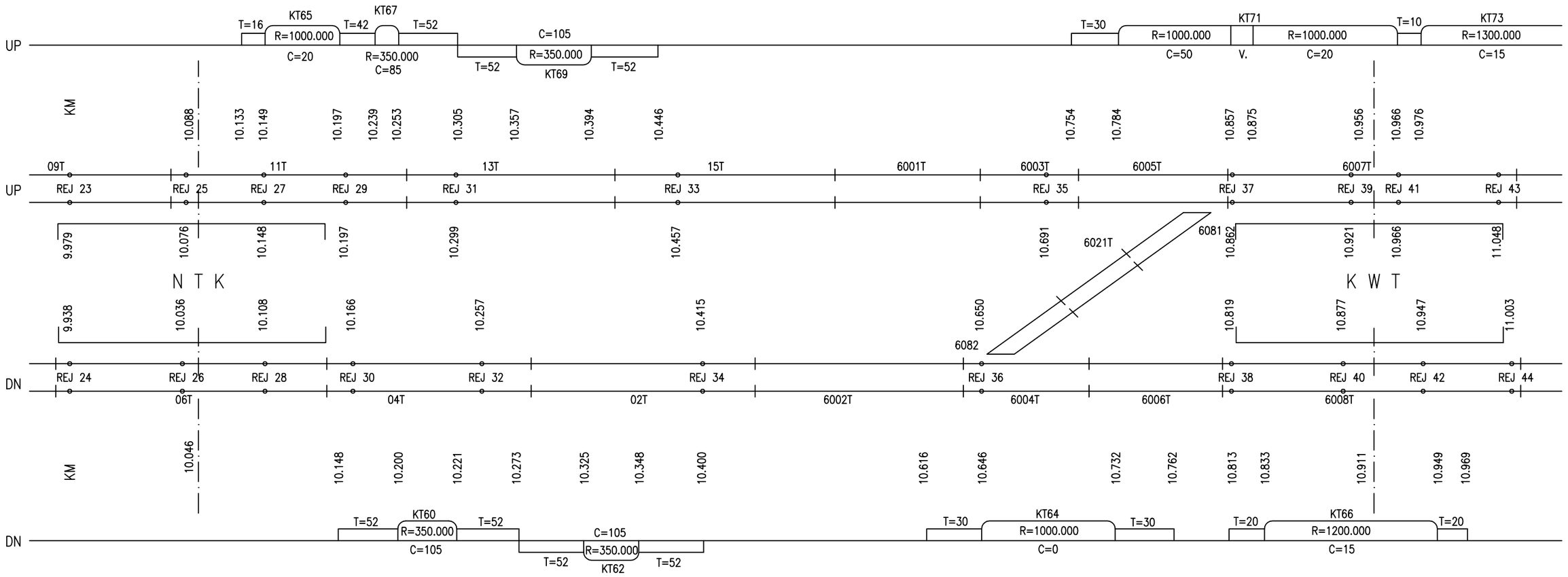
CONTRACTOR'S DRAWING NO.
PWM/KTL/014

	INITIAL	DESIGNATION	DATE
TRACED BY	Y38	ZESTC	14-12-93
DESIGNED BY			
CHECKED BY	T. HO	PWO	04-1-95
APPROVED BY	R. KEEFE	TM(PW)	04-1-95
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.		317355V1	

MASS TRANSIT RAILWAY CORPORATION

TITLE
LINE DIAGRAM – KTL
DEP & RECEPTION TK – NTK

SCALE NTS | DWG NO. OD4/501/00104/016 | A



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
D	ALIGNMENT UPDATED	P.S.CHUNG 21-08-06	P.S.CHUNG 21-08-06	K.HUNG 21-08-06
C	ALIGNMENT DATA FOR CURVE KT65, KT67 & KT71 AMENDED	P.S.CHUNG 23-08-01	P.S.CHUNG 23-08-01	B.TANG 23-08-01
B	KWT 6091 & KWT 6092 REMOVED ON SEPT. 1994	T.TONG 15-11-96	T.TONG 15-11-96	C.W.LAU 15-11-96
A	DIGITIZATION	Y24 04-01-95	T.HO 04-01-95	C.W.LAU 04-01-95

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/KTL/015

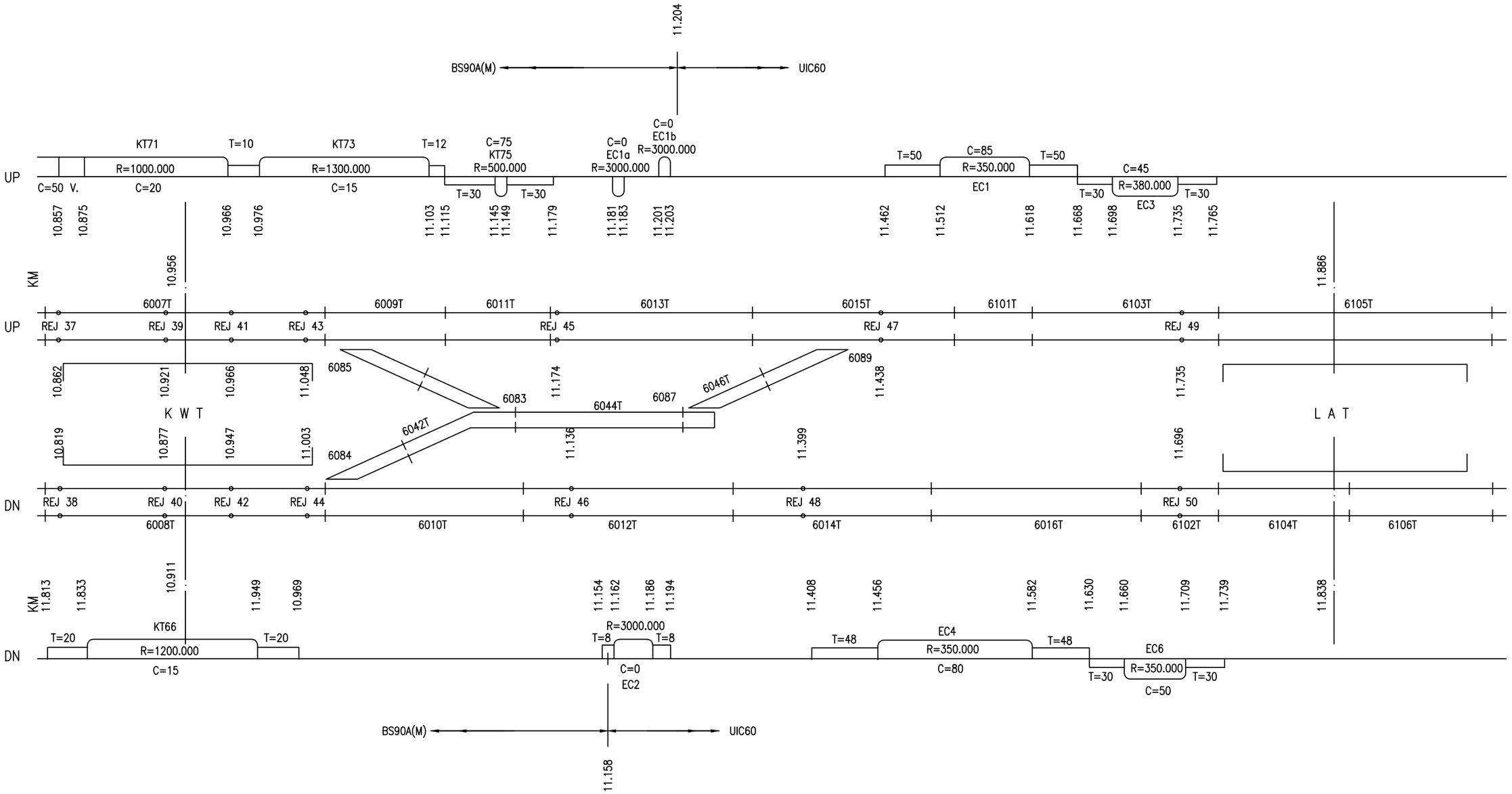
	INITIAL	DESIGNATION	DATE
DRAWN	Y24	ZESTC	16-12-1993
DESIGNED			
CHECKED			
APPROVED			
CAD FILE NAME	0D4_501_00104_0017_D		

地鐵公司 MTR Corporation

TITLE
NTK – KWT
LINE DIAGRAM – KTL

SCALE N.T.S.

OED DRAWING NO. 0D4/501/00104/0017 | D



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
D	KM FIGURES REVISED	P.S.CHUNG 21-08-06	P.S.CHUNG 21-08-06	K.HUNG 21-08-06
C	KM FIGURES REVISED TO NEAREST METER	P.S.CHUNG 03-03-06	P.S.CHUNG 03-03-06	ZOE TSE 03-03-06
B	DRAWING UPDATED	T.TONG 15-11-96	T.TONG 15-11-96	C.W.LAU 15-11-96
A	DIGITIZATION	Y43 16-12-93	TIM HO 04-01-95	C.W.LAU 04-01-95

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/KTL/016

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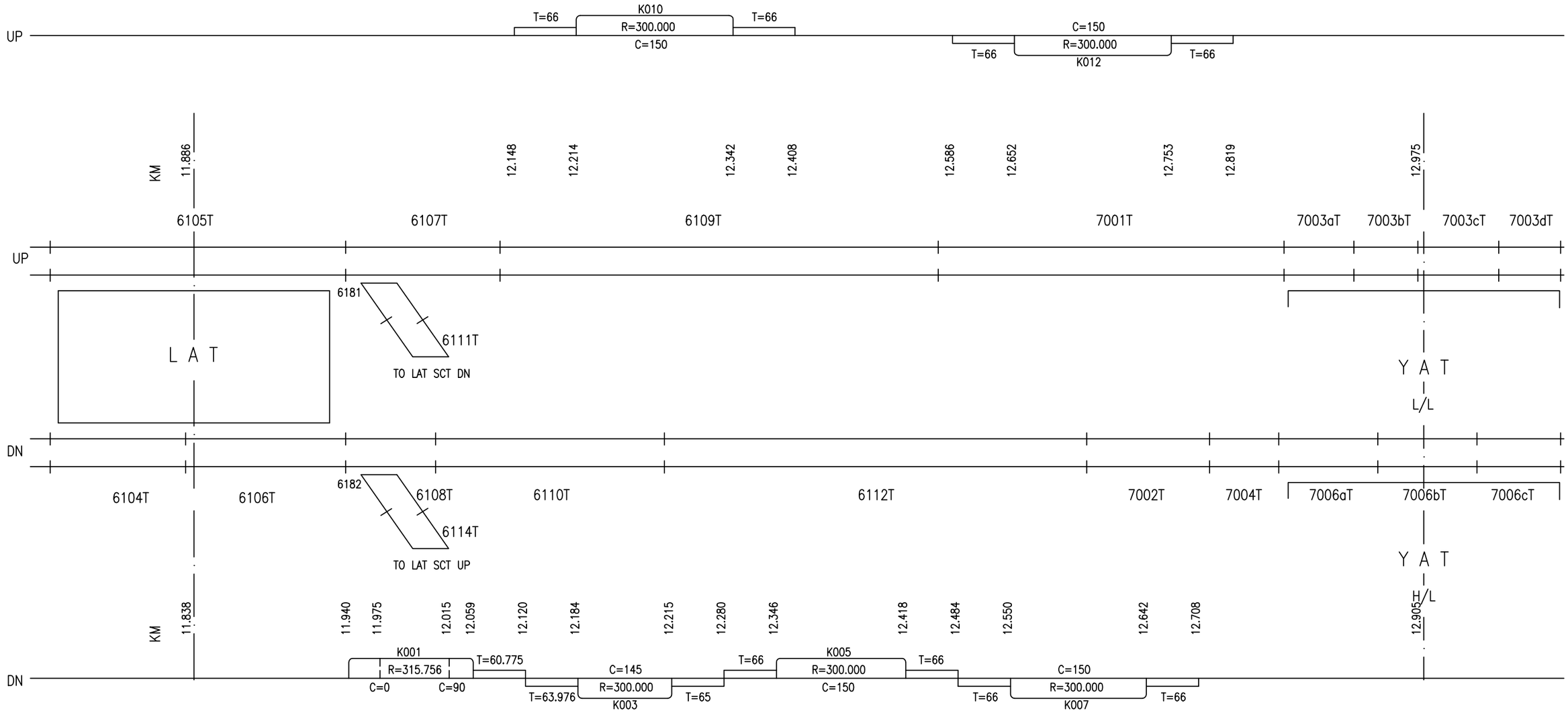
DRAWN	Y143	ZESTC	16-12-1993
DESIGNED			
CHECKED			
APPROVED			
CAD FILE NAME	0D4_501_00104_0018_D		

地鐵公司 MTR Corporation

TITLE
KWT – LAT
LINE DIAGRAM – KTL

SCALE N.T.S.

OED DRAWING NO. OD4/501/00104/0018 D



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C	C606 MERGED INTO KTL	P.S.CHUNG 17-08-06	P.S.CHUNG 17-08-06	K.HUNG 17-08-06
B	DRAWING UPDATED	T.TONG 15-11-96	T.TONG 15-11-96	C.W.LAU 15-11-96
A	DIGITIZATION	Y39 11-12-93	T.TONG 04-01-95	C.W.LAU 04-01-95

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CONTRACTOR REFERENCE NO.
PWM/KTL/017

	INITIAL	DESIGNATION	DATE
DRAWN	Y39	ZESTC	11-12-1993
DESIGNED			
CHECKED			
APPROVED			

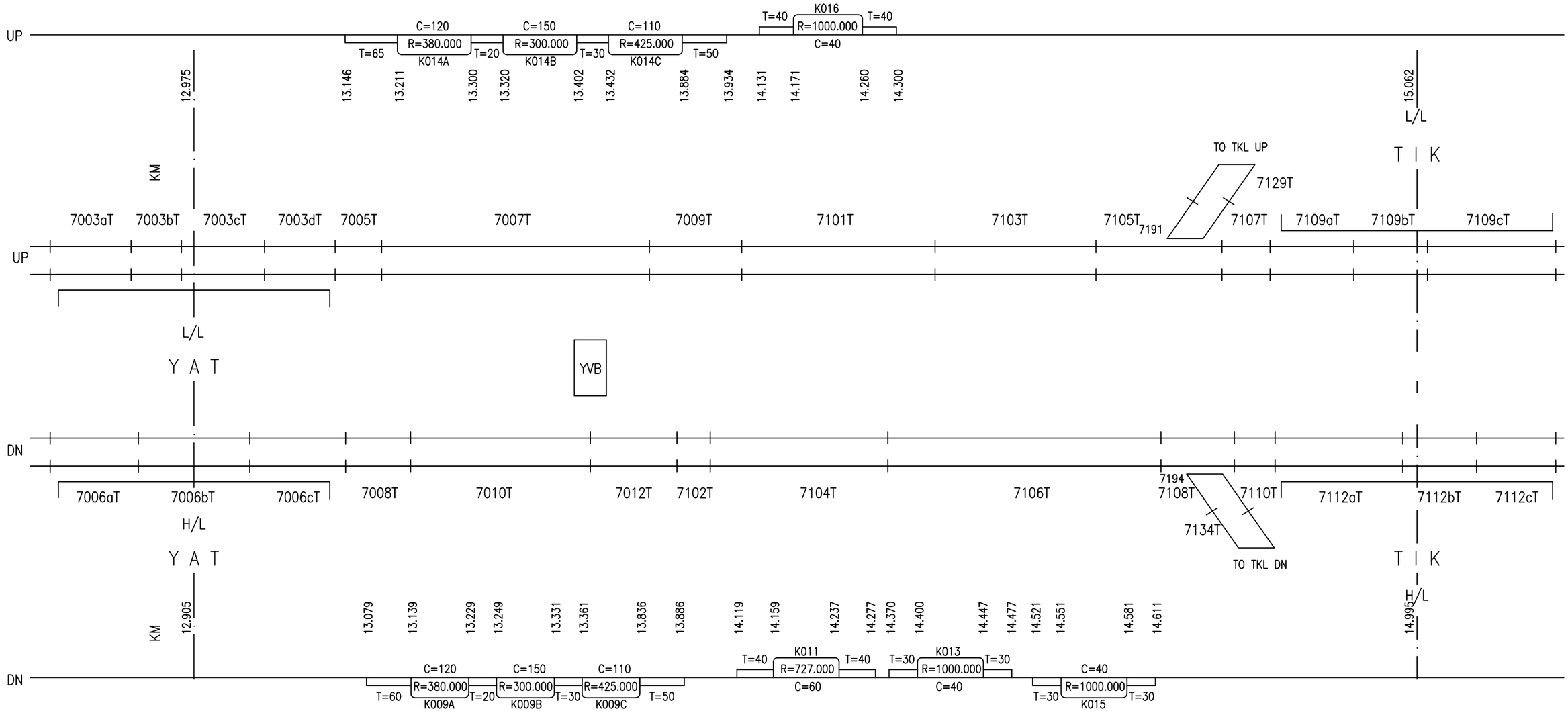
CAD FILE NAME 0D4_501_00104_0019_C

地鐵公司 MTR Corporation

TITLE
LAT – YAT
LINE DIAGRAM – KTL

SCALE N.T.S.

OED DRAWING NO. 0D4/501/00104/0019 C



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C	C806 MERGED INTO KTL	P.S.CHUNG 17-08-06	P.S.CHUNG 17-08-06	K.HUNG 17-08-06
B	TRACK CIRCUIT AND CURVE EC11 REVISED	P.S.CHUNG 15-04-02	P.S.CHUNG 15-04-02	ZOE TSE 15-04-02
A	DIGITIZATION	Y14 11-12-93	TIM HO 13-01-95	R.KEEFE 13-01-95

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/KTL/018

	INITIAL	DESIGNATION	DATE
DRAWN	Y14	ZESTC	11-12-1993
DESIGNED	MTRC	MTRC	11-12-1993
CHECKED	TIM HO	PWO	13-01-1995
APPROVED	R.KEEFE	TM-PW	13-01-1995

CAD FILE NAME 0D4_501_00104_0020_C

地鐵公司 MTR Corporation

TITLE
YAT – TIK
LINE DIAGRAM – KTL

SCALE N.T.S.
OED DRAWING NO. 0D4/501/00104/0020
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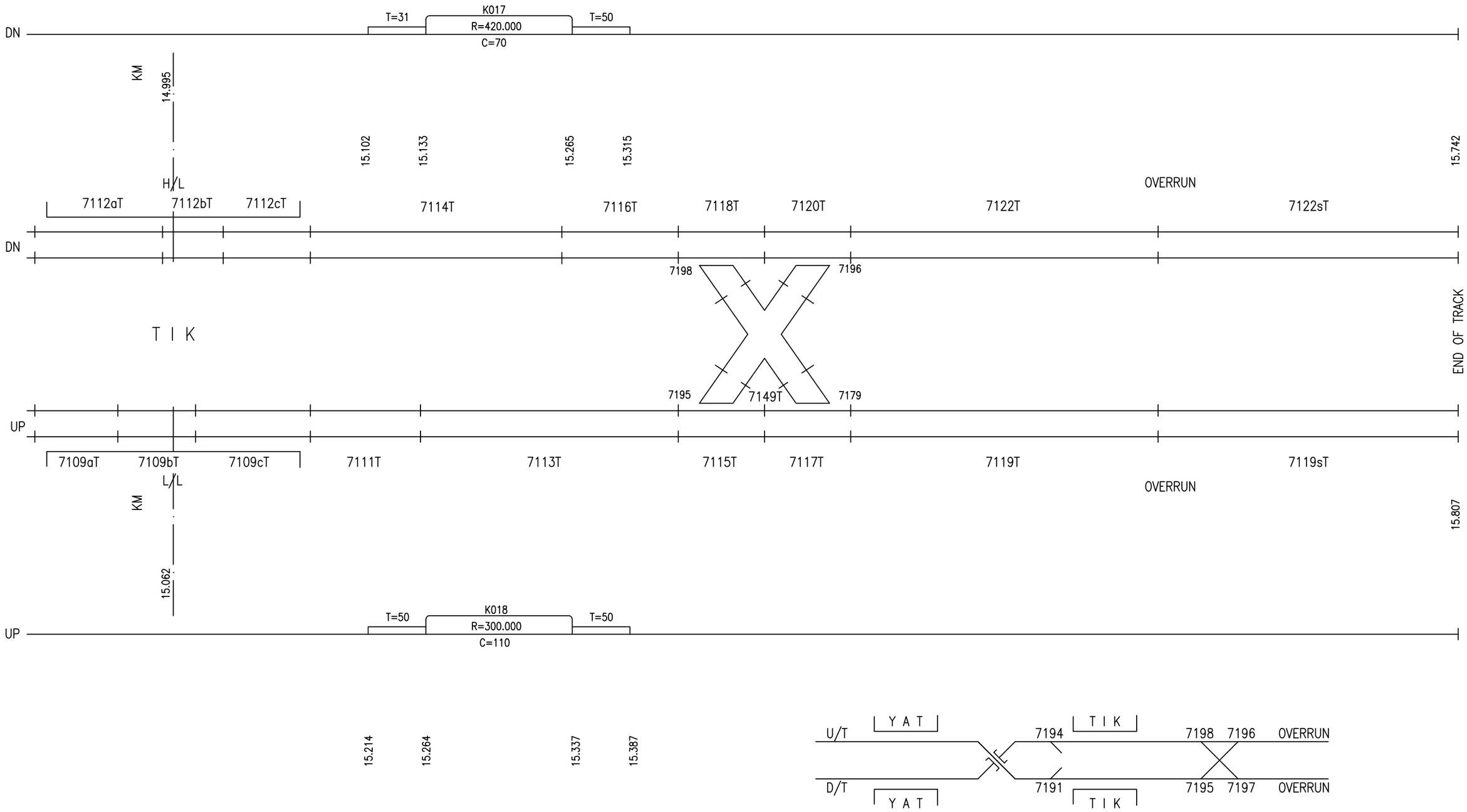

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
C	C806 MERGED INTO KTL	P.S.CHUNG 17-08-06	P.S.CHUNG 17-08-06	K.HUNG 17-08-06
B	QBR MERGED WITH KTL	P.S.CHUNG 09-04-02	P.S.CHUNG 09-04-02	ZOE TSE 09-04-02
A	DIGITIZATION	Y40 17-12-93	TIM HO 04-01-95	R.KEEFE 04-01-95

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/KTL/019

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DRAWN	Y40	ZESTC	17-12-1993
DESIGNED	MTRC	MTRC	17-12-1993
CHECKED	TIM HO	PWO	04-01-1995
APPROVED	R.KEEFE	TM-PW	04-01-1995

CAD FILE NAME 0D4_501_00104_0021_C

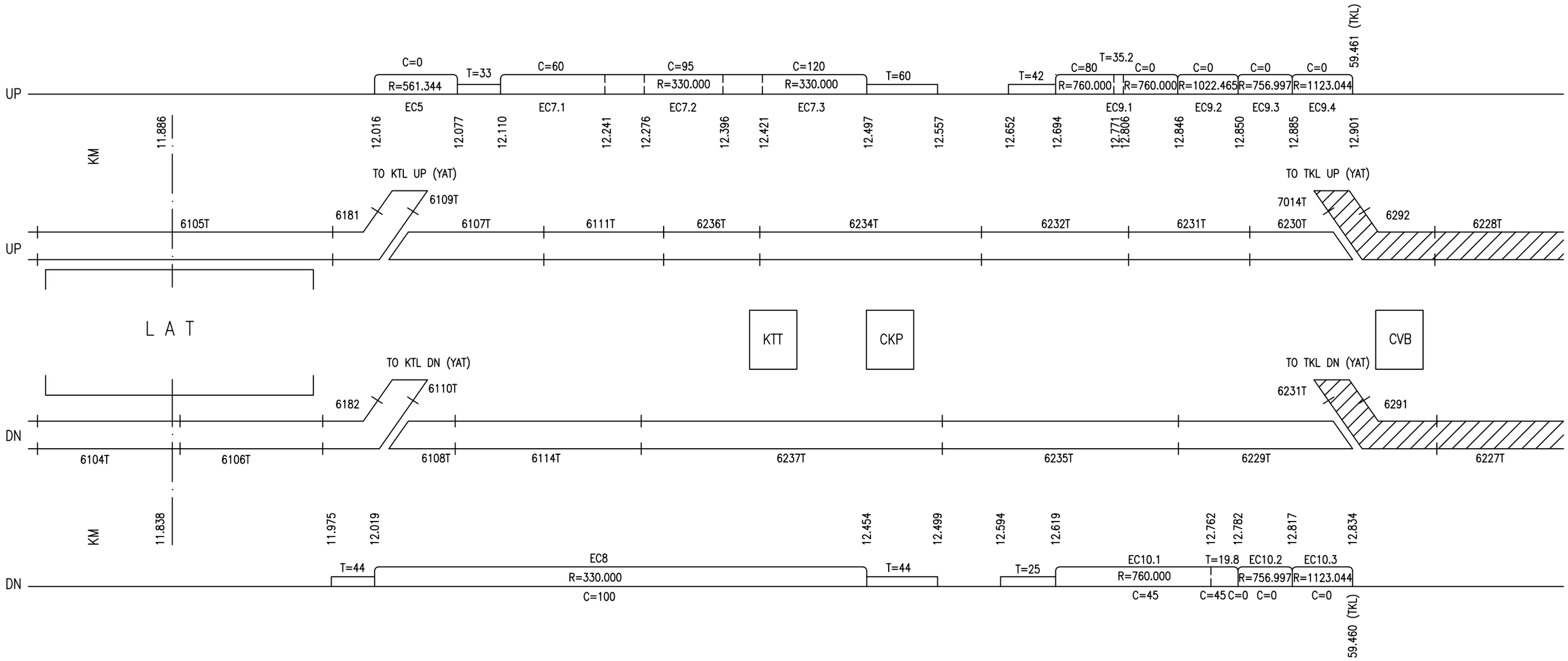
地鐵公司 MTR Corporation

TITLE
TIK – OVERRUN
LINE DIAGRAM – KTL

SCALE N.T.S.

OED DRAWING NO. OD4/501/00104/0021 C

OD4/501/00104/0022 | A



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
A	C606 MERGED INTO KTL	P.S.CHUNG 17-08-06	P.S.CHUNG 17-08-06	K.HUNG 17-08-06

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/KTL/020

	INITIAL	DESIGNATION	DATE
DRAWN	P.S.CHUNG	PWO	10-04-2002
DESIGNED	MTRC	MTRC	10-04-2002
CHECKED	P.S.CHUNG	PWO	10-04-2002
APPROVED	ZOE TSE	ESM-PW	10-04-2002

CAD FILE NAME OD4_501_00104_0022_A

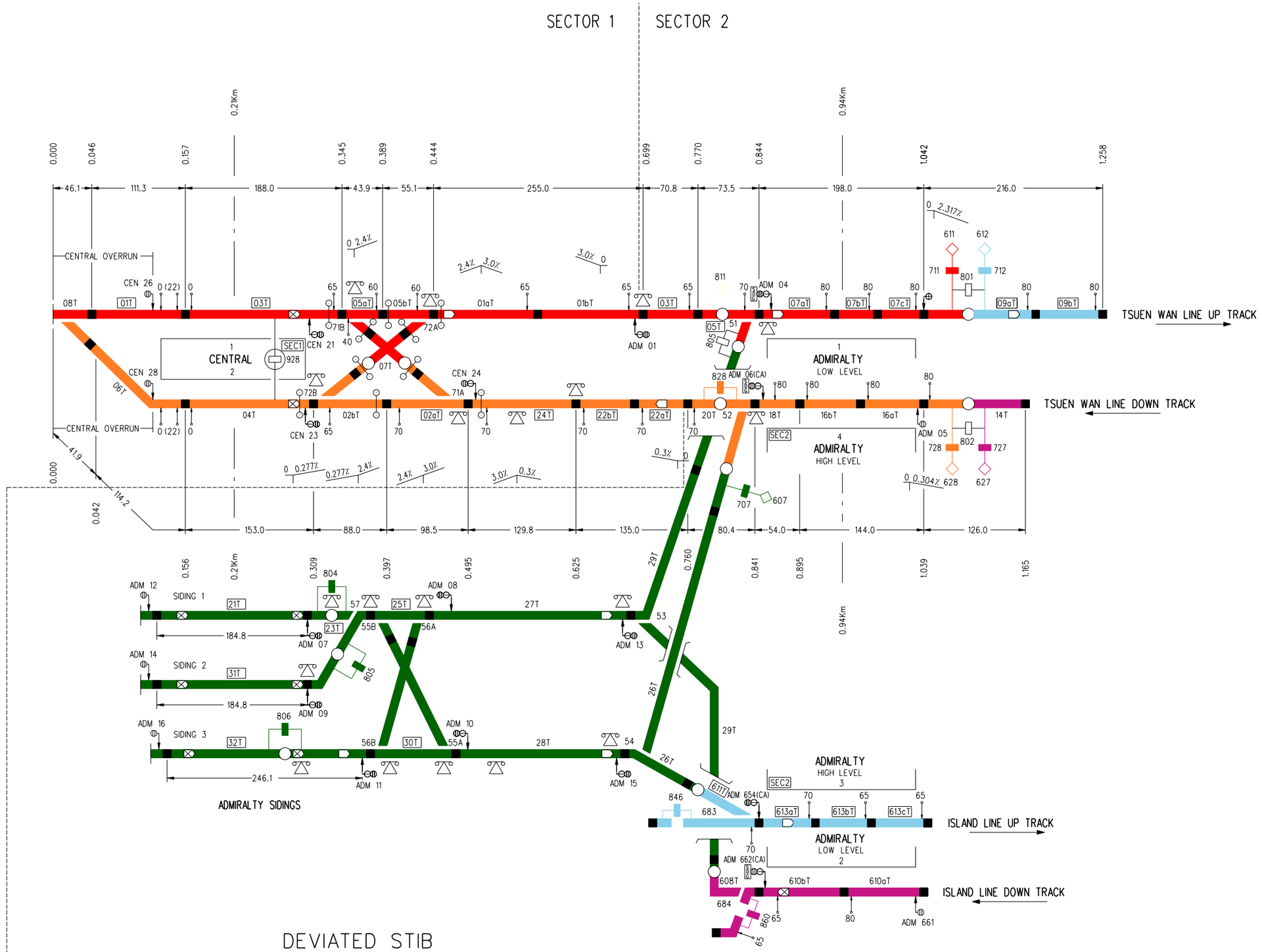
地鐵公司 MTR Corporation

TITLE
LAT – CVB
LINE DIAGRAM – KTL
LAT SERVICE CONNECTION

SCALE N.T.S.

OED DRAWING NO. OD4/501/00104/0022 | A

Central Station – Admiralty Station



DEVIATED STIB

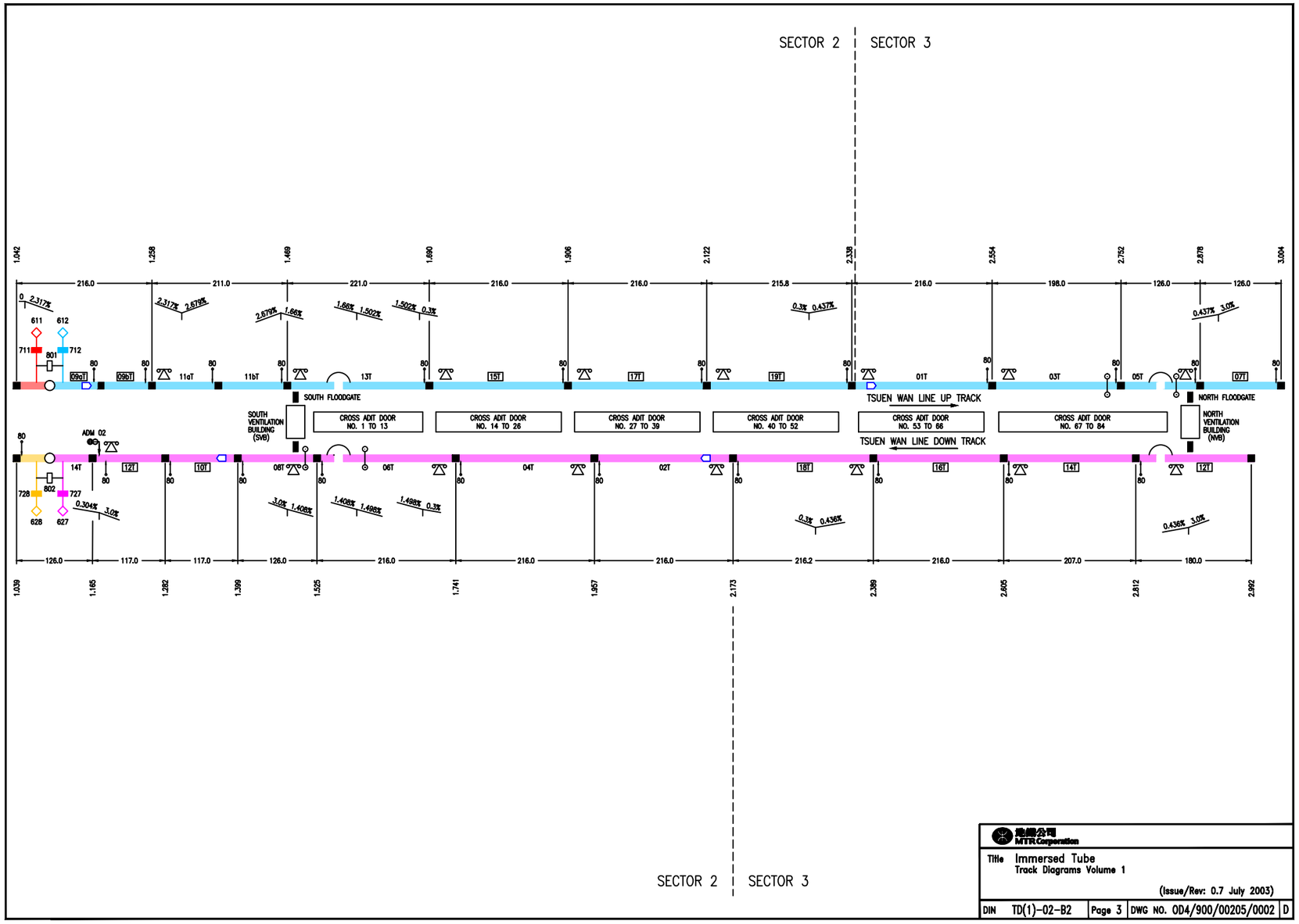
Track Circuit	Deviation
ADM610bT	+1.4m from CL

SECTOR 1 | SECTOR 2

地鐵公司 MTR Corporation

Title Central Station - Admiralty Station
Track Diagrams Volume 1
(Issue/Rev: 0.9 September 2004)

DIN TD(1)-02-B1	Page 2	DWG NO. TWL/M/SQ/W02/201	A



地鐵公司 MTR Corporation

TITle Immersed Tube
Track Diagrams Volume 1

(Issue/Rev: 0.7 July 2003)

DIN	TD(1)-02-B2	Page 3	DWG NO. OD4/900/00205/0002	D

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
D	MTIB ADDED TO ADM10T	KSK 08-07-03	K. MARK 08-07-03	
C	ADDITIONAL & UPDATED INFORMATION	DIXON K. 6-11-98	JENNY C. 20-11-98	STANLEY S. 20-11-98

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MTRC REFERENCE NO.
TD(1)-02-B2

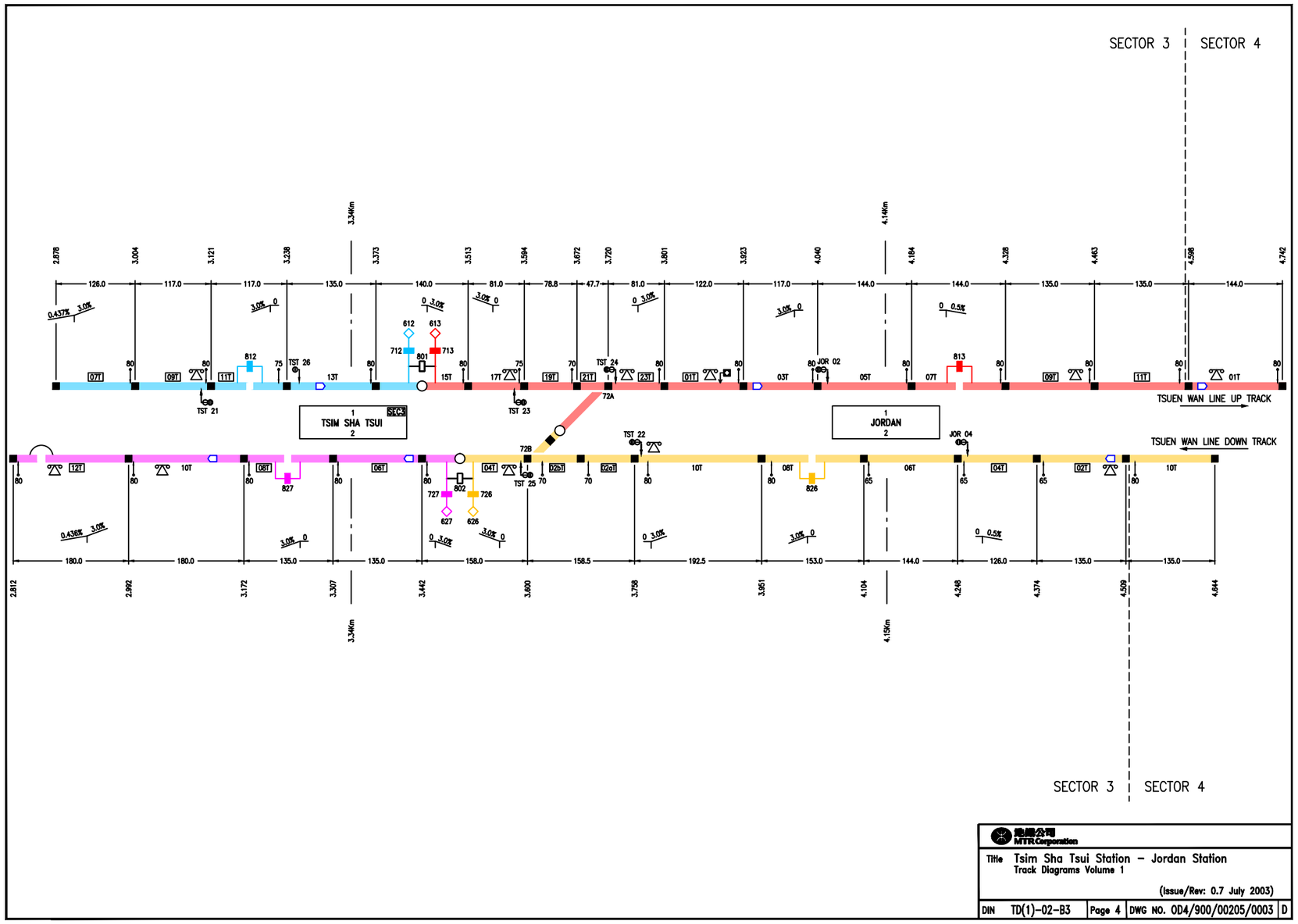
CONTRACTOR REFERENCE NO.

	INITIAL	DESIGNATION	DATE
DRAWN	H.K.HO	D'MAN	23-5-90
DESIGNED			
CHECKED			
APPROVED			
CAD FILE NAME	00205002		

地鐵公司 MTR Corporation

TITLE IMMERSED TUBE
TRACK DIAGRAMS VOLUME 1

SCALE NTS
OED DRAWING NO. OD4/900/00205/0002 D



地鐵公司 MTR Corporation

Title Tsim Sha Tsui Station – Jordan Station
Track Diagrams Volume 1

(Issue/Rev: 0.7 July 2003)

DIN	TD(1)-02-B3	Page 4	DWG NO. OD4/900/00205/0003	D

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
D	MTIB ADDED TO TST10T, 13T	KSK 08-07-03	K. MARK 08-07-03	
C	ADDITIONAL & UPDATED INFORMATION	DIXON K. 6-11-98	JENNY C. 20-11-98	STANLEY S. 20-11-98

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MTRC REFERENCE NO.
TD(1)-02-B3

CONTRACTOR REFERENCE NO.

	INITIAL	DESIGNATION	DATE
DRAWN	H.K.HO	D'MAN	23-5-90
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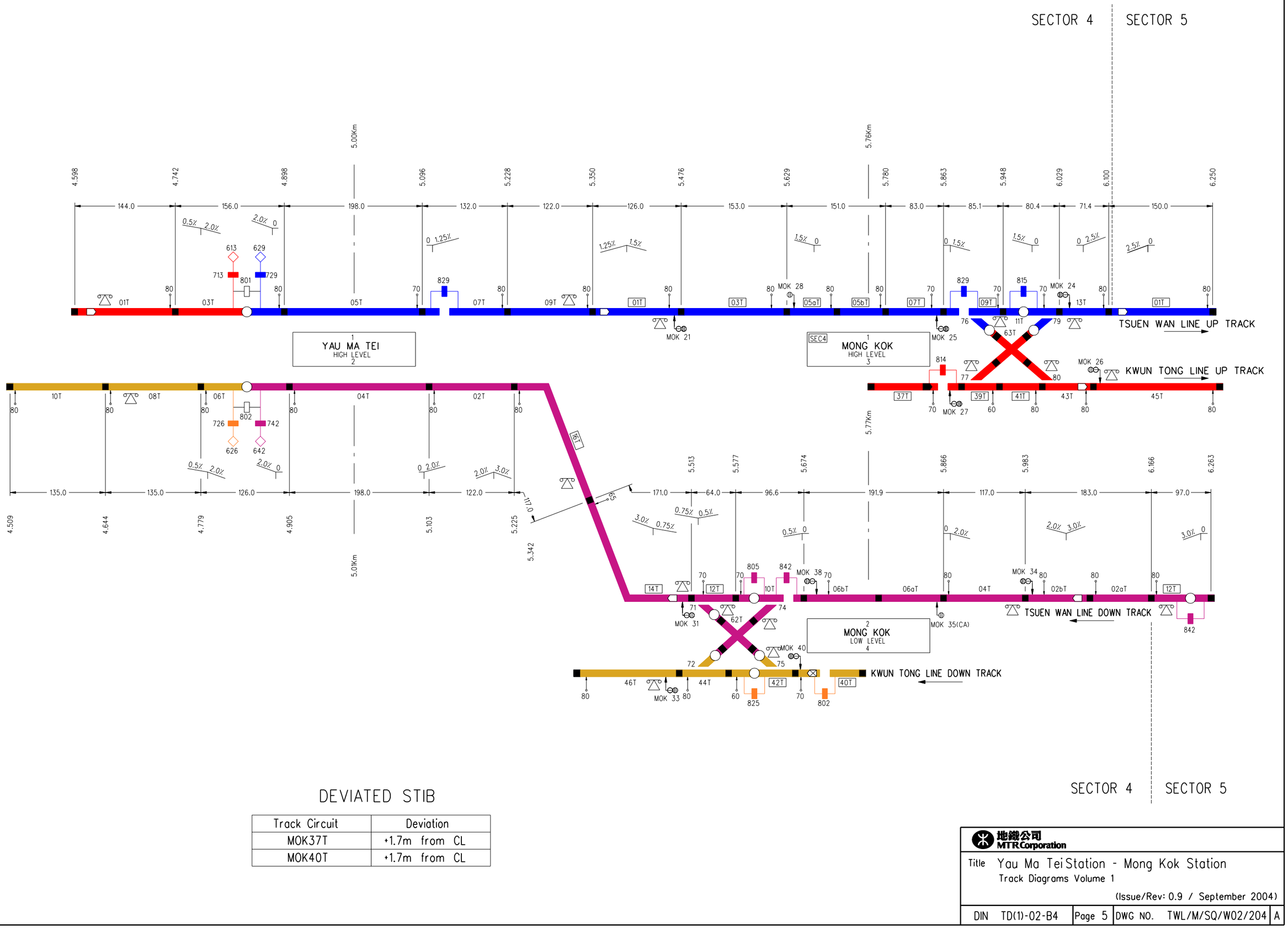
APPROVED			
CAD FILE NAME	00205003		

地鐵公司 MTR Corporation

TITLE TSIM SHA TSUI STATION – JORDAN STATION
TRACK DIAGRAMS VOLUME 1

SCALE NTS
OED DRAWING NO. OD4/900/00205/0003 D

Yau Ma Tei Station – Mong Kok Station



DEVIATED STIB

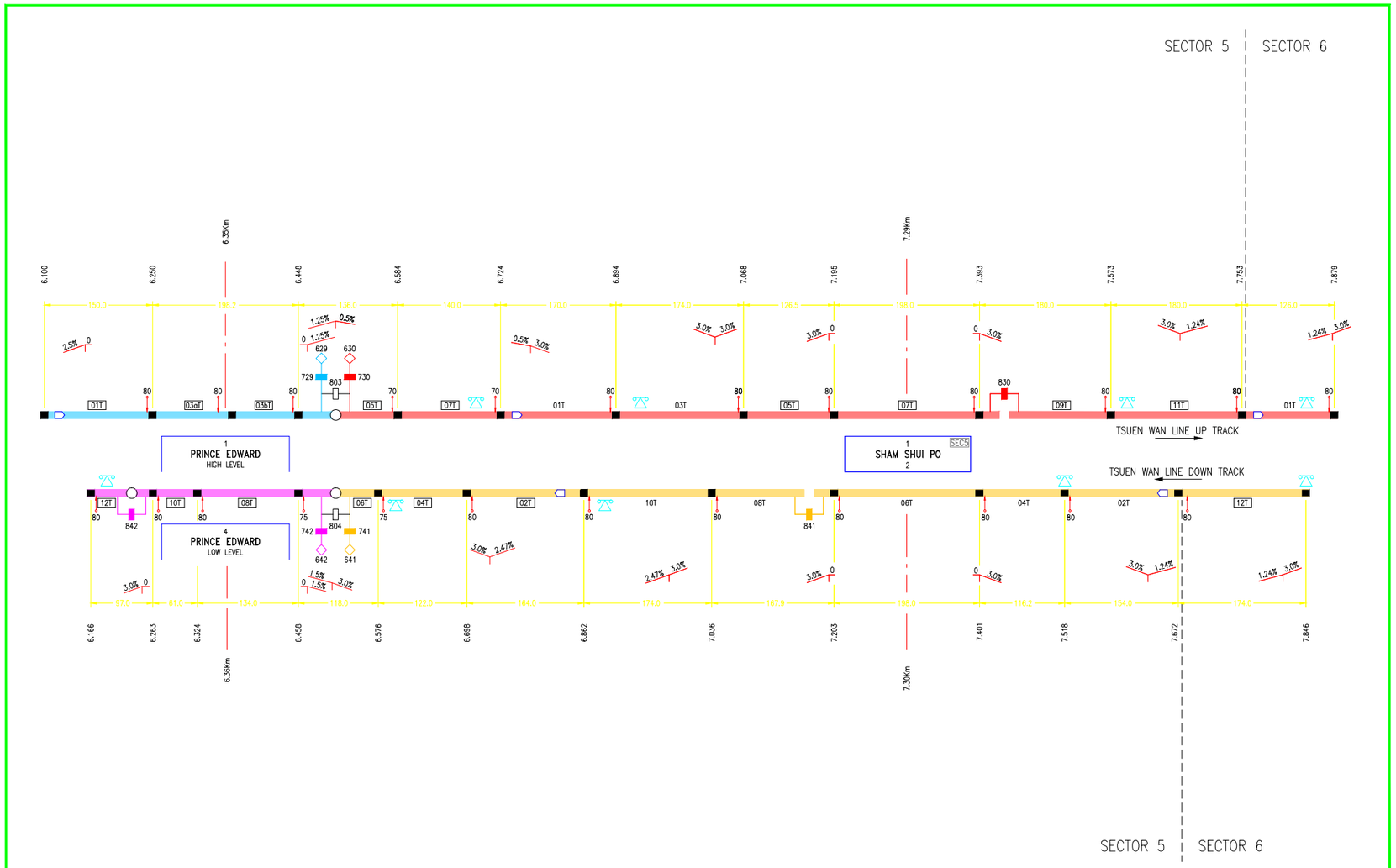
Track Circuit	Deviation
MOK37T	+1.7m from CL
MOK40T	+1.7m from CL

地鐵公司 MTR Corporation

Title: Yau Ma Tei Station - Mong Kok Station
Track Diagrams Volume 1

(Issue/Rev: 0.9 / September 2004)

DIN	TD(1)-02-B4	Page 5	DWG NO.	TWL/M/SQ/W02/204	A



地鐵公司 MTR Corporation

Title Prince Edward Station – Sham Shui Po Station
Track Diagrams Volume 1

(Rev: 0.3 / 11 November 1999)

DIN OD-TD(1)-02-B5 | Page 6 | DWG NO. OD4/900/00205/0005 | D

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
D	ADDITIONAL & UPDATED INFORMATION (101044)	DIXON K. 11-11-99	KEVIN LO 11-11-99	STANLEY S. 11-11-99
C	ADDITIONAL & UPDATED INFORMATION	DIXON K. 6-11-98	JENNY C. 20-11-98	STANLEY S. 20-11-98

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MTRC REFERENCE NO.
OD-TD(1)-02-B5

CONTRACTOR REFERENCE NO.

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DRAWN	H.K.HO	D'MAN	23-5-90
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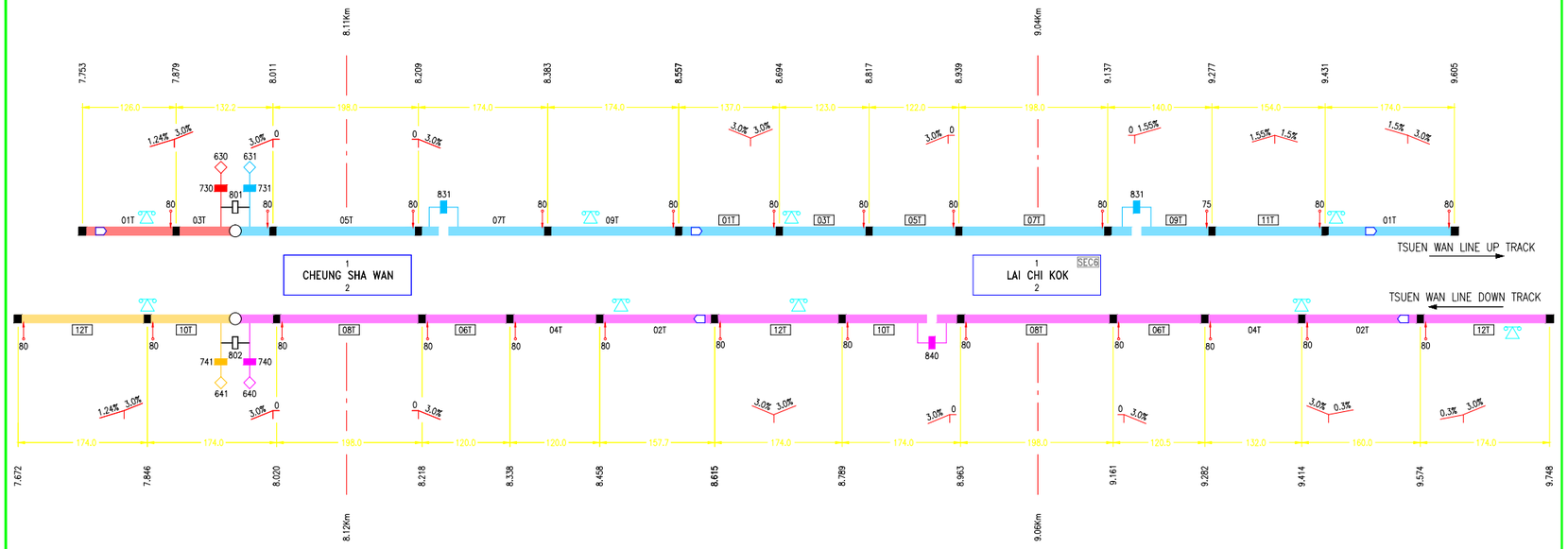
APPROVED			
CAD FILE NAME	00205005		

地鐵公司 MTR Corporation

TITLE PRINCE EDWARD STATION – SHAM SHUI PO STATION
TRACK DIAGRAMS VOLUME 1

SCALE NTS | OED DRAWING NO. OD4/900/00205/0005 | D

SECTOR 6



SECTOR 6

地鐵公司 MTR Corporation

Title Cheung Sha Wan Station – Lai Chi Kok Station
Track Diagrams Volume 1

(Rev: 0.0 / 6 November 1998)

DIN OD-TD(1)-02-B6 | Page 7 | DWG NO. OD4/900/00205/0006 | C

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
C	ADDITIONAL & UPDATED INFORMATION	DIXON K. 6-11-98	JENNY C. 20-11-98	STANLEY S. 20-11-98

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MTRC REFERENCE NO. OD-TD(1)-02-B6

CONTRACTOR REFERENCE NO.

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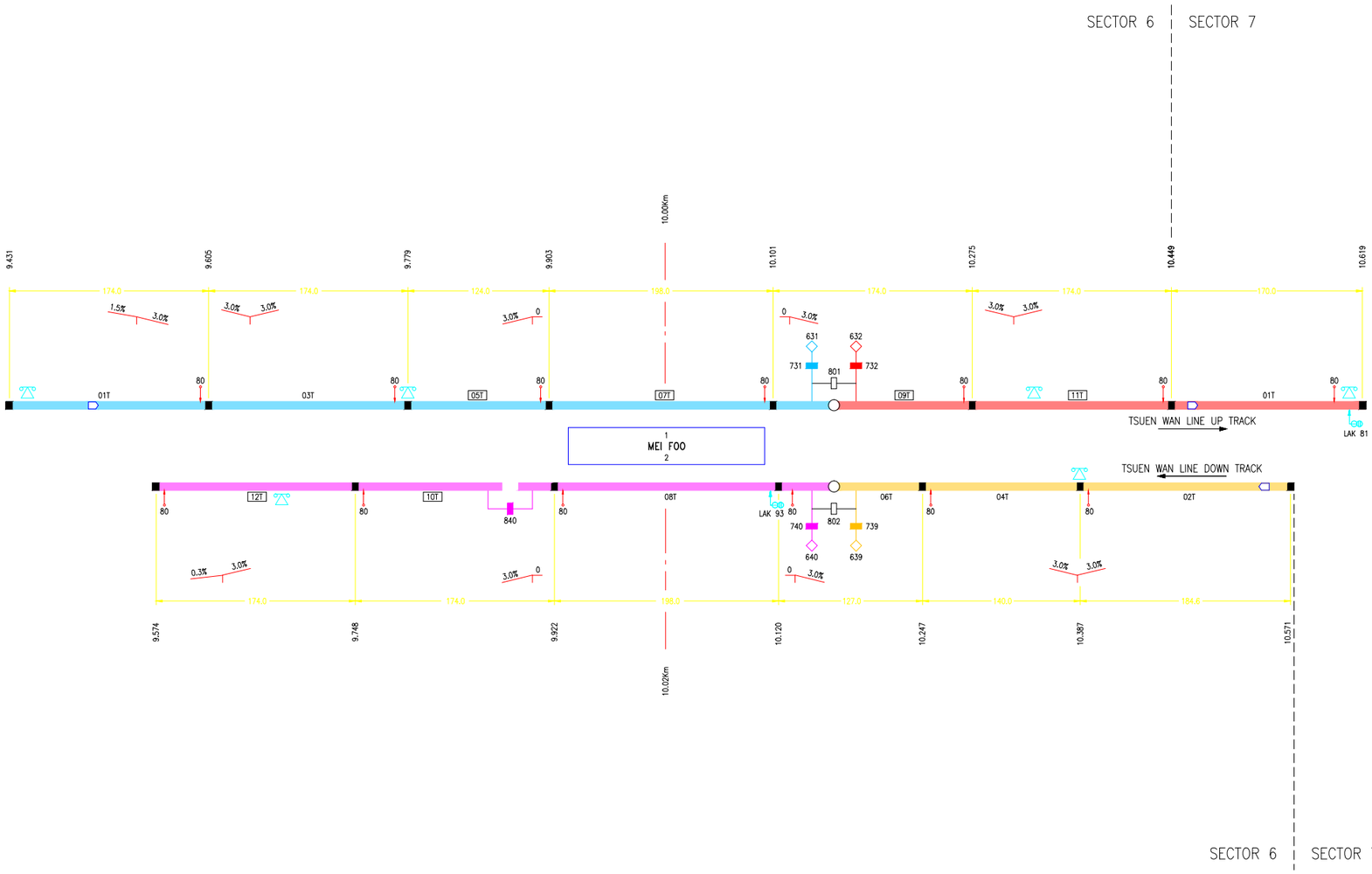
CHECKED			
APPROVED			
CAD FILE NAME	00205006		

地鐵公司 MTR Corporation

TITLE CHEUNG SHA WAN STATION – LAI CHI KOK STATION
TRACK DIAGRAMS VOLUME 1

SCALE NTS | OED DRAWING NO. OD4/900/00205/0006 | C



地鐵公司 MTR Corporation

Title Mei Foo Station
Track Diagrams Volume 1

(Rev: 0.0 / 6 November 1998)

DIN 0D-TD(1)-02-B7 | Page 8 | DWG NO. 0D4/900/00205/0007 | C

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
C	ADDITIONAL & UPDATED INFORMATION	DIXON K. 6-11-98	JENNY C. 20-11-98	STANLEY S. 20-11-98

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MTRC REFERENCE NO.
0D-TD(1)-02-B7

CONTRACTOR REFERENCE NO.

	INITIAL	DESIGNATION	DATE
DRAWN	H.K.HO	D'MAN	23-5-90
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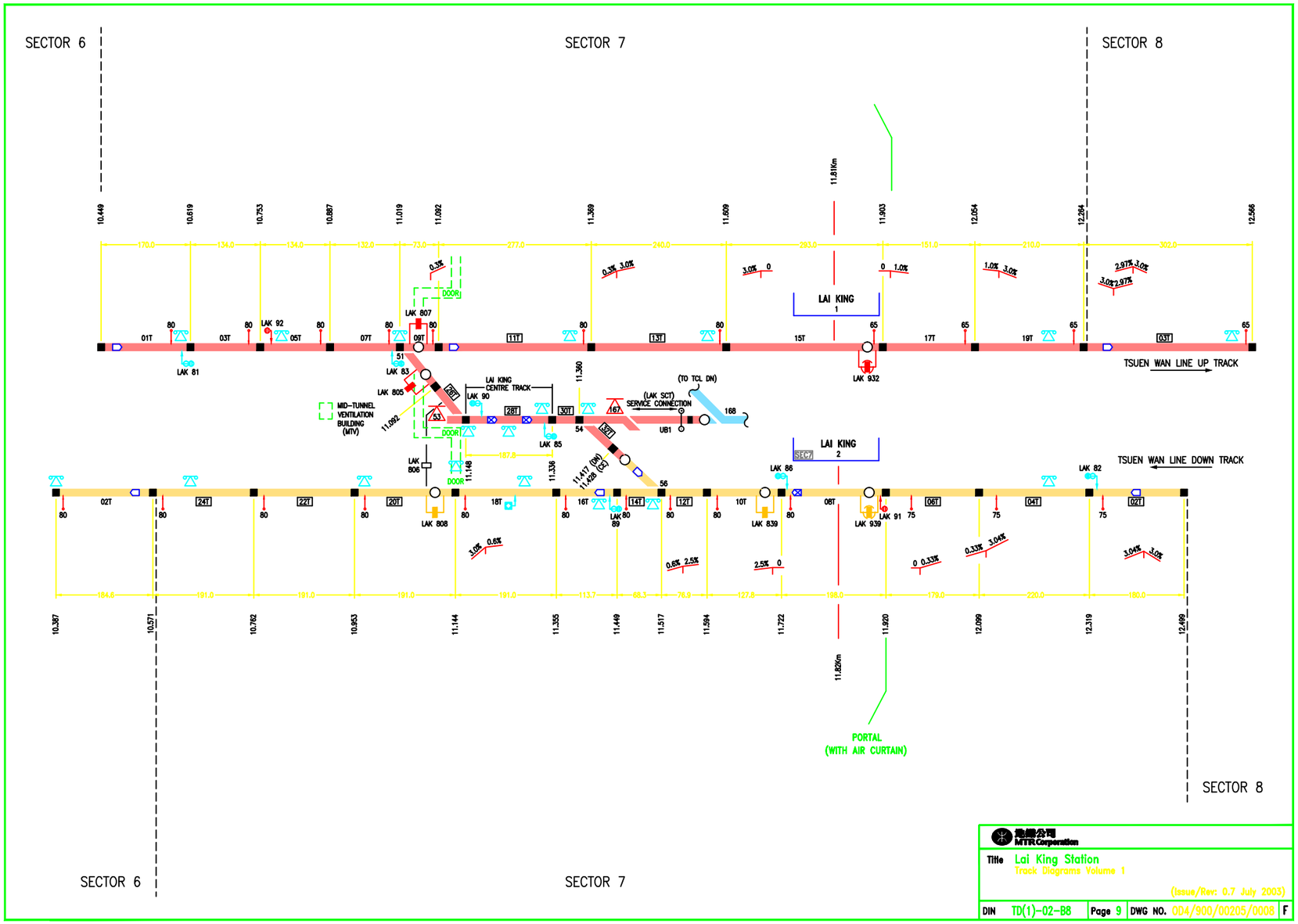
CAD FILE NAME 00205007

地鐵公司 MTR Corporation

TITLE MEI FOO STATION
TRACK DIAGRAMS VOLUME 1

SCALE NTS | OED DRAWING NO. 0D4/900/00205/0007 | C



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
F	LAK SCT ADDED	KSK 08-07-03	K. MARK 08-07-03	
E	ADDITIONAL & UPDATED INFORMATION (101044)	DIXON K. 11-11-99	KEVIN LO 11-11-99	STANLEY S. 11-11-99
D	ADDITIONAL & UPDATED INFORMATION	P.C.YU 03-05-99	JENNY C. 24-05-99	STANLEY S. 24-05-99
C	ADDITIONAL & UPDATED INFORMATION	DIXON K. 6-11-98	JENNY C. 20-11-98	STANLEY S. 20-11-98

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MTRC REFERENCE NO. TD(1)-02-B8

CONTRACTOR REFERENCE NO.

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CHECKED			
APPROVED			

CAD FILE NAME 00205008

地鐵公司 MTR Corporation

TITLE LAI KING STATION
TRACK DIAGRAMS VOLUME 1

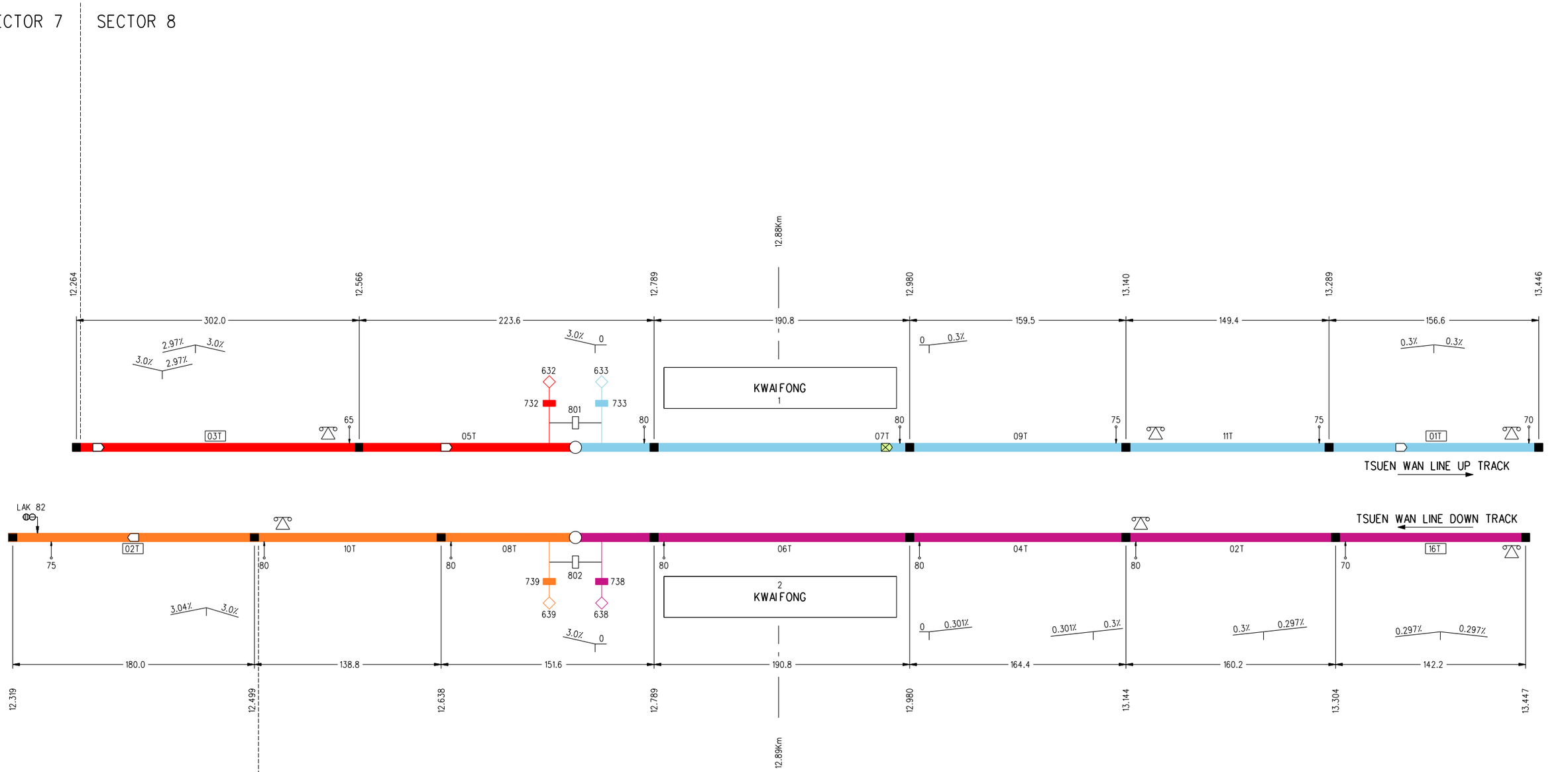
SCALE NTS | OED DRAWING NO. 0D4/900/00205/0008 | F

地鐵公司 MTR Corporation
Title Lai King Station
Track Diagrams Volume 1
(Issue/Rev: 0.7 July 2003)

DIN TD(1)-02-B8 | Page 9 | DWG NO. 0D4/900/00205/0008 | F

Kwai Fong Station

SECTOR 7 | SECTOR 8



DEVIATED STIB

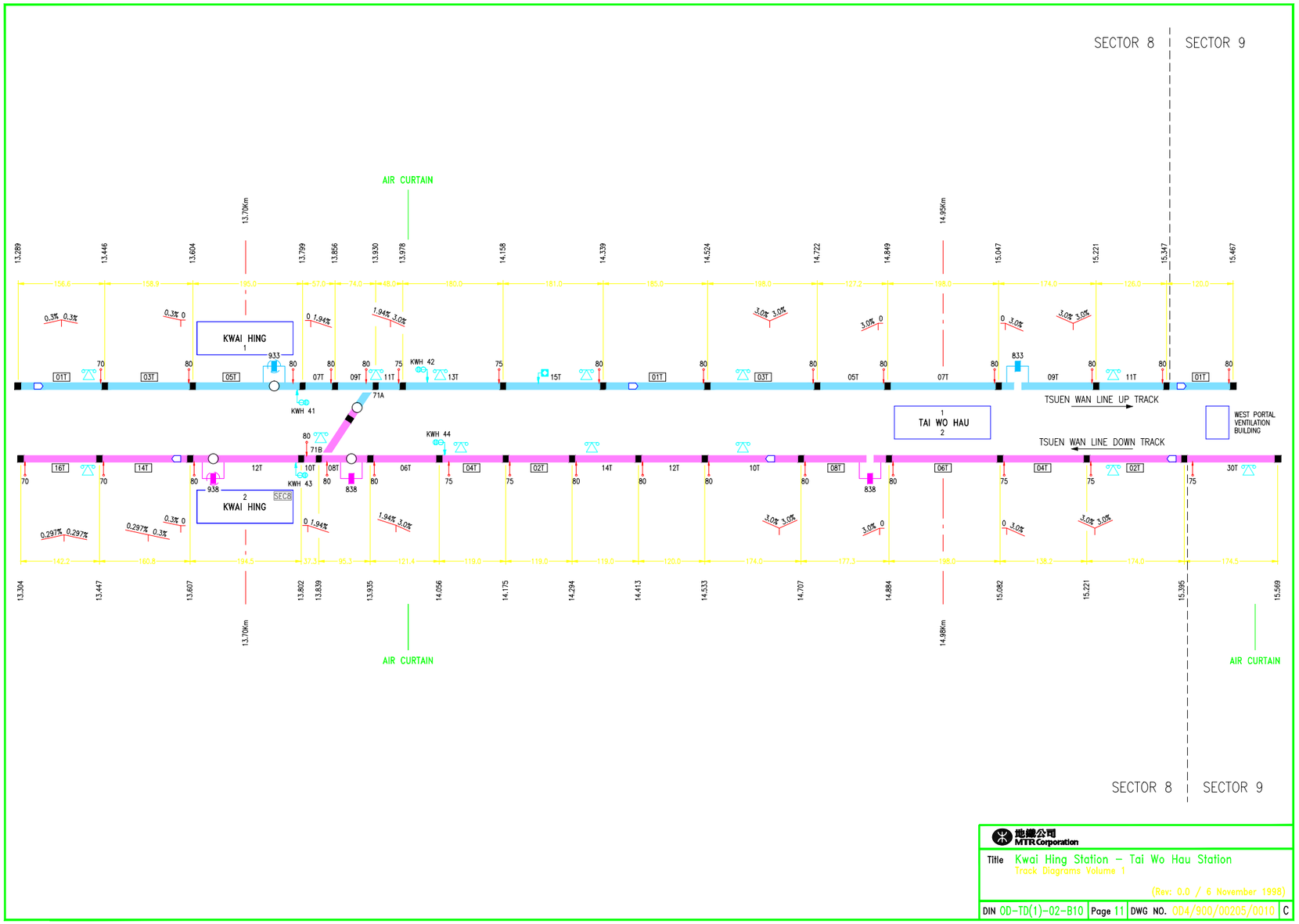
Track Circuit	Deviation
KWF07T	+1.4m from CL

SECTOR 7 | SECTOR 8

地鐵公司 MTR Corporation

Title Kwai Fong Station
Track Diagrams Volume 1
(Issue/Rev: 0.11 July 2007)

DIN	TD(1)-02-B9	Page 10	DWG NO.	TWL/SQ/TD1/R38/209	A



地鐵公司 MTR Corporation

Title Kwai Hing Station – Tai Wo Hau Station
Track Diagrams Volume 1

(Rev: 0.0 / 6 November 1998)

DIN OD-TD(1)-02-B10 | Page 11 | DWG NO. OD4/900/00205/0010 | C

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
C	ADDITIONAL & UPDATED INFORMATION	DIXON K. 6-11-98	JENNY C. 20-11-98	STANLEY S. 20-11-98

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OD-TD(1)-02-B10

CONTRACTOR REFERENCE NO.

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CAD FILE NAME	00205010		

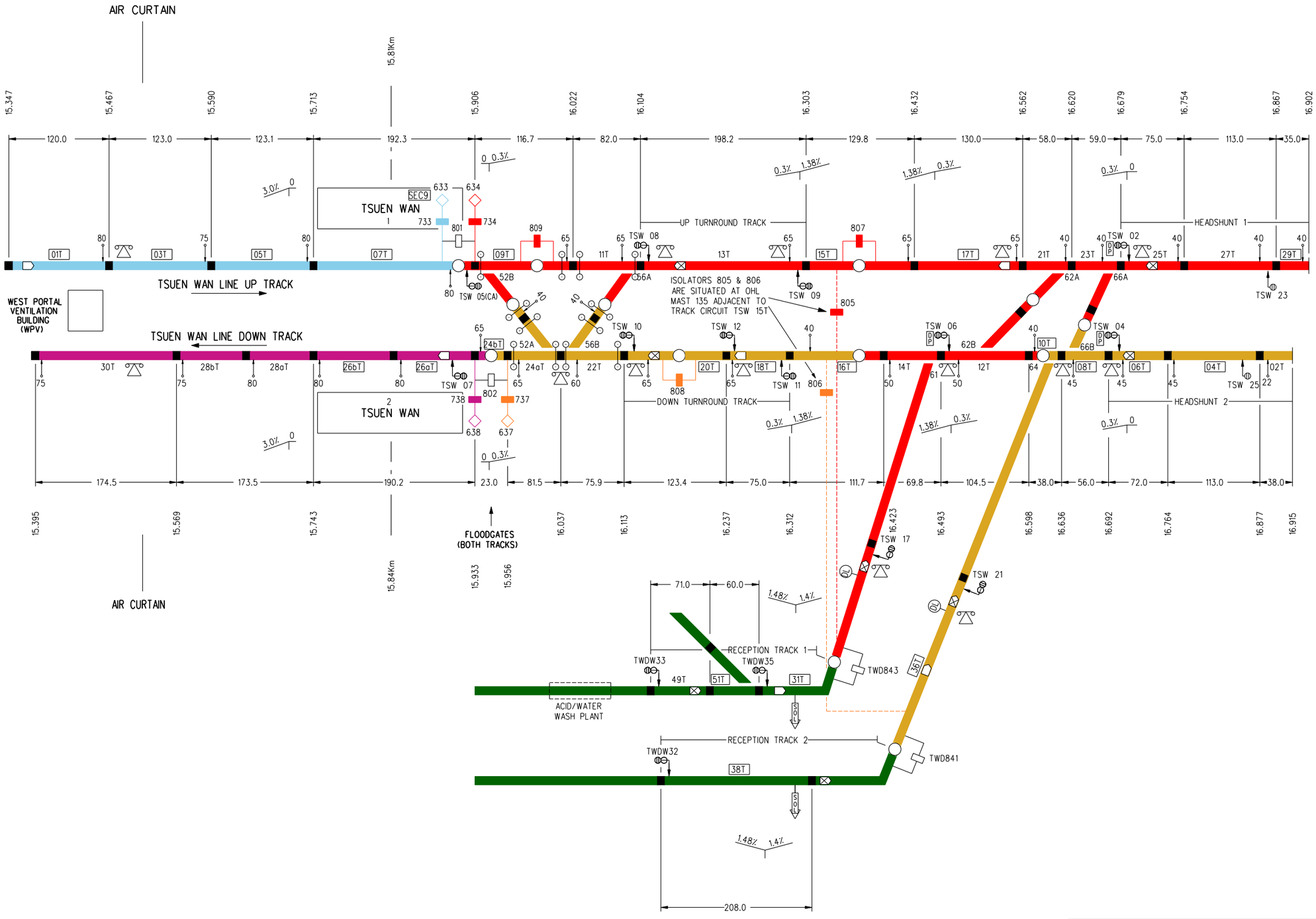
地鐵公司 MTR Corporation

TITLE KWAI HING STATION – TAI WO HAU STATION
TRACK DIAGRAMS VOLUME 1

SCALE NTS | OED DRAWING NO. OD4/900/00205/0010 | C

Tsuen Wan Station

SECTOR 9



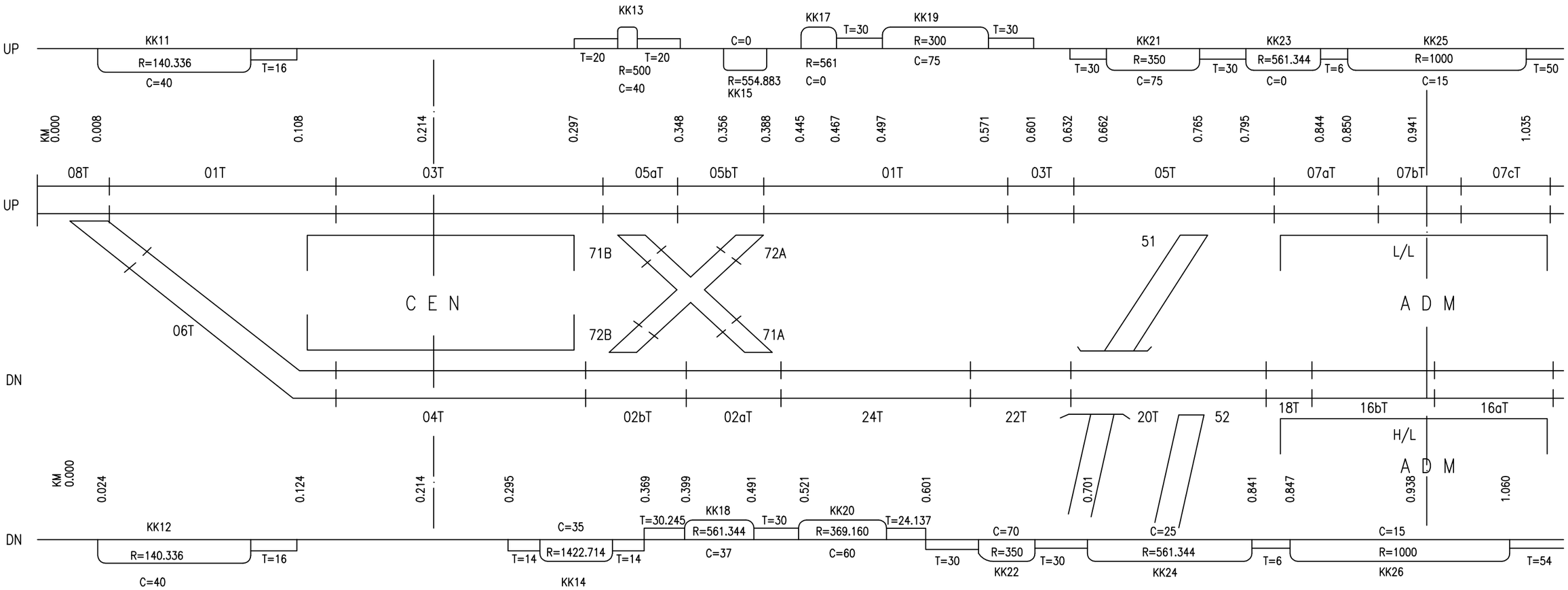
SECTOR 9

地鐵公司 MTR Corporation

Title Tsuen Wan Station
Track Diagrams Volume 1

(Issue/Rev: 0.11 July 2007)

DIN TD(1)-02-B11	Page 12	DWG NO. TWL/SQ/TD1/R38/211	A



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
D	ADM DOWN PLATFORM AMENDED	P.S.CHUNG 18-11-02	P.S.CHUNG 18-11-02	ZOE TSE 18-11-02
C	CURVE KK11, KK12, KK18, KK23 & KK26 AMENDED	P.S.CHUNG 19-02-02	P.S.CHUNG 19-02-02	ZOE TSE 19-02-02
B	CURVES KK23, KK24 AMENDED	P.S.CHUNG 21-09-99	T.TONG 21-09-99	T.WONG 21-09-99
A	DIGITIZATION	Y34 17-12-93	T.TONG 04-01-95	R.KEEFE 04-01-95

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/TWL/001

	INITIAL	DESIGNATION	DATE
DRAWN	Y34	ZESTC	17-12-1993
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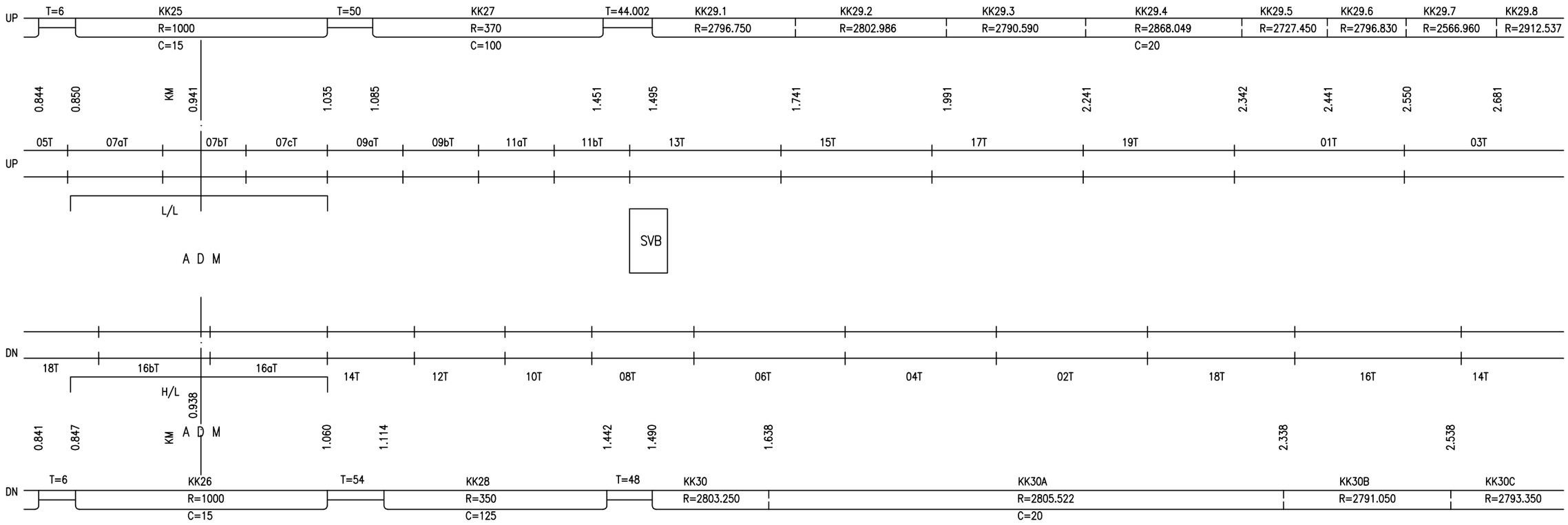
CHECKED			
APPROVED			
CAD FILE NAME	317362V1		

地鐵公司 MTR Corporation

TITLE
CEN – ADM
LINE DIAGRAM – TWL

SCALE N.T.S.

OED DRAWING NO. OD4/501/00204/0002 | D



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	ADM DOWN PLATFORM AMENDED	P.S.CHUNG 18-11-02	P.S.CHUNG 18-11-02	ZOE TSE 18-11-02
A	DIGITIZATION	Y31 15-12-93	TONG 13-01-95	R.KEEFE 13-01-95

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/TWL/002

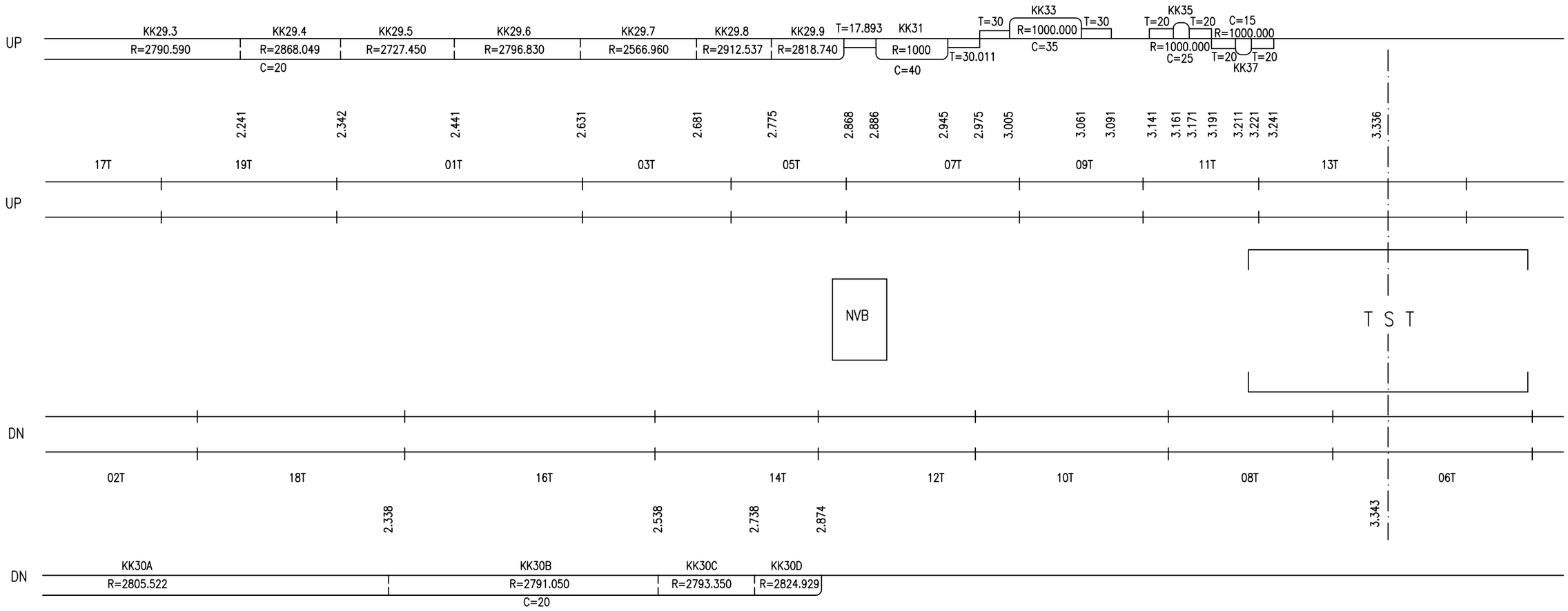
	INITIAL	DESIGNATION	DATE
DRAWN	Y31	ZESTC	15-12-1993
DESIGNED			
CHECKED			
APPROVED			
CAD FILE NAME	317363V1		

地鐵公司 MTR Corporation

TITLE
ADM – SVB
LINE DIAGRAM – TWL

SCALE N.T.S.

OED DRAWING NO. 0D4/501/00204/0003 B



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B	CURVE KK29, KK30 AMENDED	P.S.CHUNG 02-08-06	P.S.CHUNG 02-08-06	K.HUNG 02-08-06
A	DIGITIZATION	Y31 17-12-93	TONG 13-01-95	R.KEEFE 13-01-95

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CONTRACTOR REFERENCE NO.
PWM/TWL/003

	INITIAL	DESIGNATION	DATE
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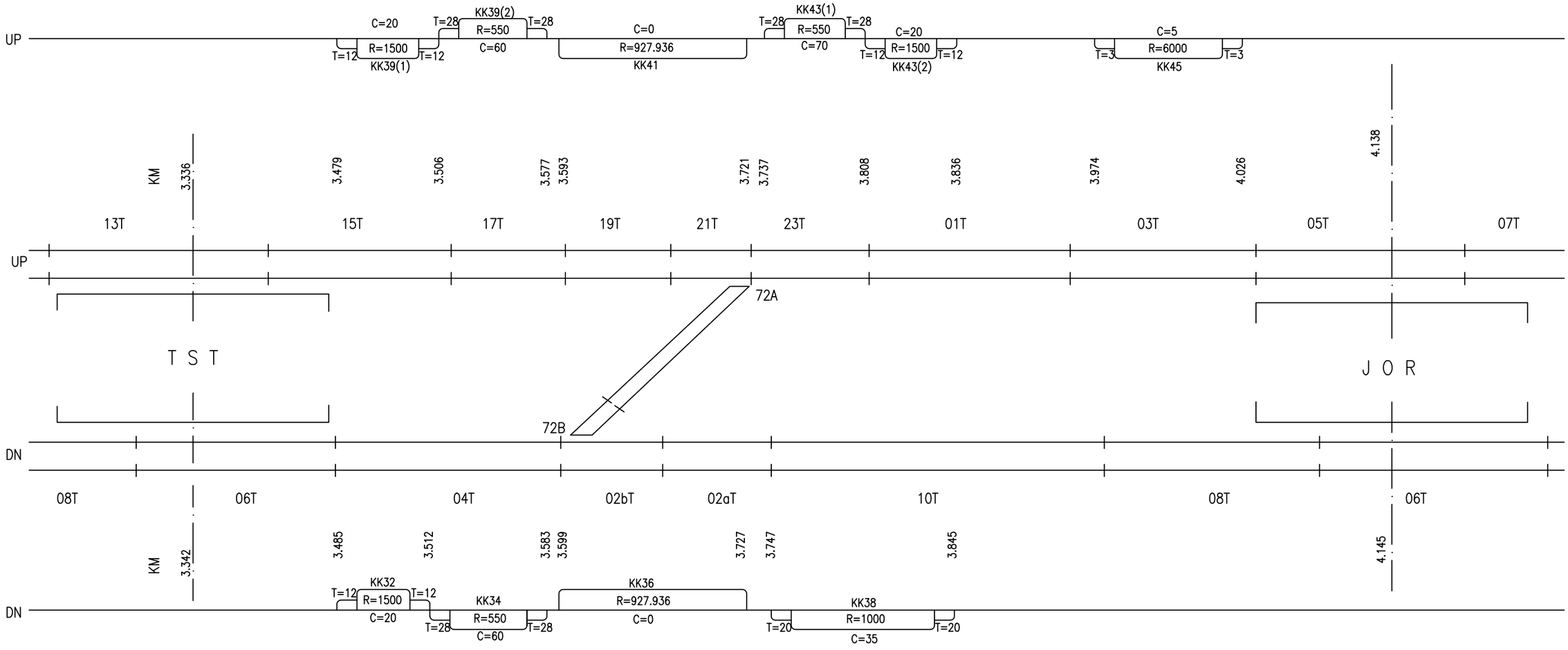
CAD FILE NAME 0D4_501_00204_0004_B

地鐵公司 MTR Corporation

TITLE
SVB – TST
LINE DIAGRAM – TWL

SCALE N.T.S.

OED DRAWING NO. 0D4/501/00204/0004 B



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B	CURVE KK43(2), KK45 AMENDED	P.S.CHUNG 17-05-04	P.S.CHUNG 17-05-04	ZOE TSE 17-05-04
A	DIGITIZATION	Y47 15-12-93	T.TONG 15-12-93	R.KEEFE 15-12-93

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CONTRACTOR REFERENCE NO.
PWM/TWL/004

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DESIGNED			
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CAD FILE NAME	OD4_501_00204_0005_B		

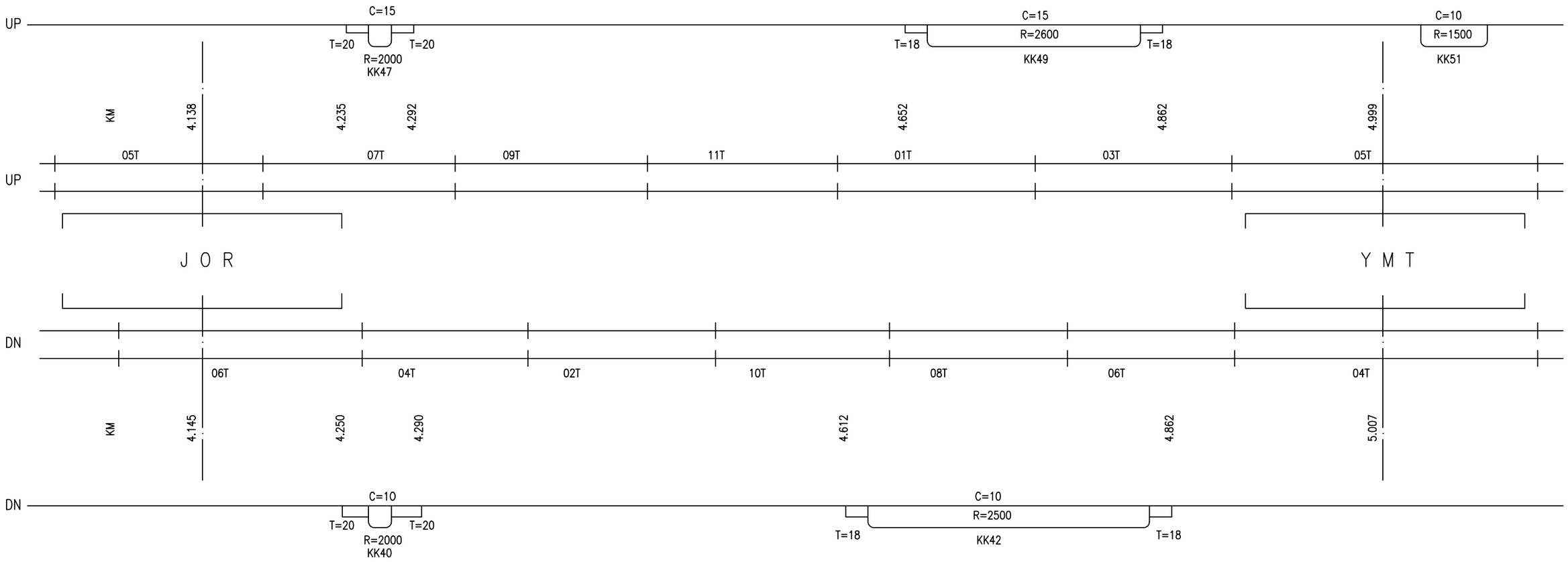
地鐵公司 MTR Corporation

TITLE
TST-JOR
LINE DIAGRAM - TWL

SCALE N.T.S.

OED DRAWING NO. OD4/501/00204/0005 B

OD4/501/00204/006 A



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REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE		DESIGNED BY			
						CHECKED BY	T. HO	PWO	04-1-95
						APPROVED BY	R. KEEFE	TM(PW)	04-1-95
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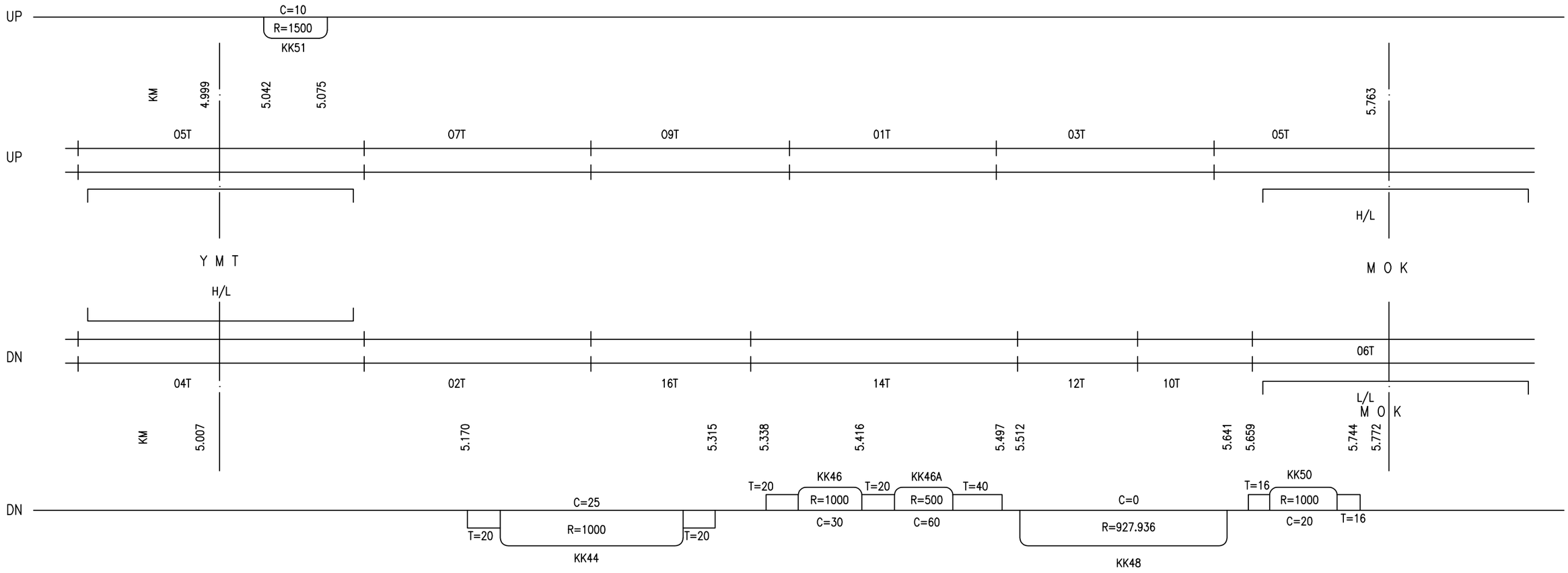
						PEN SET		PRINT DATE	
						CAD REF NO.	317366V1		

MASS TRANSIT RAILWAY CORPORATION

TITLE
JOR–YMT
LINE DIAGRAM – TWL

SCALE NTS | DWG NO. OD4/501/00204/006 A

OD4/501/00204/007 A



REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE
A	DIGITIZATION	TONG	TM(PW)	15-12-93

REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
PWM/TWL/006

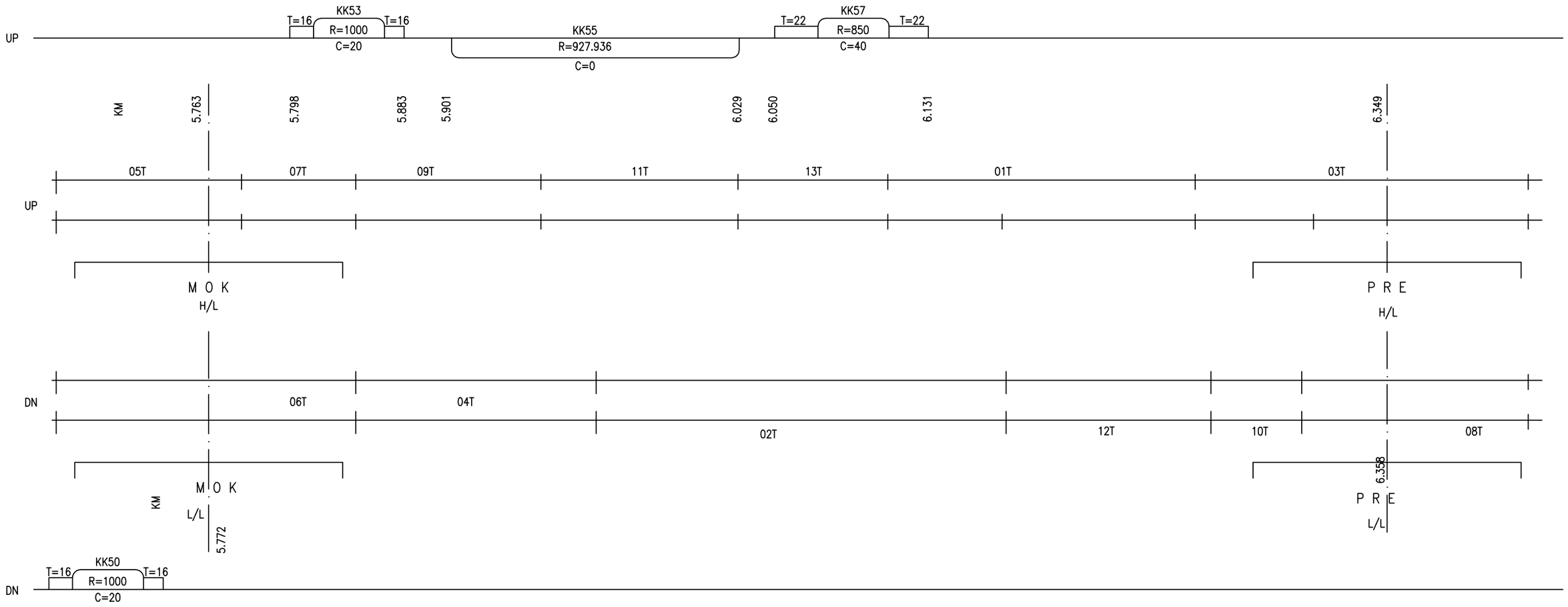
	INITIAL	DESIGNATION	DATE
TRACED BY	Y44	ZESTC	15-12-93
DESIGNED BY			
CHECKED BY	T. HO	PWO	04-1-95
APPROVED BY	R. KEEFE	TM(PW)	04-1-95
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.		317367V1	

MASS TRANSIT RAILWAY CORPORATION

TITLE
YMT-MOK
LINE DIAGRAM - TWL

SCALE NTS | DWG NO. OD4/501/00204/007 A

OD4/501/00204/008 A



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TRACED BY	Y41	ZESTC	11-12-93
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APPROVED BY	R. KEEFE	TM(PW)	04-1-95
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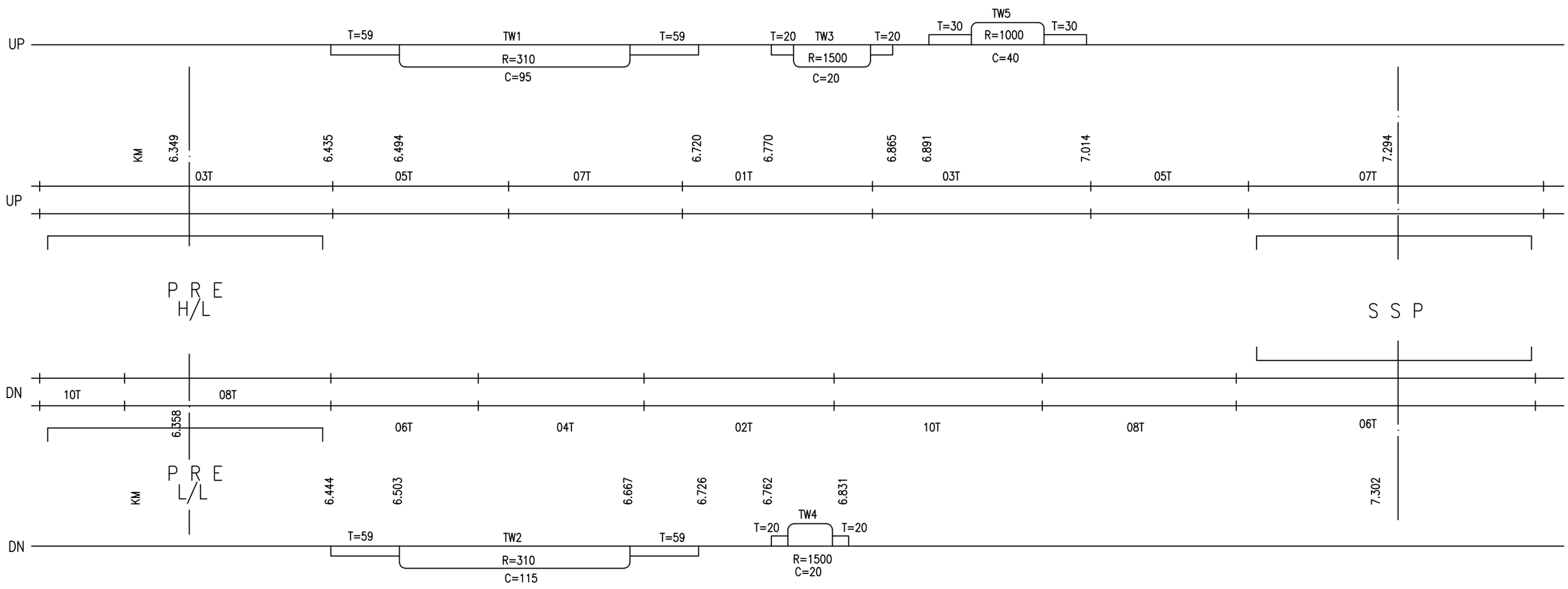
CAD REF NO.	317368V1		

MASS TRANSIT RAILWAY CORPORATION

TITLE
MOK–PRE
LINE DIAGRAM – TWL

SCALE NTS | DWG NO. OD4/501/00204/008 A

OD4/501/00204/009 A



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A	DIGITIZATION	TONG	TM(PW)	15-12-93

REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
PWM/TWL/008

	INITIAL	DESIGNATION	DATE
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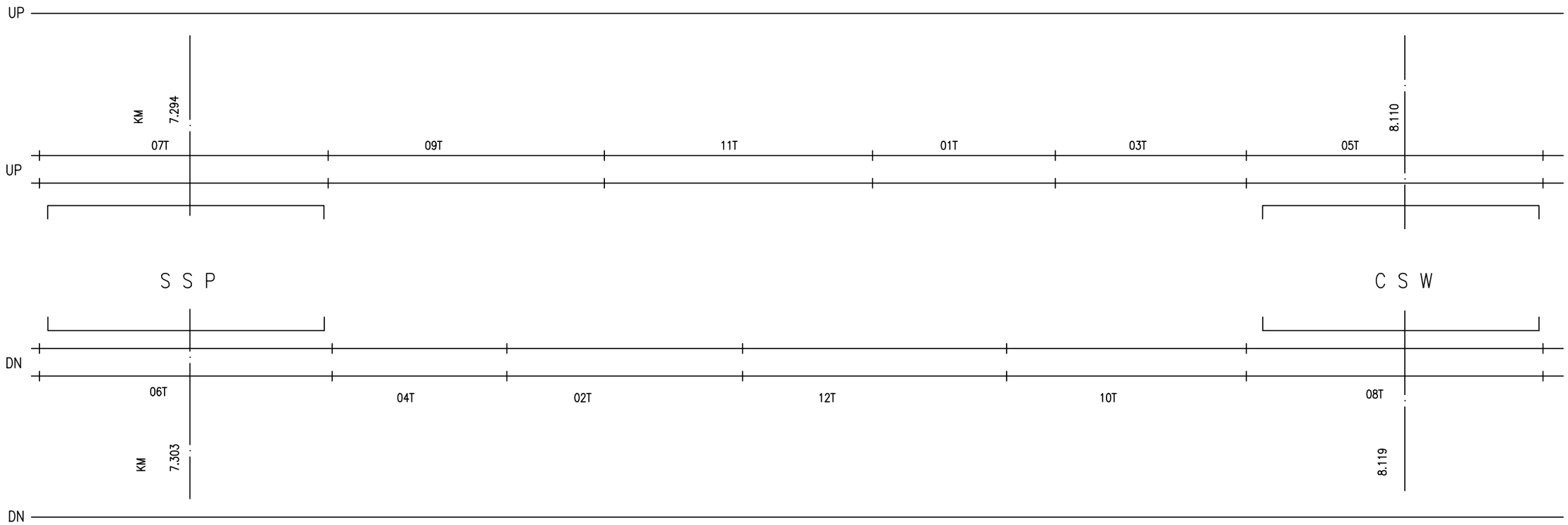
DESIGNED BY			
CHECKED BY	T. HO	PWO	04-1-95
APPROVED BY	R. KEEFE	TM(PW)	04-1-95
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.	317369V1		

MASS TRANSIT RAILWAY CORPORATION

TITLE
PRE-SSP
LINE DIAGRAM - TWL

SCALE NTS | DWG NO. OD4/501/00204/009 A



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	STATION CENTRE UPDATED	P.S.CHUNG 02-08-06	P.S.CHUNG 02-08-06	K.HUNG 02-08-06
A	DIGITIZATION	Y4 15-12-93	T.TONG 04-01-95	R.KEEFE 04-01-95

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/TWL/010

	INITIAL	DESIGNATION	DATE
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DESIGNED			
CHECKED			
APPROVED			

CAD FILE NAME 0D4_501_00204_0010_B

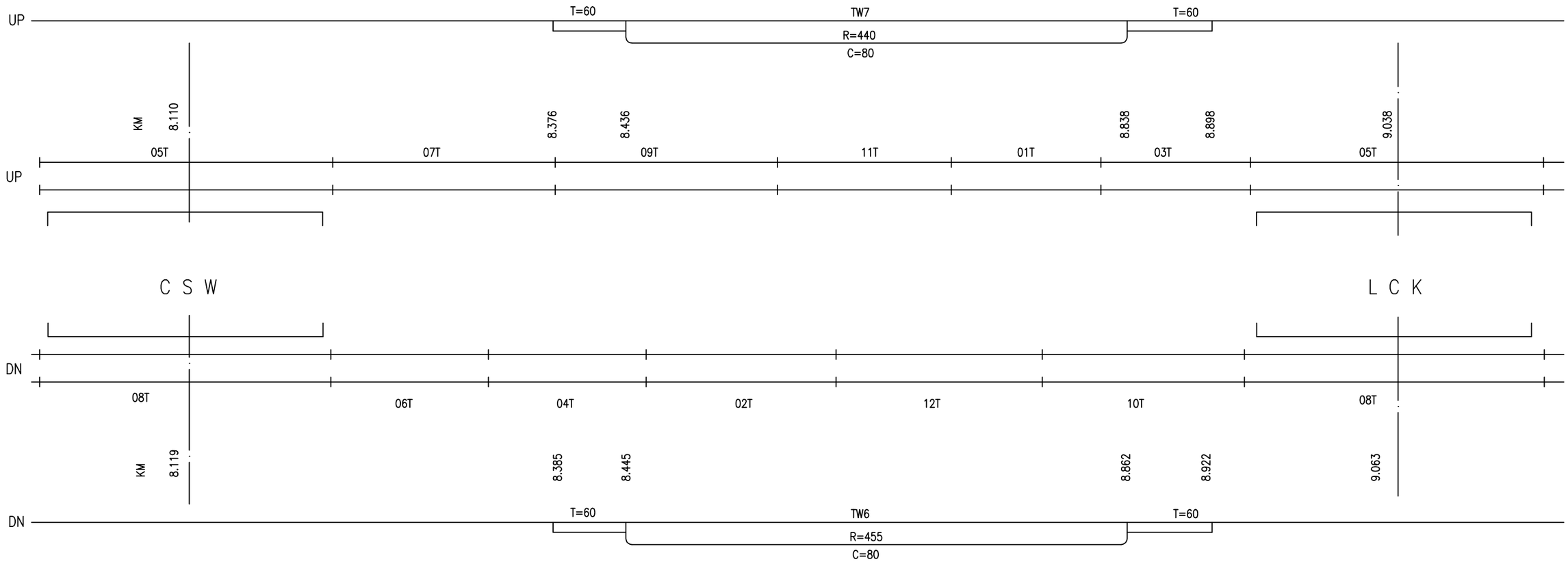
地鐵公司 MTR Corporation

TITLE
SSP – CSW
LINE DIAGRAM – TWL

SCALE N.T.S.

OED DRAWING NO. 0D4/501/00204/0010 B

OD4/501/00204/011 A



REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE
A	DIGITIZATION	TONG	TM(PW)	15-12-93

REFERENCE DWGS

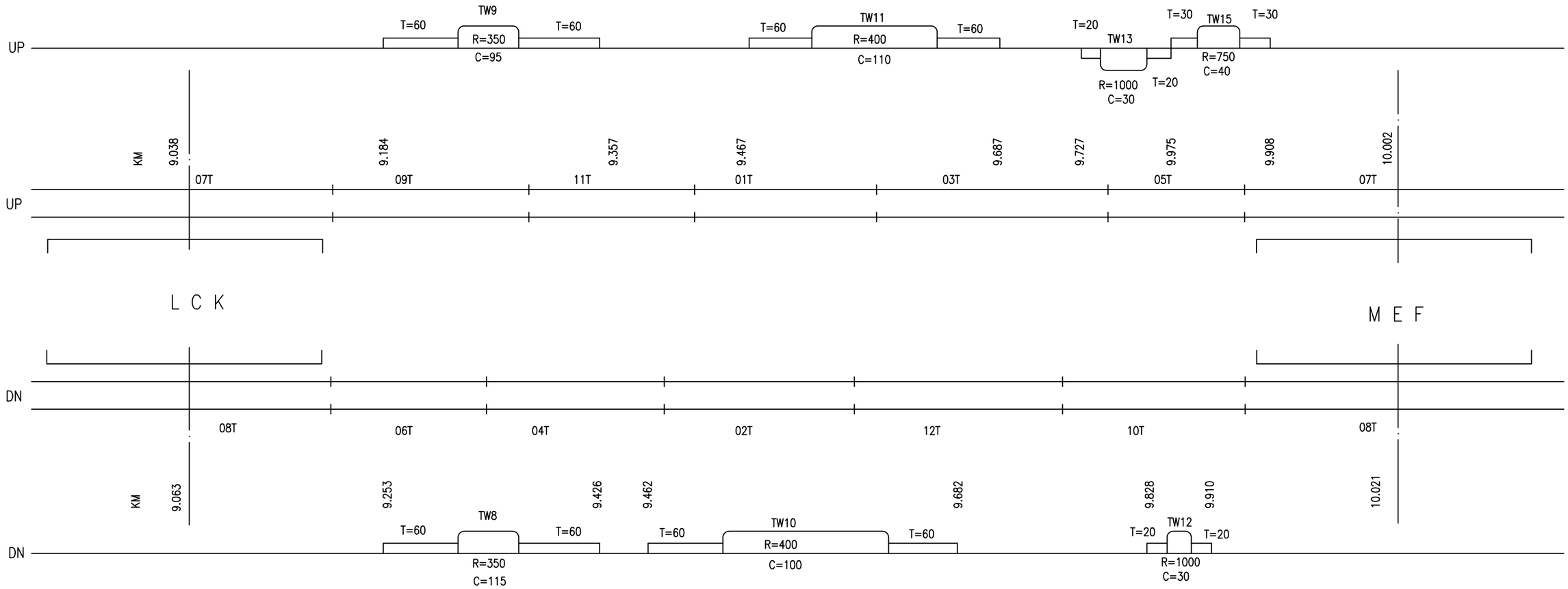
CONTRACTOR'S DRAWING NO.
PWM/TWL/010

	INITIAL	DESIGNATION	DATE
TRACED BY	Y4	ZESTC	15-12-93
DESIGNED BY			
CHECKED BY	T. HO	PWO	04-1-95
APPROVED BY	R. KEEFE	TM(PW)	04-1-95
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.	317371V1		

MASS TRANSIT RAILWAY CORPORATION

TITLE
CSW–LCK
LINE DIAGRAM – TWL

SCALE NTS | DWG NO. OD4/501/00204/011 A



REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE
A	DIGITIZATION	TONG	TM(PW)	15-12-93

REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
PWM/TWL/011

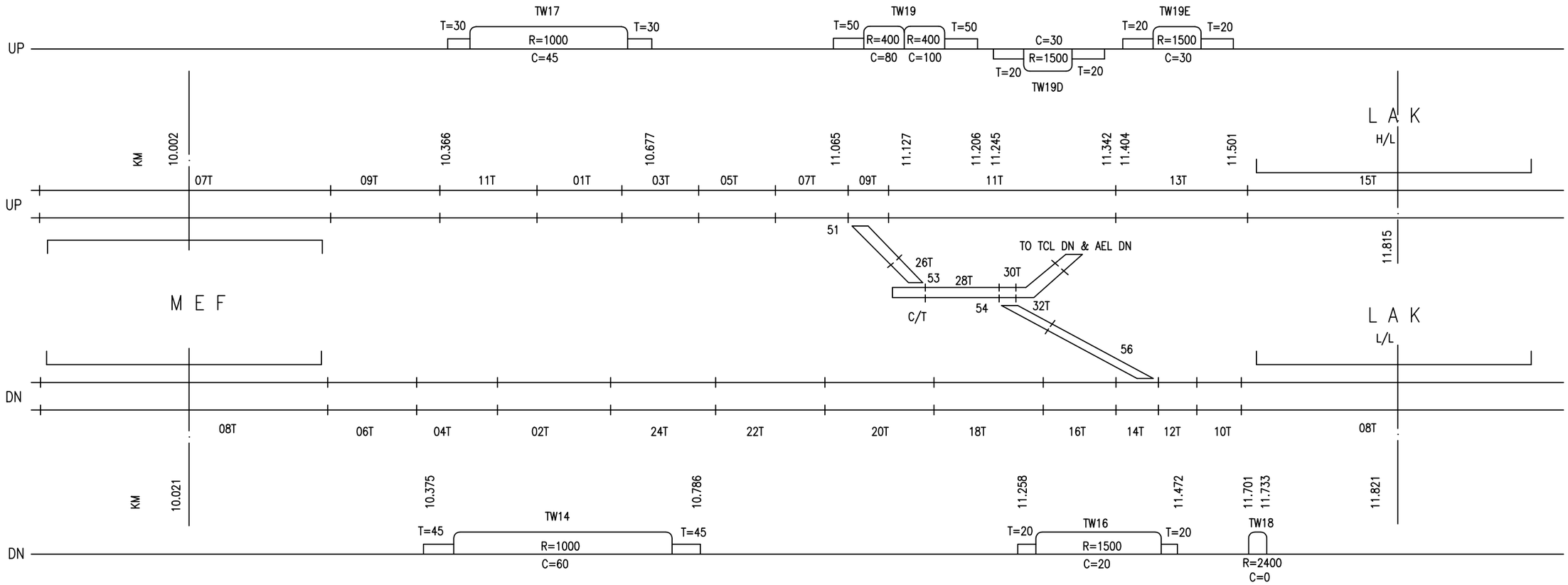
	INITIAL	DESIGNATION	DATE
TRACED BY	Y4	ZESTC	15-12-93
DESIGNED BY			
CHECKED BY	T. HO	PWO	04-1-95
APPROVED BY	R. KEEFE	TM(PW)	04-1-95
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.	317372V1		

MASS TRANSIT RAILWAY CORPORATION

TITLE
LCK–MEF
LINE DIAGRAM – TWL

SCALE NTS

DWG NO. OD4/501/00204/012 A



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
D	CURVE TW17 & TW19D AMENDED	P.S.CHUNG 25-02-02	P.S.CHUNG 25-02-02	ZOE TSE 25-02-02
C	TRACK CIRCUITS UPDATED	P.S.CHUNG 25-02-98	T.TONG 25-02-98	T.WONG 25-02-98
B	CURVE TW19 UPDATED	P.S.CHUNG 15-01-98	T.TONG 15-01-98	T.WONG 15-01-98
A	DIGITIZATION	Y4 16-12-93	T.TONG 16-12-93	TM(PW) 16-12-93

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/TWL/012

	INITIAL	DESIGNATION	DATE
DRAWN	Y4	ZESTC	16-12-1993
DESIGNED			
CHECKED	T.HO	PWO	04-01-1995
APPROVED	R.KEEFE	TM(PW)	04-01-1995
CAD FILE NAME	317373V1		

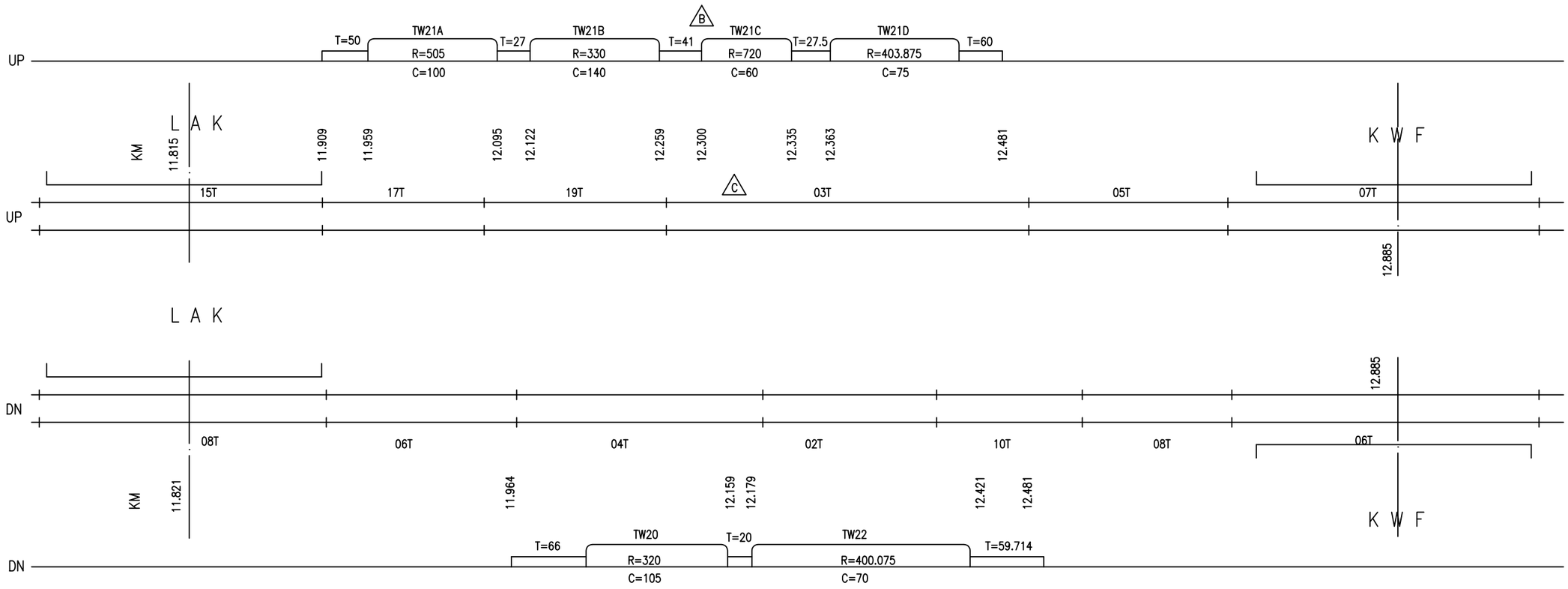
地鐵公司 MTR Corporation

TITLE
MEF – LAK
LINE DIAGRAM – TWL

SCALE NTS

OED DRAWING NO. OD4/501/00204/0013 | D

OD4/501/00204/0014 | C



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
C	TRACK CIRCUITS UPDATED	P.S.CHUNG 25-02-98	T.TONG 25-02-98	T.WONG 25-02-98
B	CURVE TW21 UPDATED	P.S.CHUNG 15-01-98	T.TONG 15-01-98	T.WONG 15-01-98
A	DIGITIZATION	Y4 15-12-93	T.TONG 15-12-93	TM(PW) 15-12-93

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/TWL/013

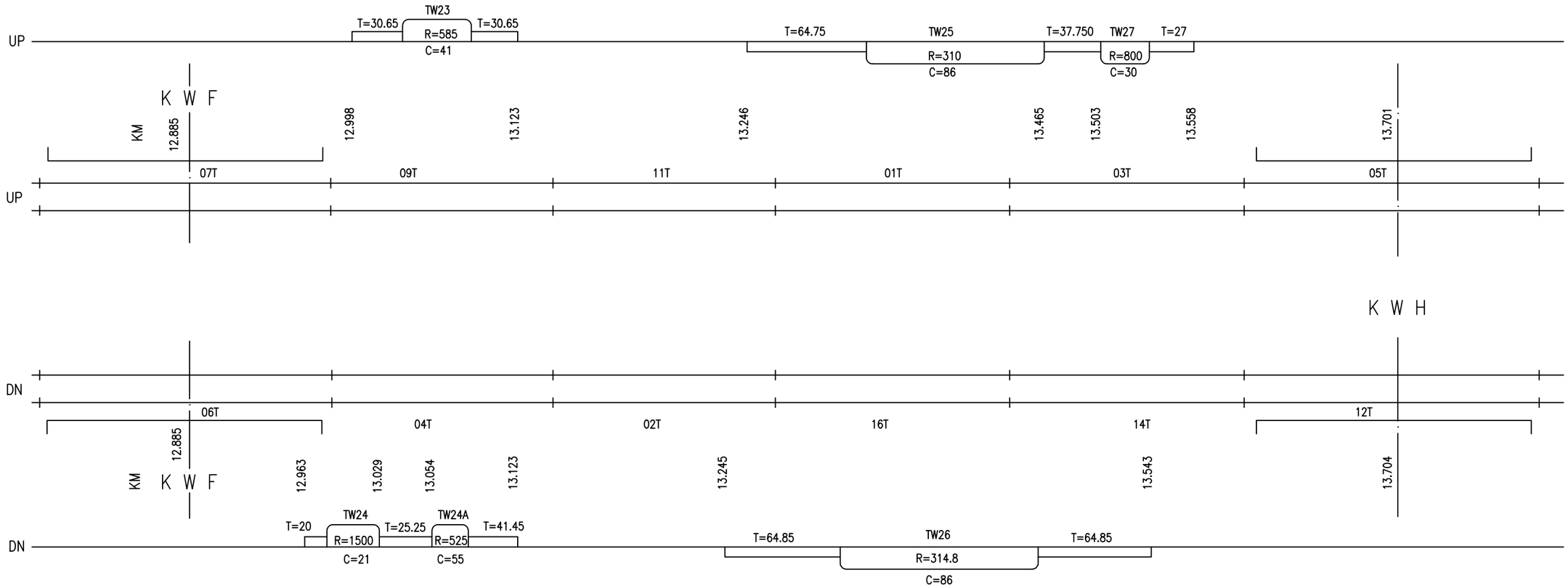
	INITIAL	DESIGNATION	DATE
DRAWN	Y4	ZESTC	15-12-1993
DESIGNED			
CHECKED	T.HO	PWO	04-01-1995
APPROVED	R.KEEFE	TM(PW)	04-01-1995
CAD FILE NAME	317374V1		

地鐵公司 MTR Corporation

TITLE
LAK-KWF
LINE DIAGRAM - TWL

SCALE NTS

OED DRAWING NO. OD4/501/00204/0014 | C



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	KWF UP & DOWN PLATFORM AMENDED	P.S.CHUNG 19-11-02	P.S.CHUNG 19-11-02	ZOE TSE 19-11-02
A	DIGITIZATION	Y4 15-12-93	T.TONG 04-01-95	TM(PW) 04-01-95

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/TWL/014

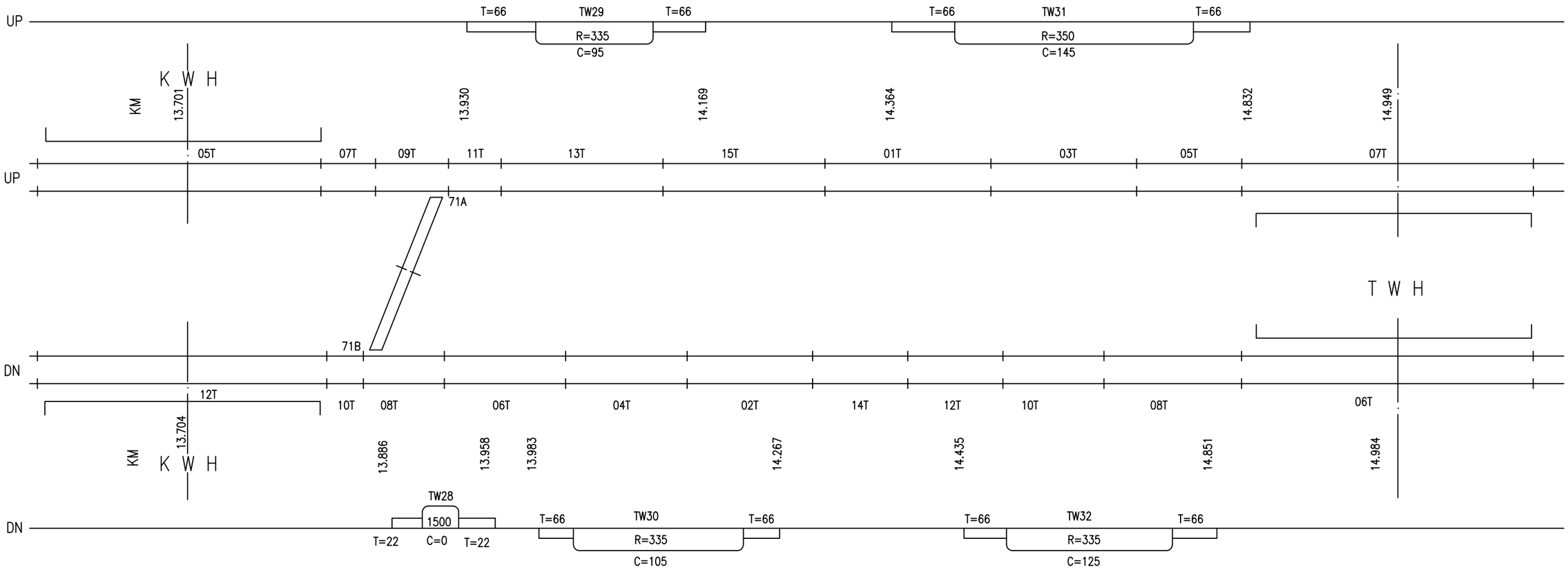
	INITIAL	DESIGNATION	DATE
DRAWN	Y4	ZESTC	15-12-1993
DESIGNED			
CHECKED			
APPROVED			
CAD FILE NAME	317375V1		

地鐵公司 MTR Corporation

TITLE
KWF – KWH
LINE DIAGRAM – TWL

SCALE N.T.S.

OED DRAWING NO. OD4/501/00204/0015 | B



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	KWH UP & DOWN PLATFORM AMENDED	P.S.CHUNG 19-11-02	P.S.CHUNG 19-11-02	ZOE TSE 19-11-02
A	DIGITIZATION	Y4 15-12-93	TONG 04-01-95	R.KEEFE 04-01-95

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CONTRACTOR REFERENCE NO.
PWM/TWL/015

	INITIAL	DESIGNATION	DATE
DRAWN	Y4	ZESTC	15-12-1993
DESIGNED			
CHECKED			
APPROVED			
CAD FILE NAME	317376V1		

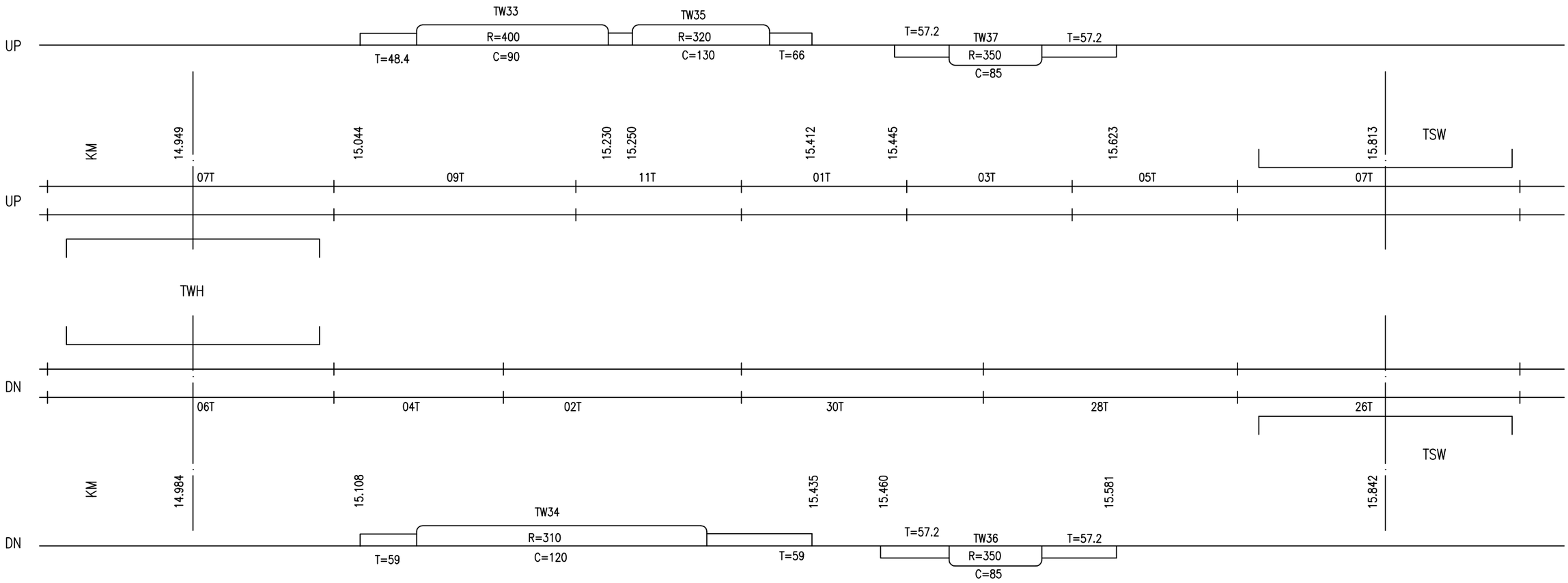
地鐵公司 MTR Corporation

TITLE
KWH – TWH
LINE DIAGRAM – TWL

SCALE N.T.S.

OED DRAWING NO. OD4/501/00204/0016 B

OD4/501/00204/017 A



REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE
A	DIGITIZATION	TONG	TM(PW)	14-12-93

REFERENCE DWGS

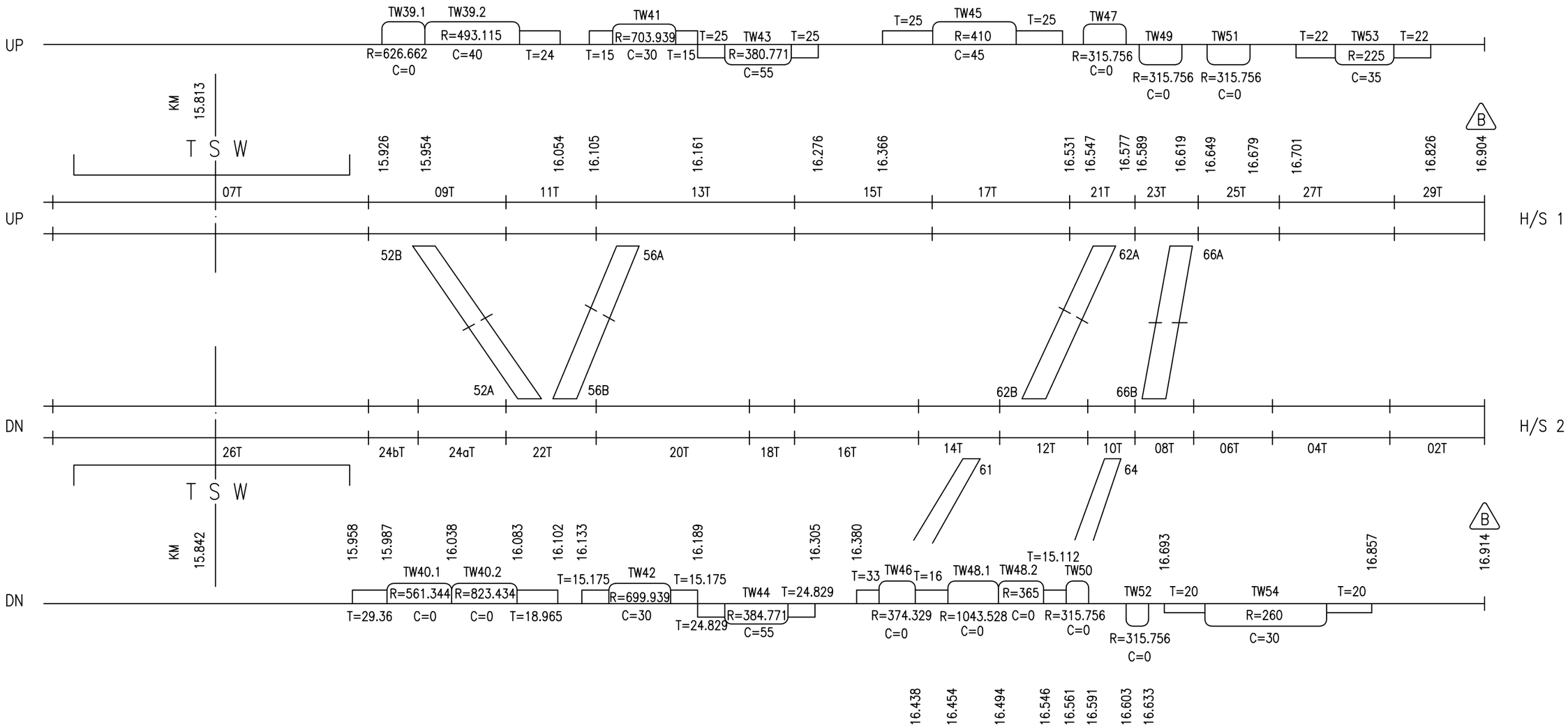
CONTRACTOR'S DRAWING NO.
PWM/TWL/016

	INITIAL	DESIGNATION	DATE
TRACED BY	Y43	ZESTC	14-12-93
DESIGNED BY			
CHECKED BY	T. HO	PWO	04-1-95
APPROVED BY	R. KEEFE	TM(PW)	04-1-95
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.	317377V1		

MASS TRANSIT RAILWAY CORPORATION

TITLE
TWH–TSW
LINE DIAGRAM – TWL

SCALE NTS | DWG NO. OD4/501/00204/017 A



* SIMPLE CURVE TW38 WITH RADIUS 350m (Km 15.956 to Km 15.976) MODIFIED TO A SPIRAL CURVE OF 29.360m ON 14-03-1995 DUE TO Vmax OPTIMIZATION.

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	CHAINAGE UPDATED AT H/S 1 & 2	P.S.CHUNG 02-02-06	W.TSE 02-02-06	ZOE TSE 02-02-06
A	DIGITIZATION	Y43 21-12-93	T.TONG 24-09-96	C.W.LAU 24-09-96

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.

PWM/TWL/017

	INITIAL	DESIGNATION	DATE
DRAWN	Y43	ZESTC	21-12-1993
DESIGNED			
CHECKED			
APPROVED			

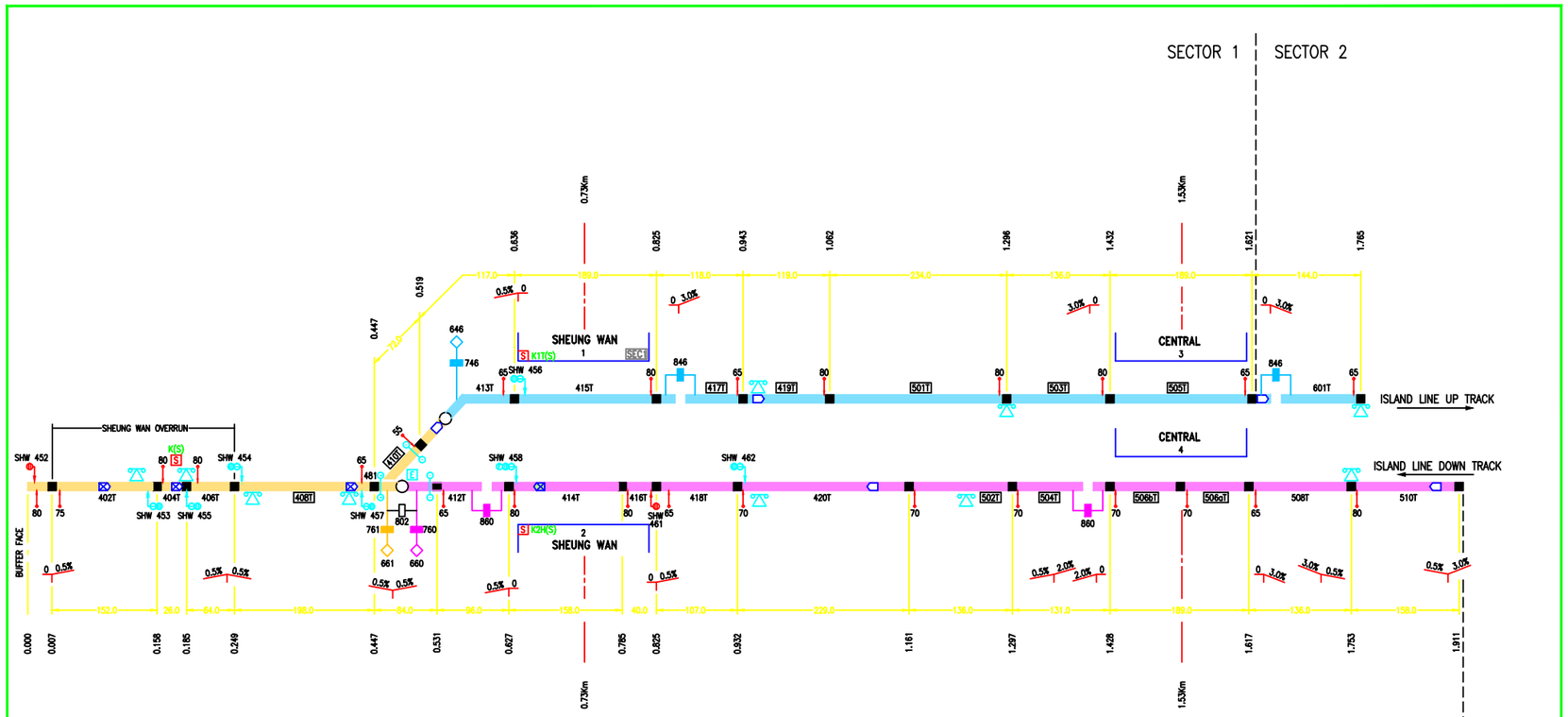
CAD FILE NAME 0D4_501_00204_0018_B

地鐵公司 MTR Corporation

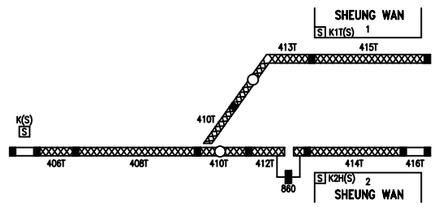
TITLE
TSW - H/S
LINE DIAGRAM - TWL

SCALE N.T.S.

OED DRAWING NO. 0D4/501/00204/0018 B



When Co-operative Keyswitch K1T(S), K2T(S) or K(S) is operated:



SECTOR 1 | SECTOR 2

DEVIATED STIB

Track Circuit	Deviation
SHW414T	+6m from CL

地鐵公司 MTR Corporation

Title Sheung Wan Station – Central Station
Track Diagrams Volume 1

(Issue/Rev: 0.7 July 2003)

DIN TD(1)-02-A1 | Page 2 | DWG NO. 0D4/900/00305/0001 | F

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
F	DEVIATED STIB SPECIFIED, STIB RELOCATED FROM TRACK END TO SHW402T	KSK 08-07-03	K. MARK 08-07-03	
E	ADDITIONAL & UPDATED INFORMATION (101044)	DIXON K. 11-11-99	KEVIN LO 11-11-99	STANLEY S. 11-11-99
D	ADDITIONAL & UPDATED INFORMATION	P.C.YU 03-05-99	JENNY C. 24-05-99	STANLEY S. 24-05-99
C	ADDITIONAL & UPDATED INFORMATION	DIXON K. 6-11-98	JENNY C. 20-11-98	STANLEY S. 20-11-98

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MTRC REFERENCE NO. TD(1)-02-A1

CONTRACTOR REFERENCE NO.

	INITIAL	DESIGNATION	DATE
DRAWN	H.K.HO	D'MAN	23-5-90
DESIGNED			
CHECKED			
APPROVED			

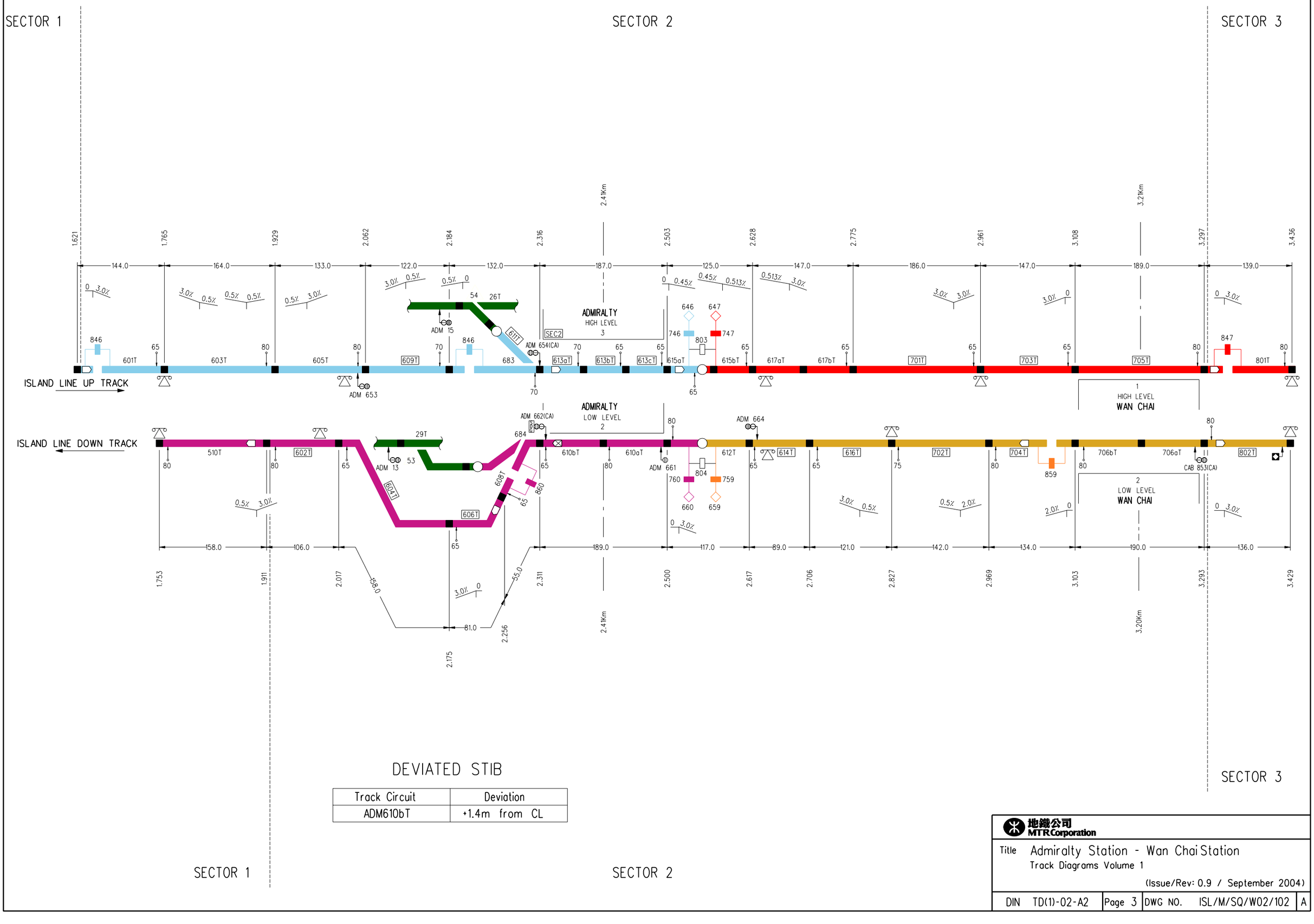
CAD FILE NAME 00305001

地鐵公司 MTR Corporation

TITLE SHEUNG WAN STATION – CENTRAL STATION
TRACK DIAGRAMS VOLUME 1

SCALE NTS | OED DRAWING NO. 0D4/900/00305/0001 | F

Admiralty Station – Wan Chai Station

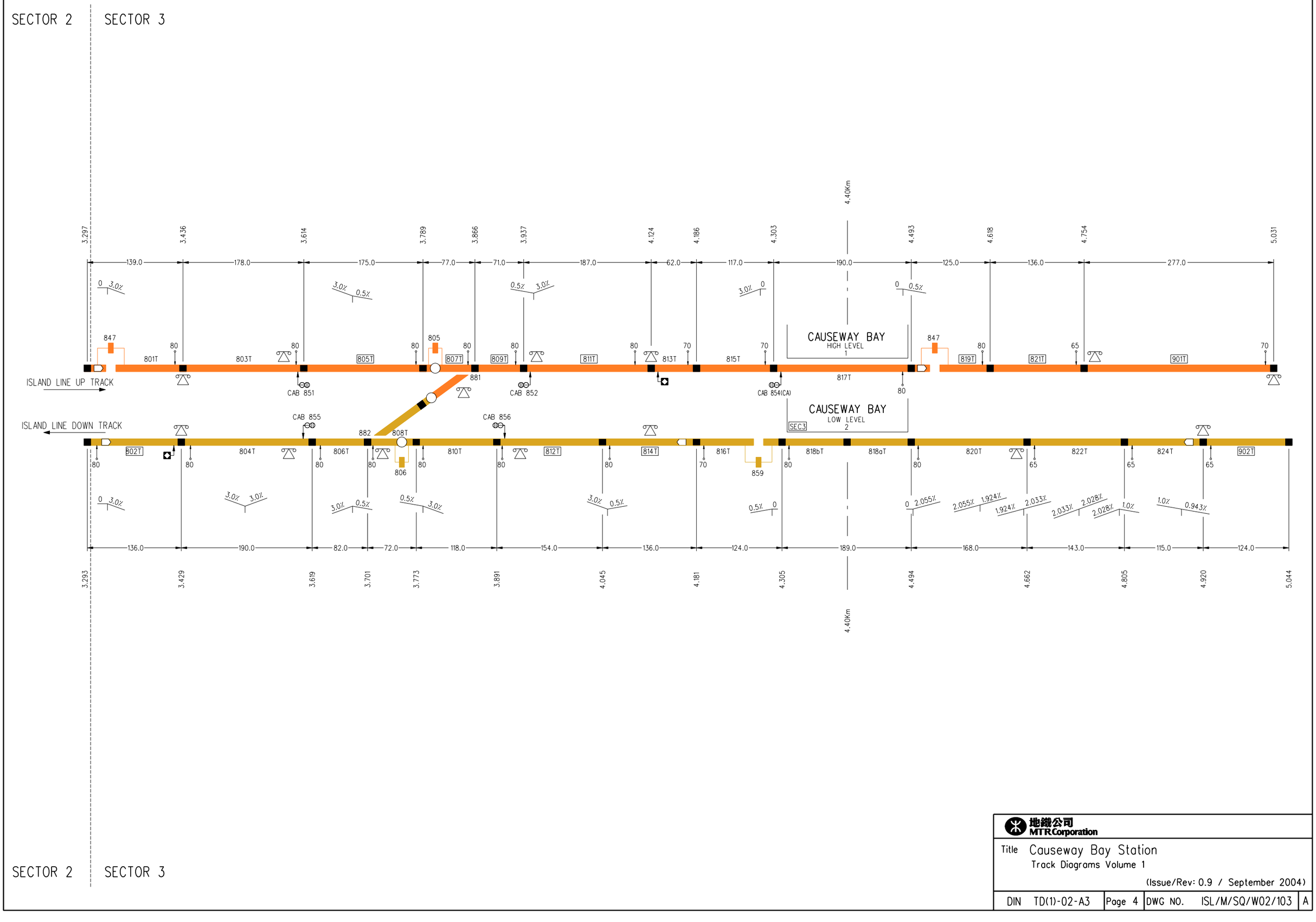


DEVIATED STIB

Track Circuit	Deviation
ADM610bT	+1.4m from CL

地鐵公司 MTR Corporation					
Title	Admiralty Station - Wan Chai Station Track Diagrams Volume 1 (Issue/Rev: 0.9 / September 2004)				
DIN	TD(1)-02-A2	Page 3	DWG NO.	ISL/M/SQ/W02/102	A

Causeway Bay Station

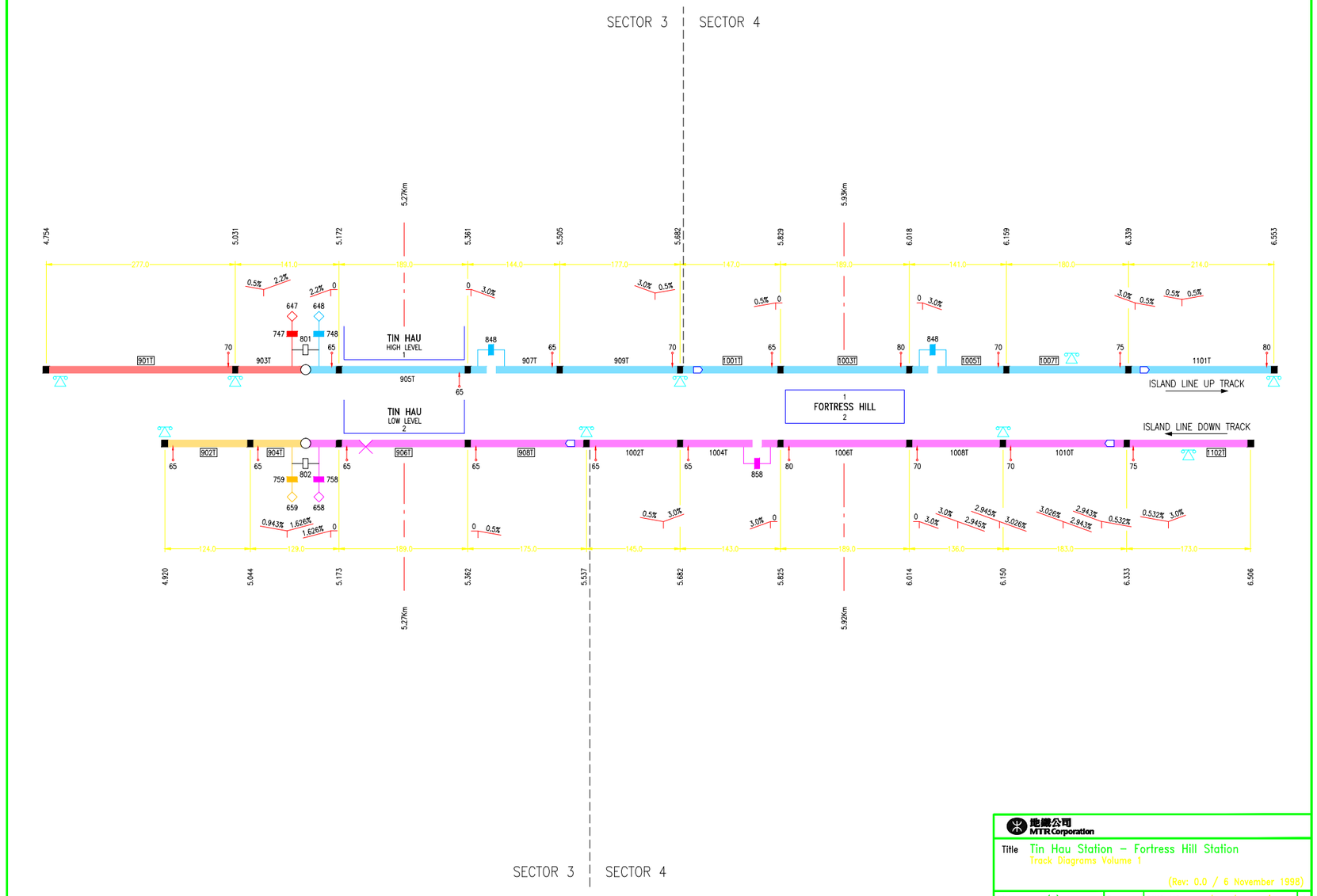


地鐵公司
MTR Corporation

Title Causeway Bay Station
Track Diagrams Volume 1

(Issue/Rev: 0.9 / September 2004)

DIN TD(1)-02-A3	Page 4	DWG NO. ISL/M/SQ/W02/103	A



Title: Tin Hau Station – Fortress Hill Station
Track Diagrams Volume 1
(Rev: 0.0 / 6 November 1998)

DIN OD-TD(1)-02-A4 | Page 5 | DWG NO. OD4/900/00305/0004 | C

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
C	ADDITIONAL & UPDATED INFORMATION	DIXON K. 6-11-98	JENNY C. 20-11-98	STANLEY S. 20-11-98

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MTRC REFERENCE NO. OD-TD(1)-02-A4

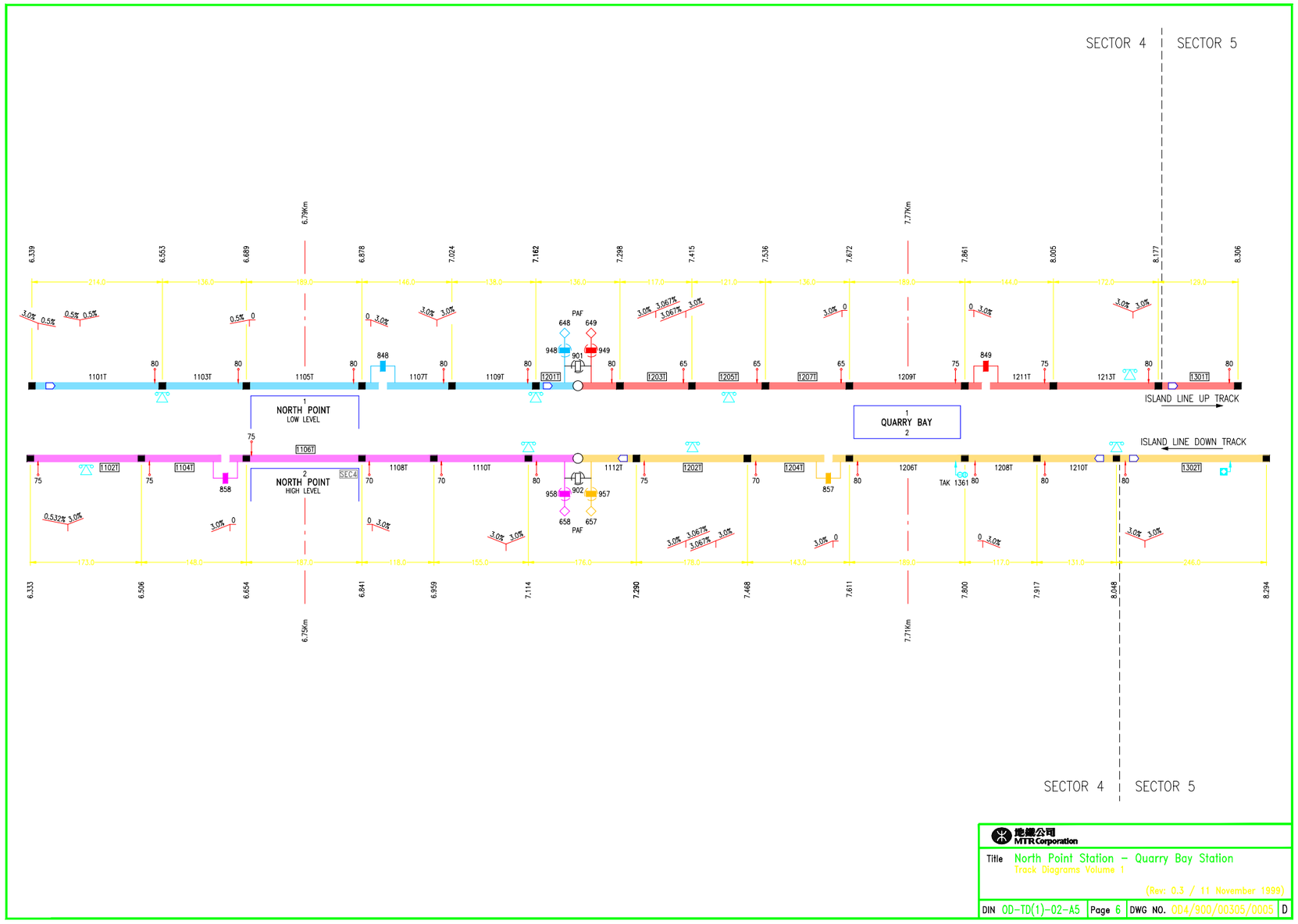
CONTRACTOR REFERENCE NO.

	INITIAL	DESIGNATION	DATE
DRAWN	H.K.HO	D'MAN	23-5-90
DESIGNED			
CHECKED			
APPROVED			

CAD FILE NAME 00305004

TITLE: TIN HAU STATION – FORTRESS HILL STATION
TRACK DIAGRAMS VOLUME 1

SCALE NTS | OED DRAWING NO. OD4/900/00305/0004 | C



地鐵公司 MTR Corporation

Title North Point Station – Quarry Bay Station
Track Diagrams Volume 1

(Rev: 0.3 / 11 November 1999)

DIN OD-TD(1)-02-A5 | Page 6 | DWG NO. OD4/900/00305/0005 | D

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
D	ADDITIONAL & UPDATED INFORMATION (101044)	DIXON K. 11-11-99	KEVIN LO 11-11-99	STANLEY S. 11-11-99
C	ADDITIONAL & UPDATED INFORMATION	DIXON K. 06-11-98	JENNY C. 20-11-98	STANLEY S. 20-11-98

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MTRC REFERENCE NO. OD-TD(1)-02-A5

CONTRACTOR REFERENCE NO.

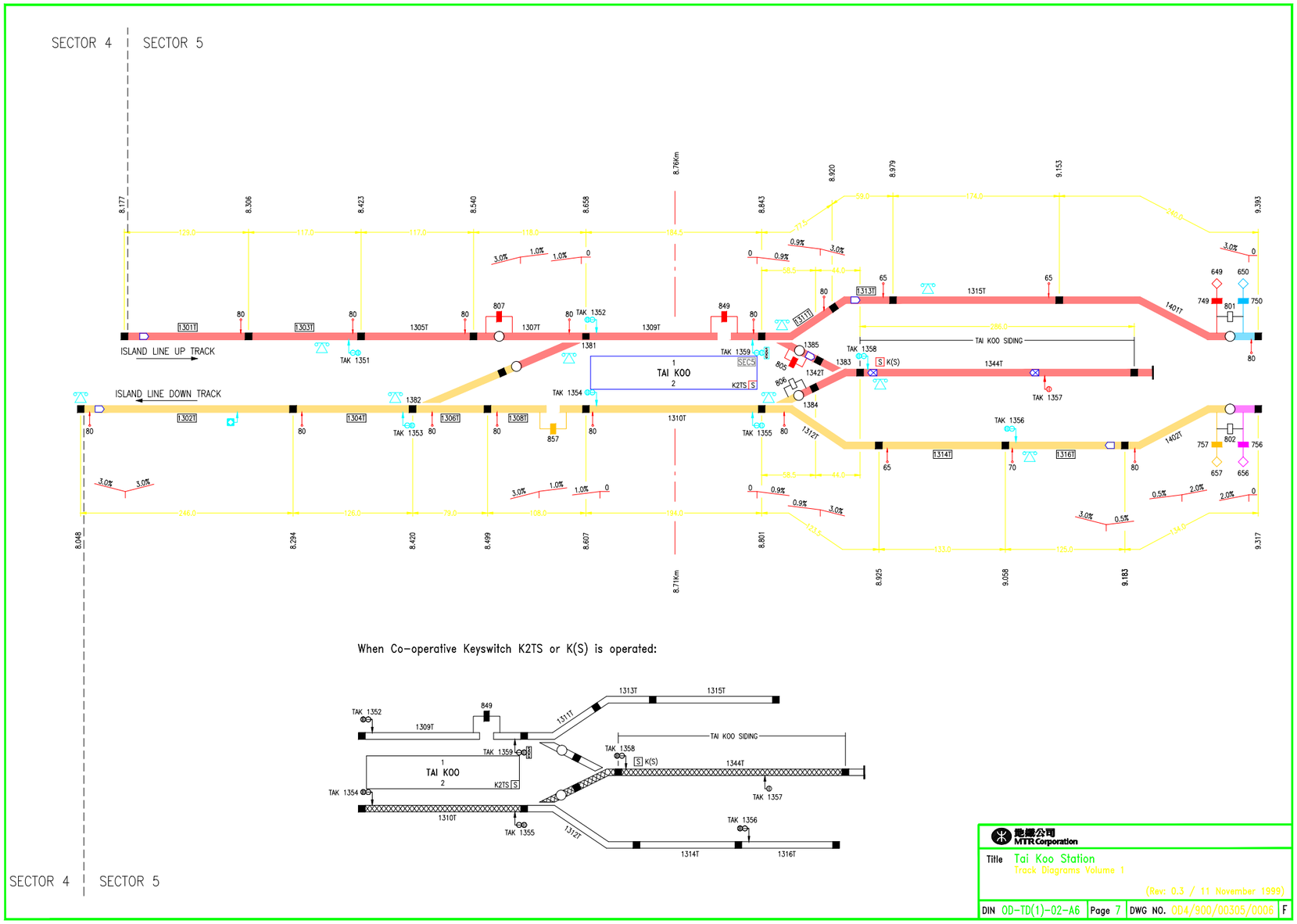
	INITIAL	DESIGNATION	DATE
DRAWN	H.K.HO	D'MAN	23-5-90
DESIGNED			
CHECKED			
APPROVED			

CAD FILE NAME 00305005

地鐵公司 MTR Corporation

TITLE NORTH POINT STATION – QUARRY BAY STATION
TRACK DIAGRAMS VOLUME 1

SCALE NTS | OED DRAWING NO. OD4/900/00305/0005 | D



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
F	ADDITIONAL & UPDATED INFORMATION (101044)	DIXON K. 11-11-99	KEVIN LO 11-11-99	STANLEY S. 11-11-99
E	ADDITIONAL & UPDATED INFORMATION	P.C.YU 03-08-99	JENNY C. 09-08-99	STANLEY S. 09-08-99
D	ADDITIONAL & UPDATED INFORMATION	P.C.YU 03-05-99	JENNY C. 24-05-99	STANLEY S. 24-05-99
C	ADDITIONAL & UPDATED INFORMATION	DIXON K. 6-11-98	JENNY C. 20-11-98	STANLEY S. 20-11-98

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MTRC REFERENCE NO. OD-TD(1)-02-A6

CONTRACTOR REFERENCE NO.

	INITIAL	DESIGNATION	DATE
DRAWN	H.K.HO	D'MAN	23-5-90
DESIGNED			
CHECKED			
APPROVED			

CAD FILE NAME 00305006

地鐵公司 MTR Corporation

TITLE TAI KOO STATION
TRACK DIAGRAMS VOLUME 1

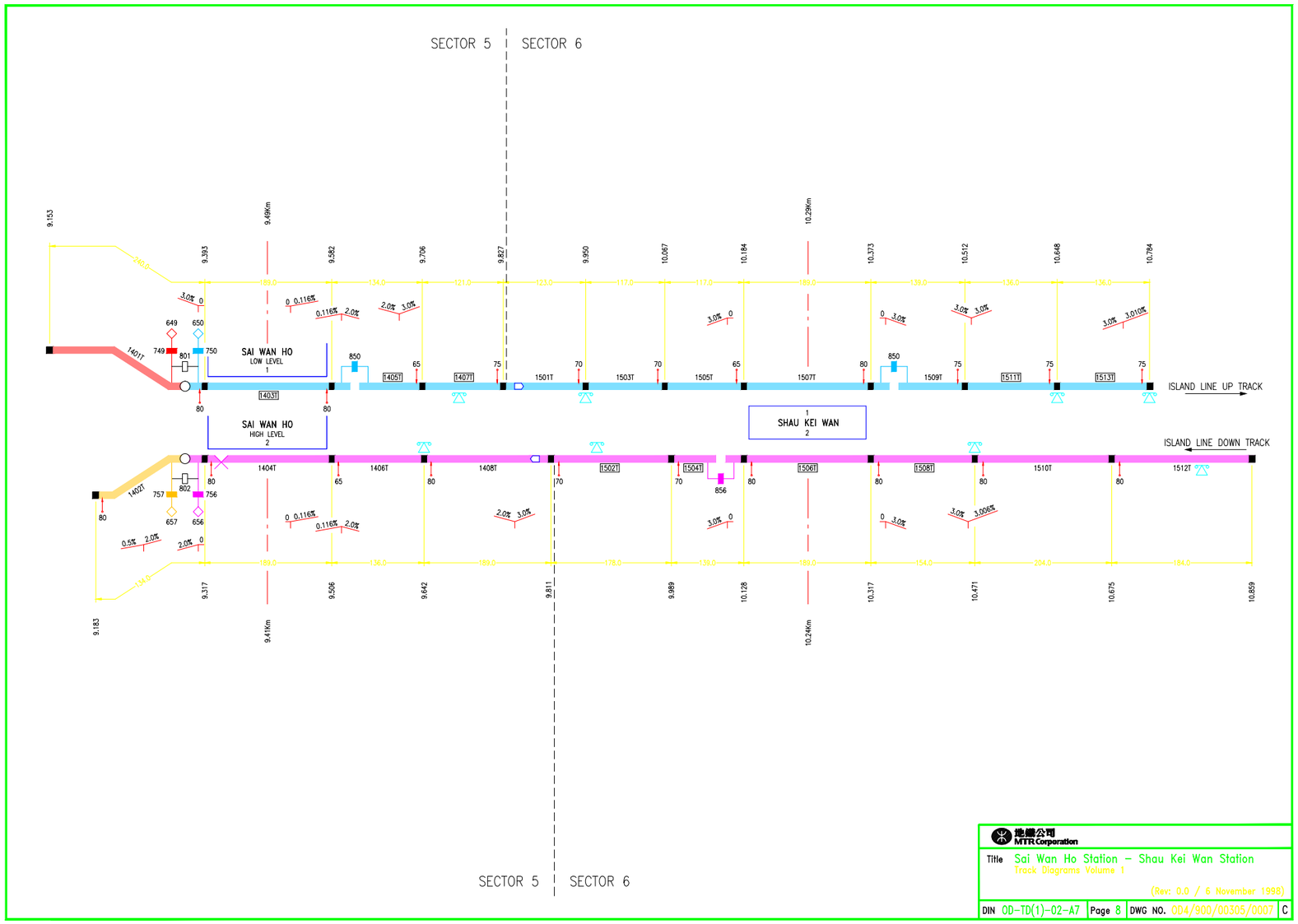
SCALE NTS | OED DRAWING NO. OD4/900/00305/0006 | F

地鐵公司 MTR Corporation

Title Tai Koo Station
Track Diagrams Volume 1

(Rev: 0.3 / 11 November 1999)

DIN OD-TD(1)-02-A6 | Page 7 | DWG NO. OD4/900/00305/0006 | F



地鐵公司 MTR Corporation

Title Sai Wan Ho Station – Shau Kei Wan Station
Track Diagrams Volume 1

(Rev: 0.0 / 6 November 1998)

DIN 0D-TD(1)-02-A7 | Page 8 | DWG NO. 0D4/900/00305/0007 | C

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
C	ADDITIONAL & UPDATED INFORMATION	DIXON K. 6-11-98	JENNY C. 20-11-98	STANLEY S. 20-11-98

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MTRC REFERENCE NO. 0D-TD(1)-02-A7

CONTRACTOR REFERENCE NO.

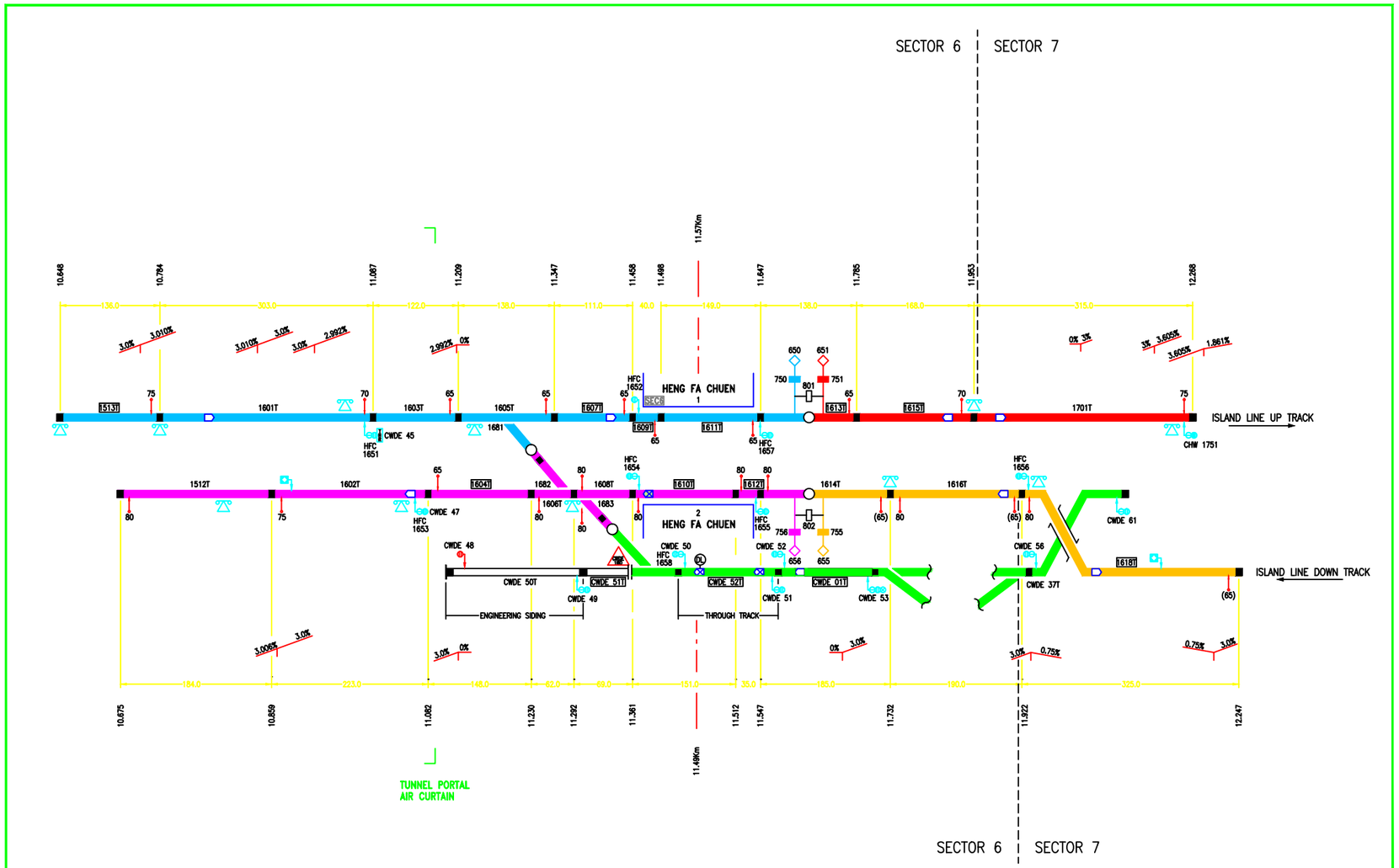
	INITIAL	DESIGNATION	DATE
DRAWN	H.K.HO	D'MAN	23-5-90
DESIGNED			
CHECKED			
APPROVED			

CAD FILE NAME 00305007

地鐵公司 MTR Corporation

TITLE SAI WAN HO STATION – SHAU KEI WAN STATION
TRACK DIAGRAMS VOLUME 1

SCALE NTS | OED DRAWING NO. 0D4/900/00305/0007 | C



DEVIATED STIB

Track Circuit	Deviation
HFC1610T	+1.1m from CL

地鐵公司 MTR Corporation

Title Heng Fa Chuen Station
Track Diagrams Volume 1

(Issue/Rev: 0.7 July 2003)

DIN TD(1)-02-A8 | Page 9 | DWG NO. 0D4/900/00305/0008 | G

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
G	DEVIATED STIB SPECIFIED	KSK 08-07-03	K. MARK 08-07-03	
F	MTIB IS ADDED AT TRACK CIRCUIT CWDE01T	J.L. 11.07.01		
E	GENERAL REVISION	WH CHENG 01.04.01		
D	ADDITIONAL & UPDATED INFORMATION	P.C.YU 03-05-99	JENNY C. 24-05-99	STANLEY S. 24-05-99
C	ADDITIONAL & UPDATED INFORMATION	DIXON K. 6-11-98	JENNY C. 20-11-98	STANLEY S. 20-11-98

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MTRC REFERENCE NO.
TD(1)-02-A8

CONTRACTOR REFERENCE NO.

	INITIAL	DESIGNATION	DATE
DRAWN	H.K.HO	D'MAN	23-5-90
DESIGNED			
CHECKED			
APPROVED			

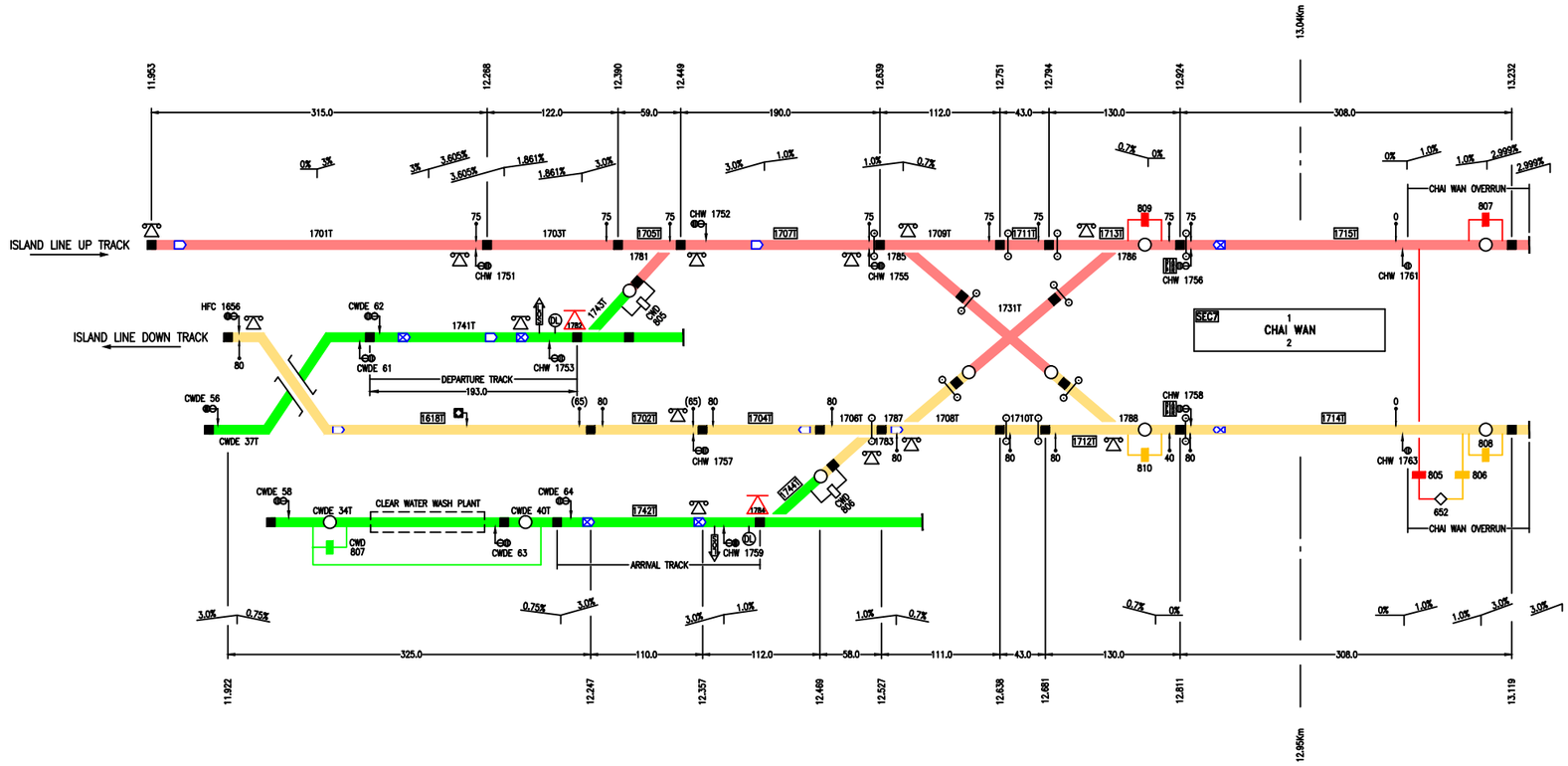
CAD FILE NAME 00305008

地鐵公司 MTR Corporation

TITLE HENG FA CHUEN STATION
TRACK DIAGRAMS VOLUME 1

SCALE NTS | OED DRAWING NO. 0D4/900/00305/0008 | G

SECTOR 7



SECTOR 7

地鐵公司 MTR Corporation

Title Chai Wan Station
Track Diagrams Volume 1

(Issue/Rev: 0.7 July 2003)

DIN	TD(1)-02-A9	Page 10	DWG NO. OD4/900/00305/0009	F

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
F	AXLE COUNTERS INSTALLED AT CHW CROSSOVER	KSK 08-07-03	K. MARK 08-07-03	
E	ADDITIONAL & UPDATED INFORMATION (101044)	DIXON K. 11-11-99	KEVIN LO 11-11-99	STANLEY S. 11-11-99
D	ADDITIONAL & UPDATED INFORMATION	P.C.YU 03-08-99	JENNY C. 09-08-99	STANLEY S. 09-08-99
C	ADDITIONAL & UPDATED INFORMATION	DIXON K. 6-11-98	JENNY C. 20-11-98	STANLEY S. 20-11-98

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MTRC REFERENCE NO.
TD(1)-02-A9

CONTRACTOR REFERENCE NO.

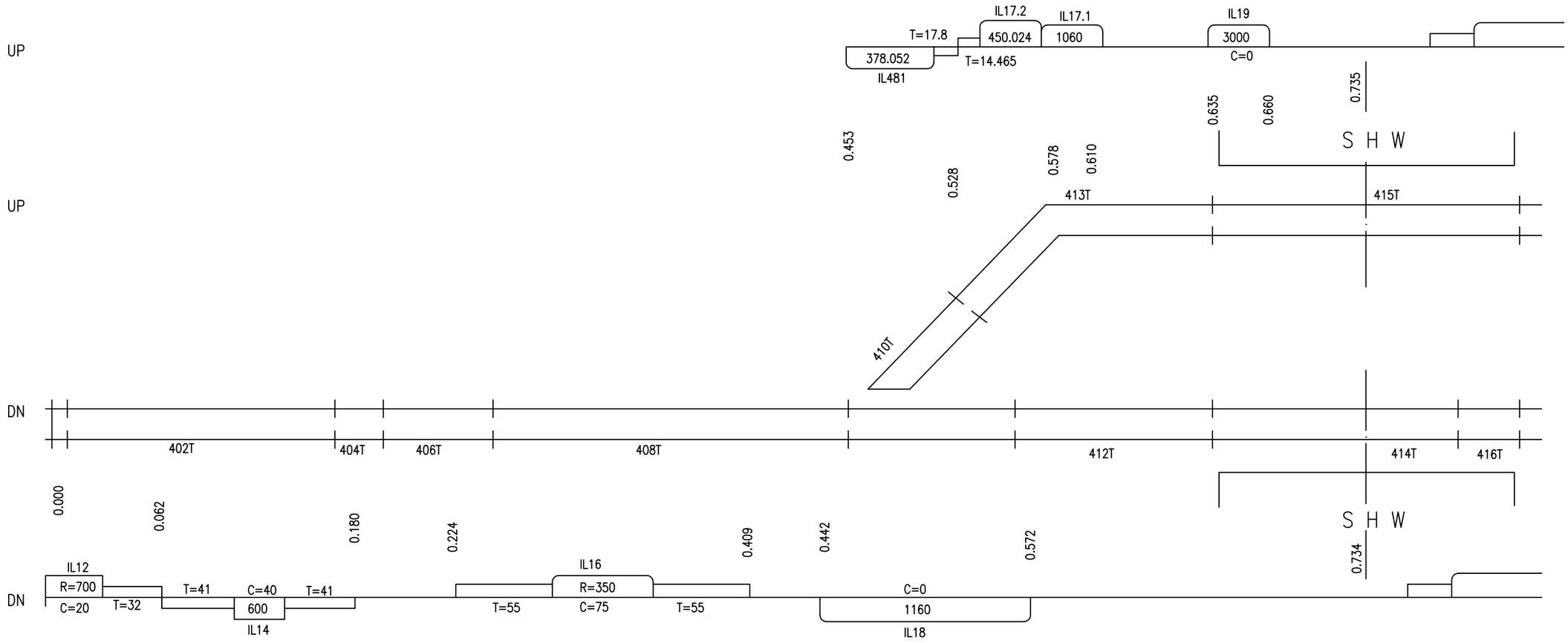
	INITIAL	DESIGNATION	DATE
DRAWN	H.K.HO	D'MAN	23-5-90
DESIGNED			
CHECKED			
APPROVED			
CAD FILE NAME	00305009		

地鐵公司 MTR Corporation

TITLE CHAI WAN STATION
TRACK DIAGRAMS VOLUME 1

SCALE NTS | OED DRAWING NO. OD4/900/00305/0009 | F

OD4/501/00304/002 A



REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE
A	DIGITIZATION	TONG	TM(PW)	14-12-93

REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
PWM/ISL/001

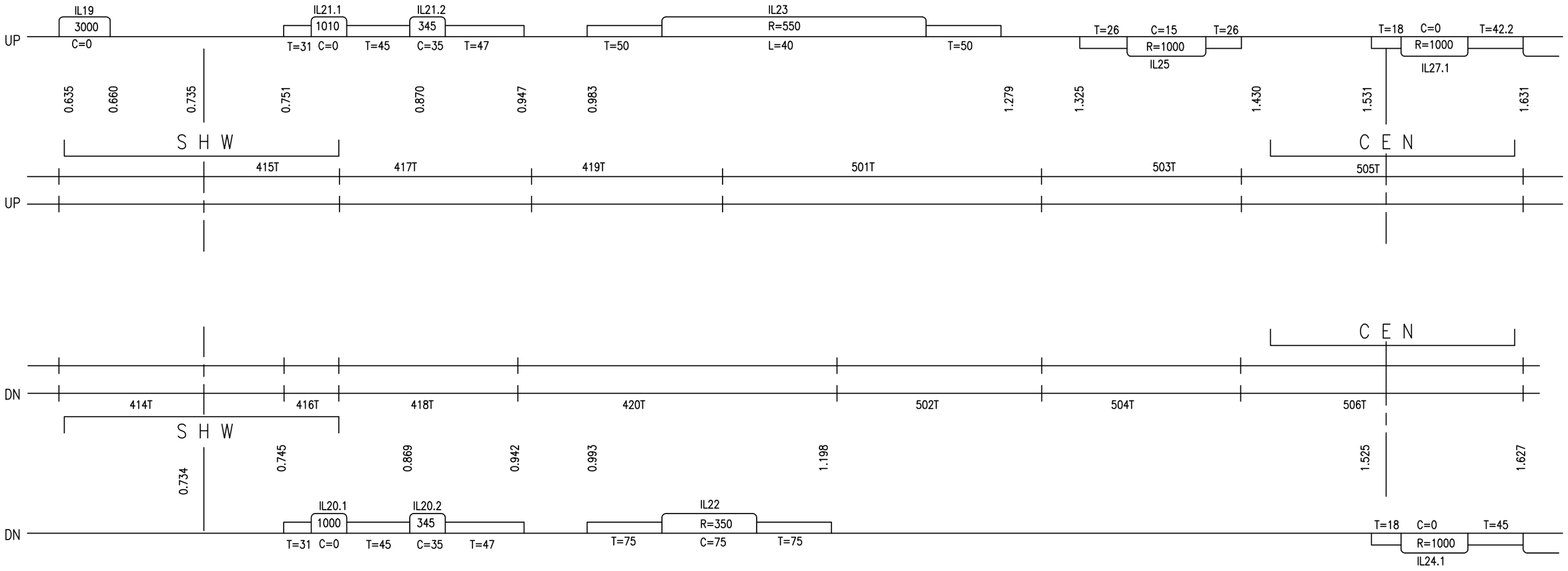
	INITIAL	DESIGNATION	DATE
TRACED BY	Y30	ZESTC	14-12-93
DESIGNED BY			
CHECKED BY	T. HO	PWO	13-1-95
APPROVED BY	R. KEEFE	TM(PW)	13-1-95
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.	317380V1		

MASS TRANSIT RAILWAY CORPORATION

TITLE
OVERRUN-SHW
LINE DIAGRAM - ISL

SCALE NTS | DWG NO. OD4/501/00304/002 A

OD4/501/00304/003 A



REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE
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REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
PWM/ISL/002

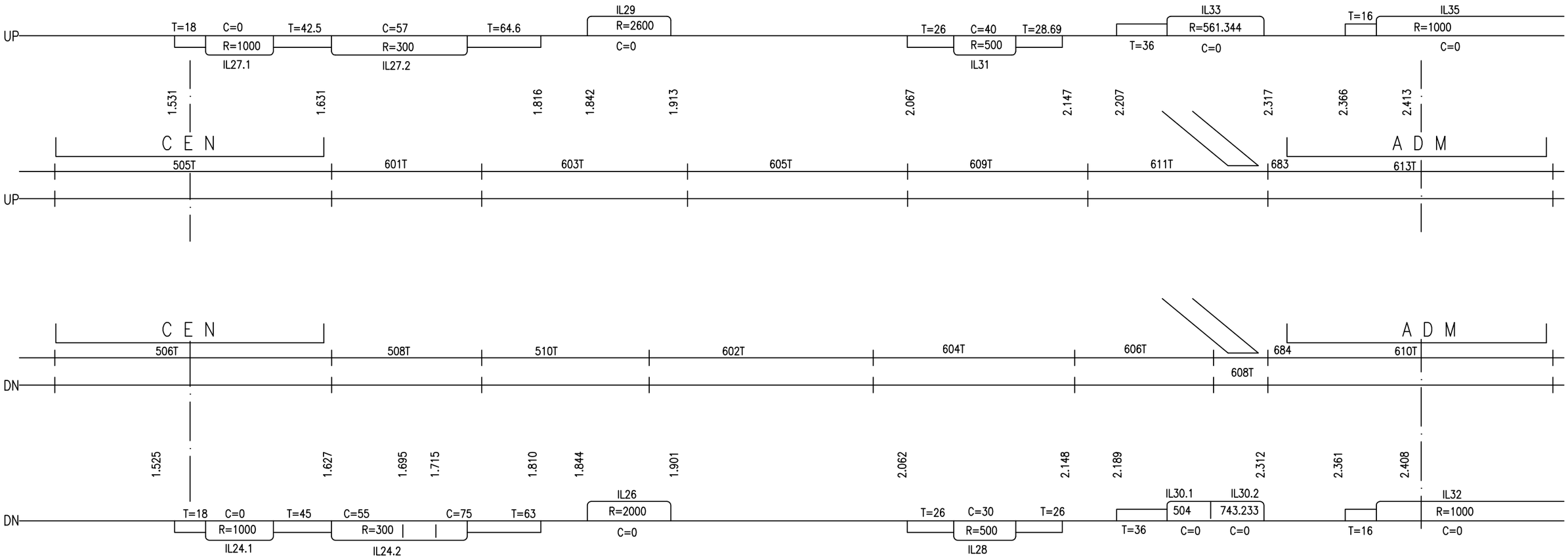
	INITIAL	DESIGNATION	DATE
TRACED BY	Y30	ZESTC	14-12-93
DESIGNED BY			
CHECKED BY	T. HO	PWO	13-1-95
APPROVED BY	R. KEEFE	TM(PW)	13-1-95
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.		317381V1	

MASS TRANSIT RAILWAY CORPORATION

TITLE
SHW-CEN
LINE DIAGRAM-ISL

SCALE NTS | DWG NO. OD4/501/00304/003 A

OD4/501/00304/004 A



REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE
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REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
PWM/ISL/003

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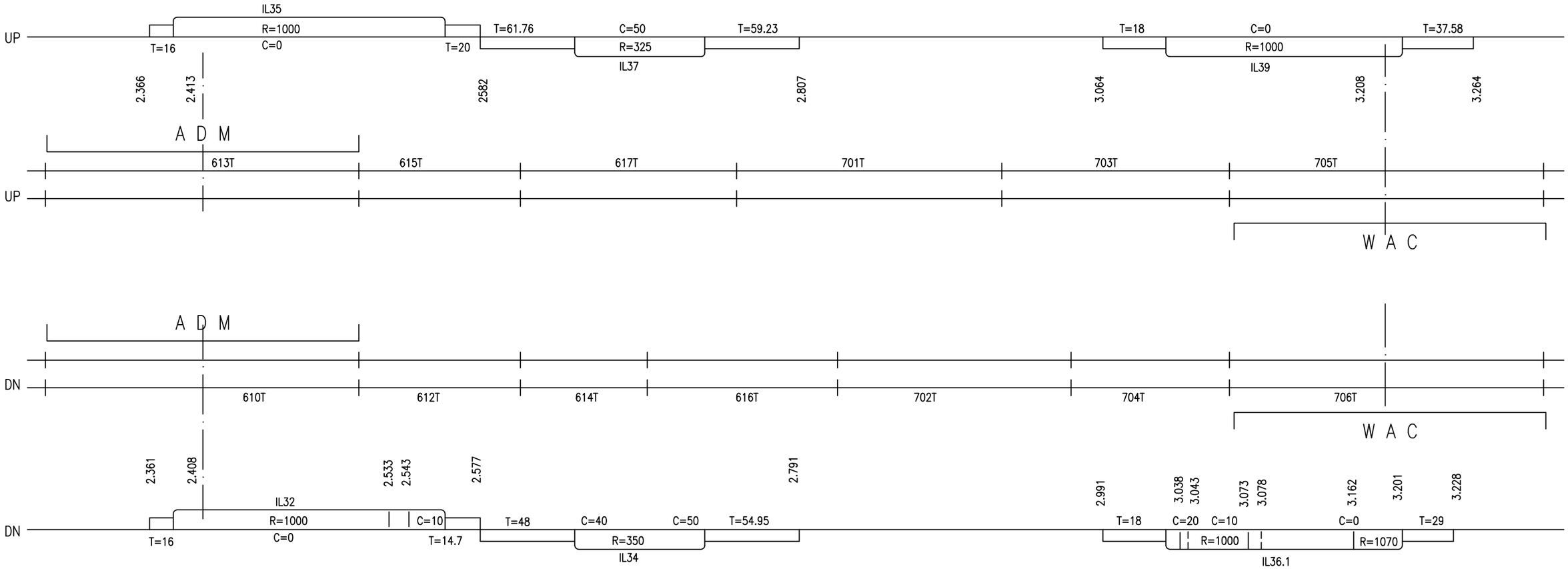
TRACED BY	Y30	ZESTC	14-12-93
DESIGNED BY			
CHECKED BY	T. HO	PWO	13-1-95
APPROVED BY	R. KEEFE	TM(PW)	13-1-95
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.	317382V1		

MASS TRANSIT RAILWAY CORPORATION

TITLE
CEN–ADM
LINE DIAGRAM – ISL

SCALE NTS | DWG NO. OD4/501/00304/004 A

OD4/501/00304/005 A



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REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
PWM/ISL/004

	INITIAL	DESIGNATION	DATE
TRACED BY	Y30	ZESTC	14-12-93
DESIGNED BY			
CHECKED BY	T. HO	PWO	04-1-95
APPROVED BY	R. KEEFE	TM(PW)	04-1-95
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.		317383V1	

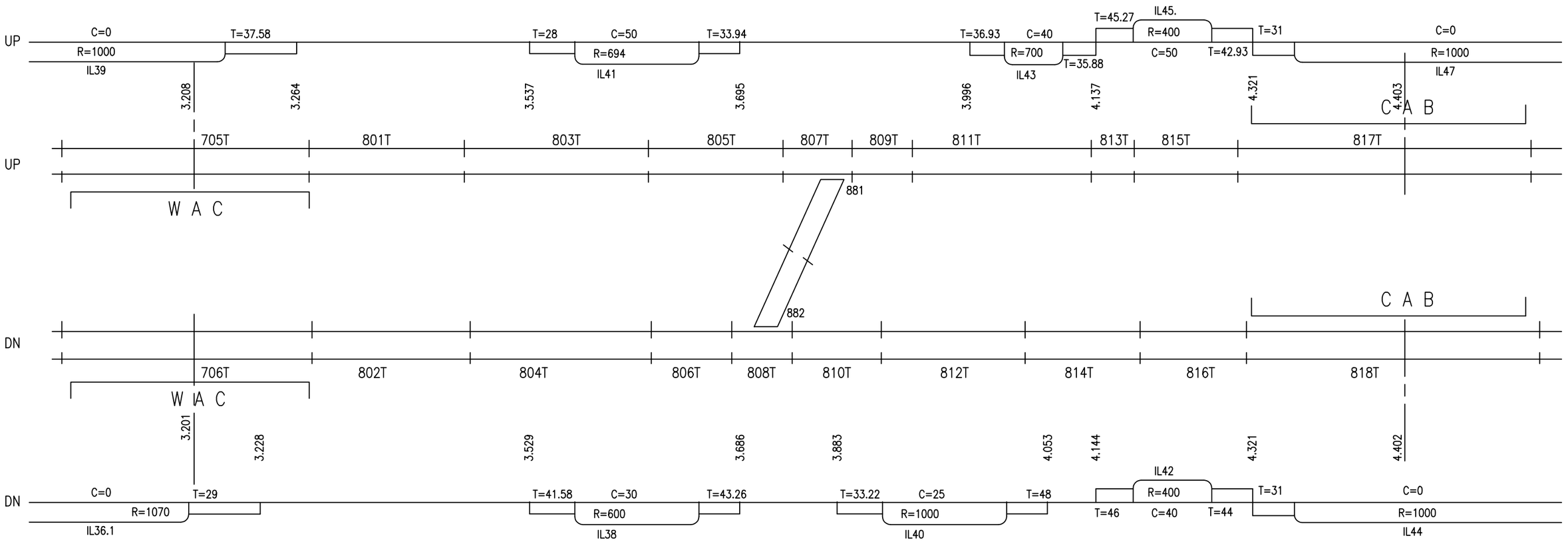
MASS TRANSIT RAILWAY CORPORATION

TITLE
ADM-WAC
LINE DIAGRAM - ISL

SCALE NTS

DWG NO. OD4/501/00304/005 A

OD4/501/00304/006 A



REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE
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REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
PWM/ISL/005

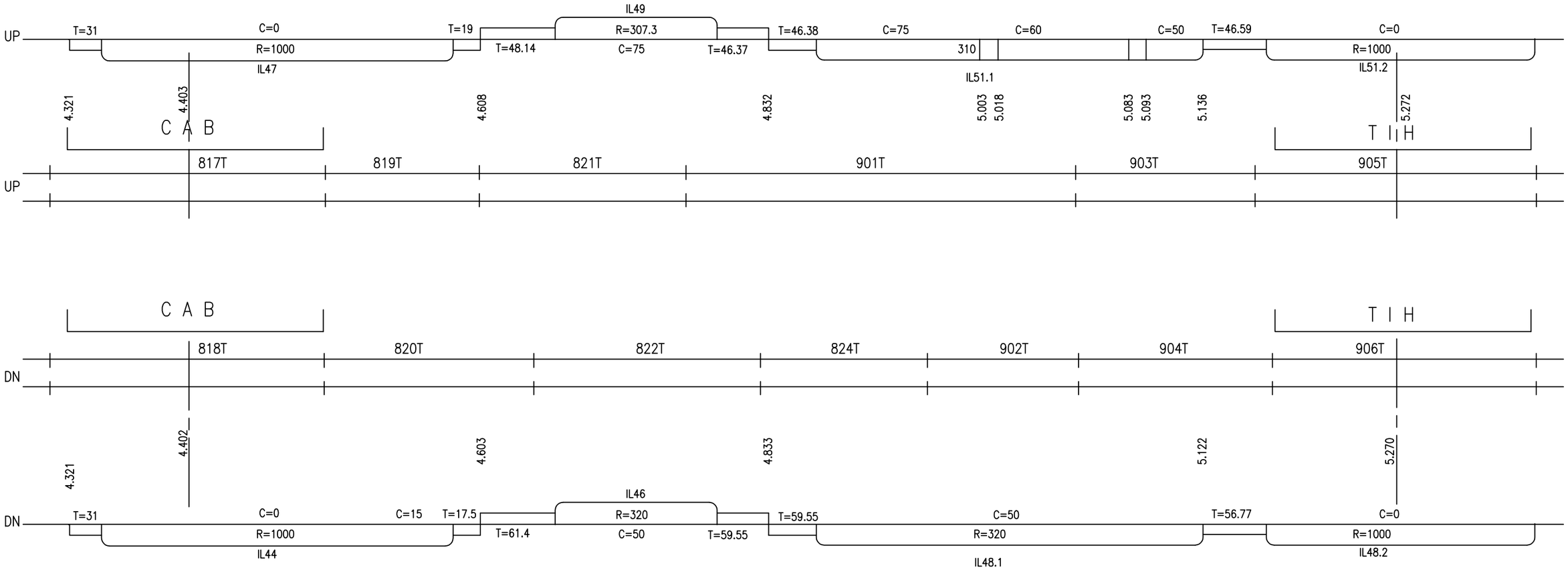
	INITIAL	DESIGNATION	DATE
TRACED BY	Y7	ZESTC	20-12-93
DESIGNED BY			
CHECKED BY	T. TONG	PWO	24-9-96
APPROVED BY	C. W. LAU	ATM(PW)	24-9-96
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.	317384V1		

MASS TRANSIT RAILWAY CORPORATION

TITLE
WAC-CAB
LINE DIAGRAM - ISL

SCALE NTS | DWG NO. OD4/501/00304/006 A

OD4/501/00304/007 A



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REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
PWM/ISL/006

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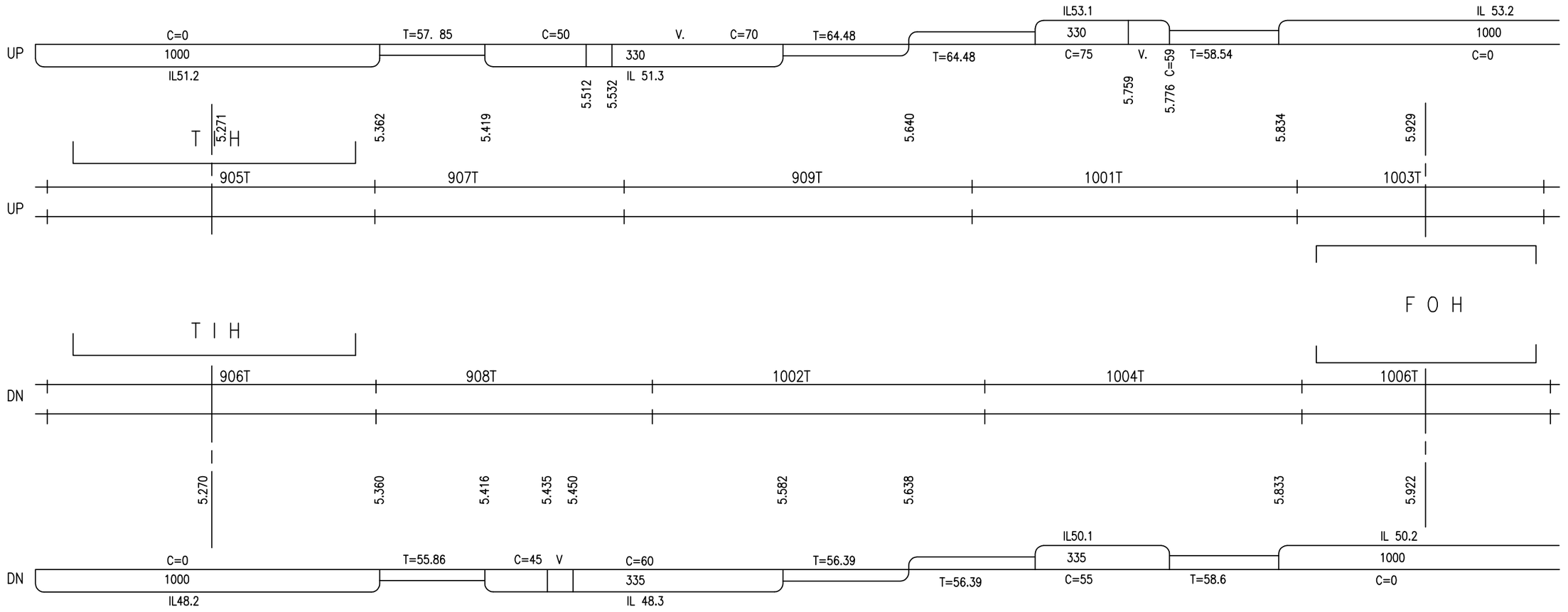
TRACED BY	Y7	ZESTC	20-12-93
DESIGNED BY			
CHECKED BY	T. HO	PWO	04-1-95
APPROVED BY	R. KEEFE	TM(PW)	04-1-95
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.	317385V1		

MASS TRANSIT RAILWAY CORPORATION

TITLE
CAB–TIH
LINE DIAGRAM – ISL

SCALE NTS | DWG NO. OD4/501/00304/007 A

OD4/501/00304/008 A



REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE
A	DIGITIZATION	T.TONG	C.W.LAU	20-12-93

REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
PWM/ISL/007

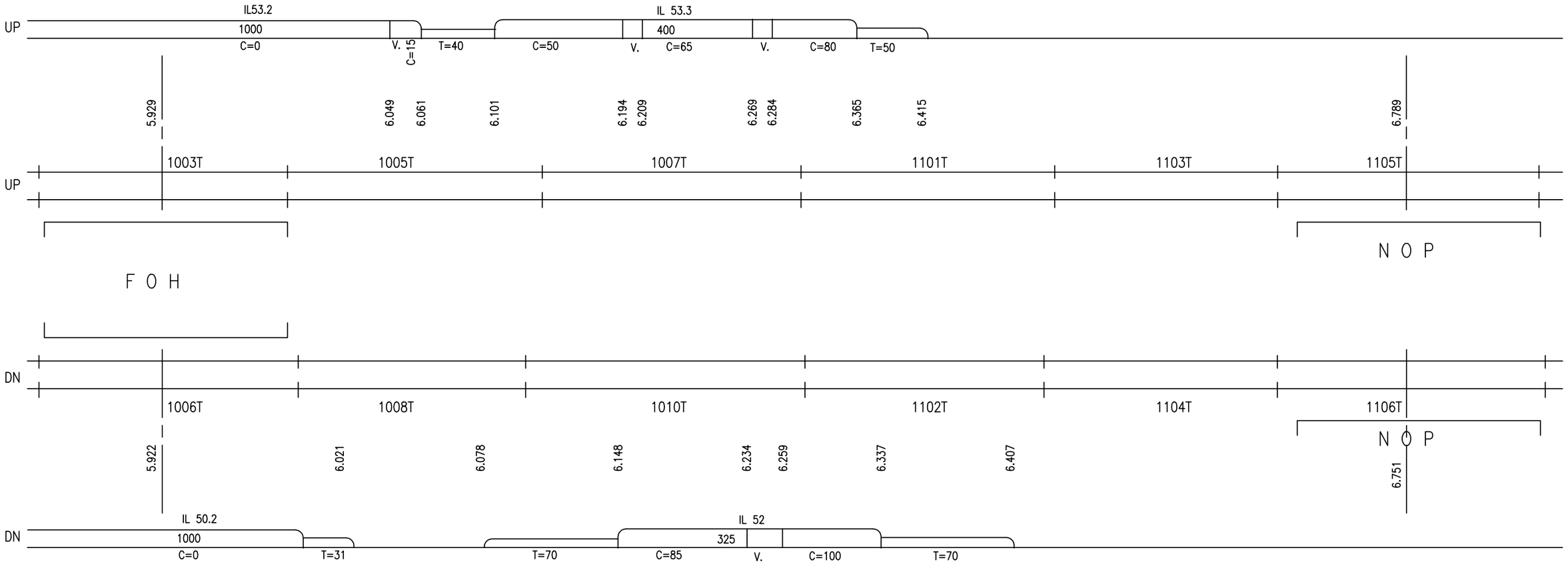
	INITIAL	DESIGNATION	DATE
TRACED BY	Y7	ZESTC	20-12-93
DESIGNED BY			
CHECKED BY	T. TONG	PWO	24-9-96
APPROVED BY	C. W. LAU	ATM(PW)	24-9-96
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.		317386V1	

MASS TRANSIT RAILWAY CORPORATION

TITLE
TIH-FOH
LINE DIAGRAM - ISL

SCALE NTS | DWG NO. OD4/501/00304/008 A

OD4/501/00304/009 A



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REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
PWM/ISL/008

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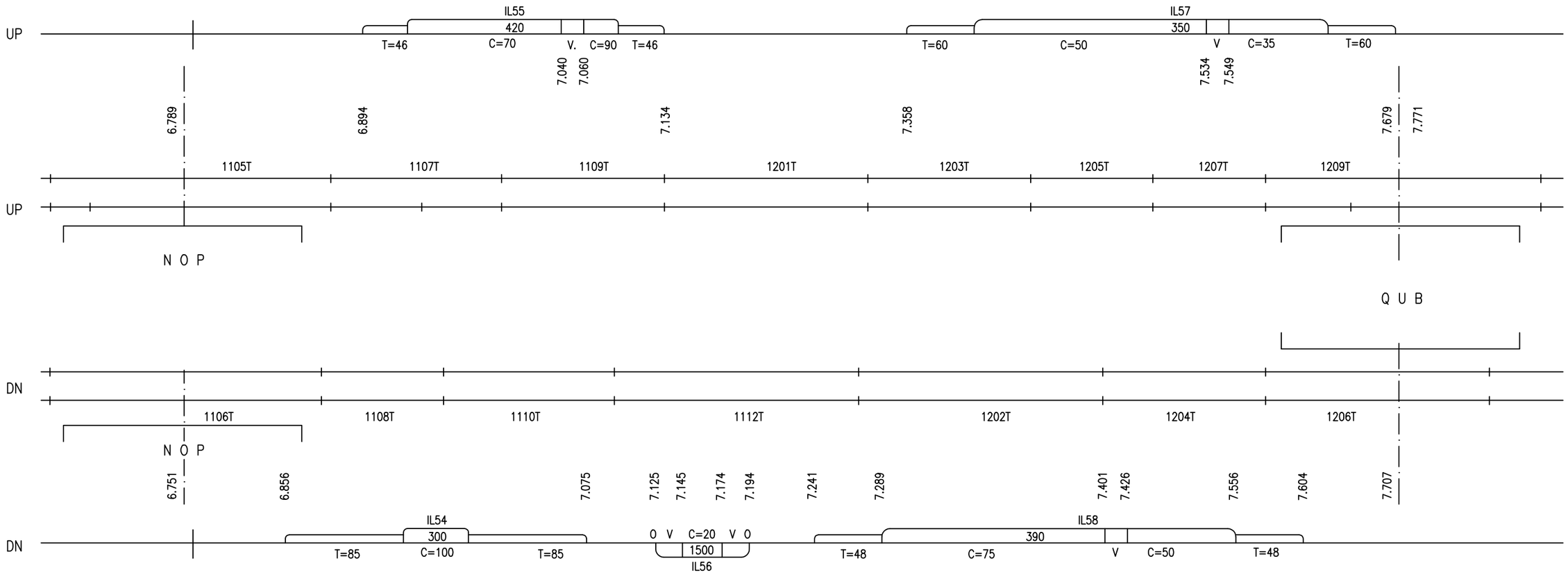
DESIGNED BY			
CHECKED BY	T. TONG	PWO	24-9-96
APPROVED BY	C. W. LAU	ATM(PW)	24-9-96
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.		317387V1	

MASS TRANSIT RAILWAY CORPORATION

TITLE
FOH–NOP
LINE DIAGRAM – ISL

SCALE NTS | DWG NO. OD4/501/00304/009 A



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B	CURVE IL58 AMENDED	P.S.CHUNG 21-09-99	T.TONG 21-09-99	T.WONG 21-09-99
A	DIGITIZATION	Y49 13-12-93	T.TONG 04-01-95	R.KEEFE 04-01-95

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/ISL/009

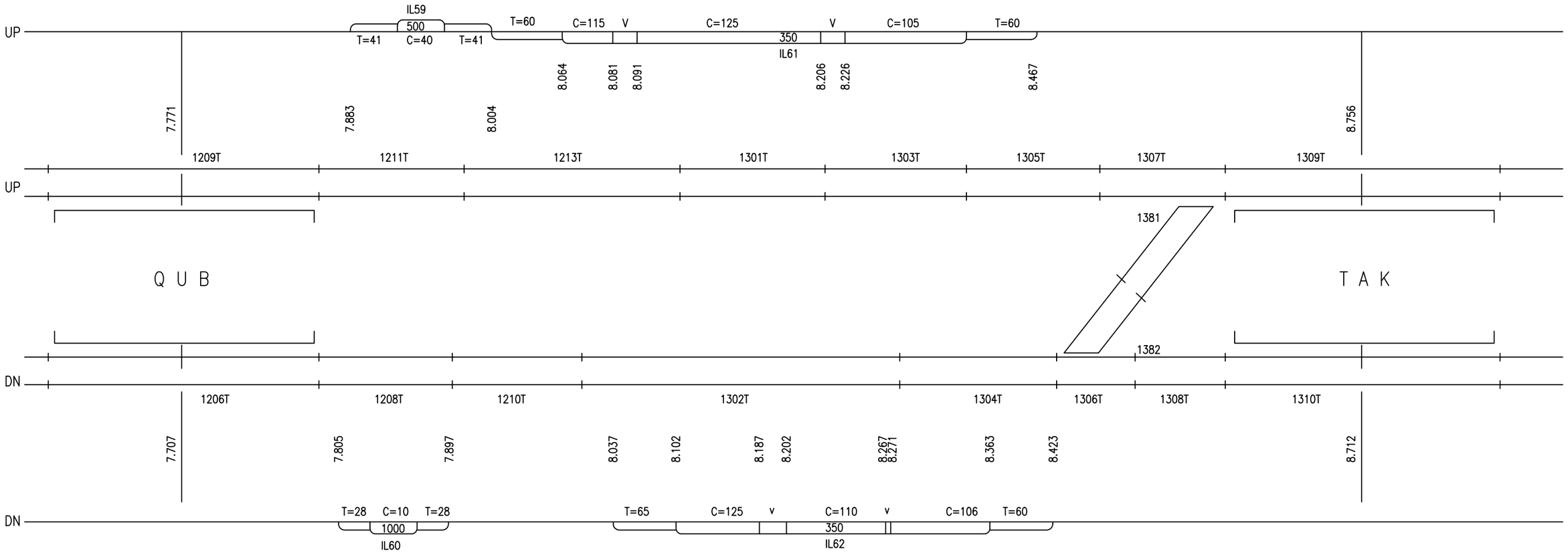
	INITIAL	DESIGNATION	DATE
DRAWN	Y49	ZESTC	13-12-1993
DESIGNED			
CHECKED	T.TONG	PWO(D)	04-01-1995
APPROVED	R.KEEFE	TM(PW)	04-01-1995
CAD FILE NAME	317388V1		

地鐵公司 MTR Corporation

TITLE
NOP-QUB
LINE DIAGRAM - ISL

SCALE N.T.S.

OED DRAWING NO. OD4/501/00304/0010 B



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	CURVE IL 61 AND IL62 AMENDED	P.S.CHUNG 21-09-99	T.TONG 21-09-99	T.WONG 21-09-99
A	DIGITIZATION	Y27 13-12-93	T.TONG 04-01-95	R.KEEFE 04-01-95

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/ISL/010

	INITIAL	DESIGNATION	DATE
DRAWN	Y27	ZESTC	13-12-1993
DESIGNED			
CHECKED	T.TONG	PWO(D)	04-01-1995
APPROVED	R.KEEFE	TM(PW)	04-01-1995
CAD FILE NAME	317389V1		

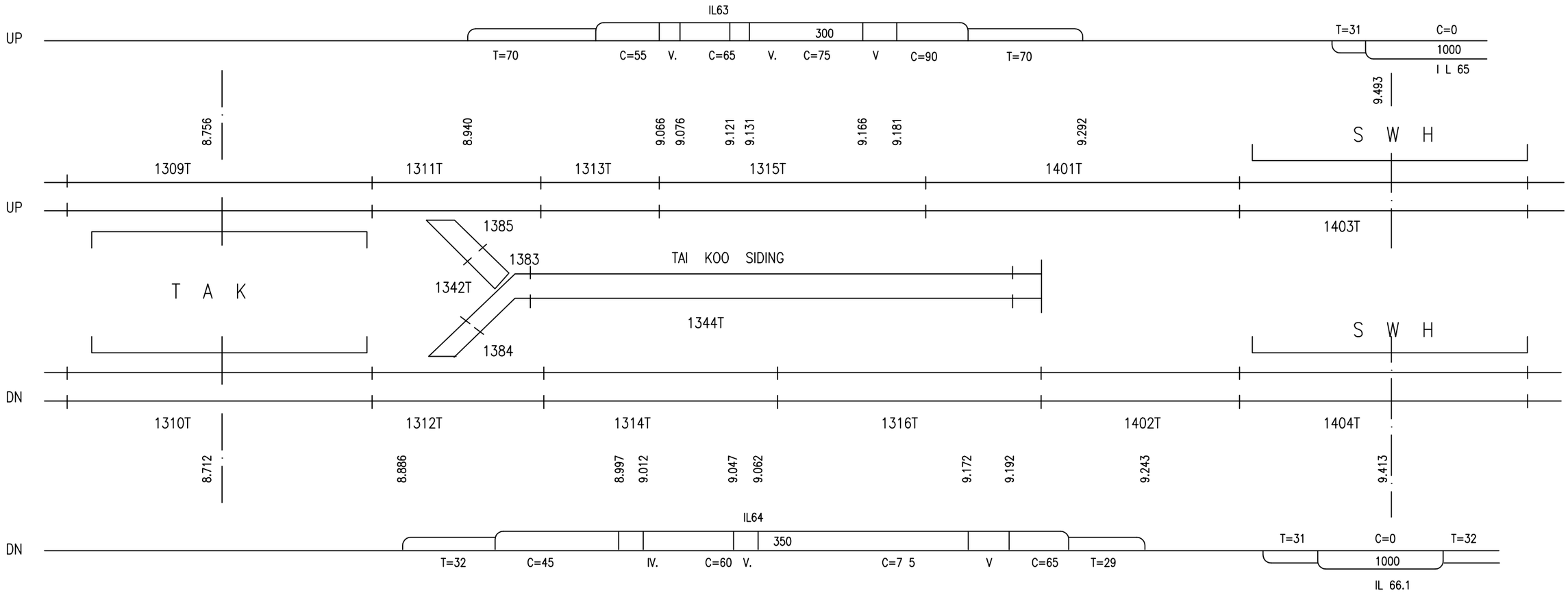
地鐵公司 MTR Corporation

TITLE
QUB–TAK
LINE DIAGRAM – ISL

SCALE N.T.S.

OED DRAWING NO. OD4/501/00304/0011 B

OD4/501/00304/012 A



REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE
A	DIGITIZATION	TONG	TM(PW)	17-12-93

REFERENCE DWGS

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PWM/ISL/011

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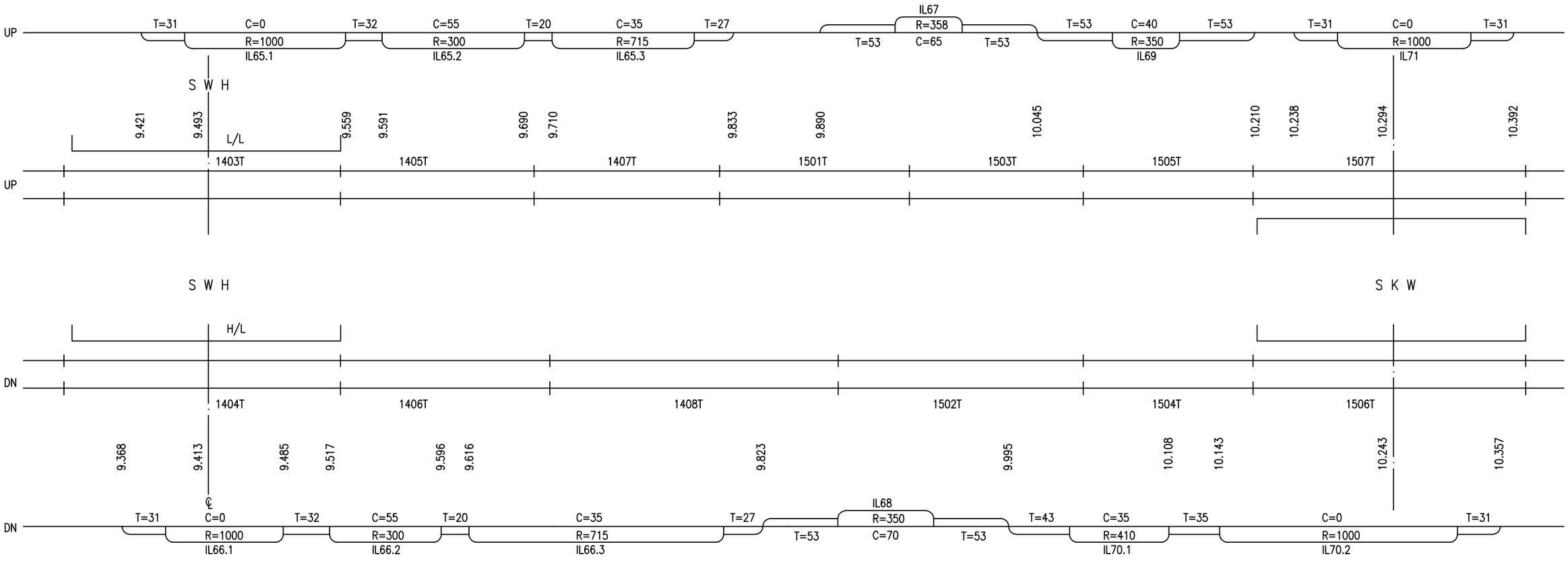
TRACED BY	Y34	ZESTC	17-12-93
DESIGNED BY			
CHECKED BY	T. HO	PWO	04-1-95
APPROVED BY	R. KEEFE	TM(PW)	04-1-95
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.		317390V1	

MASS TRANSIT RAILWAY CORPORATION

TITLE
TAK-SWH
LINE DIAGRAM - ISL

SCALE NTS | DWG NO. OD4/501/00304/012 A



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
B	SWH UP PLATFORM AMENDED	P.S.CHUNG 20-11-02	P.S.CHUNG 20-11-02	ZOE TSE 20-11-02
A	DIGITIZATION	Y31 15-12-93	TONG 04-01-95	R.KEEFE 04-01-95

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/ISL/012

	INITIAL	DESIGNATION	DATE
DRAWN	Y31	ZESTC	15-12-1993
DESIGNED			
CHECKED			
APPROVED			
CAD FILE NAME	317391V1		

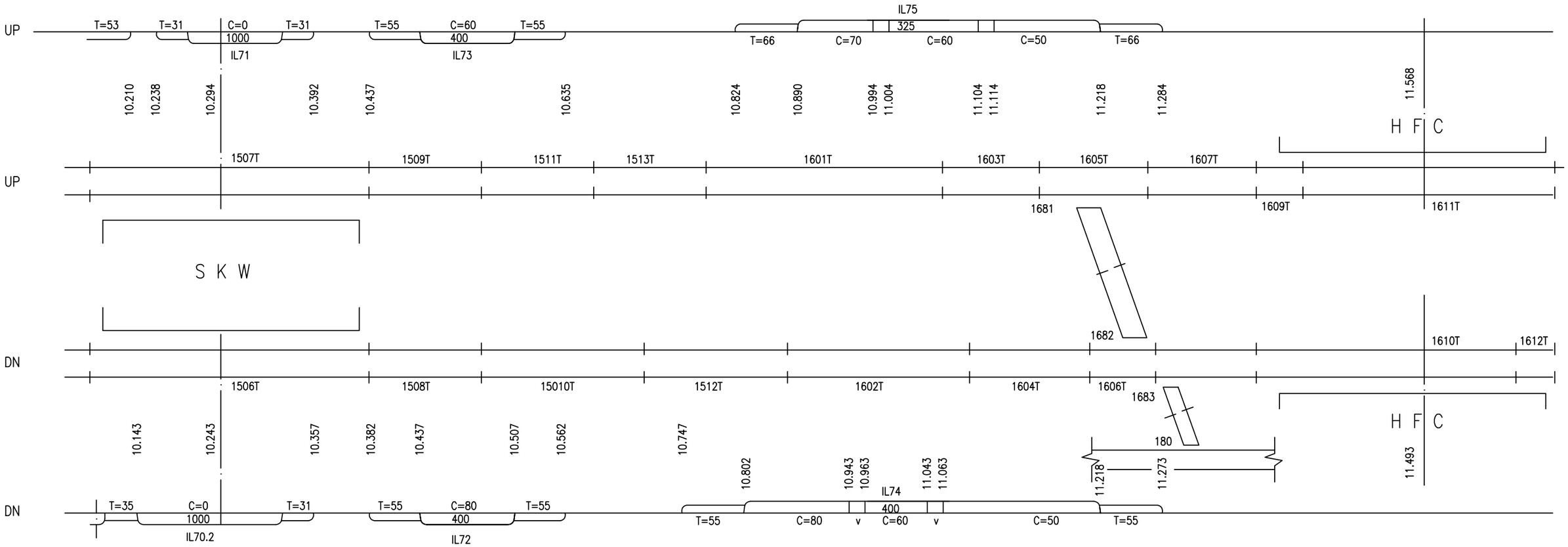
地鐵公司 MTR Corporation

TITLE
SWH – SKW
LINE DIAGRAM – ISL

SCALE N.T.S.

OED DRAWING NO. OD4/501/00304/0013 B

OD4/501/00304/014 A



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						CHECKED BY	T. TONG	PWO	24-9-96
						APPROVED BY	C. W. LAU	ATM(PW)	24-9-96
						PLOT SCALE		PLOT DATE	
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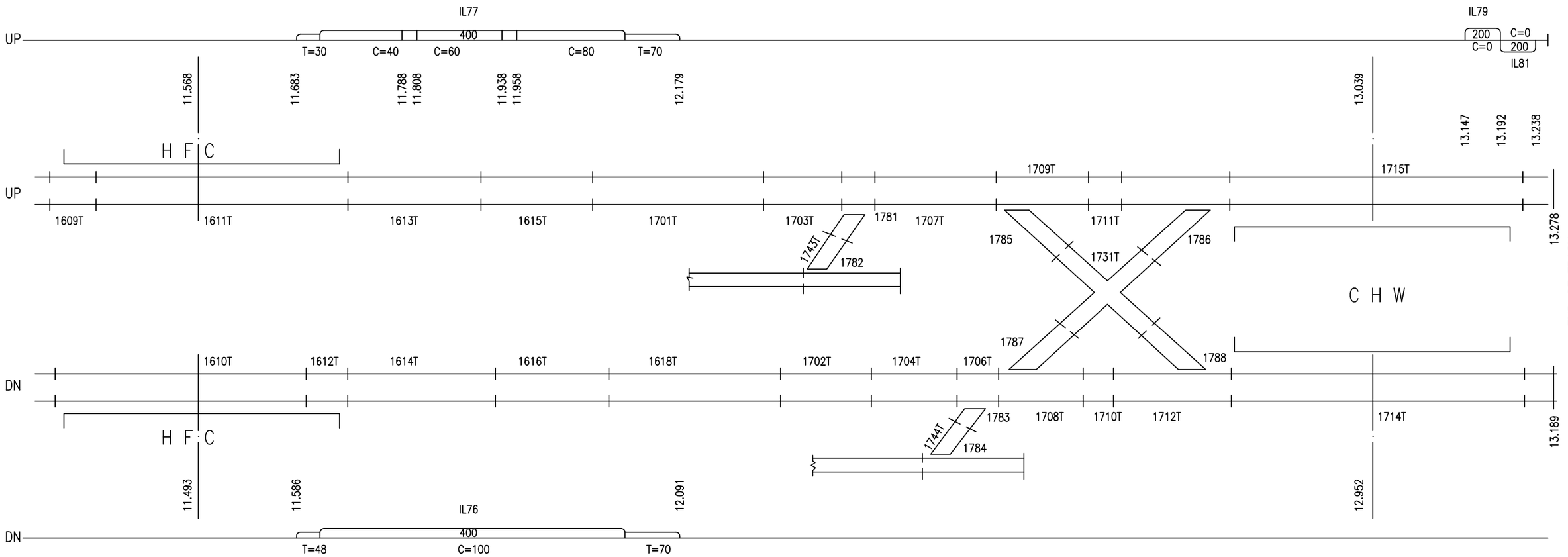
A	DIGITIZATION	T.TONG	C.W.LAU	17-12-93	CONTRACTOR'S DRAWING NO.				
REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE	PWM/ISL/013				

MASS TRANSIT RAILWAY CORPORATION

TITLE
SKW–HFC
LINE DIAGRAM – ISL

SCALE NTS | DWG NO. OD4/501/00304/014 A

OD4/501/00304/015 A



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REFERENCE DWGS

CONTRACTOR'S DRAWING NO.
PWM/ISL/014

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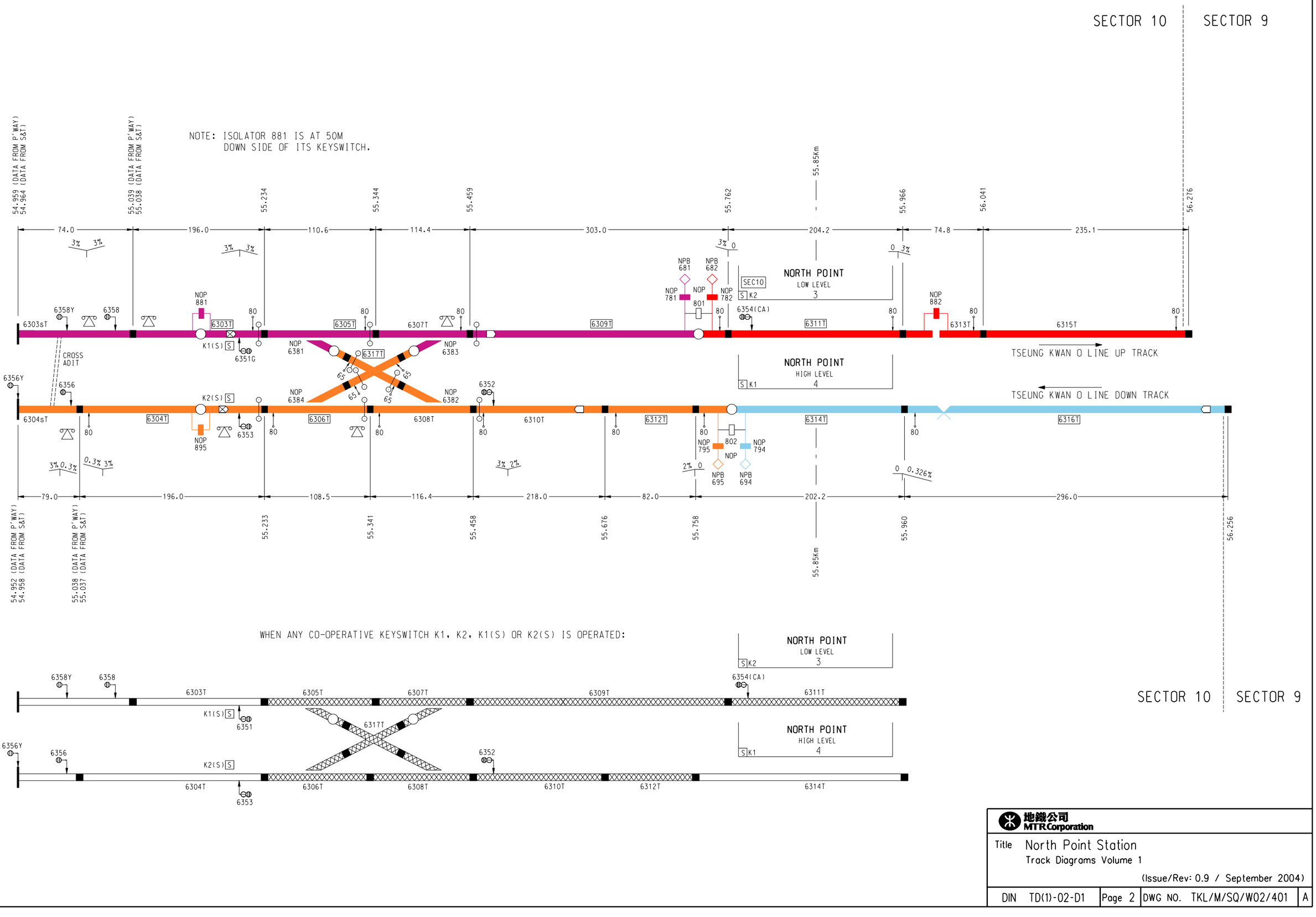
CHECKED BY	T. TONG	PWO	24-9-96
APPROVED BY	C. W. LAU	ATM(PW)	24-9-96
PLOT SCALE		PLOT DATE	
PEN SET		PRINT DATE	
CAD REF NO.		317393V1	

MASS TRANSIT RAILWAY CORPORATION

TITLE
HFC-CHW
LINE DIAGRAM - ISL

SCALE NTS | DWG NO. OD4/501/00304/015 A

North Point Station



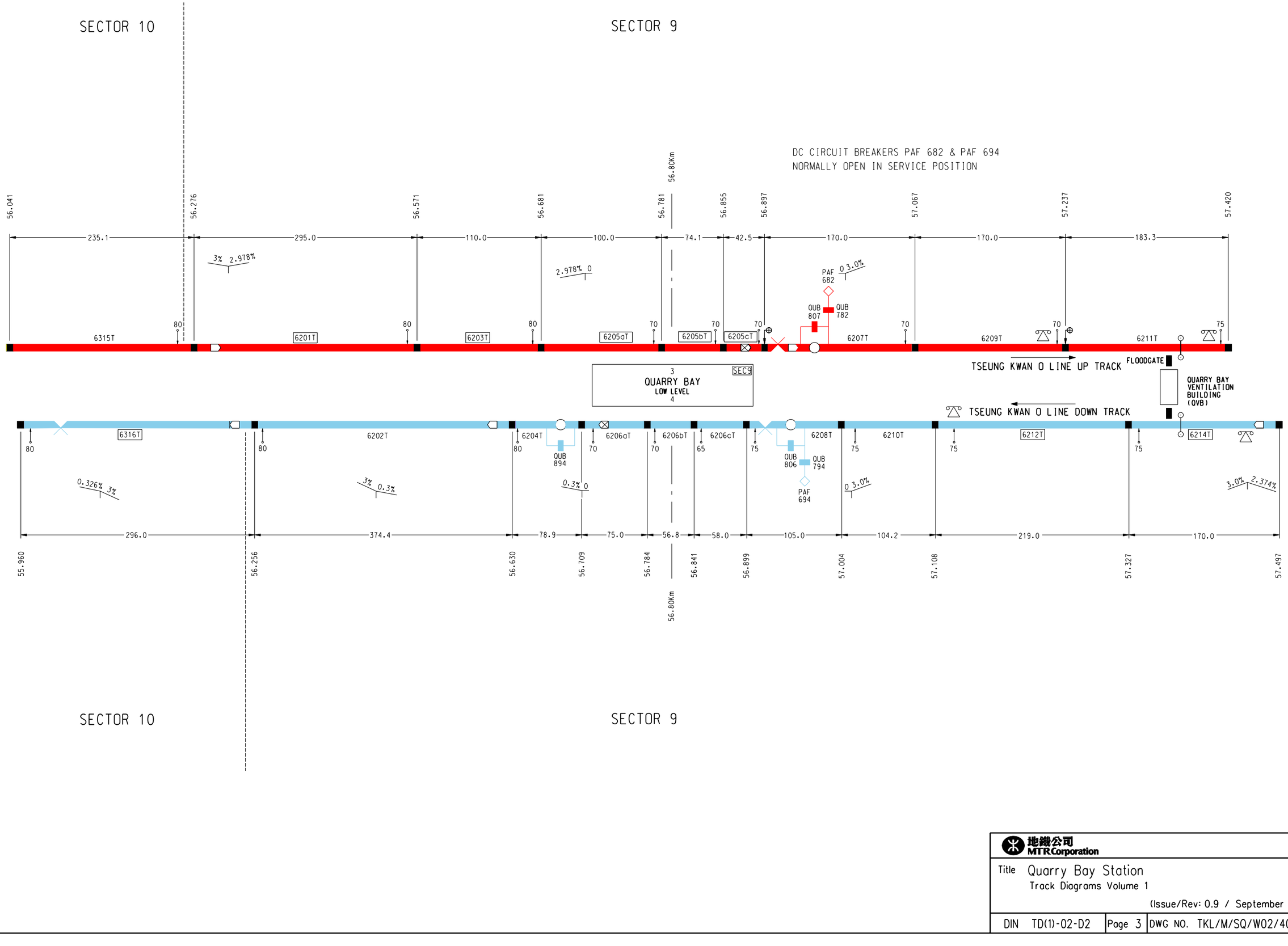
地鐵公司 MTR Corporation

Title North Point Station
Track Diagrams Volume 1

(Issue/Rev: 0.9 / September 2004)

DIN TD(1)-02-D1	Page 2	DWG NO. TKL/M/SQ/W02/401	A

Quarry Bay Station



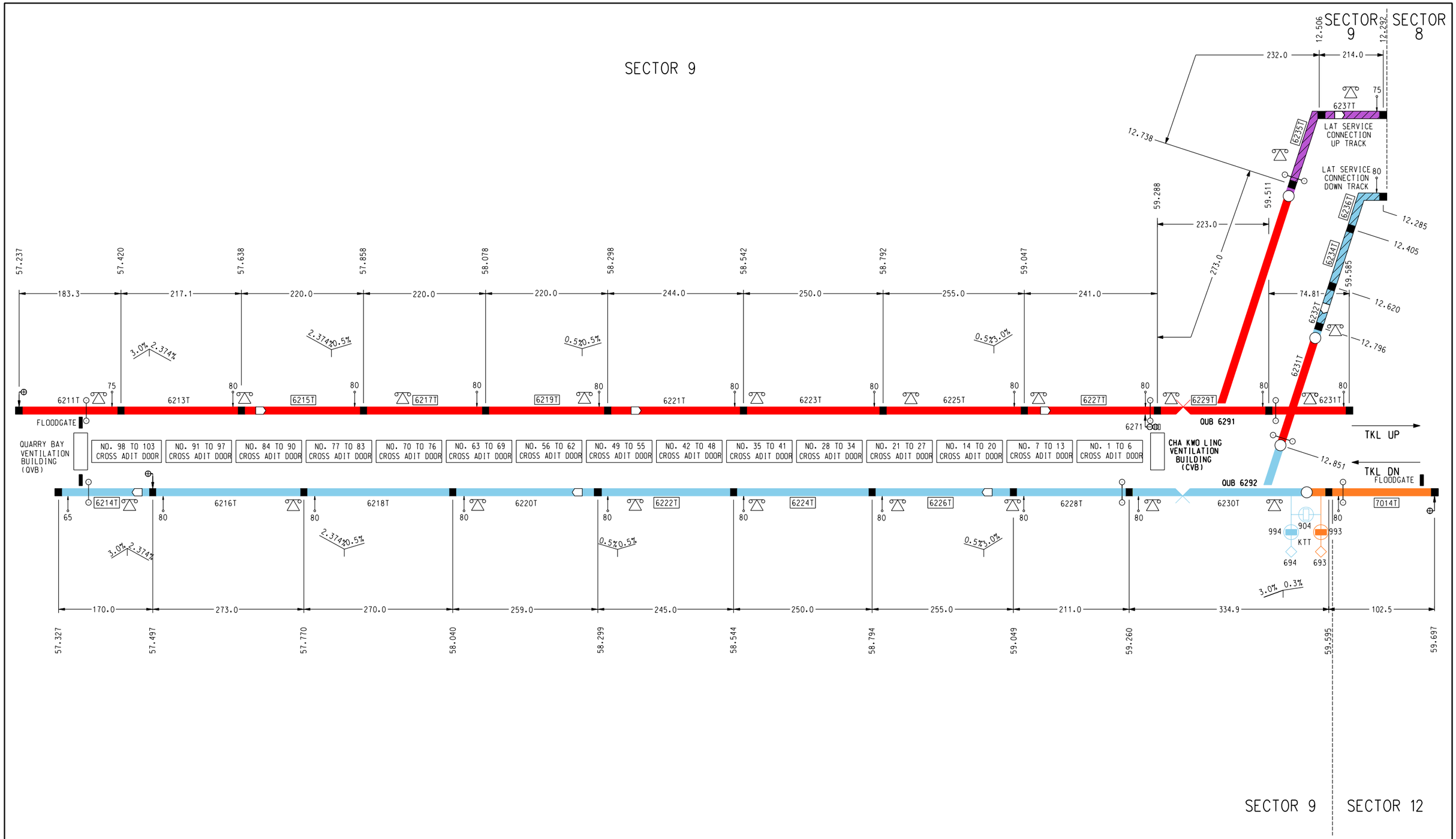
地鐵公司
MTR Corporation

Title Quarry Bay Station
Track Diagrams Volume 1

(Issue/Rev: 0.9 / September 2004)

DIN TD(1)-02-D2	Page 3	DWG NO. TKL/M/SQ/W02/402	A

Eastern Immersed Tube



NOTES:

1. LAT SERVICE CONNECTION UP TRACK: 6114T, 6237T & 6235T
   LAT SERVICE CONNECTION DOWN TRACK: 6111T, 6236T, 6234T & 6232T

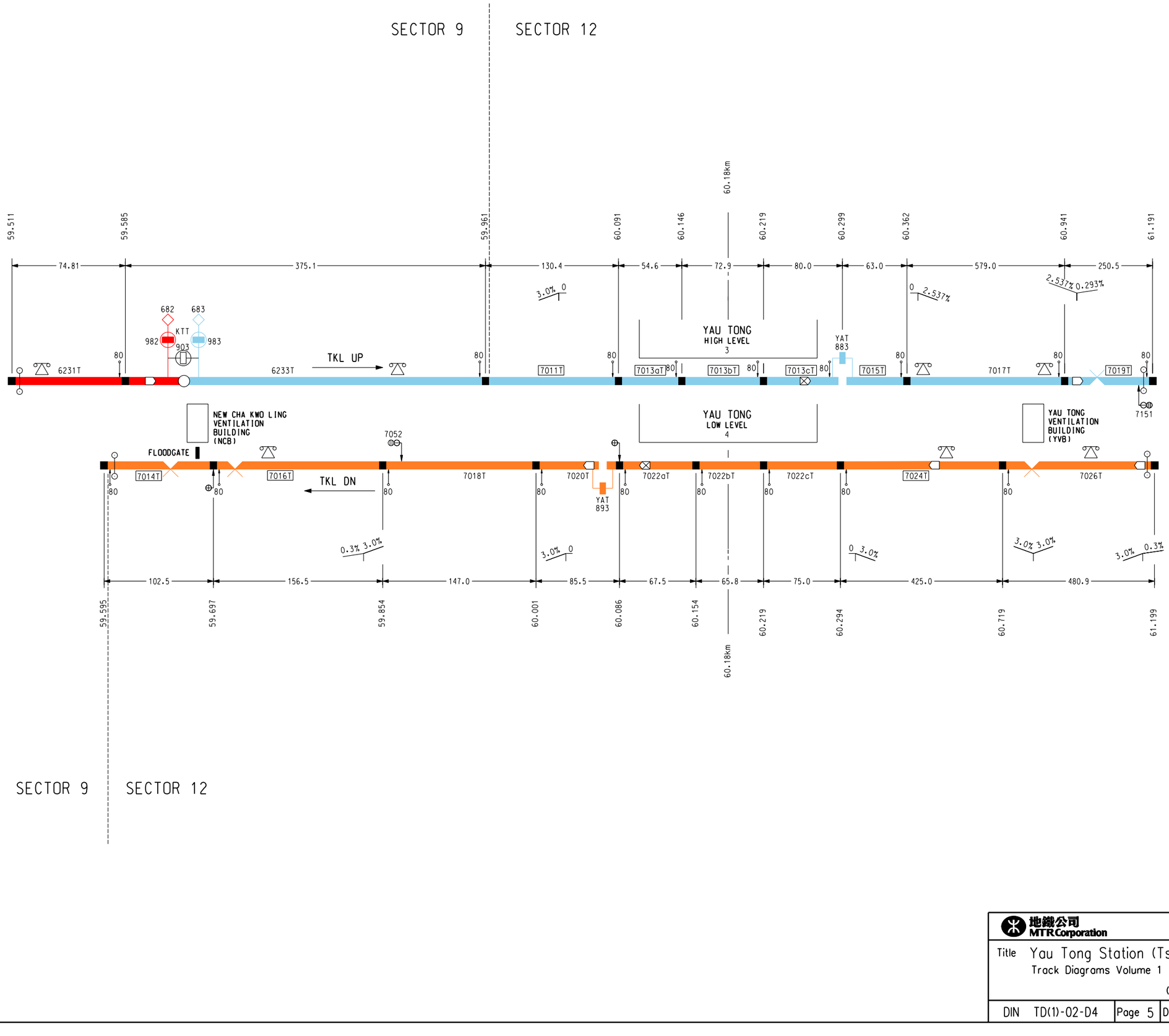
2. ▨ LAT SCT ARE SHADED IN ORDER TO DISTINGUISH THEM FROM OTHER TRACKS.

地鐵公司 MTR Corporation

Title Eastern Immersed Tube
Track Diagrams Volume 1
(Issue/Rev: 0.9 / September 2004)

DIN TD(1)-02-D3	Page 4	DWG NO. TKL/M/SQ/W02/403	A

Yau Tong Station (Tseung Kwan O Line)



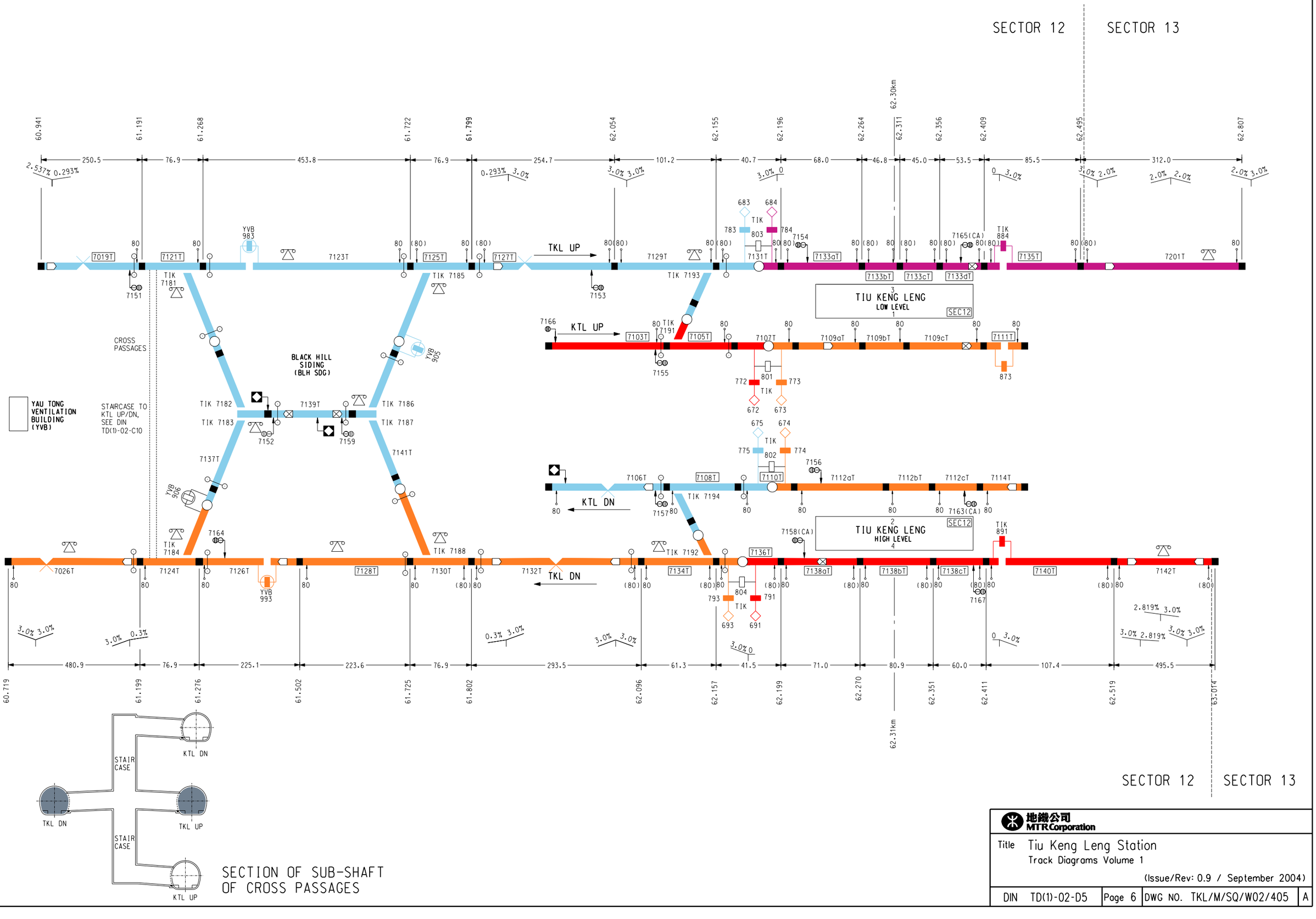
地鐵公司
MTR Corporation

Title Yau Tong Station (Tseung Kwan O Line)
Track Diagrams Volume 1

(Issue/Rev: 0.9 / September 2004)

DIN TD(1)-02-D4	Page 5	DWG NO. TKL/M/SQ/W02/404	A

Tiu Keng Leng Station

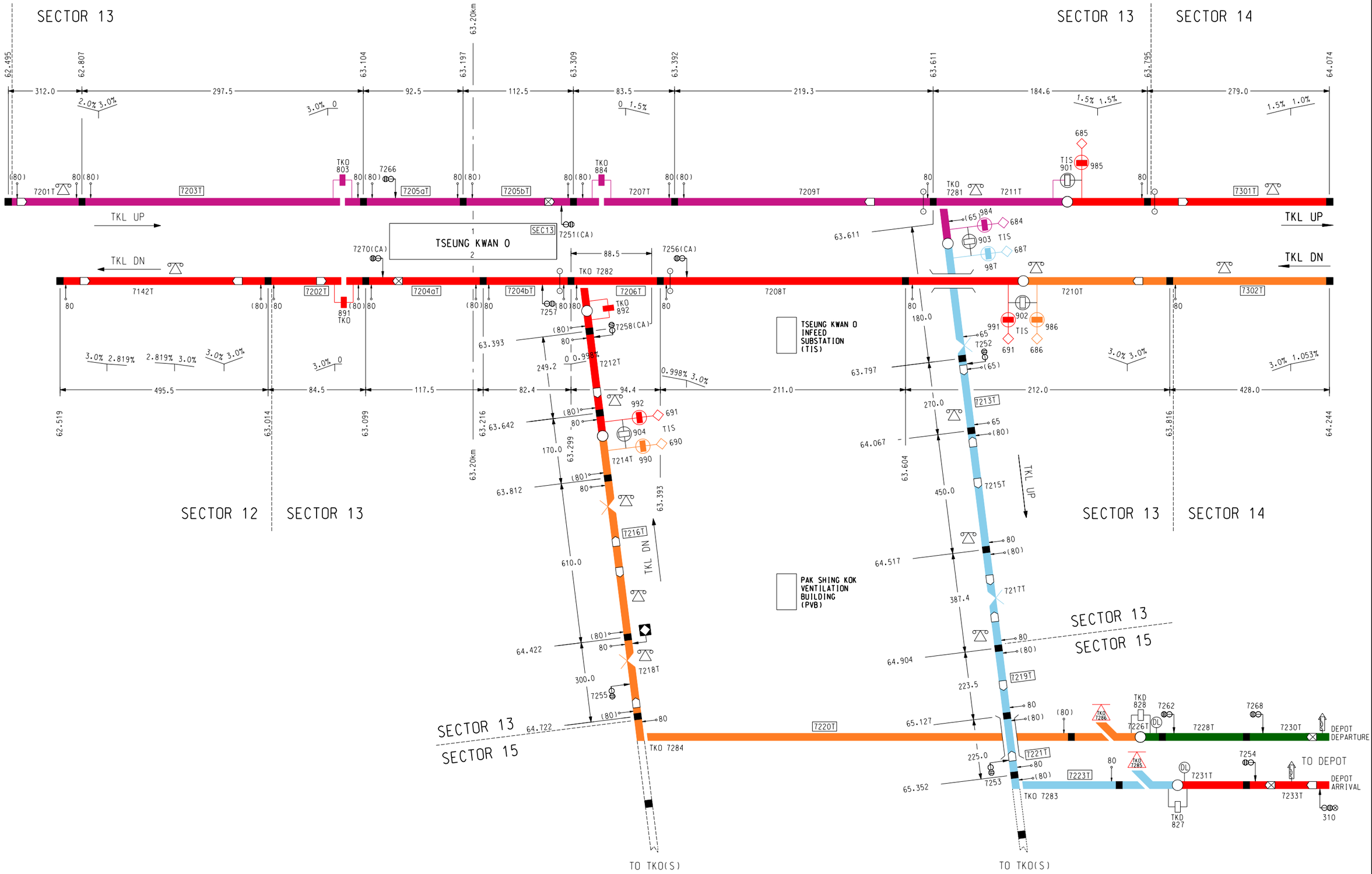


地鐵公司 MTR Corporation

Title Tiu Keng Leng Station
Track Diagrams Volume 1
(Issue/Rev: 0.9 / September 2004)

DIN	TD(1)-02-D5	Page 6	DWG NO. TKL/M/SQ/W02/405	A

Tseung Kwan O Station



地鐵公司
MTR Corporation

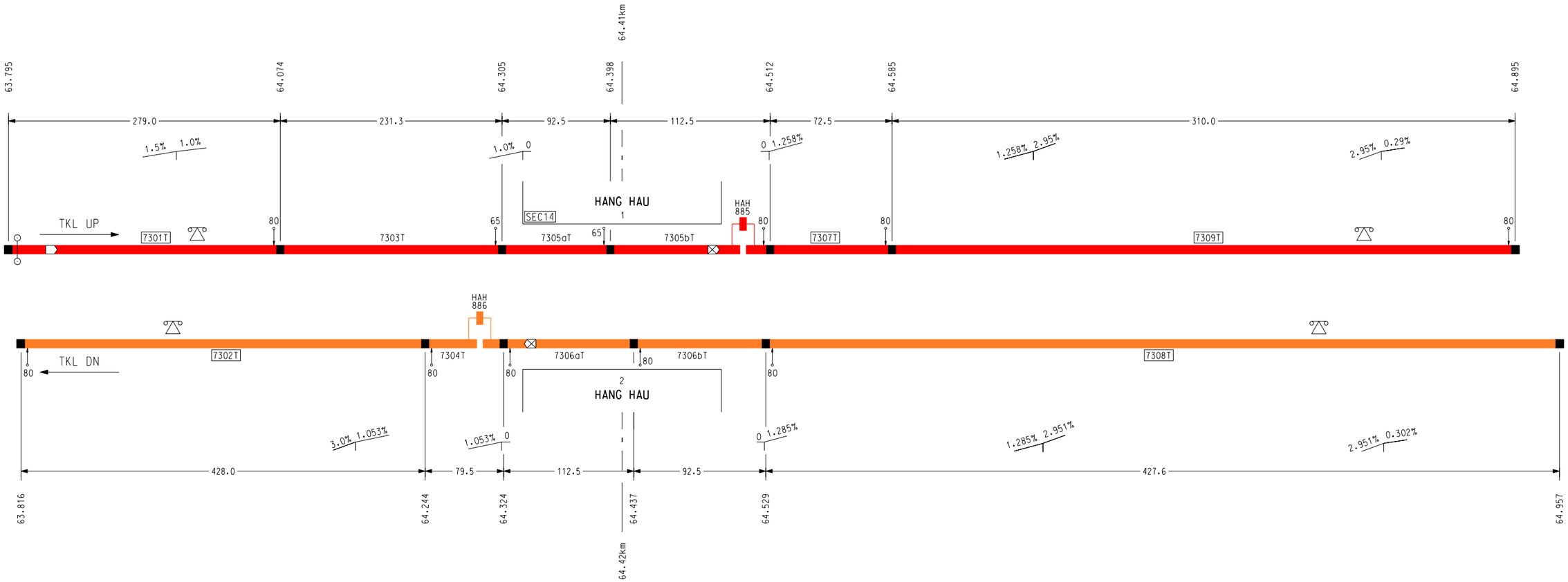
Title Tseung Kwan O Station
Track Diagrams Volume 1

(Issue/Rev: 0.9 / September 2004)

DIN TD(1)-02-D6	Page 7	DWG NO. TKL/M/SQ/W02/406	A

Hang Hau Station

SECTOR 14

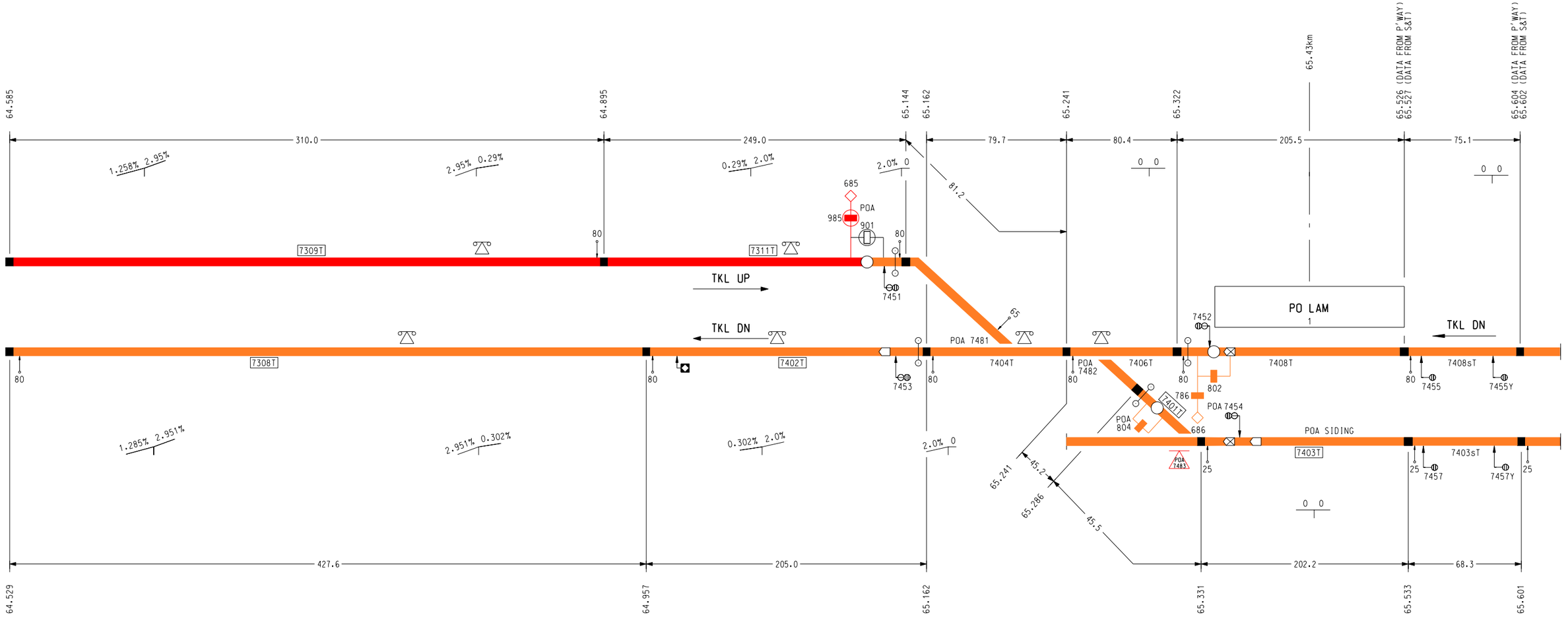


SECTOR 14

地鐵公司 MTR Corporation			
Title Hang Hau Station Track Diagrams Volume 1			
(Issue/Rev: 0.9 / September 2004)			
DIN TD(1)-02-D7	Page 8	DWG NO. TKL/M/SQ/W02/407	A

Po Lam Station

SECTOR 14

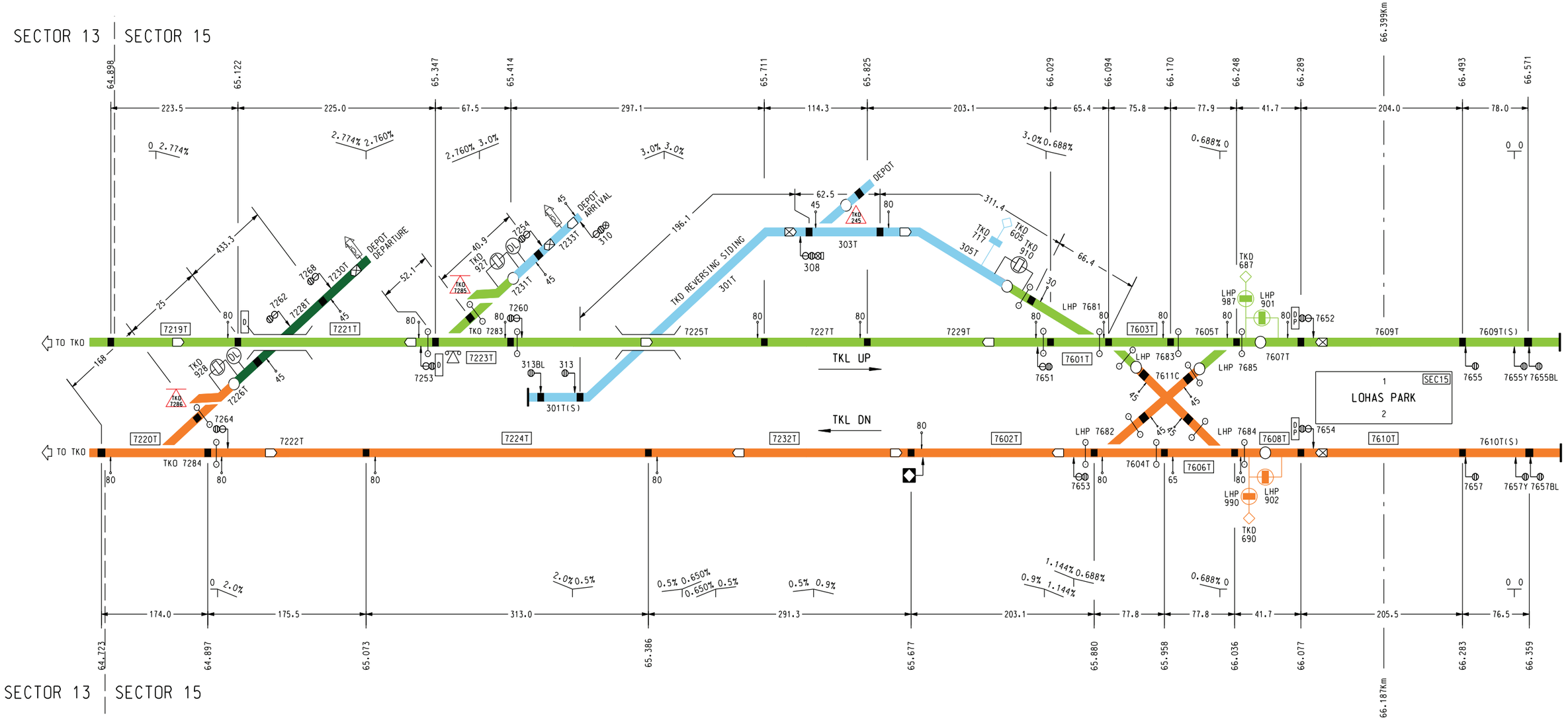


SECTOR 14

地鐵公司 MTR Corporation

Title Po Lam Station
Track Diagrams Volume 1
(Issue/Rev: 0.9 / September 2004)

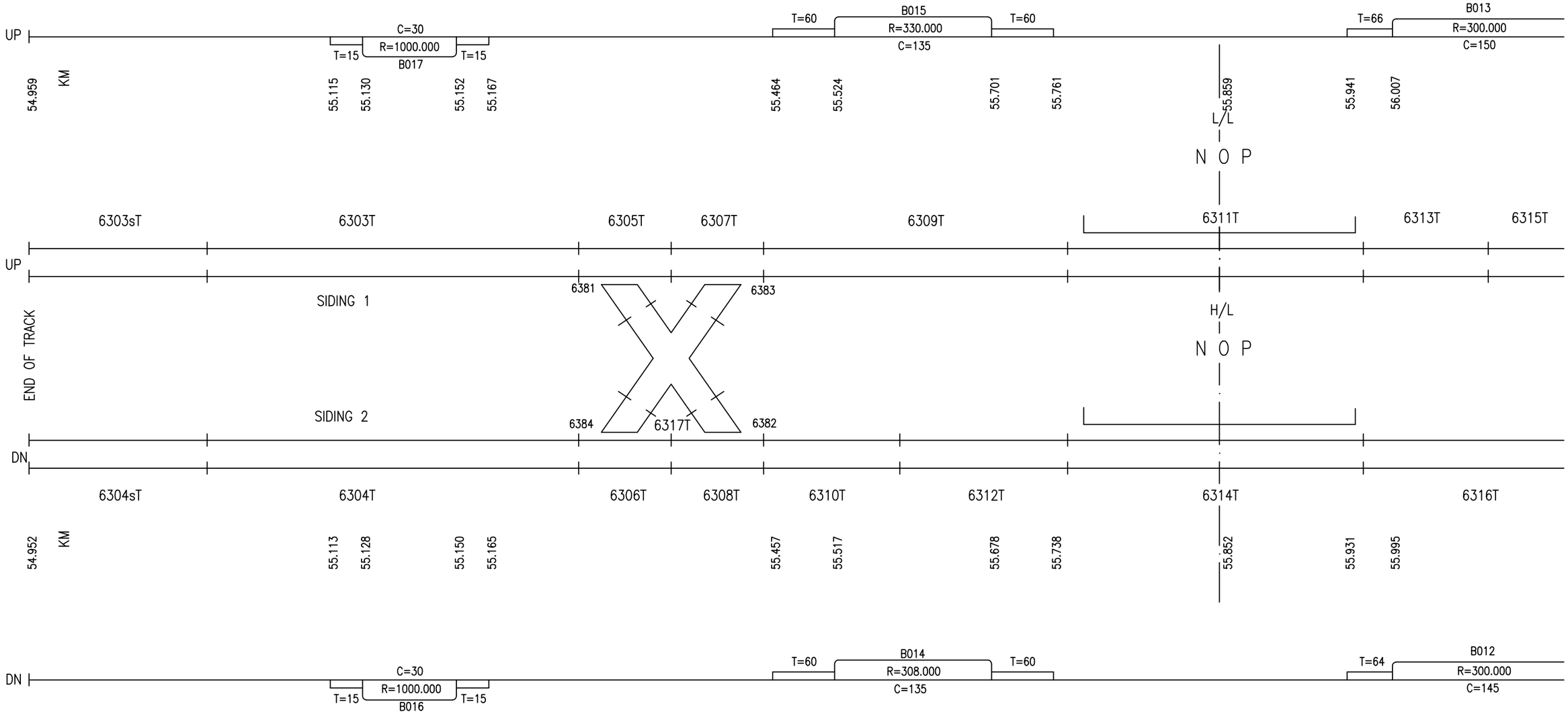
DIN TD(1)-02-D8	Page 9	DWG NO. TKL/M/SQ/W02/408	A



MTR

Title	LOHAS Park Station Track Diagrams Volume 1	
DWG No.	TKL/SQ/TD1/R38/451	B1
S&Q Ref.	(Issue/Rev: 1.2 August 2011)	Page 4A1-15

OD4/501/00704/0030 | –



REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/TKL/001

	INITIAL	DESIGNATION	DATE
DRAWN	P.S.CHUNG	PWO	02-08-2006
DESIGNED	MTRC	MTRC	02-08-2006
CHECKED	P.S.CHUNG	PWO	02-08-2006
APPROVED	KERRY HUNG	MSM-PW	02-08-2006
CAD FILE NAME	OD4_501_00704_0030_–		

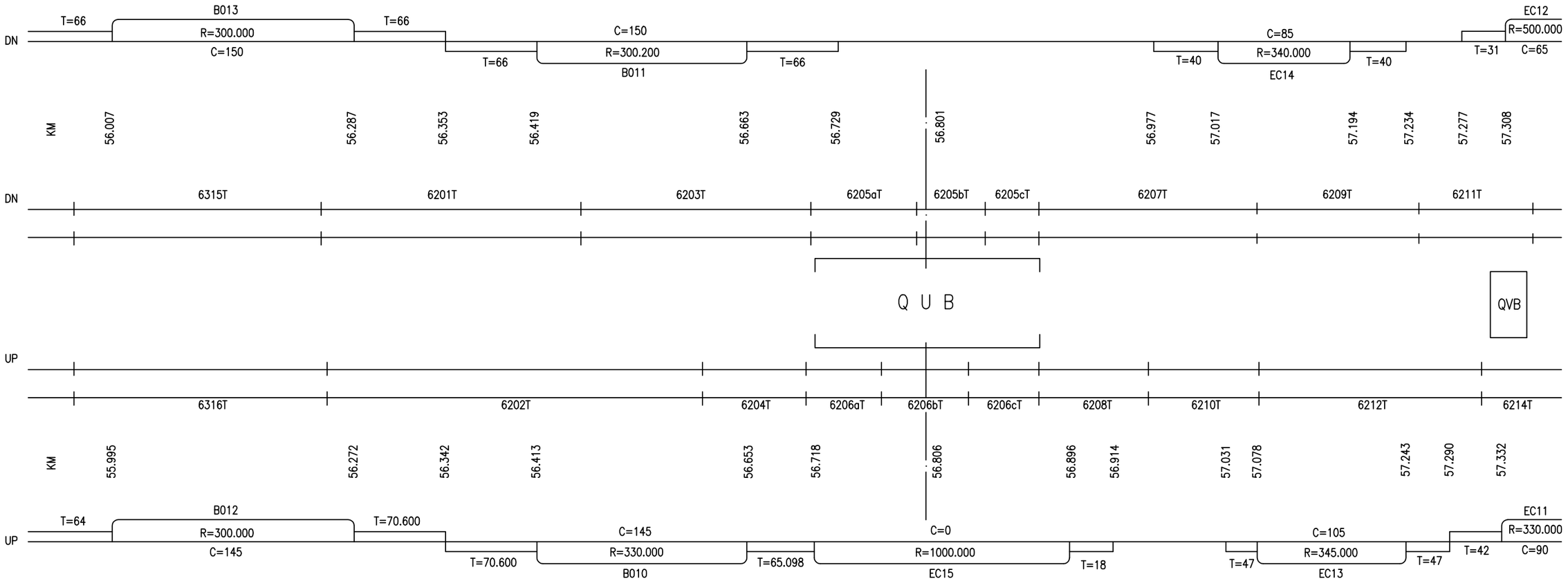
地鐵公司 MTR Corporation

TITLE
NOP SIDINGS – NOP
LINE DIAGRAM – TKL

SCALE N.T.S.

OED DRAWING NO. OD4/501/00704/0030 | –

OD4/501/00704/0031 | –



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DRAWN	P.S.CHUNG	PWO	02-08-2006
DESIGNED	MTR	MTR	02-08-2006
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APPROVED	KERRY HUNG	MSM-PW	02-08-2006
CAD FILE NAME	OD4_501_00704_0031_–		

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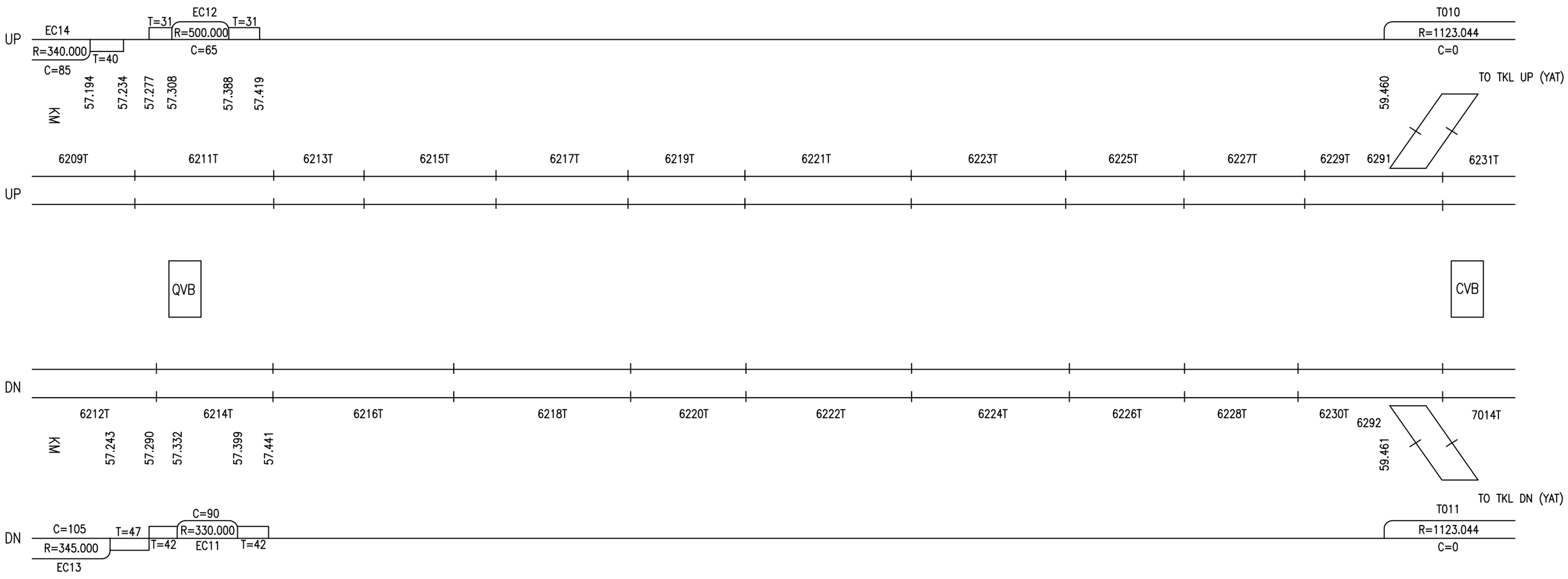
TITLE
NOP – QVB
LINE DIAGRAM – TKL

SCALE N.T.S.

OED DRAWING NO. OD4/501/00704/0031 | –

OD4/501/00704/0032 | –



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PWM/TKL/003

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DRAWN	P.S.CHUNG	PWO	02-08-2006
DESIGNED	MTR	MTR	02-08-2006
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APPROVED	KERRY HUNG	MSM-PW	02-08-2006
CAD FILE NAME	OD4_501_00704_0032_–		

地鐵公司 MTR Corporation

TITLE
QVB – CVB
LINE DIAGRAM – TKL

SCALE N.T.S.

OED DRAWING NO. OD4/501/00704/0032 | –

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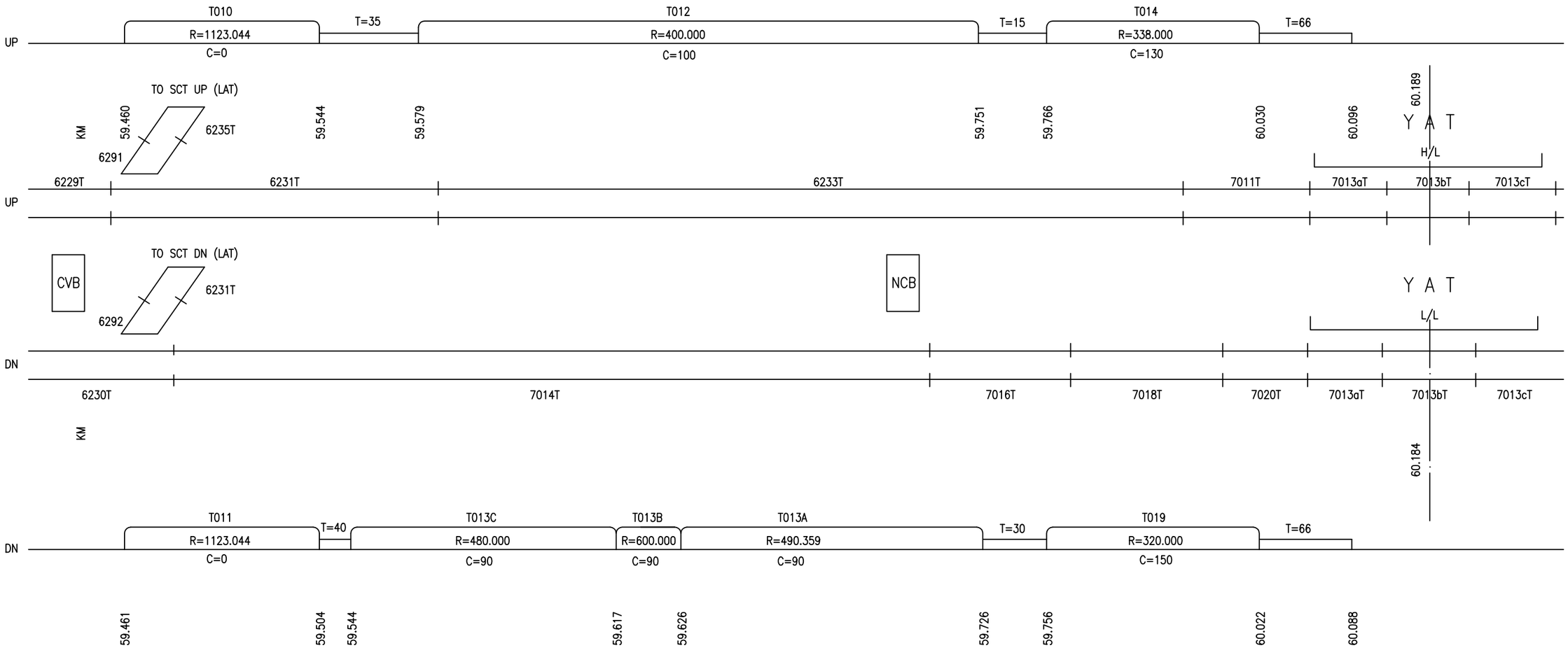

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DESIGNED	MTR	MTR	02-08-2006
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APPROVED	KERRY HUNG	MSM-PW	02-08-2006
CAD FILE NAME	OD4_501_00704_0033_–		

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TITLE
CVB – YAT
LINE DIAGRAM – TKL

SCALE N.T.S.

OED DRAWING NO. OD4/501/00704/0033 | –

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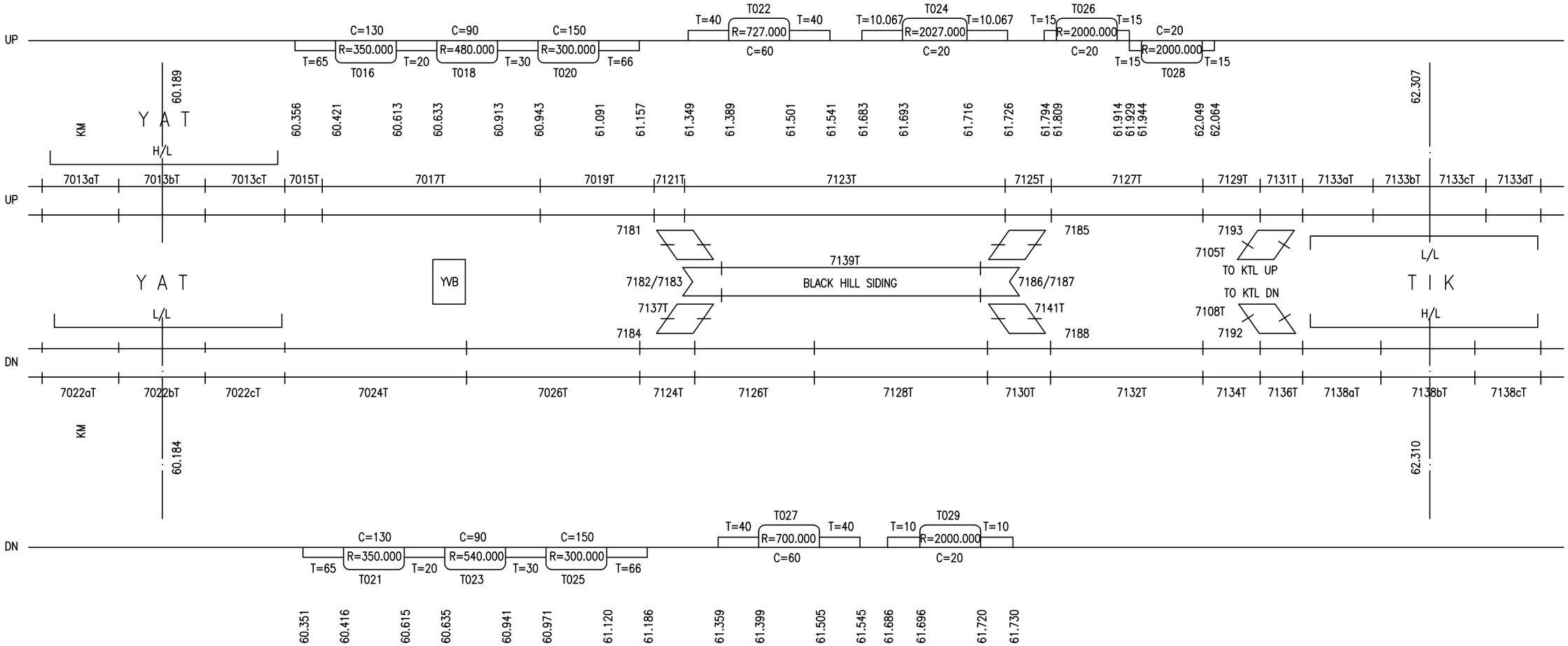

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DESIGNED	MTR	MTR	02-08-2006
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APPROVED	KERRY HUNG	MSM-PW	02-08-2006
CAD FILE NAME	OD4_501_00704_0034_–		

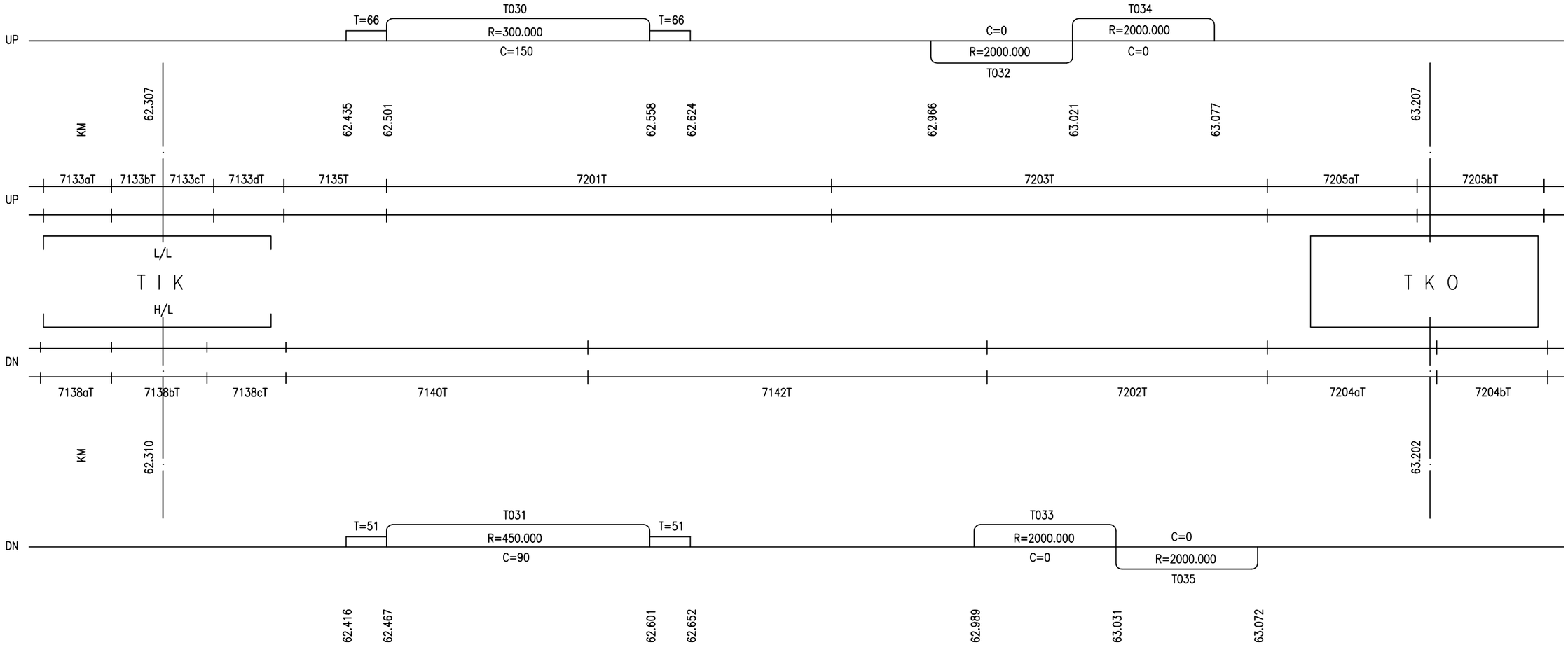
地鐵公司 MTR Corporation

TITLE
YAT – TIK
LINE DIAGRAM – TKL

SCALE N.T.S.

OED DRAWING NO. OD4/501/00704/0034 | –

OD4/501/00704/0035 | –



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PWM/TKL/006

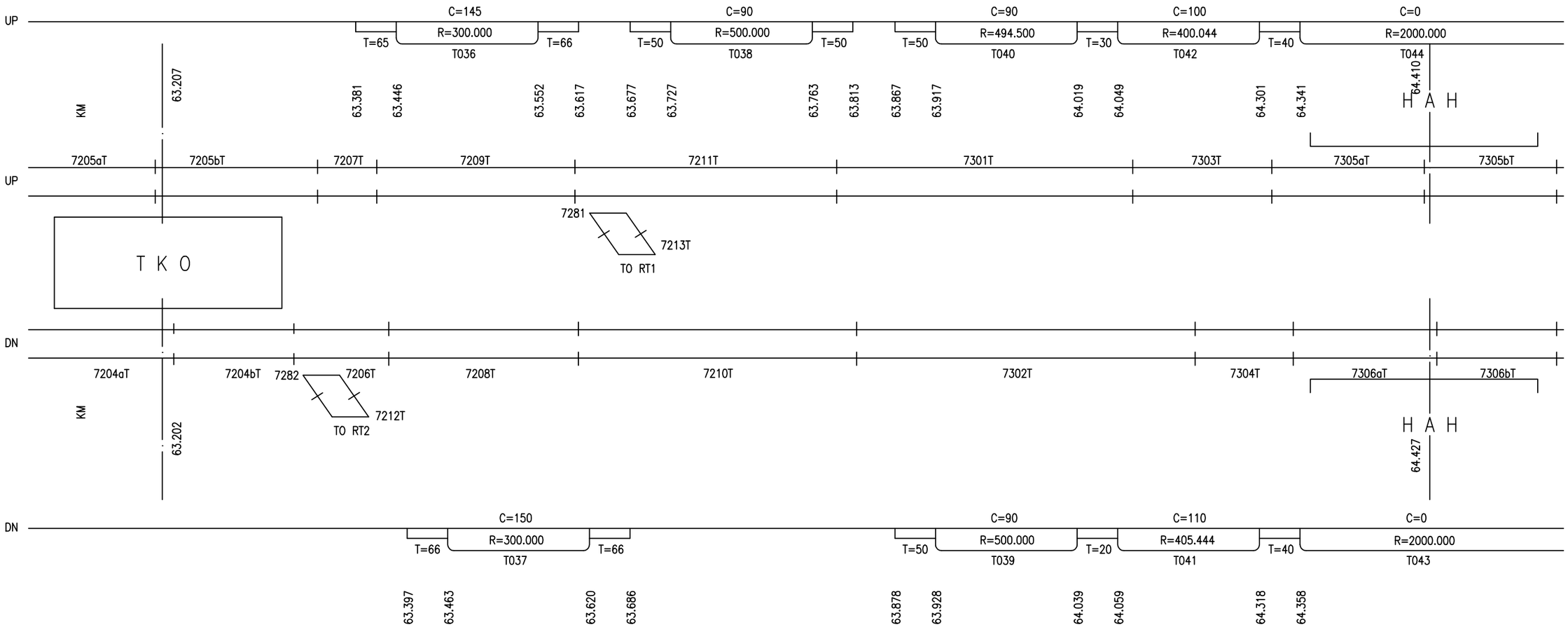
	INITIAL	DESIGNATION	DATE
DRAWN	P.S.CHUNG	PWO	02-08-2006
DESIGNED	MTR	MTR	02-08-2006
CHECKED	P.S.CHUNG	PWO	02-08-2006
APPROVED	KERRY HUNG	MSM-PW	02-08-2006
CAD FILE NAME	OD4_501_00704_0035_–		

地鐵公司 MTR Corporation

TITLE
TIK – TKO
LINE DIAGRAM – TKL

SCALE N.T.S.

OED DRAWING NO. OD4/501/00704/0035 | –



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PWM/TKL/007

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DRAWN	P.S.CHUNG	PWO	02-08-2006
DESIGNED	MTR	MTR	02-08-2006
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APPROVED	KERRY HUNG	MSM-PW	02-08-2006
CAD FILE NAME	OD4_501_00704_0036_–		

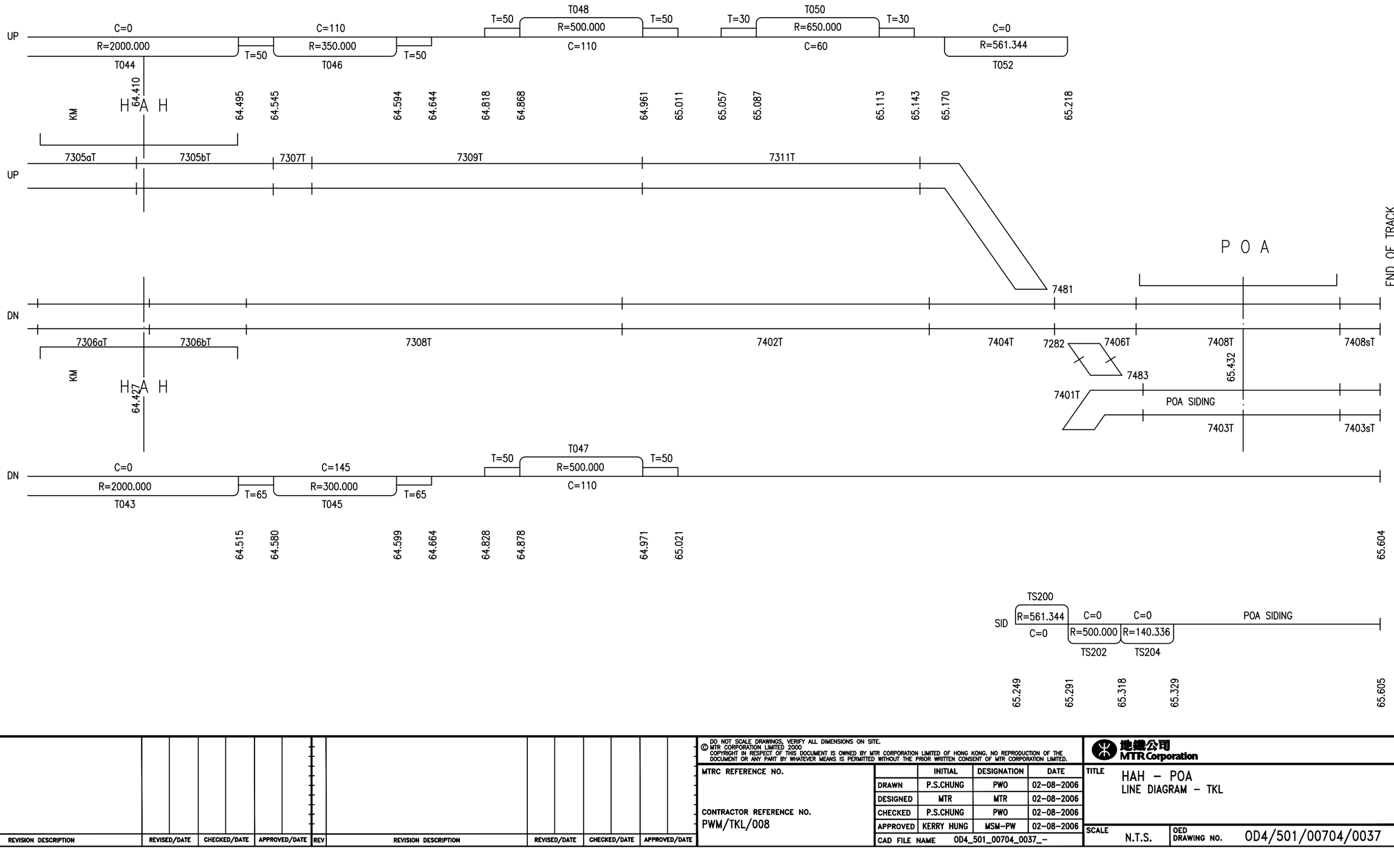
地鐵公司 MTR Corporation

TITLE
TKO – HAH
LINE DIAGRAM – TKL

SCALE N.T.S.

OED DRAWING NO. OD4/501/00704/0036 –

OD4/501/00704/0037 | –



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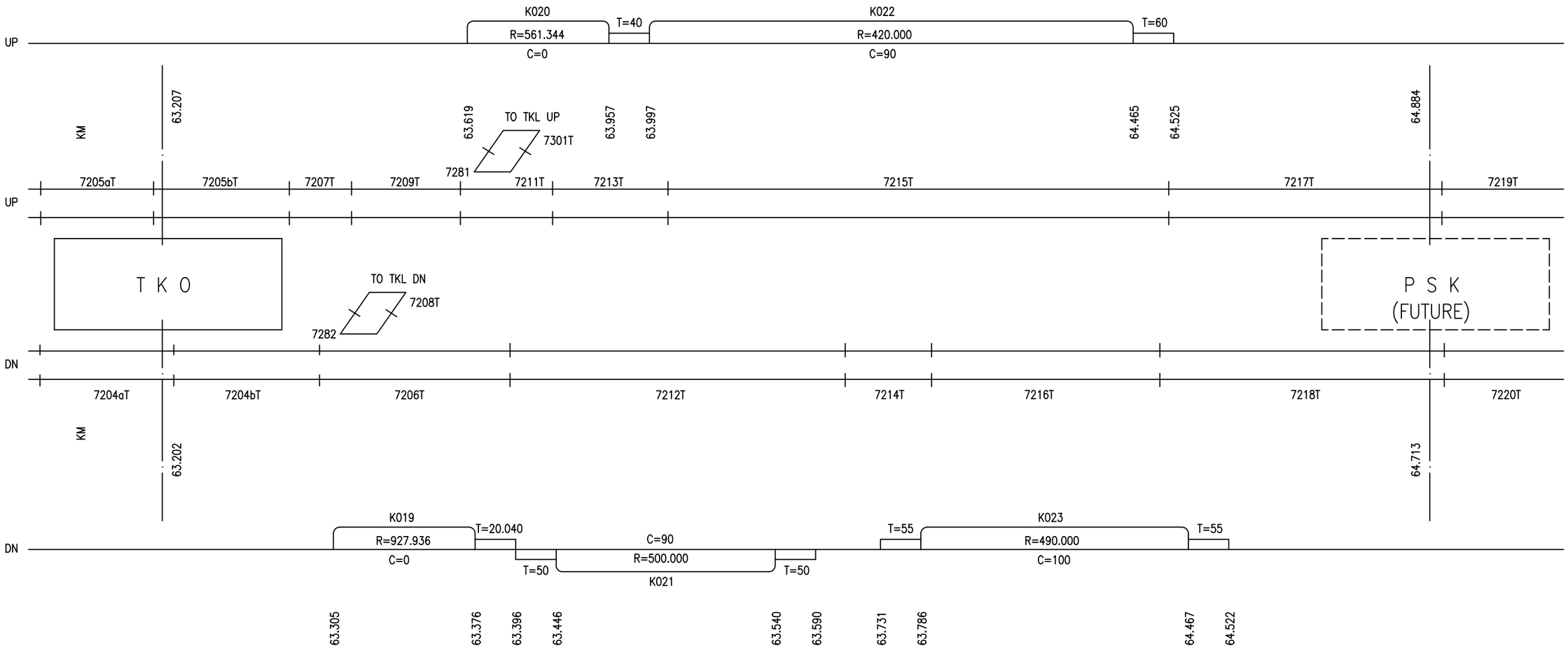
	INITIAL	DESIGNATION	DATE
DRAWN	P.S.CHUNG	PWO	02-08-2006
DESIGNED	MTR	MTR	02-08-2006
CHECKED	P.S.CHUNG	PWO	02-08-2006
APPROVED	KERRY HUNG	MSM-PW	02-08-2006
CAD FILE NAME	OD4_501_00704_0037_–		

地鐵公司 MTR Corporation

TITLE
HAH – POA
LINE DIAGRAM – TKL

SCALE N.T.S.

OED DRAWING NO. OD4/501/00704/0037 | –



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CONTRACTOR REFERENCE NO.
PWM/TKL/009

	INITIAL	DESIGNATION	DATE
DRAWN	P.S.CHUNG	PWO	02-08-2006
DESIGNED	MTR	MTR	02-08-2006
CHECKED	P.S.CHUNG	PWO	02-08-2006
APPROVED	KERRY HUNG	MSM-PW	02-08-2006
CAD FILE NAME	OD4_501_00704_0038_–		

地鐵公司 MTR Corporation

TITLE
TKO – PSK
LINE DIAGRAM – TKL

SCALE N.T.S.

OED DRAWING NO. OD4/501/00704/0038 –

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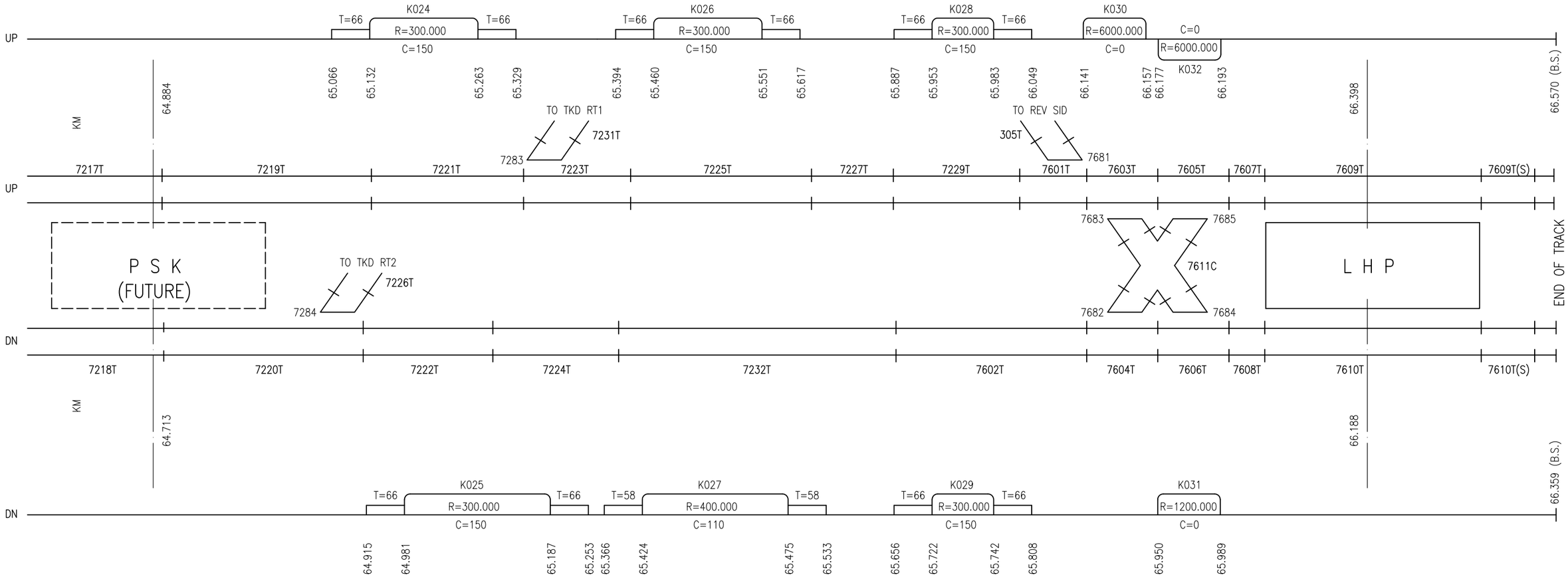

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
A	TRACK LAYOUT UPDATED	P.S.CHUNG 16-06-09	P.S.CHUNG 16-06-09	RICK WONG 16-06-09

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MTRC REFERENCE NO.

CONTRACTOR REFERENCE NO.
PWM/TKL/010

	INITIAL	DESIGNATION	DATE
DRAWN	P.S.CHUNG	PWO	02-08-2006
DESIGNED	P.S.CHUNG	PWO	02-08-2006
CHECKED	P.S.CHUNG	PWO	02-08-2006
APPROVED	KERRY HUNG	MSM-PW	02-08-2006
CAD FILE NAME	OD4_501_00704_0039_A		

地鐵公司 MTR Corporation

TITLE
PSK – LHP
LINE DIAGRAM – TKL

SCALE N.T.S.

OED DRAWING NO. OD4/501/00704/0039 | A

A3 SIZE, 420 x 297mm, TYPE 3

GENERAL NOTES

1. THESE GENERAL NOTES AND LEGEND (DRAWING No. 715/W/WIL/MTR/C01/002) SHALL BE READ IN CONJUNCTION WITH ALL WIL CONTRACT DRAWINGS.
2. ALL CO-ORDINATES REFER TO THE HONG KONG 1980 GEODETIC DATUM.
3. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.
4. ALL LEVELS ARE GIVEN IN METRES AND REFER TO PRINCIPAL DATUM HONG KONG.
5. ALL DIMENSIONS ARE PARALLEL TO OR NORMAL TO THE PLANE OF THE RAILS UNLESS OTHERWISE STATED.
6. TRACK GAUGE THROUGHOUT IS 1432.
7. ALL RAILS TO BE RAIL PROFILE 60E1 IN ACCORDANCE WITH EN 13674-1 EXCEPT DEPOT LINES.
8. RAIL GRADE TO BE GRADE R260 OR R350HT UNLESS OTHERWISE NOTED.
9. RAILS TO BE INCLINED AT 1 IN 20 TOWARDS THE TRACK CENTRELINE UNLESS SHOWN OTHERWISE.

ALIGNMENT DRAWINGS

1. CHAINAGE IS GIVEN IN METRES MEASURED ALONG THE HORIZONTAL TRACK CENTRELINE. CHAINAGE GIVEN IS A CONTINUOUS CHAINAGE SYSTEM INCREASING IN THE SAME DIRECTION ON BOTH UP AND DOWN TRACK.
2. ALL RADII REFER TO TRACK CENTRELINE RADII AND ARE GIVEN IN METRES.
3. VERTICAL ALIGNMENT SHOWN REFERS TO THE CROWN OF THE GRADE RAIL (INSIDE / LOW RAIL ON CURVES).
4. CANT IS APPLIED BY RAISING THE OUTER RAIL ABOVE THE INNER RAIL.
5. FOR DETAILED SETTING OUT INFORMATION REFER TO THE ALIGNMENT DATA SHEETS.
6. BREAK CHAINAGE REFERS TO A SINGLE POINT WITH TWO CHAINAGE VALUES.

JUNCTION LAYOUT - GENERAL NOTES

1. THE JUNCTION LAYOUT DRAWINGS SHOW THE GEOMETRY AND TYPE OF TRACKFORM REQUIRED.
2. THE CONTRACTOR SHALL INSTALL, TEST AND COMMISSION THE TURNOUTS AND JUNCTIONS, INCLUDING ASSOCIATED TRACKFORMS IN ACCORDANCE WITH THE DRAWINGS AND THE SPECIFICATION.
3. THE CONCRETE TRACKBASE FOR TURNOUTS SHALL INCORPORATE RECESSES TO ACCOMMODATE DRIVE BARS AND POINT MACHINES IN THE POSITION SHOWN ON THE DRAWINGS OR AS COORDINATED WITH THE INTERFACING CONTRACTOR.
4. THE CONCRETE TRACKBASE SHALL INCLUDE DUCTING TO ACCOMMODATE CABLES ETC IN THE POSITIONS DEFINED BY THE ENGINEER AND THE DESIGNATED CONTRACTORS.
5. JUNCTION LAYOUTS AND TURNOUT GENERAL ARRANGEMENTS DO NOT SHOW INSULATED RAIL JOINT (IRJ) LOCATIONS. LOCATIONS OF IRJ'S TO BE ADVISED BY THE DESIGNATED CONTRACTOR FOR SIGNALLING.

TRACKFORM CONSTRUCTION - GENERAL NOTES

1. THESE NOTES SHALL APPLY TO ALL TRACKFORMS UNLESS NOTED OTHERWISE.
2. TWO BASEPLATES OR BLOCKS BETWEEN ANY TWO ADJACENT CABLE CROSSINGS ACROSS THE TRACKS.
3. ALL REINFORCED CONCRETE SHALL BE GRADE 40/20 UNLESS NOTED OTHERWISE.
4. NOMINAL CONCRETE COVER TO ALL REINFORCEMENT SHALL BE 50mm UNLESS NOTED OTHERWISE.
5. CONCRETE SURFACE FINISHES SHALL BE AS INDICATED ON THE DRAWINGS AND STATED IN THE MATERIALS AND WORKMANSHIP SPECIFICATION AND ARE INDICATED THUS : ◁F4
6. RUNNING LINE RAIL FASTENERS SHALL BE AT THE FOLLOWING CENTRES : -

   TUNNEL - 600mm

   TURNOUTS - 650mm

   STATION - 650mm

7. ALL REINFORCEMENT REQUIRED TO COMPLY WITH BS 4449 AND IS NOTED THUS : -

   T - HIGH YIELD STEEL, TYPE 2 DEFORMED BARS MINIMUM CHARACTERISTIC STRENGTH OF 425 MPa.

   R - MILD STEEL, PLAIN ROUND BARS, MINIMUM CHARACTERISTIC STRENGTH OF 250 MPa.

8. ALL FABRIC REINFORCEMENT SHALL COMPLY WITH BS 4483. FOR RECTANGULAR SHAPE OF WIRE MESH, THE WIDER WIRE SPACING ARE IN THE LONGITUDINAL DIRECTION.
9. ALL RADII AND BENDS IN REINFORCEMENT SHALL BE IN ACCORDANCE WITH BS 5400 AND BS 8666.
10. ALL REINFORCEMENT SHALL BE SUPPORTED BY APPROVED NON-METALLIC SPACER BLOCKS AND TIED WITH NYLON TIES. FOR DETAILS REFER TO THE MATERIALS AND WORKMANSHIP SPECIFICATION FOR TRACKWORK.
11. WHERE INDICATED ON THE DRAWINGS, LONGITUDINAL REINFORCEMENT SHALL BE ELECTRICALLY INSULATED FROM LATERAL REINFORCEMENT AND STARTER BARS BY THE USE OF INSULATING CLIPS OR SIMILAR APPROVED.
12. ALL ARRISSES SHALL BE FORMED WITH A 25x25 CHAMFER, UNLESS NOTED OTHERWISE.
13. ALL INTERNAL FORMED ANGLES SHALL HAVE A FORMED 25x25 FILLET, UNLESS NOTED OTHERWISE.
14. ALL STRUCTURAL STEELWORK SHALL BE GRADE S275JR BS EN 10 025 AND ARE GALVANISED.
15. CONCRETE SURFACES IN AND IMMEDIATELY ABOVE DRAINAGE CHANNELS / PATHS SHALL HAVE A WATERPROOF PROTECTIVE COATING. FOR DETAILS REFER TO THE DRAWINGS AND THE MATERIALS AND WORKMANSHIP SPECIFICATION FOR TRACKWORK.
16. THE SUPPORTING STRUCTURE CONCRETE BELOW THE CAST IN-SITU TRACKFORM CONCRETE, INCLUDING PLINTHS AND SLABS, WHICH IS NOT CONSTRAINED TRANSVERSELY BY STRUCTURAL ELEMENTS, e.g. ON BRIDGES AND VIADUCTS, SHALL BE SCABBLED TO EXPOSE A MINIMUM 3mm OF THE AGGREGATE, WITHOUT CAUSING ANY DAMAGE TO THE AGGREGATE.
17. PRIOR TO SCABBLING, THE CONTRACTOR SHALL REMOVE ANY GREASE, OIL OR DEBRIS AND CLEAN ALL SURFACES INCLUDING RECESSES AND SLOTS.
18. THE STRAY CURRENT MESH SHALL BE PREFORMED GALVANISED WELDED MESH. FABRIC MESH SHALL HAVE A MINIMUM 150mm WELDED LAP FOR EACH BAR. THE WELDS SHALL BE CLEANED AND THEN COATED WITH 'GALVAFROID'.
22. REINFORCEMENT NOTATION :

    6 - T12 - 05 - 150

    NO. OF BARS
    TYPE OF STEEL
    BAR SIZE
    SPACING
    BAR MARK

23. ALL CAST-IN STEEL SOCKETS SHALL BE GALVANISED.
24. FOAMED CONCRETE INGREDIENTS SHALL COMPLY WITH THE MATERIALS AND WORKMANSHIP SPECIFICATION VOLUMES 1 & 2. FOAMED CONCRETE SHALL BE MANUFACTURED FROM APPROVED QUANTITIES OF ORDINARY PORTLAND CEMENT, PFA, CRUSHED ROCK FINES, RIVER SAND, WATER, RETARDING ADMIXTURES AND FOAMING ADMIXTURES.
25. FOAMED CONCRETE SHALL HAVE A COMPACTED DENSITY OF BETWEEN 300 AND 800 kg/cu.m AND COMPRESSIVE STRENGTH OF NOT LESS THAN 5 mPA AT 28 DAYS.

BASEPLATED CONCRETE TIE TRACK

1. CONCRETE SUPPLIED FOR MANUFACTURE OF PRECAST REINFORCED CONCRETE SLEEPERS TO BE USED IN NON-BALLASTED TRACKFORM SHALL BE GRADE 40/20 CATEGORY A IN ACCORDANCE WITH THE MATERIALS AND WORKMANSHIP SPECIFICATION FOR CIVIL ENGINEERING WORKS VOLUME 2 SECTION 11 AND THE DRAWINGS.
2. THE REINFORCEMENT SHALL COMPLY THE MATERIALS AND WORKMANSHIP SPECIFICATION FOR CIVIL ENGINEERING WORKS VOLUMEN 1 SECTION 10.
3. SCREW DOWELS ARE PERPENDICULAR TO WITHIN 0.4 DEGREE.
4. ALL SLEEPERS FROM FIRST BATCH SHALL BE DIMENSIONALLY CHECKED INCLUDING HOLDING DOWN ASSEMBLIES CHECKED AND TESTED, RECORDED AND APPROVED BY THE ENGINEER BEFORE THEY ARE USED FOR MASS PRODUCTION IN ORDER TO ENSURE ALL MOULDS USED ARE DIMENSIONALLY CORRECT.
5. HOLDING DOWN ASSEMBLIES SHALL BE TESTED IN ACCORDANCE TO CLAUSE 5.58 OF THE TRACKWORK M&W.
6. 5% OR MINIMUM 5 SLEEPERS RANDOMLY SELECTED DURING PRODUCTION SHALL BE DIMENSIONALLY CHECKED, HOLDING DOWN ASSEMBLIES CHECKED AND TESTED AND ASSEMBLY TEST WITH RAILS, BASEPLATES AND FASTENINGS DEMONSTRATING COMPLIANCE WITH GAUGE.
7. CONSTRUCTION JOINT, IN ACCORDANCE WITH THE MATERIALS AND WORKMANSHIP SPECIFICATION VOLUME 1 SECTION 8, ARE AT MAXIMUM SPACING OF 11.9m. ALL CONSTRUCTION JOINTS SHALL HAVE A MINIMUM 25mm x 25mm REBATE AT THE SLAB SURFACE FILLED WITH AN APPROVED POLY-SULPHIDE SEALANT.
8. THE RAIL, BASEPLATE AND HOLDING DOWN ASSEMBLIES OF PLAIN LINE TRACK SHALL BE LAID TO THE DESIGN HORIZONTAL / VERTICAL ALIGNMENT, GAUGE, CANT AND INCLINATION AND TEMPORARILY SUPPORTED FOR CONCRETING AT THE SAME TIME AS THE TRACKBASE.

TRACKWORKS - SCHEDULE OF DRAWINGS

VOLUME 1 - GENERAL DRAWINGS

VOLUME 2 - TRACK SCHEMATICS

VOLUME 3 - ALIGNMENT

VOLUME 4 - JUNCTION LAYOUTS

VOLUME 5 - STANDARD DETAILS

VOLUME 6 - TRACK COMPONENTS

VOLUME 7 - E&M SERVICES

VOLUME 8 - WORKS AREA

REV	DESCRIPTION	BY	DATE	APPROVED
A	ISSUE FOR WORKING	AME	DEC10	DE

DRAWN	AME
DESIGNED	JL
CHECKED	FTC
APPROVED	DE
DATE	03.12.2010

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WEST ISLAND LINE

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PROJECTS DIVISION | PROJECT ENGINEERING / CIVIL & PLANNING DEPARTMENT

CADD REF. 715_W_WIL_MTR_C01_001A.dgn

TITLE
CONTRACT 715
GENERAL DRAWINGS

GENERAL NOTES

SCALE -

DRAWING NO. 715/W/WIL/MTR/C01/001

REV. A

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ABBREVIATIONS

STATIONS

SHW	SHEUNG WAN
SYP	SAI YING PUN
HKU	HONG KONG UNIVERSITY
KET	KENNEDY TOWN

RAILWAY LINE

ISL	ISLAND LINE
WIL	WEST ISLAND LINE

GENERAL

TC/CT	TANGENT TO CURVE / CURVE TO TANGENT
S/S	SPIRAL TO SPIRAL
ST/TS	SPIRAL TO TANGENT / TANGENT TO SPIRAL
SC/CS	SPIRAL TO CURVE / CURVE TO SPIRAL
CC	CURVE TO CURVE
HIP	HORIZONTAL INTERSECTION POINT
VIP	VERTICAL INTERSECTION POINT
IP	INTERSECTION POINT OF GAUGE LINES
RE	RUNNING EDGE OF RAIL
WCB	WHOLE CIRCLE BEARING
RMJ	RAIL MOVEMENT JOINT
S&C	SWITCHES & CROSSING
R	RADIUS
DN	DOWN
RL	RAIL LEVEL
IRJ	INSULATED RAIL JOINT
℄	CENTRE LINE
CH	CHAINAGE
IST	ISOLATED SLAB TRACK
RH	RIGHT HAND
LH	LEFT HAND
T/O	TURNOUT

703 | 704 — APPROXIMATE DESIGNATED INTERFACE

DN ISL — TRAFFIC DIRECTION

SHW — ADJACENT STATION DIRECTION

T ℄ C — TANGENT TO CURVE

VIP CH:3093.1281
RL : 8.9500 — VERTICAL PROFILE INTERSECTION POINT, CHAINAGE, AND REDUCED LEVEL

INSULATED RAIL JOINTS (IRJ)

TWIST RAILS

BRIDGE

TUNNEL / IMMERSED TUBE — TUNNEL/IMMERSED TUBE/VIADUCT INTERFACE

BUILDING/STRUCTURE

SIDE PLATFORMS

ISLAND PLATFORMS

EMBANKMENT / CUTTING

834356.1922 E
816245.9685 N — TRACK CENTRE CO-ORDINATES AT ZERO OR END CHAINAGES

T 1234 — TURNOUT NUMBER 1234

1 IN 10.5RH — TYPE 1 IN 10.5 RH (REFER TO JUNCTION LAYOUT DRAWINGS)

B1/01 — FRICTION SLIDING BUFFER STOP BUFFER NUMBER

B2/01 — FIXED BUFFER STOP BUFFER NUMBER

B3/01 — FRICTION HYDRAULIC BUFFER STOP BUFFER NUMBER

RMJ1/27
CH123.456 — RAIL MOVEMENT JOINT TYPE; RAIL MOVEMENT JOINT NUMBER; CHAINAGE AT ℄ OF STRUCTURE MOVEMENT JOINT NUMBER

UP
CH 180 — CHAINAGE OF EXTENT OF STRUCTURE AND TRACKFORM TYPE

DERAILMENT GUARD TRANSITION

CURVE NO. — CURVE NUMBER DESCRIPTION

L = ELEMENT LENGTH

T = TRANSITION LENGTH

R = HORIZONTAL AND VERTICAL CURVE RADIUS

1809.759
1809.940 — BREAK CHAINAGE

FP — FOUL POINT

NOTES

1. FOR GENERAL NOTES, SEE DRAWING NO. 715/W/WIL/MTR/C01/001.

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CADD REF. 715_W_WIL_MTR_C01_002A.DGN

TITLE
CONTRACT 715
GENERAL DRAWINGS

LEGEND

SCALE -

DRAWING NO. 715/W/WIL/MTR/C01/002

REV. A

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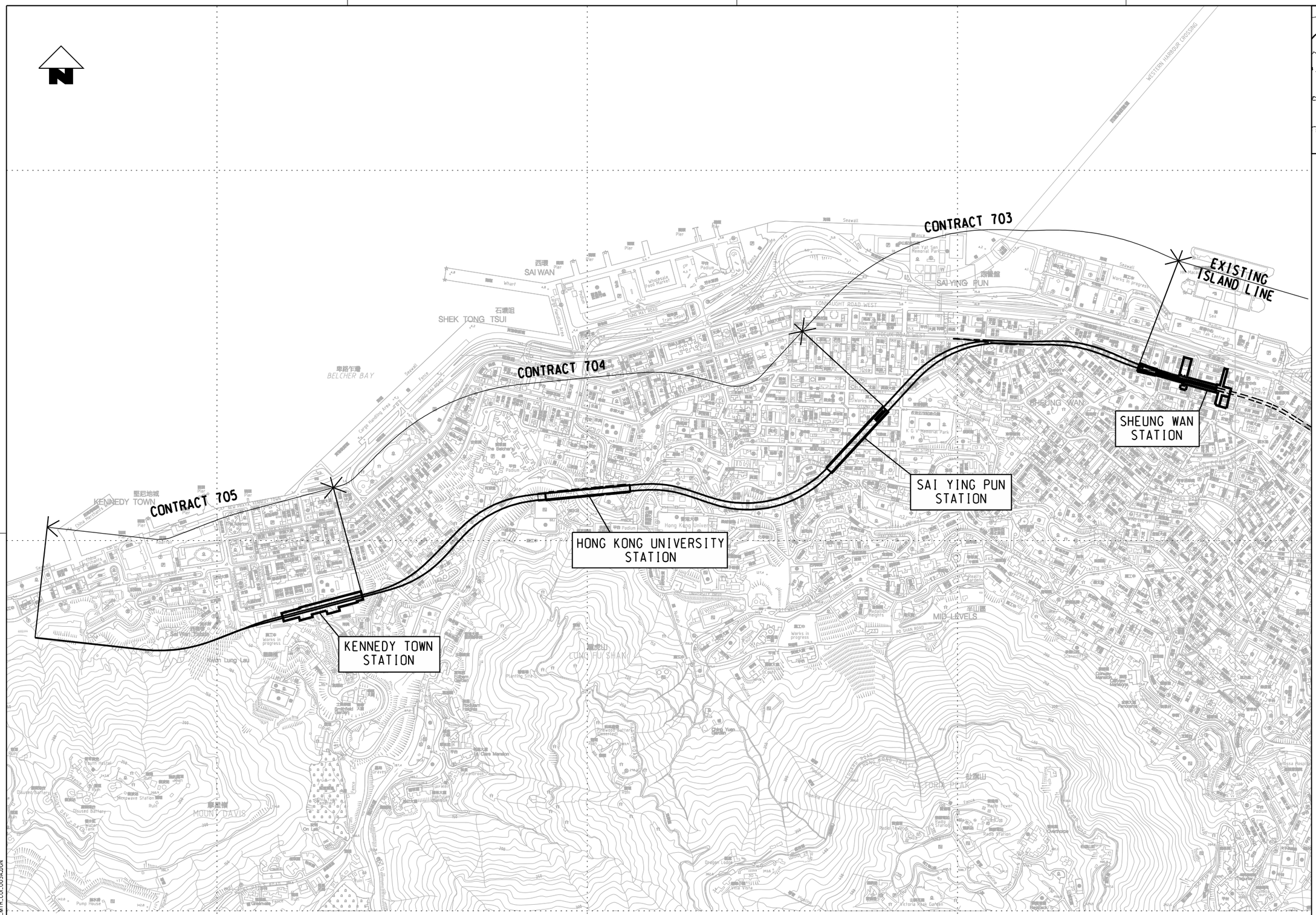

KEYPLAN

NOTES:

1. FOR GENERAL NOTES, SEE DRG NO. 715/W/WIL/MTR/C01/001.
2. UNLESS NOTED OTHERWISE, THE E&M CONTRACTS ARE SYSTEM WIDE AND LOCATED ALONG ALL OF WIL.

LEGEND:

- - - - EXISTING MTRC LINE

——— WEST ISLAND LINE

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TITLE

CONTRACT 715
GENERAL DRAWINGS

SITE LOCATION PLAN

SCALE 1:10000 @ A3 | DRAWING NO. 715/W/WIL/MTR/C01/003 | REV. A

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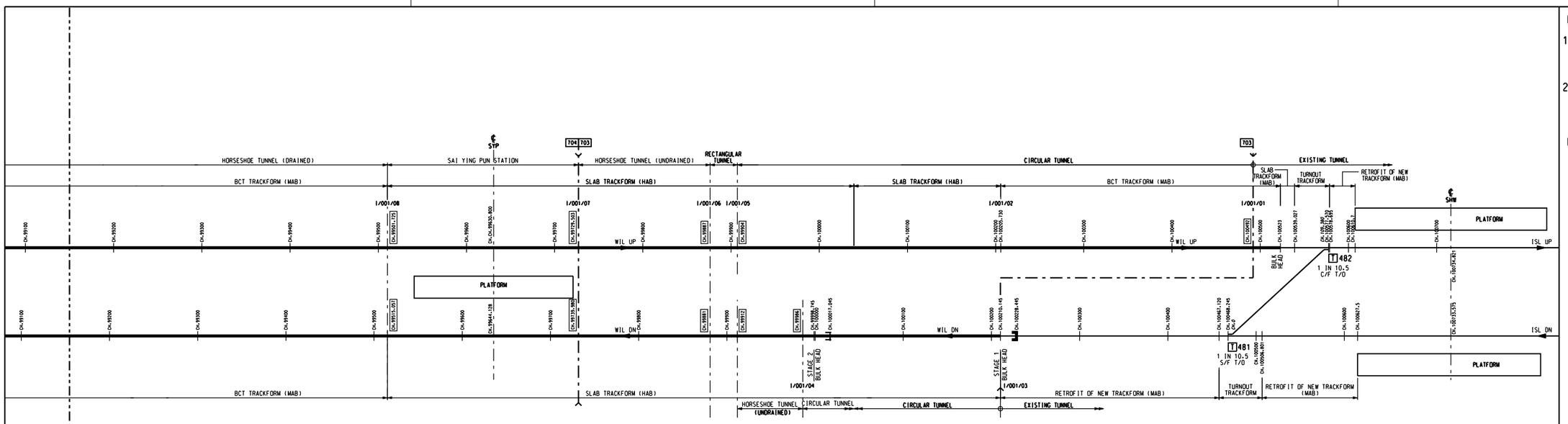

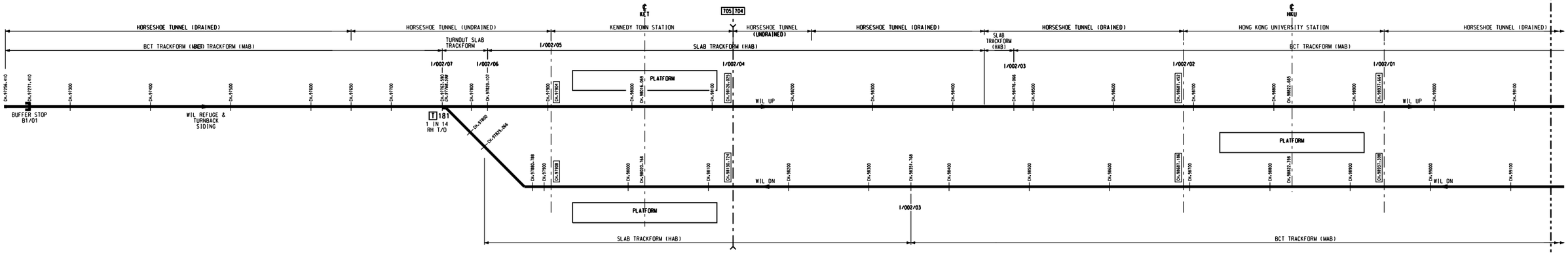

MATCH LINE
SEE BELOW FOR CONTINUATION

MATCH LINE
SEE ABOVE FOR CONTINUATION

NOTES:

1. FOR GENERAL NOTES AND LEGEND, REFER TO DRAWING No. 715/W/WIL/MTR/MTR/C01/001 & 002.
2. CHAINAGE SHOWN FOR THE TURNOUTS ARE FOR THE TANGENT POINT (TC).

LEGEND:

TRACK BY 715

EXISTING TRACK

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TITLE
CONTRACT 715
GENERAL DRAWING

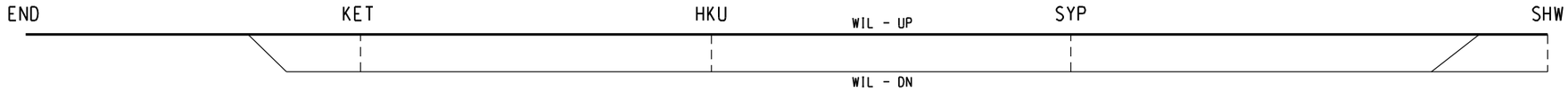
OVERALL TRACK SCHEMATIC DIAGRAM

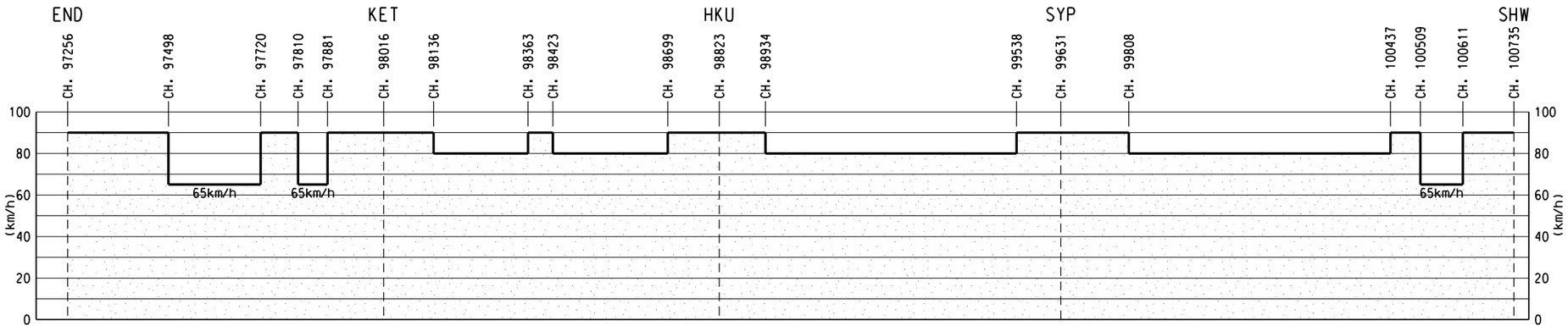
SCALE NTS

DRAWING NO. 715/W/WIL/MTR/C01/004

REV. A

UP TRACK





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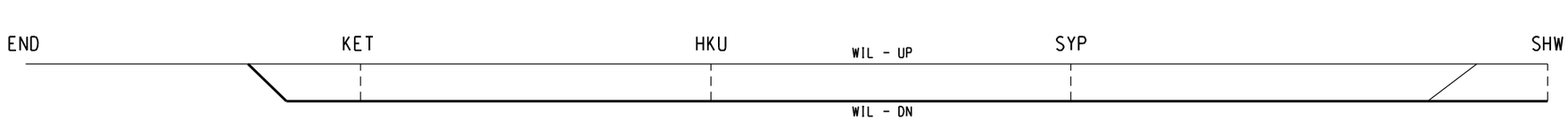

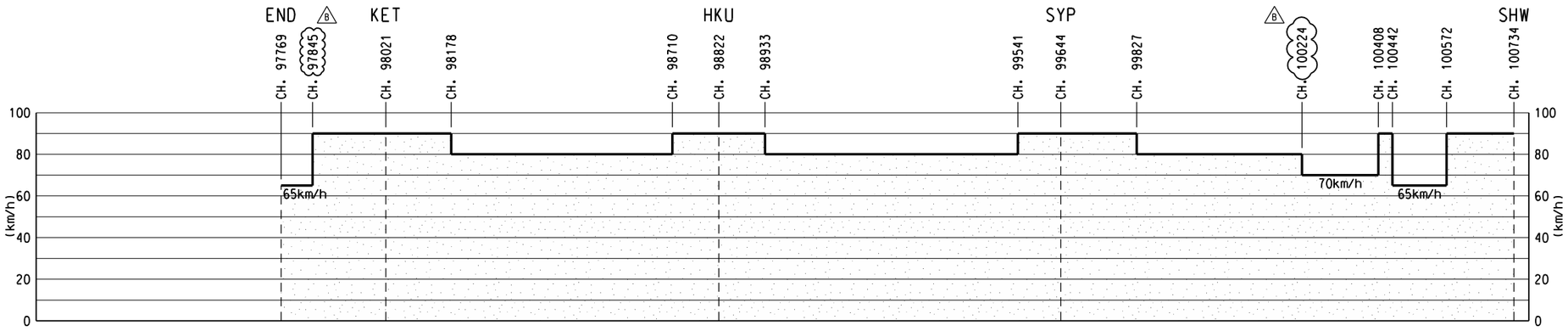

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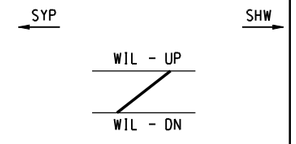

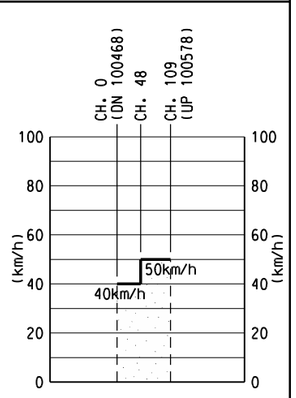

NOTES:

1. FOR NOTES AND LEGEND SEE DRAWING NO. 715/W/WIL/MTR/C01/001 & 002.
2. SPEEDS SHOWN ARE CIVIL LIMITING SPEEDS.

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A	ISSUE FOR WORKING	AME	DEC10	DE

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TITLE

CONTRACT 715
GENERAL DRAWINGS

PERMANENT SPEED RESTRICTION DIAGRAM

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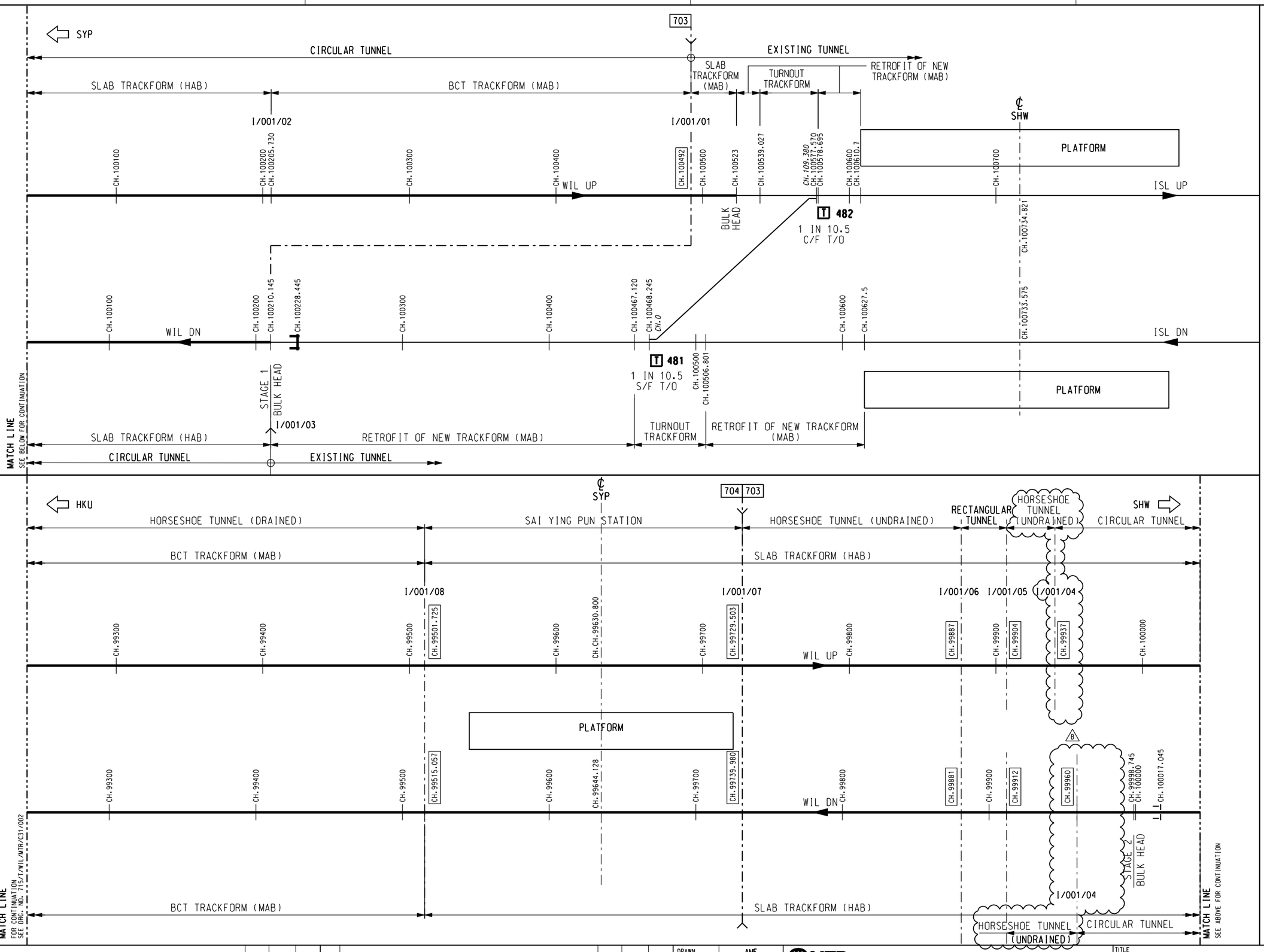

NOTES:

1. FOR GENERAL NOTES AND LEGEND, REFER TO DRAWING NO. 715/W/WIL/MTR/C01/001 & 002.
2. CHAINAGES SHOWN FOR THE TURNOUTS ARE FOR THE TANGENT POINT (TC).

DRAWING REFERENCE:

VOLUME 2 : SCHEMATICS

INTERFACE SCHEDULE	- C31/004

VOLUME 5 : STANDARD DETAILS

CIRCULAR TUNNEL BCT (MAB)	- C32/001
CIRCULAR TUNNEL SLAB TRACKFORM (HAB)	- C32/002
HORSESHOE TUNNEL SLAB TRACKFORM (HAB)	- C32/003
HORSESHOE TUNNEL BCT (MAB)	- C32/004
STATION SLAB TRACKFORM (HAB)	- C32/005
STATION BCT (MAB)	- C32/006
RECTANGULAR TUNNEL SLAB TRACKFORM (HAB)	- C32/007
HORSESHOE TUNNEL TURNOUT SLAB TRACKFORM	- C32/008
EXISTING CROSSOVER BOX SLAB TRACKFORM (MAB)	- C32/009

LEGEND:

TRACK BY 715

EXISTING TRACK

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A	ISSUE FOR WORKING	AME	DEC10	DE

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TITLE

CONTRACT 715
TRACK SCHEMATICS

SHEUNG WAN TO SAI YING PUN

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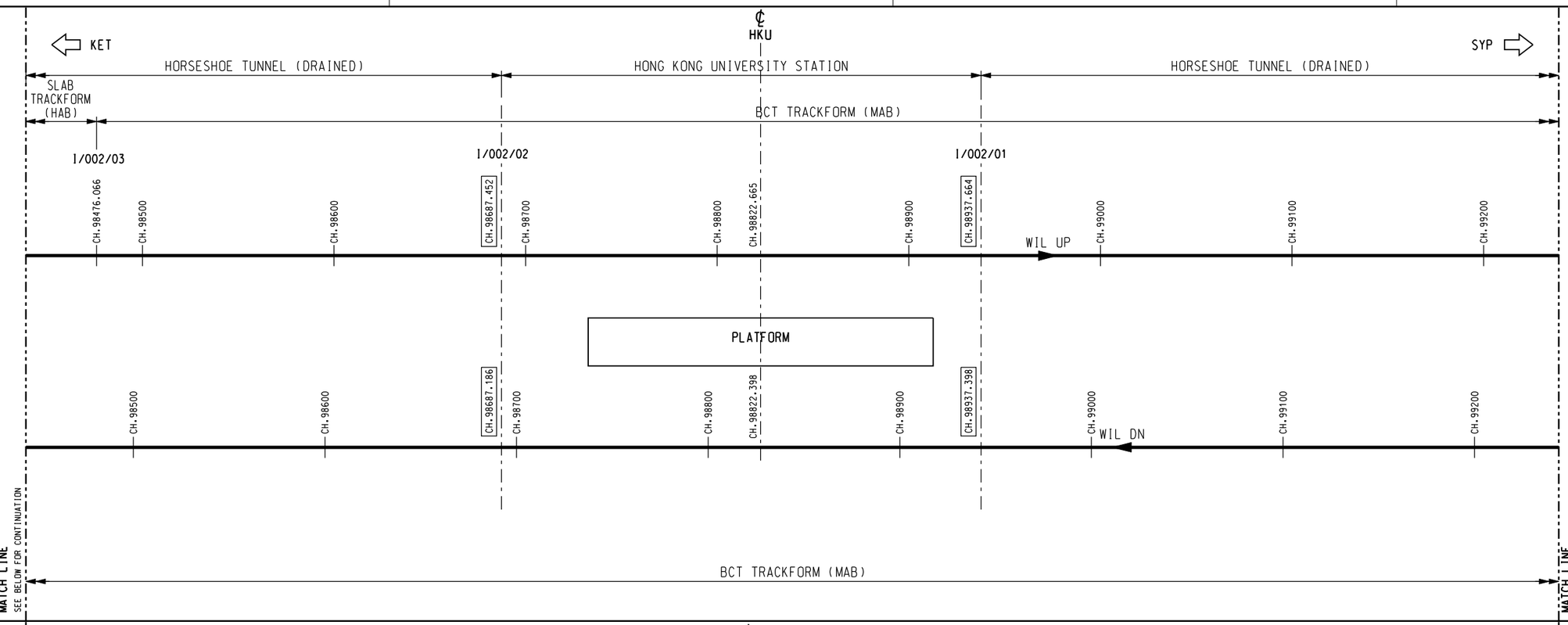

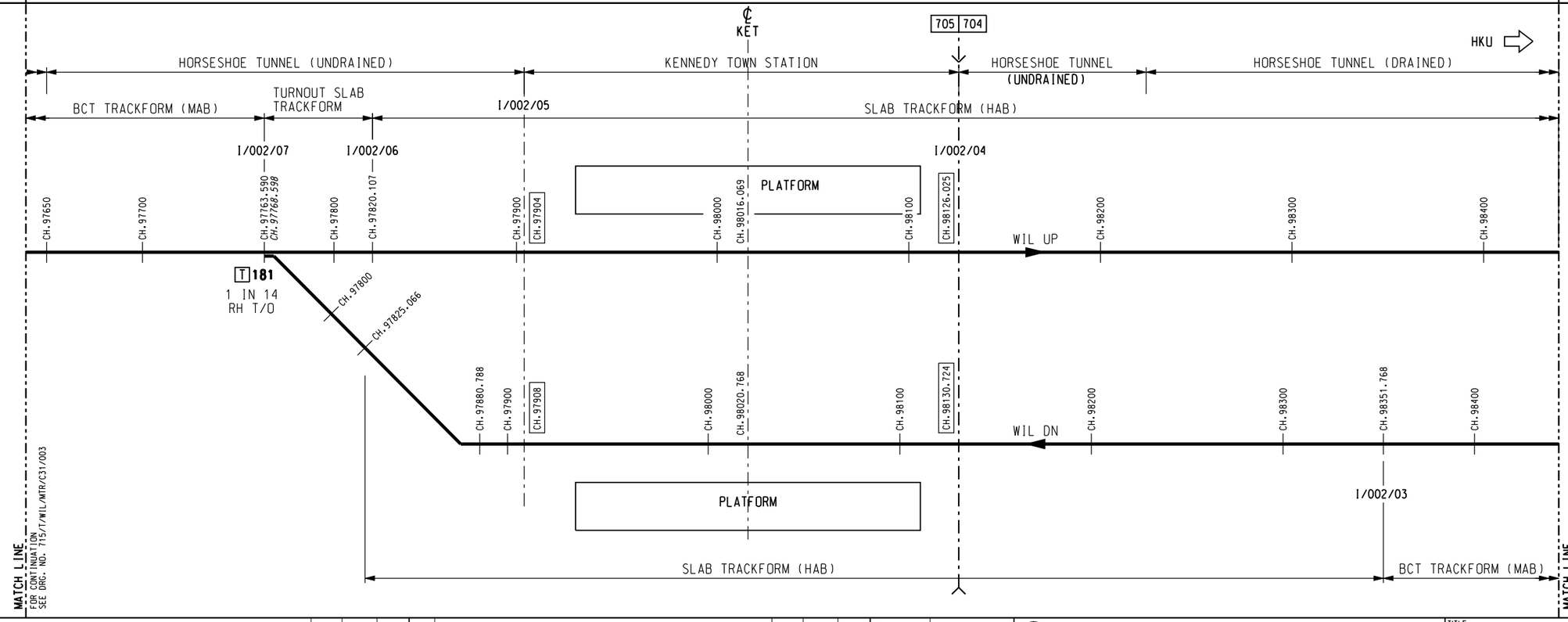

NOTES:

1. FOR GENERAL NOTES AND LEGEND, REFER TO DRAWING NO. 715/W/WIL/MTR/C01/001 & 002.
2. CHAINAGES SHOWN FOR THE TURNOUTS ARE FOR THE TANGENT POINT (TC).

DRAWING REFERENCE:

VOLUME 2 : SCHEMATICS

INTERFACE SCHEDULE	- C31/004

VOLUME 5 : STANDARD DETAILS

CIRCULAR TUNNEL BCT (MAB)	- C32/001
CIRCULAR TUNNEL SLAB TRACKFORM (HAB)	- C32/002
HORSESHOE TUNNEL SLAB TRACKFORM (HAB)	- C32/003
HORSESHOE TUNNEL BCT (MAB)	- C32/004
STATION SLAB TRACKFORM (HAB)	- C32/005
STATION BCT (MAB)	- C32/006
RECTANGULAR TUNNEL SLAB TRACKFORM (HAB)	- C32/007
HORSESHOE TUNNEL TURNOUT SLAB TRACKFORM	- C32/008
EXISTING CROSSOVER BOX SLAB TRACKFORM (MAB)	- C32/009

LEGEND:

TRACK BY 715

EXISTING TRACK

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TITLE
CONTRACT 715
TRACK SCHEMATICS

HONG KONG UNIVERSITY TO KENNEDY TOWN

SCALE NTS | DRAWING NO. 715/W/WIL/MTR/C31/002 | REV. A

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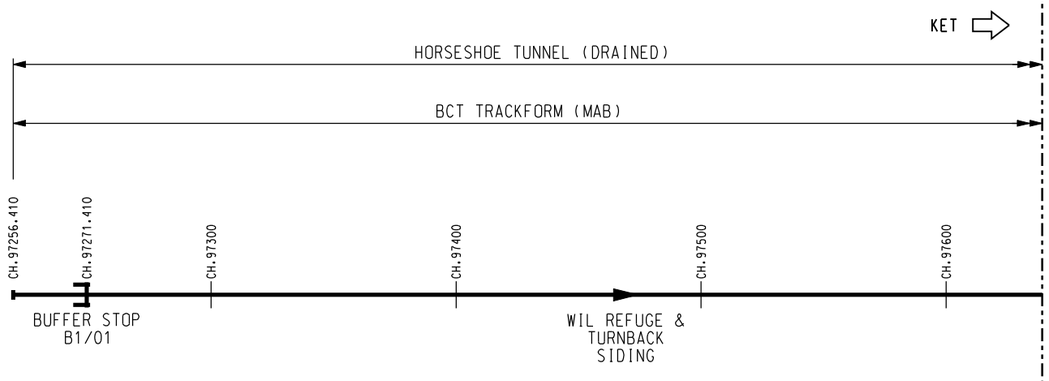

NOTES:

1. FOR GENERAL NOTES AND LEGEND. REFER TO DRAWING NO. 715/W/WIL/MTR/C01/001 & 002.
2. CHAINAGES SHOWN FOR THE TURNOUTS ARE FOR THE TANGENT POINT (TC).

DRAWING REFERENCE:

VOLUME 2 : SCHEMATICS

INTERFACE SCHEDULE	- C31/004

VOLUME 5 : STANDARD DETAILS

CIRCULAR TUNNEL BCT (MAB)	- C32/001
CIRCULAR TUNNEL SLAB TRACKFORM (HAB)	- C32/002
HORSESHOE TUNNEL SLAB TRACKFORM (HAB)	- C32/003
HORSESHOE TUNNEL BCT (MAB)	- C32/004
STATION SLAB TRACKFORM (HAB)	- C32/005
STATION BCT (MAB)	- C32/006
RECTANGULAR TUNNEL SLAB TRACKFORM (HAB)	- C32/007
HORSESHOE TUNNEL TURNOUT SLAB TRACKFORM	- C32/008
EXISTING CROSSOVER BOX SLAB TRACKFORM (MAB)	- C32/009

LEGEND:

TRACK BY 715

EXISTING TRACK

REV	DESCRIPTION	BY	DATE	APPROVED
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DESIGNED	JL
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DATE	03.12.2010

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TITLE

CONTRACT 715
TRACK SCHEMATICS

TURNBACK SIDING

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INTERFACE SCHEDULE

LOCATION	LINE	INTERFACE NUMBER	TRACKFORM CODE		APPROX. CHAINAGE
			FROM	TO	
SHW - SYP	WIL UP	I/001/01	1	OR	100523
	WIL UP	I/001/02	2	1	100206
	WIL DN	I/001/03	OR	2	100210
	WIL UP	I/001/04	2	3	99937
	WIL DN	I/001/04	2	3	99960
	WIL UP	I/001/05	7	2	99904
	WIL DN	I/001/05	3	7	99912
	WIL UP	I/001/06	3	7	99987
	WIL DN	I/001/06	7	3	99881
	WIL UP	I/001/07	5	3	99730
	WIL DN	I/001/07	3	5	99740
SYP - HKU	WIL UP	I/001/08	4	5	99502
	WIL DN	I/001/08	5	4	99515
	WIL UP	I/002/01	6	4	98938
	WIL DN	I/002/01	4	6	98937
HKU - KET	WIL UP	I/002/02	4	6	98687
	WIL DN	I/002/02	6	4	98687
	WIL UP	I/002/03	3	4	98476
	WIL DN	I/002/03	4	3	98352
	WIL UP	I/002/04	5	3	98126
	WIL DN	I/002/04	3	5	98131
KET - OVERRUN	WIL UP	I/002/05	3	5	97904
	WIL DN	I/002/05	5	3	97908
	WIL UP	I/002/06	8	3	97820
	WIL DN	I/002/06	3	8	97825
	WIL UP	I/002/07	4	8	97762

BUFFER STOP SCHEDULE

BUFFER STOP NO.	LOCATION	LINE	CHAINAGE	TYPE	TRACKFORM TYPE
01	KET	WIL REFUGE SIDING	97256.410	B1	BCT
02	SHW	WIL UP (USED AS TEMPORARY REFUGE SIDING)	100268.462	B1	BCT

NOTES

1. FOR GENERAL NOTES, SEE DRAWING NO. 715/W/WIL/MTR/C01/001.
2. ALL TRACKFORM INTERFACE CHAINAGE ARE APPROXIMATE ONLY. EXACT LOCATIONS OF WHICH SHALL BE DETERMINED BY THE ENGINEER ON SITE TO SUIT CONDITIONS.
3. TRACKFORM CODE ARE AS FOLLOW:

   1 - CIRCULAR TUNNEL BCT (MAB)
   2 - CIRCULAR TUNNEL SLAB (HAB)
   3 - HORSESHOE TUNNEL SLAB (HAB)
   4 - HORSESHOE TUNNEL BCT (MAB)
   5 - STATION SLAB (HAB)
   6 - STATION BCT (MAB)
   7 - RECTANGULAR TUNNEL SLAB (HAB)
   8 - HORSESHOE TUNNEL TURNOUT SLAB
   OR - OPERATING RAILWAY

REV	DESCRIPTION	BY	DATE	APPROVED
B	TUNNEL DEMARKATION REVISED BY CIVIL	CHW	JUL12	CK
A	ISSUE FOR WORKING	AME	DEC10	DE

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DESIGNED	JL
CHECKED	FTC
APPROVED	DE
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CADD REF. 715_W_WIL_MTR_C31_004B.DGN

TITLE
CONTRACT 715
TRACK SCHEMATICS

INTERFACE SCHEDULE AND BUFFER STOP SCHEDULE

SCALE -

DRAWING NO. 715/W/WIL/MTR/C31/004

REV. B

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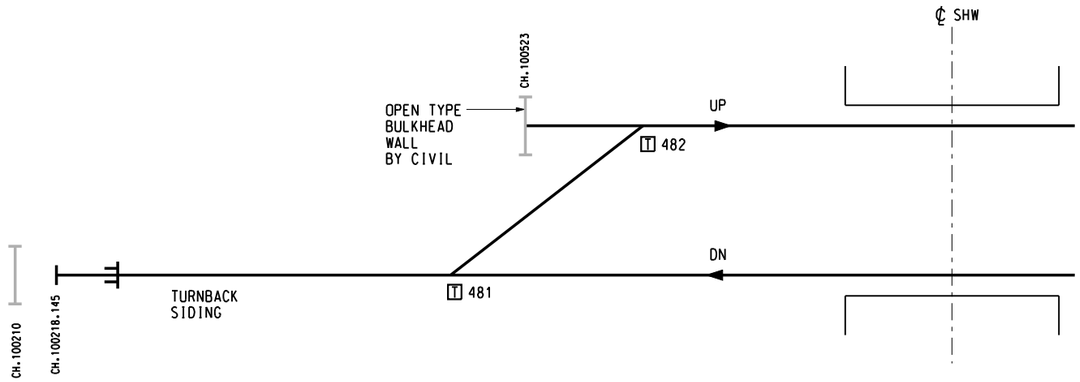
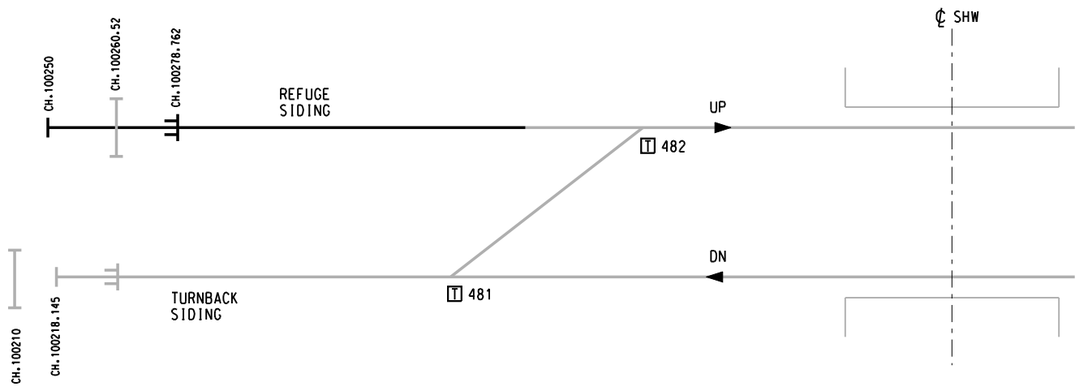


EXISTING TRACK SCHEMATIC DURING TRACK ACCESS

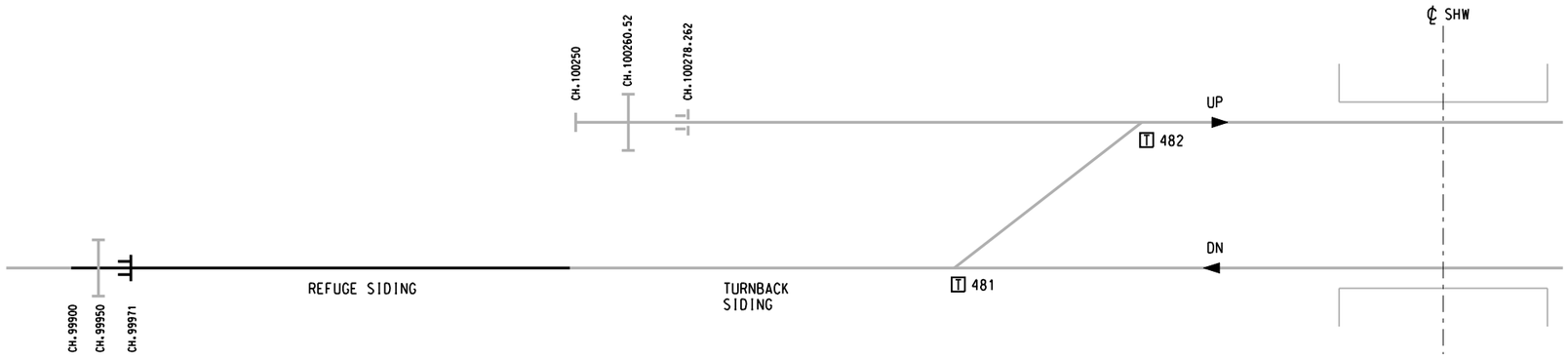
1. UP TRACK TUNNEL TO BE COMPLETED BY APRIL 2012. DOWN TRACK TUNNEL TO BE COMPLETED BY DEC 2012.



STAGE 1 - OPENING OF UP TRACK REFUGE SIDING

1. RAIL TO BE WELDED TO 72m LONG BY MTRCL AND DELIVERED TO SHW CROSSOVER BOX VIA OPERATING AREA DURING NON TRAFFIC HOUR(NTH).
2. 715 CONTRACTOR SHALL ARRANGE AT THE SAME TIME THE APPROPRIATE EQUIPMENT TO PULL THE RAIL TO THE CONSTRUCTION SITE THROUGH THE OPEN TYPE BULKHEAD WALL.
3. THE CONTRACTOR SHALL DELIVER CONCRETE AND OTHER TRACK COMPONENT TO THE SITE VIA SAI WOO LANE SHAFT.
4. THE CONTRACTOR SHALL CONSTRUCT THE TRACK FROM CH.100250 TO CH.100523. AND INSTALL THE BUFFER STOP AT UP TRACK CH.100278 (BUFFER FACE).
5. THE BULKHEAD WALL WILL THEN BE RELOCATED FROM CH.100523 TO CH.100260.52 BY THE CIVIL CONTRACTOR. MTRCL WILL CONNECT AND COMMISSION ALL E&M SYSTEM INCLUDING OVERHEAD LINE WIRE DURING NTH.
6. THE COMPLETED UP TRACK WILL BE TEMPORARILY USED AS REFUGE SIDING UNTIL THE DOWN TRACK TEMPORARY SIDING IS AVAILABLE.

FROM



STAGE 2 - OPENING OF DN TRACK REFUGE SIDING

1. 715 CONTRACTOR SHALL CONSTRUCT THE TRACK FROM CH.99900 (SAI WOO LANE SHAFT) TO CH.100210.
2. ALL MATERIAL SHALL BE DELIVERED FROM SAI WOO LANE SHAFT AND RAIL SHALL BE DELIVERED FROM PRAYA SHAFT.
3. THE BULKHEAD WALL WILL THEN BE RELOCATED FROM CH.100210 TO CH.99950 BY THE CIVIL CONTRACTOR. MTRCL WILL CONNECT THE TRACK AND COMMISSION ALL E&M SYSTEM DURING NTH
4. THE DOWN TRACK BUFFER STOP WILL BE RELOCATED TO CH.99971 (BUFFER FACE) BY MTRCL. THE UP TRACK TEMPORARY REFUGE SIDING WILL BE CLOSED AND THE DOWN TRACK WILL BE OPENED AS TEMPORARY REFUGE SIDING UNTIL THE OPENING OF WIL.

NOTES :

1. ALL THE CHAINAGES ARE APPROXIMATE ONLY.
2. FOR TRACK ACCESS DATE, PLEASE REFER TO PARTICULAR SPECIFIATION APPENDIX D.

LEGEND

BUFFER STOP

BULKHEAD WALL

REV	DESCRIPTION	BY	DATE	APPROVED
A	ISSUE FOR WORKING	AME	DEC10	DE

DRAWN	AME
DESIGNED	JL
CHECKED	FTC
APPROVED	DE
DATE	03.12.2010

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CADD REF. 715_W_WIL_MTR_C31_005A.dgn

TITLE

CONTRACT 715
TRACK SCHEMATICS

STAGE OPENING OF REFUGE SIDING AT SHW

SCALE NTS | DRAWING NO. 715/W/WIL/MTR/C31/005 | REV. A

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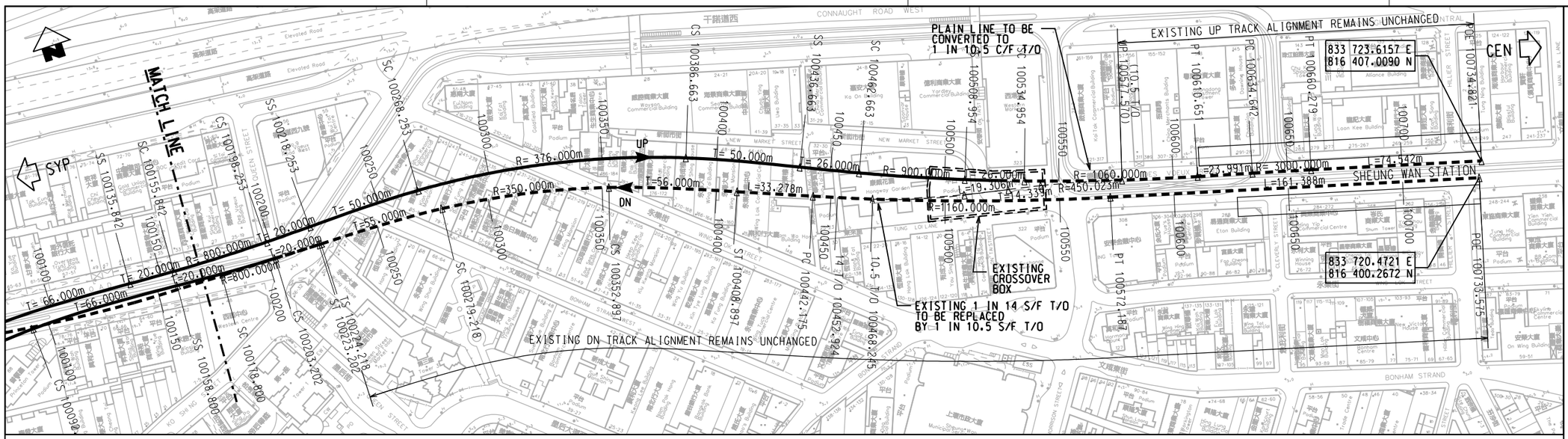

NOTES

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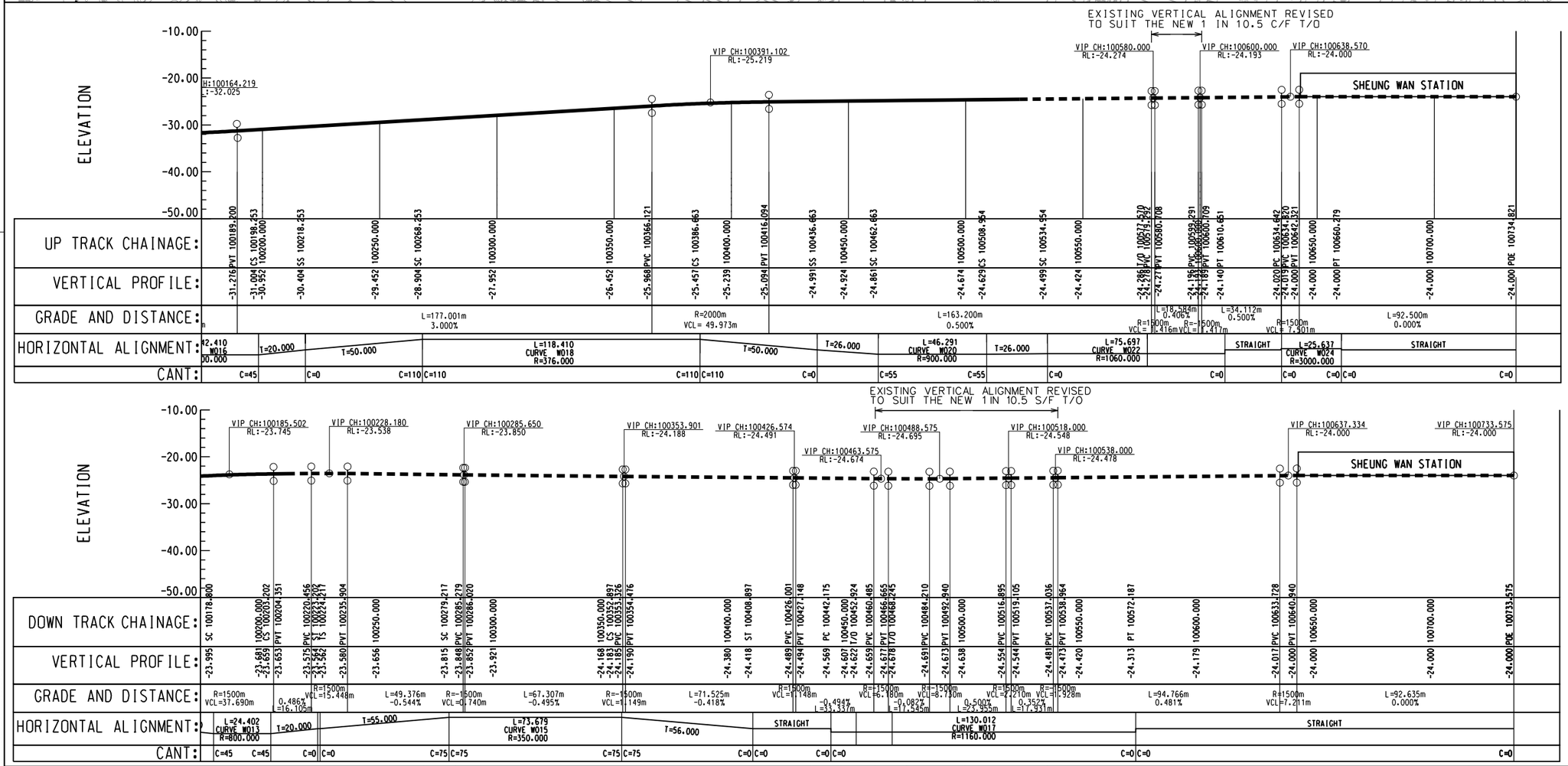
T/O = TURNOUT

WIL ALIGNMENT

EXISTING ISL ALIGNMENT



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CHECKED	FTC
APPROVED	DE
DATE	03.12.2010

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CADD REF. 715_W_WIL_MTR_C30_001A.DGN

TITLE

CONTRACT 715
ALIGNMENT

SHEUNG WAN STATION TO SAI YING PUN STATION
SHEET 1 OF 2

SCALE HORT. 1:1000 VERT. 1:500

DRAWING NO. 715/W/WIL/MTR/C30/001

REV. A

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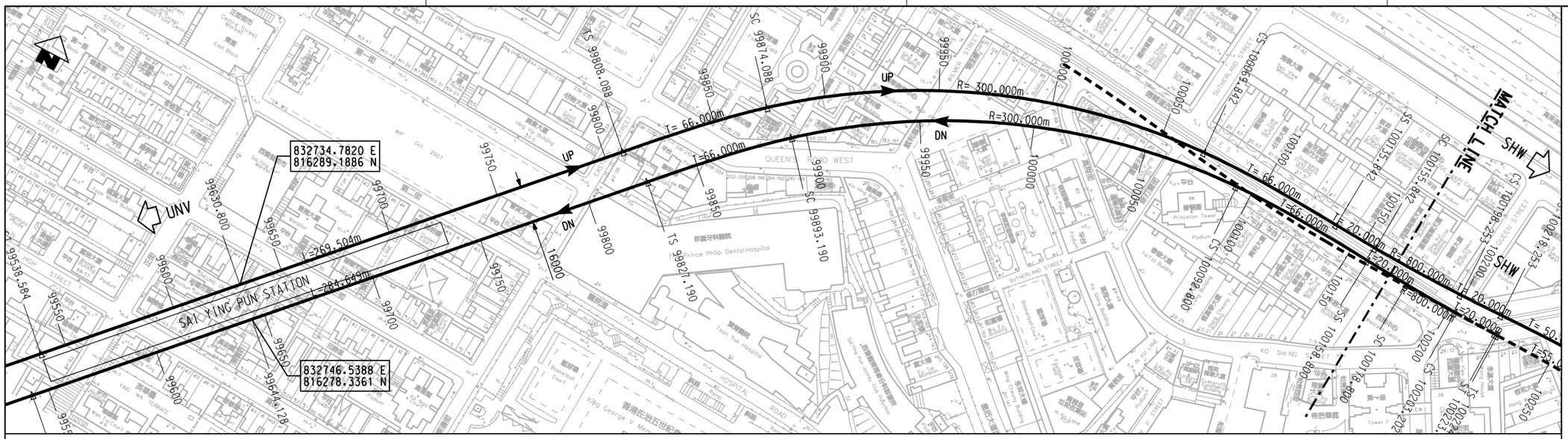

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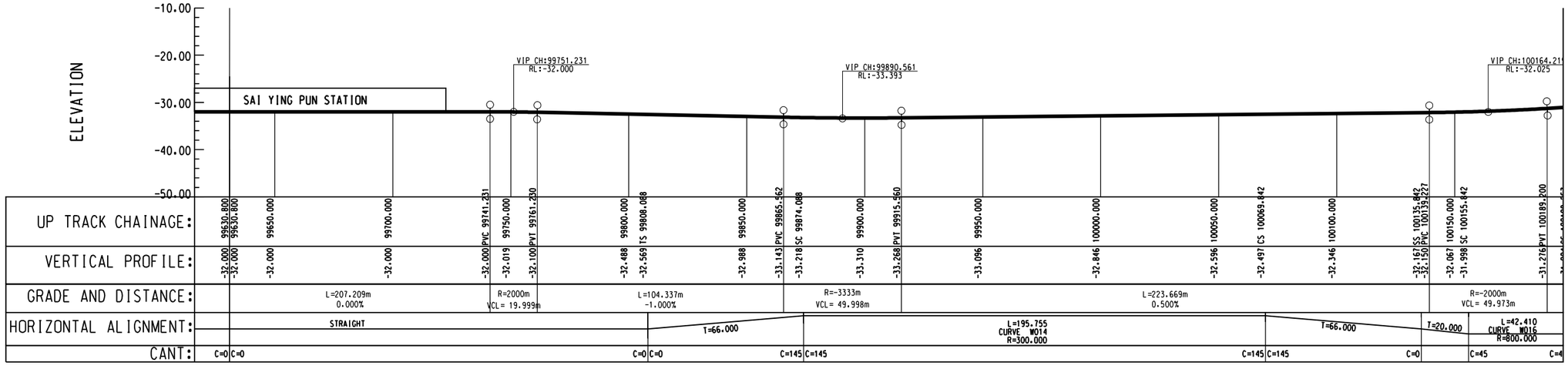
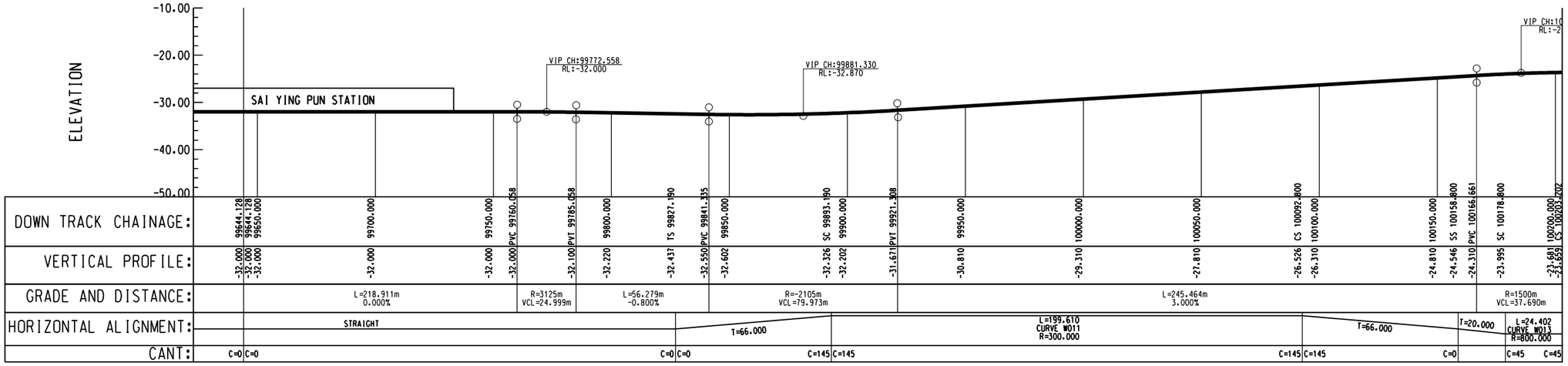
EXISTING ISL ALIGNMENT





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DATE	03.12.2010

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CADD REF. 715_W_WIL_MTR_C30_002A.DGN

TITLE
CONTRACT 715
ALIGNMENT

SHEUNG WAN STATION TO SAI YING PUN STATION
SHEET 2 OF 2

SCALE HORT. 1:1000 VERT. 1:500 | DRAWING NO. 715/W/WIL/MTR/C30/002 | REV. A

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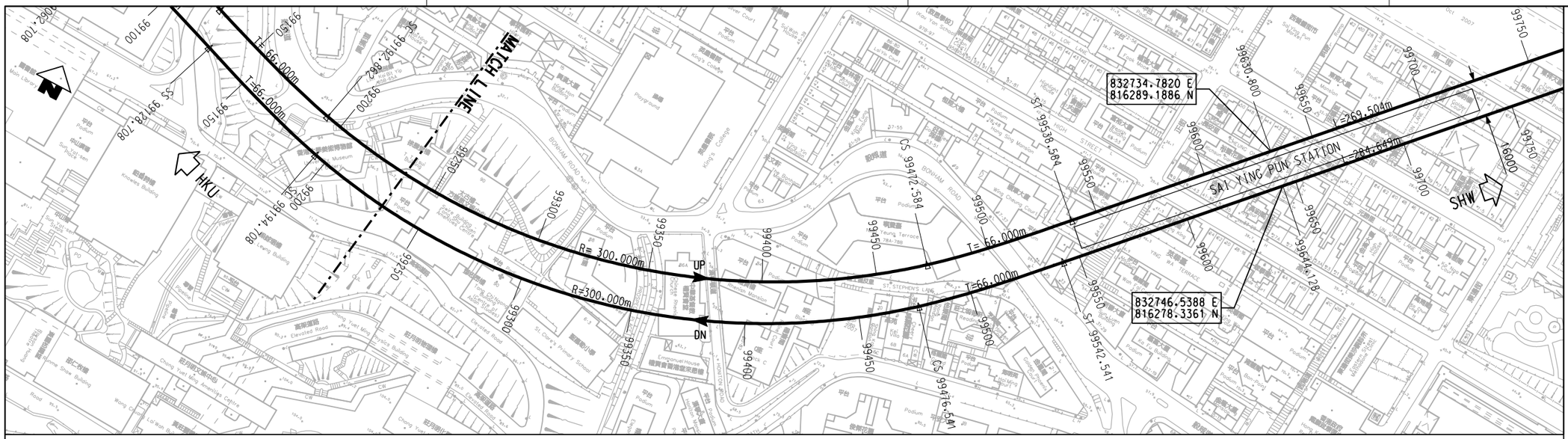

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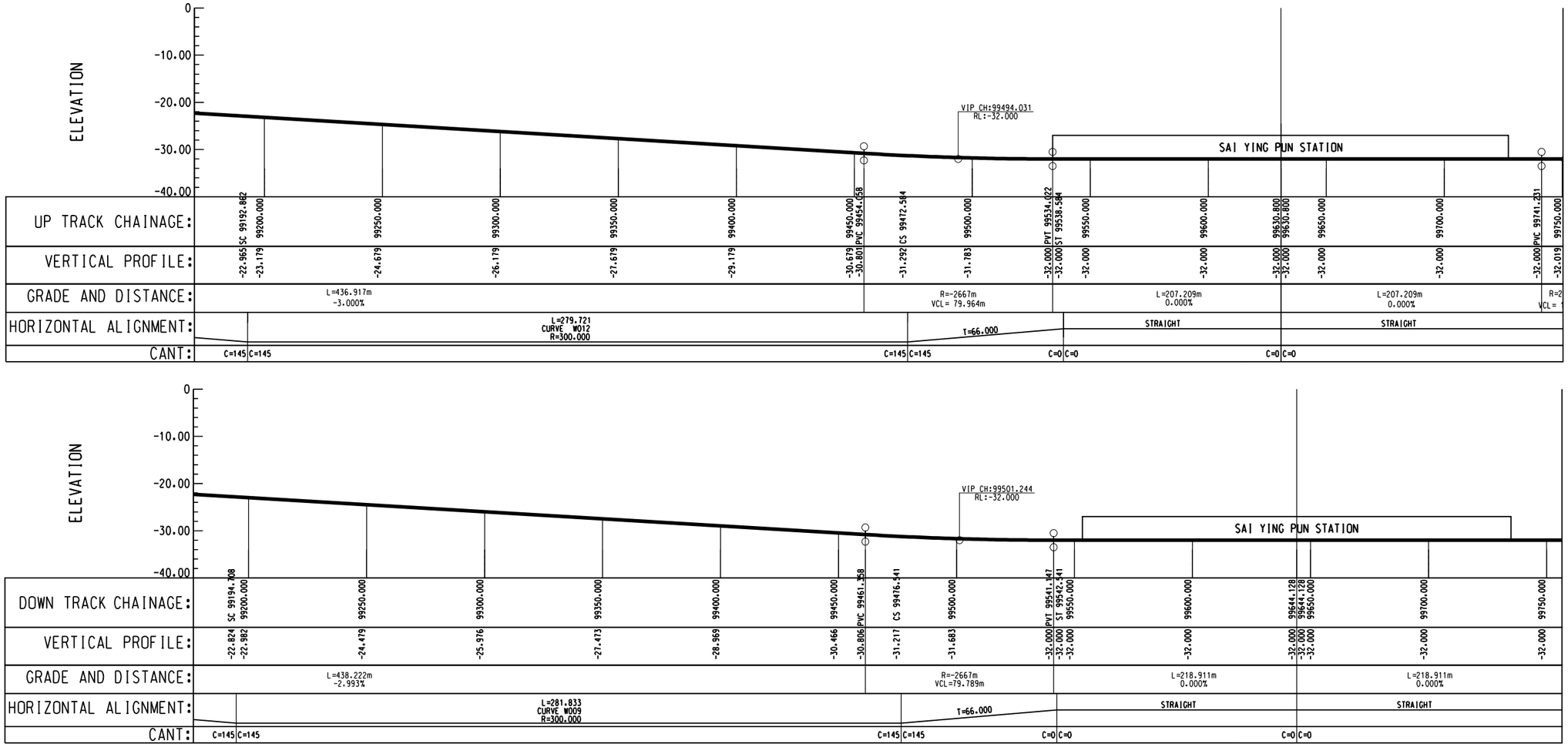
WIL ALIGNMENT

EXISTING ISL ALIGNMENT



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CADD REF. 715_W_WIL_MTR_C30_003A.DGN

TITLE

CONTRACT 715
ALIGNMENT

SAI YING PUN STATION TO HONG KONG UNIVERSITY STATION

SCALE HORT. 1:1000 VERT. 1:500

DRAWING NO. 715/W/WIL/MTR/C30/003

REV. A

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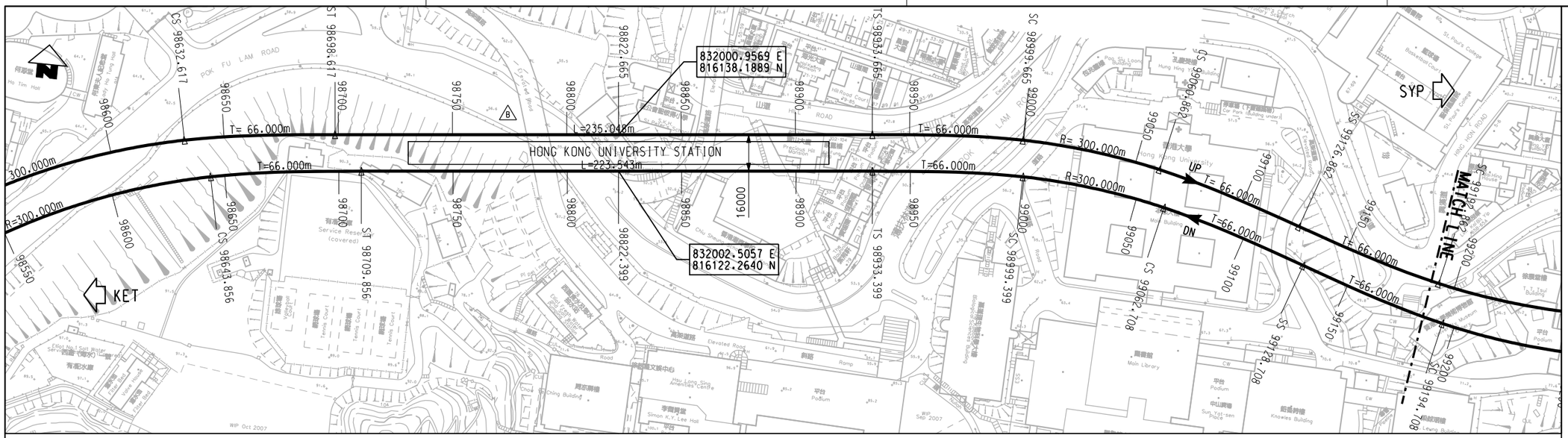

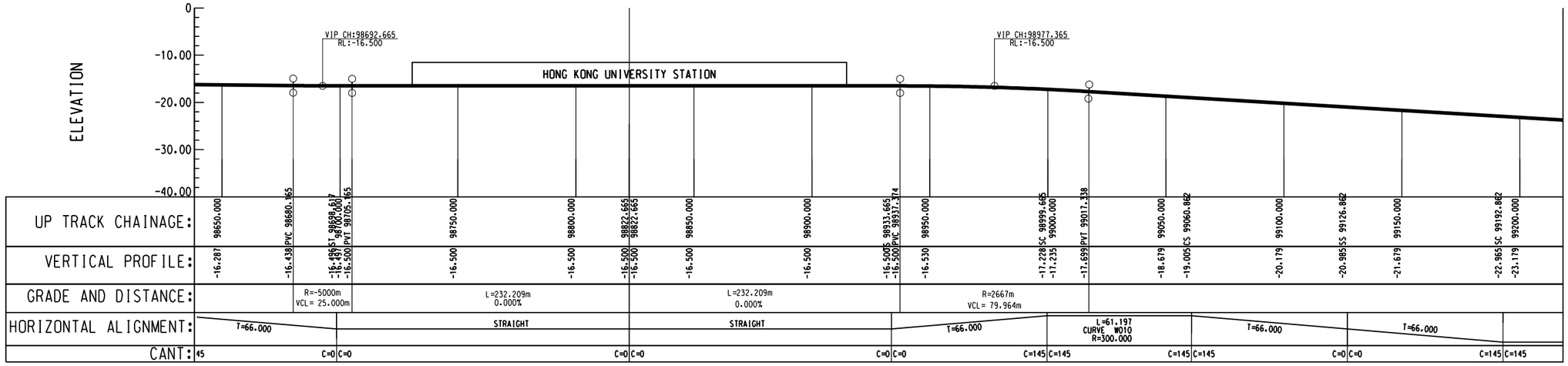

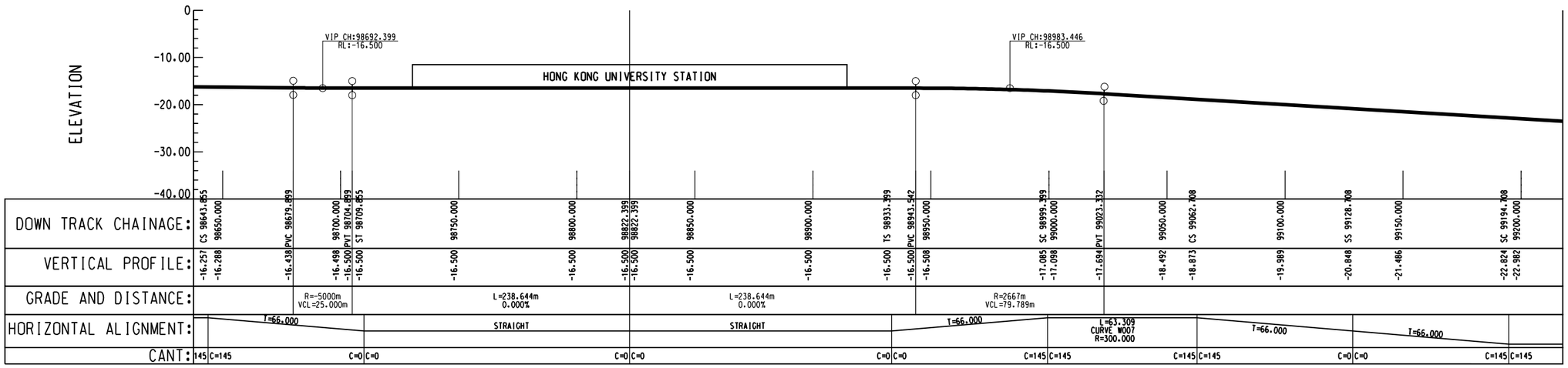

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WIL ALIGNMENT

EXISTING ISL ALIGNMENT

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CADD REF. 715_W_WIL_MTR_C30_004A.DGN

TITLE

CONTRACT 715
ALIGNMENT

HONG KONG UNIVERSITY STATION TO KENNEDY TOWN STATION
SHEET 1 OF 2

SCALE HORT. 1:1000 VERT. 1:500

DRAWING NO. 715/W/WIL/MTR/C30/004

REV. A

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NOTES

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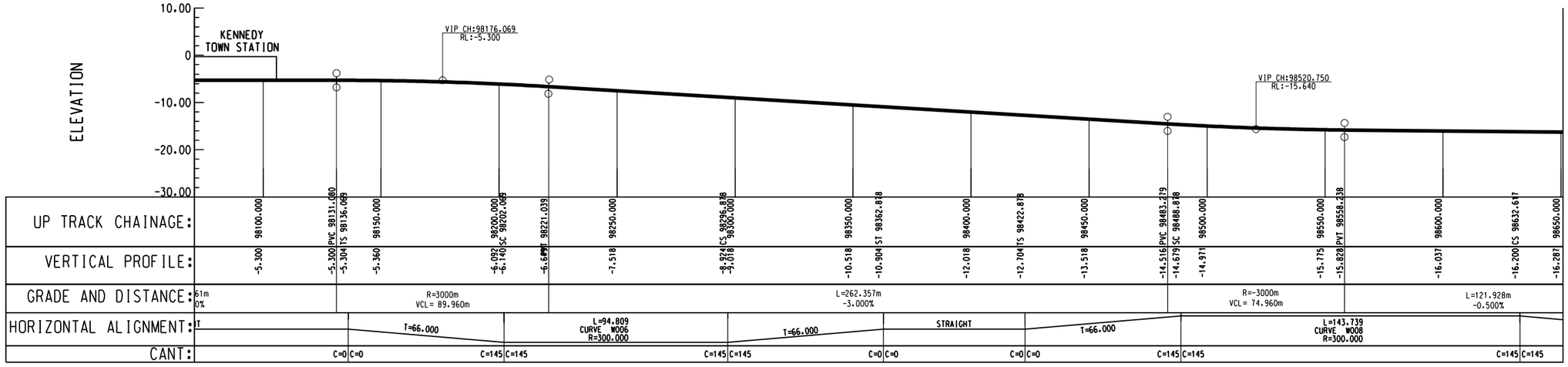

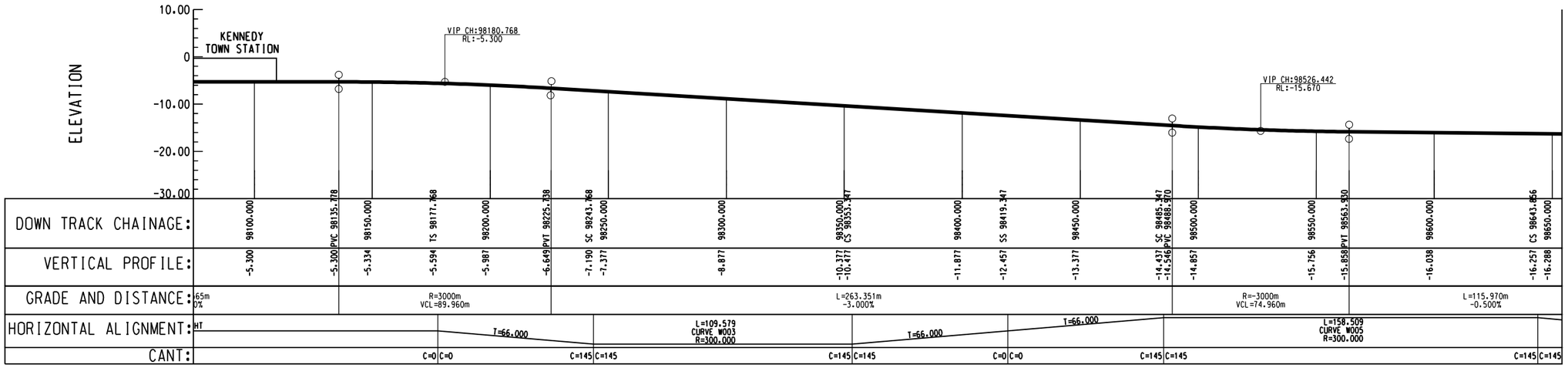

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APPROVED	DE
DATE	03.12.2010

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CADD REF. 715_W_WIL_MTR_C30_005A.DGN

TITLE

CONTRACT 715
ALIGNMENT

HONG KONG UNIVERSITY STATION TO KENNEDY TOWN STATION
SHEET 2 OF 2

SCALE HORT. 1:1000 VERT. 1:500

DRAWING NO. 715/W/WIL/MTR/C30/005

REV. A

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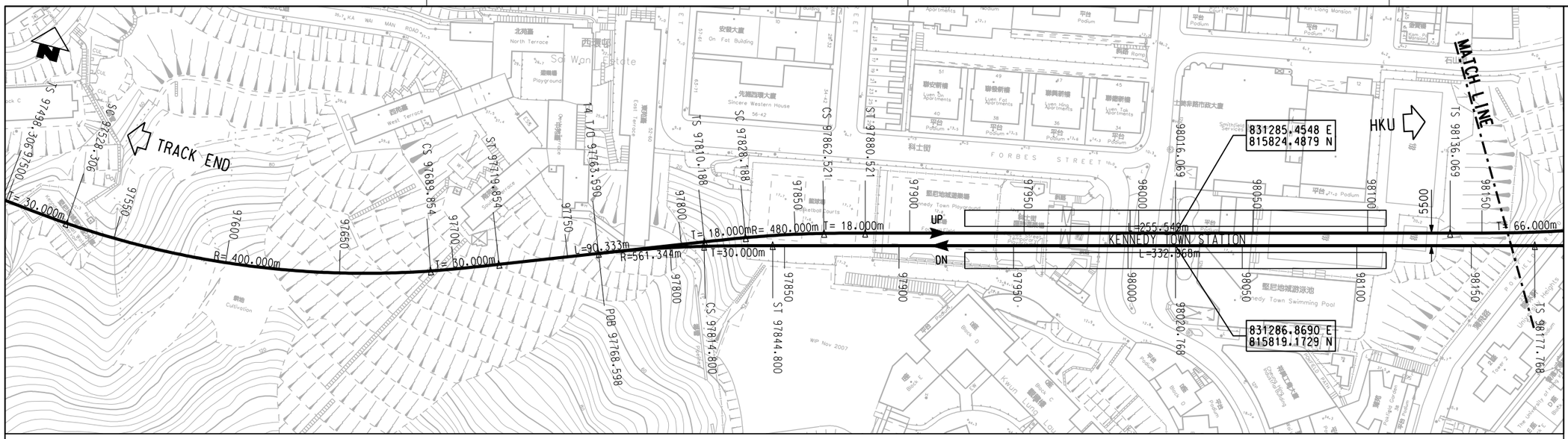

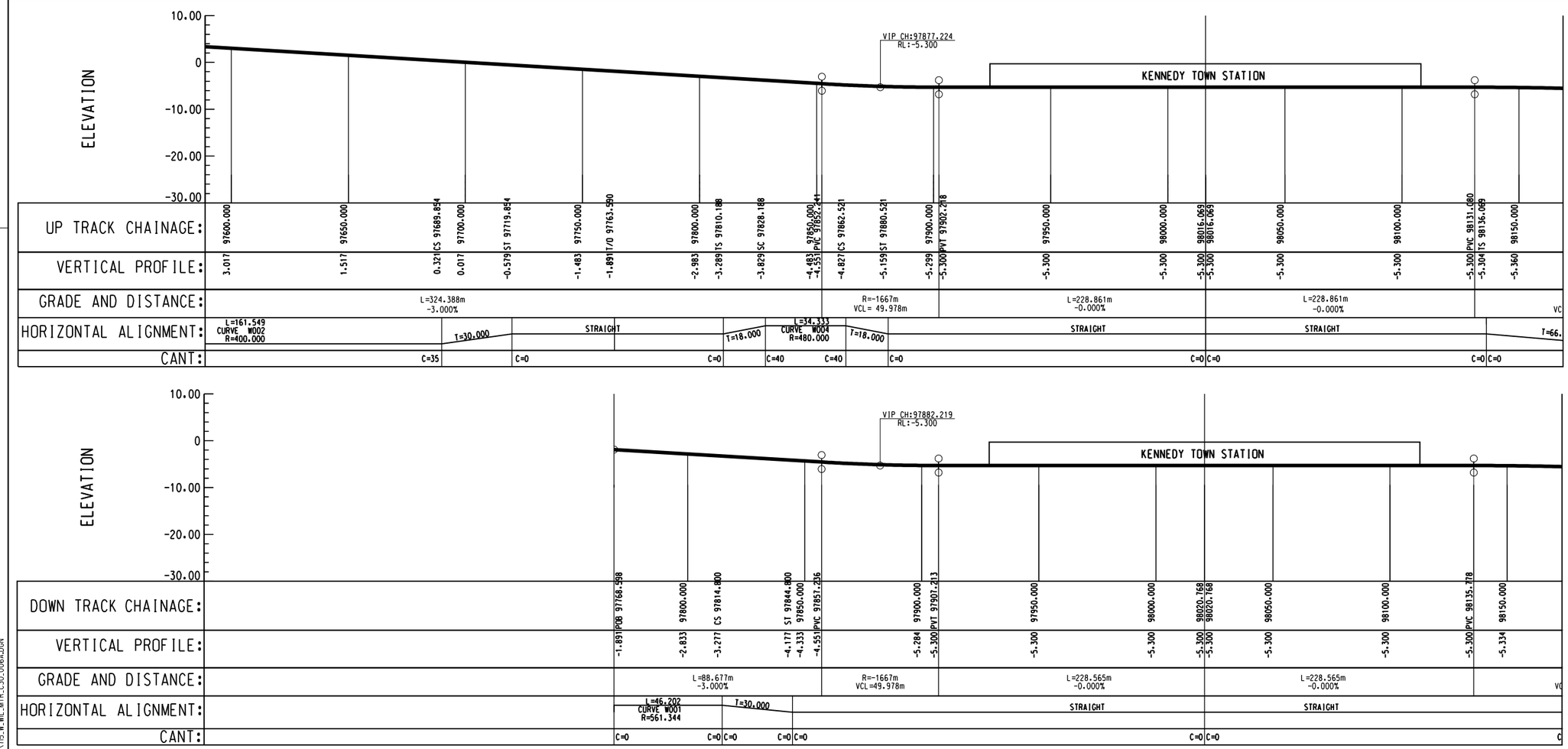

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2. ALL RADII REFER TO TRACK CENTRELINE RADII AND ARE GIVEN IN METRES.
3. VERTICAL ALIGNMENT SHOWN REFERS TO THE CROWN OF THE GRADE RAIL (INSIDE/LOW RAIL ON CURVES).
4. CANT IS APPLIED BY RAISING THE OUTER RAIL ABOVE THE INNER RAIL.
5. BREAK CHAINAGE REFERS TO A SINGLE POINT WITH TWO CHAINAGE VALUES.

LEGEND

L = LENGTH OF STRAIGHT TRACK

T = LENGTH OF TRANSITION CURVE

R = RADIUS OF CIRCULAR CURVE

C/F = CONTRAFLEXURE

S/F = SIMILAR FLEXURE

T/O = TURNOUT

WIL ALIGNMENT

EXISTING ISL ALIGNMENT

REV	DESCRIPTION	BY	DATE	APPROVED
A	ISSUE FOR WORKING	AME	DEC10	DE

DRAWN	AME
DESIGNED	JL
CHECKED	FTC
APPROVED	DE
DATE	03.12.2010

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MTR

WEST ISLAND LINE

ORIGINATOR
PROJECTS DIVISION | PROJECT ENGINEERING / CIVIL & PLANNING DEPARTMENT

CADD REF.
715_W_WIL_MTR_C30_006A.DGN

TITLE
CONTRACT 715
ALIGNMENT

KENNEDY TOWN STATION TO TRACK END
SHEET 1 OF 2

SCALE
HORT. 1:1000
VERT. 1:500

DRAWING NO.
715/W/WIL/MTR/C30/006

REV.
A

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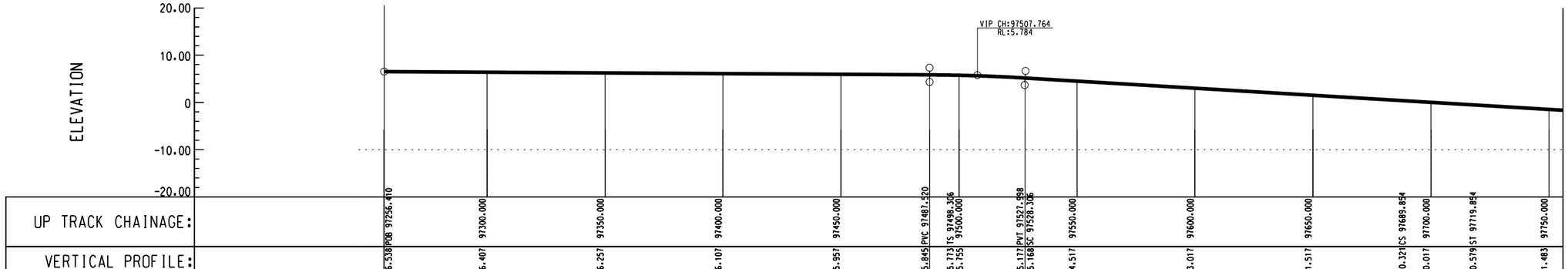
PRINTED BY: skip
DATE/TIME: 03/12/2010 16:60:38

830545.8658 E
815733.5018 N
POB 97256.410
L=241.896m
UP
TS 97498.306
SC 97528.306
T= 30.000m
R= 400.000m
MATCH LINE
CS 97689.854
ST 97719.854
T= 30.000m
R=361.690
L=90.333m
KET
TURNBACK + REFUGE SIDING
VICTORIA ROAD
Cultivation


ELEVATION
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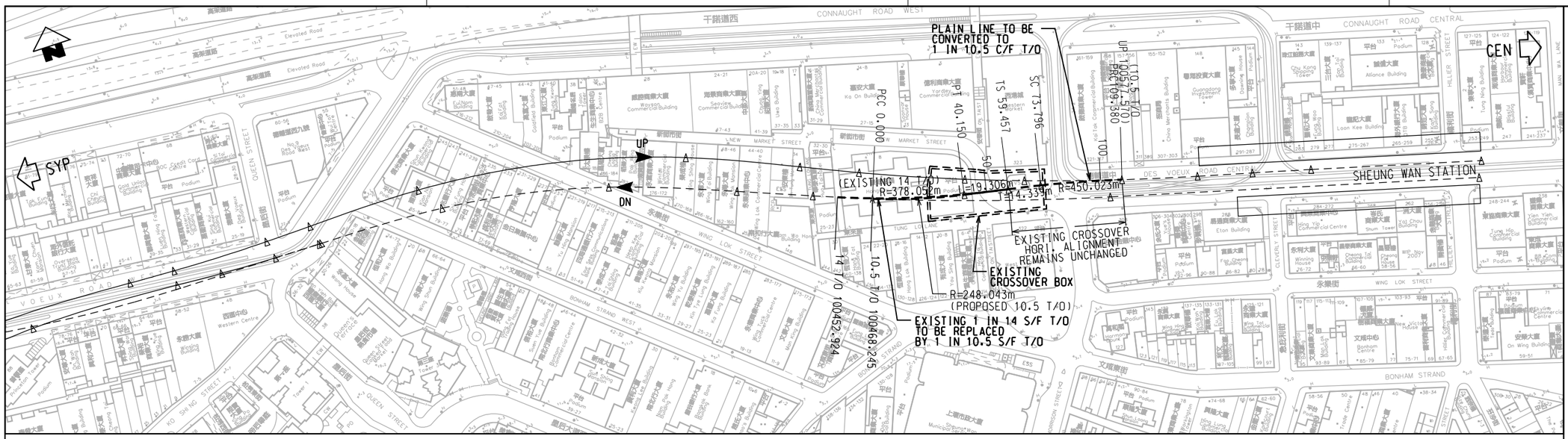
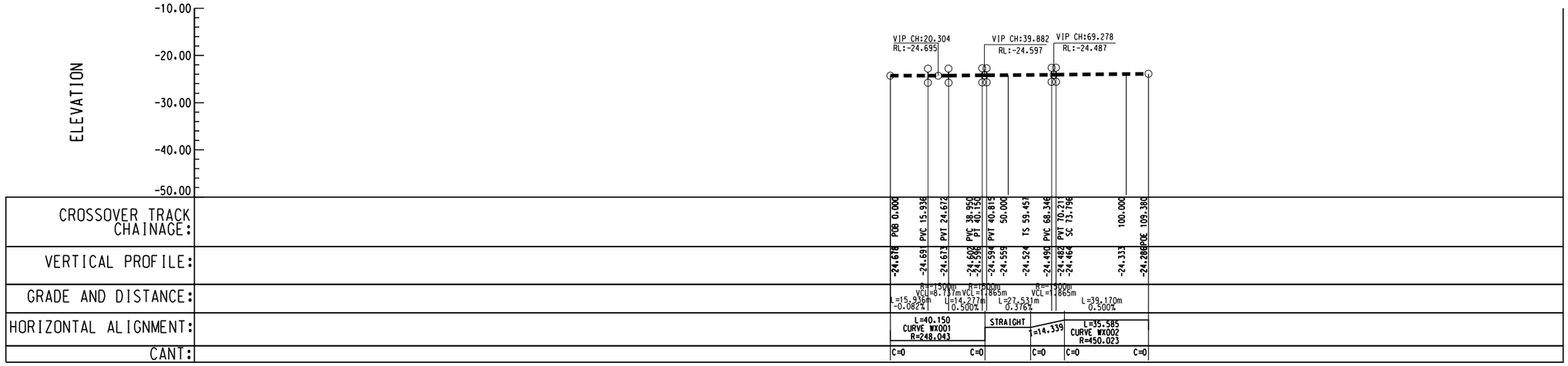
10.00
0
-10.00
-20.00
VIP CH:97507.764
RL:5.784

| | | |


PLAIN LINE TO BE CONVERTED TO 1 IN 10.5 C/F T/O
UP
DN
SYP
CEN
PCC 0.000
PT 40.150
TS 59.457
SC 73.796
(EXISTING 14 T/O) R=378.052m
L=19.306m
L=14.339m
R=450.023m
SHEUNG WAN STATION
EXISTING CROSSOVER HORIZ. ALIGNMENT REMAINS UNCHANGED
EXISTING CROSSOVER BOX
R=248.043m
(PROPOSED 10.5 T/O)
EXISTING 1 IN 14 S/F T/O TO BE REPLACED BY 1 IN 10.5 S/F T/O
14 T/O 10045452.924
10.5 T/O 10046845.245
CONNAUGHT ROAD WEST
CONNAUGHT ROAD CENTRAL
DES VOEUX ROAD CENTRAL
QUEEN'S ROAD CENTRAL
WING LOK STREET
BONHAM STRAND
HILLIER STREET
CLEVERLY STREET
QUEEN STREET
KO SHING STREET
NEW MARKET STREET
TUNG LOI
Elevated Road


ELEVATION
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-20.00
-30.00
-40.00
-50.00
VIP CH:20.304
RL:-24.695
VIP CH:39.882
RL:-24.597
VIP CH:69.278
RL:-24.487

| | | |

Report Results
March 3, 2009

HORIZONTAL ALIGNMENT LIST

Project: wil_05
Alignment: wil_up_02
Description: WIL UP HORIZONTAL ALIGNMENT

POINT TYPE	STATION	EAST(X)	NORTH(Y)	BEARING	RADIUS	ELE_LENGTH
POB	97256.410	830545.86576	815733.50177	96°17'25.6647		
TS	97498.306	830786.30544	815706.99750	96°17'25.6647		241.896
TS	97498.306	830786.30544	815706.99750	96°17'25.6647		
SC	97528.306	830816.16171	815704.08360	94°08'30.7345		30.000
SC	97528.306	830816.16171	815704.08360	94°08'30.7345		
CC		830845.05224	816103.03891		-400.000	
CS	97689.854	830975.26811	815724.82755	71°00'06.2152		161.549
CS	97689.854	830975.26811	815724.82755	71°00'06.2152		
ST	97719.854	831003.37921	815735.29911	68°51'11.2850		30.000
ST	97719.854	831003.37921	815735.29911	68°51'11.2850		
TS	97810.188	831087.62924	815767.88769	68°51'11.2850		90.333
TS	97810.188	831087.62924	815767.88769	68°51'11.2850		
SC	97828.188	831104.45710	815774.27622	69°55'38.7501		18.000
SC	97828.188	831104.45710	815774.27622	69°55'38.7501		
CC		831269.19792	815323.43206		480.000	
CS	97862.521	831137.09862	815784.89687	74°01'32.3618		34.333
CS	97862.521	831137.09862	815784.89687	74°01'32.3618		
ST	97880.521	831154.46384	815789.63383	75°05'59.8269		18.000
ST	97880.521	831154.46384	815789.63383	75°05'59.8269		
TS	98136.069	831401.41987	815855.34397	75°05'59.8269		255.549
TS	98136.069	831401.41987	815855.34397	75°05'59.8269		
SC	98202.069	831464.50182	815874.63086	68°47'50.6982		66.000
SC	98202.069	831464.50182	815874.63086	68°47'50.6982		
CC		831356.00184	816154.32311		-300.000	
CS	98296.878	831546.05575	815922.20351	50°41'24.7683		94.809
CS	98296.878	831546.05575	815922.20351	50°41'24.7682		
ST	98362.878	831593.89545	815967.62025	44°23'15.6395		66.000
ST	98362.878	831593.89545	815967.62025	44°23'15.6394		
TS	98422.878	831635.86581	816010.49741	44°23'15.6394		60.000
TS	98422.878	831635.86581	816010.49741	44°23'15.6395		
SC	98488.878	831683.70550	816055.91415	50°41'24.7682		66.000
SC	98488.878	831683.70550	816055.91415	50°41'24.7682		
CC		831873.75942	815823.79455		300.000	
CS	98632.617	831812.11525	816117.39291	78°08'32.5237		143.739
CS	98632.617	831812.11525	816117.39291	78°08'32.5237		
ST	98698.617	831877.49178	816126.18072	84°26'41.6524		66.000
ST	98698.617	831877.49178	816126.18072	84°26'41.6524		
TS	98933.665	832111.43560	816148.93402	84°26'41.6524		235.048
TS	98933.665	832111.43560	816148.93402	84°26'41.6524		
SC	98999.665	832177.28025	816152.90874	90°44'50.7811		66.000
SC	98999.665	832177.28025	816152.90874	90°44'50.7811		
CC		832173.36678	815852.93426		300.000	
CS	99060.862	832237.96770	816145.89624	102°26'06.9494		61.197
CS	99060.862	832237.96770	816145.89624	102°26'06.9494		
SS	99126.862	832301.17074	816127.00994	108°44'16.0781		66.000
SS	99126.862	832301.17074	816127.00994	108°44'16.0781		
SC	99192.862	832364.37378	816108.12363	102°26'06.9494		66.000
SC	99192.862	832364.37378	816108.12363	102°26'06.9494		
CC		832428.97470	816401.08561		-300.000	
CS	99472.584	832625.74341	816174.63015	49°00'44.6359		279.721
CS	99472.584	832625.74341	816174.63015	49°00'44.6359		
ST	99538.584	832672.23283	816221.42813	42°42'35.5072		66.000
ST	99538.584	832672.23283	816221.42813	42°42'35.5072		
TS	99808.088	832855.03361	816419.45902	42°42'35.5072		269.504
TS	99808.088	832855.03361	816419.45902	42°42'35.5072		
SC	99874.088	832901.52303	816466.25700	49°00'44.6359		66.000
SC	99874.088	832901.52303	816466.25700	49°00'44.6359		
CC		833098.29173	816239.80154		300.000	
CS	100069.842	833079.44833	816539.20917	86°23'55.6956		195.755
CS	100069.842	833079.44833	816539.20917	86°23'55.6957		
SS	100135.842	833145.40922	816538.51758	92°42'04.8244		66.000
SS	100135.842	833145.40922	816538.51758	92°42'04.8244		
SC	100155.842	833165.39061	816537.65824	91°59'06.5143		20.000
SC	100155.842	833165.39061	816537.65824	91°59'06.5143		
CC		833193.10289	817337.17811		-800.000	
CS	100198.253	833207.79445	816537.31302	88°56'51.8469		42.410
CS	100198.253	833207.79445	816537.31302	88°56'51.8469		
SS	100218.253	833227.78718	816537.84693	88°13'53.5369		20.000
SS	100218.253	833227.78718	816537.84693	88°13'53.5369		
SC	100268.253	833277.77546	816538.28200	92°02'27.9522		50.000
SC	100268.253	833277.77546	816538.28200	92°02'27.9522		
CC		833264.38372	816162.52056		376.000	
CS	100386.663	833393.50542	816515.65451	110°05'04.8915		118.410
CS	100386.663	833393.50542	816515.65451	110°05'04.8916		
SS	100436.663	833439.64866	816496.42383	113°53'39.3069		50.000
SS	100436.663	833439.64866	816496.42383	113°53'39.3069		
SC	100462.663	833463.47053	816486.00721	113°03'59.9263		26.000
SC	100462.663	833463.47053	816486.00721	113°03'59.9263		
CC		833816.09196	817314.05197		-900.000	
CS	100508.954	833506.50810	816468.97337	110°07'10.8114		46.291
CS	100508.954	833506.50810	816468.97337	110°07'10.8114		
SC	100534.954	833531.04114	816460.36582	108°35'21.7682		26.000
SC	100534.954	833531.04114	816460.36582	108°35'21.7682		
CC		833868.95179	817465.06298		-1060.000	
PT	100610.651	833603.58909	816438.81611	104°29'51.9395		75.697
PT	100610.651	833603.58909	816438.81611	104°29'51.9394		
PC	100634.642	833626.81638	816432.81010	104°29'51.9394		23.991

POINT TYPE	STATION	EAST(X)	NORTH(Y)	BEARING	RADIUS	ELE_LENGTH
PC	100634.642	833626.81638	816432.81010	104°29'51.9395		
CC		832875.78987	813528.33782		3000.000	25.637
PT	100660.279	833651.60949	816426.28605	104°59'14.6225		
PT	100660.279	833651.60949	816426.28605	104°59'14.6225		
POE	100734.821	833723.61575	816407.00901	104°59'14.6225		74.542

Report Results
March 3, 2009

VERTICAL ALIGNMENT LIST

Project: wil_05
Alignment: wil_up_v_02
Description: WIL UP VERTICAL ALIGNMENT

POINT TYPE	STATION	LEVEL	GRADE	RADIUS	ELE_LENGTH
POB	97256.410	6.538	-0.00300		
PVC	97487.520	5.845	-0.00300		231.110
PVI	97507.764	5.784		1500.000	
PVT	97527.998	5.177	-0.03000		
PVC	97852.241	-4.551	-0.03000		324.242
PVI	97877.224	-5.300		-1666.667	
PVT	97902.218	-5.300	0.00000		
PVC	98131.080	-5.300	0.00000		228.861
PVI	98176.069	-5.300		3000.000	
PVT	98221.039	-6.649	-0.03000		
PVC	98483.279	-14.516	-0.03000		262.239
PVI	98520.750	-15.640		-3000.000	
PVT	98558.238	-15.828	-0.00500		
PVC	98680.165	-16.438	-0.00500		121.927
PVI	98692.665	-16.500		-5000.000	
PVT	98705.165	-16.500	0.00000		
PVC	98937.374	-16.500	0.00000		232.209
PVI	98977.365	-16.500		2666.667	
PVT	99017.338	-17.699	-0.03000		
PVC	99454.058	-30.801	-0.03000		436.721
PVI	99494.031	-32.000		-2666.667	
PVT	99534.022	-32.000	0.00000		
PVC	99741.231	-32.000	0.00000		207.209
PVI	99751.231	-32.000		2000.000	
PVT	99761.230	-32.100	-0.01000		
PVC	99865.562	-33.143	-0.01000		104.332
PVI	99890.561	-33.393		-3333.333	
PVT	99915.560	-33.268	0.00500		
PVC	100139.227	-32.150	0.00500		223.666
PVI	100164.219	-32.025		-2000.000	
PVT	100189.200	-31.276	0.03000		
PVC	100366.121	-25.968	0.03000		176.921
PVI	100391.102	-25.219		2000.000	
PVT	100416.094	-25.094	0.00500		
PVC	100579.292	-24.278	0.00500		163.198
PVI	100580.000	-24.274		1500.000	
PVT	100580.708	-24.271	0.00406		
PVC	100599.291	-24.196	0.00406		18.583
PVI	100600.000	-24.193		-1500.000	
PVT	100600.709	-24.189	0.00500		
PVC	100634.820	-24.019	0.00500		34.112
PVI	100638.570	-24.000		1500.000	
PVT	100642.321	-24.000	0.00000		
POE	100734.821	-24.000	0.00000		92.500

Report Results
February 4, 2009

HORIZONTAL ALIGNMENT LIST

Project: wil_04
Alignment: wil_dn_01
Description: WIL DOWN HORIZONTAL ALIGNMENT

POINT TYPE	STATION	EAST(X)	NORTH(Y)	BEARING	RADIUS	ELE_LENGTH
POB	97768.598	831044.16978	815751.07723	68°51'11.2852		
CC		831246.68013	815227.53483		561.344	46.202
CS	97814.800	831087.89734	815765.95391	73°34'08.1048		
CS	97814.800	831087.89734	815765.95391	73°34'08.1048		
ST	97844.800	831116.81784	815773.92559	75°05'59.8269		30.000
ST	97844.800	831116.81784	815773.92559	75°05'59.8269		
TS	98177.768	831438.58990	815859.54280	75°05'59.8269		332.968
TS	98177.768	831438.58990	815859.54280	75°05'59.8269		
SC	98243.768	831501.67185	815878.82970	68°47'50.6982		66.000
SC	98243.768	831501.67185	815878.82970	68°47'50.6982		
CC		831393.17186	816158.52195		-300.000	
CS	98353.347	831594.41869	815936.03664	47°52'09.8497		109.579
CS	98353.347	831594.41869	815936.03664	47°52'09.8497		
SS	98419.347	831639.96535	815983.75266	41°34'00.7210		66.000
SS	98419.347	831639.96535	815983.75266	41°34'00.7210		
SC	98485.347	831685.51200	816031.46869	47°52'09.8497		66.000
SC	98485.347	831685.51200	816031.46869	47°52'09.8497		
CC		831886.75883	815808.98337		300.000	
CS	98643.856	831825.11466	816102.58173	78°08'32.5237		158.509
CS	98643.856	831825.11466	816102.58173	78°08'32.5237		
ST	98709.856	831890.49120	816111.36954	84°26'41.6524		66.000
ST	98709.856	831890.49120	816111.36954	84°26'41.6524		
TS	98933.399	832112.98444	816133.00916	84°26'41.6524		223.543
TS	98933.399	832112.98444	816133.00916	84°26'41.6524		
SC	98999.399	832178.82910	816136.98388	90°44'50.7811		66.000
SC	98999.399	832178.82910	816136.98388	90°44'50.7811		
CC		832174.91563	815837.00941		300.000	
CS	99062.708	832241.57720	816129.50938	102°50'18.9245		63.309
CS	99062.708	832241.57720	816129.50938	102°50'18.9245		
SS	99128.708	832304.64573	816110.17864	109°08'28.0532		66.000
SS	99128.708	832304.64573	816110.17864	109°08'28.0532		
SC	99194.708	832367.71426	816090.84790	102°50'18.9245		66.000
SC	99194.708	832367.71426	816090.84790	102°50'18.9245		
CC		832434.37583	816383.34787		-300.000	
CS	99476.541	832631.14453	816156.89241	49°00'44.6359		281.833
CS	99476.541	832631.14453	816156.89241	49°00'44.6359		
ST	99542.541	832677.63395	816203.69039	42°42'35.5072		66.000
ST	99542.541	832677.63395	816203.69039	42°42'35.5072		
TS	99827.190	832870.70746	816412.84989	42°42'35.5072		284.649
TS	99827.190	832870.70746	816412.84989	42°42'35.5072		
SC	99893.190	832917.19688	816459.64787	49°00'44.6359		66.000
SC	99893.190	832917.19688	816459.64787	49°00'44.6359		
CC		833113.96559	816233.19241		300.000	
CS	100092.800	833098.97130	816532.81746	87°08'06.3898		199.610
CS	100092.800	833098.97130	816532.81746	87°08'06.3898		
SS	100158.800	833164.91786	816531.27829	93°26'15.5185		66.000
SS	100158.800	833164.91786	816531.27829	93°26'15.5185		
SC	100178.800	833184.88655	816530.16225	92°43'17.2084		20.000
SC	100178.800	833184.88655	816530.16225	92°43'17.2084		
CC		833222.87083	817329.25999		-800.000	
CS	100203.202	833209.27497	816529.37553	90°58'25.6048		24.402
CS	100203.202	833209.27497	816529.37553	90°58'25.6048		
ST	100223.202	833229.27408	816529.20228	90°15'27.2947		20.000
ST	100223.202	833229.27408	816529.20228	90°15'27.2947		
TS	100224.218	833230.28939	816529.19772	90°15'27.2947		1.015
TS	100224.218	833230.28939	816529.19772	90°15'27.2948		
SC	100279.218	833285.24842	816527.51079	94°45'33.8153		55.000
SC	100279.218	833285.24842	816527.51079	94°45'33.8153		
CC		833256.20837	816178.71762		350.000	
CS	100352.897	833357.49159	816513.74255	106°49'15.1635		73.679
CS	100352.897	833357.49159	816513.74255	106°49'15.1635		
ST	100408.897	833410.14048	816494.70809	111°24'16.3475		56.000
ST	100408.897	833410.14048	816494.70809	111°24'16.3475		
PC	100442.175	833441.12311	816482.56330	111°24'16.3475		33.278
PC	100442.175	833441.12311	816482.56330	111°24'16.3480		
CC		833864.46578	817562.55450		-1160.000	
PT	100572.187	833564.57094	816441.99076	104°58'58.2868		130.012
PT	100572.187	833564.57094	816441.99076	104°58'58.2868		
POE	100733.575	833720.47214	816400.26715	104°58'58.2868		161.388

Report Results
February 4, 2009

HORIZONTAL ALIGNMENT LIST

Project: wil_04
Alignment: xushwh1_105_01
Description: SHW CROSS-OVER HORIZONTAL ALIGNMENT

POINT TYPE	STATION	EAST(X)	NORTH(Y)	BEARING	RADIUS	ELE_LENGTH
PCC	0.000	833465.49951	816473.32269	110°07'00.7873		
CC		833550.81054	816706.23332		-248.043	40.150
PT	40.150	833504.15131	816462.61836	100°50'32.9051		
PT	40.150	833504.15131	816462.61836	100°50'32.9051		
TS	59.457	833523.11277	816458.98670	100°50'32.9051		19.306
TS	59.457	833523.11277	816458.98670	100°50'32.9051		
SC	73.796	833537.18111	816456.21468	101°45'18.9939		14.339
SC	73.796	833537.18111	816456.21468	101°45'18.9939		
CC		833445.49706	816015.63014		450.023	
PRC	109.380	833571.69671	816447.59583	106°17'08.9865		35.585

Report Results
February 19, 2010

VERTICAL ALIGNMENT LIST

Project: wil_06
Alignment: wil_dn_v_02
Description: WIL DOWN VERTICAL ALIGNMENT

POINT TYPE	STATION	LEVEL	GRADE	RADIUS	ELE_LENGTH
POB	97768.598	-1.891	-0.03000		
PVC	97857.235	-4.551	-0.03000		88.637
PVI	97882.219	-5.300		-1666.667	
PVT	97907.213	-5.300	0.00000		
PVC	98135.778	-5.300	0.00000		228.565
PVI	98180.768	-5.300		3000.000	
PVT	98225.738	-6.649	-0.03000		
PVC	98488.970	-14.546	-0.03000		263.233
PVI	98526.442	-15.670		-3000.000	
PVT	98563.930	-15.858	-0.00500		
PVC	98679.899	-16.438	-0.00500		115.969
PVI	98692.399	-16.500		-5000.000	
PVT	98704.899	-16.500	0.00000		
PVC	98943.542	-16.500	0.00000		238.644
PVI	98983.446	-16.500		2666.667	
PVT	99023.332	-17.694	-0.02993		
PVC	99461.358	-30.806	-0.02993		438.026
PVI	99501.244	-32.000		-2666.667	
PVT	99541.147	-32.000	0.00000		
PVC	99760.058	-32.000	0.00000		218.911
PVI	99772.558	-32.000		3125.000	
PVT	99785.058	-32.100	-0.00800		
PVC	99841.335	-32.550	-0.00800		56.277
PVI	99881.330	-32.870		-2105.300	
PVT	99921.307	-31.671	0.03000		
PVC	100166.661	-24.310	0.03000		245.353
PVI	100185.502	-23.745		1500.000	
PVT	100204.351	-23.653	0.00486		
PVC	100220.456	-23.575	0.00486		16.105
PVI	100228.180	-23.538		1500.000	
PVT	100235.904	-23.580	-0.00544		
PVC	100285.279	-23.848	-0.00544		49.375
PVI	100285.650	-23.850		-1500.000	
PVT	100286.020	-23.852	-0.00495		
PVC	100353.326	-24.185	-0.00495		67.306
PVI	100353.901	-24.188		-1500.000	
PVT	100354.476	-24.190	-0.00418		
PVC	100426.001	-24.489	-0.00418		71.525
PVI	100426.574	-24.491		1500.000	
PVT	100427.148	-24.494	-0.00494		
PVC	100460.485	-24.659	-0.00494		33.337
PVI	100463.575	-24.674		-1500.000	
PVT	100466.665	-24.677	-0.00082		
PVC	100484.210	-24.691	-0.00082		17.545
PVI	100488.575	-24.695		-1500.000	
PVT	100492.940	-24.673	0.00500		
PVC	100516.895	-24.554	0.00500		23.955
PVI	100518.000	-24.548		1500.000	
PVT	100519.105	-24.544	0.00352		
PVC	100537.036	-24.481	0.00352		17.931
PVI	100538.000	-24.478		-1500.000	
PVT	100538.964	-24.473	0.00481		
PVC	100633.728	-24.017	0.00481		94.765
PVI	100637.334	-24.000		1500.000	
PVT	100640.940	-24.000	0.00000		
POE	100733.575	-24.000	0.00000		92.635

Report Results
February 4, 2009

VERTICAL ALIGNMENT LIST

Project: wil_04
Alignment: xushwv_01
Description: SHW CROSS-OVER VERTICAL ALIGNMENT

POINT TYPE	STATION	LEVEL	GRADE	RADIUS	ELE_LENGTH
POB	0.000	-24.678	-0.00082		
PVC	15.936	-24.691	-0.00082		15.936
PVI	20.304	-24.695		-1500.000	
PVT	24.672	-24.673	0.00500		
PVC	38.950	-24.602	0.00500		14.277
PVI	39.882	-24.597		1500.000	
PVT	40.815	-24.594	0.00376		
PVC	68.346	-24.490	0.00376		27.531
PVI	69.278	-24.487		-1500.000	
PVT	70.211	-24.482	0.00500		
POE	109.380	-24.286	0.00500		39.169

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DATE	03.12.2010

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PROJECTS DIVISION
PROJECT ENGINEERING / CIVIL & PLANNING DEPARTMENT

CADD REF. 715_W_WIL_MTR_C30_009A.DGN

TITLE
CONTRACT 715
ALIGNMENT

ALIGNMENT DATA SHEET

SCALE N.T.S.
DRAWING NO. 715/W/WIL/MTR/C30/009
REV. A

NOTES

1. FOR GENERAL NOTES SEE DRAWING NO. 715/W/WIL/MTR/C01/001.

DRAWING REFERENCE:

VOLUME 3 : ALIGNMENT

ALIGNMENT - C30/006, 009

VOLUME 5 : STANDARD DETAILS

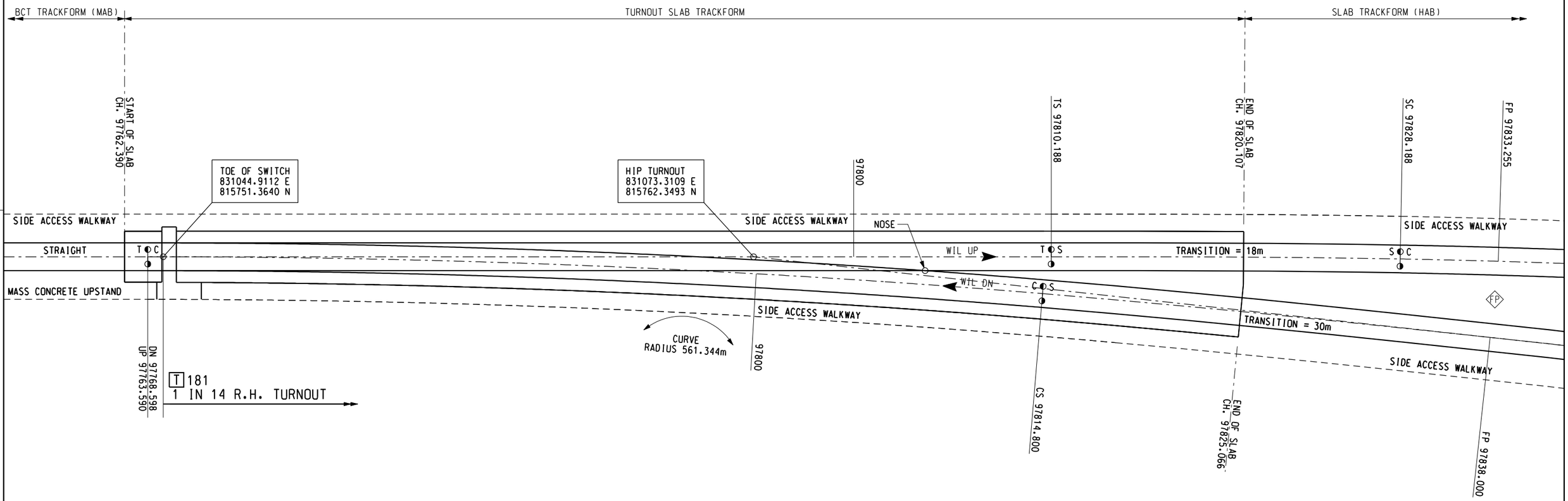
HORSESHOE TUNNEL SLAB TRACKFORM (HAB) - C32/003

HORSESHOE TUNNEL BCT TRACKFORM (MAB) - C32/004

HORSESHOE TUNNEL TURNOUT SLAB TRACKFORM - C32/008

TRACK END

KET



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CADD REF. 715_W_WIL_MTR_C33_001A.dgn

TITLE

CONTRACT 715
JUNCTION LAYOUTS

TRACK END TO KENNEDY TOWN STATION
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SCALE	DRAWING NO.	REV.
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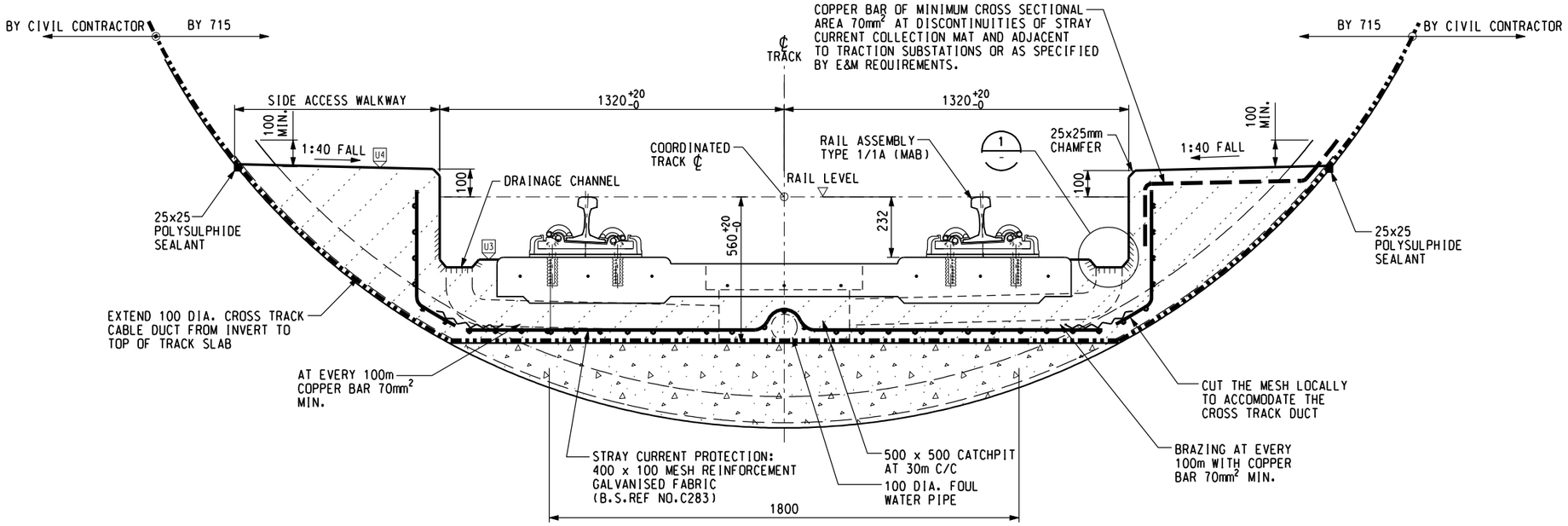
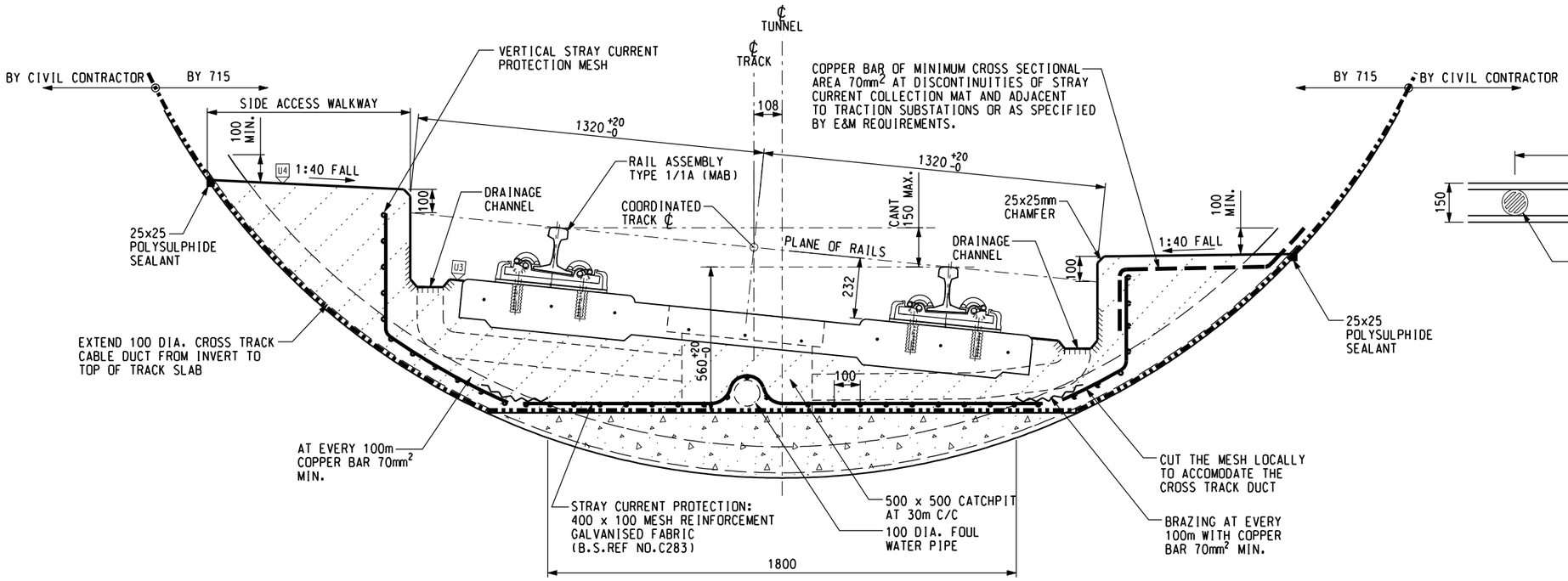


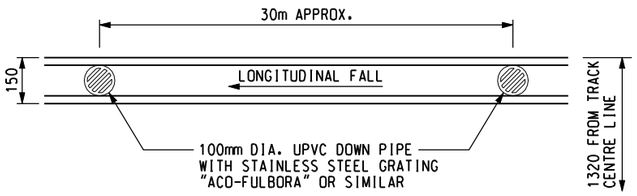
TYPICAL CROSS SECTION THROUGH CIRCULAR TUNNEL WITH STRAIGHT TRACK

SCALE 1:20



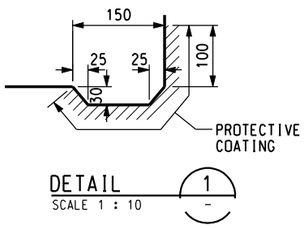
TYPICAL CROSS SECTION THROUGH CIRCULAR TUNNEL WITH CANTED TRACK

SCALE 1:20



DRAINAGE CHANNEL DETAILS

NTS



DETAIL 1

SCALE 1 : 10

NOTES:

1. FOR GENERAL NOTES AND LEGEND, REFER TO DRAWING NO. C01/001 & 002.
2. NOMINAL CONCRETE COVER TO STRAY CURRENT REINFORCEMENT SHALL BE 50mm.
3. TUNNEL SURFACE DRAINAGE TO FLOW BY GRAVITY TO LOW POINT / GULLIES AND TO BE CONNECTED INTO TRACK WASH DRAINAGE SYSTEM.
4. TRACKFORM CONCRETE TO BE GRADE 40/20 NON-METALLIC FIBRE REINFORCED CONCRETE.
5. THE LOCATION OF THE SIDE ACCESS WALKWAY IS INDICATIVE ONLY. EXACT LOCATION OF SIDE ACCESS WALKWAY SHALL BE DETERMINED BY THE DESIGNATED CONTRACTOR FOR TRACKSIDE AUXILIARIES.
6. REFER TO 715/W/WIL/MTR/C32/005 FOR DETAILS OF CONSTRUCTION AND MOVEMENT JOINT.
7. COPPER BAR TO BE BRAZED TO STRAY CURRENT COLLECTION MESH WITH A MINIMUM LAP LENGTH OF 150mm.
8. REFER TO 715/W/WIL/MTR/C32/022 FOR CATCHPIT COVER DETAILS.

LEGEND:

SUPPORT STRUCTURE CONCRETE BY OTHERS

TRACKFORM CONCRETE BY 715

DRAWING REFERENCE:

VOLUME 6 : TRACK COMPONENTS

RAIL ASSEMBLY TYPE 1 - C35/040
RAIL ASSEMBLY TYPE 1A - C35/041

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DESIGNED	JL
CHECKED	FTC
APPROVED	DE
DATE	03.12.2010

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CADD REF. 715_W_WIL_MTR_C32_001A.dgn

TITLE

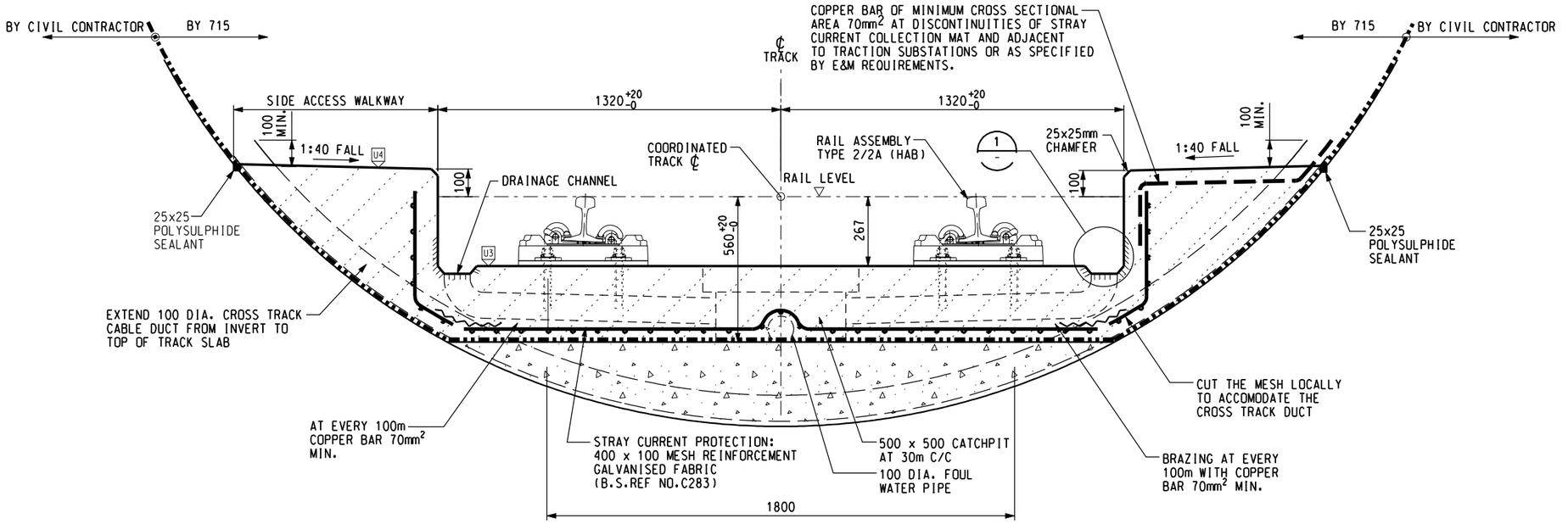
CONTRACT 715
STANDARD DETAILS

CIRCULAR TUNNEL NON-BALLASTED BCT TRACKFORM (MAB)

SCALE AS SHOWN

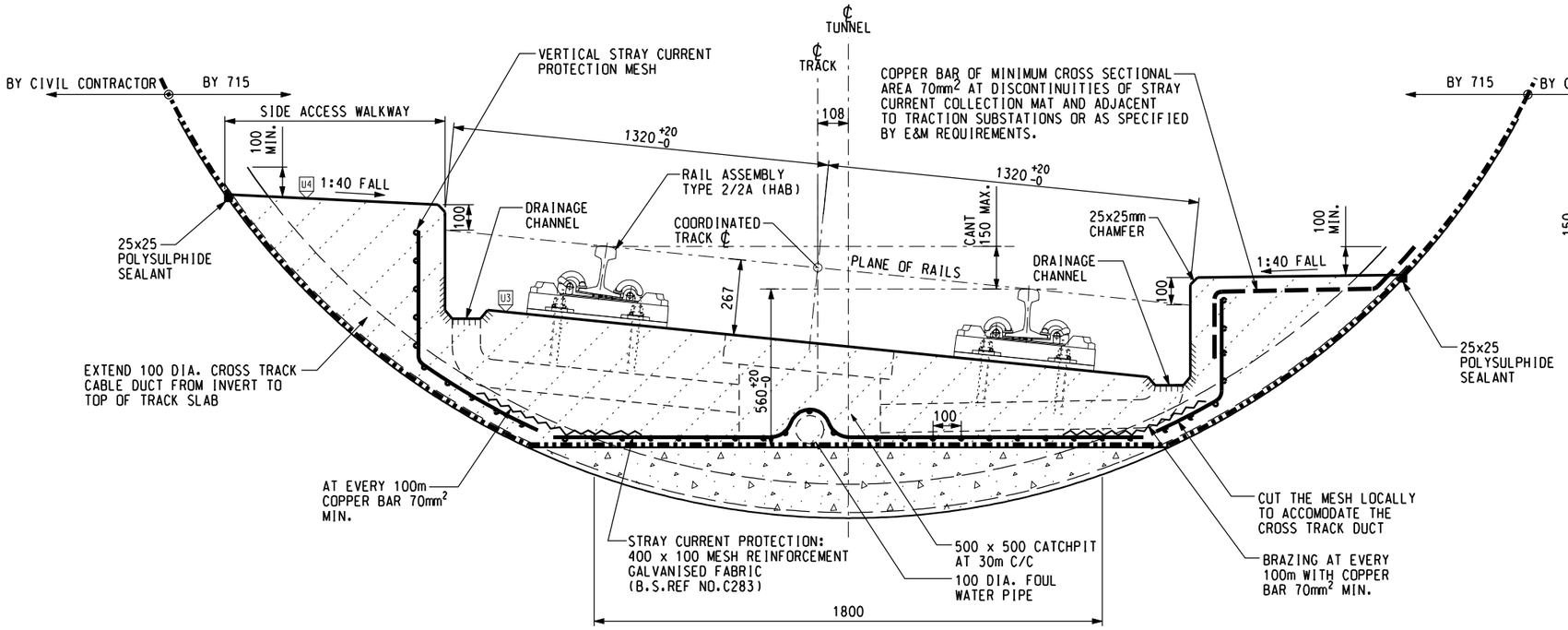
DRAWING NO. 715/W/WIL/MTR/C32/001

REV. A



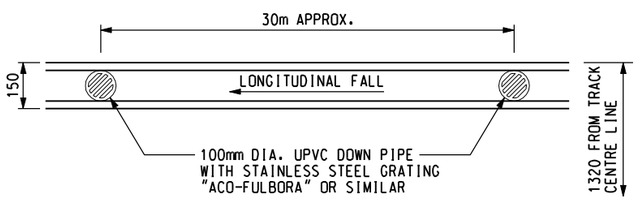
TYPICAL CROSS SECTION THROUGH CIRCULAR TUNNEL WITH STRAIGHT TRACK

SCALE 1:20



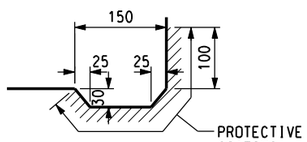
TYPICAL CROSS SECTION THROUGH CIRCULAR TUNNEL WITH CANTED TRACK

SCALE 1:20



DRAINAGE CHANNEL DETAILS

NTS



DETAIL 1 -

SCALE 1 : 10

NOTES:

1. FOR GENERAL NOTES AND LEGEND, REFER TO DRAWING NO. C01/001 & 002.
2. NOMINAL CONCRETE COVER TO STRAY CURRENT REINFORCEMENT SHALL BE 50mm.
3. TUNNEL SURFACE DRAINAGE TO FLOW BY GRAVITY TO LOW POINT / GULLIES AND TO BE CONNECTED INTO TRACK WASH DRAINAGE SYSTEM.
4. TRACKFORM CONCRETE TO BE GRADE 40/20 NON-METALLIC FIBRE REINFORCED CONCRETE.
5. THE LOCATION OF THE SIDE ACCESS WALKWAY IS INDICATIVE ONLY. EXACT LOCATION OF SIDE ACCESS WALKWAY SHALL BE DETERMINED BY THE DESIGNATED CONTRACTOR FOR TRACKSIDE AUXILIARIES.
6. REFER TO 715/W/WIL/MTR/C32/005 FOR DETAILS OF CONSTRUCTION AND MOVEMENT JOINT.
7. COPPER BAR TO BE BRAZED TO STRAY CURRENT COLLECTION MESH WITH A MINIMUM LAP LENGTH OF 150mm.
8. THE 100 DIA. FOUL WATER PIPE APPLY TO UP TRACK CH.99904 - CH.100180 ONLY.
9. REFER TO 715/W/WIL/MTR/C32/022 FOR CATCHPIT COVER DETAILS.

LEGEND:

SUPPORT STRUCTURE CONCRETE BY OTHERS

TRACKFORM CONCRETE BY 715

DRAWING REFERENCE:

VOLUME 6 : TRACK COMPONENTS

RAIL ASSEMBLY TYPE 2 - C35/042
RAIL ASSEMBLY TYPE 2A - C35/043

REV	DESCRIPTION	BY	DATE	APPROVED
A	ISSUE FOR WORKING	AME	DEC10	DE

DRAWN	AME
DESIGNED	JL
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DATE	03.12.2010

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CADD REF. 715_W_000_MTR_C32_002A.DGN

TITLE

CONTRACT 715
STANDARD DETAILS

CIRCULAR TUNNEL NON-BALLASTED SLAB TRACKFORM (HAB)

SCALE AS SHOWN

DRAWING NO. 715/W/WIL/MTR/C32/002

REV. A

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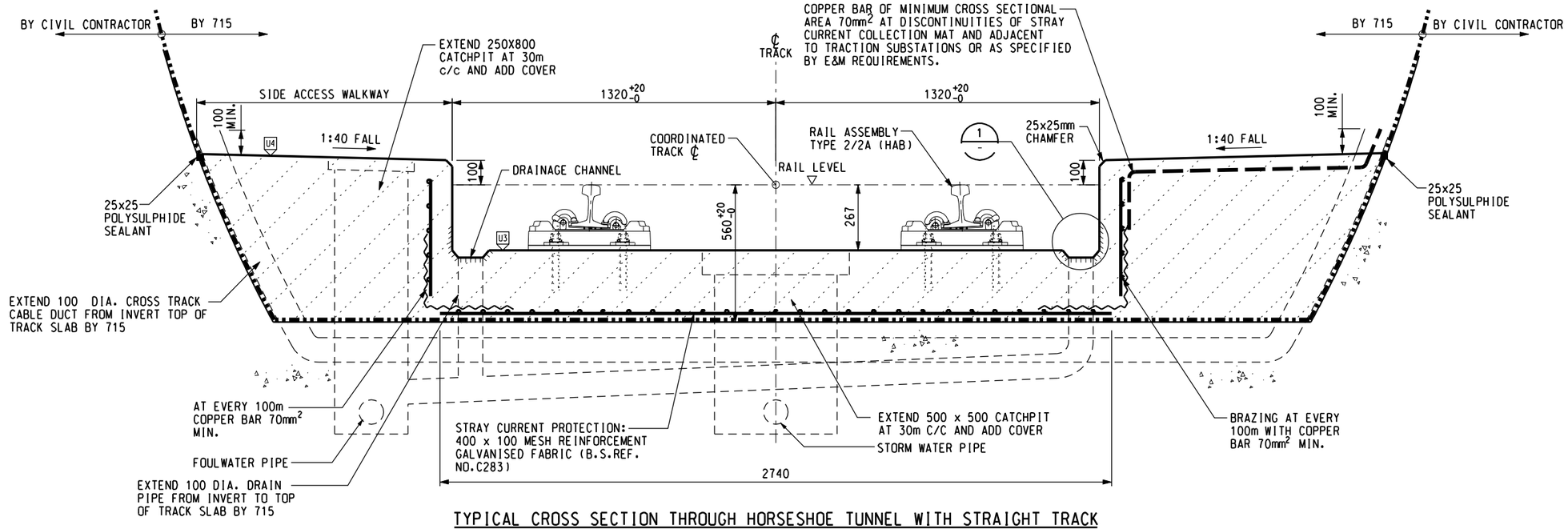
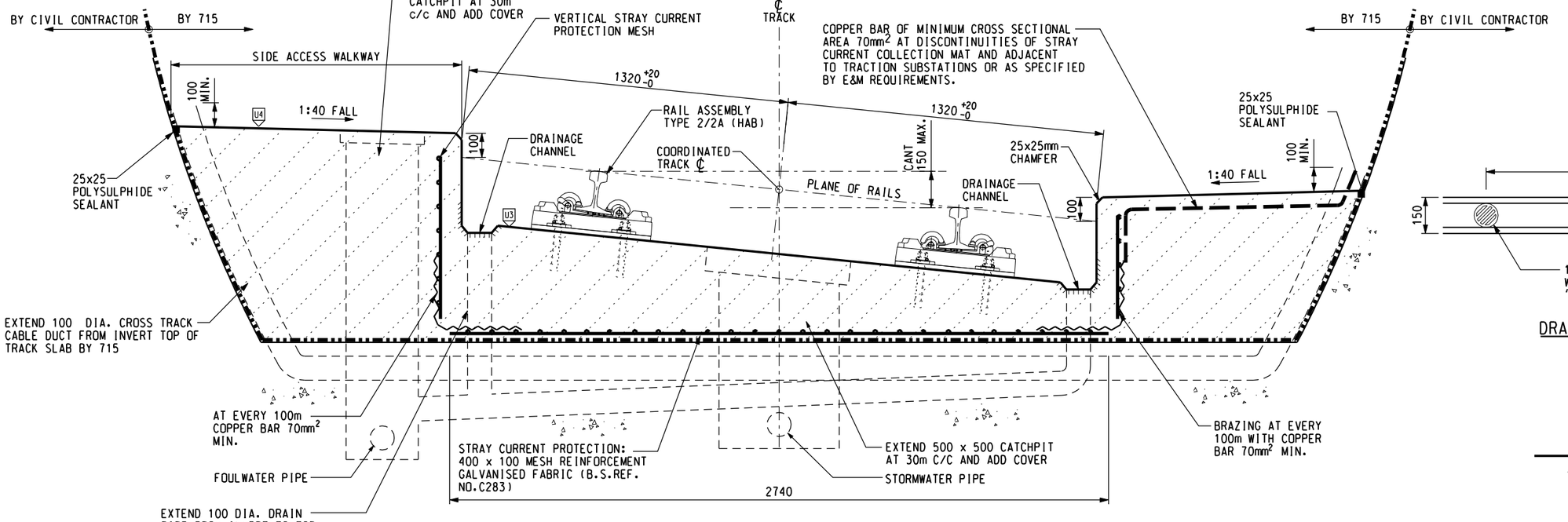


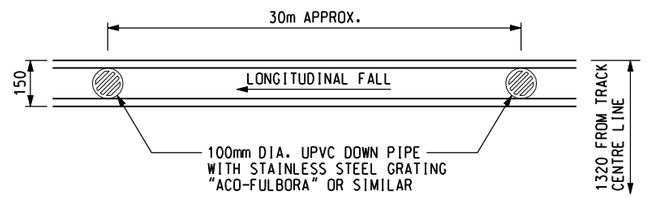
TYPICAL CROSS SECTION THROUGH HORSESHOE TUNNEL WITH STRAIGHT TRACK

SCALE 1:20



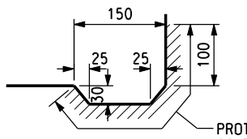
TYPICAL CROSS SECTION THROUGH HORSESHOE TUNNEL WITH CANTED TRACK

SCALE 1:20



DRAINAGE CHANNEL DETAILS

NTS



DETAIL 1 -

SCALE 1 : 10

NOTES:

1. FOR GENERAL NOTES AND LEGEND, REFER TO DRAWING NO. C01/001 & 002.
2. NOMINAL CONCRETE COVER TO STRAY CURRENT REINFORCEMENT SHALL BE 50mm.
3. TUNNEL SURFACE DRAINAGE TO FLOW BY GRAVITY TO LOW POINT / GULLIES AND TO BE CONNECTED INTO TRACK WASH DRAINAGE SYSTEM.
4. TRACKFORM CONCRETE TO BE GRADE 40/20 NON-METALLIC FIBRE REINFORCED CONCRETE.
5. THE LOCATION OF THE SIDE ACCESS WALKWAY IS INDICATIVE ONLY. EXACT LOCATION OF SIDE ACCESS WALKWAY SHALL BE DETERMINED BY THE DESIGNATED CONTRACTOR FOR TRACKSIDE AUXILIARIES.
6. REFER TO 715/W/WIL/MTR/C32/005 FOR DETAILS OF CONSTRUCTION AND MOVEMENT JOINT.
7. COPPER BAR TO BE BRAZED TO STRAY CURRENT COLLECTION MESH WITH A MINIMUM LAP LENGTH OF 150mm.
8. FOR UNDRAINED TUNNEL AT 703 AREA (SYP-SHW), THE FOUL WATER DRAIN PIPE AND CATCHPIT ARE LOCATED AT TRACK CENTRE INSTEAD OF AT THE TRACK SIDE. (SEE DRG.NO. C32/007 FOR REFERENCE)
9. REFER TO 715/W/WIL/MTR/C32/022 FOR CATCHPIT COVER DETAILS.

LEGEND:

SUPPORT STRUCTURE CONCRETE BY OTHERS

TRACKFORM CONCRETE BY 715

DRAWING REFERENCE:

VOLUME 6 : TRACK COMPONENTS

RAIL ASSEMBLY TYPE 2 - C35/042
RAIL ASSEMBLY TYPE 2A - C35/043

REV	DESCRIPTION	BY	DATE	APPROVED
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DRAWN	AME
DESIGNED	JL
CHECKED	FTC
APPROVED	DE
DATE	03.12.2010

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CADD REF. 715_W_WIL_MTR_C32_003A.dgn

TITLE: CONTRACT 715
STANDARD DETAILS

HORSESHOE TUNNEL NON-BALLASTED SLAB TRACKFORM (HAB)

SCALE: AS SHOWN | DRAWING NO. 715/W/WIL/MTR/C32/003 | REV. A

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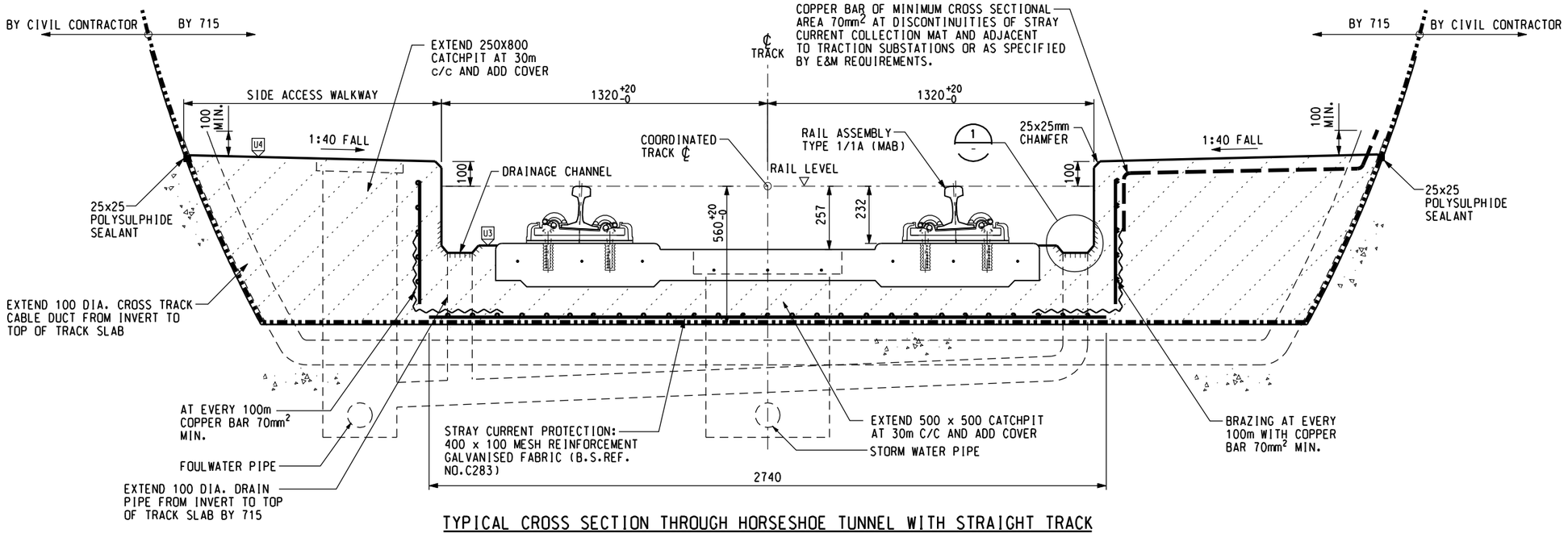
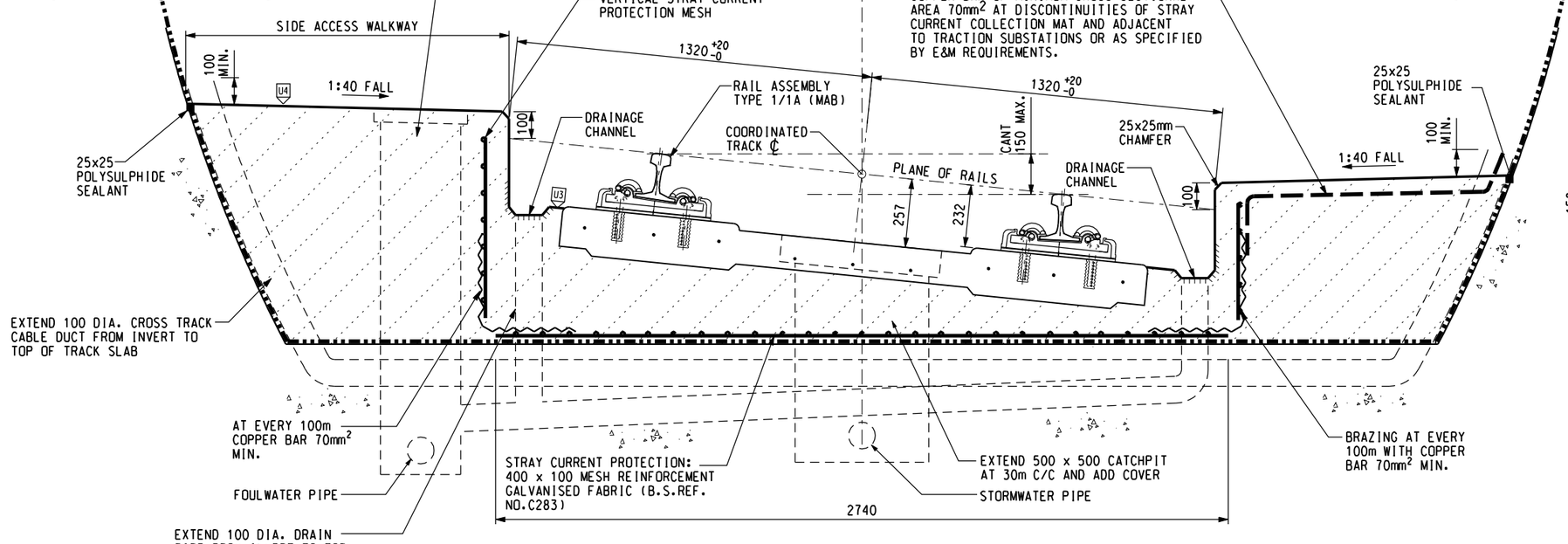


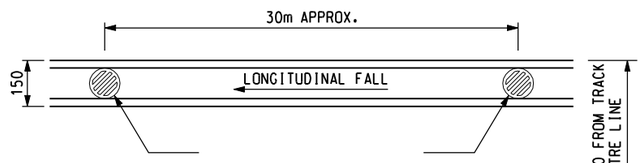
TYPICAL CROSS SECTION THROUGH HORSESHOE TUNNEL WITH STRAIGHT TRACK

SCALE 1:20



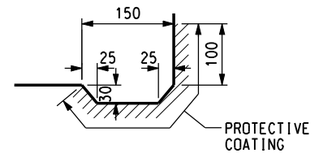
TYPICAL CROSS SECTION THROUGH HORSESHOE TUNNEL WITH CANTED TRACK

SCALE 1:20



DRAINAGE CHANNEL DETAILS

NTS



DETAIL 1

SCALE 1 : 10

NOTES:

1. FOR GENERAL NOTES AND LEGEND, REFER TO DRAWING No. C01/001 & 002.
2. NOMINAL CONCRETE COVER TO STRAY CURRENT REINFORCEMENT SHALL BE 50mm.
3. TUNNEL SURFACE DRAINAGE TO FLOW BY GRAVITY TO LOW POINT/GULLIES AND TO BE CONNECTED INTO TRACK WASH DRAINAGE SYSTEM.
4. TRACKFORM CONCRETE TO BE GRADE 40/20 NON-METALLIC FIBRE REINFORCEMENT CONCRETE.
5. THE LOCATION OF THE SIDE ACCESS WALKWAY IS INDICATIVE ONLY. EXACT LOCATION OF SIDE ACCESS WALKWAY SHALL BE DETERMINED BY THE DESIGNATED CONTRACTOR FOR TRACKSIDE AUXILIARIES.
6. REFER TO 715/W/WIL/MTR/C32/005 FOR DETAILS OF CONSTRUCTION AND MOVEMENT JOINT.
7. COPPER BAR TO BE BRAZED TO STRAY CURRENT COLLECTION MESH WITH A MINIMUM LAP LENGTH OF 150mm.
8. TWIN BLOCK SLEEPER IS PROVIDED AT DRAINAGE INSPECTION CHAMBERS LOCATIONS.
9. REFER TO 715/W/WIL/NTR/C32/022 FOR CATCHPIT COVER DETAILS.

LEGEND:

SUPPORT STRUCTURE CONCRETE BY OTHERS

TRACKFORM CONCRETE BY 715

DRAWING REFERENCE:

VOLUME 6 : TRACK COMPONENTS

RAIL ASSEMBLY TYPE 1 - C35/040
RAIL ASSEMBLY TYPE 1A - C35/041

REV	DESCRIPTION	BY	DATE	APPROVED
A	ISSUE FOR WORKING	AME	DEC10	DE

DRAWN	AME
DESIGNED	JL
CHECKED	FTC
APPROVED	DE
DATE	03.12.2010

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MTR

WEST ISLAND LINE

ORIGINATOR

PROJECTS DIVISION | PROJECT ENGINEERING / CIVIL & PLANNING DEPARTMENT

CADD REF. 715_W_WIL_MTR_C32_004A.DGN

TITLE

CONTRACT 715
STANDARD DETAILS

HORSESHOE TUNNEL NON-BALLASTED BCT TRACKFORM (MAB)

SCALE AS SHOWN

DRAWING NO. 715/W/WIL/MTR/C32/004

REV. A

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NOTES

1. FOR GENERAL NOTES SEE DRAWING NO. 715/W/WIL/MTR/C01/001.

DRAWING REFERENCE:

VOLUME 3 : ALIGNMENT

ALIGNMENT - C30/006, 009

VOLUME 5 : STANDARD DETAILS

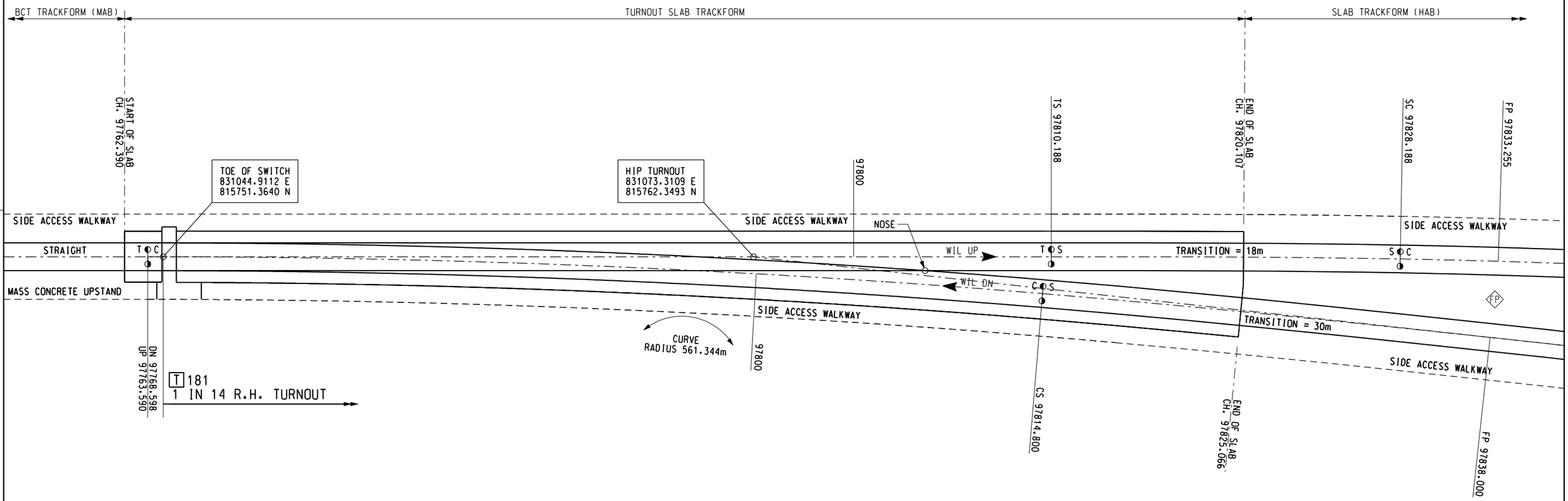
HORSESHOE TUNNEL SLAB TRACKFORM (HAB) - C32/003

HORSESHOE TUNNEL BCT TRACKFORM (MAB) - C32/004

HORSESHOE TUNNEL TURNOUT SLAB TRACKFORM - C32/008

TRACK END

KET



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DRAWN	AME
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APPROVED	DE
DATE	06.12.2010

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WEST ISLAND LINE

ORIGINATOR

PROJECTS DIVISION | PROJECT ENGINEERING / CIVIL & PLANNING DEPARTMENT

CADD REF. 715_W_WIL_MTR_C33_001A.dgn

TITLE

CONTRACT 715
JUNCTION LAYOUTS

TRACK END TO KENNEDY TOWN STATION
T 181

SCALE	DRAWING NO.	REV.
1 : 100 @ A1	715/W/WIL/MTR/C33/001	A

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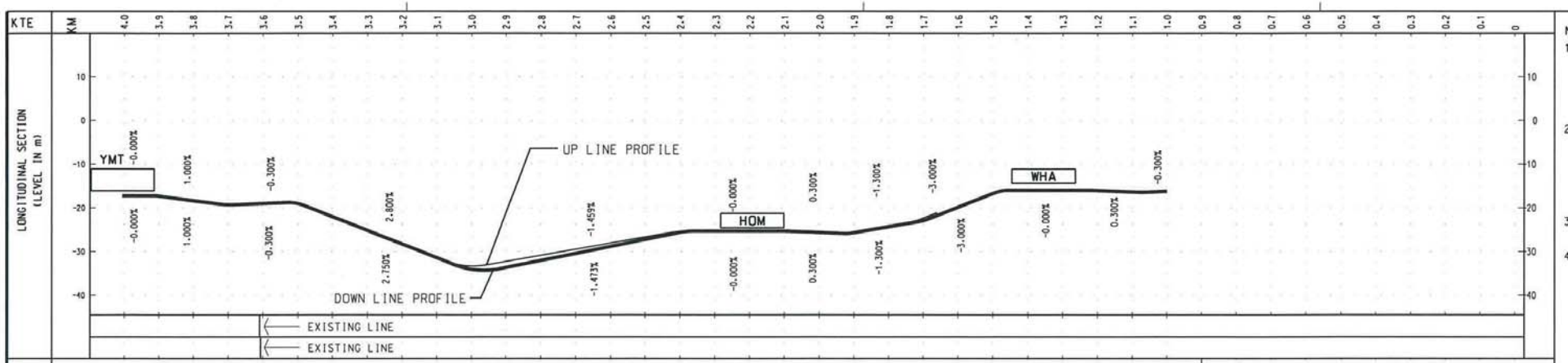

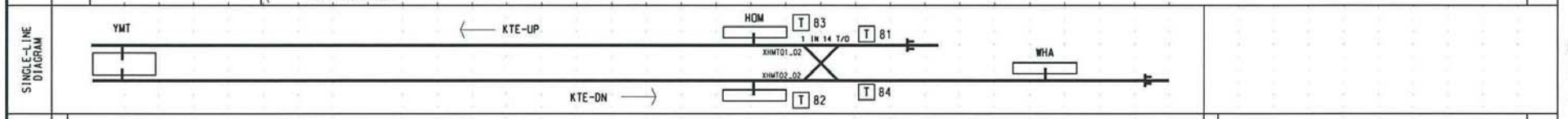

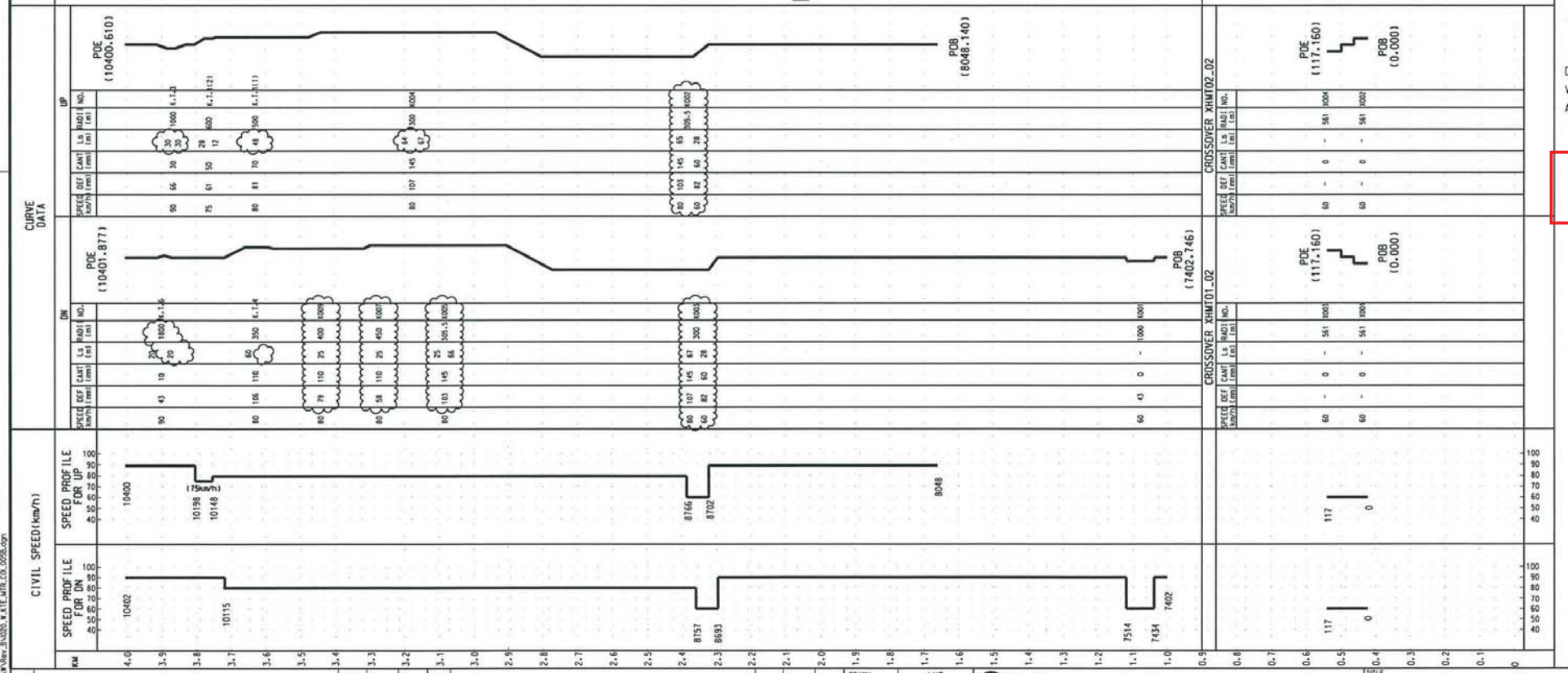

NOTES

1. THIS DIAGRAM GIVES AN OVERVIEW OF TRACK ALIGNMENT AND SPEED PROFILES FOR INFORMATION ONLY. REFER TO SPECIFIC DOCUMENTS FOR SOURCE DATA.
2. SPEED PROFILES ARE CONSTRAINED ONLY BY MAXIMUM CIVIL SPEED. LOCAL SPEED RESTRICTIONS, AERODYNAMIC EFFECTS, AND OPERATIONAL SMOOTHING (COASTING) ARE NOT INCLUDED.
3. CANT AND CANT DEFICIENCIES ARE INDICATIVE ONLY.
4. CHAINAGES SHOWN ARE CONSTRUCTION CHAINAGES. OPERATION CHAINAGES TO BE OBTAINED BY THE FOLLOWING FORMULA:
   UP & DN TRACK - OPERATION CHAINAGES = CONSTRUCTION CHAINAGE + 90000

LEGEND

- PLATFORM
- UP TRACK
- DN TRACK

DRAWING REFERENCE:
VOLUME 3 - ALIGNMENT
ALIGNMENT - C30/001-007

Printed from LAN on Dec 08, 2014

REV	DESCRIPTION	BY	DATE	APPROVED
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A	ISSUE FOR CONSTRUCTION	KLT	31JAN12	DE

DRAWN	LHT
DESIGNED	ML
CHECKED	BT
APPROVED	CK
DATE	31/JAN/2012

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KWUN TONG LINE EXTENSION

ORIGINATOR
PROJECTS DIVISION CIVIL & PLANNING DEPARTMENT

CADD REF. 1020_W_KTE_MTR_C01_0058.dgn

TITLE
CONTRACT 1020
ALIGNMENT
PERMANENT SPEED RESTRICTION DIAGRAM

SCALE	DRAWING NO.	REV.
NTS	1020/W/KTE/MTR/C01/005	B

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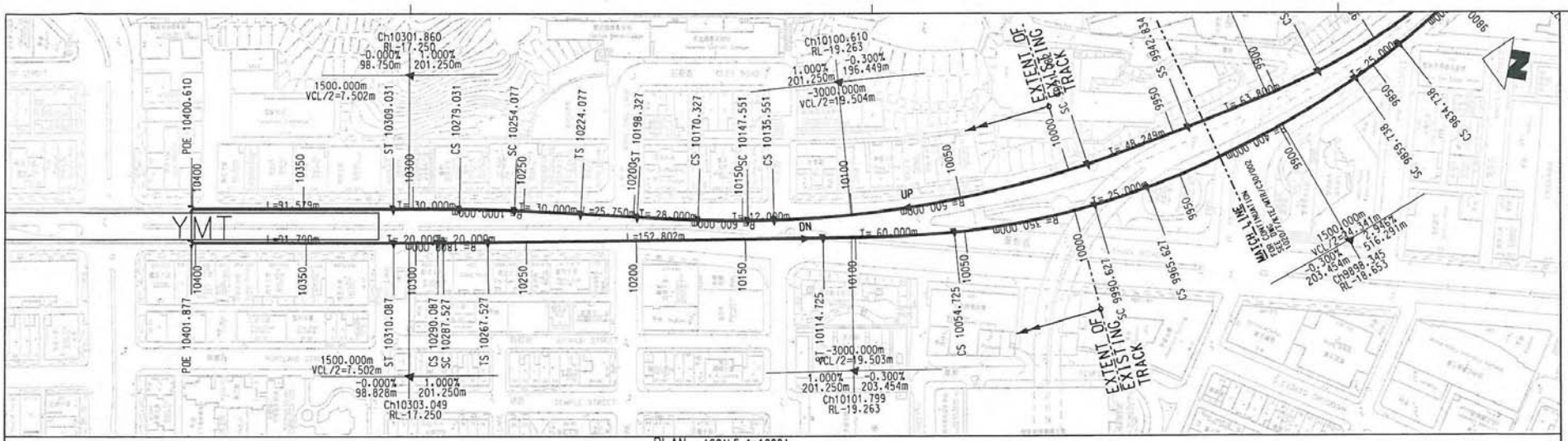

NOTES:

1. FOR GENERAL NOTES AND LEGEND, REFER TO DRAWING NO. 1020/W/KTE/MTR/C01/001 & 002.
2. CHAINAGE IS GIVEN IN METRES MEASURED ALONG THE HORIZONTAL TRACK CENTRELINE INCREASING IN THE DIRECTION FROM WHA TO YMT.
3. ALL RADII REFER TO TRACK CENTRELINE RADII AND ARE GIVEN IN METRES.
4. VERTICAL ALIGNMENT SHOWN REFERS TO THE CROWN OF THE GRADE RAIL (INSIDE/LOW RAIL ON CURVES).
5. CANT IS APPLIED BY RAISING THE OUTER RAIL ABOVE THE INNER RAIL.
6. BREAK CHAINAGE REFERS TO A SINGLE POINT WITH TWO CHAINAGE VALUES.
7. CHAINAGES SHOWN ARE CONSTRUCTION CHAINAGES. OPERATIONAL CHAINAGES TO BE OBTAINED BY THE FOLLOWING FORMULA FOR UP & DOWN TRACK -

   OPERATIONAL CHAINAGES = CONSTRUCTION CHAINAGES + 90000

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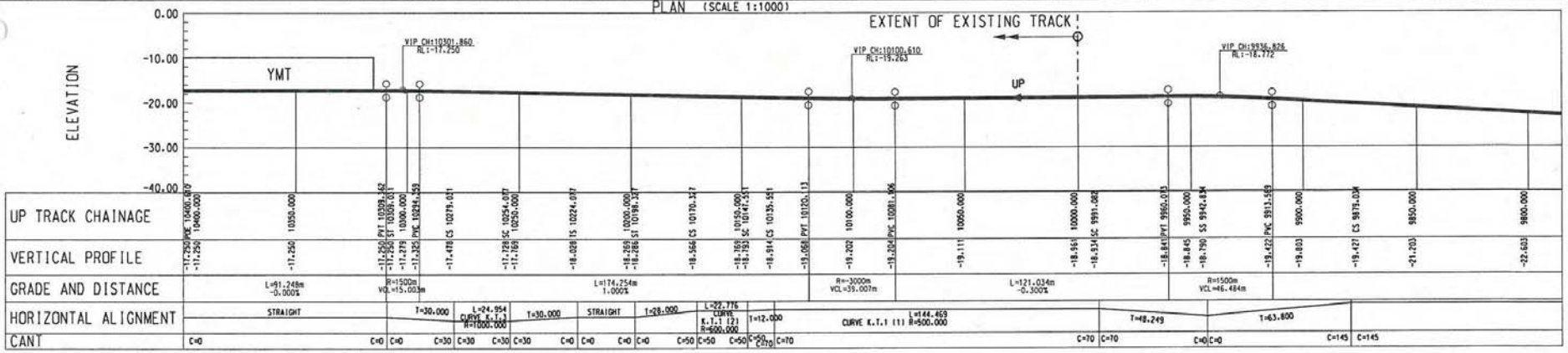

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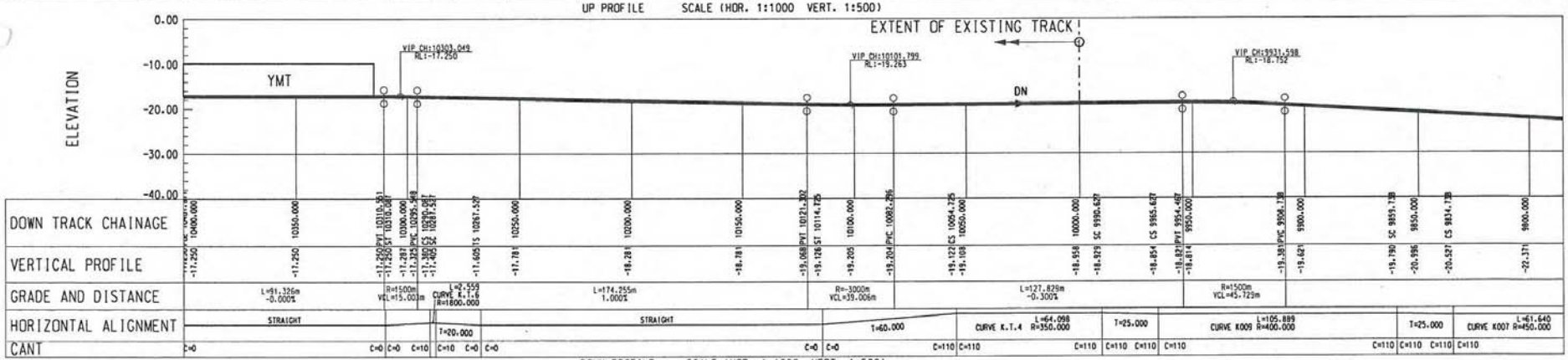

DOWN PROFILE SCALE (HOR. 1:1000 VERT. 1:500)

Printed from LAN on Dec 08, 2014

DRAWN	KLT
DESIGNED	JL
CHECKED	BT
APPROVED	DE
DATE	31/JAN/2012

MTR

KWUN TONG LINE EXTENSION

ORIGINATOR: PROJECTS DIVISION | CIVIL & PLANNING DEPARTMENT

CADD REF. 1020_W_KTE_MTR_C30_001A.DGN

TITLE: CONTRACT 1020
ALIGNMENT
YAU MA TEI STATION
TO HO MAN TIN STATION
SHEET 1 OF 4

SCALE: AS SHOWN @ A1

DRAWING NO. 1020/W/KTE/MTR/C30/001

REV. A

REV	DESCRIPTION	BY	DATE	APPROVED
A	ISSUE FOR CONSTRUCTION	KLT	31JAN12	DE

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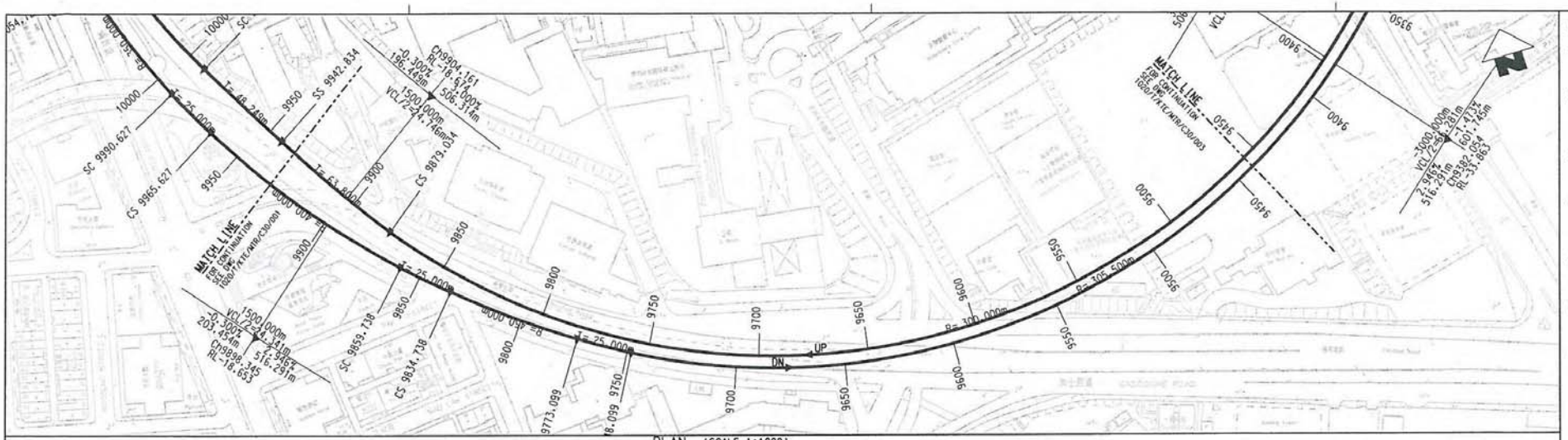

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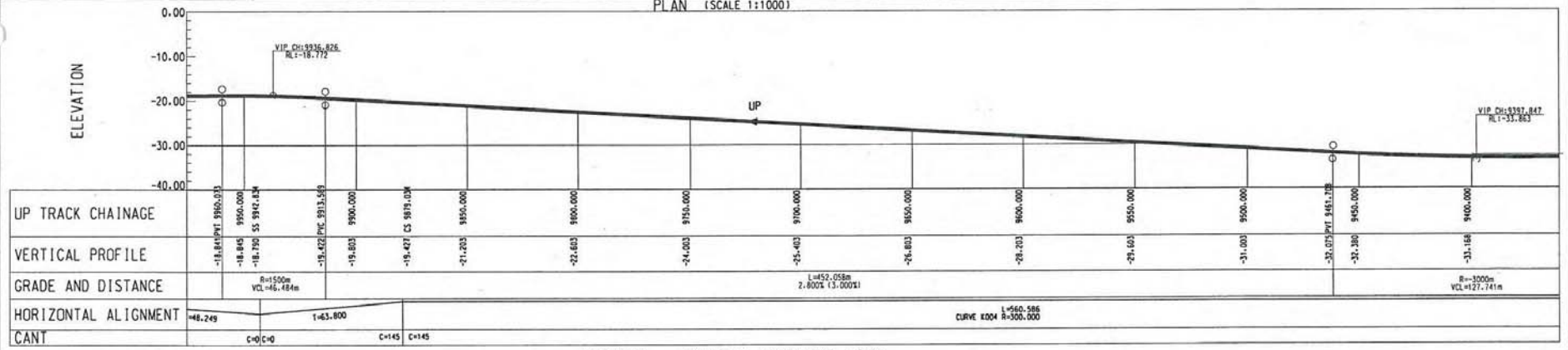

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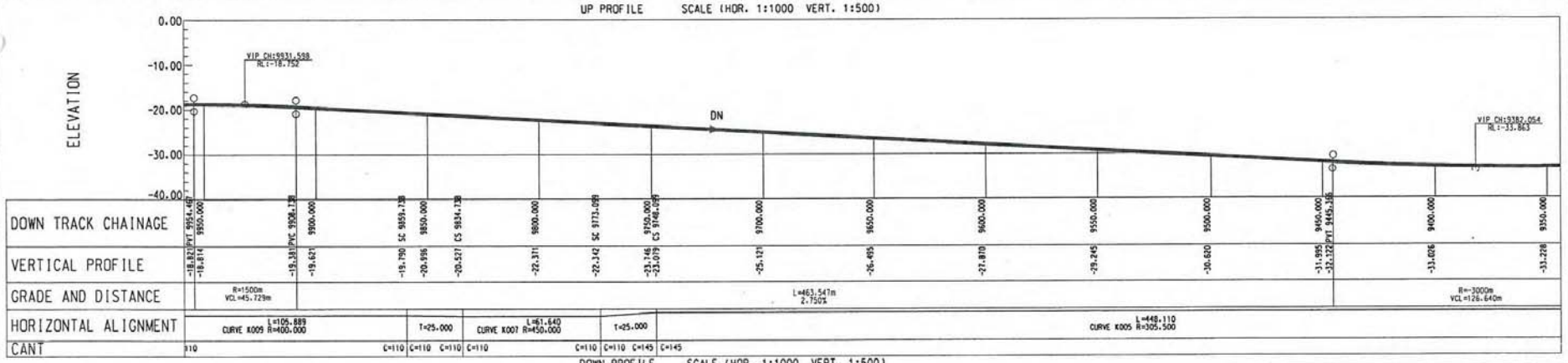

DOWN PROFILE SCALE (HOR. 1:1000 VERT. 1:500)

NOTES:

1. FOR GENERAL NOTES AND LEGEND. REFER TO DRAWING NO. 1020/W/KTE/MTR/C01/001 & 002.
2. CHAINAGE IS GIVEN IN METRES MEASURED ALONG THE HORIZONTAL TRACK CENTRELINE INCREASING IN THE DIRECTION FROM WHA TO YMT.
3. ALL RADII REFER TO TRACK CENTRELINE RADII AND ARE GIVEN IN METRES.
4. VERTICAL ALIGNMENT SHOWN REFERS TO THE CROWN OF THE GRADE RAIL (INSIDE/LOW RAIL ON CURVES).
5. CANT IS APPLIED BY RAISING THE OUTER RAIL ABOVE THE INNER RAIL.
6. BREAK CHAINAGE REFERS TO A SINGLE POINT WITH TWO CHAINAGE VALUES.
7. CHAINAGES SHOWN ARE CONSTRUCTION CHAINAGES. OPERATIONAL CHAINAGES TO BE OBTAINED BY THE FOLLOWING FORMULA FOR UP & DOWN TRACK -

   OPERATIONAL CHAINAGES = CONSTRUCTION CHAINAGES + 90000
8. VERTICAL GRADIENT SHOWN IN BRACKET IS THE COMPENSATED GRADIENT.

Printed from LAN on

Dec 08, 2014

REV	DESCRIPTION	BY	DATE	APPROVED
A	ISSUE FOR CONSTRUCTION	KLT	31JAN12	DE

DRAWN	KLT
DESIGNED	JL
CHECKED	BT
APPROVED	DE
DATE	31/JAN/2012

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KWUN TONG LINE EXTENSION

ORIGINATOR

PROJECTS DIVISION | CIVIL & PLANNING DEPARTMENT

CADD REF. 1020_W_KTE_MTR_C30_002A.DGN

TITLE

CONTRACT 1020
ALIGNMENT
YAU MA TEI STATION
TO HO MAN TIN STATION
SHEET 2 OF 4

SCALE AS SHOWN @ A1

DRAWING NO. 1020/W/KTE/MTR/C30/002

REV. A

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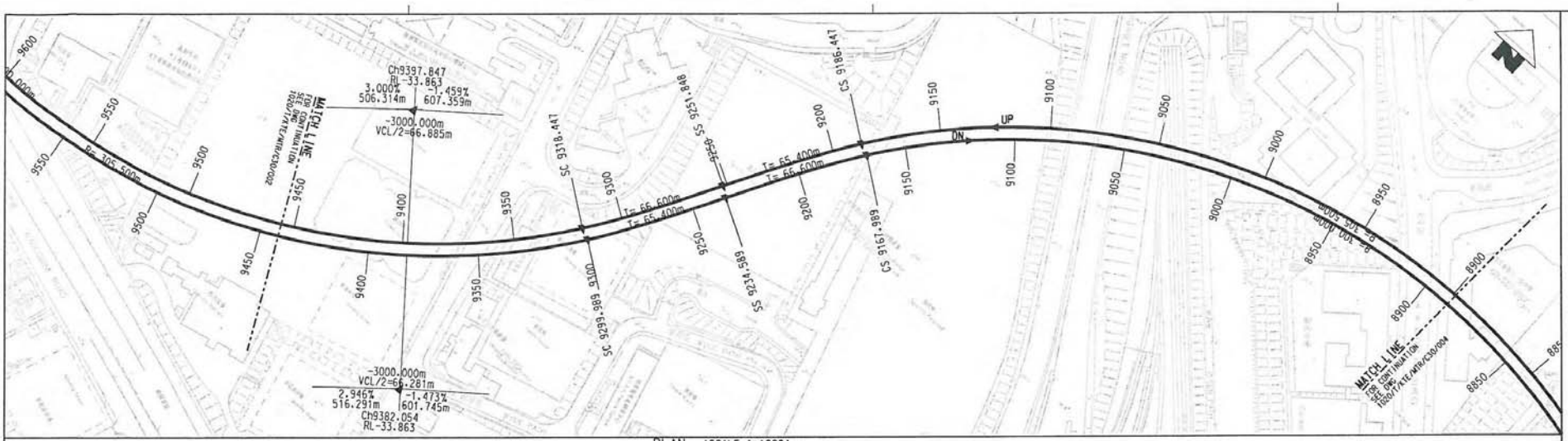

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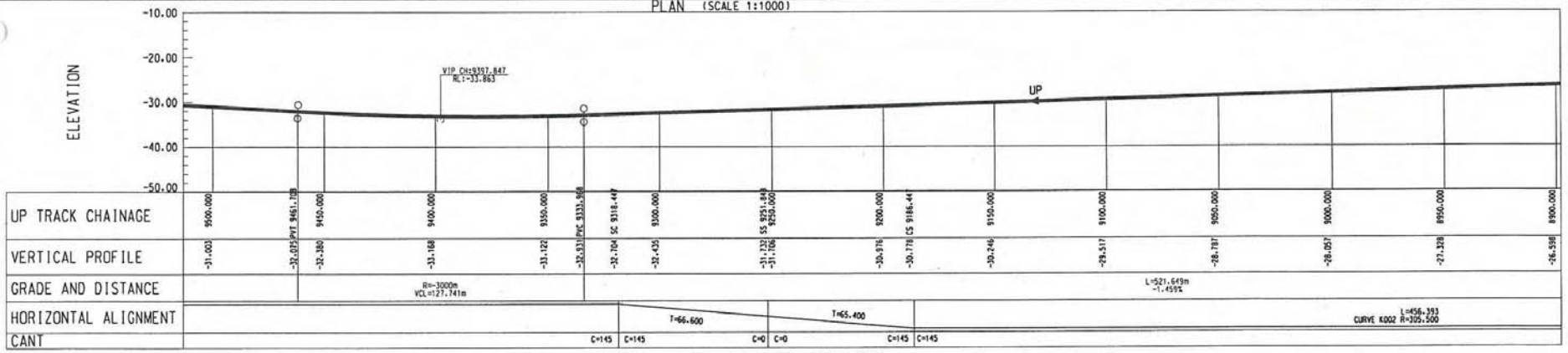

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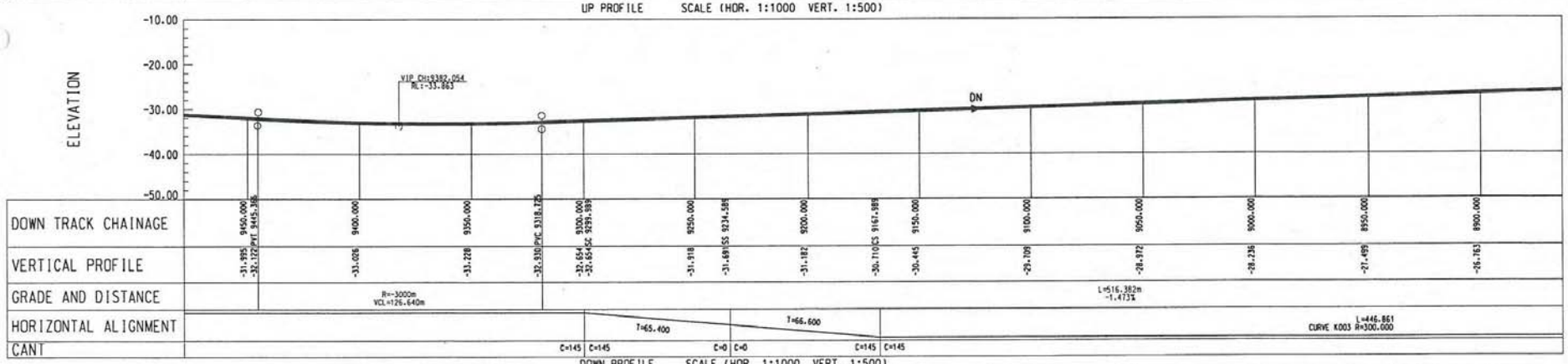

DOWN PROFILE SCALE (HOR. 1:1000 VERT. 1:500)

NOTES:

1. FOR GENERAL NOTES AND LEGEND, REFER TO DRAWING NO. 1020/W/KTE/MTR/C01/001 & 002.
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REV	DESCRIPTION	BY	DATE	APPROVED
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DRAWN	KLT
DESIGNED	JL
CHECKED	BT
APPROVED	DE
DATE	31/JAN/2012

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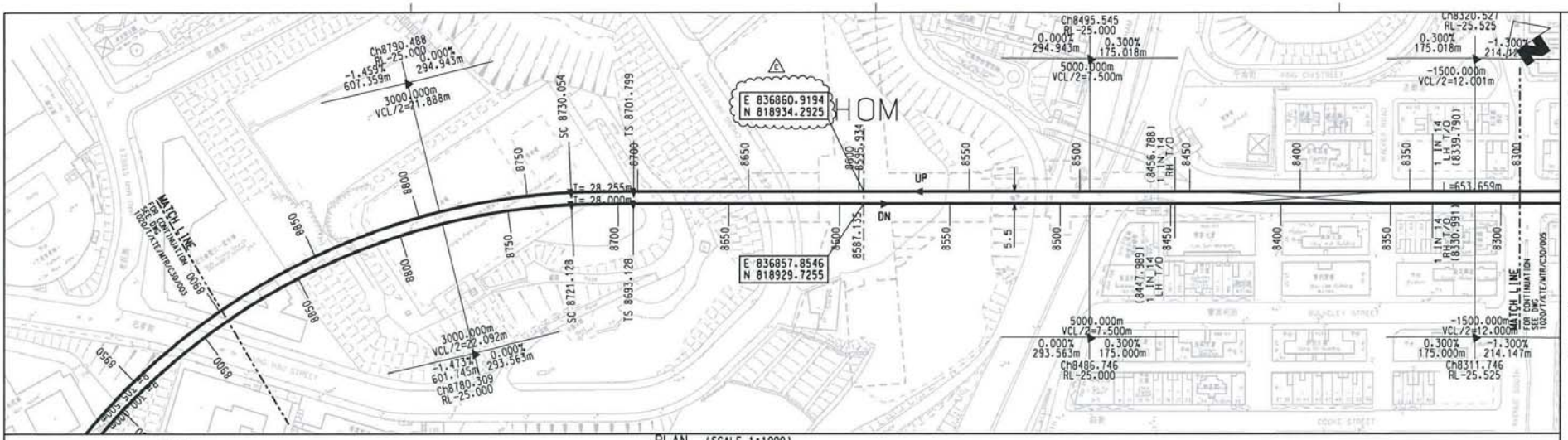
KWUN TONG LINE EXTENSION

ORIGINATOR
PROJECTS DIVISION | CIVIL & PLANNING DEPARTMENT

CADD REF. 1020_W_KTE_MTR_C30_003A.DGN

TITLE
CONTRACT 1020
ALIGNMENT
YAU MA TEI STATION
TO HO MAN TIN STATION
SHEET 3 OF 4

SCALE AS SHOWN @ A1 | DRAWING NO. 1020/W/KTE/MTR/C30/003 | REV. A



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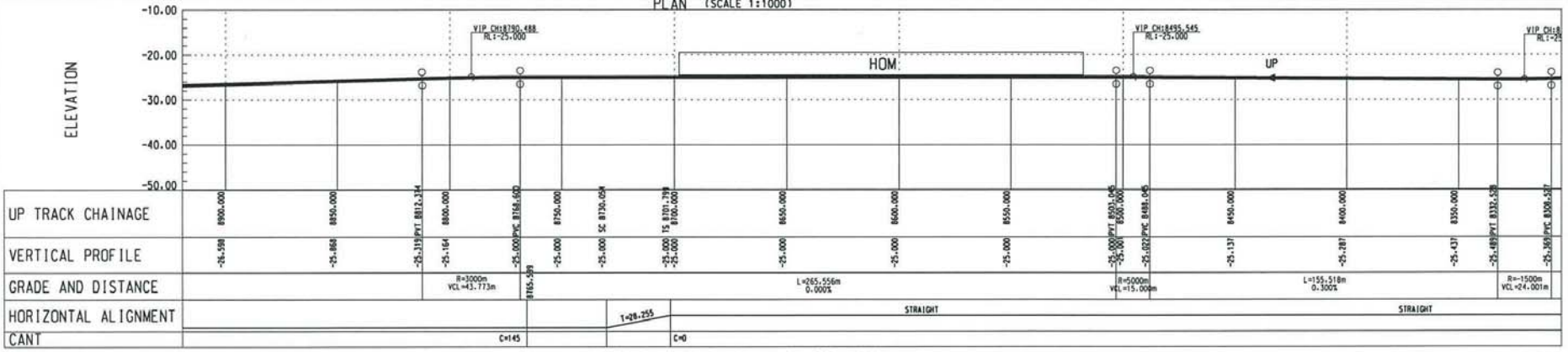
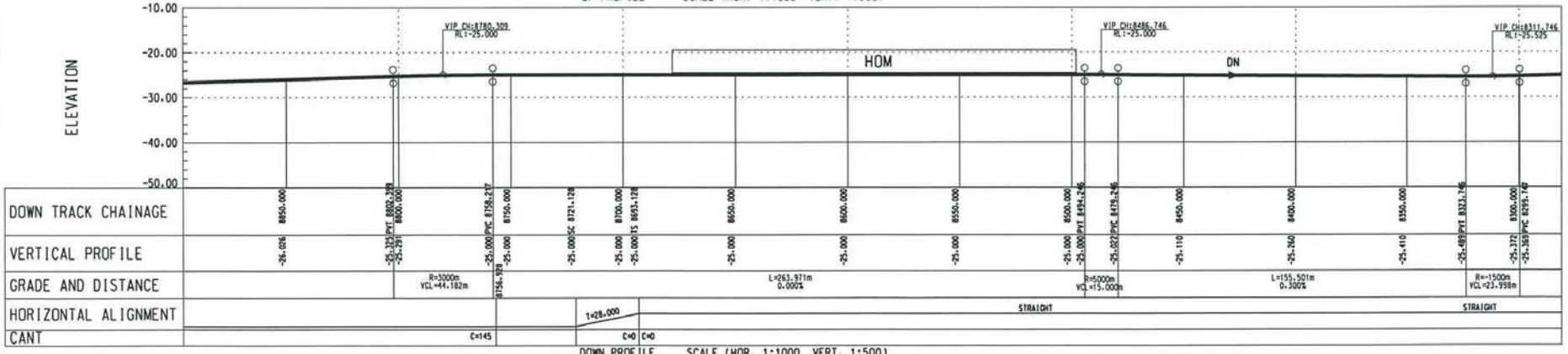


UP PROFILE SCALE (HOR. 1:1000 VERT. 1:500)



DOWN PROFILE SCALE (HOR. 1:1000 VERT. 1:500)

NOTES:

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Dec 08, 2014

REV	DESCRIPTION	BY	DATE	APPROVED
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B	CHAINAGES CLARIFIED	KLT	19FEB13	CK
A	ISSUE FOR CONSTRUCTION	KLT	31JAN12	DE

DRAWN	KLT
DESIGNED	JL
CHECKED	BT
APPROVED	DE
DATE	31/JAN/2012

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KWUN TONG LINE EXTENSION

ORIGINATOR

PROJECTS DIVISION | CIVIL & PLANNING DEPARTMENT

CADD REF. 1020_W_KTE_MTR_C30_004C.dgn

TITLE

CONTRACT 1020
ALIGNMENT
YAU MA TEI STATION
TO HO MAN TIN STATION
SHEET 4 OF 4

SCALE AS SHOWN @ A1

DRAWING NO. 1020/W/KTE/MTR/C30/004

REV. C

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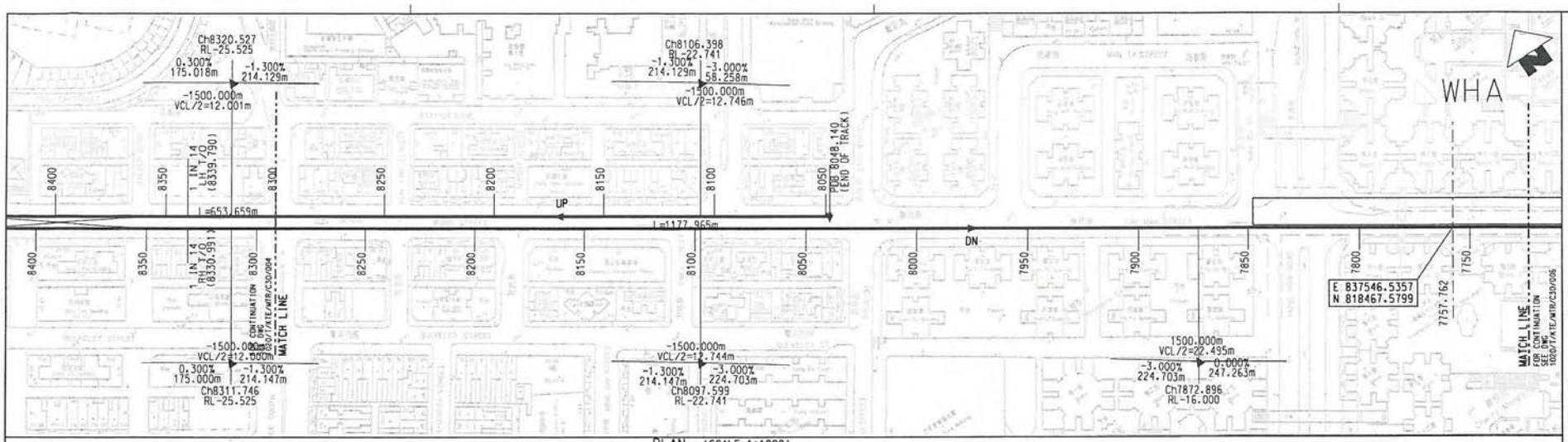

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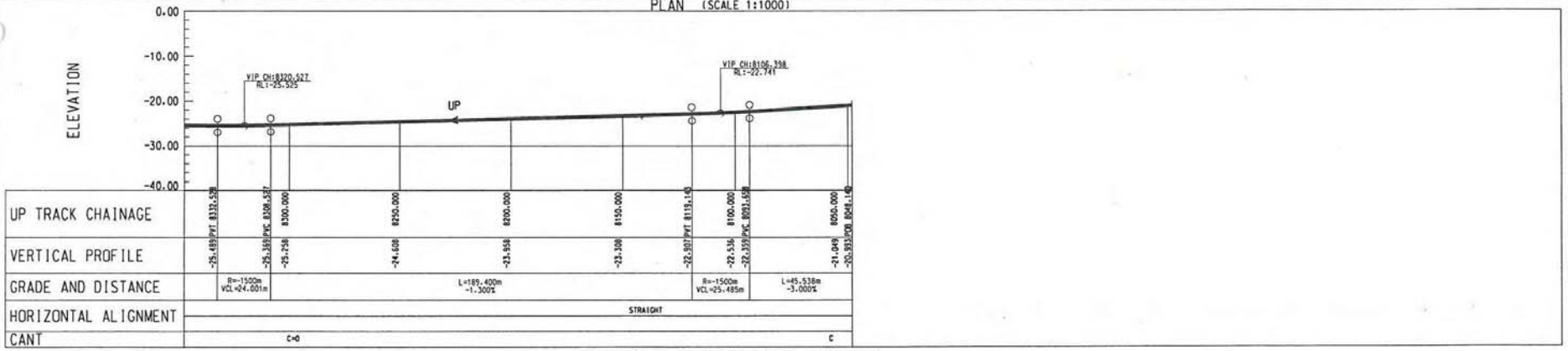

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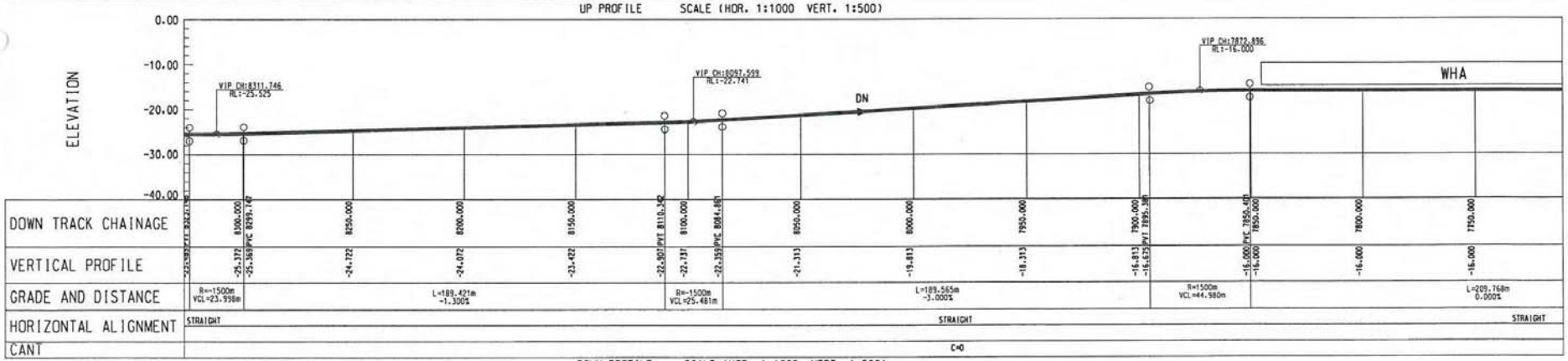

DOWN PROFILE SCALE (HOR. 1:1000 VERT. 1:500)

NOTES:

1. FOR GENERAL NOTES AND LEGEND. REFER TO DRAWING NO. 1020/W/KTE/MTR/C01/001 & 002.
2. CHAINAGE IS GIVEN IN METRES MEASURED ALONG THE HORIZONTAL TRACK CENTRELINE INCREASING IN THE DIRECTION FROM WHA TO YMT.
3. ALL RADII REFER TO TRACK CENTRELINE RADII AND ARE GIVEN IN METRES.
4. VERTICAL ALIGNMENT SHOWN REFERS TO THE CROWN OF THE GRADE RAIL (INSIDE/LOW RAIL ON CURVES).
5. CANT IS APPLIED BY RAISING THE OUTER RAIL ABOVE THE INNER RAIL.
6. BREAK CHAINAGE REFERS TO A SINGLE POINT WITH TWO CHAINAGE VALUES.
7. CHAINAGES SHOWN ARE CONSTRUCTION CHAINAGES. OPERATIONAL CHAINAGES TO BE OBTAINED BY THE FOLLOWING FORMULA FOR UP & DOWN TRACK -

   OPERATIONAL CHAINAGES = CONSTRUCTION CHAINAGES + 90000

Printed from LAN on Dec 08, 2014

REV	DESCRIPTION	BY	DATE	APPROVED
A	ISSUE FOR CONSTRUCTION	KLT	31JAN12	DE

DRAWN	KLT
DESIGNED	JL
CHECKED	BT
APPROVED	DE
DATE	31/JAN/2012

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MTR

KWUN TONG LINE EXTENSION

ORIGINATOR: PROJECTS DIVISION | CIVIL & PLANNING DEPARTMENT

CADD REF. 1020_W_KTE_MTR_C30_005A.DGN

TITLE: CONTRACT 1020
ALIGNMENT
HO MAN TIN STATION
TO WHAMPOA STATION
SHEET 1 OF 2

SCALE: AS SHOWN @ A1

DRAWING NO. 1020/W/KTE/MTR/C30/005

REV. A

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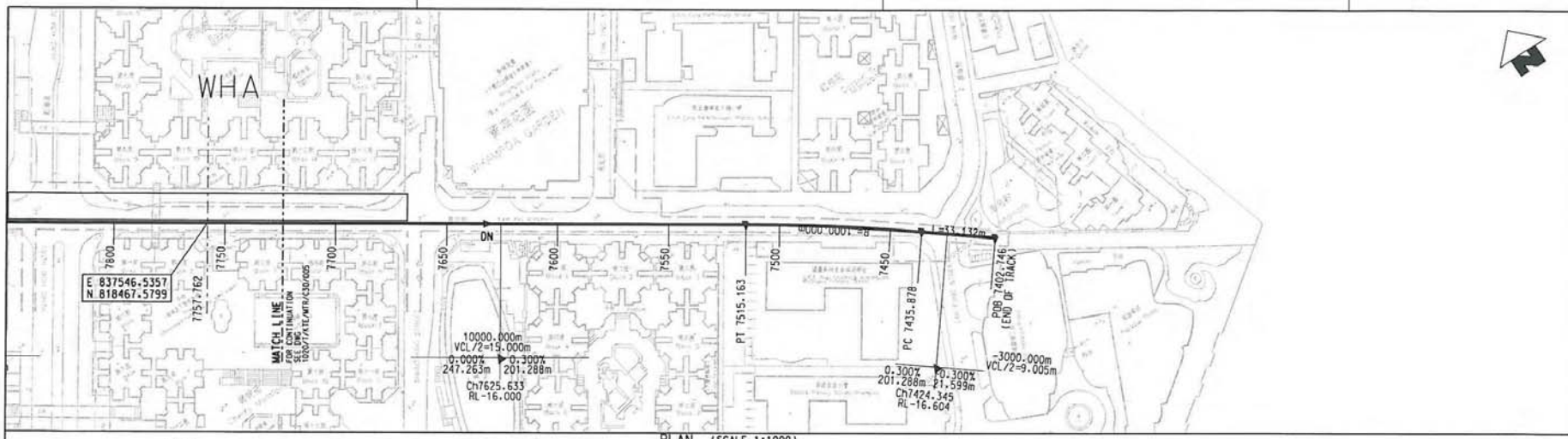
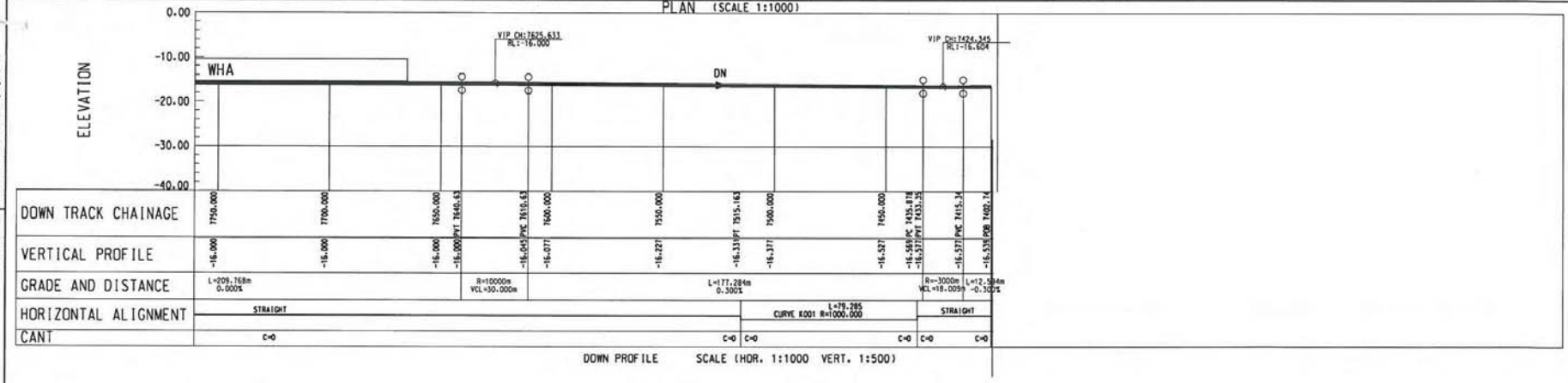


PLAN (SCALE 1:1000)



DOWN PROFILE SCALE (HOR. 1:1000 VERT. 1:500)

NOTES:

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   OPERATIONAL CHAINAGES = CONSTRUCTION CHAINAGES + 90000

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Dec 08, 2014

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REV	DESCRIPTION	BY	DATE	APPROVED
A	ISSUE FOR CONSTRUCTION	KLT	31JAN12	DE

DRAWN	KLT
DESIGNED	JL
CHECKED	BT
APPROVED	DE
DATE	31/JAN/2012

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KWUN TONG LINE EXTENSION

ORIGINATOR

PROJECTS DIVISION | CIVIL & PLANNING DEPARTMENT

CADD REF. 1020_W_KTE_MTR_C30_006A.DGN

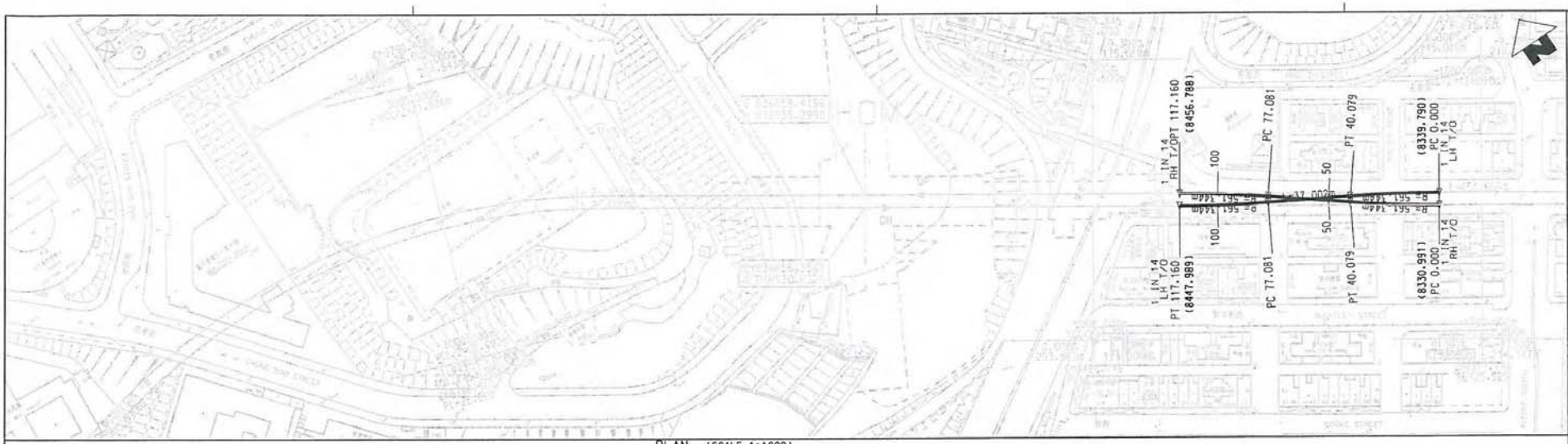
TITLE

CONTRACT 1020
ALIGNMENT
HO MAN TIN STATION
TO WHAMPOA STATION
SHEET 2 OF 2

SCALE AS SHOWN @ A1

DRAWING NO. 1020/W/KTE/MTR/C30/006

REV. A



NOTES:

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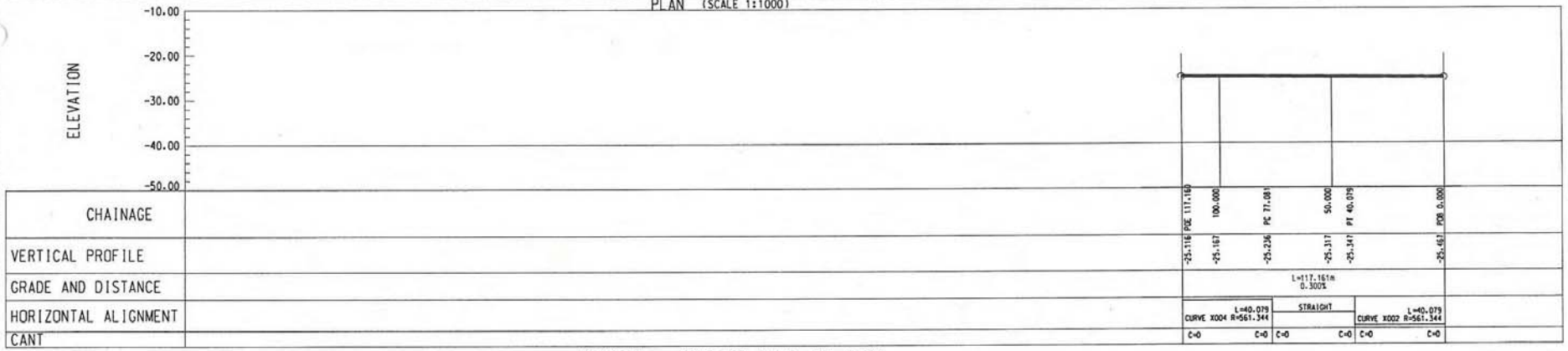
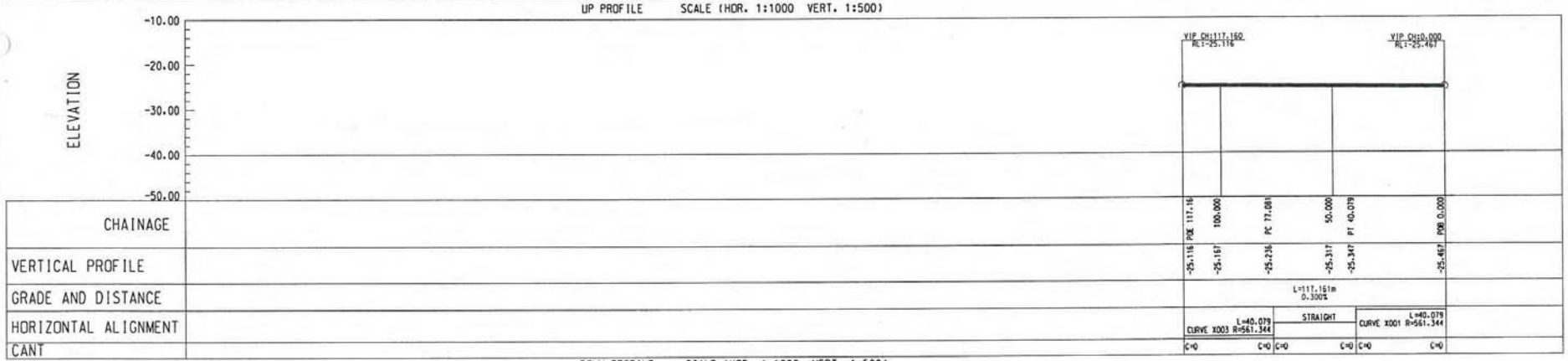
Printed from LAN on Dec 08, 2014

PLAN (SCALE 1:1000)



UP PROFILE SCALE (HOR. 1:1000 VERT. 1:500)



DOWN PROFILE SCALE (HOR. 1:1000 VERT. 1:500)

REV	DESCRIPTION	BY	DATE	APPROVED
A	ISSUE FOR CONSTRUCTION	KLT	31JAN12	DE

DRAWN	KLT
DESIGNED	JL
CHECKED	BT
APPROVED	DE
DATE	31/JAN/2012

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KWUN TONG LINE EXTENSION

ORIGINATOR PROJECTS DIVISION | CIVIL & PLANNING DEPARTMENT

CADD REF. 1020_W_KTE_MTR_C30_007A.DGN

TITLE
CONTRACT 1020
ALIGNMENT

CROSSOVER EAST OF HOM

SCALE AS SHOWN @ A1

DRAWING NO. 1020/W/KTE/MTR/C30/007

REV. A

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HORIZONTAL ALIGNMENT LIST

January 31, 2012

Project: KTE_05
Alignment: UP_04
Description: KTE UP TRACK

POINT TYPE	STATION	EAST(X)	NORTH(Y)	BEARING	RADIUS	ELE_LENGTH
POB	8048.140	837315.78751	818629.04920	303°51'50.1753		
TS	8701.799	836773.01318	818993.28273	303°51'50.1753		653.659
TS	8701.799	836773.01318	818993.28273	303°51'50.1753		
SC	8730.054	836749.31322	819008.66234	301°12'51.5315		28.255
SC	8730.054	836749.31322	819008.66234	301°12'51.5315		
CC		836590.99069	818747.38811		-305.500	456.393
CS	9186.447	836342.64729	818925.30890	215°37'08.2839		
CS	9186.447	836342.64729	818925.30890	215°37'08.2839		
SS	9251.848	836308.46365	818869.59221	209°29'10.0175		65.400
SS	9251.848	836308.46365	818869.59221	209°29'10.0175		
SC	9318.447	836273.57980	818812.90221	215°50'45.2411		66.600
SC	9318.447	836273.57980	818812.90221	215°50'45.2411		
CC		836030.40132	818988.58439		300.000	560.586
CS	9879.034	835791.09446	818807.66389	322°54'36.1174		
CS	9879.034	835791.09446	818807.66389	322°54'36.1174		
SS	9942.834	835756.33769	818861.12713	329°00'08.9418		63.800
SS	9942.834	835756.33769	818861.12713	329°00'08.9418		
SC	9991.082	835732.16047	818902.87521	331°46'00.9185		48.249
SC	9991.082	835732.16047	818902.87521	331°46'00.9185		
CC		836172.67572	819139.40496		500.000	144.469
CS	10135.551	835683.02570	819038.19793	348°19'18.6180		
CS	10135.551	835683.02570	819038.19793	348°19'18.6180		
SC	10147.551	835680.73012	819049.97607	349°34'56.4438		12.000
SC	10147.551	835680.73012	819049.97607	349°34'56.4438		
CC		836270.83960	819158.46939		600.000	22.776
CS	10170.327	835677.03788	819072.44892	351°45'26.0874		
CS	10170.327	835677.03788	819072.44892	351°45'26.0874		
ST	10198.327	835673.45521	819100.21808	353°05'38.9329		28.000
ST	10198.327	835673.45521	819100.21808	353°05'38.9329		
TS	10224.077	835670.35906	819125.78139	353°05'38.9329		25.750
TS	10224.077	835670.35906	819125.78139	353°05'38.9329		
SC	10254.077	835666.60308	819155.54503	352°14'04.9608		30.000
SC	10254.077	835666.60308	819155.54503	352°14'04.9608		
CC		834675.77320	819020.42971		-1000.000	24.954
CS	10279.031	835662.92325	819180.22575	350°48'17.7908		
CS	10279.031	835662.92325	819180.22575	350°48'17.7908		
ST	10309.031	835657.83352	819209.79054	349°56'43.8187		30.000
ST	10309.031	835657.83352	819209.79054	349°56'43.8187		
POE	10400.610	835641.84530	819299.96265	349°56'43.8187		91.579

Project: KTE_05
Alignment: DN_03
Description: KTE DOWN TRACK

POINT TYPE	STATION	EAST(X)	NORTH(Y)	BEARING	RADIUS	ELE_LENGTH
POB	7402.746	837837.95950	818265.07409	308°24'23.8653		
PC	7435.878	837811.99655	818285.65696	308°24'23.8653		33.132
PC	7435.878	837811.99675	818285.65680	308°24'23.8654		
CC		837190.75830	817502.03521		-1000.000	79.285
PT	7515.163	837747.98088	818332.39838	303°51'50.1753		
PT	7515.163	837747.98088	818332.39838	303°51'50.1753		
TS	8693.128	836769.84237	818988.78692	303°51'50.1753		1177.965
TS	8693.128	836769.84237	818988.78692	303°51'50.1753		
SC	8721.128	836746.35460	819004.02414	301°11'24.4844		28.000
SC	8721.128	836746.35460	819004.02414	301°11'24.4844		
CC		836590.99069	818747.38811		-300.000	446.861
CS	9167.989	836347.81235	818923.07048	215°50'45.4111		
CS	9167.989	836347.81235	818923.07048	215°50'45.4111		
SS	9234.589	836312.92822	818866.38008	209°29'10.0176		66.600
SS	9234.589	836312.92822	818866.38008	209°29'10.0176		
SC	9299.989	836278.74486	818810.66380	215°37'08.1164		65.400
SC	9299.989	836278.74486	818810.66380	215°37'08.1164		
CC		836030.40132	818988.58439		305.500	448.110
CS	9748.099	835879.21993	818723.11417	299°39'39.1581		
CS	9748.099	835879.21993	818723.11417	299°39'39.1581		
SC	9773.099	835857.96630	818736.26852	303°35'48.3762		25.000
SC	9773.099	835857.96630	818736.26852	303°35'48.3762		
CC		836106.97138	819111.09711		450.000	61.640
CS	9834.738	835809.11623	818773.78077	311°26'41.8674		
CS	9834.738	835809.11623	818773.78077	311°26'41.8674		
SC	9859.738	835790.86567	818790.86103	314°49'37.2206		25.000
SC	9859.738	835790.86567	818790.86103	314°49'37.2206		
CC		836072.85310	819074.55645		400.000	105.889
CS	9965.627	835726.46233	818874.52286	329°59'40.0010		
CS	9965.627	835726.46233	818874.52286	329°59'40.0010		
SC	9990.627	835714.67777	818896.56578	333°49'52.3764		25.000
SC	9990.627	835714.67777	818896.56578	333°49'52.3764		
CC		836028.80234	819050.92171		350.000	64.098
CS	10054.725	835691.82025	818956.35389	344°19'27.1237		
CS	10054.725	835691.82025	818956.35389	344°19'27.1237		
ST	10114.725	835678.93865	819014.93472	349°14'06.9643		60.000
ST	10114.725	835678.93865	819014.93472	349°14'06.9643		
TS	10267.527	835650.39877	819165.04799	349°14'06.9643		152.802
TS	10267.527	835650.39877	819165.04799	349°14'06.9643		
SC	10287.527	835646.69963	819184.70290	349°33'12.8799		20.000
SC	10287.527	835646.69963	819184.70290	349°33'12.8799		
CC		837416.86443	819511.07169		1800.000	2.559
CS	10290.087	835646.23736	819187.22023	349°38'06.1692		
CS	10290.087	835646.23736	819187.22023	349°38'06.1692		
ST	10310.087	835642.71190	819206.90703	349°57'12.0848		20.000
ST	10310.087	835642.71190	819206.90703	349°57'12.0848		
POE	10401.877	835626.69908	819297.28996	349°57'12.0848		91.790

Project: KTE_05
Alignment: XHMT01_02
Description: CROSSOVER EAST OF HOM

POINT TYPE	STATION	EAST(X)	NORTH(Y)	BEARING	RADIUS	ELE_LENGTH
PC	0.000	837073.61198	818791.56324	303°51'50.1753		
CC		836760.81842	818325.44386		-561.344	40.079
PT	40.079	837039.56329	818812.68957	299°46'23.2647		
PT	40.079	837039.56329	818812.68957	299°46'23.2647		
PC	77.081	837007.44522	818831.06376	299°46'23.2647		37.002
PC	77.081	837007.44522	818831.06376	299°46'23.2647		
CC		837286.19009	819318.30948		561.344	40.079
PT	117.160	836973.39653	818852.19009	303°51'50.1755		

Project: KTE_05
Alignment: XHMT02_02
Description: CROSSOVER EAST OF HOM

POINT TYPE	STATION	EAST(X)	NORTH(Y)	BEARING	RADIUS	ELE_LENGTH
PC	0.000	837070.54725	818786.99624	303°51'50.1752		
CC		837383.34080	819253.11562		561.344	40.079
PT	40.079	837038.09241	818810.49769	307°57'17.0859		
PT	40.079	837038.09241	818810.49769	307°57'17.0859		
PC	77.081	837008.91610	818833.25564	307°57'17.0859		37.002
PC	77.081	837008.91610	818833.25564	307°57'17.0859		
CC		836663.66771	818390.63771		-561.344	40.079
PT	117.160	836976.46126	818856.75709	303°51'50.1753		

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Dec 08, 2014

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DRAWN	KLT
DESIGNED	AL
CHECKED	BT
APPROVED	DE
DATE	31/JAN/2012

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KWUN TONG LINE EXTENSION

ORIGINATOR: PROJECTS DIVISION | CIVIL & PLANNING DEPARTMENT

CADD REF. 1020_W_KTE_MTR_C30_008A.DGN

TITLE: CONTRACT 1020
ALIGNMENT

ALIGNMENT DATA SHEET
HORIZONTAL ALIGNMENT

SCALE: -

DRAWING NO. 1020/W/KTE/MTR/C30/008

REV. A

Project: KTE 06
Alignment: DN V05
Description: KTE DOWN TRACK

POINT TYPE	STATION	LEVEL	GRADE	RADIUS	ELE LENGTH
POB	7402.746	-16.539	-0.00300		
PVC	7415.340	-16.577	-0.00300		12.594
PVI	7424.345	-16.604		-3000.000	
PVT	7433.350	-16.577	0.00300		
PVC	7610.633	-16.045	0.00300		177.283
PVI	7625.633	-16.000		10000.000	
PVT	7640.633	-16.000	0.00000		
PVC	7850.401	-16.000	0.00000		209.768
PVI	7872.896	-16.000		1500.000	
PVT	7895.381	-16.675	-0.03000		
PVC	8084.861	-22.359	-0.03000		189.480
PVI	8097.599	-22.741		-1500.000	
PVT	8110.342	-22.907	-0.01300		
PVC	8299.747	-25.369	-0.01300		189.405
PVI	8311.746	-25.525		-1500.000	
PVT	8323.746	-25.489	0.00300		
PVC	8479.246	-25.022	0.00300		155.500
PVI	8486.746	-25.000		5000.000	
PVT	8494.246	-25.000	0.00000		
PVC	8758.217	-25.000	0.00000		263.971
PVI	8780.309	-25.000		3000.000	
PVT	8802.399	-25.325	-0.01473		
PVC	9318.725	-32.930	-0.01473		516.326
PVI	9382.054	-33.863		-3000.000	
PVT	9445.366	-32.122	0.02750		
PVC	9908.738	-19.381	0.02750		463.372
PVI	9931.598	-18.752		1500.000	
PVT	9954.467	-18.821	-0.00300		
PVC	10082.296	-19.204	-0.00300		127.829
PVI	10101.799	-19.263		-3000.000	
PVT	10121.302	-19.068	0.01000		
PVC	10295.548	-17.325	0.01000		174.246
PVI	10303.049	-17.250		1500.000	
PVT	10310.551	-17.250	0.00000		
POE	10401.877	-17.250	0.00000		91.326

Project: KTE 06
Alignment: UP V05
Description: KTE UP TRACK

POINT TYPE	STATION	LEVEL	GRADE	RADIUS	ELE LENGTH
POB	8048.140	-20.993	-0.03000		
PVC	8093.658	-22.359	-0.03000		45.518
PVI	8106.398	-22.741		-1500.000	
PVT	8119.143	-22.907	-0.01300		
PVC	8308.527	-25.369	-0.01300		189.384
PVI	8320.527	-25.525		-1500.000	
PVT	8332.528	-25.489	0.00300		
PVC	8488.045	-25.022	0.00300		155.517
PVI	8495.545	-25.000		5000.000	
PVT	8503.045	-25.000	0.00000		
PVC	8768.600	-25.000	0.00000		265.556
PVI	8790.488	-25.000		3000.000	
PVT	8812.374	-25.319	-0.01459		
PVC	9333.968	-32.931	-0.01459		521.594
PVI	9397.847	-33.863		-3000.000	
PVT	9461.708	-32.075	0.02800		
PVC	9913.589	-19.422	0.02800		451.880
PVI	9936.826	-18.772		1500.000	
PVT	9960.073	-18.841	-0.00300		
PVC	10081.106	-19.204	-0.00300		121.033
PVI	10100.610	-19.263		-3000.000	
PVT	10120.113	-19.068	0.01000		
PVC	10294.359	-17.325	0.01000		174.246
PVI	10301.860	-17.250		1500.000	
PVT	10309.362	-17.250	0.00000		
POE	10400.610	-17.250	0.00000		91.248

Project: KTE_05
Alignment: XHWT01_V02
Description: CROSSOVER EAST OF HOM

POINT TYPE	STATION	LEVEL	GRADE	RADIUS	ELE_LENGTH
POB	0.000	-25.467	0.00300		
POE	117.160	-25.116	0.00300		117.160

Project: KTE_05
Alignment: XHWT02_V02
Description: CROSSOVER EAST OF HOM

POINT TYPE	STATION	LEVEL	GRADE	RADIUS	ELE_LENGTH
POB	0.000	-25.467	0.00300		
POE	117.160	-25.116	0.00300		117.160

Printed from LAN on
Dec 08, 2014

P.01 DRV: X:\CAD\Library\MicroStation\Workspace\data\dgn\PDF_BW_1006pl.08092Cpit
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MODELNAME: \\hpscad1fs01\cad\cpd120\dwy\w\1020_W_KTE_MTR_C30_009A.DGN
FILENAME:

REV	DESCRIPTION	BY	DATE	APPROVED
A	ISSUE FOR CONSTRUCTION	KLT	31JAN12	DE

DRAWN	KLT
DESIGNED	AL
CHECKED	BT
APPROVED	DE
DATE	31/JAN/2012

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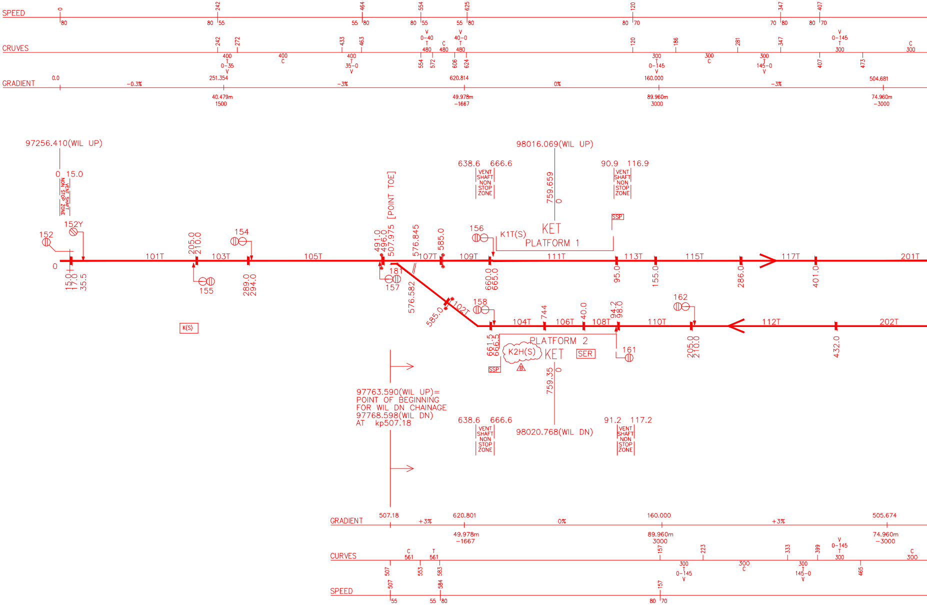
MTR
KWUN TONG LINE EXTENSION
ORIGINATOR
PROJECTS DIVISION | CIVIL & PLANNING DEPARTMENT
CADD REF. 1020_W_KTE_MTR_C30_009A.DGN

TITLE
CONTRACT 1020
ALIGNMENT

ALIGNMENT DATA SHEET
VERTICAL ALIGNMENT

SCALE -
DRAWING NO. 1020/W/KTE/MTR/C30/009
REV. A


SPEED
CRUVES
GRADIENT
0.0
-0.3%
251.354
40.479m
1500
-3%
620.814
49.978m
-1667
0%
160.000
89.960m
3000
504.681
74.960m
-3000
97256.410(WIL UP)
0 15.0
VENT SHAFT NON STOP ZONE
152
152Y
0
15.0
17.0
35.5
101T
205.0
210.0
155
154
103T
289.0
294.0
105T
K(S)
491.0
496.0
507.975
[POINT TOE]
576.845
181
157
576.582
585.0
107T
585.0
102T
156
K1T(S)
109T
660.0
665.0
98016.069(WIL UP)
638.6 666.6
VENT SHAFT NON STOP ZONE
759.659
0
KET
PLATFORM 1
111T
90.9 116.9
VENT SHAFT NON STOP ZONE
SSP
95.0
113T
155.0
115T
286.0
117T
401.0
201T
158
104T
744
106T
40.0
108T
94.2
98.0
110T
162
205.0
210.0
112T
432.0
202T
661.5
666.5
SSP
K2H(S)
PLATFORM 2
KET
SER
161
759.35
0
97763.590(WIL UP)=
POINT OF BEGINNING
FOR WIL DN CHAINAGE
97768.598(WIL DN)
AT kp507.18
638.6 666.6
VENT SHAFT NON STOP ZONE
98020.768(WIL DN)
91.2 117.2
VENT SHAFT NON STOP ZONE
GRADIENT
507.18
+3%
620.801
49.978m
-1667
0%
160.000
89.960m
3000
+3%
505.674
74.960m
-3000
CURVES
SPEED

PLOT DRV: $PLTDRV$
MODELNAME: $MODEL$
FILENAME: $FILE$
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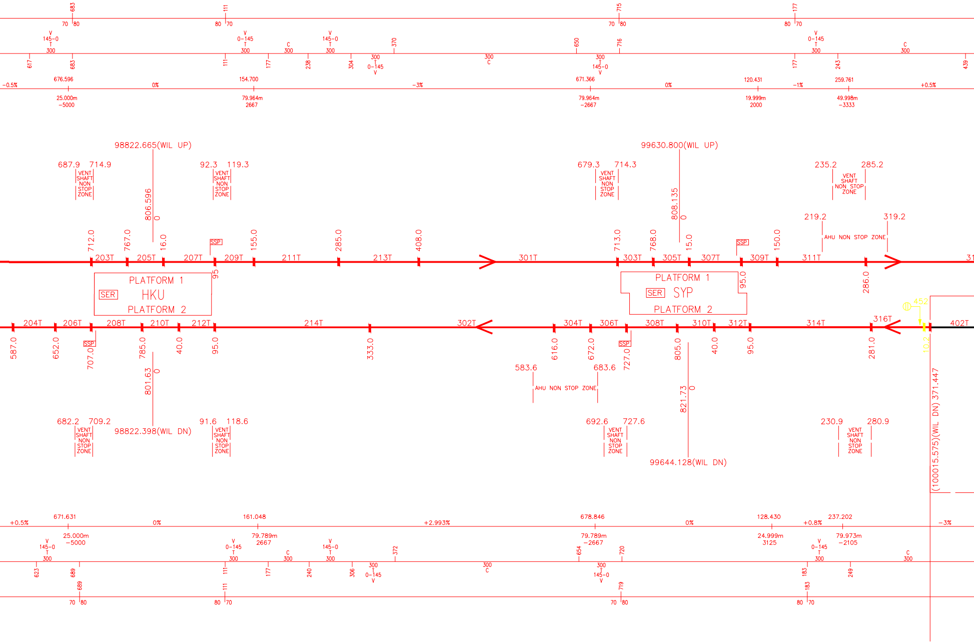
98822.665(WIL UP)
99630.800(WIL UP)
98822.398(WIL DN)
99644.128(WIL DN)
(100015.575)(WIL DN) 371.447
806.596
808.135
801.63
821.73
687.9 714.9 VENT SHAFT NON STOP ZONE
92.3 119.3 VENT SHAFT NON STOP ZONE
679.3 714.3 VENT SHAFT NON STOP ZONE
235.2 285.2 VENT SHAFT NON STOP ZONE
219.2 319.2 AHU NON STOP ZONE
583.6 683.6 AHU NON STOP ZONE
682.2 709.2 VENT SHAFT NON STOP ZONE
91.6 118.6 VENT SHAFT NON STOP ZONE
692.6 727.6 VENT SHAFT NON STOP ZONE
230.9 280.9 VENT SHAFT NON STOP ZONE
203T
205T
207T
209T
211T
213T
301T
303T
305T
307T
309T
311T
204T
206T
208T
210T
212T
214T
302T
304T
306T
308T
310T
312T
314T
316T
402T
SSP
PLATFORM 1
SER
HKU
PLATFORM 2
PLATFORM 1
SER
SYP
PLATFORM 2
712.0
767.0
16.0
155.0
285.0
408.0
713.0
768.0
15.0
150.0
286.0
95
95.0
587.0
652.0
707.0
785.0
40.0
95.0
333.0
616.0
672.0
727.0
805.0
40.0
95.0
281.0
452
10.2
-0.5%
676.596
25.000m
-5000
0%
154.700
79.964m
2667
-3%
671.366
79.964m
-2667
0%
120.431
19.999m
2000
-1%
259.761
49.998m
-3333
+0.5%
+0.5%
671.631
25.000m
-5000
0%
161.048
79.789m
2667
+2.993%
678.846
79.789m
-2667
0%
128.430
24.999m
3125
+0.8%
237.202
79.973m
-2105
-3%
V 145-0 T 300
V 0-145 T 300
C 300
300 T 0-145 V
300 C
617
683
111
177
238
304
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650
716
439
243
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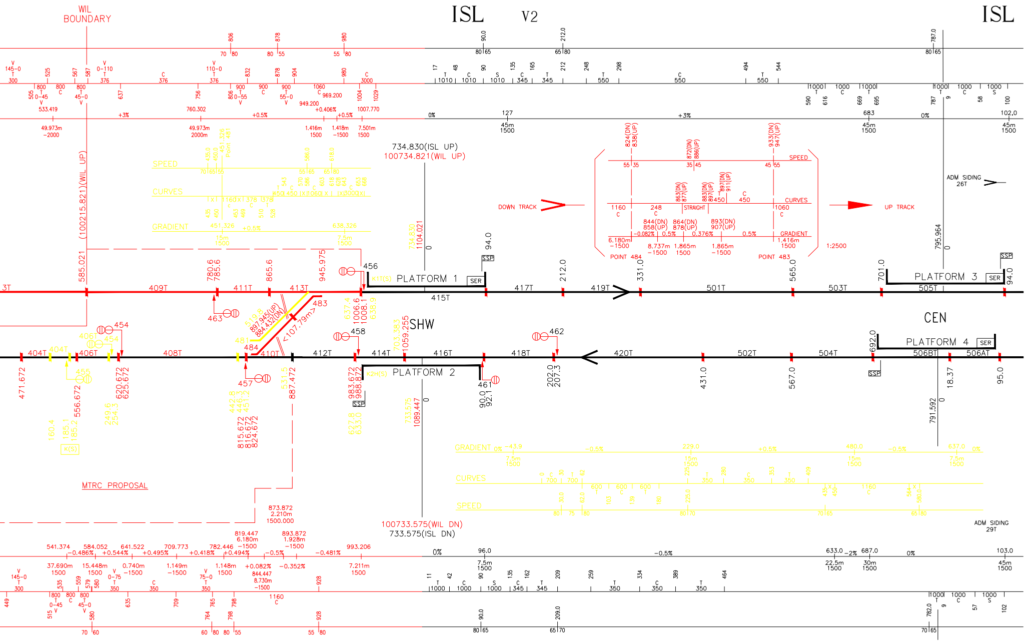
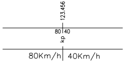
689
240
306
372
654
720
183
249
719
70 80

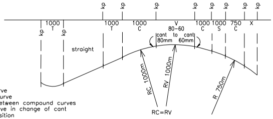

WIL BOUNDARY
ISL
V2
ISL
SPEED
CURVES
GRADIENT
734.830(ISL UP)
100734.821(WIL UP)
(100215.821)(WIL UP)
585.021
DOWN TRACK
UP TRACK
POINT 484
POINT 483
1:2500
ADM SIDING 26T
PLATFORM 1
SER
SSP
PLATFORM 3
PLATFORM 2
PLATFORM 4
SHW
CEN
409T
411T
413T
415T
417T
419T
501T
503T
505T
404T
406T
408T
410T
412T
414T
416T
418T
420T
502T
504T
506BT
506AT
456
458
461
462
463
454
455
457
481
483
484
K1T(S)
K2H(S)
K(S)
<107.79m>
897.945(UP)
884.432(DN)
MTRC PROPOSAL
100733.575(WIL DN)
733.575(ISL DN)
ADM SIDING 29T
873.872
2.210m
1500.000

LEGEND :

SPEED LIMIT in Km/h

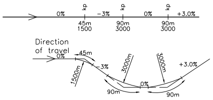

123.456
80 40
kp
80Km/h 40Km/h

CURVES

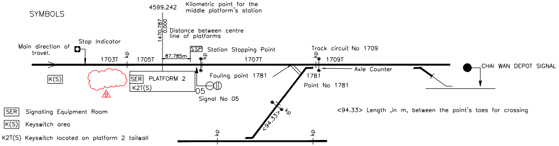

kp
1000 T
1000 T
1000 C
V 80–60
1000 C
1000 S
750 C
X
cant to cant
80mm 60mm
straight
RC 1000m
RV 1000m
R 750m
RC=RV

C: Circular curve
T: Transition curve
S: Transtion between compound curves
V: Circular curve in change of cant
X: Virtual transition

GRADIENT


0%
kp
−3%
0%
+3.0%
45m 1500
90m 3000
90m 3000
Direction of travel
45m
0%
1500m
−3%
3000m
3000m
+3.0%
0%
90m
90m

SYMBOLS


4599.242
Kilometric point for the middle platform's station
1470.787
0.000
Distance between centre line of platforms
Stop Indicator
Main direction of travel.
SSP
Station Stopping Point
Track circuit No 1709
87.785m
1703T
kp
1705T
1707T
1709T
Axle Counter
CHAI WAN DEPOT SIGNAL
K(S)
SER
PLATFORM 2
K2T(S)
Fouling point 1781
1781
Point No 1781
05
Signal No 05
<94.33> Length ,in m, between the point's toes for crossing
<94.33>

SER Signalling Equipment Room

K(S) Keyswitch area

K2T(S) Keyswitch located on platform 2 tailwall

REV	DESCRIPTION	BY	DATE	APPROVED
B	SECOND FORMAL ISSUE	H.C.	16/09/2011	N.G.
1B	ADDTION OF KEYSWITCH K2H(S) IN RELAY OF ERFC NO. 752–ERFC–RM(SIG)–SIG–000083	H.C.	24/08/2011	N.G.
A	FORMAL ISSUE	H.C.	23/05/2011	N.G.
1A	CONVERT FROM PRELIMINARY SCHEME PLAN 752/DRW/0320 REV.1D: & ADDRESS ENG. COM. ERF:752 ERF0320_1D DRAFT.DOC	H.C.	13/05/2011	N.G.

DRAWN	R.AY.
DESIGNED	K.Y.C.
CHECKED	H.C.
APPROVED	N.G.
DATE	13/05/2011

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MTR

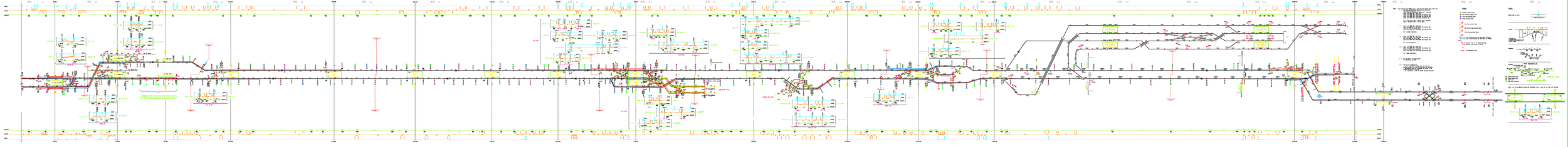
WEST ISLAND LINE

ORIGINATOR
ALSTOM

CADD REF. 752_DRW_0083_B.dwg

TITLE
CONTRACT NO. 752
FINAL SCHEME PLAN

SCALE N.T.S.
DRAWING NO. 752/DRW/0083
REV. B



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REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE

REV	REVISION DESCRIPTION	REVISED/DATE	CHECKED/DATE	APPROVED/DATE
A	DRAWN UPDATING FOR IVC	DRN 05-02-07	AHP 05-02-07	CHJD 05-02-07

WORK REFERENCE NO.

CONTRACTOR REFERENCE NO.

	INITIAL	DESIGNATION	DATE
DRAWN	C.M.YU	CADD	05-02-01
DESIGNED			
CHECKED	R.K.P.	D(CTS)	05-02-01
APPROVED	C.K.LEE	M(CTS)	05-02-01
CAD FILE NAME		00129002	

九廣鐵路公司
KCR Corporation

TITLE

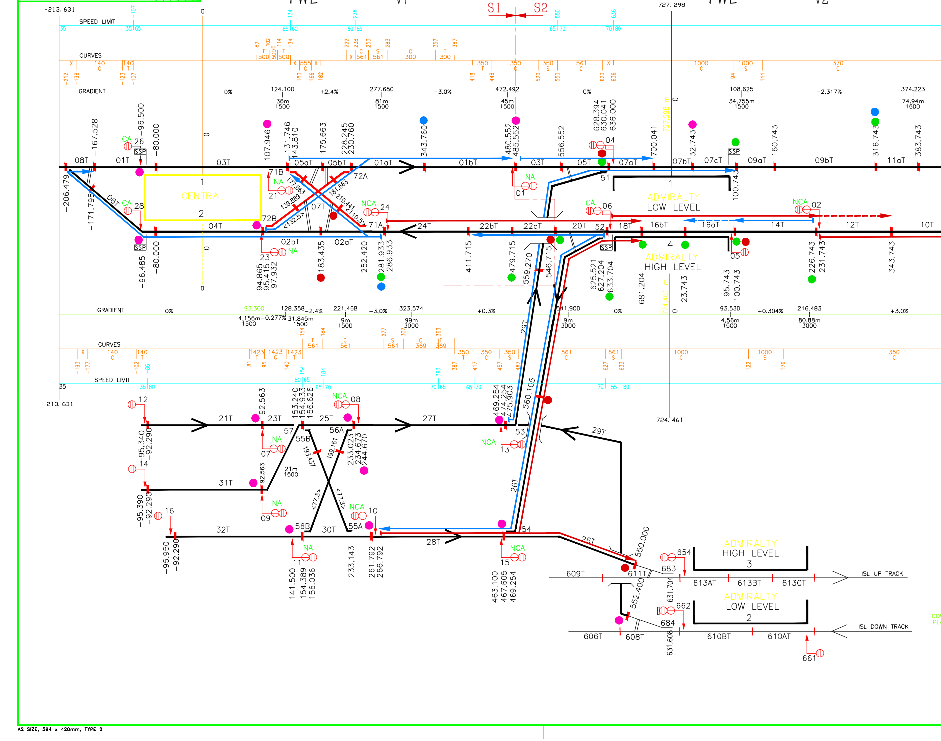
KTL PEL SCHEME PLAN
KAOWAI SECTION STOPPING POINTS

SCALE N.T.S.

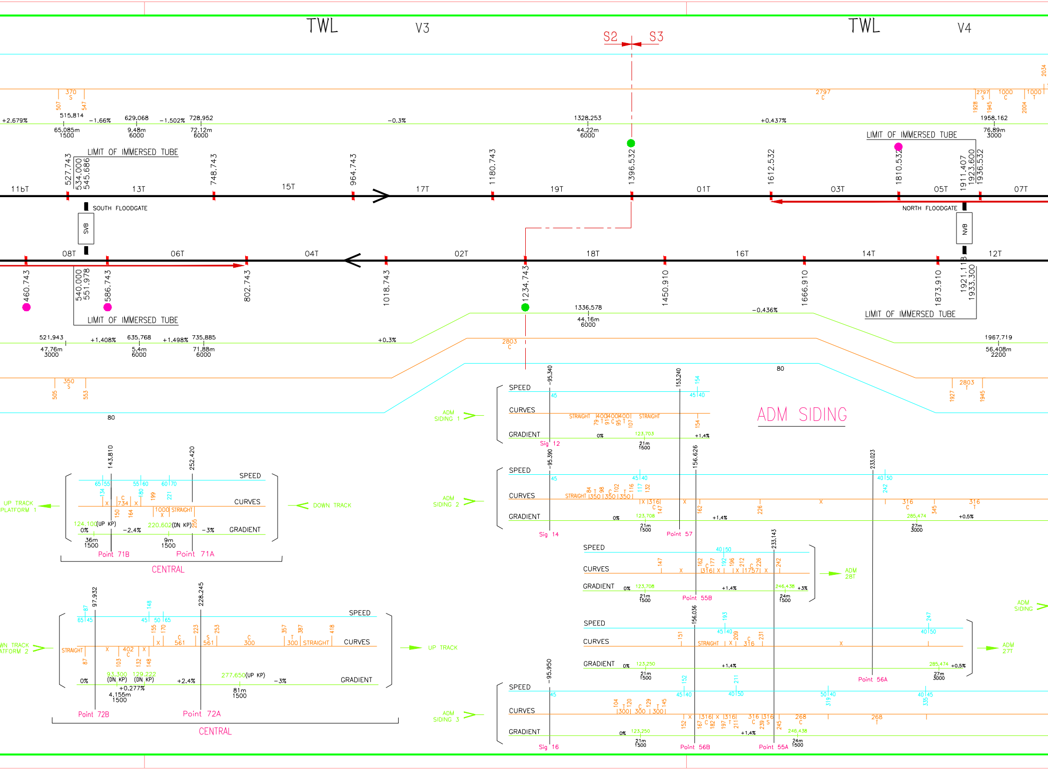
DES. DRAWING NO. 001/411/00129/0002 H

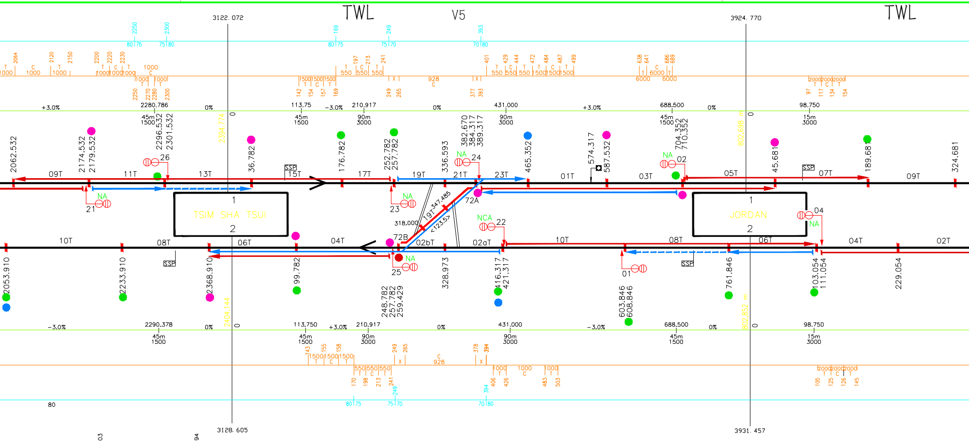
0D1/411/00229/002

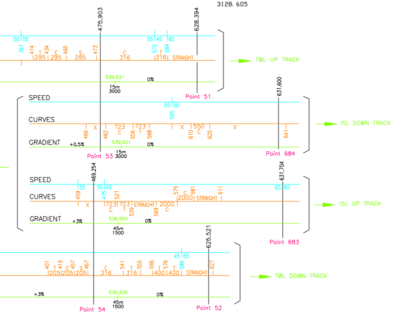
G	H	I	J	J1
A	B	C	D	E	F

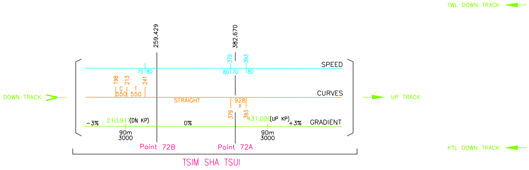

TWL
V1
TWL
V2
S1
S2
-213. 631
727. 298
724. 461
SPEED LIMIT
CURVES
GRADIENT
0%
124,100
+2.4%
277,650
-3.0%
472,492
0%
108,625
-2.317%
374,223
08T
01T
03T
05aT
05bT
01aT
01bT
03T
05T
07aT
07bT
07cT
09aT
09bT
11aT
04T
02bT
02aT
07T
24T
22bT
22aT
20T
18T
16bT
16aT
14T
12T
10T
CENTRAL
1
2
ADMIRALTY
LOW LEVEL
ADMIRALTY
HIGH LEVEL
4
CA
26
SSP
CA
28
NA
21
71B
72A
72B
71A
NCA
24
NA
23
NA
01
51
52
04
CA
06
NCA
02
05
06T
-206.479
-171.798
-167.528
-96.500
-80.000
-96.485
-80.000
107.946
131.746
143.810
175.663
228.245
230.760
343.760
480.552
485.552
556.552
628.394
630.041
636.000
700.041
32.743
100.743
160.743
316.743
383.743
183.435
252.420
281.933
286.933
411.715
479.715
559.270
546.715
625.521
627.204
633.704
681.204
23.743
95.743
100.743
226.743
231.743
343.743
94.865
95.415
97.932
171.663
181.663
139.889
210.441
132.57
110.57
GRADIENT
0%
93.300
128.358
-2.4%
221.468
-3.0%
323.574
+0.3%
541.900
0%
93.530
+0.304%
216.483
+3.0%
CURVES
SPEED LIMIT
12
14
16
21T
23T
25T
27T
31T
32T
30T
28T
29T
26T
57
55B
56A
56B
55A
53
54
NA
07
NA
09
NCA
08
NCA
13
NCA
10
NA
11
NCA
15
92.563
153.240
154.933
156.626
233.023
234.673
244.670
469.254
474.254
475.903
560.105
-95.340
-92.290
-95.390
-92.290
-95.950
-92.290
193.437
199.161
77.37
77.37
21m
1500
141.500
154.389
156.036
233.143
261.792
266.792
463.100
467.605
469.254
550.000
552.400
654
683
662
684
661
609T
611T
613AT
613BT
613CT
606T
608T
610BT
610AT
631.704
631.608
ADMIRALTY
HIGH LEVEL
3
ADMIRALTY
LOW LEVEL
2
ISL UP TRACK
ISL DOWN TRACK

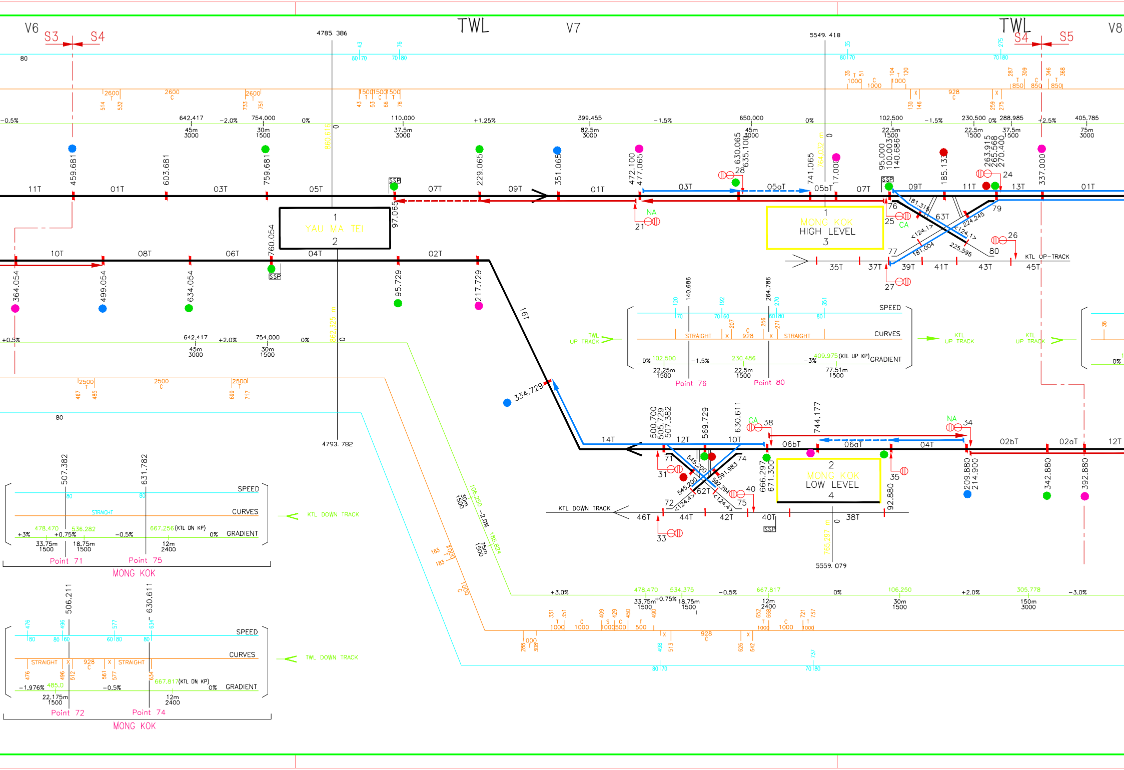
A2 SIZE, 594 x 420mm, TYPE 2

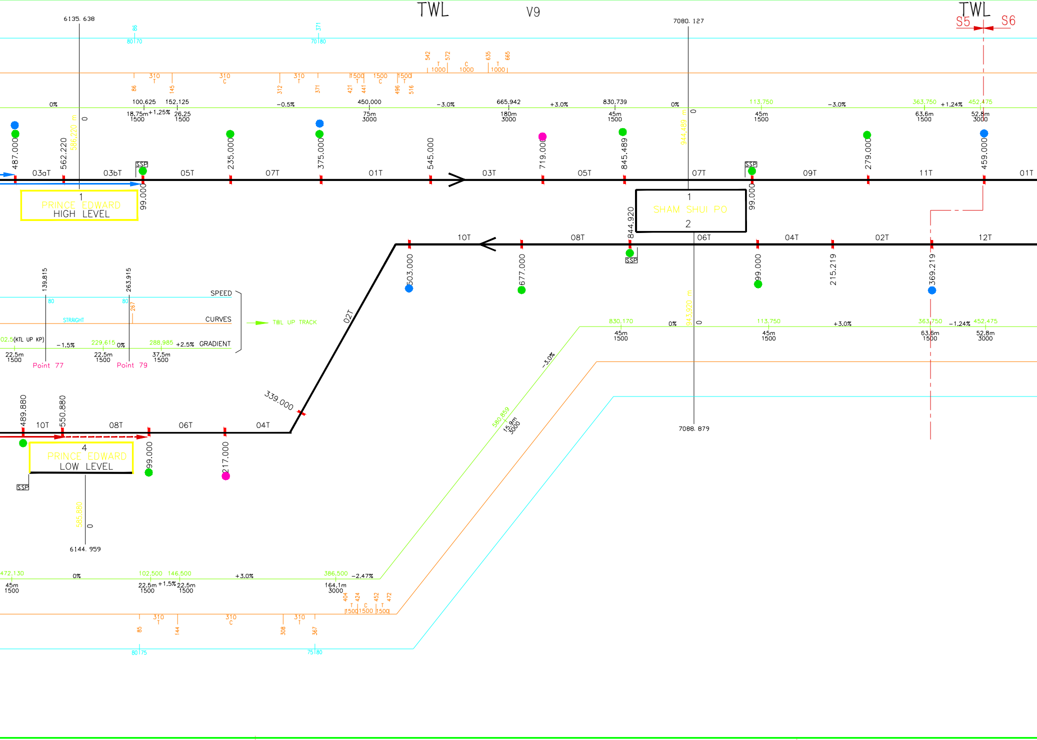

TWL
V3
S2
S3
TWL
V4
LIMIT OF IMMERSED TUBE
527.743
534.000
545.686
748.743
964.743
1180.743
1396.532
1612.532
1810.532
1911.407
1923.600
1936.532
11bT
13T
15T
17T
19T
01T
03T
05T
07T
SOUTH FLOODGATE
SVB
NORTH FLOODGATE
NVB
08T
06T
04T
02T
18T
16T
14T
12T
460.743
540.000
551.978
586.743
802.743
1018.743
1234.743
1450.910
1666.910
1873.910
1921.118
1933.300
+2.679%
515.814
65.085m 1500
-1.66%
629.068
9.48m 6000
-1.502%
728.952
72.12m 6000
-0.3%
1328.253
44.22m 6000
+0.437%
1958.162
76.89m 3000
521.943
47.76m 3000
+1.408%
635.768
5.4m 6000
+1.498%
735.885
71.88m 6000
+0.3%
1336.578
44.16m 6000
-0.436%
1967.719
56.408m 2200
370 S
2797 C
1000 C
1000 T
2803 C
350 S
2803 T
80
ADM SIDING
SPEED
CURVES
GRADIENT
Sig 12
Sig 14
Sig 16
Point 57
Point 55B
Point 56A
Point 56B
Point 55A
ADM SIDING 1
ADM SIDING 2
ADM SIDING 3
ADM 28T
ADM 27T
ADM SIDING
UP TRACK PLATFORM 1
DOWN TRACK
Point 71B
Point 71A
CENTRAL
143.810
252.420
124.100(UP KP)
220.602(DN KP)
-2.4%
-3%
36m 1500
9m 1500
DN TRACK PLATFORM 2
UP TRACK
97.932
228.245
93.300 (DN KP)
129.222 (DN KP)
+0.277%
4.155m 1500
+2.4%
277.650(UP KP)
-3%
81m 1500
Point 72B
Point 72A
CENTRAL
-95.340
153.240
-95.390
156.626
233.023
233.143
156.036
-95.950
123.703
123.708
123.250
246.438
285.474
21m 1500
27m 3000
24m 1500
STRAIGHT
0%
+1.4%
+0.5%
+3%

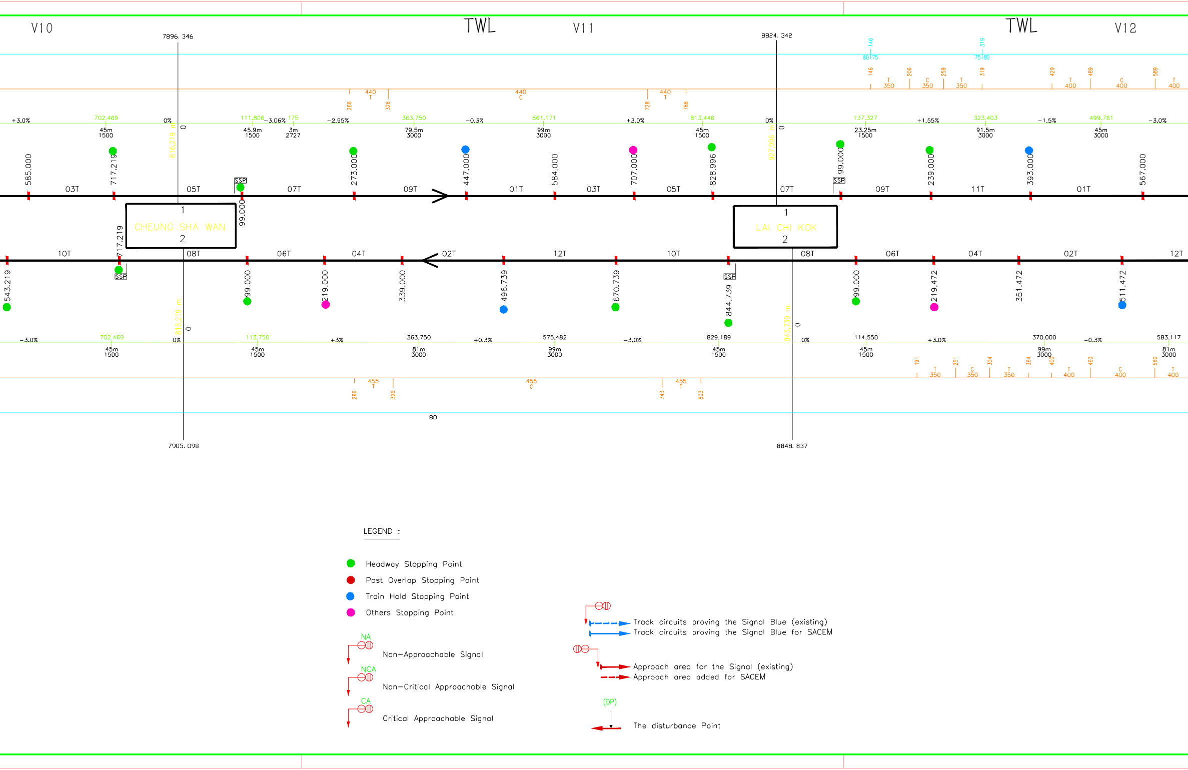

TWL
V5
TWL
3122. 072
3924. 770
3128. 605
3931. 457
TSIM SHA TSUI
JORDAN
1
2
09T
11T
13T
15T
17T
19T
21T
23T
01T
03T
05T
07T
09T
10T
08T
06T
04T
02bT
02aT
10T
08T
06T
04T
02T
19T
72A
72B
21
23
25
26
24
22
02
01
04
NA
NCA
SSP
+3.0%
0%
-3.0%
+3.0%
0%
2280.786
113.75
210.917
431.000
688.500
98.750
2290.378
113.750
210.917
431.000
688.500
98.750
45m 1500
90m 3000
15m 3000
2062.532
2174.532
2179.532
2296.532
2301.532
36.782
176.782
252.782
257.782
336.593
382.670
384.317
389.317
465.352
574.317
587.532
704.352
710.352
45.681
189.681
324.681
2053.910
2233.910
2368.910
99.782
248.782
257.782
259.429
328.973
416.317
421.317
603.846
608.846
761.846
103.054
111.054
229.054
318.000
347.485
123.5
2394.774
2404.144
802.698
802.852
80


475.903
628.394
TWL UP TRACK
STRAIGHT
539.521
0%
15m 3000
Point 51
SPEED
CURVES
GRADIENT
631.600
ISL DOWN TRACK
+0.5%
539.521
0%
15m 3000
Point 53
Point 684
469.254
631.704
SPEED
CURVES
GRADIENT
ISL UP TRACK
STRAIGHT
+3%
536.950
0%
45m 1500
Point 683
625.521
TWL DOWN TRACK
STRAIGHT
+3%
536.930
0%
45m 1500
Point 54
Point 52

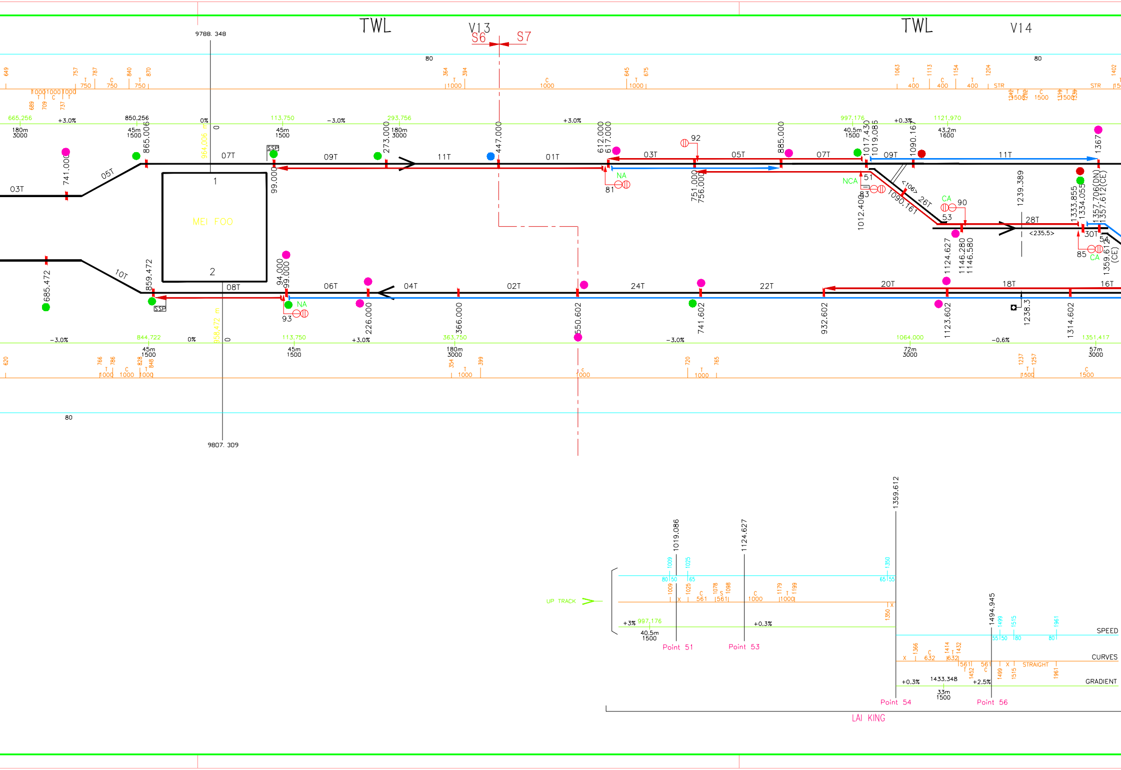

TWL DOWN TRACK
259.429
382.670
SPEED
CURVES
GRADIENT
DOWN TRACK
UP TRACK
STRAIGHT
928
-3%
210.917(DN KP)
0%
431.000(UP KP)
+3%
90m 3000
90m 3000
Point 72B
Point 72A
TSIM SHA TSUI
KTL DOWN TRACK

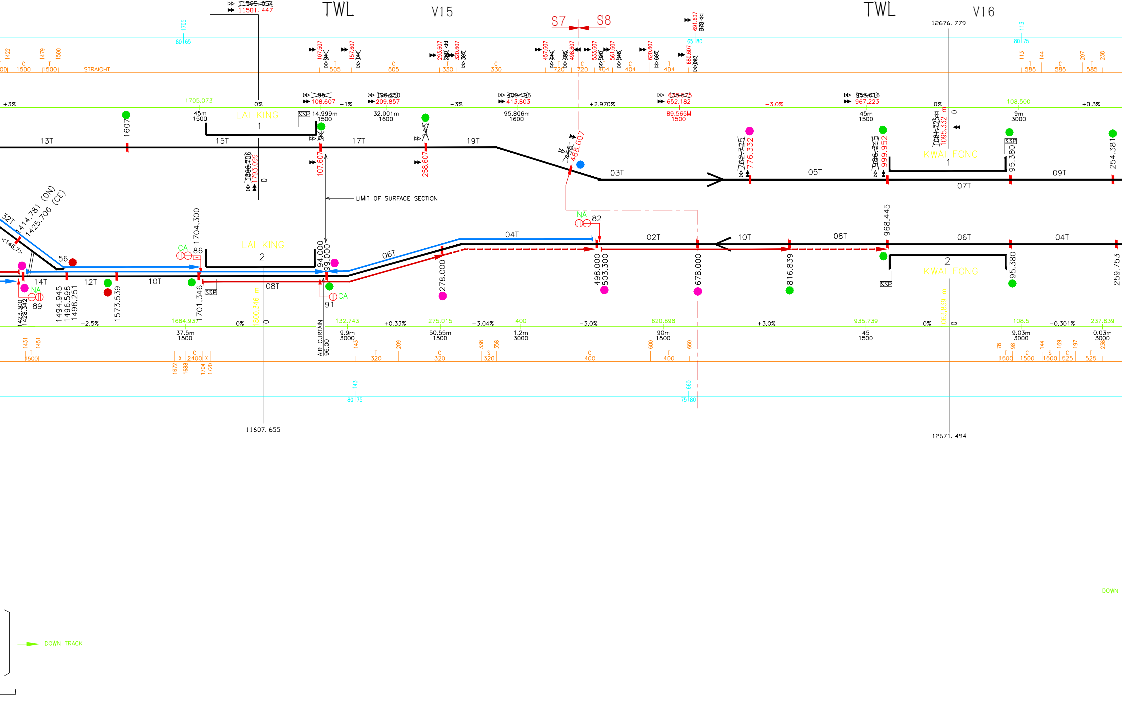

TWL
V6
S3
S4
V7
TWL
V8
S4
S5
4785. 386
5549. 418
11T
01T
03T
05T
07T
09T
01T
03T
05aT
05bT
07T
09T
11T
13T
01T
10T
08T
06T
04T
02T
16T
14T
12T
10T
06bT
06aT
04T
02bT
02aT
12T
35T
37T
39T
41T
43T
45T
46T
44T
42T
40T
38T
63T
62T
1
YAU MA TEI
2
1
MONG KOK
HIGH LEVEL
3
2
MONG KOK
LOW LEVEL
4
SSP
KTL UP-TRACK
KTL DOWN TRACK
TWL UP TRACK
KTL UP TRACK
KTL DOWN TRACK
TWL DOWN TRACK
NA
CA
21
24
25
26
27
28
31
33
34
35
38
40
71
72
74
75
76
77
79
80
459.681
603.681
759.681
229.065
351.065
472.100
477.065
630.065
635.100
741.065
17.000
95.000
100.003
140.686
185.135
263.915
265.568
270.400
337.000
364.054
499.054
634.054
760.054
95.729
217.729
97.065
334.729
500.700
505.729
507.382
569.729
630.611
744.177
666.297
671.300
92.880
209.880
214.900
342.880
392.880
4793. 782
5559. 079
SPEED
CURVES
GRADIENT
STRAIGHT
Point 76
Point 80
Point 71
Point 75
Point 72
Point 74
MONG KOK
MONG KOK

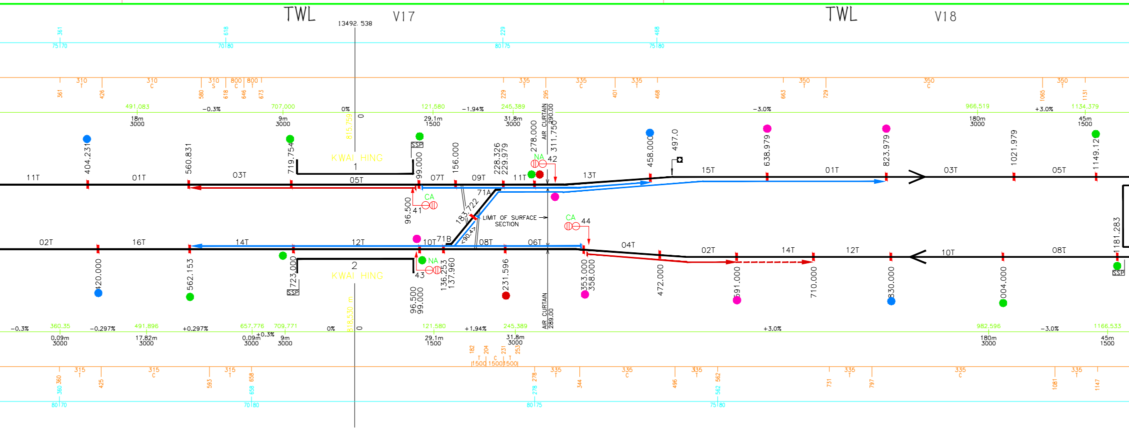

TWL
V9
TWL
S5
S6
6135. 638
7080. 127
86
80 70
371
70 80
542
572
T
1000
C
1000
635
666
T
1000
310
T
310
C
310
T
1500
T
1500
C
1500
T
86
145
312
371
421
441
496
516
0%
100.625
152.125
18.75m
1500
+1.25%
26.25
1500
-0.5%
450,000
75m
3000
-3.0%
665,942
180m
3000
+3.0%
830,739
45m
1500
0%
113,750
45m
1500
-3.0%
363,750
63.6m
1500
+1.24%
452,475
52.8m
3000
586.220 m
0
944.489 m
0
487.000
562.220
235.000
375.000
545.000
719.000
845.489
279.000
459.000
03aT
03bT
05T
07T
01T
03T
05T
07T
09T
11T
01T
SSP
SSP
99.000
99.000
1
PRINCE EDWARD
HIGH LEVEL
1
SHAM SHUI PO
2
844.920
10T
08T
06T
04T
02T
12T
SSP
503.000
677.000
99.000
215.219
369.219
139.815
263.915
SPEED
80
80
267
STRAIGHT
CURVES
TWL UP TRACK
02.5(KTL UP KP)
-1.5%
229.615
0%
288.985
+2.5%
GRADIENT
22.5m
1500
22.5m
1500
37.5m
1500
Point 77
Point 79
02T
830,170
45m
1500
0%
943.920 m
0
113,750
45m
1500
+3.0%
363,750
63.6m
1500
-1.24%
452,475
52.8m
3000
-3.0%
580,859
15.9m
3000
339.000
7088. 879
489.880
550.880
10T
08T
06T
04T
99.000
217.000
4
PRINCE EDWARD
LOW LEVEL
SSP
585.880
0
6144. 959
472,130
45m
1500
0%
102,500
146,500
22.5m
1500
+1.5%
22.5m
1500
+3.0%
386,500
-2.47%
164.1m
3000
404
424
452
472
T
C
T
1500
1500
1500
310
T
310
C
310
T
85
144
308
367
80 75
75 80

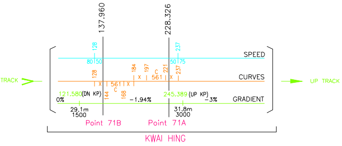


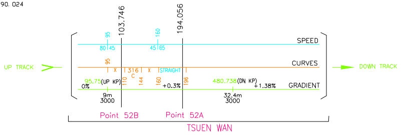
V10
TWL
V11
TWL
V12
7896. 346
8824. 342
7905. 098
8848. 837
CHEUNG SHA WAN
LAI CHI KOK
1
2
03T
05T
07T
09T
01T
11T
10T
08T
06T
04T
02T
12T
SSP
585.000
717.219
273.000
447.000
584.000
707.000
828.996
99.000
239.000
393.000
567.000
543.219
219.000
339.000
496.739
670.739
844.739
219.472
351.472
511.472
816.219 m
927.996 m
943.739 m
+3.0%
0%
-3.06%
-2.95%
-0.3%
+1.55%
-1.5%
-3.0%
+3%
+0.3%
702.469
111.806
175
363.750
561.171
813.446
137.327
323.403
499.761
113.750
575.482
829.189
114.550
370.000
583.117
45m 1500
45.9m 1500
3m 2727
79.5m 3000
99m 3000
23.25m 1500
91.5m 3000
81m 3000
440 T
440 C
455 T
455 C
350
400
80
LEGEND :
Headway Stopping Point
Post Overlap Stopping Point
Train Hold Stopping Point
Others Stopping Point
NA
Non-Approachable Signal
NCA
Non-Critical Approachable Signal
CA
Critical Approachable Signal
Track circuits proving the Signal Blue (existing)
Track circuits proving the Signal Blue for SACEM
Approach area for the Signal (existing)
Approach area added for SACEM
(DP)
The disturbance Point

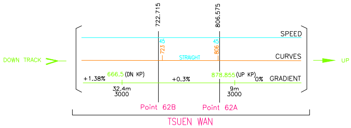

TWL
V13
S6
S7
TWL
V14
9788. 348
80
03T
05T
07T
09T
11T
01T
03T
05T
07T
09T
11T
26T
28T
30T
10T
08T
06T
04T
02T
24T
22T
20T
18T
16T
MEI FOO
1
2
SSP
NA
NCA
CA
92
81
51
53
90
85
54
93
741.000
865.006
964.006 m
99.000
273.000
447.000
612.000
617.000
751.000
756.000
885.000
1012.400
1017.430
1019.085
1090.167
1090.161
1239.389
1333.855
1334.055
1357.706(DN)
1357.612(CE)
1359.612(CE)
1367
1124.627
1146.280
1146.580
<235.5>
<106.7>
685.472
859.472
958.472 m
94.000
99.000
226.000
366.000
550.602
741.602
932.602
1123.602
1238.3
1314.602
+3.0%
0%
-3.0%
+3.0%
+0.3%
-0.6%
9807. 309
1019.086
1124.627
1359.612
1494.945
UP TRACK
Point 51
Point 53
Point 54
Point 56
SPEED
CURVES
GRADIENT
STRAIGHT
1433.348
LAI KING

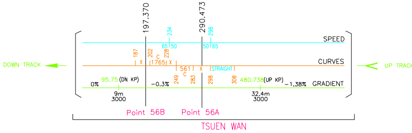

TWL
V15
TWL
V16
S7
S8
11595.054
11581.447
12676.779
12671.494
11607.655
LAI KING 1
LAI KING 2
KWAI FONG 1
KWAI FONG 2
13T
15T
17T
19T
03T
05T
07T
09T
32T
14T
12T
10T
08T
06T
04T
02T
10T
08T
06T
04T
1414.781 (DN)
1425.706 (CE)
1607
1704.300
1701.346
1573.539
1494.945
1496.598
1498.251
1423.300
1428.342
1806.706
1793.099
107.607
258.607
94.000
99.000
278.000
498.000
503.300
678.000
816.839
968.445
95.380
259.753
254.381
762.725
776.332
986.345
999.952
1081.725
1095.332
455
468.607
245
94
STRAIGHT
LIMIT OF SURFACE SECTION
AIR CURTAIN 96.00
SSP
CA
NA
56
86
89
91
82
+3%
0%
−1%
−3%
+2.970%
−3.0%
+0.3%
−2.5%
+0.33%
−3.04%
+3.0%
−0.301%
1705.073
108.607
209.857
413.803
652.182
967.223
108.500
45m 1500
14.999m 1500
32.001m 1600
95.806m 1600
89.565M 1500
9m 3000
1684.937
132.743
275.015
400
620.698
935.739
108.5
237.839
37.5m 1500
9.9m 3000
50.55m 1500
1.2m 3000
90m 1500
45 1500
9.03m 3000
0.03m 3000
1800.346 m
1063.839 m
DOWN
DOWN TRACK

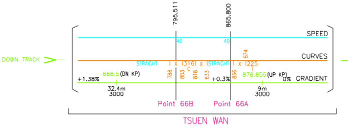

TWL
V17
TWL
V18
13492. 538
13490. 024
KWAI HING
1
KWAI HING
2
11T
01T
03T
05T
07T
09T
11T
13T
15T
01T
03T
05T
02T
16T
14T
12T
10T
08T
06T
04T
02T
14T
12T
10T
08T
71A
71B
LIMIT OF SURFACE SECTION
AIR CURTAIN 290.00
AIR CURTAIN 289.00
CA
41
NA
42
CA
44
NA
43
SSP
404.231
560.831
719.754
99.000
156.000
228.326
229.979
278.000
311.750
458.000
497.0
638.979
823.979
1021.979
1149.12
1181.283
96.500
183.722
420.000
562.153
723.000
96.500
99.000
136.253
137.960
231.596
353.000
358.000
472.000
591.000
710.000
830.000
1004.000
815.750
818.530
491.083
707.000
121.580
245.389
966.519
1134.379
-0.3%
0%
-1.94%
-3.0%
+3.0%
18m 3000
9m 3000
29.1m 1500
31.8m 3000
180m 3000
45m 1500
360.35
491.896
657.776
709.771
121.580
245.389
982.596
1166.533
-0.297%
+0.297%
+0.3%
+1.94%
0.09m 3000
17.82m 3000
0.09m 3000
9m 3000
29.1m 1500
31.8m 3000
180m 3000
45m 1500
310
335
350
315
75 70
70 80
80 75
75 80
80 70

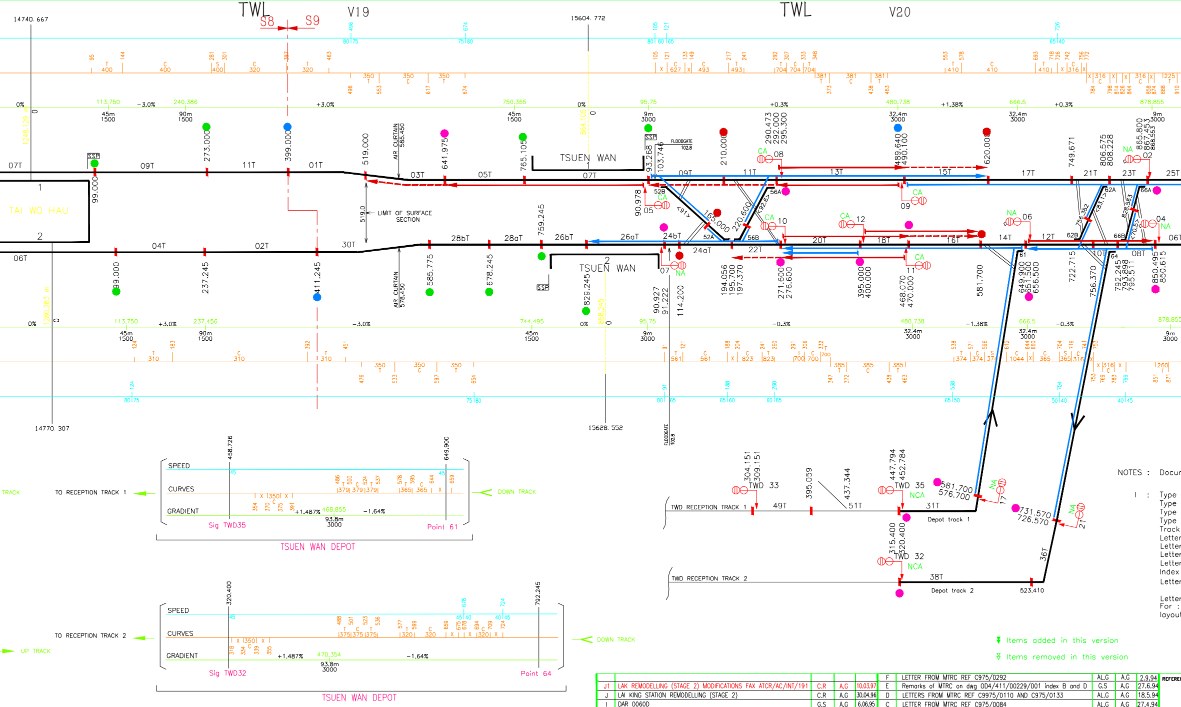

137.960
228.326
SPEED
CURVES
GRADIENT
TRACK
UP TRACK
80 50
50 75
561
121.580 (DN KP)
245.389 (UP KP)
0%
-1.94%
-3%
29.1m 1500
31.8m 3000
Point 71B
Point 71A
KWAI HING


103.746
194.056
SPEED
CURVES
GRADIENT
UP TRACK
DOWN TRACK
80 45
45 65
316
STRAIGHT
95.75 (UP KP)
480.738 (DN KP)
0%
+0.3%
+1.38%
9m 3000
32.4m 3000
Point 52B
Point 52A
TSUEN WAN


722.715
806.575
SPEED
CURVES
GRADIENT
DOWN TRACK
UP
STRAIGHT
666.5 (DN KP)
878.855 (UP KP)
+1.38%
+0.3%
0%
32.4m 3000
9m 3000
Point 62B
Point 62A
TSUEN WAN


197.370
290.473
SPEED
CURVES
GRADIENT
DOWN TRACK
UP TRACK
65 50
50 65
1765
561
STRAIGHT
95.75 (DN KP)
480.738 (UP KP)
0%
-0.3%
-1.38%
9m 3000
32.4m 3000
Point 56B
Point 56A
TSUEN WAN


795.511
865.800
SPEED
CURVES
GRADIENT
DOWN TRACK
STRAIGHT
316
STRAIGHT
225
666.5 (DN KP)
878.855 (UP KP)
+1.38%
+0.3%
0%
32.4m 3000
9m 3000
Point 66B
Point 66A
TSUEN WAN


TWL
S8
S9
V19
TWL
V20
14740. 667
15604. 772
14770. 307
15628. 552
TAI WO HAU
TSUEN WAN
TSUEN WAN
07T
09T
11T
01T
03T
05T
07T
09T
11T
13T
15T
17T
21T
23T
25T
06T
04T
02T
30T
28bT
28aT
26bT
26aT
24bT
24aT
22T
20T
18T
16T
14T
12T
10T
08T
SSP
AIR CURTAIN 585.450
AIR CURTAIN 578.450
LIMIT OF SURFACE SECTION
519.0
FLOODGATE 102.8
CA
NA
NCA
52A
52B
56A
56B
62A
62B
64
66A
66B
61
TWD 33
TWD 35
TWD 32
TWD RECEPTION TRACK 1
TWD RECEPTION TRACK 2
49T
51T
31T
38T
36T
Depot track 1
Depot track 2
523.410
SPEED
CURVES
GRADIENT
TO RECEPTION TRACK 1
TO RECEPTION TRACK 2
DOWN TRACK
UP TRACK
Sig TWD35
Point 61
Sig TWD32
Point 64
TSUEN WAN DEPOT
TSUEN WAN DEPOT
+1.487%
−1.64%
93.8m
3000
0%
−3.0%
+3.0%
+0.3%
+1.38%
−0.3%
−1.38%

NOTES : Docur

I : Type
Type
Type
Type
Track
Letter
Letter
Letter
Letter
Index
Letter

Letter
For :
layout

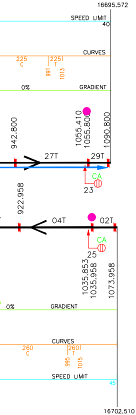
Items added in this version

Items removed in this version

REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE
J1	LAK REMODELLING (STAGE 2) MODIFICATIONS FAX ATCR/AC/INT/191	C.R	A.G	10.03.97
J	LAI KING STATION REMODELLING (STAGE 2)	C.R	A.G	30.04.96
I	DAR 0060D	G.S	A.G	6.06.95
H	DAR 0060C	G.S	A.G	25.04.95
G	INDEX F MTRC COMMENTS – LETTER FROM MTRC REF C975/0367	G.S	A.G	24.10.94
F	LETTER FROM MTRC REF C975/0292	AL.G	A.G	2.9.94
E	Remarks of MTRC on dwg OD4/411/00229/001 index B and D	G.S	A.G	27.6.94
D	LETTERS FROM MTRC REF C9975/0110 AND C975/0133	AL.G	A.G	18.5.94
C	LETTER FROM MTRC REF C975/0084	AL.G	A.G	27.4.94
B	LEGEND AND NOTES ADDING	AL.G	A.G	14.4.94
A	CURVES , GRADIENT AND SPEED MODIFICATIONS	AL.G	A.G	6.4.94

REFERE

CONTRA

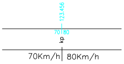

16695.572
SPEED LIMIT
40
CURVES
225
C
225
T
991
1013
0%
GRADIENT
942.800
1055.410
1055.800
1090.800
27T
29T
CA
23
922.958
04T
02T
CA
25
1035.853
1035.958
1073.958
0%
GRADIENT
CURVES
260
C
260
T
995
1015
SPEED LIMIT
45
16702.510

TWL

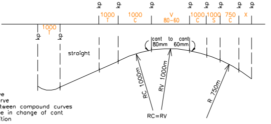
V21

LEGEND :

SPEED LIMIT in Km/h

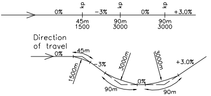

123.456
70
80
kp
70Km/h
80Km/h

CURVES

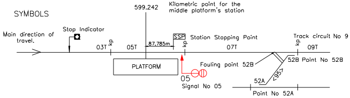

kp
1000
T
kp
kp
1000
C
kp
V
80-60
kp
1000
C
kp
1000
S
kp
750
C
kp
X
kp
straight
cant 80mm
to
cant 60mm
RC 1000m
RV 1000m
R 750m
RC=RV

C: Circular curve
T: Transition curve
S: Transtion between compound curves
V: Circular curve in change of cant
X: Virtual transition

GRADIENT


0%
kp
-3%
kp
0%
kp
+3.0%
45m
1500
90m
3000
90m
3000
Direction
of travel
0%
45m
1500m
-3%
3000m
3000m
0%
+3.0%
90m
90m

SYMBOLS


599.242
Kilometric point for the middle platform's station
Main direction of travel.
Stop Indicator
03T
kp
05T
SSP
87.785m
kp
Station Stopping Point
07T
Track circuit No 9
kp
09T
52B Point No 52B
PLATFORM
Fouling point 52B
<95>
05
Signal No 05
52A
Point No 52A

<95> Length between the point's toes for crossing

mentation from MTRC used to build the pre scheme plan of TWL line :

A2/1373/ Serial No 1 to 16A .
A2/1200/ Serial No 1 to 9 .
EM/E2/01/ 01A and 03 .
RA2/1374/ 1 and 2 .
Diagrams (Amendment Leaflet No3 - Sept 91)
from MTRC Ref C975/0084 (13 April 94)
from MTRC Ref C975/0133 (12 May 94)
from MTRC Ref C975/0192 (17 june 94)
from MTRC Ref C975/0292 (16 August 94)
F MTRC comments
s from MTRC Ref C975/0741 (14 March 95)
and C975/0802 (4 APRIL 95)
from MTRC Ref C975/0908 (15 May 95)
Track circuit layout , station layout ,signalling
, kilometric point , TWL line plan .

II : Letter from MTRC No C975/0050 of the 16 MARCH 94.
Fax from MTRC No 93604 of the 21 March 94.
Index F MTRC comments
Letters from MTRC Ref C975/0741 (14 March 95)
and C975/0802 (4 APRIL 95)
Letter from MTRC Ref C975/0908 (15 May 95)
For : Gradient indications .

III : Schedule of informations No2 .
Letter from MTRC Ref C975/0084 (13 April 94)
Index F MTRC comments and letter from MTRC
Ref C975/0367 (21 October 94)
Letters from MTRC Ref C975/0741 (14 March 95)
and C975/0802 (4 APRIL 95)
Letter from MTRC Ref C975/0908 (15 May 95)
For : Curves indications .

IV: Track diagrams (Amendment Leaflet No3 - sept 91)
Letter from MTRC Ref C975/0292 (16 August 94)
Index F MTRC comments
Letters from MTRC Ref C975/0741 (14 March 95)
and C975/0802 (4 APRIL 95)
Letter from MTRC Ref C975/0908 (15 May 95)
For : Speed restrictions

NCE DWGS

CTOR'S DRAWING NO.

	INITIAL	SIGNATURE	DESIGNATION	DATE
DRAWN BY	BULOT		FCV-BE	MARCH 1994
CHECKED BY	ROLLET		FCV-BE	MARCH 1994
APPROVED BY	GHIURITAN		FCV-BE	MARCH 1994
PLOT SCALE	FIT	PLOT DATE		MARCH 1994
PEN SET	0.3MM	PRINT DATE		MARCH 1994
CAD REF NO.	TWLSP			

GEC ALSTHOM TRANSPORT S. A.

TITLE

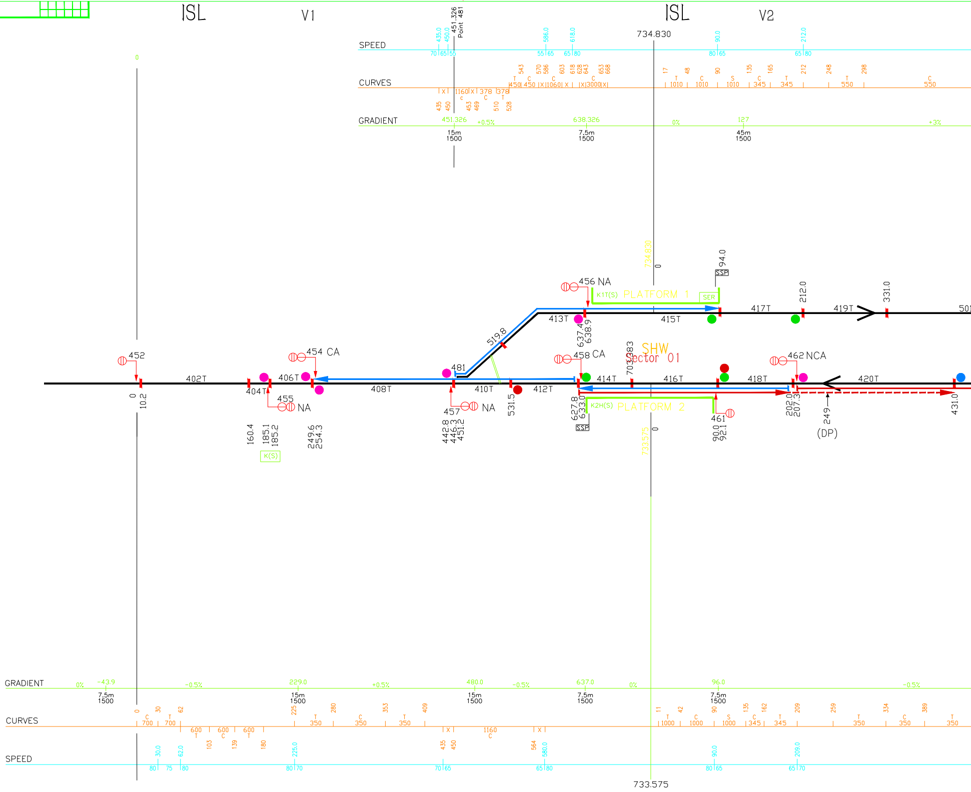
TWL PRE SCHEME PLAN
SACEM SECTORS STOPPING POINTS

SCALE NOT TO SCALE

DWG NO. OD1/411/00229/002

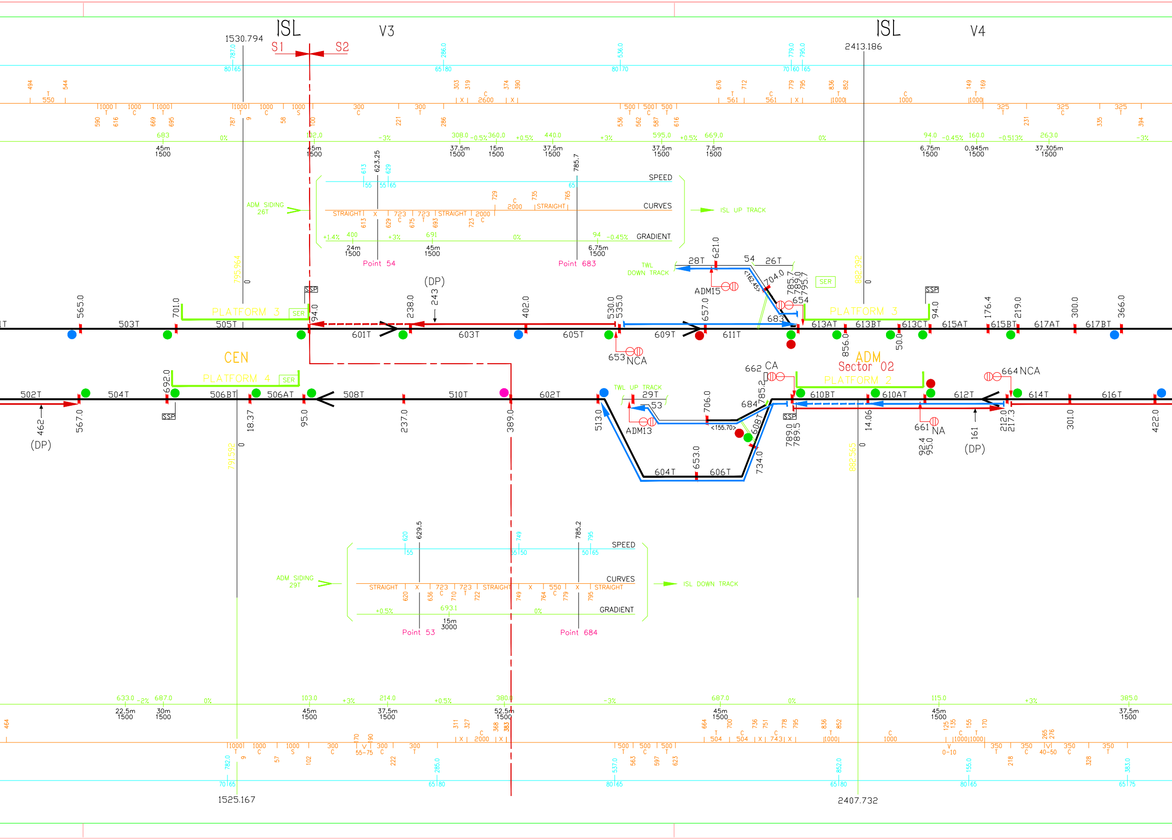
G	H	I	J	J1	
A	B	C	D	E	F

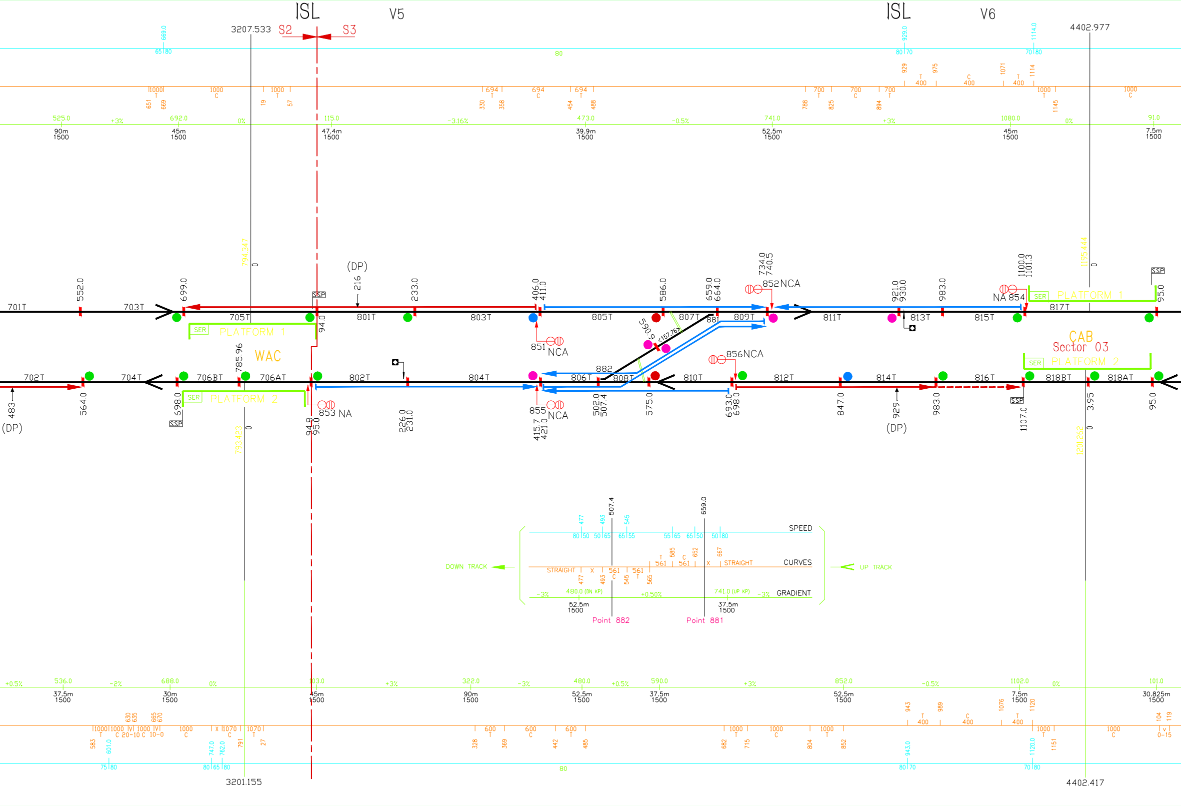
0D1/411/00329/002

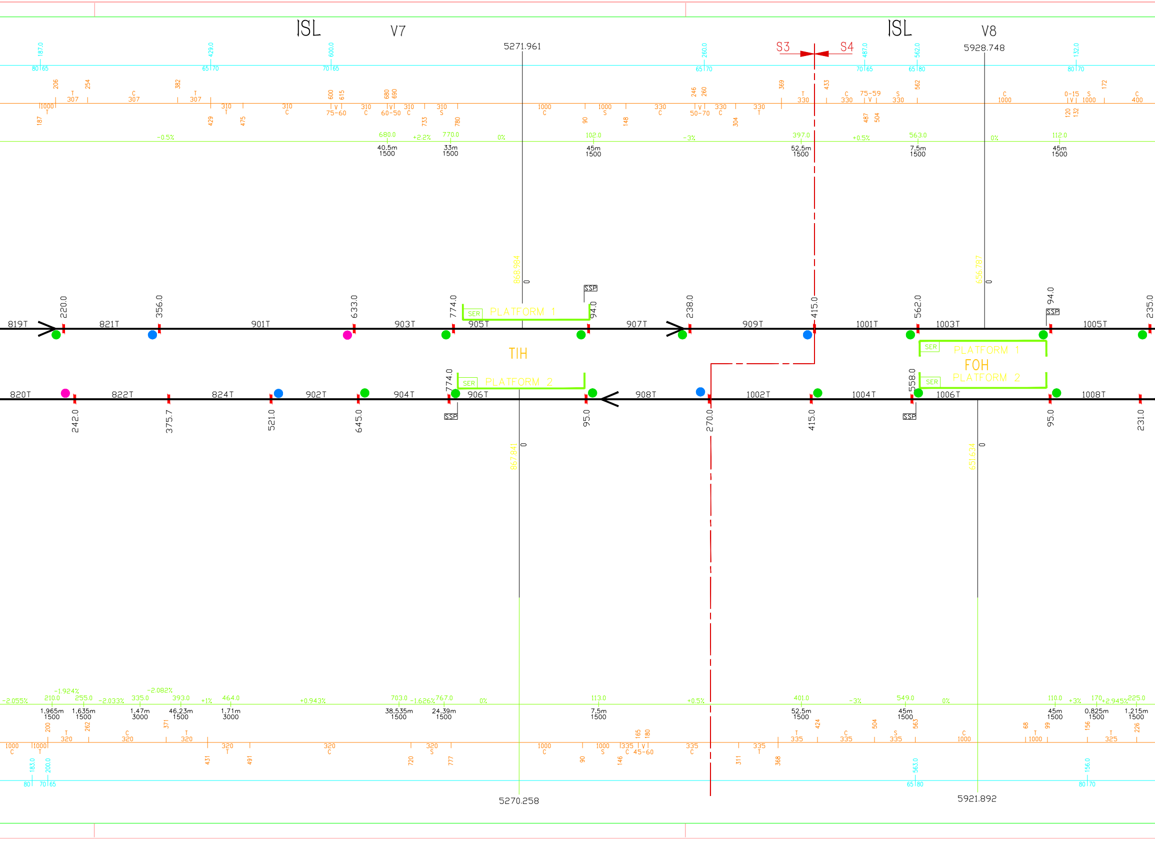


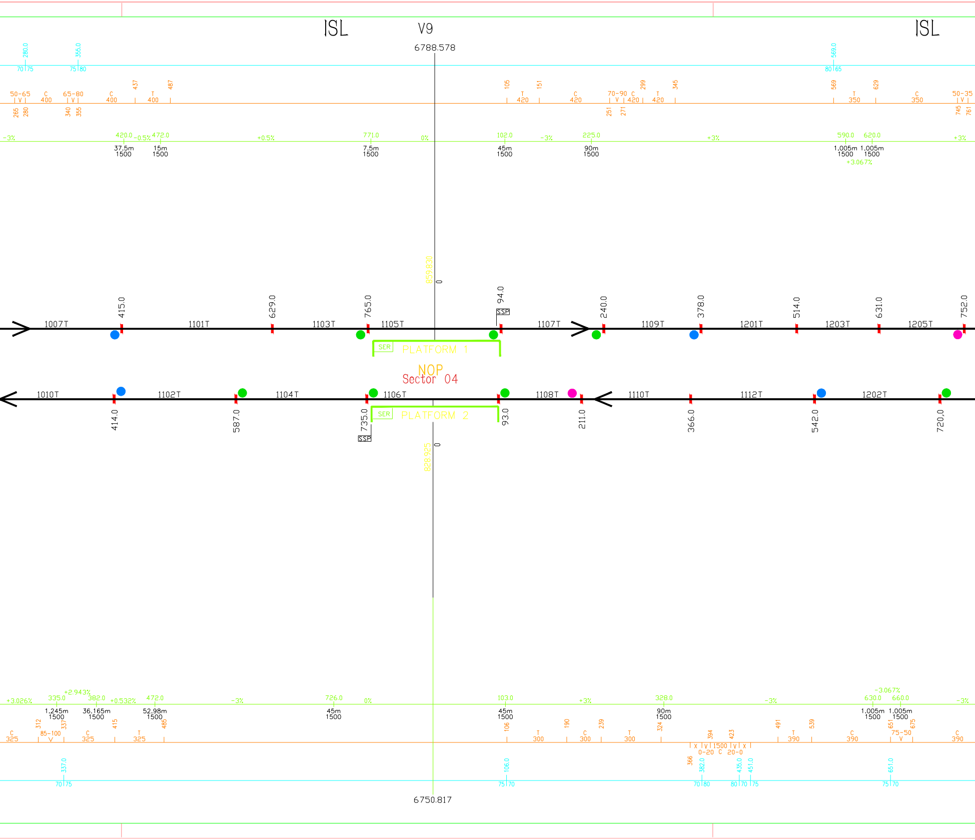
ISL
V1
ISL
V2
734.830
451.326 Point 481
SPEED
CURVES
GRADIENT
451.326
+0.5%
638.326
0%
127
+3%
15m 1500
7.5m 1500
45m 1500
734.830
94.0
SSP
456 NA
K1T(S)
PLATFORM 1
SER
417T
212.0
419T
331.0
413T
415T
637.4
638.9
519.8
481
454 CA
452
402T
404T
406T
455 NA
408T
410T
412T
457 NA
458 CA
414T
SHW
Sector 01
703.383
416T
462 NCA
418T
420T
461
K2H(S)
PLATFORM 2
0
10.2
160.4
185.1
185.2
K(S)
249.6
254.3
442.8
446.3
451.2
531.5
627.8
633.0
SSP
733.575
90.0
92.1
202.0
207.3
249
(DP)
431.0
GRADIENT
0%
-43.9
-0.5%
229.0
+0.5%
480.0
-0.5%
637.0
0%
96.0
-0.5%
7.5m 1500
15m 1500
15m 1500
7.5m 1500
7.5m 1500
CURVES
SPEED
733.575

A2 SIZE, 594 x 420mm, TYPE 2

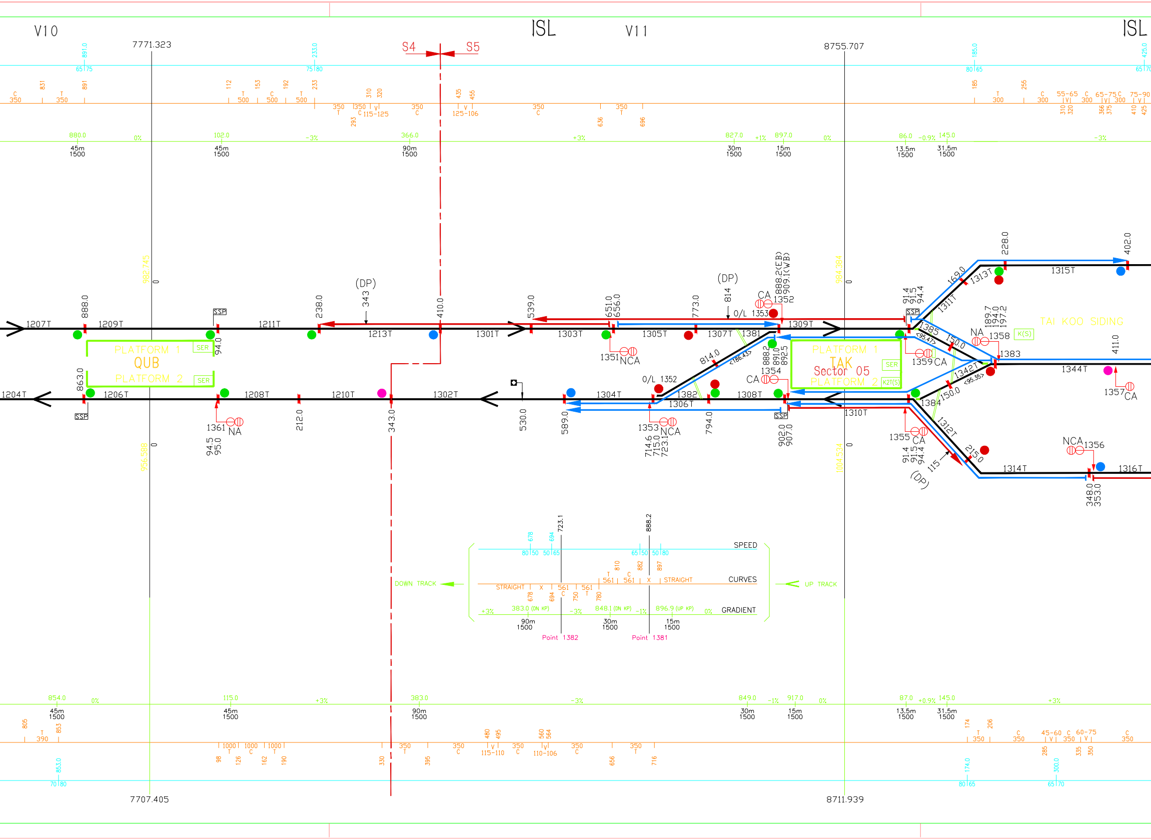

ISL
V3
1530.794
S1
S2
ISL
V4
2413.186
SPEED
CURVES
GRADIENT
ADM SIDING 26T
ISL UP TRACK
STRAIGHT
723
2000
Point 54
Point 683
(DP)
243
TWL DOWN TRACK
28T
621.0
54
26T
704.0
<162.45>
785.7
789.0
795.7
654
683
ADM15
SER
SSP
PLATFORM 3
565.0
503T
701.0
505T
94.0
601T
238.0
603T
402.0
605T
530.0
535.0
609T
657.0
611T
613AT
613BT
613CT
615AT
176.4
615BT
219.0
617AT
300.0
617BT
366.0
856.0
50.0
653 NCA
CEN
PLATFORM 4
ADM
Sector 02
PLATFORM 2
662 CA
664 NCA
502T
504T
692.0
506BT
506AT
508T
510T
602T
29T
53
706.0
684
785.2
610BT
610AT
612T
614T
616T
462
(DP)
567.0
18.37
95.0
237.0
389.0
513.0
ADM13
<155.70>
608T
604T
653.0
606T
734.0
789.0
789.5
14.06
661 NA
92.4
95.0
161
(DP)
212.0
217.3
301.0
422.0
TWL UP TRACK
ADM SIDING 29T
ISL DOWN TRACK
629.5
785.2
550
Point 53
Point 684
693.1
15m
3000
1525.167
2407.732

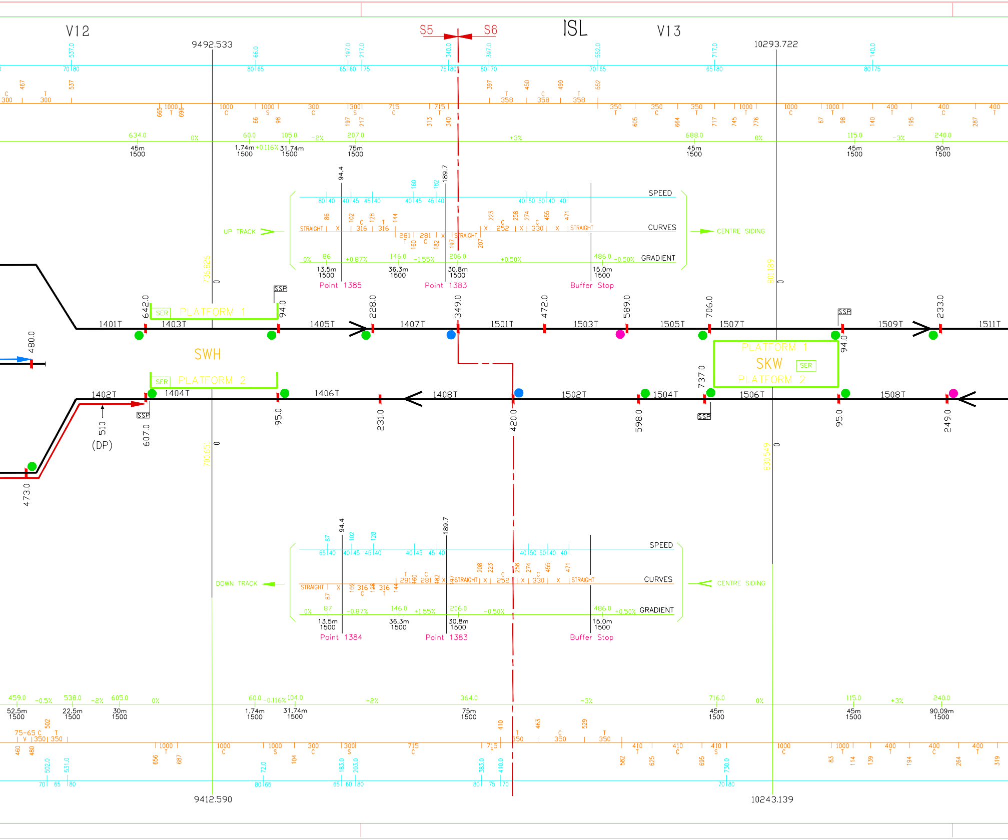

ISL
V5
ISL
V6
3207.533
S2
S3
4402.977
80
525.0
+3%
692.0
0%
115.0
-3.16%
473.0
-0.5%
741.0
+3%
1080.0
0%
91.0
90m 1500
45m 1500
47.4m 1500
39.9m 1500
52.5m 1500
45m 1500
7.5m 1500
701T
703T
705T
801T
803T
805T
807T
809T
811T
813T
815T
817T
702T
704T
706BT
706AT
802T
804T
806T
808T
810T
812T
814T
816T
818BT
818AT
881
882
552.0
699.0
216
(DP)
233.0
406.0 411.0
586.0
659.0 664.0
734.0 740.5
852NCA
921.0 930.0
983.0
NA 854
1100.0 1101.3
95.0
SSP
SER
PLATFORM 1
PLATFORM 2
94.0
785.96
WAC
851 NCA
590.6
<157.762
856NCA
CAB
Sector 03
483
(DP)
564.0
698.0
853 NA
94.8 95.0
226.0 231.0
855 NCA
415.7 421.0
502.0 507.4
575.0
693.0 698.0
847.0
929
(DP)
983.0
1107.0
3.95
95.0
794.347
793.423
1195.444
1201.262
0
507.4
659.0
SPEED
CURVES
GRADIENT
DOWN TRACK
UP TRACK
STRAIGHT
X
561
480.0 (ON KP)
+0.50%
741.0 (UP KP)
-3%
52.5m 1500
37.5m 1500
Point 882
Point 881
+0.5%
536.0
-2%
688.0
0%
103.0
+3%
322.0
-3%
480.0
+0.5%
590.0
+3%
852.0
-0.5%
1102.0
0%
101.0
37.5m 1500
30m 1500
45m 1500
90m 1500
52.5m 1500
37.5m 1500
52.5m 1500
7.5m 1500
30.825m 1500
3201.155
4402.417

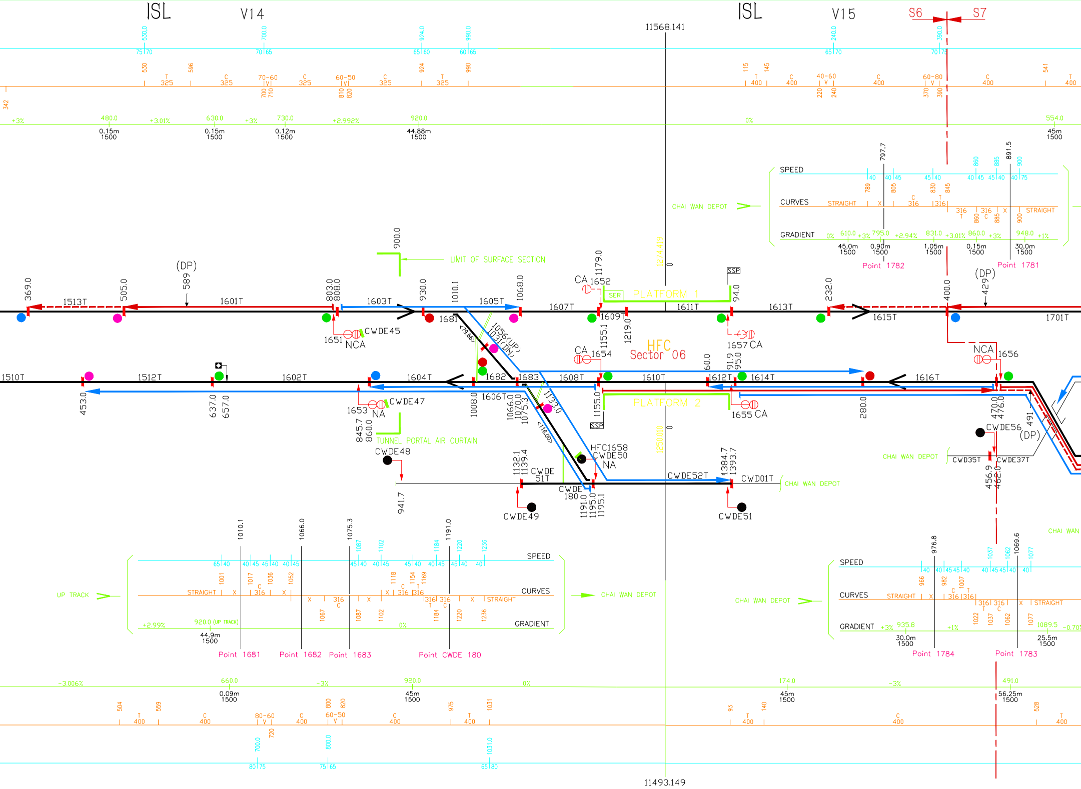

ISL
V7
5271.961
ISL
V8
5928.748
S3
S4
819T
821T
901T
903T
905T
907T
909T
1001T
1003T
1005T
820T
822T
824T
902T
904T
906T
908T
1002T
1004T
1006T
1008T
220.0
356.0
633.0
774.0
94.0
238.0
415.0
562.0
94.0
235.0
242.0
375.7
521.0
645.0
774.0
95.0
270.0
415.0
558.0
95.0
231.0
SER PLATFORM 1
SER PLATFORM 2
TIH
SER PLATFORM 1
FOH
SER PLATFORM 2
SSP
858.984
867.841
656.787
651.634
5270.258
5921.892
-0.5%
680.0
+2.2%
770.0
0%
102.0
-3%
397.0
+0.5%
563.0
0%
112.0
40.5m 1500
33m 1500
45m 1500
52.5m 1500
7.5m 1500
45m 1500
-2.055%
210.0
-1.924%
255.0
-2.033%
335.0
-2.082%
393.0
+1%
464.0
+0.943%
703.0
-1.626%
767.0
0%
113.0
+0.5%
401.0
-3%
549.0
0%
110.0
+3%
170
+2.945%
225.0
1.965m 1500
1.635m 1500
1.47m 3000
46.23m 1500
1.71m 3000
38.535m 1500
24.39m 1500
7.5m 1500
52.5m 1500
45m 1500
45m 1500
0.825m 1500
1.215m 1500

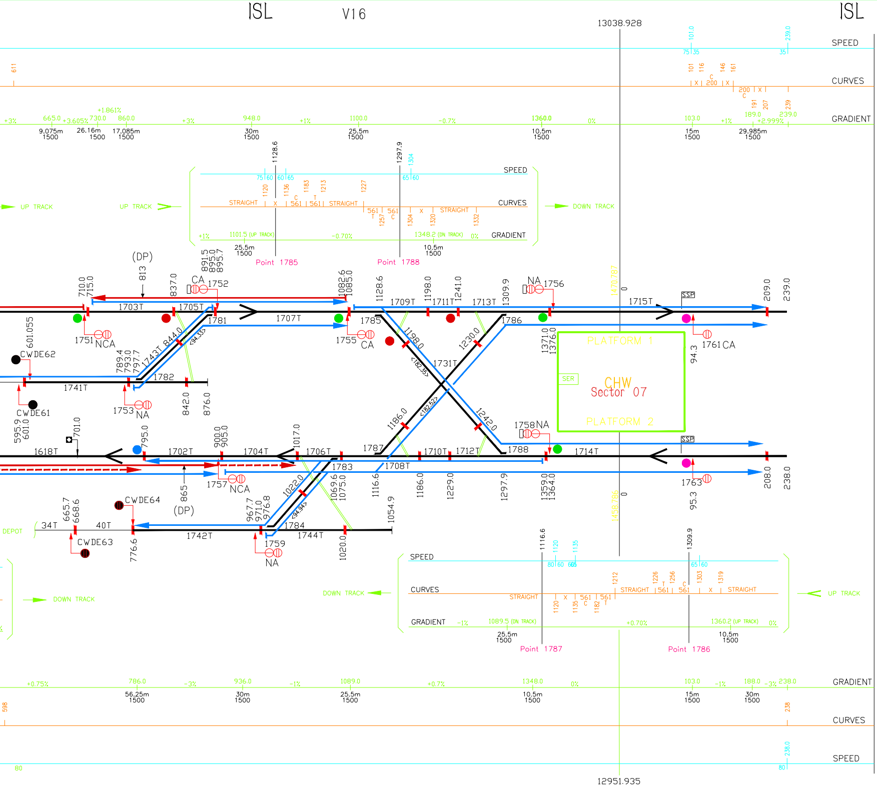


ISL
V9
ISL
6788.578
280.0
355.0
70 75
75 80
569.0
80 65
50-65
V
C
400
65-80
V
C
400
437
T
400
487
265
280
340
355
105
T
420
151
C
420
70-90
V
C
420
299
T
420
345
251
271
569
T
350
629
C
350
50-35
V
745
761
-3%
420.0
-0.5%
472.0
+0.5%
771.0
0%
102.0
-3%
225.0
+3%
590.0
620.0
+3%
37.5m
1500
15m
1500
7.5m
1500
45m
1500
90m
1500
1.005m
1500
1.005m
1500
+3.067%
959.830
0
415.0
629.0
765.0
94.0
SSP
240.0
378.0
514.0
631.0
752.0
1007T
1101T
1103T
1105T
1107T
1109T
1201T
1203T
1205T
SER
PLATFORM 1
NOP
Sector 04
1010T
1102T
1104T
1106T
1108T
1110T
1112T
1202T
SER
PLATFORM 2
414.0
587.0
735.0
SSP
93.0
211.0
366.0
542.0
720.0
828.925
0
+3.026%
335.0
+2.943%
382.0
+0.532%
472.0
-3%
726.0
0%
103.0
+3%
328.0
-3%
-3.067%
630.0
660.0
-3%
1.245m
1500
36.165m
1500
52.98m
1500
45m
1500
45m
1500
90m
1500
1.005m
1500
1.005m
1500
312
337
415
485
C
325
85-100
V
C
325
T
325
106
T
300
190
C
300
239
T
300
324
394
423
X
V
1500
V
X
0-20
C
20-0
491
T
390
539
C
390
651
675
75-50
V
C
390
366
337.0
70 75
106.0
75 70
382.0
70 80
436.0
451.0
80 70 75
651.0
75 70
6750.817


V10
7771.323
S4
S5
ISL
V11
8755.707
ISL
1207T
1209T
1211T
1213T
1301T
1303T
1305T
1307T
1309T
1311T
1313T
1315T
1204T
1206T
1208T
1210T
1302T
1304T
1306T
1308T
1310T
1312T
1314T
1316T
1342T
1344T
PLATFORM 1
QUB
PLATFORM 2
SER
SSP
PLATFORM 1
TAK
Sector 05
PLATFORM 2
K2T(S)
TAI KOO SIDING
K(S)
(DP)
343
(DP)
814
0/L 1353
CA 1352
888.2(EB)
909.1(WB)
1351 NCA
1381
1382
0/L 1352
1353 NCA
1354
CA
1359 CA
1385
1383
NA 1358
1384
1355 CA
115
(DP)
NCA 1356
1357 CA
1361 NA
888.0
863.0
94.0
94.5
95.0
238.0
212.0
410.0
343.0
539.0
530.0
589.0
651.0
656.0
773.0
794.0
714.6
715.0
723.1
814.0
888.2
891.0
892.5
902.0
907.0
91.4
91.5
94.4
169.0
150.0
189.7
194.0
197.2
228.0
402.0
411.0
150.0
215.0
348.0
353.0
982.745
956.588
984.384
1004.534
7707.405
8711.939
SPEED
CURVES
GRADIENT
DOWN TRACK
UP TRACK
STRAIGHT
X
561
C
T
810
882
897
678
694
750
780
723.1
888.2
383.0 (DN KP)
848.1 (DN KP)
896.9 (UP KP)
+3%
-3%
-1%
0%
90m 1500
30m 1500
15m 1500
Point 1382
Point 1381
880.0
102.0
366.0
827.0
897.0
86.0
145.0
854.0
115.0
383.0
849.0
917.0
87.0
45m 1500
13.5m 1500
31.5m 1500
+0.9%
-0.9%
+1%


V12
S5
S6
ISL
V13
9492.533
10293.722
SPEED
CURVES
GRADIENT
UP TRACK
CENTRE SIDING
STRAIGHT
Point 1385
Point 1383
Buffer Stop
94.4
189.7
13.5m 1500
36.3m 1500
30.8m 1500
15.0m 1500
+0.87%
-1.55%
+0.50%
-0.50%
PLATFORM 1
PLATFORM 2
SER
SSP
SWH
SKW
1401T
1403T
1405T
1407T
1501T
1503T
1505T
1507T
1509T
1511T
1402T
1404T
1406T
1408T
1502T
1504T
1506T
1508T
642.0
94.0
228.0
349.0
472.0
589.0
706.0
233.0
480.0
737.0
607.0
95.0
231.0
420.0
598.0
249.0
473.0
510 (DP)
736.826
700.651
801.189
830.549
DOWN TRACK
Point 1384
Point 1383
Buffer Stop
9412.590
10243.139
634.0
0%
60.0
+0.116%
105.0
-2%
207.0
+3%
688.0
115.0
-3%
240.0
45m 1500
1.74m 1500
31.74m 1500
75m 1500
90m 1500
459.0
-0.5%
538.0
605.0
104.0
+2%
364.0
716.0
52.5m 1500
22.5m 1500
30m 1500
90.09m 1500
75-65


ISL
V14
ISL
V15
S6
S7
11568.141
11493.149
SPEED
CURVES
GRADIENT
STRAIGHT
CHAI WAN DEPOT
UP TRACK
Point 1782
Point 1781
Point 1784
Point 1783
Point 1681
Point 1682
Point 1683
Point CWDE 180
LIMIT OF SURFACE SECTION
TUNNEL PORTAL AIR CURTAIN
(DP)
PLATFORM 1
PLATFORM 2
SER
SSP
HFC
Sector 06
1513T
1601T
1603T
1605T
1607T
1609T
1611T
1613T
1615T
1701T
1510T
1512T
1602T
1604T
1606T
1608T
1610T
1612T
1614T
1616T
1681
1682
1683
CA 1652
CA 1654
1657 CA
1655 CA
1651 NCA
CWDE45
1653 NA
CWDE47
CWDE48
CWDE49
CWDE 51T
CWDE 180
HFC1658
CWDE50
NA
CWDE52T
CWD01T
CWDE51
NCA 1656
CWDE56
CWD35T
CWDE37T
1056(UP)
1031(DN)
369.0
505.0
589
803.0
808.0
930.0
1010.1
1068.0
900.0
1179.0
1155.1
1219.0
94.0
232.0
400.0
429
453.0
637.0
657.0
845.7
860.0
1008.0
1066.0
1070.0
1075.3
1133.0
1155.0
60.0
91.9
95.0
280.0
470.0
476.0
491
941.7
1132.1
1139.4
1191.0
1195.0
1195.1
1384.7
1393.7
456.9
462.0
1274.419
1250.010



ISL V16
ISL V17
13038.928
12951.935
SPEED
CURVES
GRADIENT
UP TRACK
DOWN TRACK
DEPOT
Point 1785
Point 1788
Point 1787
Point 1786
PLATFORM 1
PLATFORM 2
CHW
Sector 07
SER
SSP
(DP)
1703T
1705T
1707T
1709T
1711T
1713T
1715T
1741T
1743T
1731T
1618T
1702T
1704T
1706T
1708T
1710T
1712T
1714T
1742T
1744T
34T
40T
1751 NCA
1752 CA
1753 NA
1755 CA
1756 NA
1757 NCA
1758 NA
1759 NA
1761 CA
1763
1781
1782
1783
1784
1785
1786
1787
1788
CWDE61
CWDE62
CWDE63
CWDE64

LEGEND :

🟩 Headway Stopping Point

🟥 Post Overlap Stopping Point

● Train Hold Stopping Point

● Others Stopping Point

NA Non–Approachable Signal

NCA Non–Critical Approachable Signal

CA Critical–Approachable Signal

Track circuits proving the Signal Blue (ex

Track circuits proving the Signal Blue for

Approach area for the Signal (existing)

Approach area added for SACEM

(DP) The Disturbance Point

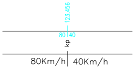
ISL V18

ISL V19

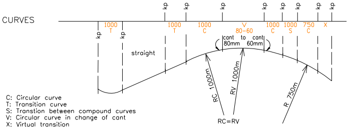
isting)
SACEM

LEGEND :

SPEED LIMIT in Km/h

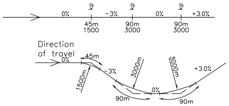

123.456
80 40
kp
80Km/h 40Km/h

CURVES

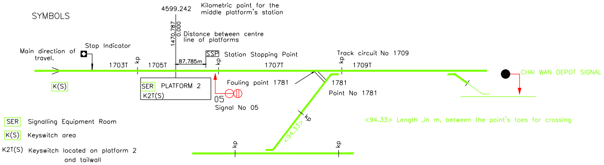

kp
1000 T
1000 T
1000 C
V 80-60
1000 C
1000 S
750 C
X
straight
cant to cant 80mm 60mm
RC 1000m
RV 1000m
R 750m
RC=RV

C: Circular curve
T: Transition curve
S: Transtion between compound curves
V: Circular curve in change of cant
X: Virtual transition

GRADIENT


kp
0%
-3%
0%
+3.0%
45m 1500
90m 3000
90m 3000
Direction of travel
0%
45m
1500m
-3%
3000m
0%
3000m
+3.0%
90m
90m

SYMBOLS


4599.242
Kilometric point for the middle platform's station
1470.787
0.000
Distance between centre line of platforms
Stop Indicator
Main direction of travel.
SSP
Station Stopping Point
Track circuit No 1709
1703T
kp
1705T
87.785m
1707T
1709T
K(S)
SER PLATFORM 2
K2T(S)
Fouling point 1781
1781
Point No 1781
05
Signal No 05
CHAI WAN DEPOT SIGNAL
<94.33>

<94.33> Length ,in m, between the point's toes for crossing

SER Signalling Equipment Room
K(S) Keyswitch area
K2T(S) Keyswitch located on platform 2 and tailwall

NOTES : Documentation from MTRC used to build the pre scheme plan of ISL line :

I : Type EM/2010/510/48 index D (6.10.82)
Type ISL/07/9668 index B (28.02.85)
Track Diagrams (Amendment Leaflet No3 – Sept 91)
Letter from MTRC Ref C975/0133 (12 May 94)
Letter from MTRC Ref C975/0329 (9 September 94)
Letter from MTRC Ref C975/0816 (12 April 95)
Letter from MTRC Ref C975/1177 (18 JULY 95)
Letter from MTRC Ref C975/1237 (10 AUGUST 95)
For : Track circuit layout , station layout ,signalling layout , kilometric point , ISL line plan .

II : Type ISL/07/9668 index B (28.02.85)
Letter from MTRC Ref C975/0329 (9 September 94)
Letter from MTRC Ref C975/0816 (12 April 95)
For : Gradient indications .

III : Schedule of informations No2 .
Letter from MTRC Ref C975/0084 (13 April 94)
Letter from MTRC Ref C975/0329 (9 September 94)
Letter from MTRC Ref C975/0816 (12 April 95)
Letter from MTRC Ref C975/1177 (18 JULY 95)
For : Curves indications .

IV : Track diagrams (Amendment Leaflet No3 – sept 91)
Letter from MTRC Ref C975/0329 (9 September 94)
Letter from MTRC Ref C975/0816 (12 April 95)
Letter from MTRC Ref C975/1177 (18 JULY 95)
For : Speed limit indications .

REV	REVISION DESCRIPTION AND RECORD OF ISSUE	CHK'D	APP'D	DATE

REFERENCE DWGS

CONTRACTOR'S DRAWING NO.

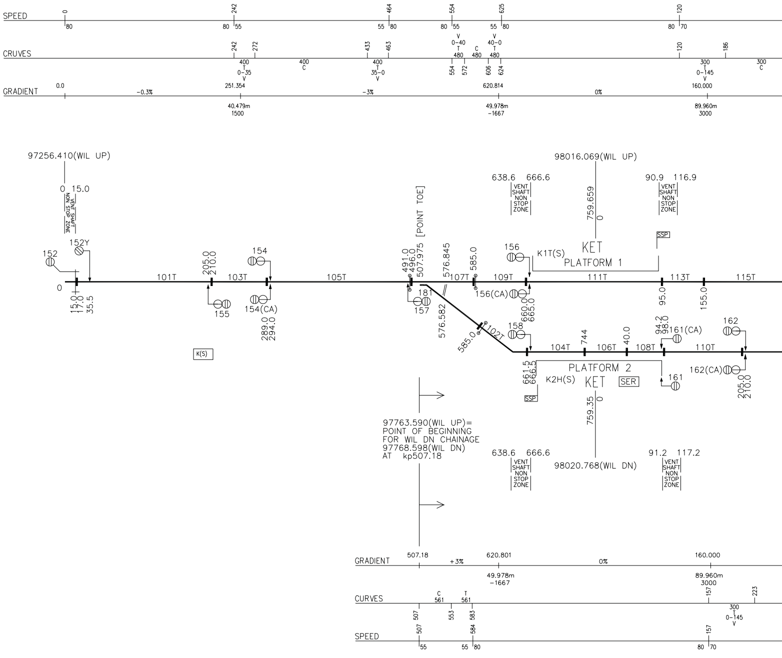
	INITIAL	SIGNATURE	DESIGNATION	DATE
DRAWN BY	BULOT		FCV-BE	APRIL 1996
CHECKED BY	ROLLET		FCV-BE	APRIL 1996
APPROVED BY	GHIURITAN		FCV-BE	APRIL 1996

PLOT SCALE FIT
PLOT DATE
PEN SET 0.3MM
PRINT DATE
CAD REF NO. ISLSP

GEC ALSTHOM TRANSPORT S. A.

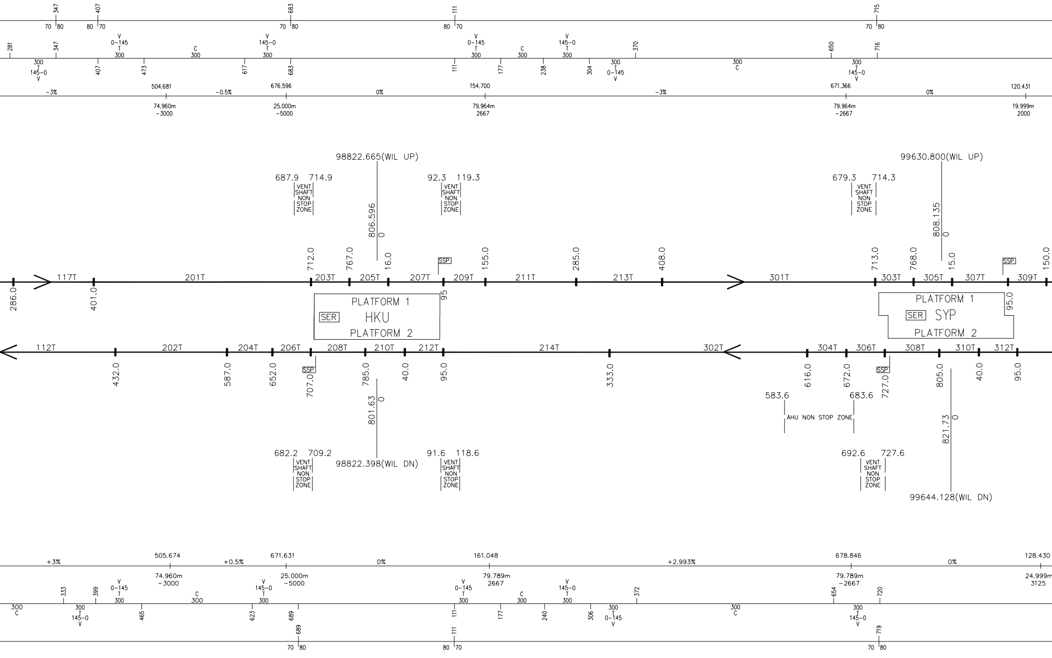
TITLE
ISL PRE SCHEME PLAN
SACEM SECTORS
STOPPING POINTS

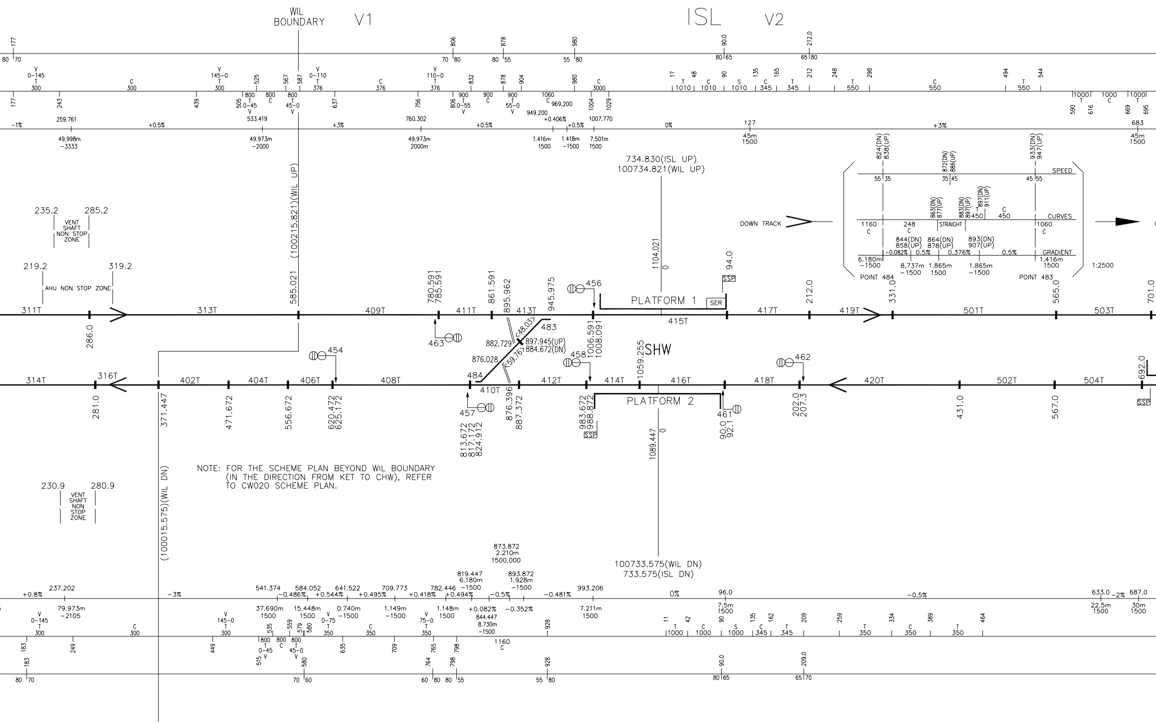
SCALE NOT TO SCALE
DWG NO. 0D1/411/00329/002


SPEED
0
80
242
80 55
464
55 80
554
80 55
625
55 80
120
80 70
CRUVES
242
272
400
T
0-35
V
400
C
433
463
400
T
35-0
V
V
0-40
T
480
554
572
C
480
V
40-0
T
480
606
624
120
186
300
T
0-145
V
300
C
GRADIENT
0.0
-0.3%
251.354
40.479m
1500
-3%
620.814
49.978m
-1667
0%
160.000
89.960m
3000
97256.410(WIL UP)
0 15.0
VENT SHAFT NON STOP ZONE
152Y
152
0
15.0
17.0
35.5
101T
205.0
210.0
103T
155
154
154(CA)
289.0
294.0
105T
K(S)
491.0
496.0
507.975 [POINT TOE]
576.845
585.0
107T
109T
181
157
576.582
585.0
102T
156
156(CA)
660.0
665.0
K1T(S)
98016.069(WIL UP)
638.6 666.6
VENT SHAFT NON STOP ZONE
759.659
0
KET
PLATFORM 1
111T
90.9 116.9
VENT SHAFT NON STOP ZONE
SSP
95.0
113T
155.0
115T
158
661.5
666.5
104T
744
106T
40.0
108T
94.2
98.0
161(CA)
110T
162
162(CA)
205.0
210.0
PLATFORM 2
K2H(S)
KET
SER
161
SSP
759.35
0
97763.590(WIL UP)=
POINT OF BEGINNING
FOR WIL DN CHAINAGE
97768.598(WIL DN)
AT kp507.18
638.6 666.6
VENT SHAFT NON STOP ZONE
98020.768(WIL DN)
91.2 117.2
VENT SHAFT NON STOP ZONE
GRADIENT
507.18
+3%
620.801
49.978m
-1667
0%
160.000
89.960m
3000
CURVES
C
561
T
561
507
553
583
157
223
300
T
0-145
V
SPEED
507
55
584
55 80
157
80 70

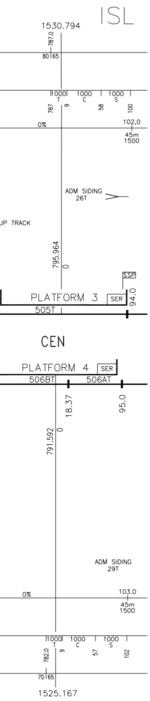
PLOT DRV: $PLTDRVL$
MODELNAME: $MODEL$
FILENAME: $FILE$

PRINTED BY: $USER$ $DATE$ $TIME$


98822.665(WIL UP)
687.9 714.9
VENT SHAFT NON STOP ZONE
92.3 119.3
VENT SHAFT NON STOP ZONE
806.596
0
712.0
767.0
16.0
SSP
155.0
285.0
408.0
117T
201T
203T
205T
207T
209T
211T
213T
286.0
401.0
95
PLATFORM 1
SER
HKU
PLATFORM 2
112T
202T
204T
206T
208T
210T
212T
214T
432.0
587.0
652.0
SSP
707.0
785.0
40.0
95.0
333.0
801.63
0
682.2 709.2
VENT SHAFT NON STOP ZONE
98822.398(WIL DN)
91.6 118.6
VENT SHAFT NON STOP ZONE
99630.800(WIL UP)
679.3 714.3
VENT SHAFT NON STOP ZONE
808.135
0
713.0
768.0
15.0
SSP
150.0
301T
303T
305T
307T
309T
PLATFORM 1
95.0
SER
SYP
PLATFORM 2
302T
304T
306T
308T
310T
312T
616.0
672.0
SSP
727.0
805.0
40.0
95.0
583.6
683.6
AHU NON STOP ZONE
821.73
0
692.6 727.6
VENT SHAFT NON STOP ZONE
99644.128(WIL DN)
347
407
683
111
715
70 80
80 70
70 80
80 70
70 80
281
347
V 0-145 T 300
C 300
V 145-0 T 300
V 0-145 T 300
C 300
V 145-0 T 300
370
650
716
300 T 145-0 V
407
473
617
683
111
177
238
304
300 T 0-145 V
300 C
300 T 145-0 V
-3%
504.681
-0.5%
676.596
0%
154.700
-3%
671.366
0%
120.431
74.960m -3000
25.000m -5000
79.964m 2667
79.964m -2667
19.999m 2000
+3%
505.674
+0.5%
671.631
0%
161.048
+2.993%
678.846
0%
128.430
74.960m -3000
25.000m -5000
79.789m 2667
79.789m -2667
24.999m 3125
333
399
V 0-145 T 300
C 300
V 145-0 T 300
V 0-145 T 300
C 300
V 145-0 T 300
372
654
720
300 C
300 T 145-0 V
465
623
689
111
177
240
306
300 T 0-145 V
300 C
300 T 145-0 V
689
111
719
70 80
80 70
70 80

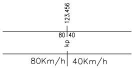

WIL BOUNDARY
V1
ISL
V2
(100215.821)(WIL UP)
585.021
(100015.575)(WIL DN)
371.447
734.830(ISL UP)
100734.821(WIL UP)
100733.575(WIL DN)
733.575(ISL DN)
1104.021
1089.447
235.2
285.2
VENT SHAFT NON STOP ZONE
219.2
319.2
AHU NON STOP ZONE
230.9
280.9
VENT SHAFT NON STOP ZONE
311T
313T
409T
411T
413T
415T
417T
419T
501T
503T
314T
316T
402T
404T
406T
408T
410T
412T
414T
416T
418T
420T
502T
504T
286.0
281.0
471.672
556.672
620.472
625.172
780.591
785.591
861.591
895.962
945.975
1006.591
1008.091
1059.255
813.672
817.172
824.912
876.396
887.372
983.672
988.872
90.0
92.1
202.0
207.3
212.0
331.0
565.0
701.0
431.0
567.0
692.0
94.0
882.729
876.028
897.945(UP)
884.672(DN)
<48.03>
<59.76>
483
484
454
456
457
458
461
462
463
PLATFORM 1
PLATFORM 2
SER
SSP
SHW
DOWN TRACK
SPEED
CURVES
GRADIENT
STRAIGHT
POINT 484
POINT 483
1:2500
824(DN)
838(UP)
872(DN)
886(UP)
933(DN)
947(UP)
863(DN)
877(UP)
883(DN)
897(UP)
897(DN)
911(UP)
844(DN)
858(UP)
864(DN)
878(UP)
893(DN)
907(UP)
1160 C
248 C
450
C 450
1060 C
-0.082%
0.5%
0.376%
0.5%
6.180m -1500
8.737m -1500
1.865m 1500
1.865m -1500
1.416m 1500
55 35
35 45
45 55
-1%
+0.5%
+3%
+0.5%
+0.406%
+0.5%
0%
+3%
259.761
533.419
760.302
949.200
969.200
1007.770
127
683
49.998m -3333
49.973m -2000
49.973m 2000m
1.416m 1500
1.418m -1500
7.501m 1500
45m 1500
+0.8%
-3%
237.202
79.973m -2105
541.374
584.052
641.522
709.773
782.446
819.447
873.872
893.872
993.206
-0.486%
+0.544%
+0.495%
+0.418%
+0.494%
-0.5%
-0.352%
-0.481%
+0.082%
0%
-0.5%
-2%
96.0
633.0
687.0
37.690m 1500
15.448m 1500
0.740m -1500
1.149m -1500
1.148m 1500
6.180m -1500
2.210m 1500.000
1.928m -1500
844.447 8.730m -1500
7.211m 1500
7.5m 1500
22.5m 1500
30m 1500

NOTE: FOR THE SCHEME PLAN BEYOND WIL BOUNDARY (IN THE DIRECTION FROM KET TO CHW), REFER TO CW020 SCHEME PLAN.

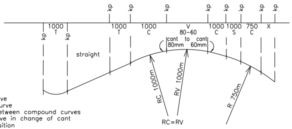

ISL
1530.794
787.0
80 65
1000 T
1000 C
1000 S
787
9
58
100
0%
102,0
45m
1500
ADM SIDING
26T
UP TRACK
795.964
0
SSP
PLATFORM 3
SER
94.0
505T
CEN
PLATFORM 4
SER
506BT
506AT
18.37
95.0
791.592
0
ADM SIDING
29T
0%
103.0
45m
1500
1000 T
1000 C
1000 S
782.0
9
57
102
70 65
1525.167

LEGEND :

SPEED LIMIT in Km/h

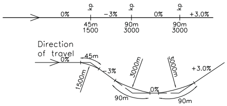

123.456
80 40
kp
80Km/h
40Km/h

CURVES

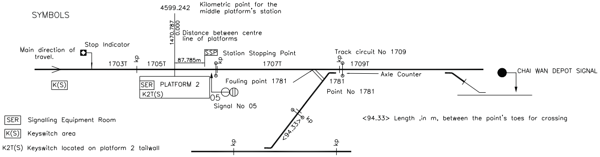

kp
1000 T
1000 T
1000 C
V 80-60
1000 C
1000 S
750 C
X
cant to cant
80mm 60mm
straight
RC 1000m
RV 1000m
R 750m
RC=RV

C: Circular curve
T: Transition curve
S: Transtion between compound curves
V: Circular curve in change of cant
X: Virtual transition

GRADIENT


0%
kp
-3%
0%
+3.0%
45m
1500
90m
3000
90m
3000
Direction of travel
0%
45m
-3%
1500m
3000m
3000m
+3.0%
0%
90m
90m

SYMBOLS


4599.242
Kilometric point for the middle platform's station
1470.787
0.000
Distance between centre line of platforms
Stop Indicator
Main direction of travel.
1703T
kp
1705T
87.785m
SSP
Station Stopping Point
1707T
Track circuit No 1709
1709T
Axle Counter
CHAI WAN DEPOT SIGNAL
K(S)
SER
PLATFORM 2
K2T(S)
Fouling point 1781
05
Signal No 05
1781
Point No 1781
<94.33>
kp
<94.33> Length ,in m, between the point's toes for crossing
SER Signalling Equipment Room
K(S) Keyswitch area
K2T(S) Keyswitch located on platform 2 tailwall

REV	DESCRIPTION	BY	DATE	APPROVED
B	SECOND ISSUE DRAWING UPDATED AND IN RESPOND OF ERF No. 752-ERFC-SCONE-SIG-001019	C.L.	14/10/14	A.P.
A	WIL As-built	C.L.	25/07/14	A.P.

DRAWN	R.AY.
DESIGNED	C.L.
CHECKED	I.T.
APPROVED	A.P.
DATE	14/10/14

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MTR

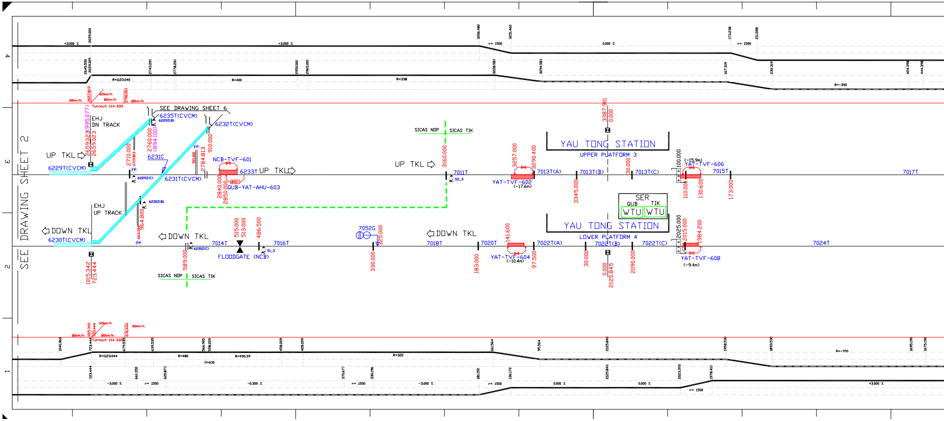
WEST ISLAND LINE

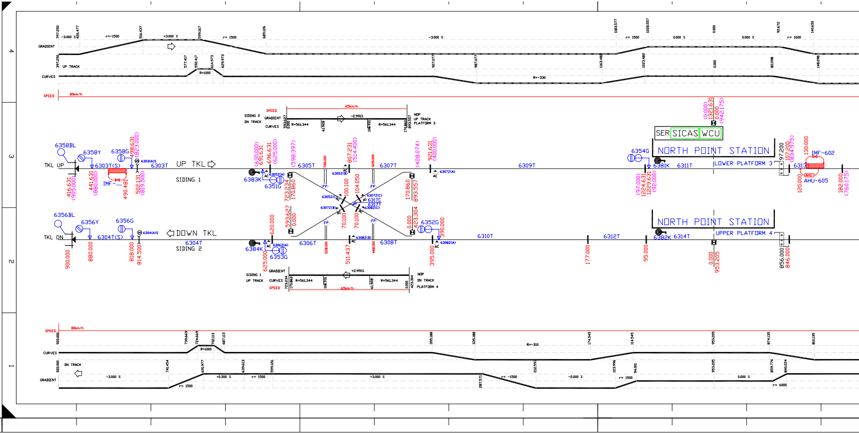
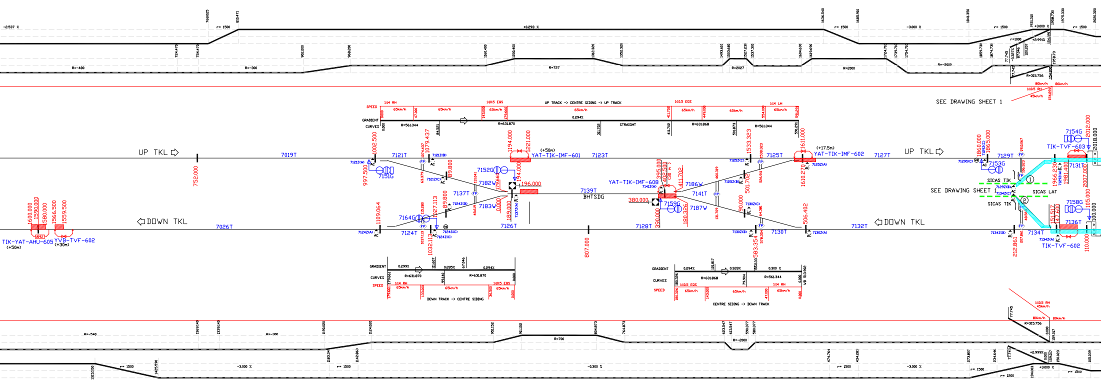
ORIGINATOR [redacted]

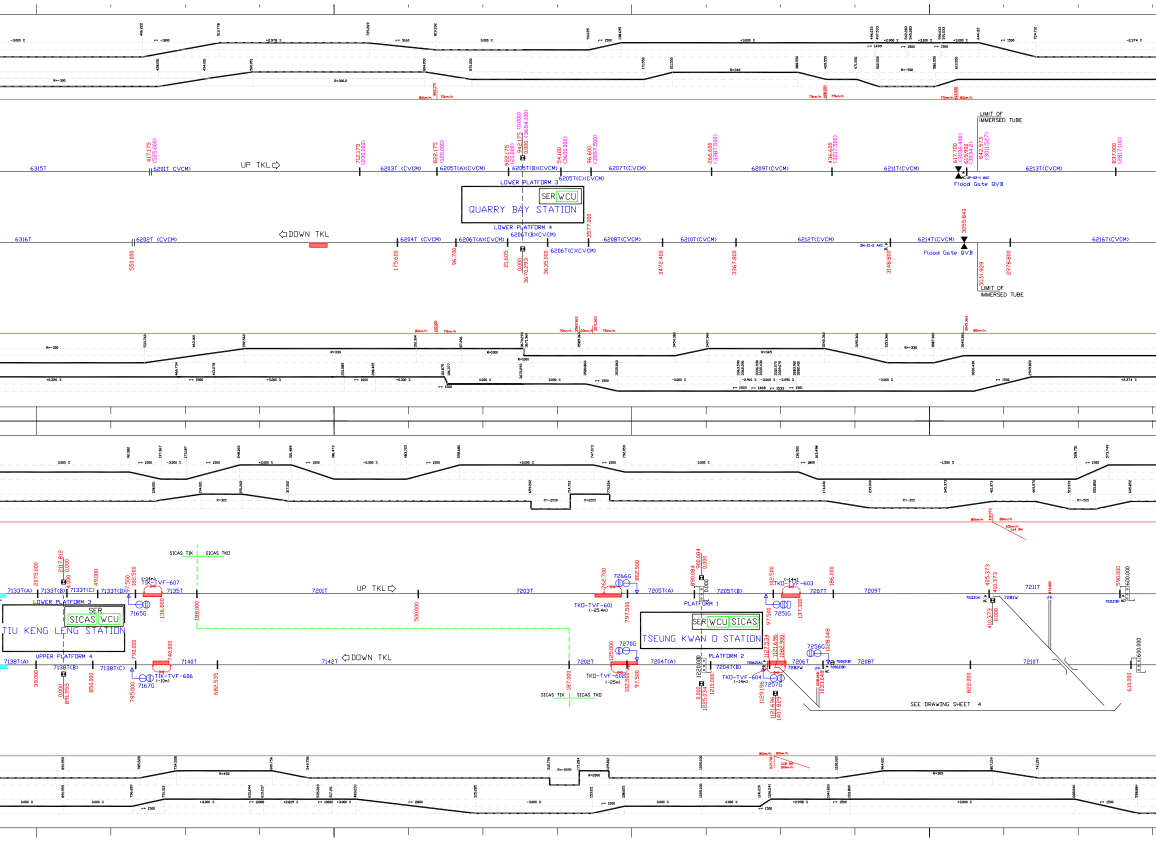
CADD REF. 752_DRW_1019_B.dwg

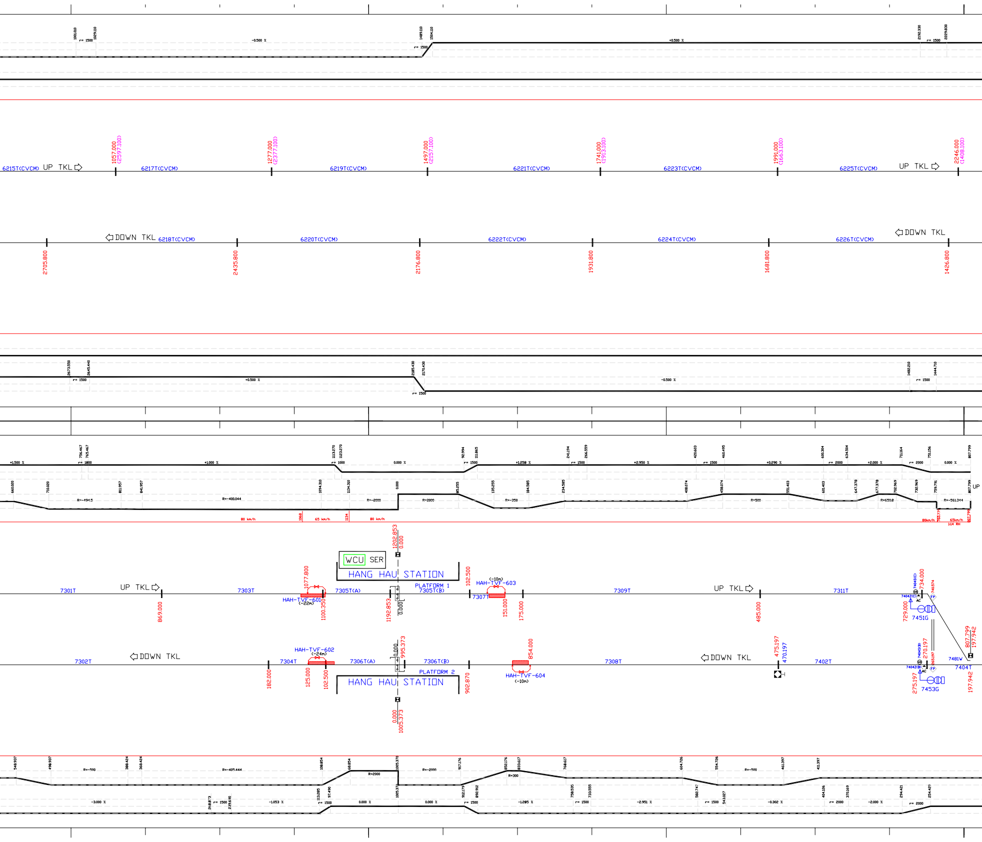
TITLE
CONTRACT NO. 752
FINAL SCHEME PLAN

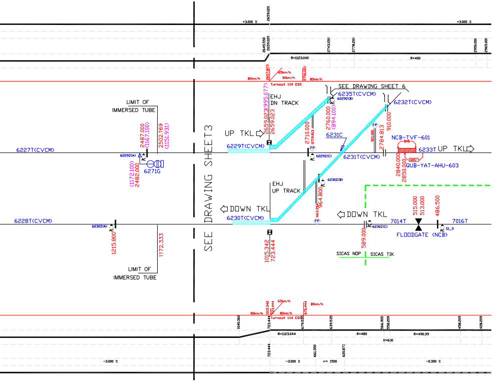
SCALE N.T.S.
DRAWING NO. 752/DRW/1019
REV. B


SEE DRAWING SHEET 2
SEE DRAWING SHEET 6
YAU TONG STATION
UPPER PLATFORM 3
YAU TONG STATION
LOWER PLATFORM 4
SER
QUB
TIK
WTU
WTU
UP TKL
DOWN TKL
EHJ
DN TRACK
EHJ
UP TRACK
6229T(CVCM)
6230T(CVCM)
6235T(CVCM)
6232T(CVCM)
6231C
6231T(CVCM)
6233T
NCB-TVF-601
QUB-YAT-AHU-603
AHU
7014T
7016T
7018T
7020T
7022T(A)
7022T(B)
7022T(C)
7024T
7011T
7013T(A)
7013T(B)
7013T(C)
7015T
7017T
7052G
FLOODGATE (NCB)
YAT-TVF-602
(-17.6m)
YAT-TVF-604
(-10.4m)
YAT-TVF-606
(-15.9m)
YAT-TVF-608
(-9.4m)
SICAS NDP
SICAS TIK
3387.901
3160.000
3257.000
3290.400
3345.000
2659.023
2659.023
(995.077)
2710.000
2760.000
(894.100)
2784.813
910.000
2840.000
2850.000
964.800
1015.342
723.444
589.000
515.000
513.000
486.500
330.000
325.000
183.000
141.600
97.500
30.000
0.000
2125.845
2090.000
2025.000
2015.000
1984.200
100.000
110.000
130.600
173.000
+3.000 %
0.000 %
-3.000 %
-0.300 %
r= 1500
R=1123.040
R=400
R=338
R=-350
R=480
R=630
R=490.39
R=320
80km/h
65km/h
Turnout 1:14 EOS

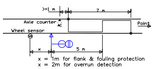

GRADIENT
UP TRACK
CURVES
SPEED
80km/h
R=1000
R=-330
-3.000 %
+3.000 %
0.000 %
r= 1500
r= 1600
SIDING 2
DN TRACK
GRADIENT
CURVES
SPEED
65km/h
-2.991%
R=561.344
NOP
UP TRACK
PLATFORM 3
6358BL
6358Y
6358G
6303T(S)
6303(A)S
6303T
TKL UP
UP TKL
SIDING 1
IMF-.....
416.631
(905.000)
441.631
(880.000)
490.481
498.631
(823.000)
502.131
(819.500)
6383K
6351G
6305Z(A)
6305T
6305Z(B)
6307T
6307Z(A)
6305Z(C)
6307Z(B)
6307Z(C)
6317C
6317T
6308Z(C)
FP
AC
(630.000)
691.631
696.631
(625.000)
(598.397)
807.231
(514.400)
(428.074)
921.631
(400.000)
723.234
170.860
593.627
0.000
100.100
104.050
70.100
893.557
423.304
6309T
SER
SICAS
WCU
NORTH POINT STATION
LOWER PLATFORM 3
UPPER PLATFORM 4
6354G
6381K
6311T
6313T
IMF-602
AHU
AHU-605
(0.000)
1321.631
(942.175)
(97.000)
1224.631
1229.631
(92.000)
97.200
107.200
(834.975)
130.000
120.000
182.000
(760.175)
6356BL
6356Y
6356G
6304T(S)
6304(A)S
DOWN TKL
TKL DN
6304T
SIDING 2
900.000
880.000
818.000
814.500
6384K
6353G
6306Z(A)
6306T
6308Z(B)
6308T
6352G
6308Z(A)
620.000
625.000
511.437
395.000
390.000
6310T
6312T
6314T
6382K
177.000
95.000
953.205
856.000
846.000
SIDING 1
UP TRACK
+2.991%
NOP
DN TRACK
PLATFORM 4
IN TRACK
R=-310
-2.000 %
+0.300 %
r= 6000
4
3
2
1

-2.537 %
+0.293 %
r= 1500
-3.000 %
R=-480
R=-300
R=727
R=2027
R=2000
R=-2000
R=315.756
80km/h
1:10.5 RH
45km/h
SEE DRAWING SHEET 1
SPEED
GRADIENT
CURVES
1:14 RH
1:10.5 EQS
1:14 LH
65km/h
UP TRACK -> CENTRE SIDING -> UP TRACK
0.294%
R=561.344
R=631.870
STRAIGHT
R=631.868
UP TKL
7019T
752.000
7121Z(A)
7121T
7121Z(B)
7121Z(C)
7151G
997.500
1002.500
1079.437
89.800
1194.000
1221.000
(+50m)
YAT-TIK-IMF-601
7123T
7152G
7182W
7137T
7183W
7137Z(A)
196.000
194.000
189.000
7139T
BHTSDG
YAT-TIK-IMF-608
7141Z(A)
395.000
402.500
(30 m)
411.702
380.000
7159G
390.000
180.326
7186W
7141T
7187W
1533.323
7125Z(C)
7125T
7125Z(B)
501.702
1611.000
1610.270
(+17.5m)
YAT-TIK-IMF-602
7125Z(A)
7127T
7129S(C)
7129Z(C)
1860.000
1865.000
7129T
7153G
SICAS TIK
①
②
SICAS LAT
7129Z(B)
7134Z(C)
7129Z(A)
1966.230
1981.400
7131T
2007.000
7154G
TIK-TVF-603
2012.000
2018.000
7158G
105.000
100.000
7136T
151.517
147.600
7134Z(B)
7134T
7134Z(A)
212.861
TIK-TVF-602
110.000
DOWN TKL
7026T
7124Z(A)
7124T
1109.064
7164G
1027.113
1032.113
7124Z(B)
7124S(C)
7124Z(C)
7126T
807.000
7128T
7130Z(C)
90.000
7130Z(B)
7130T
506.402
7130Z(A)
583.354
7132T
1600.000
1590.000
1580.000
1566.500
1559.500
AHU
TIK-YAT-AHU-605
(+50m)
YVB-TVF-602
(+30m)
0.299%
0.285%
R=631.870
DOWN TRACK -> CENTRE SIDING
0.328%
0.300 %
R=631.868
R=561.344
CENTRE SIDING -> DOWN TRACK
R=-540
R=-300
R=700
R=-2000
r= 1500
r= 1200
-3.000 %
-0.300 %
+2.999%
+3.000 %


UP TKL
DOWN TKL
QUARRY BAY STATION
SER
WCU
LOWER PLATFORM 3
LOWER PLATFORM 4
6315T
6201T (CVCM)
6203T (CVCM)
6205T(A)(CVCM)
6205T(B)(CVCM)
6205T(C)(CVCM)
6207T(CVCM)
6209T(CVCM)
6211T(CVCM)
6213T(CVCM)
6316T
6202T (CVCM)
6204T (CVCM)
6206T(A)(CVCM)
6206T(B)(CVCM)
6206T(C)(CVCM)
6208T(CVCM)
6210T(CVCM)
6212T(CVCM)
6214T(CVCM)
6216T(CVCM)
Flood Gate QVB
LIMIT OF IMMERSED TUBE
UP-S2-1 AXC
DN-S1-2 AXC
417.175 (525.000)
712.175 (230.000)
822.175 (120.000)
922.175 (20.000)
942.175 (0.000)
0.000 (3654.100)
54.100 (3600.000)
96.600 (3557.500)
266.600 (3387.500)
436.600 (3217.500)
617.700 (3036.400)
619.900 (3034.2)
642.573 (3011.527)
837.000 (2817.100)
550.000
175.600
96.700
21.605
0.000
3670.293
3635.000
3577.000
3472.400
3367.800
3148.800
3055.840
3031.929
2978.800
80km/h
70km/h
75km/h
65km/h
TIU KENG LENG STATION
TSEUNG KWAN O STATION
SICAS
SICAS TIK
SICAS TKO
LOWER PLATFORM 3
UPPER PLATFORM 4
PLATFORM 1
PLATFORM 2
7133T(A)
7133T(B)
7133T(C)
7133T(D)
7135T
7201T
7203T
7205T(A)
7205T(B)
7207T
7209T
7211T
7281W
7138T(A)
7138T(B)
7138T(C)
7140T
7142T
7202T
7204T(A)
7204T(B)
7206T
7282W
7208T
7210T
TIK-TVF-607 (-14m)
TIK-TVF-606 (-10m)
TKO-TVF-601 (-25.4m)
TKO-TVF-602 (-25m)
TKO-TVF-603 (-14m)
TKO-TVF-604 (-14m)
7165G
7167G
7266G
7270G
7251G
7256G
7257G
2075.000
2117.812
0.000
4.000
49.000
97.500
102.500
136.800
188.000
500.000
762.700
797.500
802.500
890.084
900.084
102.500
137.300
186.000
405.373
410.373
590.000
600.000
39.000
891.955
850.000
790.000
795.000
740.000
682.535
187.000
125.000
102.500
97.500
1220.000
1225.034
1210.000
1127.534
1121.696
1082.900
1129.196
1407.829
1028.048
1033.048
822.000
610.000
SEE DRAWING SHEET 4

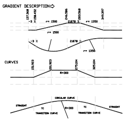

6215T(CVCM)
UP TKL
6217T(CVCM)
6219T(CVCM)
6221T(CVCM)
6223T(CVCM)
6225T(CVCM)
1057.000 (2597.100)
1277.000 (2377.100)
1497.000 (2157.100)
1741.000 (1913.100)
1991.000 (1663.100)
2246.000 (1408.100)
DOWN TKL
6218T(CVCM)
6220T(CVCM)
6222T(CVCM)
6224T(CVCM)
6226T(CVCM)
2705.800
2435.800
2176.800
1931.800
1681.800
1426.800
-0.500 %
+0.500 %
r= 1500
+1.500 %
+1.000 %
0.000 %
+1.258 %
+2.950 %
+0.290 %
+2.000 %
R=-494.5
R=-400.044
R=-2000
R=2000
R=-250
R=-500
R=-561.244
80 km/h
1068
65 km/h
1134
80 km/h
UP
WCU
SER
HANG HAU STATION
PLATFORM 1
1202.853
0.000
7301T
UP TKL
7303T
7305T(A)
7305T(B)
7307T
7309T
UP TKL
7311T
HAH-TVF-601
(-22m)
1077.800
1100.350
869.000
1192.853
0.000
102.500
HAH-TVF-603
(-10m)
151.000
175.000
485.000
7404S(C)
734.000
740.574
7404Z(C)
AC
FP
729.000
7451G
807.799
197.942
7302T
DOWN TKL
7304T
HAH-TVF-602
(-24m)
7306T(A)
7306T(B)
0.000
995.373
PLATFORM 2
HANG HAU STATION
182.000
125.000
102.500
902.870
854.000
HAH-TVF-604
(-10m)
7308T
DOWN TKL
475.197
470.197
7402T
7404S(B)
270.197
265.197
7404Z(B)
275.197
7453G
7481W
7404T
197.942
0.000
1005.373
R=-500
R=-405.444
R=2000
R=-2000
R=300
-3.000 %
-1.053 %
0.000 %
-1.285 %
-2.951 %
-0.302 %
-2.000 %
r= 1500
r= 2000


+3.000 ‰
2659.020
2645.550
2743.200
2778.200
2950.000
2965.000
R=1123.040
R=400
80km/h
65km/h
80km/h
80km/h
2657.823
2706.020
Turnout 1:14 EQS
SEE DRAWING SHEET 6
6235T(CVCM)
6229Z(B)
6232T(CVCM)
EHJ
DN TRACK
2659.023(995.077)
2659.023
LIMIT OF
IMMERSED TUBE
2487.000
(1167.100)
2502.169
(1151.931)
UP TKL
6227T(CVCM)
6229Z(A)
6271G
(1172.100)
2482.000
SEE DRAWING SHEET3
6229T(CVCM)
2710.000
2719.813
2760.000
(894.100)
910.000
6231C
6229Z(C)
6231T(CVCM)
921.000
2784.813
NCB-TVF-601
6233T
UP TKL
2840.000
2850.000
AHU
QUB-YAT-AHU-603
EHJ
UP TRACK
6230Z(B)
964.800
663.394
DOWN TKL
6230T(CVCM)
6228T(CVCM)
6230Z(A)
DOWN TKL
7014T
6230Z(C)
515.000
513.000
486.500
7016T
S1_3
FLOODGATE (NCB)
589.000
1215.800
1172.333
LIMIT OF
IMMERSED TUBE
1015.342
723.444
SICAS NOP
SICAS TIK
65km/h
80km/h
80km/h
Turnout 1:14 EQS
1040.360
1015.342
723.444
676.444
639.535
566.905
558.209
438.209
428.209
R=1123.044
R=480
R=490.39
R=600
723.444
661.350
620.872
-3.000 ‰
-3.000 ‰
r= 1500
-0.300 ‰

Principle position for weel sensor and axle counter

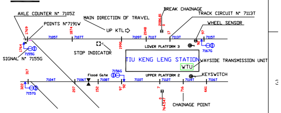

>=1 m
7 m
Axle counter
AC
Point
Wheel sensor
5 m
x

x = 1m for flank & fouling protection
x = 2m for overrun detection


GRADIENT DESCRIPTION
r= 1500
r= 1500
r= 1350
r= 1350
-3
2.878
CURVES
R=300
CIRCULAR CURVE
STRAIGHT
TC
TRANSITION CURVE
R=300
TC
TRANSITION CURVE
STRAIGHT

NOTES:
- ONLY UP TRACK IS AT SCALE
- Existing reverse chainage (Chainage)

SYMBOLS


AXLE COUNTER N° 7105Z
POINTS N°7191W
MAIN DIRECTION OF TRAVEL
BREAK CHAINAGE
TRACK CIRCUIT N° 7113T
WHEEL SENSOR
UP KTL
7105T
7107T
7109T
7111T
7113T
7115T
STOP INDICATOR
LOWER PLATFORM 3
7167G
SIGNAL N° 7155G
7155G
TIU KENG LENG STATION
WTU
WAYSIDE TRANSMISSION UNIT
Flood Gate
7156G
KEYSWITCH
7104T
7106T
7108T
7110T
7112T
7114T
7116T
UPPER PLATFORM 2
7157G
CHAINAGE POINT

SYMBOLS :

		LOS	LIMIT OF SHUNT
			AIR HANDLING UNIT
			IMPULSE FAN OR TUNNEL VENT. FAN
	TRANSITION BUS BAR		SECTION INSULATOR
AC	AXLE COUNTER		DIRECTION ONE WAY TRACK
|	S BOND ◀ TERMINAL BOND		DIRECTION TWO WAY TRACK
||	INSULATED RAIL JOINT(IRJ)		KEYSWITCH
	LIMIT OF SIGNALING SECTION		STOP INDICATOR
			FIXED YELLOW SIGNAL
	CBI CONTROL UNIT SICAS		FIXED RED SIGNAL
			MAINLINE SIGNAL (R/G)
	ATC CONTROL UNIT WCU		MAINLINE SIGNAL (R/B)
			3 ASPECT SIGNAL (R/G/B)
	ATC TRANSMISSION UNIT WTU		SIGNAL WITH ROUTE INDICATOR
⧗	FLOOD GATE		BUFFER LIGHT (RED)
FP	FOULING POINT	WS	WHEEL SENSOR

			Date	Nom
13	C652A TKS Ext. 1st issue			
12	ERF 652/0000/SS/B1/B1	Déssiné	08/07	JLL
11	ERF 652/0000/SS/B1/A7	Vérifié	08/07	POG
00	Edition originale	Homologué	08/07	POG
	Modification constructeur			
	Modification			

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Type Document: PR
MEMO: 623993
Rev: 02
Ind: 13

Echelle
1/2000

HONG KONG MTRC
Track Layout

Page
A3L
NOP->QUB->EHJ TKL LINE
2/6

REVISION	DESCRIPTION	BY	DATE	APPROVED

TSEUNG KWAN O EXTENSION

MASS TRANSIT RAILWAY CORPORATION
PROJECT DIVISION
15/F TOWER 1 WORLD TRADE SQUARE
123 HOI BUN ROAD KWUN TONG HONG KONG
TEL: 29932111
FAX: 27959981

ORIGINATOR

TITLE
CONTRACT 652
TRACK LAYOUT
NOP->QUB->EHJ TKL LINE

SCALE
DATE
DRAW
DESIGNED
APPROVED
CHECKED
CAD REF
A/C DWG NO
DRAWING NO
A/C APPR
REV

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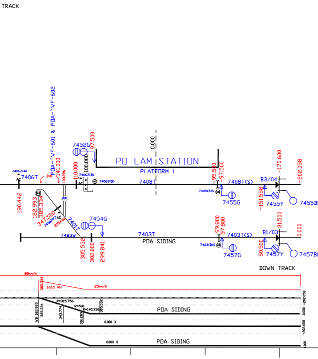
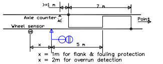
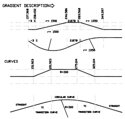

TRACK
POA-TVF-601 & POA-TVF-602
7452G
97.500
0.000
100.000
PO LAM STATION
PLATFORM 1
7406Z(A)
7406T
141.000
133.226
110.000
7406Z(B)
7406S(B)
7408T
-95.500
-97.500
7408T(S)
B3/04
-170.600
-202.058
7408(B)S
7455G
-151.558
7455Y
7455BL
190.442
182.993
385.334
347.500
7406Z(C)
335.600
7401T
7454G
7483W
7403T
POA SIDING
305.532
302.000
299.841
99.800
97.800
7403T(S)
B1/03
31.500
0.000
7403(B)S
7457G
50.500
7457Y
7457BL
DOWN TRACK
80km/h
385.334
1:10.5 RH
25km/h
R=315.756
R=500
R=140.336
POA SIDING
0.000 ‰
-202.058
0.000
0.000 ‰
POA SIDING

Principle position for weel sensor and axle counter

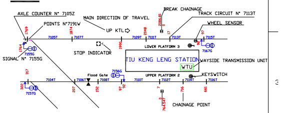

>=1 m
7 m
Axle counter
AC
Point
Wheel sensor
5 m
x

x = 1m for flank & fouling protection
x = 2m for overrun detection


GRADIENT DESCRIPTION
CURVES
CIRCULAR CURVE
STRAIGHT
TC
TRANSITION CURVE
R=300

NOTES:
- ONLY UP TRACK IS AT SCALE
- Existing reverse chainage (Chainage)

SYMBOLS


AXLE COUNTER N° 7105Z
POINTS N°7191W
MAIN DIRECTION OF TRAVEL
BREAK CHAINAGE
TRACK CIRCUIT N° 7113T
WHEEL SENSOR
UP KTL
STOP INDICATOR
SIGNAL N° 7155G
TIU KENG LENG STATION
WTU
WAYSIDE TRANSMISSION UNIT
KEYSWITCH
CHAINAGE POINT

SYMBOLS :
LIMIT OF SHUNT
AIR HANDLING UNIT
IMPULSE FAN OR TUNNEL VENT. FAN
TRANSITION BUS BAR
SECTION INSULATOR
AXLE COUNTER
DIRECTION ONE WAY TRACK
S BOND ◀ TERMINAL BOND
DIRECTION TWO WAY TRACK
INSULATED RAIL JOINT(IRJ)
KEYSWITCH
LIMIT OF SIGNALING SECTION
STOP INDICATOR
FIXED YELLOW SIGNAL
CBI CONTROL UNIT SICAS
FIXED RED SIGNAL
MAINLINE SIGNAL (R/G)
ATC CONTROL UNIT WCU
MAINLINE SIGNAL (R/B)
3 ASPECT SIGNAL (R/G/B)
ATC TRANSMISSION UNIT WTU
SIGNAL WITH ROUTE INDICATOR
FLOOD GATE
BUFFER LIGHT (RED)
FOULING POINT
WHEEL SENSOR

13 C652A TKS Ext. 1st issue
12 ERF 652/0000/SS/B1/B1 Déssiné 08/07 JLL
11 ERF 652/0000/SS/B1/A7 Vérifié 08/07 POG
00 Edition originale Homologué 08/07 POG
Modification constructeur
Modification
SIEMENS
Type Document PR MEMO 623993 Rev 02 Ind 13
Echelle 1/2000
HONG KONG MTRC
Track Layout
Page

A3L
EHJ->YAT->TIK->TKO->HAH->POA
TKL LINE
3/6

REVISION DESCRIPTION BY DATE APPROVED
TSEUNG KWAN O EXTENSION
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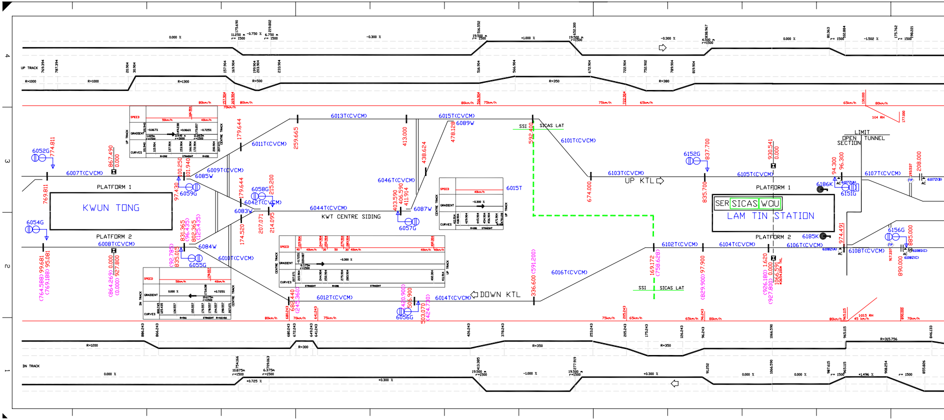
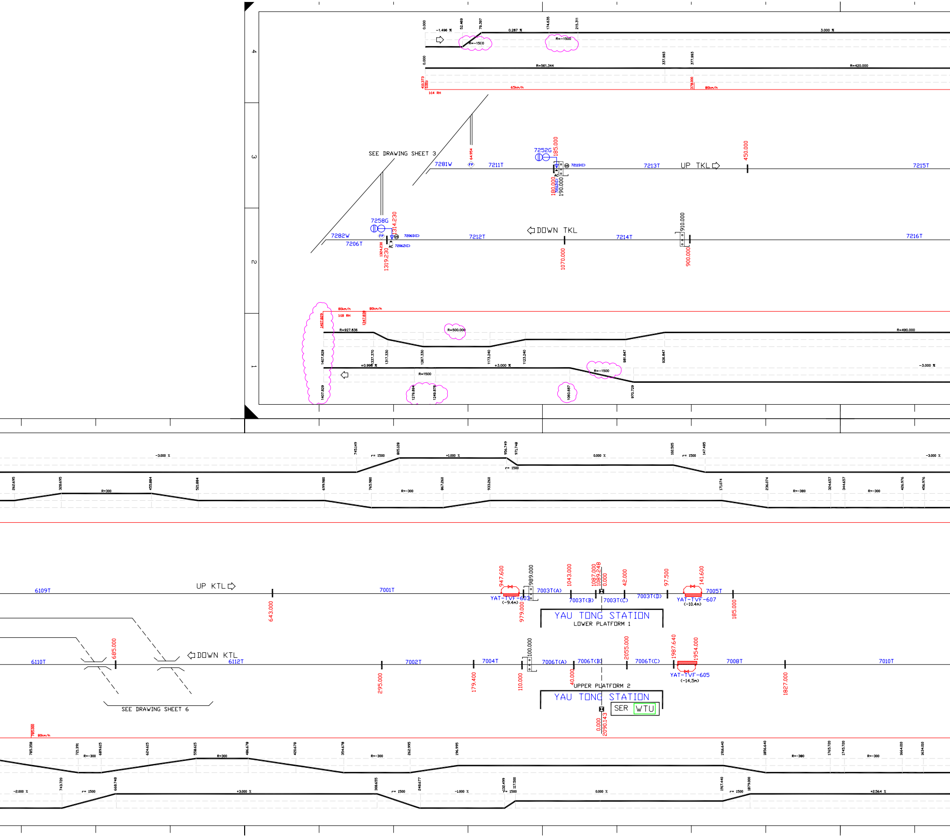
PROJECT DIVISION
15/F TOWER 1 WORLD TRADE SQUARE
123 HOI BUN ROAD KWUN TONG HONG KONG
TEL: 29932111
FAX: 27959981
ORIGINATOR
TITLE
CONTRACT 652
TRACK LAYOUT

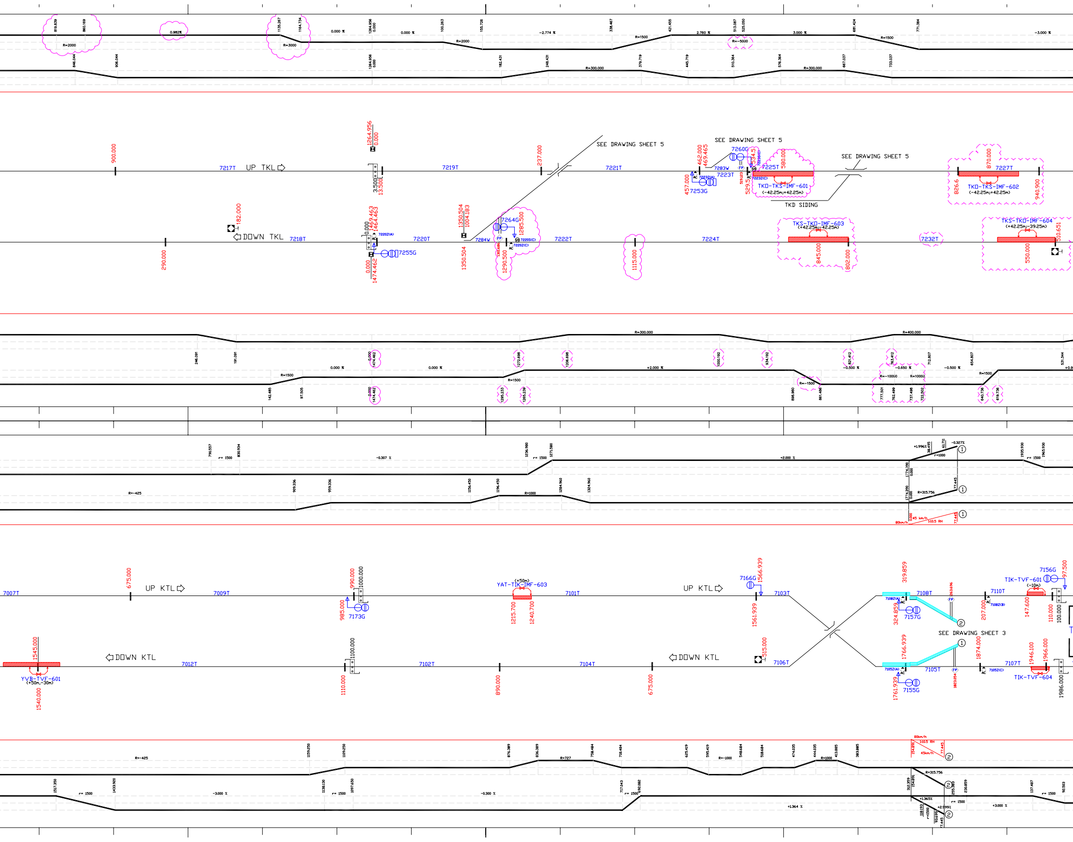
EHJ->YAT->TIK->TKO->HAH->POA

SCALE
DATE
DRAW
DESIGNED
APPROVED
CHECKED
CAD REF
A/C DWG NO
DRAWING NO
A/C APPR
REV

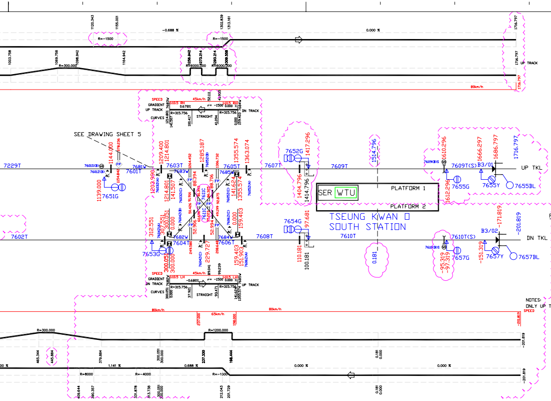

UP TRACK
DN TRACK
KWUN TONG
PLATFORM 1
PLATFORM 2
KWT CENTRE SIDING
SER SICAS WOU
LAM TIN STATION
UP KTL
DOWN KTL
SSI SICAS LAT
LIMIT
OPEN SECTION
TUNNEL
6007T(CVCM)
6008T(CVCM)
6009T(CVCM)
6010T(CVCM)
6011T(CVCM)
6012T(CVCM)
6013T(CVCM)
6014T(CVCM)
6015T(CVCM)
6015T
6016T(CVCM)
6042T(CVCM)
6044T(CVCM)
6046T(CVCM)
6101T(CVCM)
6102T(CVCM)
6103T(CVCM)
6104T(CVCM)
6105T(CVCM)
6106T(CVCM)
6107T(CVCM)
6108T(CVCM)
6052G
6054G
6055G
6056G
6057G
6058G
6059G
6151G
6152G
6156G
6083W
6084W
6085W
6087W
6089W
6185K
6186K
80km/h
70km/h
75km/h
65km/h
R=1000
R=1300
R=500
R=350
R=380
R=1200
R=300
R=315.756
0.000 %
-0.300 %
+1.000 %
-1.502 %
+0.725 %
+0.300 %
-1.000 %
+1.496 %

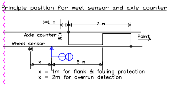


SEE DRAWING SHEET 3
7281W
7211T
7252G
185.000
7211S(C)
180.000
190.000
7213T
UP TKL
450.000
7215T
7258G
1314.230
7206S(C)
7282W
7206T
7206Z(C)
1319.230
7212T
DOWN TKL
1070.000
7214T
910.000
900.000
7216T
80km/h
65km/h
R=561.344
R=420.000
3.000 %
0.287 %
-1.496 %
R=-1500
R=927.836
R=500.000
R=490.000
+0.998 %
+3.000 %
-3.000 %
R=1500
UP KTL
6109T
643.000
7001T
947.600
989.000
YAT-TVF-603
(-9.4m)
979.000
7003T(A)
1043.000
7003T(B)
1087.000
1089.248
0.000
7003T(C)
42.000
7003T(D)
97.500
141.600
YAT-TVF-607
(-10.4m)
7005T
185.000
YAU TONG STATION
LOWER PLATFORM 1
685.000
DOWN KTL
6110T
6112T
SEE DRAWING SHEET 6
295.000
7002T
179.400
7004T
100.000
110.000
7006T(A)
40.000
7006T(B)
2055.000
7006T(C)
1987.640
1954.000
YAT-TVF-605
(-14.5m)
7008T
1827.000
7010T
UPPER PLATFORM 2
YAU TONG STATION
SER
WTU
0.000
2090.143
R=300
R=-300
R=-380
r= 1500
+1.000 %
0.000 %
-2.000 %
-1.000 %
+2.564 %



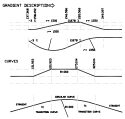
SEE DRAWING SHEET 5
SEE DRAWING SHEET 5
SEE DRAWING SHEET 5
7217T
UP TKL
7219T
7221T
7283W
7223T
7260G
7253G
7225T
TKD-TKS-IMF-601
(-42.25m)+42.25m)
TKD SIDING
7227T
TKD-TKS-IMF-602
(-42.25m)+42.25m)
DOWN TKL
7218T
7220T
7220Z(A)
7255G
7284W
7264G
7220S(C)
7220Z(C)
7222T
7224T
TKS-TKD-IMF-603
(+42.25m)-42.25m)
7232T
TKS-TKD-IMF-604
(+42.25m)-39.25m)
900.000
1264.956
0.000
3.500
13.500
237.000
462.000
469.465
457.000
534.5
529.5
580.000
870.000
826.6
940.900
182.000
290.000
1469.463
1464.463
0.000
1474.462
1350.504
1004.183
1290.500
1285.500
1115.000
845.000
802.000
550.000
510.651
R=2000
R=3000
R=2000
R=1500
R=-5000
R=1500
R=300.000
R=300.000
0.982%
0.000 %
-2.774 %
2.760 %
3.000 %
-3.000 %
R=300.000
R=400.000
R=1500
R=1500
R=-1500
R=-10000
R=10000
+2.000 %
-0.500 %
-0.650 %
R=-425
R=1000
r= 1500
-0.307 %
+2.000 %
+1.996%
-0.327%
R=315.756
80km/h
45 km/h
7007T
UP KTL
7009T
675.000
990.000
1000.000
985.000
7173G
YAT-TIK-IMF-603
(+50m)
1215.700
1240.700
7101T
UP KTL
7166G
1566.939
1561.939
7103T
319.859
7108T
7108Z(A)
7157G
324.859
207.000
7110T
7108Z(B)
TIK-TVF-601
(-10m)
7156G
97.500
147.600
110.000
100.000
SEE DRAWING SHEET 3
1545.000
1540.000
YVB-TVF-601
(+50m,-30m)
DOWN KTL
7012T
1100.000
1110.000
7102T
890.000
7104T
675.000
DOWN KTL
1515.000
7106T
1766.939
1761.939
7105Z(A)
7155G
7105T
1874.000
7107T
7105Z(C)
1946.100
1966.000
1986.000
TIK-TVF-604
R=-425
R=727
R=-1000
R=1000
R=315.756
80km/h
45km/h
r= 1500
-3.000 %
-0.300 %
+1.364 %
+1.365%
+2.999%
+3.000 %

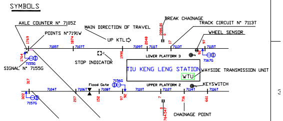

R=-1500
-0.688 %
0.000 %
R=300.000
R=6000.000
UP TRACK
80km/h
SPEED
GRADIENT
UP TRACK
CURVES
45km/h
R=315.756
STRAIGHT
DN TRACK
SEE DRAWING SHEET 5
7229T
7601S(B)
7601Z(B)
7651G
7681W
7601T
7603T
7683W
7605T
7685W
7607T
7652G
7609T
SER
WTU
PLATFORM 1
PLATFORM 2
TSEUNG KWAN O
SOUTH STATION
7610T
7609T(S)
B3/01
UP TKL
7656G
7655Y
7655BL
7602T
7682W
7604T
7684W
7606T
7653G
7608T
7654G
7610T(S)
B3/02
DN TKL
7657G
7657Y
7657BL
80km/h
65km/h
R=1200.000
R=8000
R=-4000
R=-1300


Principle position for weel sensor and axle counter
>=1 m
7 m
Axle counter
AC
Point
Wheel sensor
5 m
x

x = 1m for flank & fouling protection
x = 2m for overrun detection

NOTES:
ONLY UP TRACK IS AT SCALE


GRADIENT DESCRIPTION
r= 1500
r= 1350
-3 %
2.878 %
CURVES
R=300
CIRCULAR CURVE
STRAIGHT
TC
TRANSITION CURVE


SYMBOLS
AXLE COUNTER N° 7105Z
POINTS N°7191W
MAIN DIRECTION OF TRAVEL
UP KTL
BREAK CHAINAGE
TRACK CIRCUIT N° 7113T
WHEEL SENSOR
STOP INDICATOR
SIGNAL N° 7155G
LOWER PLATFORM 3
TIU KENG LENG STATION
WTU
WAYSIDE TRANSMISSION UNIT
Flood Gate
UPPER PLATFORM 2
KEYSWITCH
CHAINAGE POINT

SYMBOLS :

- LIMIT OF SHUNT
- AIR HANDLING UNIT
- IMPULSE FAN OR TUNNEL VENT. FAN
- TRANSITION BUS BAR
- SECTION INSULATOR
- AXLE COUNTER
- DIRECTION ONE WAY TRACK
- S BOND
- TERMINAL BOND
- DIRECTION TWO WAY TRACK
- INSULATED RAIL JOINT(IRJ)
- KEYSWITCH
- LIMIT OF SIGNALING SECTION
- STOP INDICATOR
- FIXED YELLOW SIGNAL
- FIXED RED SIGNAL
- CBI CONTROL UNIT SICAS
- MAINLINE SIGNAL (R/G)
- ATC CONTROL UNIT WCU
- MAINLINE SIGNAL (R/B)
- 3 ASPECT SIGNAL (R/G/B)
- ATC TRANSMISSION UNIT WTU
- SIGNAL WITH ROUTE INDICATOR
- FLOOD GATE
- BUFFER LIGHT (RED)
- FOULING POINT
- WHEEL SENSOR

13	C652A TKS Ext. 1st issue		Date	Nom
12	ERF 652/0000/SS/B1/B1	Déssiné	08/07	JLL
11	ERF 652/0000/SS/B1/A7	Vérifié	08/07	PDG
00	Edition originale	Homologué	08/07	PDG
Modification constructeur				

SIEMENS

Type Document: PR — MEMO: 623993 — Rev 04 — Ind 13

Echelle 1/2000

HONG KONG MTRC
Track Layout

Page

A3L TKO->TKS TKL LINE 4/6

Modification

REVISION	DESCRIPTION	BY	DATE	APPROVED

TSEUNG KWAN O EXTENSION

MASS TRANSIT RAILWAY CORPORATION
PROJECT DIVISION
15/F TOWER 1 WORLD TRADE SQUARE
123 HOI BUN ROAD KWUN TONG HONG KONG
TEL : 29932111
FAX : 27959981

ORIGINATOR

TITLE
CONTRACT 652
TRACK LAYOUT
TKO->TKS TKL LINE

SCALE
DATE
DRAW
APPROVED
CAD REF
A/C DWG NO
DESIGNED
CHECKED
DRAWING NO
A/C APPR
REV

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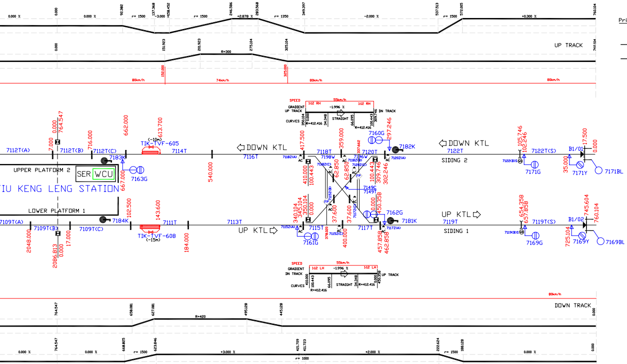
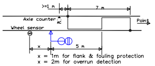
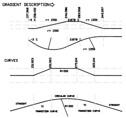

0.000 %
r= 1500
-3.000 %
+2.878 %
r= 1350
-2.000 %
+0.300 %
UP TRACK
R=300
80km/h
74km/h
7112T(A)
7112T(B)
7112T(C)
7183K
TIK-TVF-605
7114T
DOWN KTL
7116T
7118T
7198W
7120T
7160G
7182K
DOWN KTL
7122T
SIDING 2
7122T(S)
B1/01
7171G
7171Y
7171BL
UPPER PLATFORM 2
SER
WCU
7163G
TIU KENG LENG STATION
LOWER PLATFORM 1
7109T(A)
7109T(B)
7109T(C)
7184K
7111T
TIK-TVF-608
7113T
UP KTL
7115T
7199W
7161G
7117T
7162G
7181K
UP KTL
7119T
SIDING 1
7119T(S)
7169G
B1/02
7169Y
7169BL
SPEED
GRADIENT
UP TRACK
DN TRACK
CURVES
55km/h
-1.996 %
STRAIGHT
R=412.416
DOWN TRACK
R=420
+3.000 %
+2.000 %
r= 1000

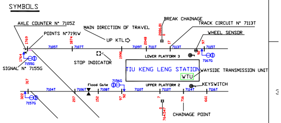
Principle position for weel sensor and axle counter


>=1 m
7 m
Axle counter
AC
Point
Wheel sensor
5 m
x

x = 1m for flank & fouling protection
x = 2m for overrun detection

NOTES:
- ONLY UP TRACK IS AT SCALE
- Existing reverse chainage (Chainage)
- Chainage in TKL reference *Chainage*TKL
- Chainage in KTL reference *Chainage*KTL


GRADIENT DESCRIPTION
r= 1500
r= 1350
-3 %
2.878 %
CURVES
R=300
CIRCULAR CURVE
STRAIGHT
TC
TRANSITION CURVE


SYMBOLS
AXLE COUNTER N° 7105Z
POINTS N°7191W
MAIN DIRECTION OF TRAVEL
UP KTL
BREAK CHAINAGE
TRACK CIRCUIT N° 7113T
WHEEL SENSOR
STOP INDICATOR
SIGNAL N° 7155G
LOWER PLATFORM 3
TIU KENG LENG STATION
WTU
WAYSIDE TRANSMISSION UNIT
Flood Gate
UPPER PLATFORM 2
KEYSWITCH
CHAINAGE POINT

SYMBOLS :

- LIMIT OF SHUNT
- AIR HANDLING UNIT
- IMPULSE FAN OR TUNNEL VENT. FAN
- TRANSITION BUS BAR
- SECTION INSULATOR
- AXLE COUNTER
- DIRECTION ONE WAY TRACK
- S BOND
- TERMINAL BOND
- DIRECTION TWO WAY TRACK
- INSULATED RAIL JOINT(IRJ)
- KEYSWITCH
- LIMIT OF SIGNALING SECTION
- STOP INDICATOR
- FIXED YELLOW SIGNAL
- FIXED RED SIGNAL
- CBI CONTROL UNIT SICAS
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- ATC CONTROL UNIT WCU
- MAINLINE SIGNAL (R/B)
- 3 ASPECT SIGNAL (R/G/B)
- ATC TRANSMISSION UNIT WTU
- SIGNAL WITH ROUTE INDICATOR
- FLOOD GATE
- BUFFER LIGHT (RED)
- FOULING POINT
- WHEEL SENSOR

13	C652A TKS Ext. 1st issue		Date	Nom
12	ERF 652/0000/SS/B1/B1	Déssiné	08/07	JLL
11	ERF 652/0000/SS/B1/A7	Vérifié	08/07	PDG
00	Edition originale	Homologué	08/07	PDG
Modification constructeur				

SIEMENS

Type Document: PR — MEMO: 623993 — Rev 02 — Ind 13

Echelle 1/2000

HONG KONG MTRC
Track Layout

Page

A3L LAT->YAT->TIK KTL LINE 1/6

Modification

REVISION	DESCRIPTION	BY	DATE	APPROVED

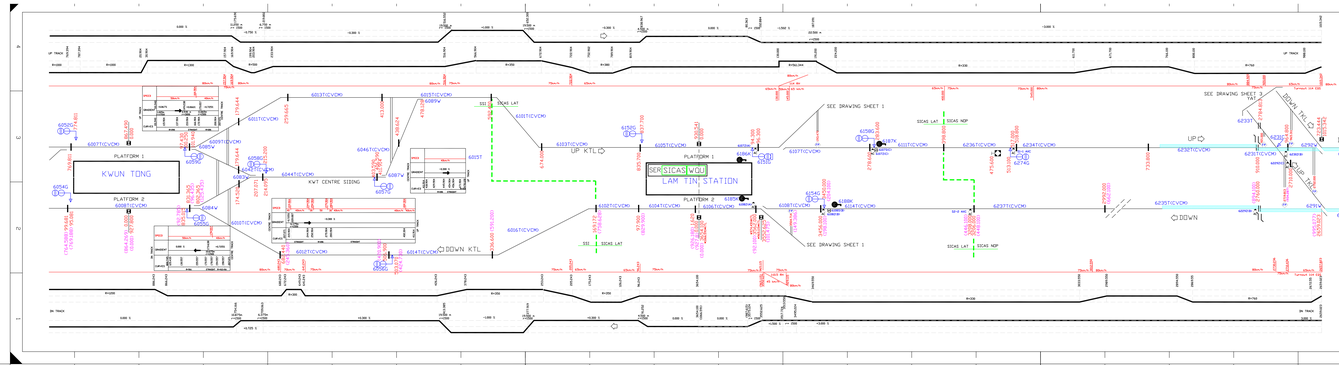
TSEUNG KWAN O EXTENSION

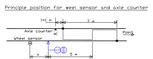
MASS TRANSIT RAILWAY CORPORATION
PROJECT DIVISION
15/F TOWER 1 WORLD TRADE SQUARE
123 HOI BUN ROAD KWUN TONG HONG KONG
TEL : 29932111
FAX : 27959981

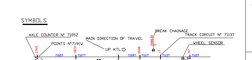
ORIGINATOR

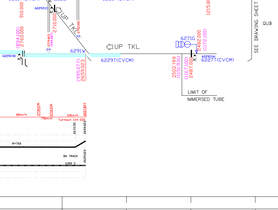
TITLE
CONTRACT 652
TRACK LAYOUT
LAT->YAT->TIK KTL LINE

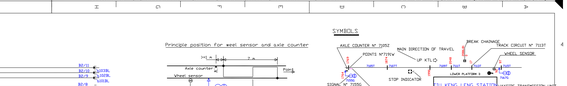
SCALE
DATE
DRAW
APPROVED
CAD REF
A/C DWG NO
DESIGNED
CHECKED
DRAWING NO
A/C APPR
REV











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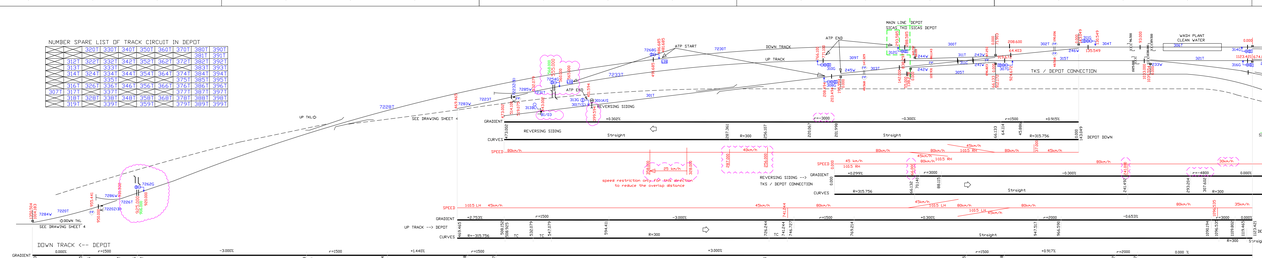
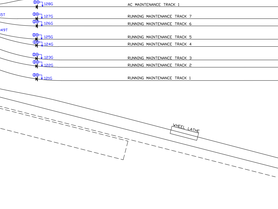
NUMBER SPARE LIST OF TRACK CIRCUIT IN DEPOT

3101	3301	3501	3601	3701	3801	3901	4101	4201	4301
3102	3302	3502	3602	3702	3802	3902	4102	4202	4302
3103	3303	3503	3603	3703	3803	3903	4103	4203	4303
3104	3304	3504	3604	3704	3804	3904	4104	4204	4304
3105	3305	3505	3605	3705	3805	3905	4105	4205	4305
3106	3306	3506	3606	3706	3806	3906	4106	4206	4306
3107	3307	3507	3607	3707	3807	3907	4107	4207	4307





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TWL Performance Requirement

1.1 TWL Round trip Time

1.1.1 The total Round Trip Time without Coasting, from Train arrival at CEN to arrival at TSW Turnaround through TWL Up and then from TSW Turnaround back to CEN through TWL Down, shall not be more than 60 minutes with the Minimum Dwell Times as specified in Table TWL - Up and Table TWL – Down.

1.1.2 The total Round Trip Time under 4% Coasting, from Train arrival at CEN to arrival at TSW Turnaround through TWL Up and then from TSW Turnaround back to CEN through TWL Down, shall not be more than 66 minutes with the Normal Dwell Times as specified in Table TWL - Up and Table TWL - Down.

1.1.3 Dwell Times as specified in Table TWL - Up and Table TWL - Down

TWL - Up direction		
Station	Minimum Dwell Time (Second)	Normal Dwell Time (Second)
CEN	30	47
ADM	25	41
TST	23	26
JOR	21	27
YMT	22	36
MOK	21	28
PRE	31	44
SSP	21	34
CSW	24	37
LCK	27	34
MEF	21	36
LAK	19	19
KWF	22	30
KWH	22	34
TWH	20	31
TSW	25	47

Table TWL - Up

TWL - Down direction		
Station	Minimum Dwell Time (Second)	Normal Dwell Time (Second)
TSW	21	32
TWH	18	29
KWH	20	32
KWF	22	34
LAK	21	27
MEF	24	34
LCK	25	37
CSW	23	38
SSP	28	43
PRE	28	43
MOK	32	41
YMT	23	37
JOR	30	33
TST	26	41
ADM	34	48
CEN	30	47

Table TWL - Down

NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	FLK
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	03/02/2015

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MTR

ORIGINATOR

OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_080_004_A.DWG

TITLE

C6014-14E
PROCUREMENT OF NEW TRAINS
TWL DWELL TIME REQUIREMENT

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/080/004	A

TKL Performance Requirements

1.1 TKL Round Trip Time

1.1.1 The total Round Trip Time without Coasting, from Train arrival at NOP Turnaround to arrival at POA through TKL Up and then from POA back to NOP Turnaround through TKL Down, shall not be more than 32.5 minutes with the Minimum Dwell Times as specified in Table TKL-Up and Table TKL-Down.

1.1.2 The total Round Trip Time without Coasting, from Train arrival at NOP Turnaround to arrival at LHP through TKL Up and then from LHP back to NOP Turnaround through TKL Down, shall not be more than 32.5 minutes with the Minimum Dwell Times as specified in Table TKL-Up and Table TKL-Down.

1.1.3 The total Round Trip Time under 4% Coasting, from Train arrival at NOP Turnaround to arrival at POA through TKL Up and then from POA back to NOP Turnaround through TKL Down, shall not be more than 37.5 minutes with the Normal Dwell Times as specified in Table TKL-Up and Table TKL-Down.

1.1.4 The total Round Trip Time under 4% Coasting, from Train arrival at NOP Turnaround to arrival at LHP through TKL Up and then from LHP back to NOP Turnaround through TKL Down, shall not be more than 37.5 minutes with the Normal Dwell Times as specified in Table TKL-Up and Table TKL-Down.

TKL - Up direction		
Station	Minimum Dwell Time (Second)	Normal Dwell Time (Second)
NOP	30	55
QUB	30	47
YAT	40	48
TIK	40	49
TKO	30	48
HAH	30	45
POA	30	45
LHP	45	47

Table TKL-Up

TKL - Down direction		
Station	Minimum Dwell Time (Second)	Normal Dwell Time (Second)
LHP	45	47
POA	30	45
HAH	30	59
TKO	30	49
TIK	40	50
YAT	40	50
QUB	30	43
NOP	30	55

Table TKL-Down

NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	FLK
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	03/02/2015

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ORIGINATOR

OPERATIONS DIVISION — TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_080_003_A.DWG

TITLE

C6014-14E

PROCUREMENT OF NEW TRAINS

TKL DWELL TIME REQUIREMENT

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/080/003	A

KTL Performance Requirements

1.1 KTL Round Trip Time

1.1.1 The total Round Trip Time without Coasting, from Train arrival at TIK Turnaround to arrival at WHA through KTL Down and then from WHA back to TIK Turnaround through KTL Up, shall not be more than 62.5 minutes with the Minimum Dwell Times as specified in Table KTL-Up and Table KTL-Down.

1.1.2 The total Round Trip Time without Coasting, from Train arrival at TIK Turnaround to arrival at HOM Siding through KTL Down and then from HOM Siding back to TIK Turnaround through KTL Up, shall not be more than 61 minutes with the Minimum Dwell Times as specified in Table KTL-Up and Table KTL-Down.

1.1.3 The total Round Trip Time under 4% Coasting, from Train arrival at TIK Turnaround to arrival at WHA through KTL Down and then from WHA back to TIK Turnaround through KTL Up, shall not be more than 69 minutes with the Normal Dwell Times as specified in Table KTL-Up and Table KTL-Down.

1.1.4 The total Round Trip Time under 4% Coasting, from Train arrival at TIK Turnaround to arrival at HOM Siding through KTL Down and then from HOM Siding back to TIK Turnaround through KTL Up, shall not be more than 67 minutes with the Normal Dwell Times as specified in Table KTL-Up and Table KTL-Down.

KTL - Up direction		
Station	Minimum Dwell Time (Second)	Normal Dwell Time (Second)
WHA	47	47
HOM	32	32
YMT	32	32
MOK	19	28
PRE	24	24
SKM	23	33
KOT	26	41
LOF	20	25
WTS	22	31
DIH	22	28
CHH	25	27
KOB	23	32
NTK	23	32
KWT	27	36
LAT	30	33
YAT	22	22
TIK	30	47

Table KTL-Up

KTL - Down direction		
Station	Minimum Dwell Time (Second)	Normal Dwell Time (Second)
TIK	30	47
YAT	30	30
LAT	27	27
KWT	23	41
NTK	22	37
KOB	24	40
CHH	20	20
DIH	21	28
WTS	24	33
LOF	24	38
KOT	32	49
SKM	28	33
PRE	26	26
MOK	24	27
YMT	32	32
HOM	32 for Trains terminate at WHA / 47 for Trains terminate at HOM	32 for Trains terminate at WHA / 47 for Trains terminate at HOM
WHA	47	47

Table KTL-Down

NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	FLK
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	03/02/2015

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OPERATIONS DIVISION TECHNICAL AND ENGINEERING SERVICES DEPARTMENT

CONTRACTOR REFERENCE NO.

FILE NAME: C6014-14E_TSEG_080_002_A.DWG

TITLE

C6014-14E

PROCUREMENT OF NEW TRAINS

KTL DWELL TIME REQUIREMENT

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/080/002	A

ISL Performance Requirements

1.1 ISL Round Trip Time

1.1.1 The total Round Trip without Coasting, from Train arrival at CHW to arrival at KET Turnaround through ISL Down and then from KET Turnaround back to CHW through ISL Up, shall not be more than 60 minutes with the Minimum Dwell Times as specified in Table ISL-Up and Table ISL-Down.

1.1.2 The total Round Trip under 4% Coasting, from Train arrival at CHW to arrival at KET Turnaround through ISL Down and then from KET Turnaround back to CHW through ISL Up, shall not be more than 66 minutes with the Normal Dwell Times as specified in Table ISL-Up and Table ISL-Down.

1.1.3 Dwell Times as specified in Table ISL-Up and Table ISL-Down below

ISL - Up direction		
Station	Minimum Dwell Time (Second)	Normal Dwell Time (Second)
KET	32	32
HKU	32	32
SYP	32	32
SHW	32	32
CEN	29	29
ADM	40	43
WAC	28	28
CAB	27	27
TIH	17	17
FOH	19	21
NOP	19	26
QUB	29	38
TAK	19	34
SWH	18	27
SKW	18	30
HFC	16	26
CHW	30	47

Table ISL-Up

ISL - Down direction		
Station	Minimum Dwell Time (Second)	Normal Dwell Time (Second)
CHW	30	47
HFC	16	19
SKW	24	27
SWH	16	31
TAK	25	35
QUB	29	37
NOP	23	51
FOH	23	33
TIH	22	37
CAB	36	48
WAC	37	49
ADM	35	46
CEN	36	42
SHW	32	32
SYP	32	32
HKU	32	32
KET	47	47

Table ISL-Down

NOTE : ALL DIMENSIONS IN MILLIMETRES

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	FLK
DESIGNED	—
CHECKED	JA/KYL
APPROVED	ML
DATE	03/02/2015

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TITLE

C6014-14E

PROCUREMENT OF NEW TRAINS

ISL DWELL TIME REQUIREMENT

SCALE	DRAWING NO.	REV.
NTS	C6014-14E/TSEG/080/001	A