LOS ANGELES COUNTY

METROPOLITAN TRANSPORTATION AUTHORITY

LIGHT RAIL VEHICLE

P2550

RUNNING MAINTENANCE AND SERVICE MANUAL

SECTION 16 TRAIN_TO_WAYSIDE COMMUNICATION

Metro

AnsaldoBreda

LOS ANGELES COUNTY

METROPOLITAN TRANSPORTATION AUTHORITY

LIGHT RAIL VEHICLE

P2550

RUNNING MAINTENANCE
AND
SERVICE MANUAL

VOLUME M-01
PART I
THEORY OF OPERATION
SECTION 16 - TRAIN-TO-WAYSIDE COMMUNICATION

SECTION 16

TRAIN-TO-WAYSIDE COMMUNICATION SYSTEM

PART I

THEORY OF OPERATION

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SECTION 16

TRAIN-TO-WAYSIDE COMMUNICATION SYSTEM

16-I-01 INTRODUCTION

This Section of the Running Maintenance and Service Manual is divided into three Parts:

- Part I: Theory of Operation
- Part II: Troubleshooting
- Part III: Maintenance

Each Paragraph is numbered accordingly, to avoid that paragraphs of the same Section, pertaining to a different Part, have the same number.

Part I - Theory of Operation

Part I gives a thorough overview of the System structure and operation, by means of descriptions, figures, photos, schematics, block diagrams and flow charts, together with references to other documents or Sections when needed.

Part II - Troubleshooting

It gives the Maintenance Technicians a path to troubleshoot the System in every condition by means of the available tools:

- The PTU, equipped with the specific SW program;
- The IDU;
- The Fault Isolation Table.
-

Part III - Maintenance

The Maintenance Part is divided into two sections: -

Preventive Maintenance

- Corrective Maintenance

each one of which is supplied with the relevant Maintenance Sheets and Job Cards.

16-I-01.a LIST OF ABBREVIATIONS, ACRONYMS AND SYMBOLS

The Abbreviations, Acronyms and Symbols commonly used throughout this manual are given below with their related meaning.

Abbreviation	Meaning
AB	AnsaldoBreda
AC/DC	Alternate Current - Direct Current Converter
ADU	Aspect Display Unit
AF	Audio Frequency
AGC	Automatic Gain Control
ATP	Automatic Train Protection
BA	Brake Assurance
BCU	Brake Control Unit
CB	Circuit Breaker
CM	Coast Motoring
CMC	Control and Maintenance Center
CPM	Cycles Per Minute
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check (Checksum)
DC/AC	Direct Current - Alternate Current Converter
DC/DC	Direct Current - Direct Current Converter
DPRAM	Dual-Ported Random Access Memory
EB	Emergency Brake
ECU	Electronic Control Unit (Brakes)
EEPROM	Electrically Erasable Programmable Read Only Memory
EMI	Electro-Magnetic Interference
FPGA	Field-Programmable Gate Array
FSB	Full Service Brake
FSK	Frequency Shift Keying
HRSB	High Rate Service Brake
HSCB	High Speed Circuit Breaker
HV	High Voltage
HVDS	High Voltage Distribution System
HW	Hardware
I/O	Input / Output
IDU	Integrated Diagnostic Unit
KO	Out of Service
LACMTA	Los Angeles County Metropolitan Transportation Authority
LED	Light Emitting Diode

LH	Left Hand Side
LON	Local Operative Network
LRV	Light Rail Vehicle
LV	Low Voltage
LVDS	Low Voltage Distribution System
LVPD	Low Voltage Power Distribution
LVPS	Low Voltage Power Supply
M	Motoring
MAS	Maximum Allowable Speed
MBL	Metro Blue Line
MPB	Momentary Push-button
MV	Medium Voltage
MVPD	Medium Voltage Power Distribution
OK	Working
PB	Push-button
PCB	Printed Circuit Board
PGL	Pasadena Gold Line
PTU	Portable Test Unit
PVID	Permanent Vehicle Identification
PWM	Pulse-Width Modulation
RH	Right Hand Side
SB	Service Brake
SCEB	Slide Controlled Emergency Brake
SW	Software
TBS	To Be Supplied
TCMS	Train Control and Monitoring System
TCN	Train Communication Network
TCU	Traction Control Unit
TWC	Train-to-Wayside Communication
US&S	Union Switch & Signal, Inc.
VDC	Volts Direct Current
VHDL	VHSIC Hardware Description Language (for FPGA)
V-zero	Velocity = Zero
WTB	Wired Train Bus

16-I-01.b LIST OF DEFINITIONS

The Definitions commonly used throughout this manual are given below with their related meaning.

Definition	Meaning
'A' body section	The section of an articulated vehicle containing the pantograph
'B' body section	The section of an articulated vehicle not containing the pantograph
AW0	Empty car operating weight
AW1	Full seated load plus AW0
AW2	Standees at 4 persons per square meter plus AW1
AW3	Standees at 6 persons per square meter plus AW1
AW4	Standees at 8 persons per square meter plus AW1
Component	(IEEE Std. 610.12-1993) One of the parts that make up a system. A component may be hardware or software and may be subdivided into other components.
Front door	The door close to the Operator's Cab
LC filter	Filter made up of Inductance and capacity
Non Vital Relay	The Non-Vital Relay is used in applications where fail-safe operation is not required. It provides no protection against welded contacts and no feedback indication if such a failure occurs.
Rear door	The door close to the Articulation Section
RLC filter	Filter made up of Resistance, Inductance and Capacity
Safety Relay	The operation of the Safety Relay depends on the forced operation of the relays inner contacts. If either of the inner contacts become welded, the normally closed outer contacts remain open. Using the back contacts as a feedback, provides a check that inner contacts have not welded. The Safety Relay differs from the Vital Relay in that the possibility still exists for the inner relay contacts to weld. However, unlike the Non-Vital Relay, a failure due to welded contacts is detectable.
Vital Relay	The Vital Relay is used in vital applications where fail-safe operation is required. Such applications include propulsion, braking, and door opening. The Vital Relay uses gravity for contact break and special contact materials to prevent contacts from welding.

16-I-01.c LIST OF MEASUREMENT UNITS AND SYMBOLS

The Measurement Units commonly used throughout this manual are given below with their related meaning.

Definition	Meaning
Ω	Ohm
°C	Celsius degree
°F	Fahrenheit degree
A	Ampere
ac	Alternate Current
dB	Decibel
dc	Direct Current
F	Farad
ft	Foot
H	Henry
Hz	Herz
in	Inch
kg	Kilogram - approx 2.205 pounds
km	Kilometer - approx 0.621 miles
kN	Kilo-Newton - approx 224.809 pounds force
mm	Millimeter - approx 0.0394 inches
ms	Milli second
rms	Root Mean Square Voltage
rpm	Revolution per Minute
V	Voltage
Vin	Input Voltage
Vpp	Peak to Peak Voltage
W	Watt

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16-I-02 THEORY OF OPERATION

This Section describes the TWC (Train to Wayside Communication) System.

Because of the strong interconnection between the TWC and the ATP System (refer to Section 15), in same cases the description may include both the ATP and the TWC System and consider them as a whole: the ATP/TWC system.

The MicroCab® ATP/TWC system for the LACMTA P2550 LRVs consists of the following:

- An enclosure designed for mounting in the vehicle equipment rack provided by the carbuilder. The enclosure incorporates the system's vital logic and interfacing circuits, a decelerometer, and relay for control of vital outputs. One (1) enclosure is installed in each P2550 vehicle.
- Cab-mounted Aspect Display Units (ADU) for the vehicle operator. Two (2) ADU's are installed in each vehicle, one in each vehicle cab (A-End and B-End).
- Cab-mounted TWC Interface Panel for the vehicle operator. Two (2) TWC Interface Panels are installed in each vehicle, one in each vehicle cab (A-End and B-End).
- Axle-mounted speed sensors. Two (2) speed sensors are mounted on different axles (one on Axle 2 of Motor Truck A; one on Axle 4 of the Trailer Truck).
- Truck-mounted FSK cab signal pick-up coils. Four (4) pick-up coils are mounted on the vehicle (two on each end truck). Each pair of coils is wired to a junction box.
- Vehicle body-mounted 100/250 Hz cab signal Track Receivers. Four (4) track receiver coils are mounted on the vehicle (two on each end). Each pair of coils is wired to a junction box.
- Vehicle body-mounted TWC antennas. Two (2) total TWC antennas are mounted on the vehicle (one on each end). The ATP system can also support mounting of two (2) additional TWC antennas (one on each end), if necessary. Each TWC antenna is wired directly to the enclosure.

Figure 16-I-02.1 shows the ATP/TWC system vehicle-level configuration.
Figure 16-I-02.2 shows the ATP/TWC system functional block diagram.

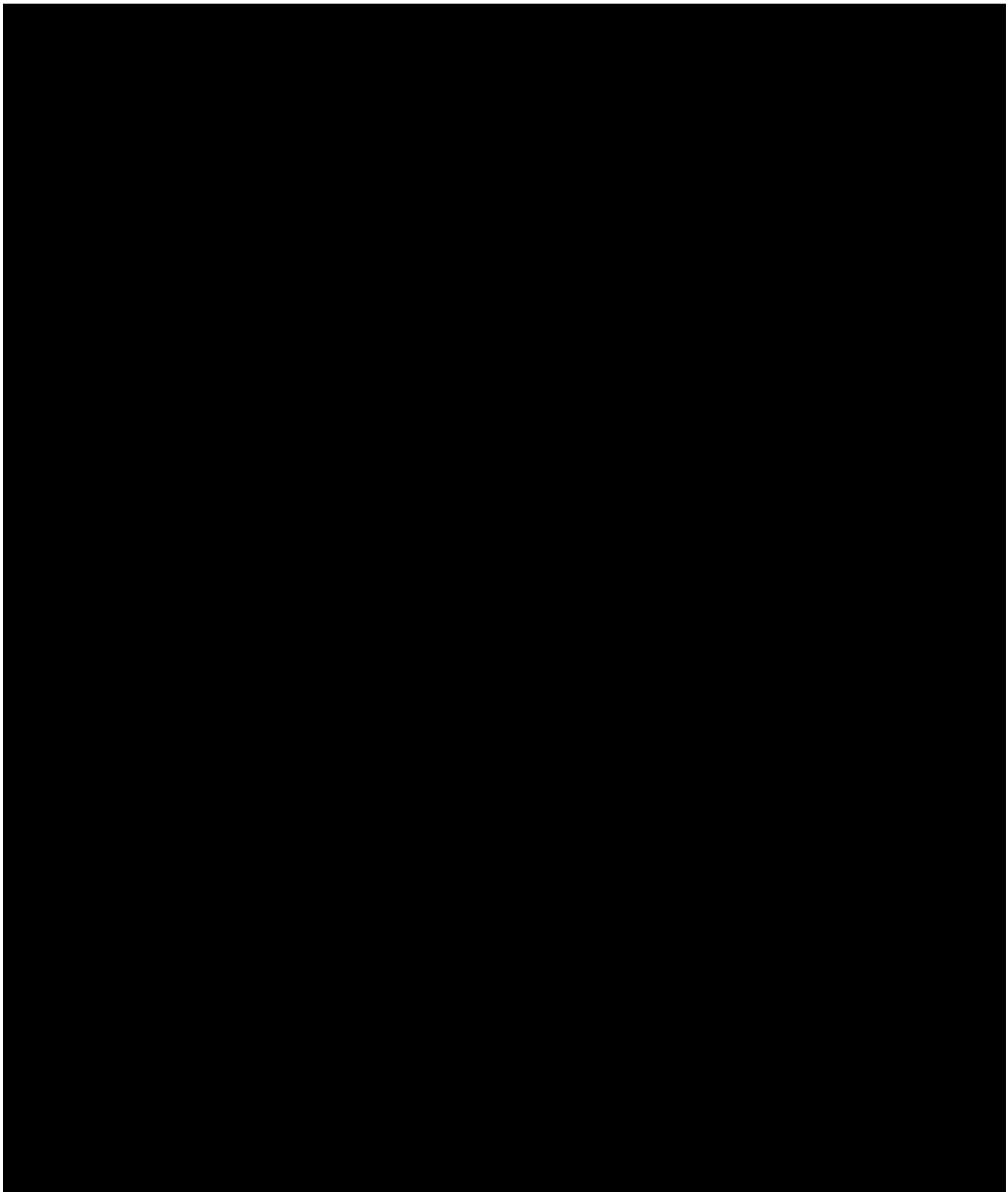
Both the ATP and the TWC System are made up of electronic boards (located in the same rack), and their peripherals.

ATP Peripherals:

- ADU;
- FSK Pick-Up Coils:
- Track Receivers;
- Speed Sensors.

TWC Peripherals:

- TWC Interface Panel;
- TWC Antennas.



The TWC System is made up of three main components:

- Electronic Boards (in the ATP/TWC Rack);
- The TWC Panel (in each Operator Cab);
- The TWC Antenna (one per Body Section Underframe).

The primary function of the TWC subsystem is to provide compatible two-way communication with TWC systems currently installed on the MBL, PGL and MGL.

The wayside transmits and receives non-vital information through the use of TWC loops situated between the rails and located at selected track locations.

The vehicle TWC subsystem transmits and receives information through the use of TWC antennas mounted at each end of the vehicle.

The selection of the active antenna is based upon which cab end is actively keyed.

A Line Selector Switch on the vehicle provides the method for properly configuring the TWC for operation on the desired line.

The TWC performs the following major functions across all three lines: -

Route Control and Indication

- Overloop Indication
- Train Identification (MGL Only)
- Departure Test

The P2550 TWC subsystem communicates with the existing Blue Line, Gold Line, and Green Line TWC wayside equipment and provides a single integrated interface for the operator to select and cancel route requests.

The TWC system receives and decodes FSK modulated signals propagated from the TWC loops mounted between the rails.

The TWC system also transmits rate-coded FSK modulated signals to the TWC loops. The TWC subsystem is also responsible for detecting when the vehicle is over a TWC loop and illuminating an overloop indicator to inform the operator.

i. System-Vehicle Relationship

The TWC System communicates with the other vehicle systems by means of:

- LVDS Relay Logic (refer to Section 10).
- LONWorks Bus (refer to Section 18);
- Cardfile Backboard (only for ATP-TWC relationship).

For this description refer to the figures in paragraph 16-I-02.02.01.

The TWC System is connected with the LVDS (Low Voltage Distribution System through LV Line and the LVDS Relay Logic for two reasons:

- TWC Bypass: the TWC System can be bypassed through the TWC By-Pass Switch (label #11S03). The By-Pass Switch is located in the By-pass Panel of the A Operator Cab.
- Line Selector Switch: the TWC Control PCB board of the ATP/TWC Equipment Enclosure is connected with the Line Selector Switch of the Data Download Panel to acquire the actual line (MGL, MBL or PGL) setting.

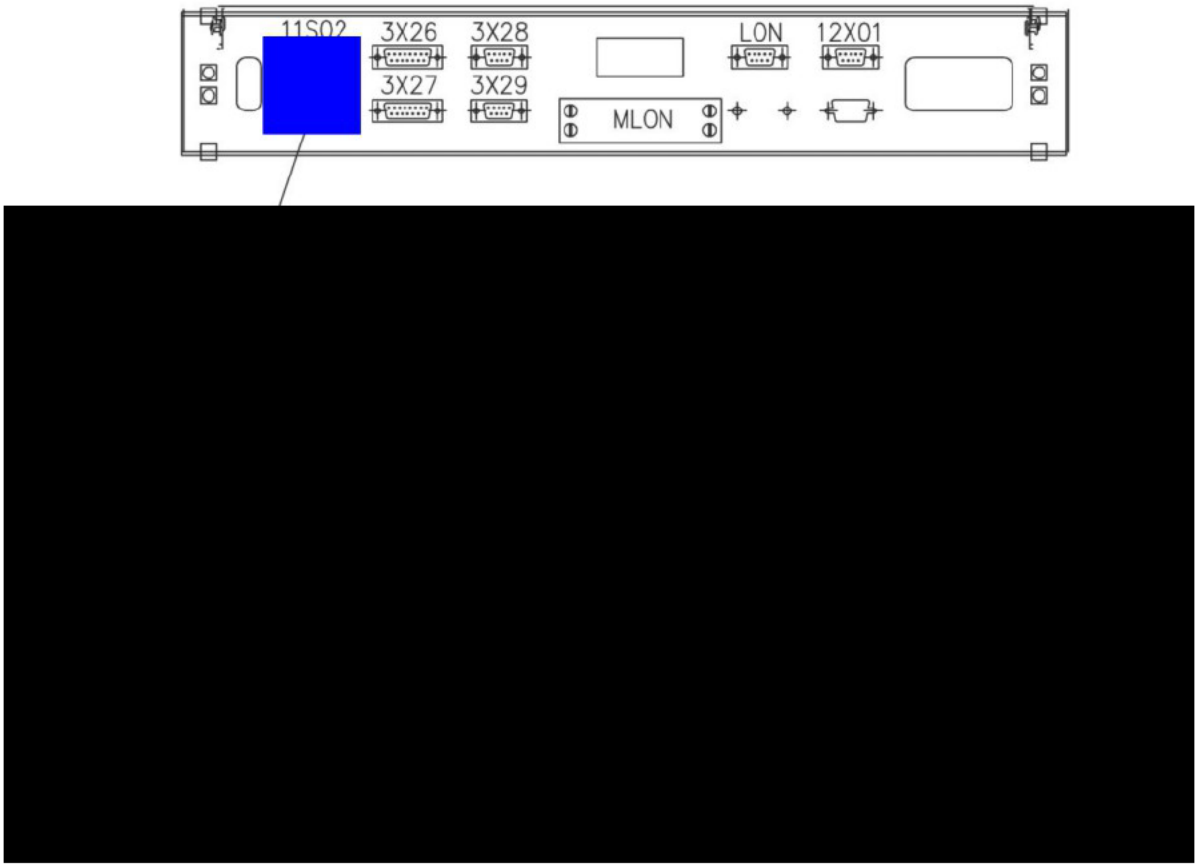
(Refer to Figure 16-I-02.3 and Figure 16-I-02.12).

Both the ATP/TWC Equipment Enclosure and the Line Selector Switch are located in the Electronic locker of the A Body Section (refer to Figure 16-I-02.7).

The TWC System is strictly linked with the ATP System, in particular, the ATP and the TWC have a common LONWorks Bus interface.

The TWC System uses the LONWorks Bus only to send its Status to the IDUs for troubleshooting reason.

The ATP System and the TWC System Electronic Boards are located in the same ATP/TWC Rack, thanks to this common location, these two systems can exchange data with each other.



ii. System-Equipment Relationship

The TWC System is made up of three main components:

- The TWC Boards (in the ATP Rack, (refer to Figure 16-I-02.7);
- The TWC Interface Panel (in each Operator Cab, (refer to Figure 16-I-02.5)
- The TWC Antenna (one per Body Section Underframe, (refer to Figure 16-I-02.6)

Figure 16-I-02.4 shows an overview of the TWC Components interconnections.

For a more detailed diagram refer to sheet # 112 of the LV Functional Schematic (237VE06965C03. (refer to Section 00 on How to Read the Functional Schematics).

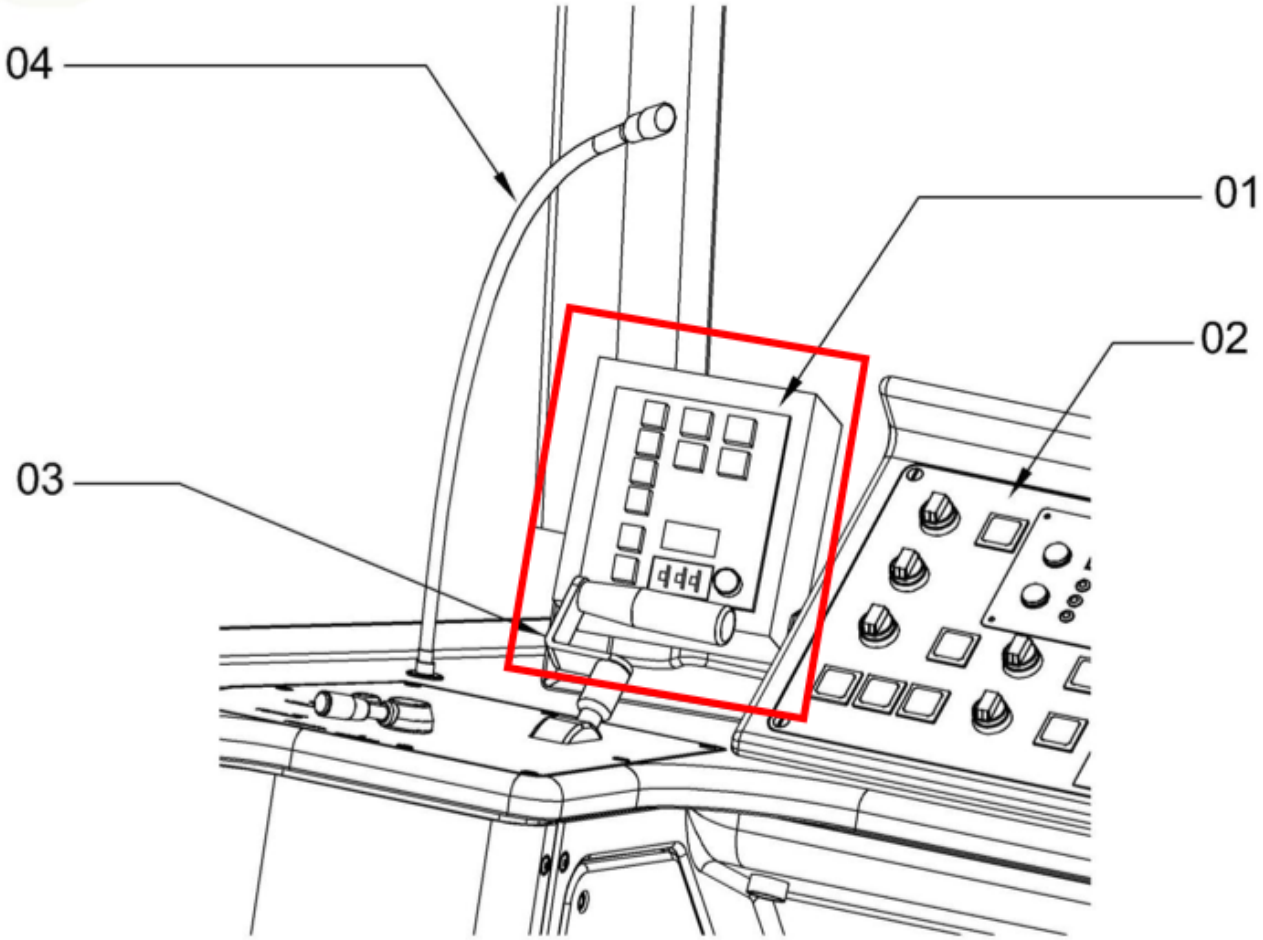
Refer to Figure 16-I-02.12 for ATP/TWC Rack and TWC Interface Panel connections. Each TWC Interface Panel is connected with the ATP/TWC Cardfile through:

- Twenty-four (24) LV wires;
- a RS485 cable.

Refer to Figure 16-I-02.13 for ATP/TWC Cardfile and TWC antennas connections. Each TWC antenna has four bipolar shielded cables.

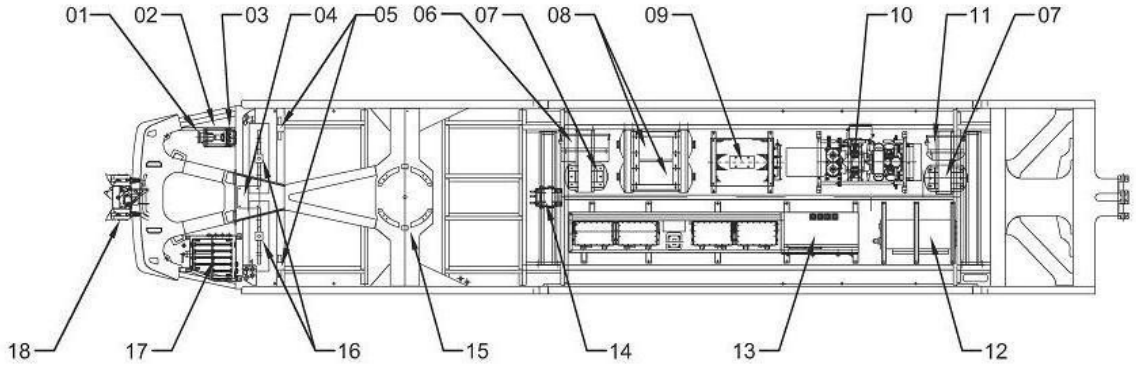
The TWC Control PCB Board implements all the logic elaborations and interfaces the TWC system with the other train systems (refer to paragraph **i**).

The TWC Interface Panel and the TWC Antenna are peripherals of the TWC Control PCB Board.

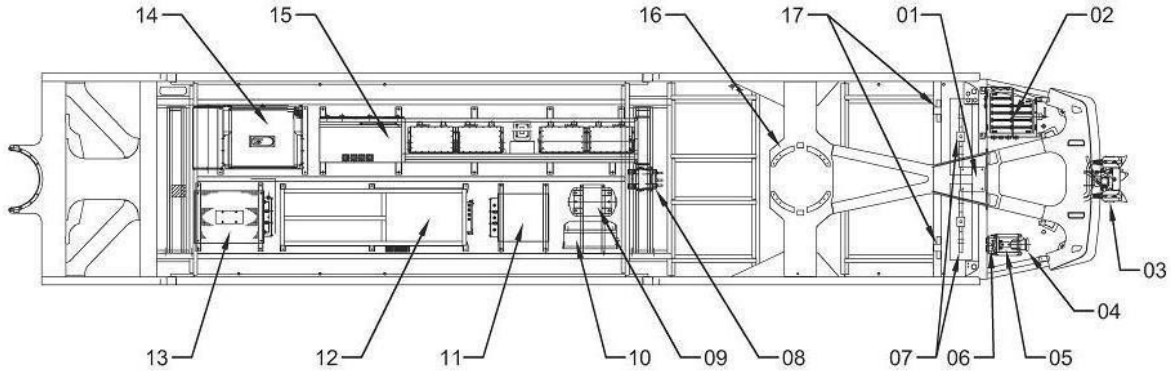


01. TWC CONTROL PANEL
02. CONSOLE
03. MASTER CONTROLLER
04. MICROPHONE GOOSENECK

Figure 16-I-02.5 TWC Interface Panel Location

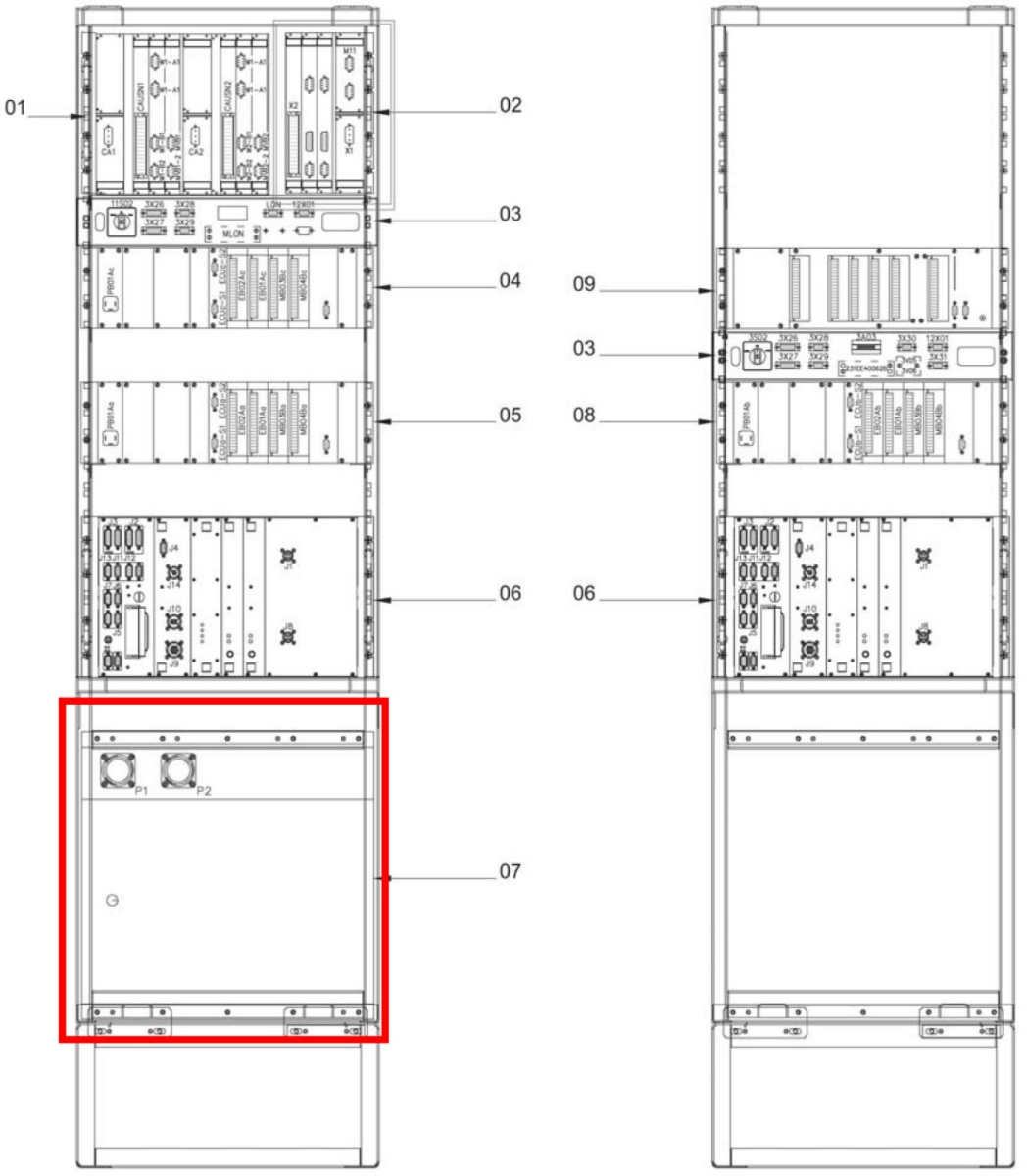


01. HORN/GONG
02. SOLENOID VALVE
03. DUPLEX SOLENOID VALVE
04. TWC ANTENNA
05. ATP ANTENNA (MBL & PGL)
06. BRAKE CONTROL UNIT M.T.
07. BCU AIR RESERVOIR (12.8 GALS)
08. MAIN AIR RESERVOIR (30.3 GALS)
09. "A" PROP. INVERTER LINE REACTOR
10. AIR COMPRESSOR UNIT
11. BRAKE CONTROL UNIT C.T.
12. KNIFE SWITCH
13. "A" PROPULSION INVERTER
14. QUICK DISCONNECT BOX
15. "A" MOTOR TRUCK CONNECTION
16. ATP ANTENNA (MGL)
17. JUNCTION BOX W/DRUM SWITCH
18. COUPLER



01. TWC ANTENNA
02. JUNCTION BOX W/DRUM SWITCH
03. COUPLER
04. HORN/GONG
05. SOLENOID VALVE
06. DUPLEX SOLENOID VALVE
07. ATP ANTENNA (MBL & PGL)
08. QUICK DISCONNECT BOX
09. BCU AIR RESERVOIR (12.8 GALS)
10. BRAKE CONTROL UNIT M.T.
11. LINE REACTOR FOR APS_LVPS BOX
12. APS_LVPS BOX
13. "B" PROP. INVERTER LINE REACTOR
14. BATTERY BOX
15. "B" PROP. INVERTER
16. "B" MOTOR TRUCK CONNECTION
17. ATP ANTENNA (MGL)

Figure 16-I-02.6 TWC Antenna Location



01. GATEWAY
02. EDU
03. DATA DOWNLOAD PANEL
04. ECU A
05. ECU C
06. COMMUNICATIONS RACK
07. ATP RACK
08. ECU B
09. EVENT RECORDER

Figure 16-I-02.7 ATP/TWC Equipment Enclosure Location

iii. Performances and Characteristics

ATP/TWC Rack:

- ATP/TWC Rack dimension:
  - The enclosure measures about 17(H) x 19(W) x 13(D) inches, and should be mounted with an additional four (4) inch clearance above the enclosure to allow appropriate space for the cable connectors.
- Input Voltage:
  - The enclosure operates from 25 to 42 Vdc vehicle battery power;
  - Nominal Input Voltage: 37.5Vdc.

TWC Interface Panel (refer to Figure 16-I-02.10):

- Dimension: about 7(H) x 6(W) x 3.5(D).

TWC Antenna:

- Dimension (refer to Figure 16-I-02.11): a square with side of 15.13 inches.
- Working frequency (4800 bound rate):
  - 54kHz
  - 64kHz

16-I-02.01 The TWC System Components

The TWC System is made up of three main components:

- The TWC Boards (in the ATP Rack, (refer to Figure 16-I-02.7);
- The TWC Interface Panesl (in each Operator Cab, (refer to Figure 16-I-02.5)
- The TWC Antennas (one per Body Section Underframe, (refer to Figure 16-I-02.6).

16-I-02.01.01 ATP/TWC Equipment Enclosure

The ATP and the TWC systems are managed through the same electronic Equipment Enclosure.

This ATP/TWC Equipment Enclosure is located in the Electronic Locker of the A Body Section (refer to Section 10). Refer to Figure 16-I-02.8 and Table 16-I-02.1.

The MicroCab® Enclosure consists of a welded steel enclosure designed for mounting in the P2550 vehicle equipment rack.

The enclosure contains the following major components:

- One (1) cardfile with plug-in PCBs for the MicroCab® vital logic and interfaces to other equipment and subsystems (e.g., speed sensors and pick-up coils)
- One (1) decelerometer for measuring vehicle braking rate
- One (1) vital relay (US&S PN-159B) for controlling vital outputs to the vehicle brake system
- One (1) Battery Conditioner PCB for filtering input power from the vehicle battery and protecting the MicroCab® circuits from voltage transients
- One (1) Relay PCB providing safety and non-vital relays for controlling various functions
- Two (2) Veam type, ¼ turn quick-disconnect plug connectors for connecting external circuit/equipment wiring (power and data) to the cardfile
- Two (2) EEPROM PCBs to store vehicle-specific data for the TWC Control and Main Logic CPU PCBs

The enclosure measures about 17(H) x 19(W) x 13(D) inches, and should be mounted with an additional four (4) inch clearance above the enclosure to allow appropriate space for the cable connectors.

The front of the enclosure is covered by an EMI-gasketed door, which can be removed for testing and servicing.

The door also has an 8-mm hex key-lock to prevent unauthorized access to the internal components.

An external ground stud, mounted near the vehicle wiring connectors, allows grounding the Enclosure to the vehicle chassis to provide EMI protection for the system.

The enclosure operates from 25 to 42 Vdc vehicle battery power.

This Section describes only the ATP/TWC Rack Components related to the TWC System; for all other components refer to Section 15.

The ATP/TWC Rack Components related to the TWC System are:

- The TWC Control PCB Board (refer to paragraph 16-I-02.02.01);
- Power Supply PCB (refer to paragraph 16-I-02.01.01.02);
- Battery Conditioner PCB (refer to paragraph 16-I-02.01.01.03);
- Relay PCB (refer to paragraph 16-I-02.01.01.04).

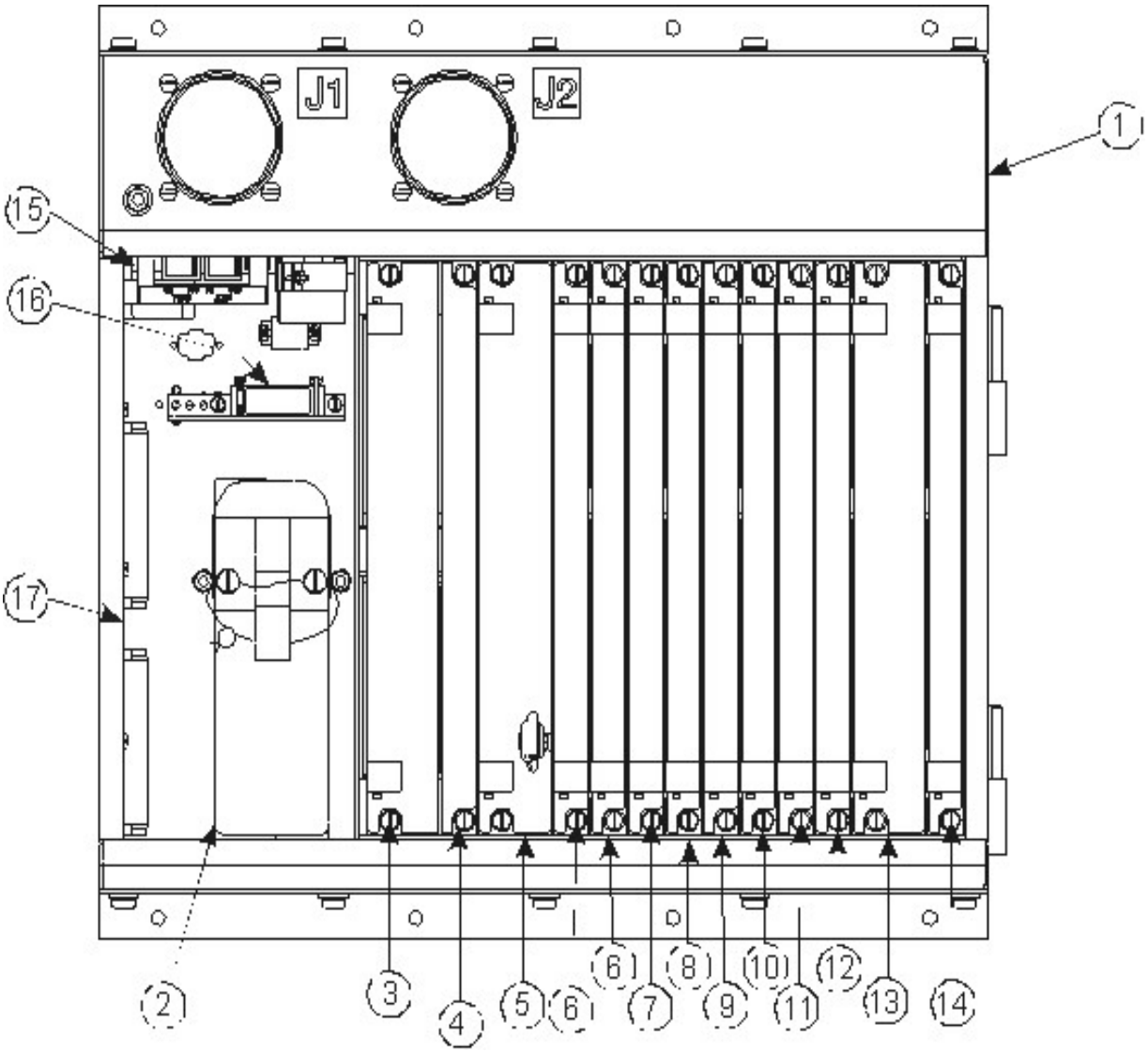


Figure 16-I-02.8 ATP/TWC Equipment Enclosure

Table 16-I-02.1 ATP/TWC Equipment Enclosure and Cardfile Components

Ref.	Component	Part Number	Description
1	ATP/TWC Equipment Enclosure	N21065601	Houses system vital components and logic software
2	PN-159B Vital Relay	N436788	Vital Relay for Brake interface
3	TWC Control PCB	N25560702	Circuitry for train-to-wayside communication
4	Blank Panel	N4518502902	Occupies an empty space in the cardfile
5	Main Logic CPU PCB	N17061322	ATP subsystem logic CPU
6	Vital Input PCBs (two)	N21260103	Monitor cab control, vehicle status, and closed-loop inputs
7	Multifunction PCB	N21272402	Contains circuitry that performs the Departure Test, provides Decelerometer interface, processes speed sensor signals, and provides vital and non-vital ATP outputs.
8	Decoder CPU PCB	N4519105507	Determines the dominant code rate received from the track receivers
9	100 HZ Filter Demodulator PCB	N21266407	Processes 100 Hz cab signals received from the track receivers
10	250 HZ Filter Demodulator PCB	N21266405	Processes 250 Hz cab signals received from the track receivers
11	FSK Receiver PCB	N4519105402	Filters FSK cab signal input from receivers coils
12	FSK CPU PCB	N21270404	FSK Decoder Subsystem CPU
13	Conditional Power Supply PCB	N4519100802	CPU-controlled vital 32 VDC power supply
14	Power Supply PCB	N21272202	Converts vehicle battery power into levels suitable for the ATP operating circuits
15	Battery Conditioner PCB	N21068001	Provides two independent battery filtered outputs, one for the ATP and one for the TWC subsystems
16	Decelerometer	N21068801	Monitors vehicle deceleration to provide brake rate
17	Relay PCB	N21213301	Provides I/O interface relays to the vehicle

16-I-02.01.01.01 The TWC Control PCB Board

The TWC Control PCB is a Field Programmable Gate Array (FPGA)-based Binary Frequency Shift Keying (BFSK) modem, non-vital I/O interface, and communication controller specifically designed for operation on LACMTA's Metro Blue Line, Metro Green Line, and Pasadena Gold Line.

The filters, Frequency-Shift-Keying (FSK) demodulator, moving reference detector, FSK modulator, Pulse Width Modulation (PWM) controller, over-current protection logic, and other interface circuitry were implemented digitally (using VHDL) within the FPGA.

This allows the PCB to be extremely versatile and adaptable to a very broad range of frequencies, signal levels, and transmit power requirements.

Key functions of this board include:

- Filtering, Automatic Gain Control (AGC), demodulation, decoding, and processing of received wayside FSK messages
- Encoding, modulation, and power control of FSK messages transmitted to the wayside
- Communications with the TWC Interface Panel indicators and displays
- Monitoring and processing of TWC Interface Panel pushbutton and thumbwheel inputs
- Monitoring and processing of vehicle inputs
- Communications with the ATP to exchange diagnostic, status, and track position data
- Managing user diagnostic and event data downloading procedures
- Storing routine event and fault data in memory
- User controls and displays on the TWC Control PCB include:
- Two alpha-numeric LED displays for showing stored data and programming menus
- Sixteen discrete LEDs for monitoring individual PCB channels and functions
- One momentary pushbutton for manually resetting the system
- Four two-position toggle switches for stepping through and selecting programming options

16-I-02.01.01.02 Power Supply PCB

The Power Supply PCB converts vehicle battery power into levels needed by the ATP system's operating circuits.

This board incorporates five power supply converter modules.

Modules PS1 and PS2 each provide 35W (70W total) of power at 30 Vdc.

This 30 Vdc is wired from the rack to vehicle subsystems to be fed back through vehicle contacts as inputs to the ATP.

Modules PS4 and PS5 are 15 Vdc supplies, one for each speed sensor.

The Power Supply PCB also provides +5.2 Vdc (PS7) and ±12 Vdc (PS6) operating power for the CPU and other cardfile circuit boards.

All supply module outputs are isolated from the vehicle battery supply. User front-panel devices include eight (8) LEDs for monitoring specific power supply module outputs.

16-I-02.01.01.03 Battery Conditioner PCB

The Battery Conditioner PCB contains two identical power conditioning circuits, one for ATP and one for TWC.

Each circuit is completely independent of the other, and is controlled by its own ON/OFF switch.

Each circuit protects against both short-term input power surges and longer-term input over-voltage input conditions.

Capacitors in the output stage of each circuit provide high-frequency filtering and limit the ripple on the output lines.

16-I-02.01.01.04 Relay PCB

The Relay PCB contains 10 safety relays and two non-vital relays which provide the ATP output interface to the vehicle, and steering logic for the selection of Cab Signal and TWC antenna sources.

Each safety relay is driven by non-vital outputs contained on the Multifunction PCB. The board also contains two signal transformers.

One transformer couples Cab Signal test signals, generated on the Multifunction PCB, to the selected track receivers during MBL and PGL Departure Tests.

The other transformer couples received FSK signals from the selected track receivers to the 100 Hz and 250 Hz Filter PCBs.

The safety relays serve the following functions within the system:

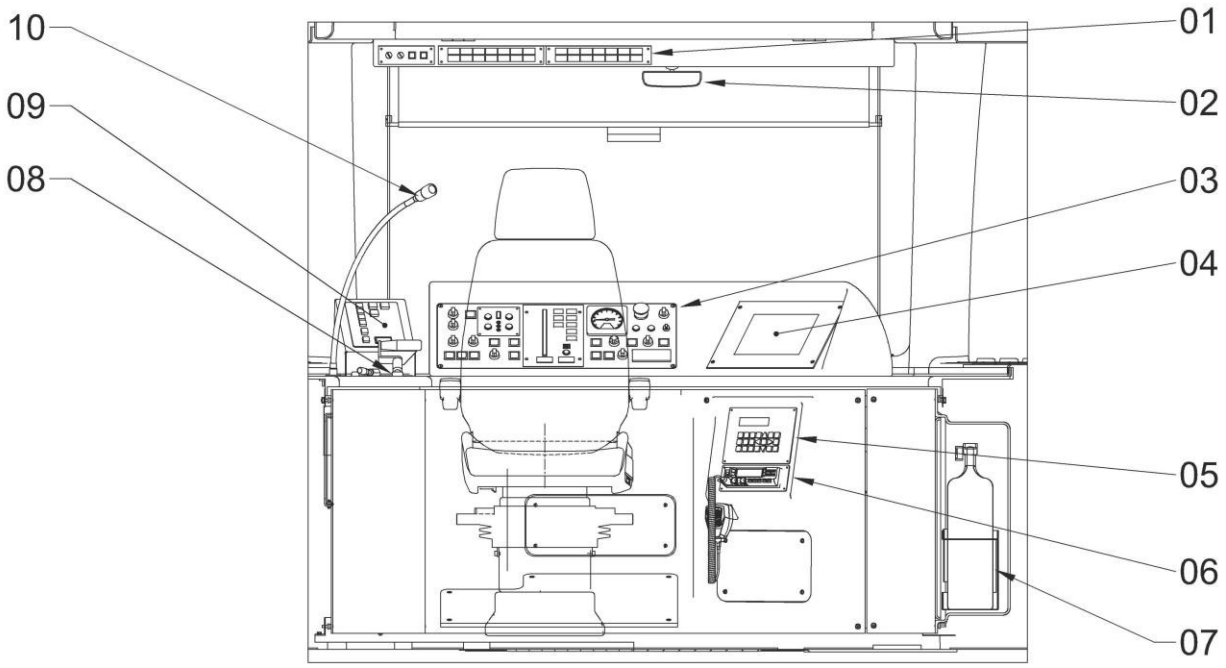
- K1: This safety relay controls the Propulsion Enable (PE) signal. When energized, two relay contacts close (one for PE+ and one for PE-) and the vehicle can receive the PE signal. A backcheck contact of the relay feeds back to the Vital Input PCB for ATP monitoring.
- K2: This safety relay controls the Enable Left Door (ELD) signal. When energized, the K2 contact closes and the vehicle can receive the ELD signal. A backcheck contact of the relay feeds back to the Vital Input PCB for ATP monitoring.
- K3, K4, and K5: These three safety relays form a circuit that selects the TWC antenna set to be used by the system. Each antenna contains two sets of transmit and receive coils. One set of coils is used the Metro Blue Line (MBL) and Pasadena Gold Line (PGL). The second set of coils is used for the Metro Green Line (MGL). K4 selects the active coil set for the B-End antenna (MBL/PGL when energized, MGL when de-energized). K5 selects the active coil set for the A-End antenna (MBL/PGL when energized, MGL when de-energized).
- K6: This safety relay controls the Enable Right Door (ERD) signal. When energized, the contact is closed and the vehicle can receive the ERD signal. A backcheck contact of the relay feeds back to the Vital Input PCB for ATP monitoring.
- K7, K8: These safety relays select between the A-End or B-End FSK antennas and track receiver signals. When K7 is energized, the A-End antennas and receivers are selected. When K8 is energized, the B-End antennas and receivers are selected. A backcheck contact of each relay feeds back to the Vital Input PCB for ATP monitoring.
- K9: This safety relay (when energized) couples the Departure Test signal from the multifunction board to the track receiver circuit selected by the K7 or K8 relay. A backcheck contact of the relay feeds back to the Vital Input PCB for ATP monitoring.
- K10: This safety relay handles the Full Service Brake Request (FSBR) signal. When K10 is energized, the contact is closed and the vehicle can receive the FSBR signal. A backcheck contact of the relay feeds back to the Vital Input PCB for ATP monitoring.
- K11, K12: These two non-vital relays power either the A-End or B-End TWC Interface Panels. When K11 is energized, the A-End panel is powered. When K12 is energized, the B-End panel is powered.

16-I-02.01.02 TWC Interface Panel

The TWC Interface Panel (in Figure 16-I-02.9) incorporates the interfaces necessary for the TWC subsystem.

One TWC Interface Panel is mounted in each operator's cab of the vehicle.

Because the P2550 vehicles will be operated on three different Metro systems, the TWC Interface Panel is designed to provide a single, integrated display to the operator.



1.Indicators Panels
2. Internal Rear View Mirror
3. Operator's Console
4. Monitor IDU
5. AADS
6. VHF Radio
7. Fire Extinguisher
8. Master Controller Panel
9. TWC Interface Panel
10. Gooseneck Microphone

Figure 16-I-02.9 Operator's Cab

Figure 16-I-02.10 shows the front panel layout of the TWC Interface Panel controls and indications.

Table 16-I-02.2 summarizes the TWC Interface Panel controls and indications.

Only one TWC Interface Panel is powered on at a time depending upon which cab end is enable.

The units are designed to be interchangeable between cab ends.

The Interface Panel interfaces to the TWCC PCB through the use of discrete I/O and a half-duplex SPI communications link.

The panel pushbuttons and thumbwheel switches are wired (via vehicle wiring) to discrete inputs on the TWC Controller PCB.

An on-board micro-controller provides control of the panel's four indicators, sevensegment displays, alarm, lamp test, and dimming functions.

Data for control of the indicators, seven-segment displays, and the alarm is received from the TWC Control PCB.

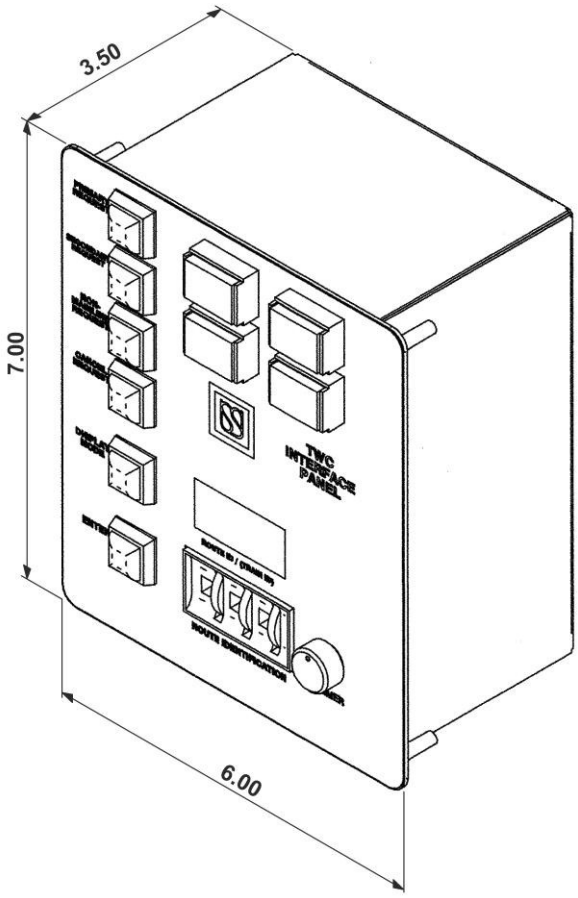


Figure 16-I-02.10 TWC Interface Panel

Table 16-I-02.2 TWC Interface Panel Controls and Indications

Name	Function	Device Type
OVER TWC LOOP	Vehicle is positioned over a TWC loop	LED lamp (Green)
TWC READY	TWC operational indicator	LED lamp (Green)
DEPART TEST	Departure Test request and result indication	Combination momentary PB and LED lamp (Green)
TWC FAULT	TWC fault/failure indicator	LED lamp (Red)
Primary Request	Primary Mainline Route Request (MBL/PGL)	Momentary PB
Secondary Request	Secondary Mainline Route Request (MBL/PGL)	Momentary PB
Non-Mainline Request	Non-Mainline Route Request (MBL/PGL)	Momentary PB
Cancel Request	Cancel Route Request (MBL/PGL)	Momentary PB
Route Identification	Route Identification (MGL)	Three thumbwheel switches
Enter	Enter (MGL)	Momentary PB
ROUTE/TRAIN ID	Display Current Route IDs (MGL/MBL/PGL) and Train IDs (MGL)	Three LED seven-segment displays
DISPLAY MODE	Change information displayed on the Route/Train ID display (MGL)	Momentary PB
DIMMER	TWC display intensity level control	Rotary potentiometer
Alarm	Audible indicator	Piezoelectric alarm

A piezoelectric alarm is located on the inside of the TWC Interface Panel that can produce a sound of sufficient intensity to be heard in the cab.

The alarm provides an audible output level of 85 dB(A) measured at a distance of 10 cm.

The TWC Interface Panel provides for external control of the Lamp Test feature, using the vehicle Lamp Test pushbutton located on the Operators Console.

16-I-02.01.03 TWC Antenna

The TWC system is equipped with two (2) TWC antennas, one at each end of the vehicle, mounted to the underframe below the cab.

Each antenna includes two sets of transmit and receive coils.

One set of coils is used during operation on the MBL and PGL.

The second set of coils is used during operation on the MGL.

The TWC antenna receives and transmits signals to and from the TWC loops mounted between the rails.

Each TWC antenna connects to the ATP/TWC enclosure through the vehicle wiring. Because only one antenna is active at a time, the ATP electronics use relays to select the appropriate antenna, as well as the appropriate set of transmit and receive coils.

Figure 16-I-02.8 shows a general view and layout of TWC antenna.

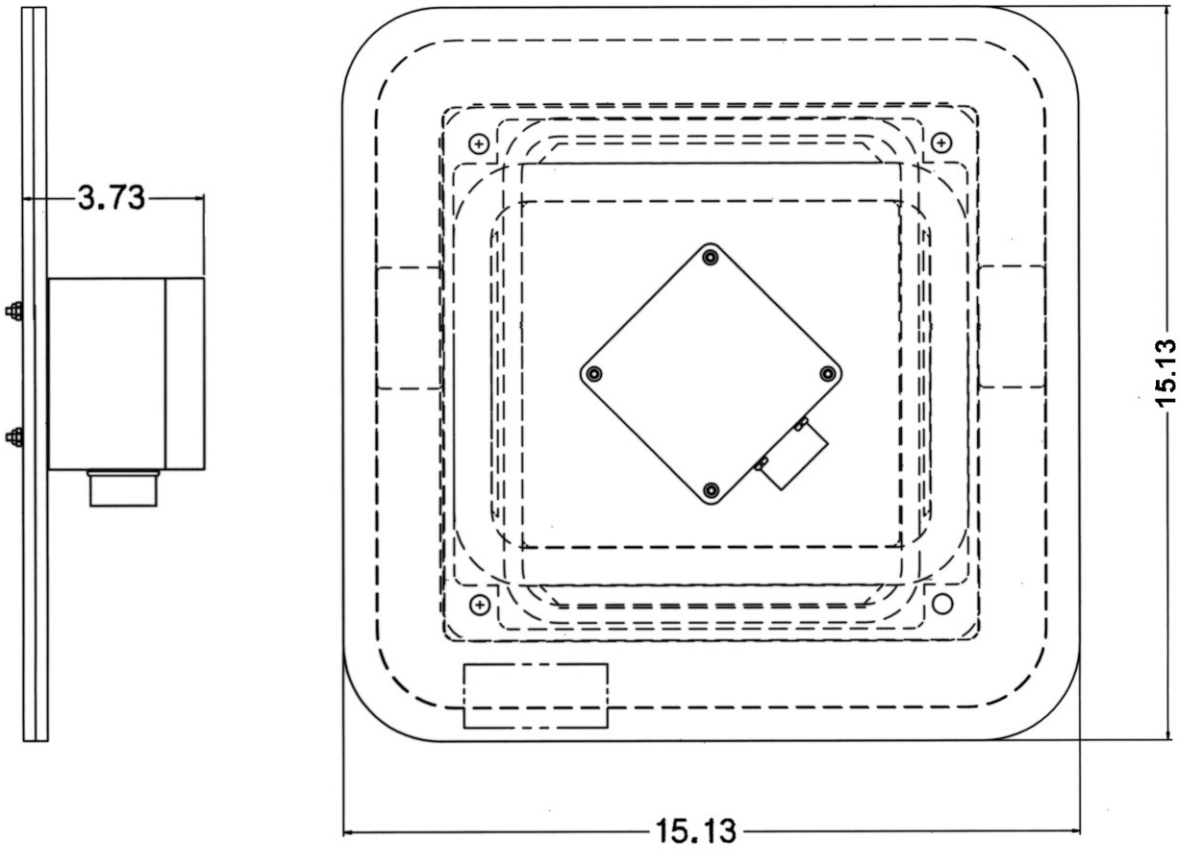
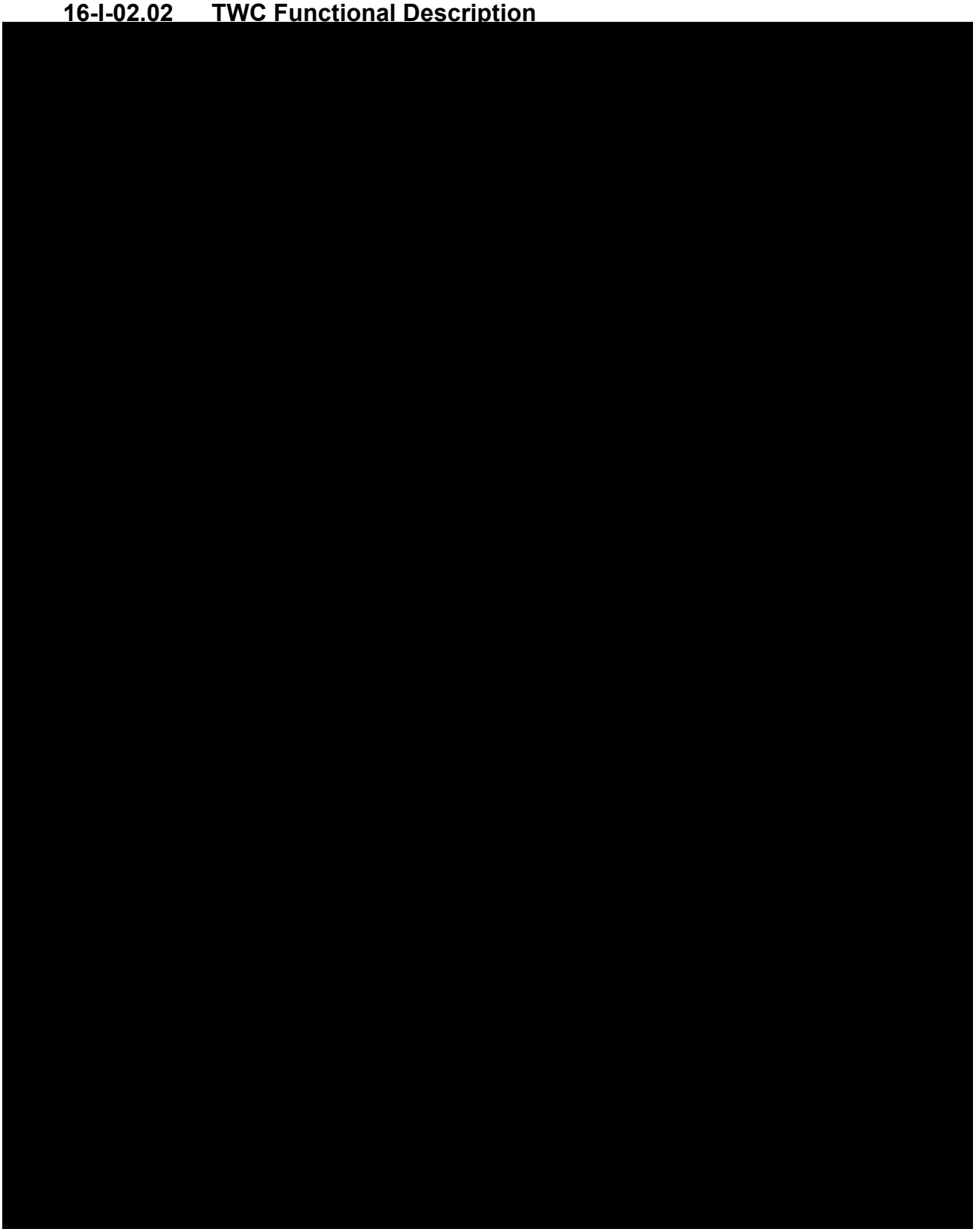
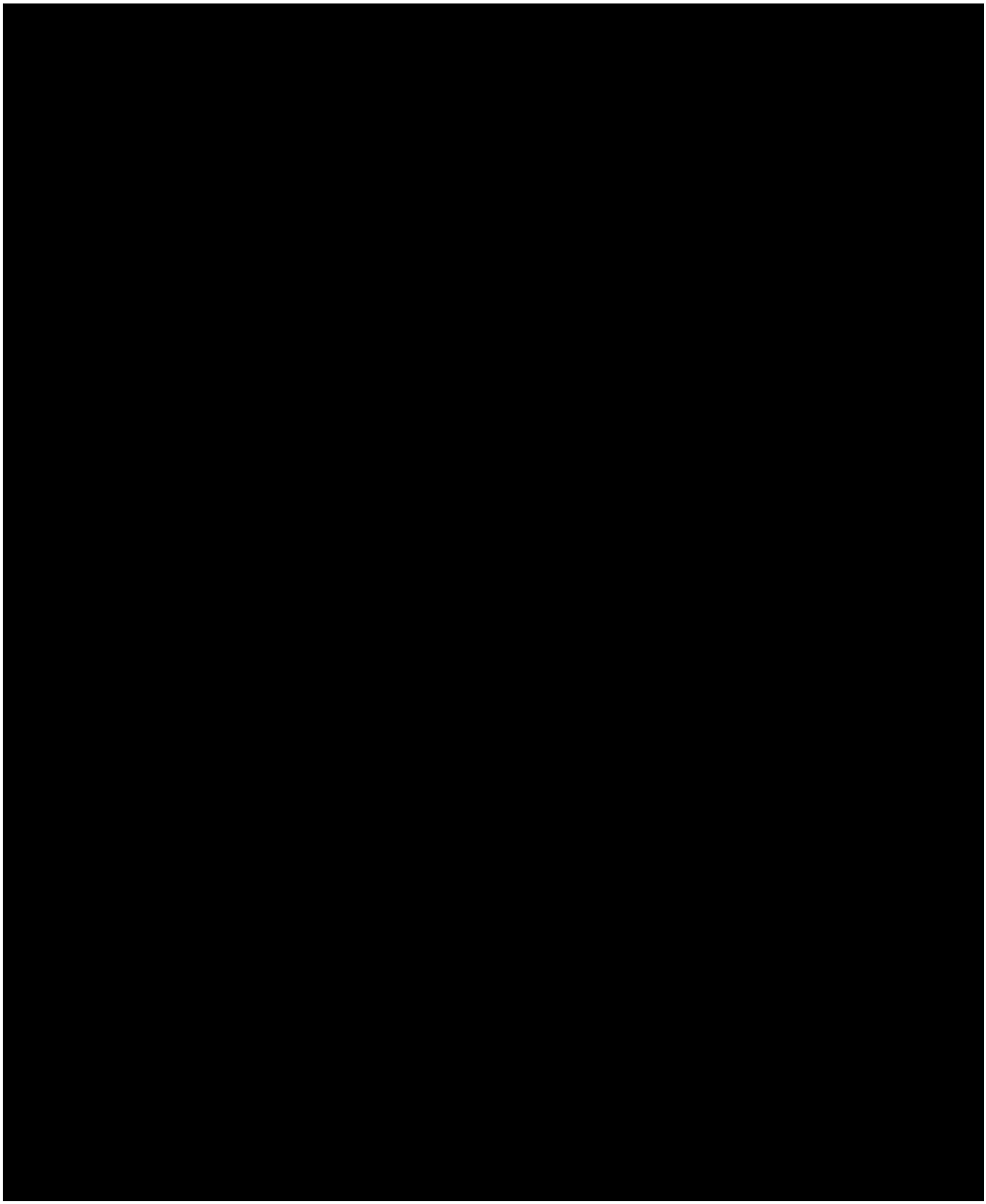
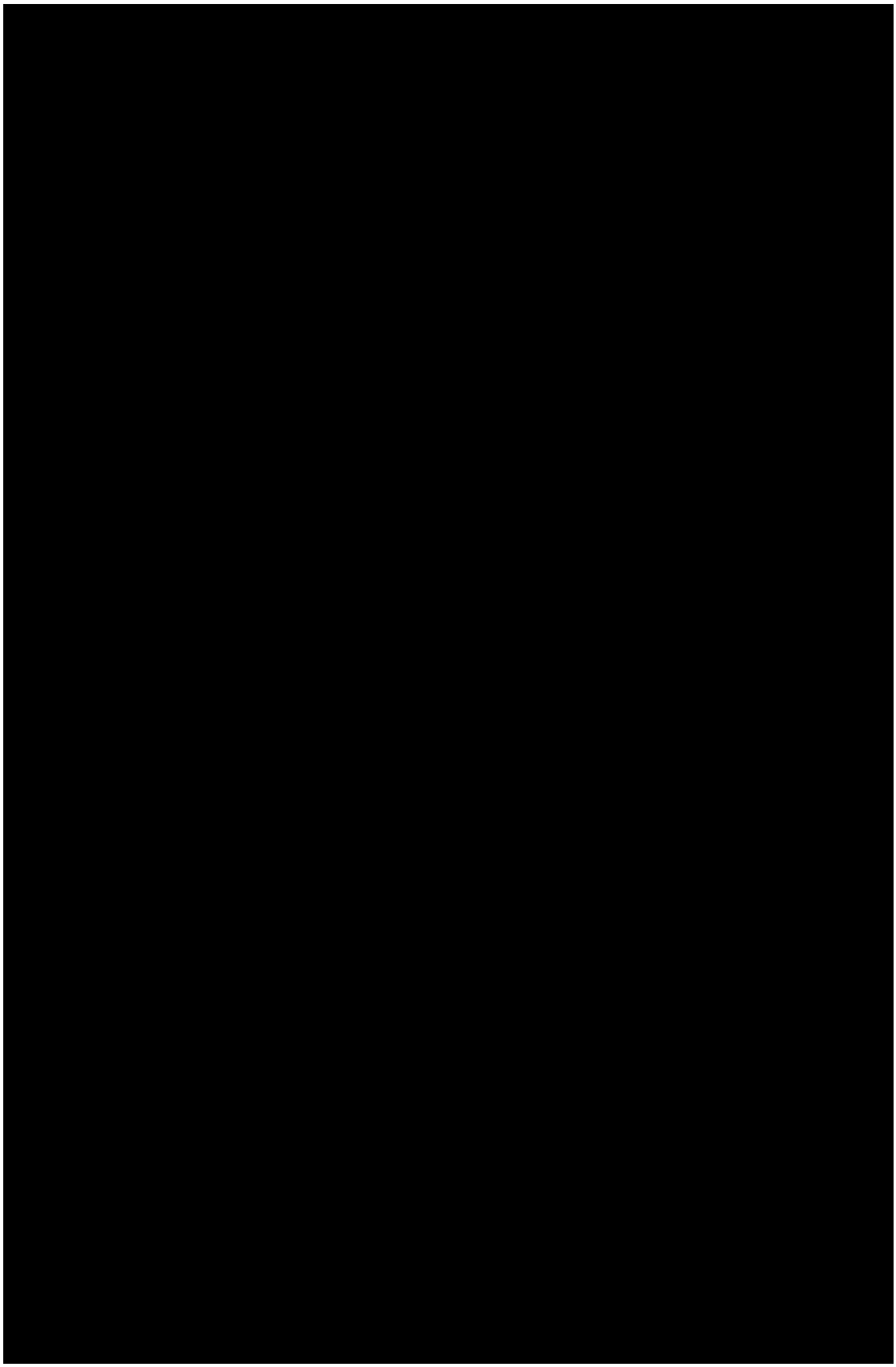


Figure 16-I-02.11 TWC Antenna

16-I-02.02 TWC Functional Description







16-I-02.02.02 TWC Interface Panel

The TWC Interface Panel is the primary Operator interface with the TWC subsystem. The TWC Interface Panel consists of displays, indicators, and controls (see Paragraph 16-I-02.01.02) that enable the Operator to position the vehicle for proper vehicle antenna-to-wayside TWC loop alignment, and to initiate, monitor, or cancel route requests.

All of the displays, indicators, and controls are non-vital. Table 16-I-02.3 shows which panel components are operational when configured for a particular line.

Table 16-I-02.3 TWC Interface Panel Component Line Operation Chart

TWC Interface Panel Component	MGL	MBL	PGL
Over TWC Loop Indicator	●	●	●
TWC Ready Indicator	●	●	●
Departure Test Control / Indicator	●	●	●
TWC Fault Indicator	●	●	●
Primary Request Control		●	●
Secondary Request Control		●	●
Non-Mainline Request Control		●	●
Cancel Control		●	●
Route Identification Control	●		
Enter Control	●		
Route / Train ID Display	●	●	●
Display Mode Control	●		
Audible Alarm	●	●	●

16-I-02.02.02.01 Route/Train ID Display

When configured for operation on the MGL, the ROUTE/TRAIN ID displays both the current Route ID (default selection) and the current Train ID.

Pressing the DISPLAY MODE pushbutton toggles the display selection between the Route ID and Train ID. If the display is left showing the Train ID, the TWC will revert back to showing the Route ID after five (5) seconds.

When configured for operation on either the MBL or the PGL, the ROUTE/TRAIN ID display is only used for displaying the requested route pushbutton commands.

The DISPLAY MODE pushbutton is not functional while operating on these lines.

For operation on all lines, the ROUTE/TRAIN ID display will indicate "– – –" when in OFF mode, or when communications between the Interface Panel and the TWC Controller PCB is interrupted.

16-I-02.02.02.02 Display Dimmer Control

This rotary control allows the Operator to set the brightness level of the TWC displays and indicators.

Turning the control clockwise brightens the displays, counter-clockwise dims the display.

16-I-02.02.02.03 Audible Alarm

The TWC Interface Panel contains an audible alarm to alert the Operator to certain panel display changes.

The TWC can produce two types of audible alarms:

- Continuous - Continuous sounding of the alarm.
- Beep - Single cycle of the alarm; on for 500 milliseconds, then off.

During operation on the MGL, the TWC sounds a beep alarm to alert the Operator that the route ID or train ID has changed.

The TWC also sounds a beep alarm when the station dwell time has expired.During operation on all three lines, the TWC sounds a beep alarm on Overloop detection.

16-I-02.02.03 Permanent Vehicle Identification (PVID)

The TWC Subsystem provides for the input and storage of a Permanent Vehicle Identification (PVID) value.

This value identifies the vehicle in which the ATP/TWC system resides.

Vehicle identity is independent of the PCBs of the TWC system.

The PVID for each vehicle is stored on an EEPROM, which is installed as a separate component of the ATP/TWC enclosure (refer to Section 15).

In Off Mode, authorized maintenance personnel perform the programming of the PVID. The appropriate value is entered into EEPROM using the function switches and alphanumeric displays on the front panel of the TWC Controller PCB (refer to Section 15).

Once programmed, the PVID only needs to be reprogrammed if the ATP/TWC enclosure or EEPROM PCB is replaced.

The PVID programming function is available when the Line Selector switch is set for any of the specified lines.

However, the data is used only for train identification and tracking functions on the MGL. PVID data is not used for operation on the MBL or PGL.

The TWC uses a default PVID value of “0000” if communications with the EEPROM cannot be established.

If a failure to communicate to the EEPROM is detected, the TWC indicates a fault to the Operator by lighting the TWC FAULT indicator on the TWC Interface Panel.

The TWC also logs an internal event, and reports the fault to the vehicle TCMS.

16-I-02.02.04 TWC Modes of Operation

The TWC on each vehicle has only two basic modes of operation:

- ON (active)
- OFF (inactive)

The vehicle controls include a TWC Bypass switch, located on the “a Cab”, to bypass the TWC should a fault occur.

However, there is no specific TWC Bypass mode defined for the MGL: Bypass mode simply removes operating power from the TWC.

The status of the TWC Bypass switch is monitored by the ATP and reported to the vehicle TCMS for being displayed on the vehicle IDU (Refer to Section 15).

16-I-02.02.04.01 On Mode

This is the normal (active) operating mode for the TWC system, with all specified functions for the selected line available.

This mode is entered by placing the Transfer Switch in one of the end cabs to ON with the TWC Bypass switch not active.

The TWC applies power only to the Interface Panel in the cab that is keyed up, and removes power from the non-keyed end.

If no errors are detected within the system, the TWC READY indicator on the TWC Interface Panel lights steady.

If errors or faults are detected, the TWC FAULT indicator lights steady.

16-I-02.02.04.02 Off Mode

In this mode, the TWC is considered inactive. Off mode is entered when the Transfer Switch is placed into the LOCAL position in either cab end, neither end cab is activated, and the TWC is not bypassed.

While in OFF mode, the TWC supply power to each end cab’s TWC Interface Panel, but all indicators except for the Route Identification Display (see paragraph 16-I-02.02.02.01) are turned off.

Also, the lamp test feature is not available in this mode.

16-I-02.02.05 TWC Configuration

Upon activation into either the Off or On modes, the TWC will self-configure its operation based upon the Line Selector inputs. Upon power-up, the TWC system defaults with no line selected.

If no Line Selector Crosscheck error (see Section 16-I-02.02.09.01, Line Selector Crosscheck) is active, the TWC will set its internal operation for the selected line.

Additionally, the TWC will select the appropriate transmit and receive coils in the TWC antenna based upon the indicated line.

Antenna selection is determined based upon the Cab In Control inputs to the TWC system.

Upon power-up, the TWC system internally defaults with no antenna selected.

If no Keyed Cab Crosscheck error is active, the TWC will select the appropriate A-End or B-End antenna based upon the corresponding Cab In Control indication.

16-I-02.02.05.01 Antenna Selection

Antenna selection is determined based upon the active Cab inputs to the TWC system. Upon power-up, the TWC system internally defaults with no antenna selected

If no Keyed Cab Crosscheck error is active, the TWC will select the appropriate A-end or B-end antenna based upon the corresponding Cab In Control indication.

16-I-02.02.06 MGL TWC Operational Description

When configured for operation on the MGL, the TWC system communicates with the wayside in a master/slave relationship.

The vehicle TWC has the master role and initiates communication with the wayside.

The following MGL TWC related features are supported by the P2550 TWC system:

- Departure Control
- Route ID Entry/Validation
- Train ID Assignment
- Serial Communications with the ATP

The P2550 TWC system also provides Overloop detection and indication, No Motion determination, and Departure Test functions.

On the MGL, the vehicle TWC system communicates with the Wayside using FSKmodulated digital serial messages.

The messages are transmitted and received using FSK frequencies of 54 kHz and 64 kHz at a 4800 baud rate using the US&S Genisys protocol.

The existing Wayside TWC units have two modes of communication: continuous and two-way.

The P2550 TWC uses two-way communication with the Wayside during normal operation.

Continuous communication mode is reserved only for use during a Departure Test.

Message transmission by the TWC occurs only with the TWC in On Mode.

When in the On Mode, transmission is further dependent on the ATP operating mode, and the integrity of the communications link between the TWC and ATP.

If the ATP is reporting that it is Bypassed or in OFF mode, or the TWC has lost communications with ATP (i.e., TWC-ATP serial link error, ATP system failure, ATP power removed, etc.), the TWC defaults the data missing from the ATP in messages sent to the wayside.

Under this condition, the TWC will log an internal event.

16-I-02.02.06.01 Overloop Detection

The vehicle TWC system has a master/slave relationship with the Wayside TWC unit. The vehicle TWC is the link Master and initiates communication with each Wayside TWC unit (link slave).

The Master transmits poll messages at a periodic rate whether a valid response is received or not.

The Slave transmits a response only after receiving a valid message containing the Master's PVID or a general PVID.

Non-valid messages/responses or messages containing incorrect PVIDs are ignored.

The vehicle TWC polls the wayside once each polling cycle.

The TWC uses two (2) different polling rates, based on whether it is detects being over a TWC loop or not. Regardless of the vehicle position on the line, the TWC begins by transmitting a poll message once every two (2) seconds.

When the antenna is not positioned over a TWC loop, the vehicle TWC will not receive any response to the transmitted poll message.

When the antenna becomes positioned over a TWC loop, the Wayside will respond to the poll message by sending the most current data from the wayside systems.

Upon seeing a valid wayside response to the poll message, the TWC system will indicate that it is now over a TWC loop.

Once the TWC system has determined that it is over a loop, it provides an indication to the Operator.

The indication to the Operator is accomplished via illumination of the OVER TWC LOOP indicator on the TWC Interface Panel.

The TWC system will continue to indicate that it is over the wayside loop as long as it continues to receive a valid response to the poll messages.

If the TWC system does not receive a valid response to any transmitted poll messages within four (4) seconds of receiving the last valid response, the TWC system will assume that it is no longer over a loop.

The TWC system will indicate this by turning off the OVER TWC LOOP indicator.

16-I-02.02.06.02 Antenna Swapping

To extend the time that the vehicle can transmit and receive messages when pulling out of a station, and to accommodate a station stop where the selected vehicle antenna is no longer over a loop, the TWC includes an antenna swapping function.

After the TWC first detects that it is over a TWC loop within in a station platform track circuit, it switches to the opposite-end antenna if it does not receive a valid response from wayside within two (2) seconds of sending a poll message.

After this first swap, the TWC reverts back to the original antenna selection if it again does not receive a valid response from wayside within two (2) seconds of sending a poll message.

The TWC will not allow any further swapping until the TWC has first determined it is no longer over a TWC loop, and then determined that it is over a TWC loop again.

The TWC uses information stored in the ATP track tables to determine whether it is within a station platform track circuit.

The TWC suspends the antenna swapping function if the ATP reports that the vehicle is not currently in a platform or platform exit track circuit, or if the TWC has suspended the transmission of all messages to the wayside.

16-I-02.02.06.03 Train Identification

For the MGL, the control center tracks the movement and supervises the routing of trains. Train identification on the MGL consists of a fixed portion and a variable portion. The fixed portion is the permanent, three-digit vehicle number unique to each LRV (see Paragraph 16-I-02.02.03).

The variable portion includes a four-digit Tracking ID number issued by the control center (the Tracking ID allows four digits; only three are used on the existing MGL).

The entire Train ID is transmitted in each TWC message transmitted to the wayside.

The Tracking ID number is displayed on the Route/Train ID display located on the TWC Interface Panel (see Paragraph 16-I-02.02.02.01).

The TWC sets (defaults) the Tracking ID to the PVID on power-up, and each time that the TWC enters an inactive mode.

16-I-02.02.06.04 Route Entry/Validation

a) Route ID Tables

On the existing MGL TWC system, route selection by the wayside is performed strictly on the Route ID received from the vehicle.

Therefore, the TWC system needs to validate any received or manually entered Route ID.

If a non-valid Route ID is received or entered, the vehicle will maintain the previous Route ID.

This ensures that any route the vehicle does not accept will have no effect on previous wayside routing decisions.

For the TWC system to validate all received or manually entered Route IDs, all valid Route IDs are stored in tables located in non-volatile memory on the TWC Control PCB.

b) Manual Route ID Entry

Under normal circumstances, the Route ID will be set by the control center and sent to the vehicle via the TWC.

However, the TWC allows manual route requests to be entered by the Operator or other MTA personnel under control center supervision.

Manual Route ID numbers are entered using the three Route Identification thumbwheel switches and the ENTER pushbutton on the TWC Interface Panel.

If the Operator and Central both change the Route ID, the TWC uses the most recent route set.

With the lead cab keyed into an active mode, the Operator dials in the desired Route ID using the Route Identification thumbwheel switches, then presses the ENTER pushbutton.

If the number entered represents a valid Route ID, the TWC displays the new Route ID. If not, the TWC continues to display the previous valid Route ID.

To complete the operation, the Operator resets the thumbwheel switches back to zero, then presses the ENTER pushbutton again.

While the vehicle is not moving, the TWC toggles its Route ID display between the newly entered number and zero as a reminder to complete the operation.

The reminder is suspended while the vehicle is in motion.

The TWC assumes a Route ID of 998 on power-up, and each time that the TWC enters an inactive mode. Route ID 999 can be input only when the vehicle is in a No Motion state.

If a Route ID of 000 is received from the control center or manually from the vehicle Operator, the TWC considers this a “No Change” and continues to use/transmit/display the last Route ID.

16-I-02.02.06.05 Departure Control

When a train makes a station stop, the TWC provides an indication to the Operator when it is time to depart the station.

The TWC maintains a 20 second default dwell timer which starts on Overloop detection (see Paragraph 16-I-02.02.06.01),

No Motion determination (see Paragraph 16-I-02.02.06.06), and berthed indication from the ATP.

The TWC informs the Operator that it is time to depart by flashing the OVER TWC LOOP indicator on the TWC Interface Panel.

If valid messages are being received, the TWC does not flash the indicator until a Close Doors command is received from the Wayside.

If no valid response message is being received, the TWC flashes the OVER TWC LOOP indicator when the on-board dwell timer expires.

The TWC disables the default dwell timer and any departure indication when movement is detected.

16-I-02.02.06.06 Motion Detection

The TWC system has an interface with the vehicle that provides a No Motion indication.

This indication is used internally for various functions and is also transmitted in the TWC indication message to the Wayside.

16-I-02.02.07 MBL TWC Operational Description

The vehicle TWC on the Blue Line simply transmits a FSK modulated signal to the wayside at a code rate corresponding to an operator request.

When configured for operation on the MBL, the TWC operation includes the following line specific functions:

- Overloop Detection;
- Operator Route Request;
- Pushbutton Activation/Detection.

16-I-02.02.07.01 Overloop Detection

Communication between the vehicle and wayside begins with the wayside transmitting a continuous, FSK-modulated poll signal.

This signal shifts between 13.8 and 13.225 kHz at a rate of 173 Hz.

When the vehicle TWC detects a valid poll signal, it lights the OVER TWC LOOP indicator on the TWC Interface Panel.

The vehicle TWC keeps the OVER TWC LOOP indictor lit as long as a valid poll signal is received from the wayside.

The vehicle TWC transmits a signal to the wayside when the Operator presses and holds the desired request pushbutton on the TWC Interface Panel (see Paragraph 16-I-02.02.07.02).

When the transmitted signal is received and decoded by the wayside, the wayside poll signal is inhibited for five (5) seconds.

This turns off the OVER TWC LOOP indicator on the vehicle TWC Interface Panel to indicate that the route request has been received.

When the route request pushbutton is released, the vehicle transmitter turns off and the process is complete.

16-I-02.02.07.02 Operator Route Request

To initiate a route request, the Operator presses and holds the desired Route Selection pushbutton on the TWC interface panel.

This activates a 20.9 kHz transmission from the vehicle.

The vehicle transmitter output then shifts between 20.9 and 21.945 kHz at a code rate corresponding to the selected request pushbutton.

Table 16-I-02.4 defines the possible valid request options and associated Code Rates.

Table 16-I-02.4 Valid MBL TWC Pushbutton Commands

Pushbutton Command	Code Rate
Primary Request	173 Hz
Secondary Request	115 Hz
Non-Mainline Request	77 Hz
Cancel Request	51 Hz

16-I-02.02.07.03 Pushbutton Activation/Detection

The vehicle TWC system monitors the TWC Interface Panel pushbuttons only when the vehicle is over a TWC loop.

Once pressed and recognized by the TWC system, the corresponding information is displayed on the Route/Train ID display.

Table 16-I-02.5 lists the pushbutton commands and the resulting Route/Train ID displays.

Pressing a pushbutton while the antenna is not over a loop, or pressing pushbutton combinations, have no effect.

Table 16-I-02.5 MBL TWC Pushbutton Display Indications

Pushbutton Command	Route/Train ID Display Indication
Primary Request	P--
Secondary Request	S--
Non-Mainline Request	O--
Cancel Request	C--

16-I-02.02.08 PGL TWC Operational Description

The vehicle TWC on the Gold Line transmits a 19-bit message to the wayside in response to a query pulse.

When configured for operation on the PGL, the TWC provides the following line specific functions:

- Overloop Detection;
- Operator Route Request;
- Pushbutton Activation/Detection.

16-I-02.02.08.01 Overloop Detection

The wayside signal generator transmits a 2 millisecond, 19-bit query pulse FSK modulated at 90 and 100 kHz every 24 milliseconds.

After each query transmission is complete, the wayside generator suspends transmission and waits about 22 milliseconds for a response from the vehicle.

If no response is received, the process repeats indefinitely until communications is established.

On receiving the wayside query pulse, the vehicle TWC initiates a single 90/100 kHz FSK, 19-bit response message.

The vehicle TWC system also indicates that it is detected to be over a loop by lighting the OVER TWC LOOP indicator.

The indicator turns off if no other query pulses are received within one (1) second of receiving a valid query pulse.

16-I-02.02.08.02 Operator Route Request

To initiate a route request, the Operator presses and releases one, or a combination of the four pushbuttons located on the TWC interface panel to select the desired route.

Interaction with any pushbutton sets data bits in the 19-bit response message corresponding to the selected request pushbutton(s).

The possible valid request options are:

- Primary Route Request
- Secondary Route Request
- Non-Mainline Route Request
- Primary + Non-Mainline Route Request
- Secondary + Non-Mainline Route Request
- Cancel Route Request

16-I-02.02.08.03 Pushbutton Activation/Detection

The TWC evaluates the TWC Interface Panel pushbuttons only when detected to be over a TWC loop.

When a pushbutton is activated with the vehicle over a TWC loop, the TWC latches the selected pushbutton or valid pushbutton combination.

Once activated and recognized by the TWC, the pushbutton or pushbutton combination is displayed on the Route/Train ID display on the TWC Interface Panel.

Table 16-I-02.6 shows the pushbutton indications that result on the Route/Train ID display.

Activating a pushbutton, or a combination of pushbuttons, while the antenna is not over a loop has no effect.

After the pushbutton(s) have been activated, the TWC system provides a 250 millisecond delay before setting and transmitting the corresponding data in the 19-bit response message.

The data bits are latched and set in the response message for two (2) seconds, then the TWC stops evaluating the pushbuttons.

The TWC continues displaying the activated pushbuttons on the Route/Train ID display until the data latch time has expired.

Once the data latch time has expired, the TWC clears the pushbutton indications on the Route/Train display.

Also, the TWC ignores any further pushbutton activation for three (3) seconds following expiration of the data latched time.

Table 16-I-02.6 PGL TWC Pushbutton Display Indications

Pushbutton Command	Route/Train ID Display Indication
Primary Request	P--
Secondary Request	S--
Non-Mainline Request	O--
Primary Request + Non-Mainline Request	PO-
Secondary Request + Non-Mainline Request	SO-
Cancel Request	C--

The CANCEL pushbutton has the highest priority and can be activated at any time. The TWC responds immediately to activating the CANCEL pushbutton, with no delay time.

The response to all previously activated pushbuttons and related time delays are cancelled.

The data corresponding to the CANCEL pushbutton is transmitted as long as the pushbutton is activated.

If the CANCEL pushbutton is activated in combination with other pushbuttons, the others are ignored and the “Cancel Request” is processed.

16-I-02.02.09 TWC Crosschecks

The TWC performs various crosschecks on the system inputs to verify proper operation.

The following sections describe the general input crosschecks that are performed by the TWC.

16-I-02.02.09.01 Line Selector Crosscheck

The TWC performs a crosscheck between the Green, Blue, and Gold Line Selector inputs.

Only one of these inputs should be active at any time. If more than one (or none) of the inputs are active for one (1) second continuous, a Line Selector Crosscheck error is declared.

On declaring a Line Selector Crosscheck error, the TWC system latches the last known valid Line Selector Switch indication, and lights the TWC FAULT indicator on the TWC Interface Panel.

The TWC also logs an internal event and reports the fault to the vehicle TCMS.

The Line Selector Crosscheck error clears when a single Line Selector input is active. The Line Selector Crosscheck is enabled only in ON mode.

If no valid Line Selector Switch indication has been previously established, the TWC considers this a failure condition, because it will not be able to properly configure itself for operation.

As a result, the TWC turns off the TWC READY indicator and lights the TWC FAULT indicator.

TWC transmit and receive functions are suspended until the crosscheck error is cleared and the system successfully configures itself for operation on the indicated line.

16-I-02.02.09.02 Keyed Cab Crosscheck

The TWC performs a crosscheck between the A Cab In Control and B Cab In Control inputs.

Only one of these inputs should be active at any time. If both inputs are active for three (3) seconds continuous, a Keyed Cab Crosscheck error is declared.

On declaring a Keyed Cab Crosscheck error, the TWC lights the TWC FAULT indicator on the TWC Interface Panel.

The TWC also logs an internal event and reports the fault to the vehicle TCMS.

The Keyed Cab Crosscheck error clears when either (but not both) Cab In Control input is active or neither Cab In Control input is active.

The Keyed Cab Crosscheck is enabled only in ON mode.

16-I-02.02.10 TWC Event Logging

The TWC includes an event logging diagnostic function to allow a maintainer to obtain detailed information on the state of the system.

All system events and faults are stored internally for extraction or viewing by maintenance personnel.

The event logs can be extracted through an RS-232 diagnostic communications port on the front panel of the TWC Controller PCB using a Portable Test Unit (PTU) (refer to Section 16 - Part II).

Limited event log information can also be viewed and managed using the toggle "key" switches and alphanumeric displays on the front panel of the TWC Controller PCB (for how to use the Front Panel Display refer to Section 15).

The TWC logs all significant system events in non-volatile memory.

Each event has a time and date stamp.

The time and date of the TWC system is set via the Master Clock information received from the vehicle TCMS and reported by ATP via the ATP-TWC serial link.

The time and date of the TWC system can also be set and updated via the PTU in the absence of the Master Clock information (i.e., lost communications with the ATP).

16-I-02.03 TESTING

Two tests should be carried out before departure on the TWC System:

- TWC Interface Panel Lamp Test;
- TWC Departure Test.

16-I-02.03.01 TWC Interface Panel Lamp Test

The TWC Interface Panel has an interface to the Lamp Test pushbutton located on the vehicle's Operator's Console.

Pressing the pushbutton will cause the TWC to illuminate all of the panel indicators, as well as all segments of the seven-segment displays.

Activation of the Lamp Test is possible at any time power is applied to the TWC Interface Panel.

16-I-02.03.02 TWC Departure Test (MGL, MBL & PGL)

When configured for operation on any line, the TWC Subsystem provides for the performance of a Departure Test, which can be performed prior to the vehicle entering main line service.

The central purpose of this test is to check the ability of the TWC system to properly transmit and receive signals with the configured Wayside, and to test the integrity of the TWC Interface Panel controls.

The integrity of TWC Interface Panel indicators is not performed as a part of the TWC Departure Test, but can be tested by pressing the Lamp Test pushbutton on the Operator's Console.

The Departure Test is initiated by pressing the DEPART TEST pushbutton on the TWC Interface Panel while the vehicle is stopped.

Additionally, the LRV must not be positioned over any TWC wayside loop when operating on the MBL or the PGL.

The LRV can be positioned over a TWC wayside loop when operating on the MGL, as communications with the wayside will be suspended during a Departure Test.

While the Departure Test is running, the TWC system will flash the DEPART TEST indicator on the Interface Panel.

During the Departure Test, the TWC sends a test signal to the currently selected TWC antenna transmit loop and confirms its receipt back through the currently selected receive loop.

Once the Departure Test has completed or has been terminated, the TWC will indicate the pass/fail test result on the DEPART TEST indicator on the TWC Interface Panel. The indicator will be steadily lit if the test successfully completes.

The indicator will be dark if any part of the test fails, or the test was terminated.

16-I-02.03.02.01 Departure Test: TWC Control and Test Sequence

Initial Conditions

- The system must be keyed
- The LRV must be stopped
- The Master Controller must be in a brake position (operator verified)
- A TWC Lamp Test is not active (operator verified)
- No crosscheck errors are active

TWC Control and Test Sequence

The test will begin and progress as follows:

1. Press and release the DEPART TEST push button on the TWC Interface Panel to begin testing. The test will progress automatically with each step taking about eight seconds.
2. The TWC will activate and flash the DEPART TEST indicator on the TWC Interface Panel.
3. The TWC will then activate the OVER TWC LOOP indicator.
4. The TWC will generate a bit pattern and modulate it relevant to the frequencies and protocol associated with the line selected. The bit stream will be transmitted and coupled from the transmit loop to the receive loop within the currently selected TWC antenna. The data will be processed via the receive channel where it will be demodulated and decoded to produce a matching pattern.
5. The TWC will then select the opposite end TWC antenna, and perform the same bit pattern test, as described in the previous step.
6. The TWC will then activate the TWC READY indicator and indicate a P - - in the ROUTE ID / TRAIN ID window. The test personnel will verify the indications then press and release the PRIMARY REQUEST button. The TWC will verify receipt of the request.
7. The TWC will then indicate a S - - in the ROUTE ID / TRAIN ID window. The test personnel will verify the indication then press and release the SECONDARY REQUEST button. The TWC will verify receipt of the request.
8. The TWC will then indicate a O - - in the ROUTE ID / TRAIN ID window. The test personnel will verify the indication then press and release the NON-MAINLINE REQUEST button. The TWC will verify receipt of the request.
9. The TWC will then indicate a C - - in the ROUTE ID / (TRAIN ID) window. The test personnel will verify the indication then press and release the CANCEL REQUEST button. The TWC will verify receipt of the request.
10. The TWC will then indicate a 555 in the ROUTE ID / TRAIN ID window. The test personnel will verify the indication then set the ROUTE IDENTIFICATION to match and press the ENTER button. The TWC will verify receipt of the ID.

11. The TWC will then activate the TWC FAULT indicator and alarm. The test personnel will verify the indication and alarm activation.
12. The test personnel will acknowledge all observer verifications and terminate the Departure test by setting the route to 000 and pressing and releasing the ENTER button within 15 seconds of the TWC FAULT indication.
13. After completion of the Departure Test, the TWC will de-activate all indications and silence the alarm. The status of the Departure Test is indicated as follows: Departure Test passed - the DEPART TEST indication will be activated solid. Departure Test failed - the DEPART TEST indication will be de-activated

The test personnel will confirm operation of the following:

- Alarm
- DEPART TEST Indicator
- OVER TWC LOOP Indicator
- TWC READY Indicator
- TWC FAULT Indicator
- ROUTE ID / TRAIN ID Indicator

NOTE: Loss of any of the Departure Test initial conditions (non-operator verified) prior to test completion will result in termination of the test and will be considered a termination (not a failure) of the Departure Test.

NOTE: Interaction with the Departure Test pushbutton on the TWC Interface Panel prior to test completion will result in termination of the Departure Test.

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LOS ANGELES COUNTY

METROPOLITAN TRANSPORTATION AUTHORITY

LIGHT RAIL VEHICLE

P2550

RUNNING MAINTENANCE
AND
SERVICE MANUAL

VOLUME M-01
PART II
TROUBLESHOOTING
SECTION 16 - TRAIN-TO-WAYSIDE COMMUNICATION

SECTION 16

TRAIN-TO-WAYSIDE COMMUNICATION SYSTEM

PART II

TROUBLESHOOTING

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SECTION 16

TRAIN-TO-WAYSIDE COMMUNICATION SYSTEM

16-II-01 INTRODUCTION

This Section of the Running Maintenance and Service Manual is divided into three Parts:

- Part I: Theory of Operation
- Part II: Troubleshooting
- Part III: Maintenance

Each Paragraph is numbered accordingly, to avoid that paragraphs of the same Section, pertaining to a different Part, have the same number.

Part I - Theory of Operation

Part I gives a thorough overview of the System structure and operation, by means of descriptions, figures, photos, schematics, block diagrams and flow charts, together with references to other documents or Sections when needed.

Part II - Troubleshooting

It gives the Maintenance Technicians a path to troubleshoot the System in every condition by means of the available tools:

- The PTU, equipped with the specific SW program;
- The IDU;
- The Fault Isolation Table.

Part III - Maintenance

The Maintenance Part is divided into two sections:

- Preventive Maintenance
- Corrective Maintenance

each one of which is supplied with the relevant Maintenance Sheets and Job Cards.

16-II-01.a LIST OF ABBREVIATIONS, ACRONYMS AND SYMBOLS

The Abbreviations, Acronyms and Symbols commonly used throughout this manual are given below with their related meaning.

Abbreviation	Meaning
AB	Ansaldo Breda
AC/DC	Alternate Current - Direct Current Converter
ADU	Aspect Display Unit
AF	Audio Frequency
AGC	Automatic Gain Control
ATP	Automatic Train Protection
BA	Brake Assurance
BCU	Brake Control Unit
CB	Circuit Breaker
CM	Coast Motoring
CMC	Control and Maintenance Center
CPM	Cycles Per Minute
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check (Checksum)
DC/AC	Direct Current - Alternate Current Converter
DC/DC	Direct Current - Direct Current Converter
DPRAM	Dual-Ported Random Access Memory
EB	Emergency Brake
ECU	Electronic Control Unit (Brakes)
EEPROM	Electrically Erasable Programmable Read Only Memory
EMI	Electro-Magnetic Interference
FPGA	Field-Programmable Gate Array
FSB	Full Service Brake
FSK	Frequency Shift Keying
HRSB	High Rate Service Brake
HSCB	High Speed Circuit Breaker
HV	High Voltage
HVDS	High Voltage Distribution System
HW	Hardware
I/O	Input / Output
IDU	Integrated Diagnostic Unit
KO	Out of Service
LACMTA	Los Angeles County Metropolitan Transportation Authority
LED	Light Emitting Diode
LH	Left Hand Side

LON	Local Operative Network
LRV	Light Rail Vehicle
LV	Low Voltage
LVDS	Low Voltage Distribution System
LVPD	Low Voltage Power Distribution
LVPS	Low Voltage Power Supply
M	Motoring
MAS	Maximum Allowable Speed
MBL	Metro Blue Line
MPB	Momentary Push-button
MV	Medium Voltage
MVPD	Medium Voltage Power Distribution
OK	Working
PB	Push-button
PCB	Printed Circuit Board
PGL	Pasadena Gold Line
PTU	Portable Test Unit
PVID	Permanent Vehicle Identification
PWM	Pulse-Width Modulation
RH	Right Hand Side
SB	Service Brake
SCEB	Slide Controlled Emergency Brake
SW	Software
TBS	To Be Supplied
TCMS	Train Control and Monitoring System
TCN	Train Communication Network
TCU	Traction control Unit
TWC	Train-to-Wayside Communication
US&S	Union Switch & Signal, Inc.
VDC	Volts Direct Current
VHDL	VHSIC Hardware Description Language (for FPGA)
V-zero	Velocity = Zero
WTB	Wired Train Bus

16-II-01.b LIST OF DEFINITIONS

The Definitions commonly used throughout this manual are given below with their related meaning.

Definition	Meaning
'A' body section	The section of an articulated vehicle containing the pantograph
'B' body section	The section of an articulated vehicle not containing the pantograph
AW0	Empty car operating weight
AW1	Full seated load plus AW0
AW2	Standees at 4 persons per square meter plus AW1
AW3	Standees at 6 persons per square meter plus AW1
AW4	Standees at 8 persons per square meter plus AW1
Component	(IEEE Std. 610.12-1993) One of the parts that make up a system. A component may be hardware or software and may be subdivided into other components.
Front door	The door close to the Operator's Cab
LC filter	Filter made up of Inductance and capacity
Non Vital Relay	The Non-Vital Relay is used in applications where fail-safe operation is not required. It provides no protection against welded contacts and no feedback indication if such a failure occurs.
Rear door	The door close to the Articulation Section
RLC filter	Filter made up of Resistance, Inductance and Capacity
Safety Relay	The operation of the Safety Relay depends on the forced operation of the relays inner contacts. If either of the inner contacts become welded, the normally closed outer contacts remain open. Using the back contacts as a feedback, provides a check that inner contacts have not welded. The Safety Relay differs from the Vital Relay in that the possibility still exists for the inner relay contacts to weld. However, unlike the Non-Vital Relay, a failure due to welded contacts is detectable.
Vital Relay	The Vital Relay is used in vital applications where fail-safe operation is required. Such applications include propulsion, braking, and door opening. The Vital Relay uses gravity for contact break and special contact materials to prevent contacts from welding.

16-II-01.c LIST OF MEASUREMENT UNITS AND SYMBOLS

The Measurement Units commonly used throughout this manual are given below with their related meaning.

Definition	Meaning
Ω	Ohm
°C	Celsius degree
°F	Fahrenheit degree
A	Ampere
ac	Alternate Current
dB	Decibel
dc	Direct Current
F	Farad
ft	Foot
H	Henry
Hz	Hertz
in	Inch
kg	Kilogram - approx 2.205 pounds
km	Kilometer - approx 0.621 miles
kN	Kilo-Newton - approx 224.809 pounds force
mm	Millimeter - approx 0.0394 inches
ms	Millisecond
rms	Root Mean Square Voltage
rpm	Revolution per Minute
V	Voltage
Vin	Input Voltage
Vpp	Peak to Peak Voltage
W	Watt

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16-II-02 TROUBLESHOOTING

The ATP and the TWC Systems, because of their strong interconnections, present the same troubleshooting approach and use the same troubleshooting tools.

The IDU, which is one of the most powerful troubleshooting tools, refers to the ATP/TWC system, as a whole.

For these reasons, the troubleshooting procedures are the same for both the ATP and the TWC systems.

Before starting any troubleshooting procedure, it is strongly advised to apply the “General Troubleshooting Guidelines”, the “General Diagnostic Routine”, “Other Troubleshooting Considerations” and the “Power Supply Check”, described in this paragraph.

The tools for troubleshooting the ATP/TWC System and its components are:

- Main Logic CPU PCB Front Panel;
- the IDU (Integrated Diagnostic Unit);
- the PTU (Portable Test Unit);
- Troubleshooting from Symptoms.

General Troubleshooting Guidelines

Before starting any Troubleshooting procedure, consider answering the questions and implementing the general rules that follow, which may help resolving the most common failures:

1. Under what circumstances did the failure occur?

Was it during normal operation, during preventive maintenance, during a diagnostic procedure, or while changing a menu setting? This information could help to repeat the failure and isolate the problem.

2. Did something change?

Has this system worked before or is this a startup problem? If the system used to work properly, has anything changed since then? Has there been any hardware, software, or wiring changes?

3. Make sure the problem is with the ATP

Could the problem be coming from something external that is interfering with ATP operation?

4. Verify the problem.

Check the major functions to verify that there really is a problem.

5. Turn power off for 10 seconds.

Allow the unit to reset completely, then turn power on and try again.

It could be an intermittent or single-occurrence problem. If the problem continues, proceed further with troubleshooting.

6. Try the simple things first .

With power turned off, remove and reseat the cards.

As the cards are removed, look for such obvious problems as hot spots and burn marks.

Check all connectors to make sure they are firmly attached. Check cables for damage and signs of wear.

7. Avoid complicating the problem.

During troubleshooting activities, avoid making the problem more difficult to isolate.

Do not create more problems, in which case there will be multiple symptoms and a much more difficult situation.

8. Could the problem be related to a noisy electrical environment?

Some faults can be caused by electromagnetic interference (refer also to EMI in Section 9).

For example, CPU faults and memory errors may be caused by electrical noise on the power line or noise from external sources.

These types of problems are difficult and time-consuming to trace, perhaps requiring special techniques and test equipment. This type of fault tracing is beyond the scope of this manual.

General Diagnostic Routine

There is no single diagnostic routine that will guarantee quick success for every problem with the ATP system.

What follows is a general course of action, a logical sequence to follow to trace almost any problem to its most likely cause.

Step 1: Thoroughly analyze the symptoms.

Symptoms may be helpful for finding a fault, but be wary of another person's report of the symptoms. The most reliable analysis is gained by recreating the symptoms.

Step 2: Observe the panel indicators

Most system faults will first be observed on the Main Logic CPU PCB front panel indicators, it's events system and the other circuit boards LEDs, and the event system on the Main Logic CPU PCB in the ATP enclosure.

Open the ATP enclosure front door and observe the LEDs and displays. Using the Main Logic CPU PCB's front-panel keys and displays, find the event logs menu.

Review the active and previously logged events for clues of the problem. Only one event at a time is accessible via the front-panel.

In order to view a history of the unit's events, a PTU must be connected to the Main Logic CPU PCB's front panel connector.

Step 3: Troubleshoot in a logical sequence.

Continue with the troubleshooting process only after identifying that there really is a hardware problem.

After removing the cover, first measure the power supply voltages.

Then, based on an error message or symptom, define which functional circuit seems to be causing the problem.

From there the problem can be isolated to a board or two, or to a major component (such as a vital relay or speed sensor).

Other Troubleshooting Considerations

Before beginning troubleshooting the ATP, here are a few more suggestions:

Have spares available

Have available at least one spare board for each unique board in the ATP enclosure cardfile, plus one spare vital relay (model PN-159B).

This will permit quick substitution when a fault has been localized to a board or relay.

Use the spare boards

If an active failure is suspected to be caused by a certain board, swap it with the spare. Note whether the problem remains.

If not, then you have found the cause.

Match the configuration of the original.

When substituting circuit boards, make sure that the new board is the correct part, that it is operating properly, and that its jumpers are set to the proper configuration.

For a list of the jumper configurations for each board in the ATP system.

Install boards correctly

Make sure that boards are correctly installed and fully seated into the cardfile. Each board is keyed to a specific slot in the cardfile.

Do not force the boards into the wrong slot.

Power Supply Check

If there are no obvious faults, the first step in analyzing a problem should be to measure the power supply voltages.

1. Check power supplies first

Ensure the power supply voltages are as specified.

The system will not function properly if the supplied power is incorrect. A low input battery supply voltage can be the cause of a failure in some other part of the system. Input Battery Power test points are located on the Power Supply PCB (B1+, B1C) (B2+, B2C).

2. Measure with the power supplies under load.

Measure the power supplies with the system fully intact, with all boards installed, and all cables connected.

If there is no output voltage from the power supply, check the obvious possibilities such as a defective switch, tripped circuit breaker, or open connection.

3. Check the stability of input power.

While checking the power supplies, also check the stability of the incoming power. Some faults can be caused by a momentary power failure or drop in the voltage level.

The CPU, memory chips, and other electronic circuits are susceptible to problems caused by voltage fluctuations.

If any of the following conditions occur during the test, the test will end and the ATP will consider the test failed:

- The Reverser is no longer in forward;
- A Departure Test Relay Crosscheck error is declared;
- The speed sensors report a speed of one (1) mph or more;
- The Emergency Brake Applied trainline is active with no ATP Emergency Brake request.

16-II-02.01 Troubleshooting with the Main Logic CPU PCB Front Panel

Refer to paragraph “15-I-02.05.05.03 Main Logic CPU Menus” Section 15 part I and following paragraphs.

16-II-02.02 Troubleshooting with the IDU

The IDU interface is made up of a display located in both vehicle cabs, at the right side of the Operator console .

The IDU can be accessed in two Modes:

- “Operating” Mode, for the operators;
- “Maintenance” Mode, for maintenance personnel, accessible by means of a numeric password.

The Operating Mode provides few, essential information to help the operator start the troubleshooting or to pass the information on to the ROC (Railway Operating Center).

In Maintenance Mode the IDU can display more detailed information, thus giving the Maintenance personnel the possibility to troubleshoot more in depth and more accurately.

The IDU manages the ATP (refer to section 15) and the TWC altogether.

The ATP System is connected to the LONWorks bus only.

So, no signal coming or going to the APS/LVPS will be exchanged on the MVB bus (for a more detailed description of the IDU and of how to troubleshoot the APS/LVPS system with it.(refer to Section 18- TCMS of this manual).

The ATP/TWC status signals go from the ATP system to the IDU through the LONWorks bus.

These signals are collected in two datasets called "nvoAPSStatus" and "nvoTwcStatus", described in the following Table 16-II-02.1 and Table 16-II-02.2.

Another dataset, called "nvoAduStatus", contains the ADU status

(refer to Table 16-II-02.3).

Table 16-II-02.1 "nvoATPStatus" LONWorks Bus dataset

byte	bit	Signal	Scale	Description
0	0	ATPBypassIndicator	0 = OFF 1 = ON 2 = toggle 3 = invalid	Defines the state of the ATP Bypass indicator
0	2	OverspeedIndicator	0 = OFF 1 = ON 2 = toggle 3 = invalid	Defines the state of the OverSpeed indicator
0	4	ATPFailureIndicator	0 = OFF 1 = ON 2 = toggle 3 = invalid	Defines the state of the ATP Failure indicator
0	6	StreetRunningIndicator	0 = OFF 1 = ON 2 = toggle 3 = invalid	Defines the state of the Street Running indicator
1	0	CabSignalIndicator	0 = OFF 1 = ON 2 = toggle 3 = invalid	Defines the state of the Cab Signal indicator
1	2	StopAndProceedIndicator	0 = OFF 1 = ON 2 = toggle 3 = invalid	Defines the state of the Stop and Proceed indicator
1	4	DepartureTestIndicator	0 = OFF 1 = ON 2 = toggle 3 = invalid	Defines the state of the Departure Test indicator
1	6	AlarmIndicator	0 = OFF 1 = ON 2 = chirp 3 = beep	Defines the state of the Alarm indicator
2	0	ATP-ADU Communications Failure	0 = false 1 = true	The communication link between the ATP and the ADU is failed.

Table 16-II-02.1 "nvoATPStatus" LONWorks Bus dataset

byte	bit	Signal	Scale	Description
2	1	Left Doors Enabled	0 = false 1 = true	The ATP has enabled the left side doors.
2	2	Right Doors Enabled	0 = false 1 = true	The ATP has enabled the right side doors.
2	3	Penalty Brake	0 = false 1 = true	The ATP System has requested a Penalty Brake application.
2	4	Overspeed Penalty	0 = false 1 = true	A Full Service Brake application has been requested because the vehicle speed has surpassed the Enforced Overspeed Limit.
2	5	Emergency Brake	0 = false 1 = true	The ATP System has requested an Emergency Brake application.
2	6	Full Service Brake	0 = false 1 = true	The ATP System has requested Full Service Brake application.
2	7	Propulsion Cut	0 = false 1 = true	The ATP System has requested a cut in Propulsion.
3	0	Speed Mismatch Error	0 = false 1 = true	The ATP System has detected the loss of a single speed sensor by the speed measurement between the two speed sensors differing excessively. A Penalty Brake application is requested.
3	1	dVdT Error	0 = false 1 = true	The ATP System has detected the loss of both speed sensors by the vehicle speed dropping excessively to 0 (zero) mph. A Penalty Brake application is requested.
3	2	Vzero-Decelerometer Error	0 = false 1 = true	The ATP System has detected that the speed sensors are electrically disconnected by the comparison of the decelerometer reading and the speed sensor inputs. A Penalty Brake application is requested.
3	3	Decoder Module Error	0 = false 1 = true	An error has been detected with the Decoder CPU PCB.
3	4	FSK Module Error	0 = false 1 = true	An error has been detected with the FSK CPU PCB.
3	5	ATP-TWC Communications Failure	0 = false 1 = true	The communication link between the ATP and TWC is failed.
3	6	ATP-Decoder Communications Failure	0 = false 1 = true	The communication link between the ATP and the Decoder Subsystem is failed.

Table 16-II-02.1 "nvoATPStatus" LONWorks Bus dataset

byte	bit	Signal	Scale	Description
3	7	ATP-FSK Communications Failure	0 = false 1 = true	The communication link between the ATP and the FSK Subsystem is failed.
4	0	Left Doors Enable Checkback Error	0 = false 1 = true	The Left Doors Enable Checkback input is in the same state as the Left Doors Enable output.
4	1	Emergency Brake Relay Checkback Error	0 = false 1 = true	The Emergency Brake Relay Checkback input is in the same state as the Emergency Brake output.
4	2	Full Service Brake Checkback Error	0 = false 1 = true	The Full Service Brake Checkback input is in the same state as the Full Service Brake output.
4	3	Propulsion Enable Checkback Error	0 = false 1 = true	The Propulsion Enable Checkback input is in the same state as the Propulsion Enable output. If propulsion cut is being requested then a Penalty Brake is also requested.
4	4	Forward Reverse Error	0=false; 1=true	Both Forward and Reverse inputs to the ATP are active. A Penalty Brake application is requested.
4	5	Keyed Cabs Error	0 = false 1 = true	Both A Cab and B Cab inputs to the ATP are active. A Penalty Brake application is requested.
4	6	Line Selector Switch Error	0 = false 1 = true	More than one or none of the line selector inputs to the ATP are active. A Penalty Brake application is requested.
4	7	Loss of Speed Sensors Error	0 = false 1 = true	The ATP has detected the loss of both speed sensors while in motion. A Penalty Brake application is requested.
5	0	250 Hz Filter Board Error	0 = false 1 = true	An error has been detected with the 250 Hz Filter Board.
5	1	100 Hz Filter Board Error	0 = false 1 = true	An error has been detected with the 100 Hz Filter Board.
5	2	Vital Input Board 2 Error	0 = false 1 = true	An error has been detected with Vital Input Board 2.
5	3	Vital Input Board 1 Error	0 = false 1 = true	An error has been detected with Vital Input Board 1.
5	4	Multi-Function Board Error	0 = false 1 = true	An error has been detected with the Multi-Function Board.

Table 16-II-02.1 "nvoATPStatus" LONWorks Bus dataset

byte	bit	Signal	Scale	Description
5	5	Track Circuit Out-of-Sequence	0 = false 1 = true	AF-900 Track Circuit ID received is out of sequence with respect to the onboard ATP track tables. A Penalty Brake is requested.
5	6	Track Circuit Invalid	0 = false 1 = true	AF-900 Track Circuit ID received is not programmed into the onboard ATP track tables. A Penalty Brake is requested and cab signal is lost.
5	7	Right Doors Enable Checkback Error	0 = false 1 = true	The Right Doors Enable Checkback input is in the same state as the Right Doors Enable output.
6	0	Spare		Not Used
6	1	Spare		Not Used
6	2	Departure Test Status	0 - 15	Defines the current status of the ATP Departure Test (DT). 0 = Not Performed 1 = Passed 2 = Running 3 = Failed: FSK (MGL) / Decoder (MBL/PGL) Communications Link 4 = Failed: ATP LON Communications Link 5 = Failed: Door Cycle Test 6 = Failed: Cab Signal Detection 7 = Failed: Overspeed Detection (MBL/PGL only) 8 = Failed: Full Service Brake Application 9 = Failed: Emergency Brake Application 10 = Failed: No Operator Acknowledgement 11 = Failed: Loss of DT System Conditions 12 - 15 = Invalid
6	6	Decelerometer Error	0 = false 1 = true	An error has been detected with the Decelerometer.
6	7	FSK Receiver Board Error	0 = false 1 = true	An error has been detected with the FSK Receiver Board.
7	0	Spare		Not Used
7	1	Spare		Not Used

Table 16-II-02.1 "nvoATPStatus" LONWorks Bus dataset

byte	bit	Signal	Scale	Description
7	2	TWC Bypass	0 = false 1 = true	Status of the ATP monitored TWC Bypass Switch: 0 = TWC switch is not in Bypass position 1 = TWC switch is in the Bypass position.
7	3	West Orientation	0 = false 1 = true	The ATP determined west orientation; 0 = East orientation (if East orientation bit set), or orientation is unknown 1 = West orientation
7	4	East Orientation	0 = false 1 = true	The ATP determined east orientation: 0 = West orientation (if West orientation bit set), or orientation is unknown 1 = East orientation
7	5	Line Selection	0 - 3	The ATP determined Line Selection configuration: 0 - Unknown 1 - Blue Line (MBL) 2 - Green Line (MGL) 3 - Gold Line (PGL)
7	7	Spare		Not Used

Table 16-II-02.2 TWC Status "nvoTWCStatus"

byte	bit	Signal	Scale	Description
0	0	Line Selection	0 - 3	The TWC determined Line Selection configuration: 0 - Unknown 1 - Blue Line (MBL) 2 - Green Line (MGL) 3 - Gold Line (PGL)
0	2	Line Selector Switch Error	0 = false 1 = true	More than one or none of the line selector inputs to the TWC are active.
0	3	Keyed Cabs Error	0 = false 1 = true	Both A Cab and B Cab inputs to the ATP are active.
0	4	Stuck Button Error	0 = false 1 = true	One or more pushbuttons on the TWC Interface Panel are considered to be stuck ON.
0	5	Spare	0 = false 1 = true	Not Used

Table 16-II-02.3 ADU Status "nvoAUDStatus"

byte	bit	Signal	Scale	Description
0	0	Location	0 = B-End 1 = A-End	ADU A-End / B-End configuration 0 - B-End ADU 1 - A-End ADU
0	1	Lamp Test	0 = false 1 = true	Lamp test is active
0	2	ATP Comm	0 = false 1 = true	Messages received from ATP
0	3	Aux Comm	0 = false 1 = true	Messages received from Aux speed source
0	4	LED Driver Self Test	0 = fault 1 = OK	Status of LED driver back check
0	5	Aux Speed In Use	0 = false 1 = true	Aux speed being displayed on ADU

The IDU screen shows the ATP/TWC status through the following screens:

- ATP/TWC System Status Screen;
- Monitor - LON Bus Screen;
- Fault List.

16-II-02.02.01 ATP/TWC System Status Screen

The ATP/TWC System Status Screen can be accessed both in Operating and in Maintenance Mode.

In Operating Mode (refer to next Figure 16-II-02-1) the IDU shows only the ATP/TWC Status (OK or FAULT) per each vehicle of the train consist.

In Maintenance Mode, by accessing the ATP/TWC System Status Screen (refer to Figure 16-II-02-2) the following information, per vehicle, is shown:

INDICATORS:

- Street Running Status: ON/OFF;
- OverSpeed Status: ON/OFF;
- Stop and Proceed Status: ON/OFF;
- Bypass Status: ON/OFF;
- Alarm Status: ON/OFF;
- CabSignal status: ON/OFF;
- Departure Test Status: ON/OFF; -

ATP Fail Status: ON/OFF.

ANALOG SIGNALS:

- Speed value;
- Line Speed value;
- Target Speed value.

ATP/TWC STAUS: OK or FAULT.

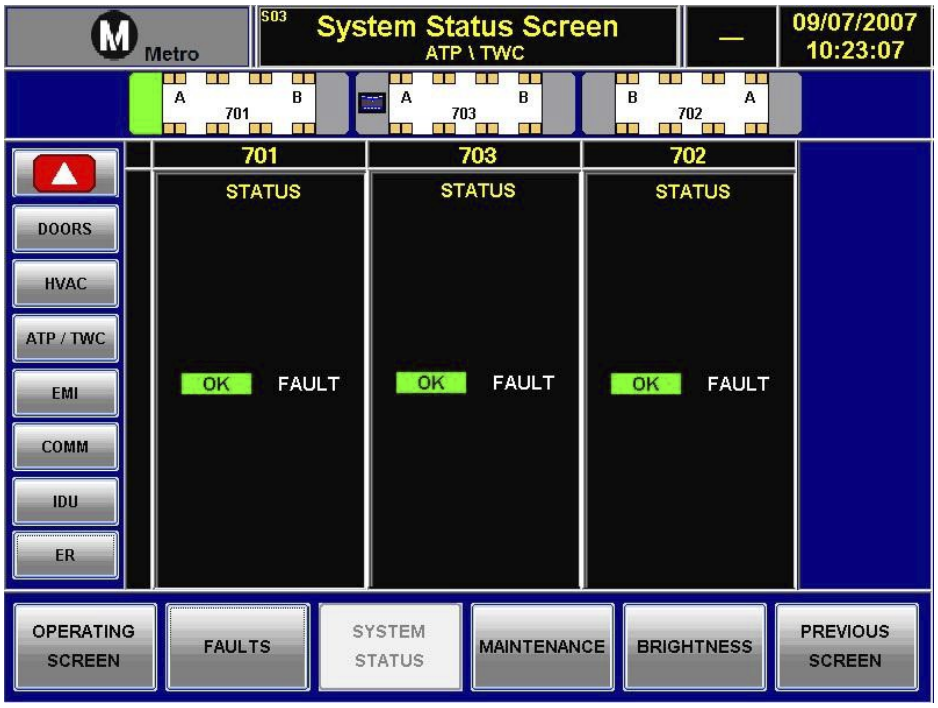


Figure 16-II-02-1ATP/TWC System Status Screen (Operating Mode)

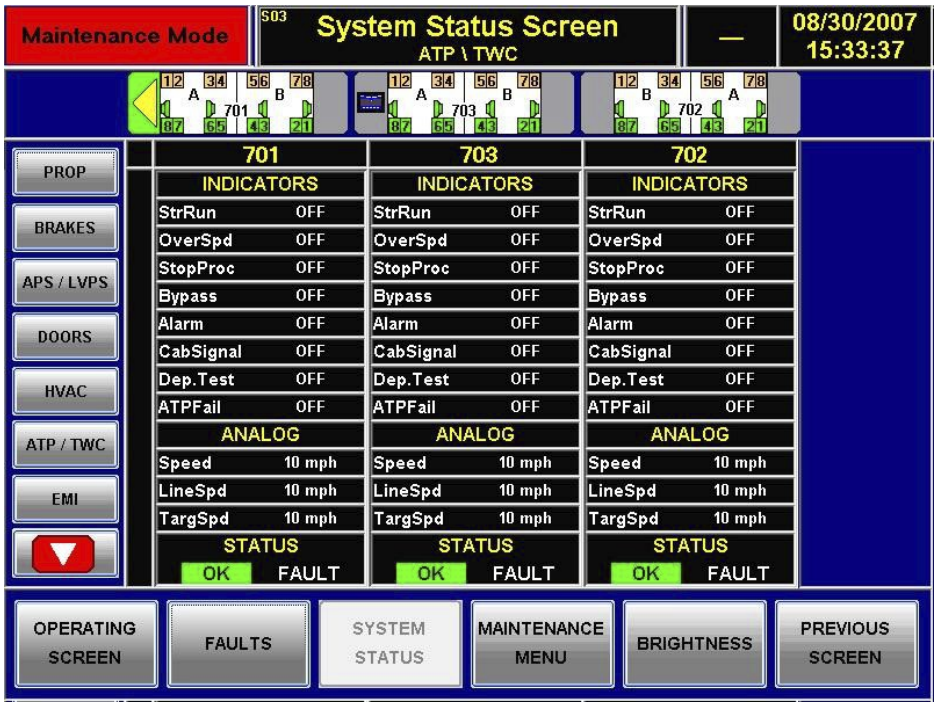


Figure 16-II-02-2ATP/TWC System Status Screen (Maintenance Mode)

16-II-02.02.02 Control of Buses (IDU LONWorks Bus Screen)

By entering Maintenance Mode and touching the MONITOR button, the IDU monitor shows information related to both the local vehicle and the train.

By touching the LON button, the signals (LON Life Signals) sent by the ATP/TWC system on the LONWorks bus can be monitored.

If no signal flow is shown on the ATP/TWC bar, it may mean that the ATP/TWC System is not working properly.

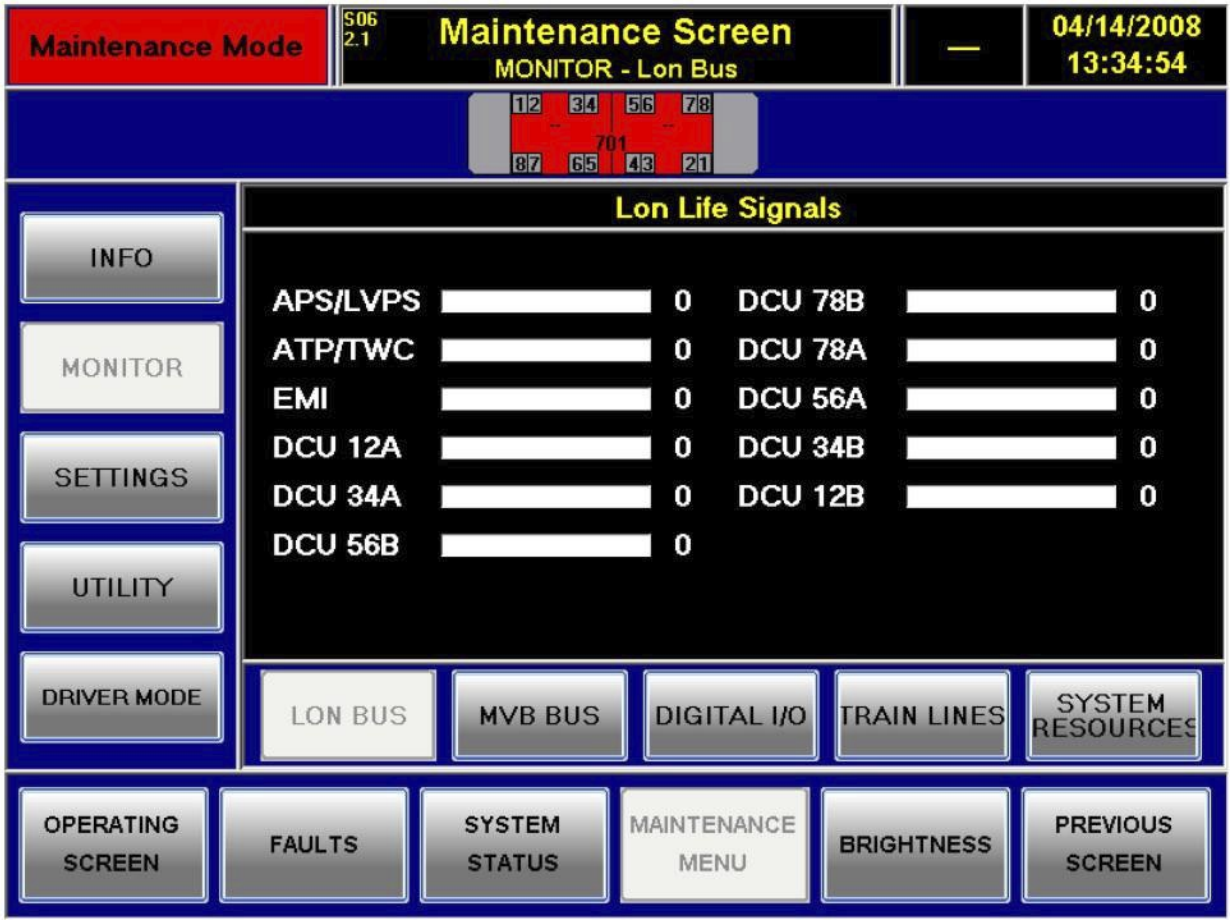


Figure 16-II-02-3 LONWorks Bus Life Signals

16-II-02.02.03 IDU Fault List

By touching the “Faults” button at the bottom of the IDU screen, the Faults Screen pops up with the list of the faults present in all train Systems, with date and time of the occurrence. In this way the Maintenance personnel can detect a fault as soon as it occurs.

As soon as a fault occurs (fault “active” - red characters), the Train Control and Monitoring System (TCMS - refer to Section 18 for a more detailed description) saves the “image” of the fault in a file of the “A” IDU memory (the B IDU has no used memory) named “LogFile.dat”.

The system saves an image of the activated fault every 100 ms for a period from 1 s before and 5 s after the activation.

The system saves a sample of the deactivated faults (green characters) once and with the information present at the time of the memorization.

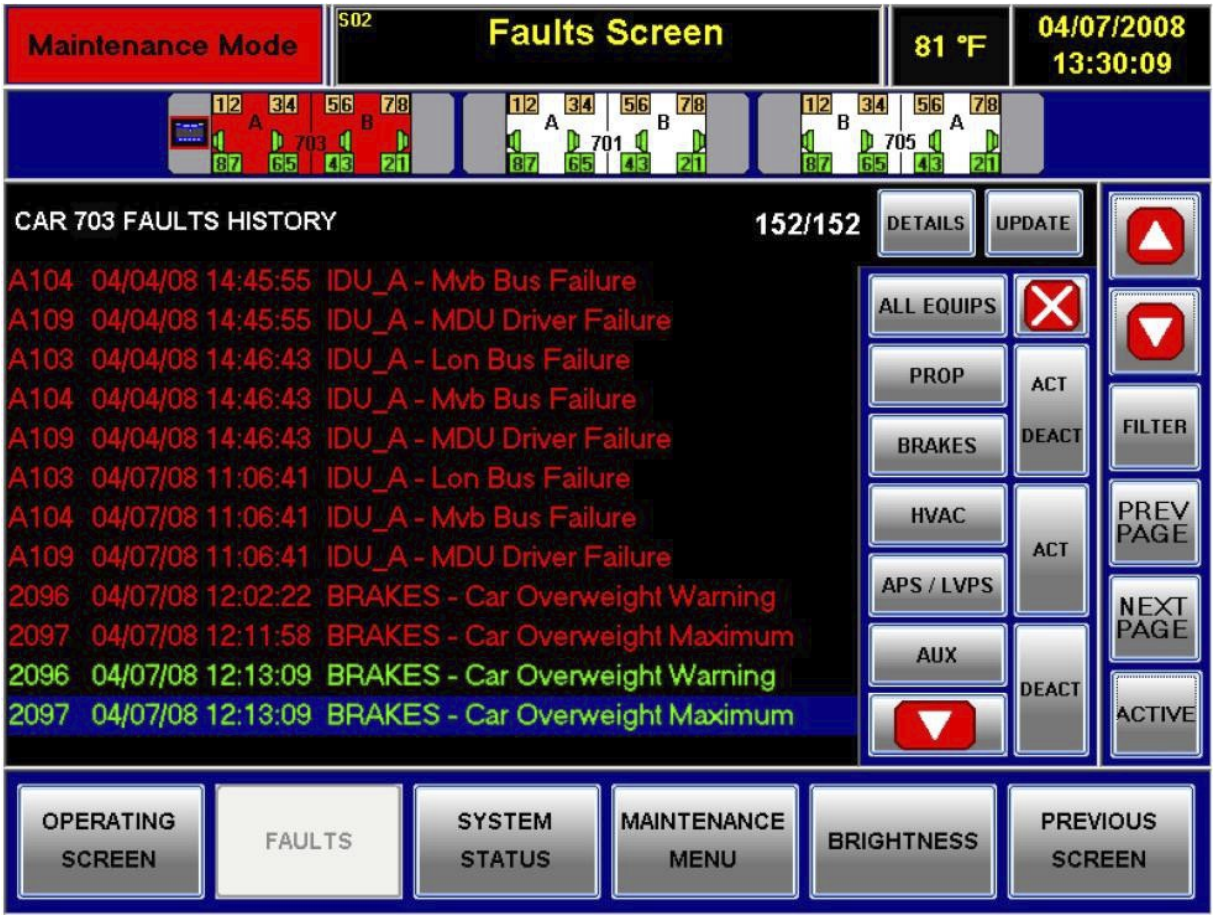


Figure 16-II-02-4I DU Faults Screen

The “Complete ATP/TWC IDU Fault List and Reference Diagram” describes, for each fault type, how to troubleshoot the APS/LVPS System using the IDU, both in Operating and in Maintenance Mode.

The suggested Maintenance Actions (troubleshooting procedures) are shown by pressing the “Details” Screen Button and are referred to the selected Fault shown on the IDU “Faults Screen.”

The Fault List can also be filtered by means of the system button (in this case the ATP/TWC button - refer to Figure 16-II-02-4).

16-II-02.03 Troubleshooting with the Portable Test Unit (PTU)

This PTU is used for both ATP and TWC systems.

16-II-02.03.01 PTU Diagnostic Equipment

The Portable Test Unit (PTU) is a software-based diagnostic tool used to monitor the US&S MicroCab® system.

There are several basic functions that the PTU can perform.

The software is installed on any commercially available laptop with the following minimum system requirements:

- IBM compatible
- Operating System: Windows® NT, XP or 2000
- 800 MHz processor
- 256 MB RAM
- 10 GB Hard Drive
- One available serial communications port

A null modem DB-9 female to DB-9 male serial cable is required to communicate between the PTU and the ATP or TWC subsystems.

The information contained in this manual is also available in the PTU's onscreen Help File.

16-II-02.03.02 Installation and Setup

The ATP/TWC PTU software is installed on a laptop from a CD-ROM disk.

1. Switch ON the laptop unit. The computer will boot-up and display the Windows® desktop.
2. Insert the CD into the laptop's CD-ROM drive. If the PTU Setup screen opens automatically, follow the on-screen instructions for PTU software installation. Otherwise, click on the Start button on the Windows® desktop and chose the Run menu option. In the Run menu box, Browse to the CD-ROM drive and select the Setup.exe file on the CD. Click the OK button in the Run menu box and follow the on-screen instructions.
3. Connect a null modem cable from the assigned serial port connector of the laptop PTU to the appropriate DB-9 serial connector located on the ATP Logic CPU PCB in the cardfile of the ATPTWC equipment enclosure.
4. After PTU software installation, the PTU desktop contains an icon to launch the PTU application.

5. Move the mouse pointer to the desktop icon that matches the ATP/TWC system connection, then click the left mouse button to select and configure the system application software.
6. The PTU desktop screen appears (refer to Figure 16-II-02-5).

16-II-02.03.03 PTU Screens and Functions

When the PTU desktop screen appears, the user must go through a login procedure to ensure that only authorized personnel can access the information that pertains to their specific responsibilities.

NOTE: PTU desktop screen toolbar menu items and options are dependent upon the access level assigned to the PTU user and may be grayed out.

The various screens and functions can be accessed and activated by either the pointand-click method using the mouse, or by using the keyboard's alternate key and assigned key (e.g., Alt+F).

The keyboard control requires the user to press and hold down the [Alt] key while the [F] letter is pressed momentarily. The [Alt] key is then released.

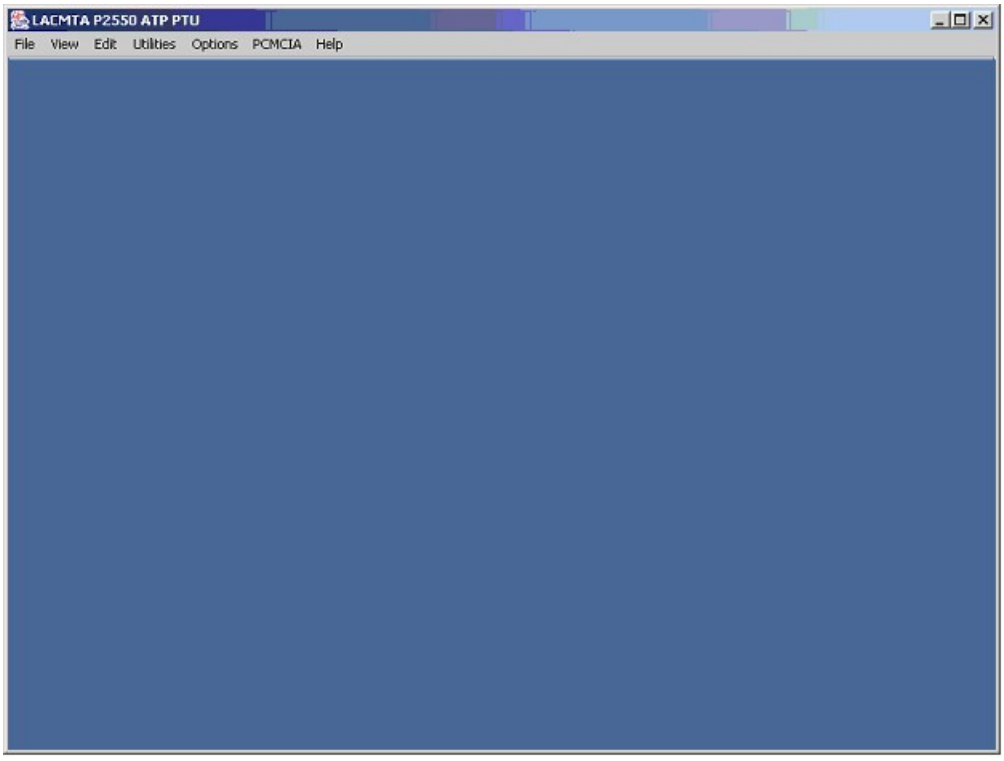


Figure 16-II-02-5PTU Desktop Screen

16-II-02.03.03.01 File Menu

The File menu is depicted below and can be displayed by depressing the left mouse button over the File keyword on the menu bar, or using the [Alt] and [F] keys on the keyboard.

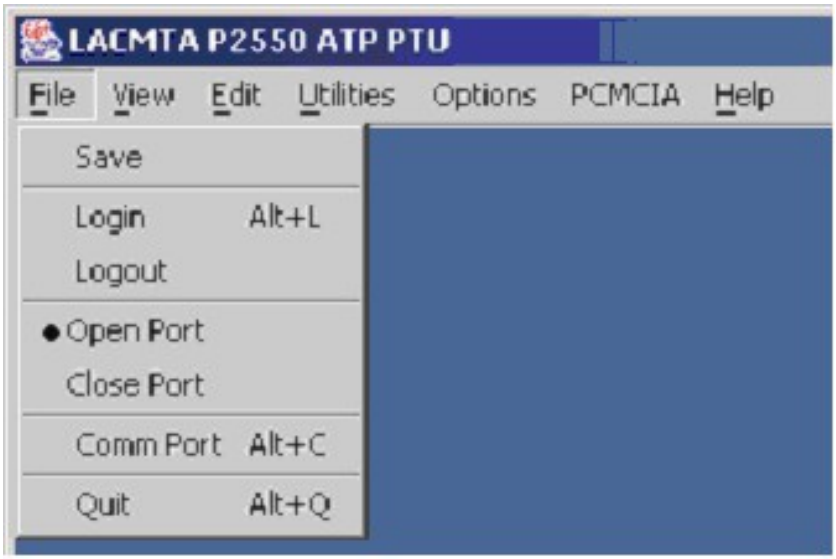


Figure 16-II-02-6File Menu Screen

a) Login

The Login Menu item is used to validate a users access to the PTU. The [Alt] and [L] keys may be used as a keyboard shortcut to bring up the login dialog.

Figure 16-II-02-7Login Screen

Passwords are administratively assigned to gain access to different PTU functions (see Paragraph 16-II-02.03.03.03e).

To log in, a valid password is typed into the text box on the login dialog.

Then the [Enter] key is pressed or the Enter button in the Login window is selected.

If a valid login name is entered, the user is given the privilege level of the entered password.

There are three access levels:

- DEFAULT: A user that is not logged on and allows access to only the most basic PTU functions.
- USER: Enables all PTU functions except password assignment. ·

ADMIN: Gives full access to all PTU functions.

The DEFAULT level allows access to the following PTU functions:

Under FILE menu:

- Save
- Login
- Logout
- Open Port
- Close Port
- Comm Port
- Quit

Under VIEW menu:

- Snapshot
- Active Events, System
- Active Events, Disk
- Event Counts, System
- Event Counts, Disk
- Event Logs, System
- Event Logs, Disk

Under UTILITIES menu:

- Enter Date and Time

Under OPTIONS menu:

- Java Look and Feel
- Motif Look and Feel
- Windows Style Look and Feel

Under PCMCIA menu:

- Retrieve Real-Time Data
- Display Real-Time Data, Plot
- Display Real-Time Data, Table

Under HELP menu:

- About PTU
- Open Help Window

The USER level allows access to all DEFAULT level items plus the following additional PTU functions:

Under EDIT menu:

- Reset Active Events
- Reset Counts
- Reset Event Logs
- Reset All

Under PCMCIA menu:

- Modify Parameters

The ADMIN level allows access to all DEFAULT and USER level items plus the following additional PTU function:

Under EDIT menu:

- Passwords

Under UTILITIES menu:

- Menu Configuration

b) Logout

The Logout menu item is used to log a user off the PTU. Once a user has logged out of the PTU system it will be necessary to login again for the user to regain access to login level functionality.

c) Open Port

The Open Port menu item allows the user to re-open the communications port. By default, the specified communications port is opened at application startup, and is indicated by a bullet next to this option.

d) Close Port

The Close Port menu item allows the user to close the communications port.

By default, the specified communications port is opened at application startup.

If the user needs to temporarily use the port for another application, then the Close Port function will release the current port in use.

All communications functions will, however, be disabled until the Open Port function is selected.

e) Comm Port

The Comm Port menu selection is depicted in Figure 16-II-02-08.

It is used to select the communications port, the baud rate, the number of data and stop bits, and the parity.

The parameter is set when a spinner item is selected.

When the Dismiss button is pressed the displayed comm parameters are written to a file and are used as the new default parameters.

f) Quit

The Quit menu selection is used to exit the PTU program.

g) Save

The Save menu selection is used to preserve Snapshot and Event data.

See Paragraph 16-II-02.03.03.02b) for further use of this function.

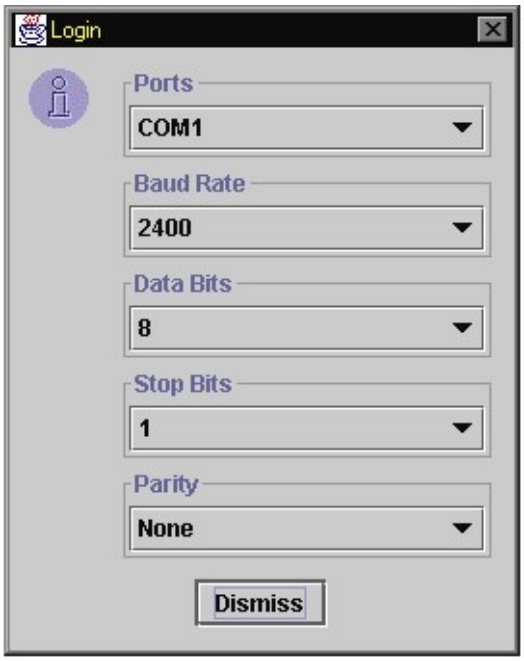


Figure 16-II-02-8File Comm Port Screen

16-II-02.03.03.02 View Menu

The View menu is depicted below and can be displayed by depressing the left mouse button over the View keyword on the menu bar.

The keyboard shortcut keys [Alt] and [V] may also be used.

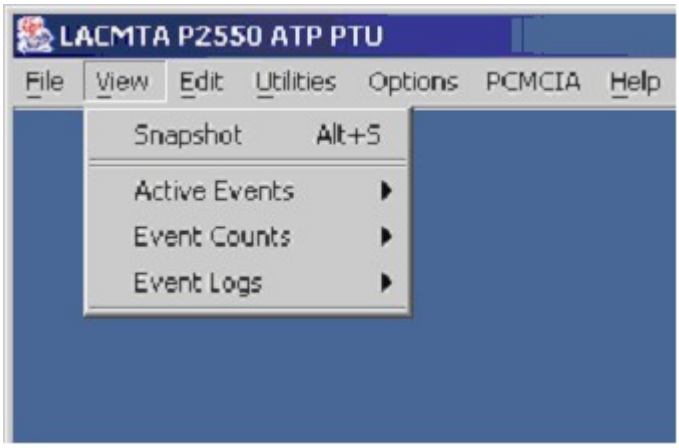


Figure 16-II-02-9View Screen

a) Snapshot

The Snapshot menu item brings up a table to display a set of system variables. Variables displayed may be real time data when connected to a MicroCab system or data from a snapshot file which was saved at an earlier time.

The Snapshot menu selection is displayed by selecting the View menu item, then selecting the Snapshot menu item of the view menu.

It can also be displayed by typing the "ALT" and "S" keys.

When the Snapshot menu item is selected, the snapshot frame opens but does not initiate communications with the system.

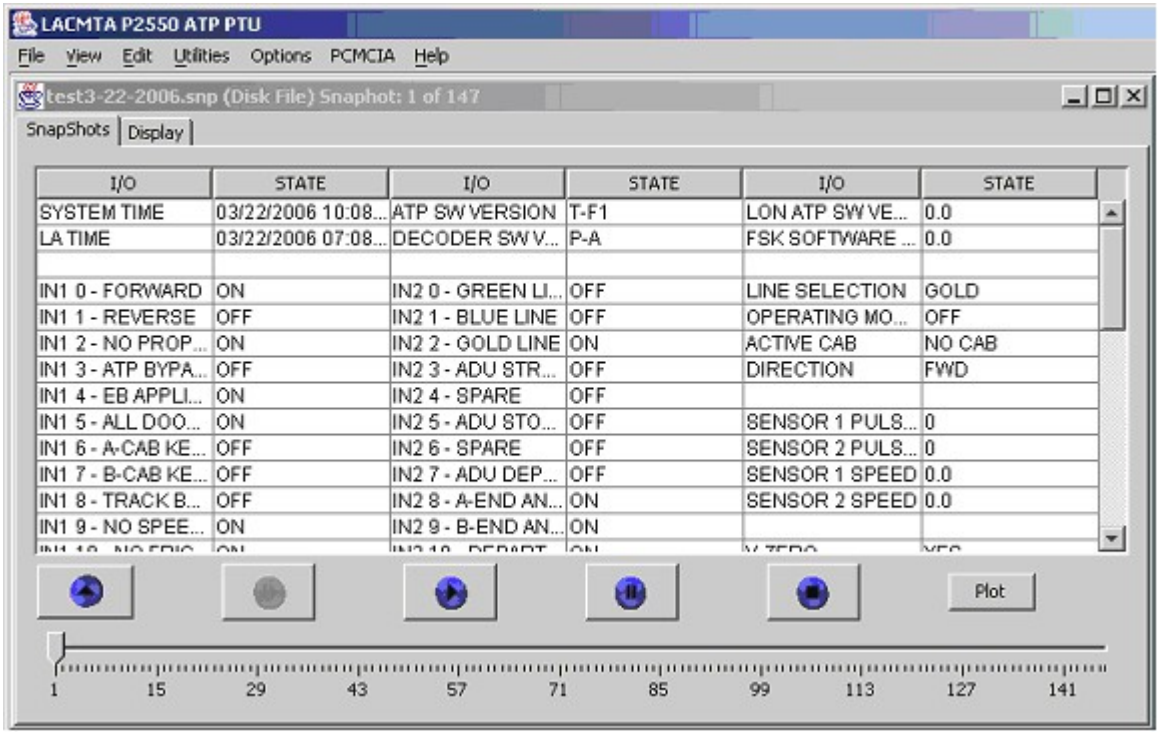


Figure 16-II-02-10 Continuous Snapshot Screen

Once a snapshot window has been opened the user has the following tools available along the bottom of the window for viewing data:

- Load/Unload: The ability to load and unload saved snapshot files from disk.
- Record: The ability to record or save a series of snapshots.
- Play: The ability to automatically move ahead one snapshot frame at a time at the snapshot update rate.
- Load: The ability to load saved snapshot files from disk.
- Stop: The ability to terminate the playing of a snapshot file.
- Pause: The ability to pause the playing of a snapshot file.
- Plot: The ability to plot the data contained in a series of snapshots.
- Slider Bar: The ability to move forward or backward through a snapshot file.

Each of the tools is selected by pressing the corresponding button for that function.

The user can choose to view data from a file or from a system by using the Load/Unload button or the Play button.

Once a file is opened or communications with the system is established, information is presented in tabular form.

The snapshot display has two tabs.

The first tab is the snapshot table itself.

The second tab contains the display properties. It allows the user to modify the vertical and horizontal spacing of the display cells, background and text color, as well as the rate at which the PTU program updates the snapshot data.

Snapshots from System

To load information from the system, select the Play button.

After Play is selected, the PTU will initiate communications with the MicroCab® system.

If communication is successfully established the data requested will be displayed in the snapshot window.

If communications with the MicroCab® system can not be established a window will appear with the message Communication Timeout.

When displaying real time data, the Snapshot frame will continue polling data until it is closed or communications is lost with the system.

The period in which the snapshot table is updated is variable from 0.250 to 2 seconds.

Snapshots from File

To Load information from a file, select the Load/Unload button.

A file dialog box will appear to allow the user to Load a file from disk.

Once the Open dialog appears, the user will need to select the location (folder) where the file exists.

By default the "Saved Logs" folder, if it exists, is selected. Otherwise, the user can change to a new location of choice.

Once the proper folder is selected, a list of files should appear in the window. By default, the dialog will look for files that have the correct extension corresponding to the current window requesting a file.

The user can change this selection to show all files by selecting the pull-down menu for Files of Type:, then selecting "All Files".

To open the file, select a file from the list of files displayed and click on the Open button.

This action will cause the information from the file to be read in and loaded into the current window. If the Cancel button is selected, then the dialog box is closed and no information is loaded.

b) Saving and Printing Snapshot Information

Saving Data

Once communications between the PTU and the system is initiated to download system event information, the user has the ability to save this information to a disk file.

File Menu - Save

Upon successful communications with the system, the user may save the real time information being displayed to a file.

To save the snapshot information, Select the Record button on the snapshot window. The information is now being saved to a temporary file as it is received.

To stop recording data press the Stop button.

A file dialog box will appear to allow the user to save the recorded snapshot information to disk.

A default filename is provided or the user can type in a name for the file. By default, and if it exists, a folder called "Saved Logs" is used to save files.

Otherwise, the system default directory is used. Finally, click the Save button.

The dialog box will close, and the file will then be saved in the specified folder with the specified filename.

The application will automatically add the corresponding extension to the filename. If the user selects the Cancel button, the dialog box will also close, but the file is not saved.

The information is saved in both a text format file and a binary format file.

The text format file provides the user with the ability to store data in a user-readable format.

This file can then be viewed in any text editing tool (i.e. Notepad, Microsoft Word, etc.). However, this format type CAN NOT be re-loaded into the current window via the Load function (described below).

The binary file provides the user with the ability to store data in a format to be used by the Load function (described below). This file CAN NOT be viewed in any text editing tool (i.e. Notepad, Microsoft Word, etc.).

Printing Snapshot Data

Once snapshot data has been loaded from either the system or from disk, the user has the ability to print the data.

Plotting Snapshot Data

Snapshot data can be graphically displayed using the plot function.

To plot the data being displayed by the snapshot window the user selects the Plot button on the Snapshot window.

Once Plot window is the active the user can select items from the Data list to be plotted. To remove an item from the plot the user de-selects the item from the data list.

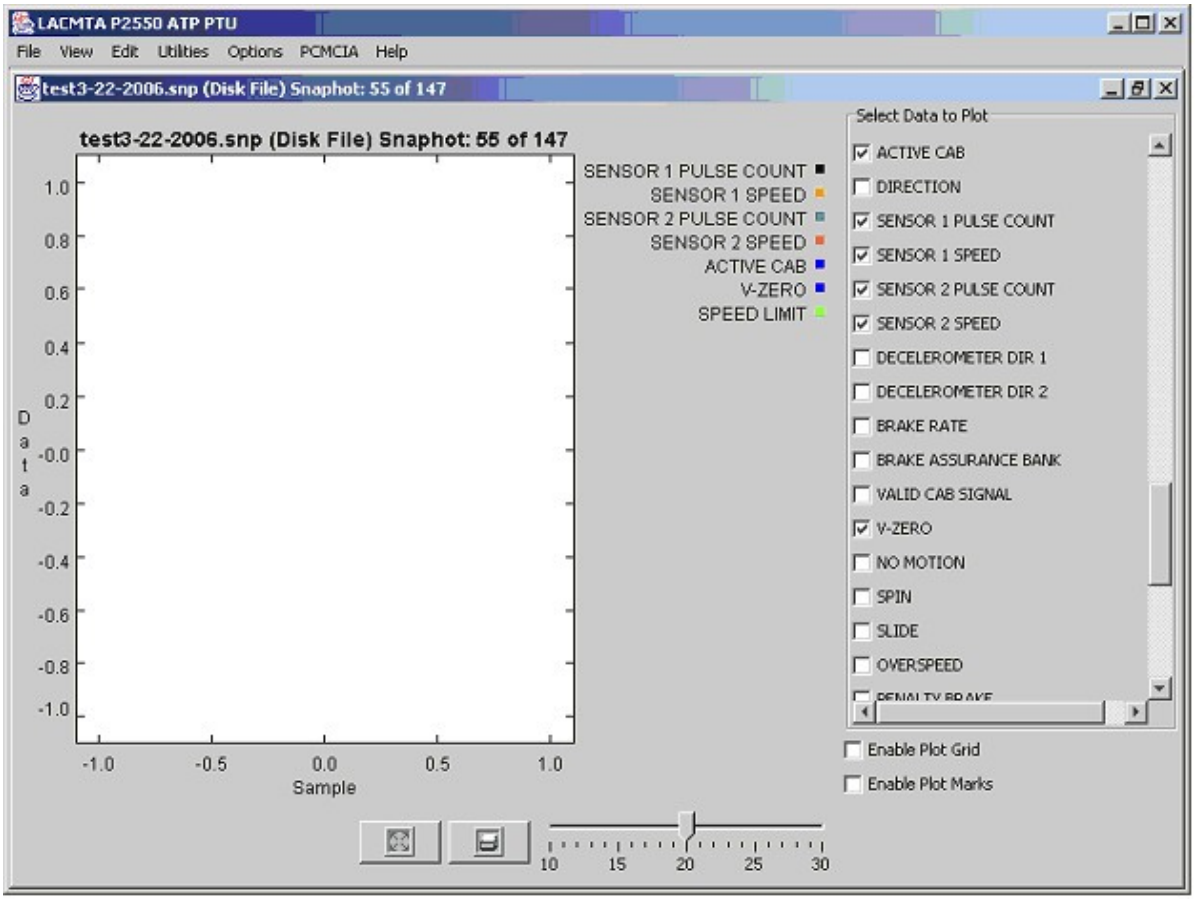


Figure 16-II-02-11 Snapshot Plotting Screen

The user can zoom in on an area of the plot by simply clicking the left mouse button and dragging the mouse cursor over the area to be enlarged.

To return the plot to original scale press the Fill Plot button.

- Fill Plot: The Fill Plot button allows the user to adjust the Y-axis to best fit the range of the data currently being plotted.
- Print: The Print button allows the user to print the displayed plot window.
- Slider Bar: The Slider Bar allows the user to adjust the range of the X-axis by determining the number of samples plotted.
- Enable Plot Grid: The Enable Plot Grid checkbox allows the user to turn on and off the grid lines of the plot.
- Enable Plot Marks: The Enable Plot Marks checkbox allows the user to turn on and off tick marks on the plotted data lines.

c) Active Events

The Active Events menu item brings up a table displaying the events that are currently active in the system.

The display shows each active event's identification, counts, and a description of each event.

The active events are displayed by selecting the View menu item then selecting the Active Events menu option on the View menu.

Active Events may be viewed from a system or a disk file.

NOTE: "Id1" and "Id2" comprise the four-digit ATC system event code. If "Id1" or "Id2" is a single digit, precede it with a zero (0). Otherwise, read "Id1" and "Id2" together as the event code.

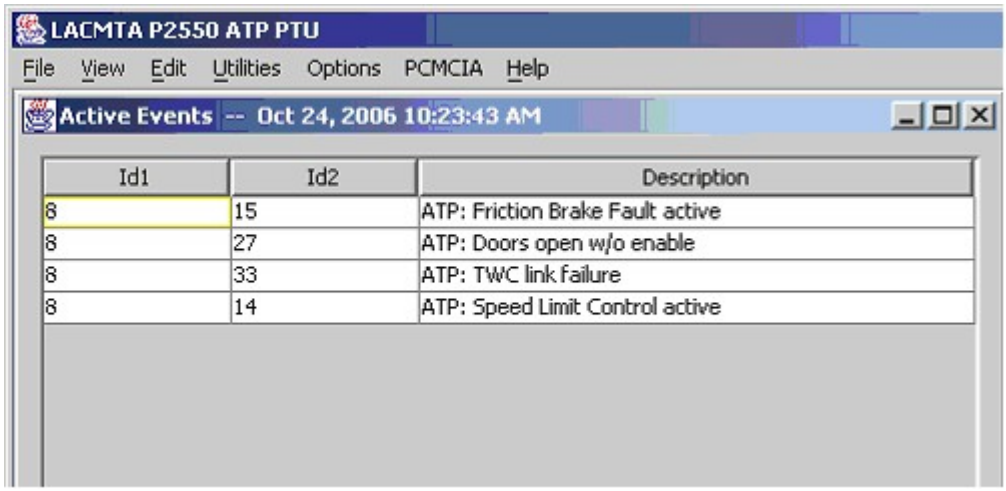


Figure 16-II-02-12 Active Events Screen

Active Events from System

To Load information from the system, select the View Menu.

A drop-down menu will appear with the Active Events menu item.

Select the Active Events menu item. A popup menu will appear with the System submenu item. Select the System sub-menu item.

After System is selected, the PTU will open an Active Events frame and initiate communications with the MicroCab system.

It can also be displayed by typing the "ALT" and "A" keys.

If communication is successfully established the data requested will be displayed in the corresponding window.

If communications with the MicroCab system can not be established a window will appear with the message Communication Timeout.

Active Events from Disk

To Load information from a file, select the View Menu.

A drop-down menu will appear with the Active Events menu item.

Select the Active Events menu item.

After Active Events Disk is selected, the PTU will open an Active Events frame and a file dialog box will appear to allow the user to Load a file from disk.

Once the Open dialog appears, the user will need to select the location (folder) where the file exists.

By default the "Saved Logs" folder, if it exists, is selected.

Otherwise, the user can change to a new location of choice.

Once the proper folder is selected, a list of files should appear in the window.

By default, the dialog will look for files that have the correct extension corresponding to the current window requesting a file.

The user can change this selection to show all files by selecting the pull-down menu for Files of Type:, then selecting "All Files".

To open the file, select a file from the list of files displayed and click on the Open button.

This action will cause the information from the file to be read in and loaded into the current window.

If the Cancel button is selected, then the dialog box is closed and no information is loaded.

Once a file is opened (DISK) or communications with the system is established (SYSTEM), information is presented in tabular form as each active events Id1, Id2, and the current date. Each event is contained in its own row in the table.

d) Saving and Printing Event Information

Saving Data

Once communications between the PTU and the system is initiated to download system event information, the user has the ability to save this information to a disk file.

File Menu - Save

Upon successful communications and completed download of the system event information, the user may save the currently loaded information to a file.

To save the system event information, Select the File Menu.

A drop-down menu will appear with the Save menu item. Select the Save menu item. After Save is selected, a file dialog box will appear to allow the user to save the file to disk.

A default filename is provided or the user can type in a name for the file.

By default, and if it exists, a folder called "Saved Logs" is used to save files.

Otherwise, the system default directory is used. Finally, click the Save button.

The dialog box will close, and the file will then be saved in the specified folder with the specified filename.

The application will automatically add the corresponding extension to the filename.

If the user selects the Cancel button, the dialog box will also close, but the file is not saved.

The information is saved in both a text format file and a binary format file.

The text format file provides the user with the ability to store data in a user-readable format.

This file can then be viewed in any text editing tool (i.e. Notepad, Microsoft Word, etc.). However, this format type CANNOT be re-loaded into the current window via the Load function (described below).

The binary file provides the user with the ability to store data in a format to be used by the Load function (described below).

This file CANNOT be viewed in any text editing tool (i.e. Notepad, Microsoft Word, etc.).

e) Event Counts

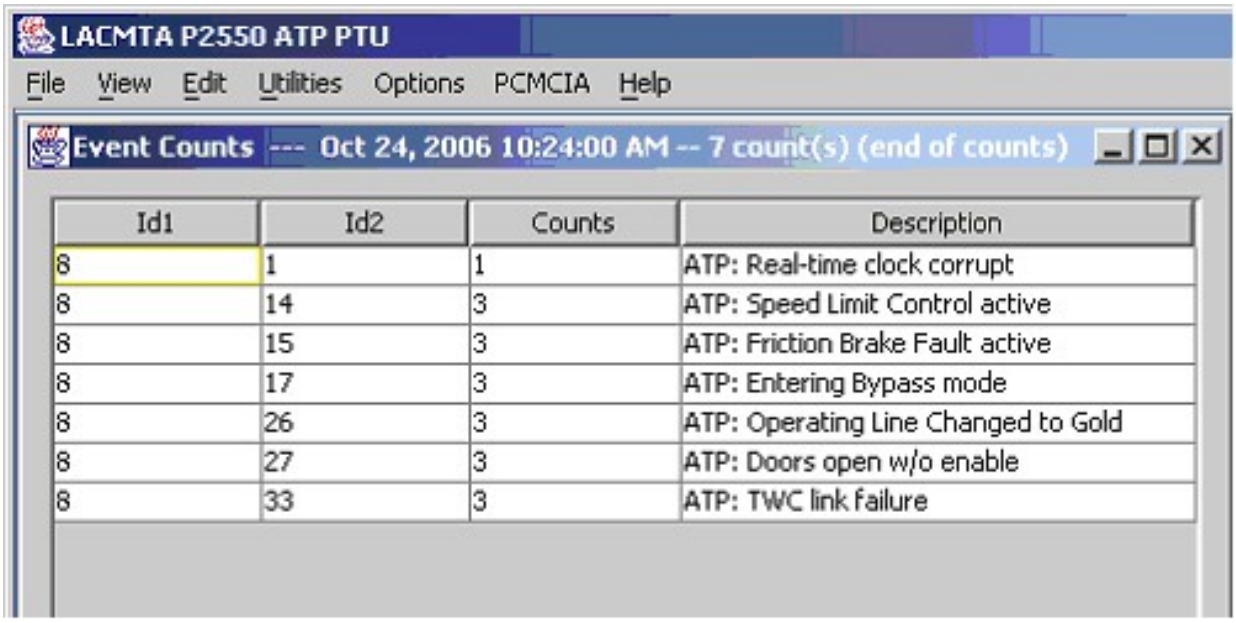
The Event Counts menu item brings up a table displaying the Event Counts for the system.

The Event Counts are indicators used to tally the number of times each event has occurred.

The actual count is contained in the ATC and is transmitted to the PTU when this menu item is selected. The count is one byte in width and therefore reaches its maximal count at 255.

The Event Counts menu selection is displayed by selecting the View menu, then selecting the Event Counts option. Event Counts may be viewed from a system or from a disk file.

NOTE: “Id1” and “Id2” comprise the four-digit ATC system event code. If “Id1” or “Id2” is a single digit, precede it with a zero (0). Otherwise, read “Id1” and “Id2” together as the event code.



Id1	Id2	Counts	Description
8	1	1	ATP: Real-time clock corrupt
8	14	3	ATP: Speed Limit Control active
8	15	3	ATP: Friction Brake Fault active
8	17	3	ATP: Entering Bypass mode
8	26	3	ATP: Operating Line Changed to Gold
8	27	3	ATP: Doors open w/o enable
8	33	3	ATP: TWC link failure

Figure 16-II-02-13 Events Counts Screen

Event Counts from System

To Load information from the system, select the View Menu.

A drop-down menu will appear with the Event Counts menu item. Select the Event Counts menu item.

A popup menu will appear with the System sub-menu item. Select the System submenu item.

After System is selected, the PTU will open an Event Counts frame and initiate communications with the MicroCab system. I

t can also be displayed by typing the "ALT" and "N" keys.

If communication is successfully established the data requested will be displayed in the corresponding window.

If communications with the MicroCab system can not be established a window will appear with the message Communication Timeout.

Event Counts from Disk

To Load information from a file, select the View Menu.

A drop-down menu will appear with the Event Counts menu item. Select the Event Counts sub-menu item.

A popup menu will appear with the Disk sub-menu item. Select the Disk sub-menu item.

After Disk is selected, the PTU will open an Event Counts frame and a file dialog box will appear to allow the user to Load a file from disk.

Once the Open dialog appears, the user will need to select the location (folder) where the file exists.

By default the "Saved Logs" folder, if it exists, is selected.

Otherwise, the user can change to a new location of choice.

Once the proper folder is selected, a list of files should appear in the window.

By default, the dialog will look for files that have the correct extension corresponding to the current window requesting a file.

The user can change this selection to show all files by selecting the pull-down menu for Files of Type:, then selecting "All Files".

To open the file, select a file from the list of files displayed and click on the Open button.

This action will cause the information from the file to be read in and loaded into the current window. If the Cancel button is selected, then the dialog box is closed and no information is loaded.

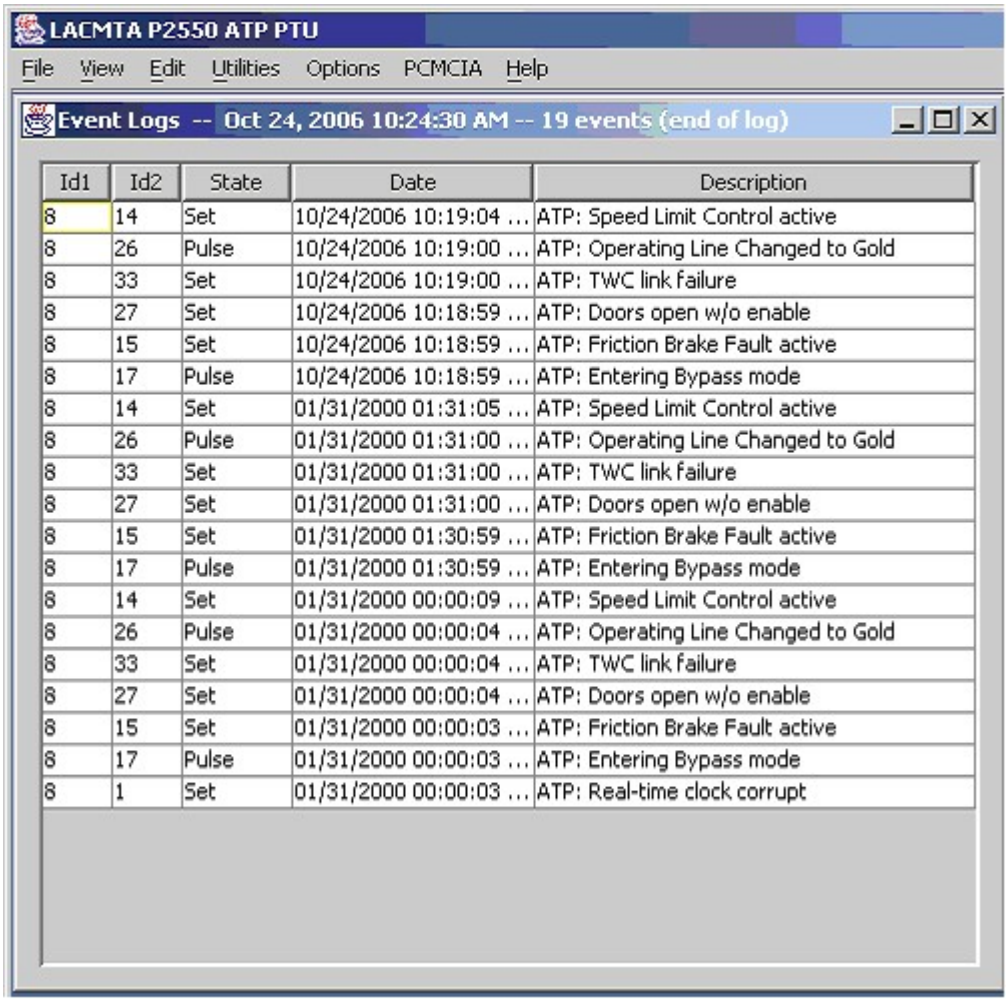
Once a file is opened (DISK) or communications with the system is established (SYSTEM), information is displayed as a table and containsan events Id1, Id2, counts, and a description.

f) Event Logs

The Event Log menu option is used to display the last 300 events that occurred in the system or a saved event log from disk.

The Event Log menu option is displayed by selecting the View menu item, then selecting the Event Log option. Event Logs may be viewed from a system or from a disk file.

NOTE: “Id1” and “Id2” comprise the four-digit ATC system event code. If “Id1” or “Id2” is a single digit, precede it with a zero (0). Otherwise, read “Id1” and “Id2” together as the event code.



Id1	Id2	State	Date	Description
8	14	Set	10/24/2006 10:19:04 ...	ATP: Speed Limit Control active
8	26	Pulse	10/24/2006 10:19:00 ...	ATP: Operating Line Changed to Gold
8	33	Set	10/24/2006 10:19:00 ...	ATP: TWC link failure
8	27	Set	10/24/2006 10:18:59 ...	ATP: Doors open w/o enable
8	15	Set	10/24/2006 10:18:59 ...	ATP: Friction Brake Fault active
8	17	Pulse	10/24/2006 10:18:59 ...	ATP: Entering Bypass mode
8	14	Set	01/31/2000 01:31:05 ...	ATP: Speed Limit Control active
8	26	Pulse	01/31/2000 01:31:00 ...	ATP: Operating Line Changed to Gold
8	33	Set	01/31/2000 01:31:00 ...	ATP: TWC link failure
8	27	Set	01/31/2000 01:31:00 ...	ATP: Doors open w/o enable
8	15	Set	01/31/2000 01:30:59 ...	ATP: Friction Brake Fault active
8	17	Pulse	01/31/2000 01:30:59 ...	ATP: Entering Bypass mode
8	14	Set	01/31/2000 00:00:09 ...	ATP: Speed Limit Control active
8	26	Pulse	01/31/2000 00:00:04 ...	ATP: Operating Line Changed to Gold
8	33	Set	01/31/2000 00:00:04 ...	ATP: TWC link failure
8	27	Set	01/31/2000 00:00:04 ...	ATP: Doors open w/o enable
8	15	Set	01/31/2000 00:00:03 ...	ATP: Friction Brake Fault active
8	17	Pulse	01/31/2000 00:00:03 ...	ATP: Entering Bypass mode
8	1	Set	01/31/2000 00:00:03 ...	ATP: Real-time clock corrupt

Figure 16-II-02-14 Event Logs Screen

Event Logs from System

To Load information from the system, select the View Menu.

A drop-down menu will appear with the Event Logs menu item. Select the Event Logs menu item.

A popup menu will appear with the System sub-menu item. Select the System submenu item.

After System is selected, the PTU will open an Event Logs frame and initiate communications with the MicroCab system.

It can also be displayed by typing the "ALT" and "G" keys.

If communication is successfully established the data requested will be displayed in the corresponding window.

If communications with the MicroCab system can not be established a window will appear with the message Communication Timeout.

Event Logs from Disk

To Load information from a file, select the View Menu.

A drop-down menu will appear with the Event Logs menu item. Select the Event Logs sub-menu item.

A popup menu will appear with the Disk sub-menu item.

Select the Disk sub-menu item.

After Disk is selected, the PTU will open an Event Logs frame and a file dialog box will appear to allow the user to Load a file from disk.

Once the Open dialog appears, the user will need to select the location (folder) where the file exists.

By default the "Saved Logs" folder, if it exists, is selected.

Otherwise, the user can change to a new location of choice.

Once the proper folder is selected, a list of files should appear in the window.

By default, the dialog will look for files that have the correct extension corresponding to the current window requesting a file.

The user can change this selection to show all files by selecting the pull-down menu for Files of Type:, then selecting "All Files".

To open the file, select a file from the list of files displayed and click on the Open button.

This action will cause the information from the file to be read in and loaded into the current window.

If the Cancel button is selected, then the dialog box is closed and no information is loaded.

Once a file is opened (DISK) or communications with the system is established (SYSTEM), information is presented in tabular form as the event major and minor ids, Id1 and Id2, the state of the event, the date the event occurred, and a description of the event.

Each event is contained in its own row in the table. If that row is selected, a second table is displayed that contains a snapshot of the state of system variables when the event happened.

See Paragraph 16-II-02.03.03.02d Saving and Printing Event Information for more information on saving and printing Event Logs.

16-II-02.03.03.03 Edit Menu

The **Edit** menu is depicted below and can be displayed by depressing the left mouse button over the Edit keyword on the menu bar.

The keyboard shortcut keys [Alt] and [E] may also be used.

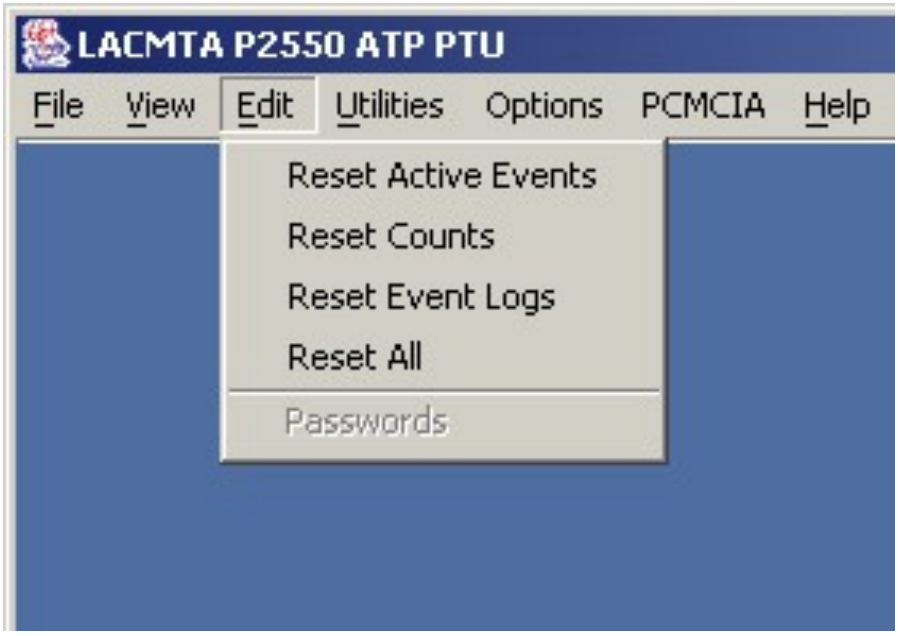


Figure 16-II-02-15 Edit Menu Screen

a) Reset Active Events

Selecting the **Reset Active Events** menu item causes the active event memory in the system to be cleared.

b) Reset Counts

Selecting the **Reset Counts** menu item causes the event counts memory in the system to be cleared.

c) Reset Event Logs

Selecting **Reset Event Logs** causes event log memory to be cleared.

d) Reset All

Selecting the **Reset All** menu item causes the active event, event log, and event counts memory to be cleared.

e) Passwords

The selection of the Passwords menu item causes the display of a dialog box that allows a user with full access to add or remove passwords or modify access levels. The dialog box is displayed below:

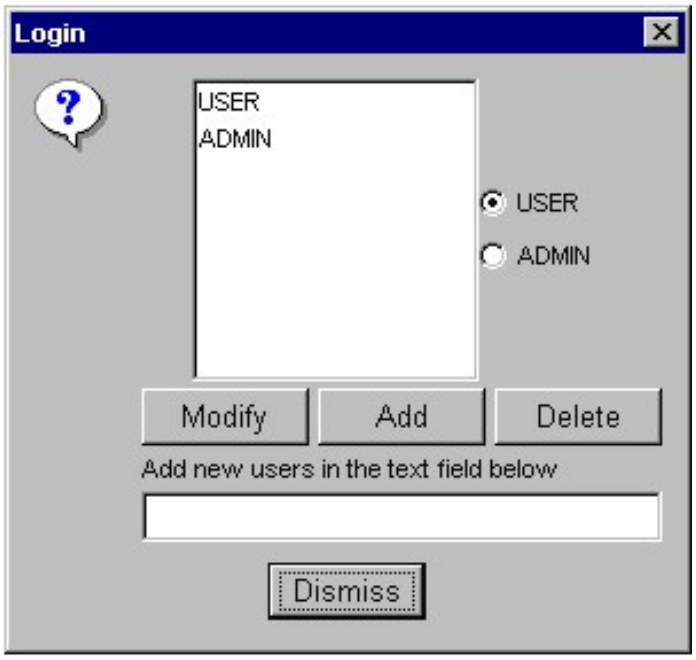


Figure 16-II-02-16 Password Dialog Box

To add a new password, type the password into the text field at the bottom of the dialog box.

Then select the access level using the radio buttons on the right side of the dialog box labeled USER and ADMIN.

Select the Add button and the new user appears in the list display.

To delete a password, select it in the list display and then select the Delete button. The password will be removed from the list.

To Modify access level, select the password in the list, then select a new access level using the radio buttons.

Select the Modify button to change the access level.

Passwords are case sensitive.

When the PTU program is quit the passwords are saved to disk.

During initial PTU software installation, the default passwords “USER” and “ADMIN” are created for their respective USER and ADMIN access levels.

Afterwards, other passwords can be administratively assigned at each access level.

See Paragraph 16-II-02.03.03.01 Login for PTU rights granted to the different access levels.

16-II-02.03.03.04 Utilities Menu

The Utilities menu is depicted below and can be displayed by depressing the left mouse button over the Options keyword on the menu bar.

Its purpose is to allow the user to set system operating parameters, enter the date and time from the PTU, and to configure the PTU menus.

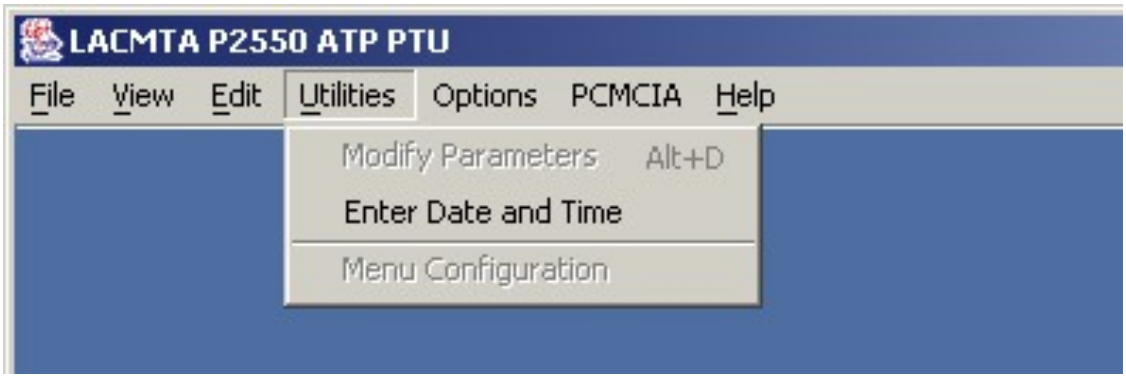


Figure 16-II-02-17 Utilities Menu Screen

16-II-02.03.03.05 Options Menu

The Options menu is depicted below and can be displayed by depressing the left mouse button over the Options keyword on the menu bar.

Its purpose is to facilitate color changes that might allow better viewing on certain PC monitors.

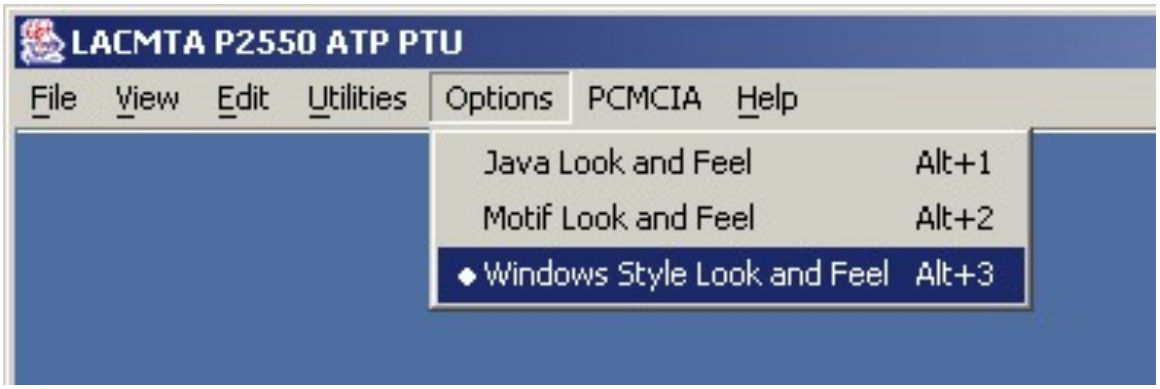


Figure 16-II-02-18 Options Menu Screen

16-II-02.03.03.06 PCMCIA Menu

The PCMCIA menu is depicted below and can be displayed by pressing the left mouse button over the PCMCIA keyword on the menu bar.

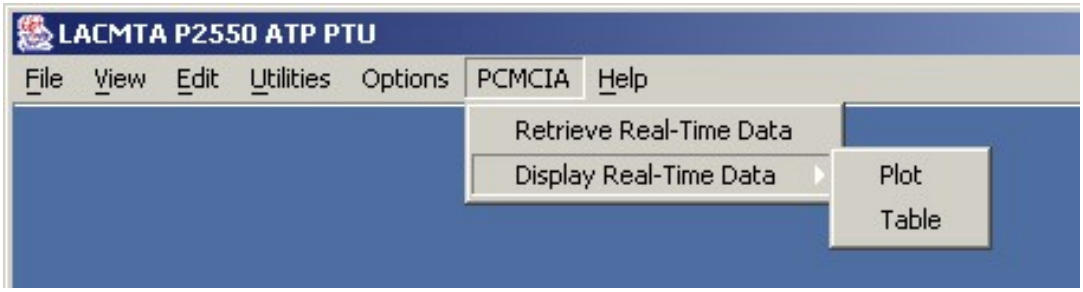


Figure 16-II-02-19 PCMCIA Menu Options

a) Retrieve Real-Time Data

The Retrieve Real-Time Data window is displayed by selecting the Retrieve Real-Time Data option of the PCMCIA menu.

The window opens but does not initiate communications with the system.

To initiate communications with the embedded system, the user must select the Refresh button.

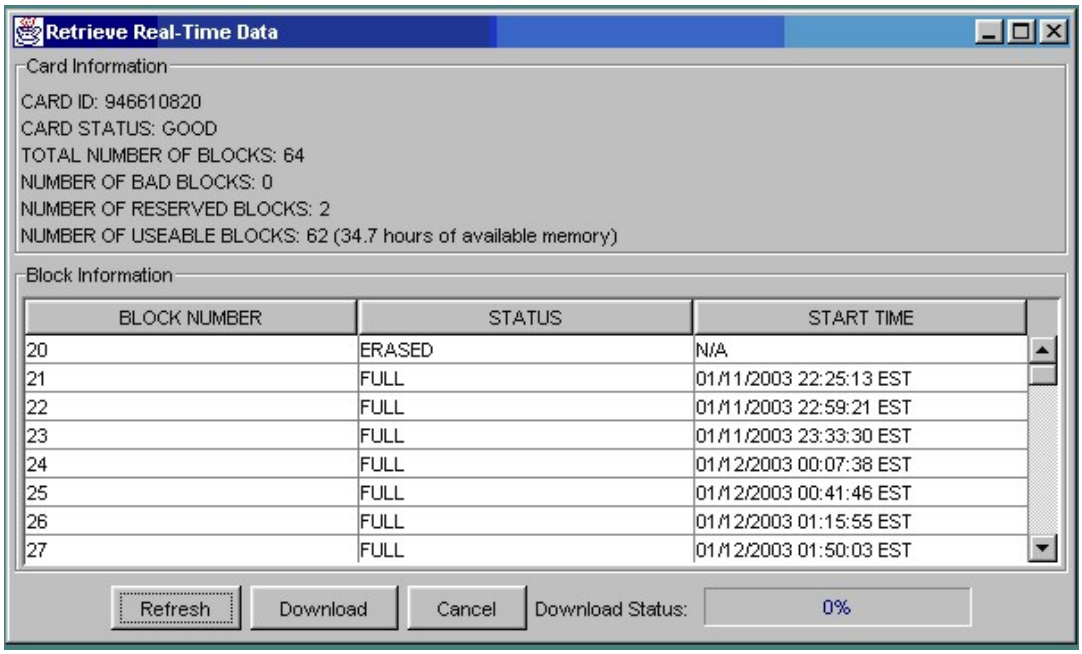


Figure 16-II-02-20 PCMCIA Retrieve Real-Time Data Screen

If communications is successful, the embedded system will respond with Card and Block information.

The Card Information is displayed in top frame of the window, and the Block information is displayed in the bottom frame.

Card Information

- CARD ID: Unique number identifying the card currently in the embedded system
- CARD STATUS: Either GOOD or BAD. If BAD, then data is no longer being written to the card
- TOTAL NUMBER OF BLOCKS: Number of available memory blocks located on the memory card
- NUMBER OF BAD BLOCKS: Number of memory blocks currently marked as BAD
- NUMBER OF RESERVED BLOCKS: Number of memory blocks currently marked as RESERVED. These blocks are not available to be used to store real-time data
- NUMBER OF USABLE BLOCKS: Number of memory blocks currently available to store real-time data. The NUMBER OF USABLE BLOCKS is calculated by subtracting the NUMBER OF RESERVED BLOCKS and the NUMBER OF BAD BLOCKS from the TOTAL NUMBER OF BLOCKS. The hours of available memory is calculated by using the NUMBER OF USABLE BLOCKS minus the one (1) block that is always erased.

Block Information

Block Number: Unique number identifying each block located on the memory card

Status: Either one of:

- ERASED - block contains no data
- IN USE - block is currently being written to this block
- FULL - block is completely full of data
- BAD - block had write errors
- RESERVED - block reserved for internal use
- UNKNOWN - state of block could not be interpreted by the PTU
- Start Time: The time stamp of the first sample of real-time data in this block

In order to retrieve real-time data from the memory card, the user must select one or more valid (i.e. FULL or IN USE) blocks.

The selections can be random or contiguous. Invalid selections will be caught by the application and reported to the user.

Once the selections have been made, the user must then select the Download button. This action will cause a file dialog box to appear to allow the user the option of naming the file and location where it is stored.

The default location is in the Saved_Logs folder.

As the data is being stored to the file, the user can monitor the progress of the download by viewing the Download Status bar.

During the operation, the Cancel button will be replaced with a Halt button.

If the user selects the Halt button, the download process will stop and the file will be saved.

Once the download is complete, either by the user or because all data has been retrieved, the Download Status bar will indicate this current status to the user, and the Halt button will be returned to the Cancel button.

The Cancel button can then be used to close the window.

16-II-02.03.03.07 Real Time Data

a) Plot

The Real-Time Data Plot window is displayed by selecting the Plot menu item of the Display Real-Time Data menu.

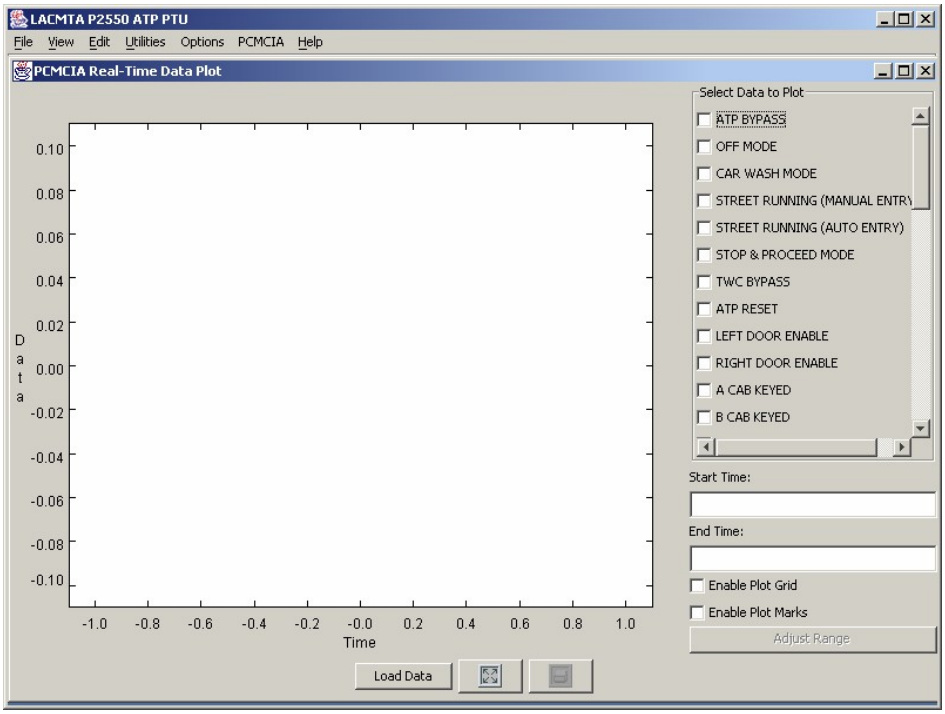


Figure 16-II-02-21 PCMCIA Real-Time Data Plotting Screen

First, the user should select the Load Data button and select a Real-Time Data file from the file dialog box that appears.

Once the file is loaded, the Select Data to Plot section will be filled with each RealTime Data parameter defined for the system.

Also, the Start Time and End Time fields will be filled with the time stamp of the first and last sample available in the specified file.

Next, the user can then select which data parameters are to be added/removed from the plot by selecting the checkbox next to the appropriate data parameter in the Select Data to Plot area.

If the checkbox is marked, the data will be plotted.

If it is unmarked, then the data will be removed from the plot.

If so desired, the user can also adjust the Start Time and End Time fields to view a sub-set of the data parameters.

If either time field is modified, the user must then select the Adjust Range button.

This will cause the X-Axis to be re-adjusted to the Start and End Time fields, and currently selected data to be re-plotted.

The plot also has the built in ability to zoom in on a sub-set of plotted data by highlighting a rectangular area of the plot.

This is accomplished by placing the cursor at the top left corner of the desired area, clicking and holding the left mouse button, dragging the mouse to the lower right corner of the desired area, then releasing the left mouse button.

To return the plot to its maximum display area, the user may then select the Fill Plot button.

Other features available to the user are Plot Grid, Plot Mark, and Print. Selecting the Enable Plot Grid checkbox will turn on or off the plot grid.

Selecting the Enable Plot Marks checkbox will turn on or off unique markings for each data point plotted.

The Print button will send the current visible plot area to a printer selected by the user.

b) Table

The Real-Time Data Table window is displayed by selecting the Table menu item of the Display Real-Time Data menu.

The Table window displays the same data as the Plot window, except in tabular format. In order to view data, the user must first select the Load button.

The user will then be given the option of selecting a file to load via a file dialog box. Once the file is successfully loaded, the table header row will be loaded with a data parameter name in each column.

Each row after the header will contain the data values for that column's specified parameter, in chronological order.

The user may then use the scroll bars to move the table left and right, to view additional parameters, or up and down to view additional data values.

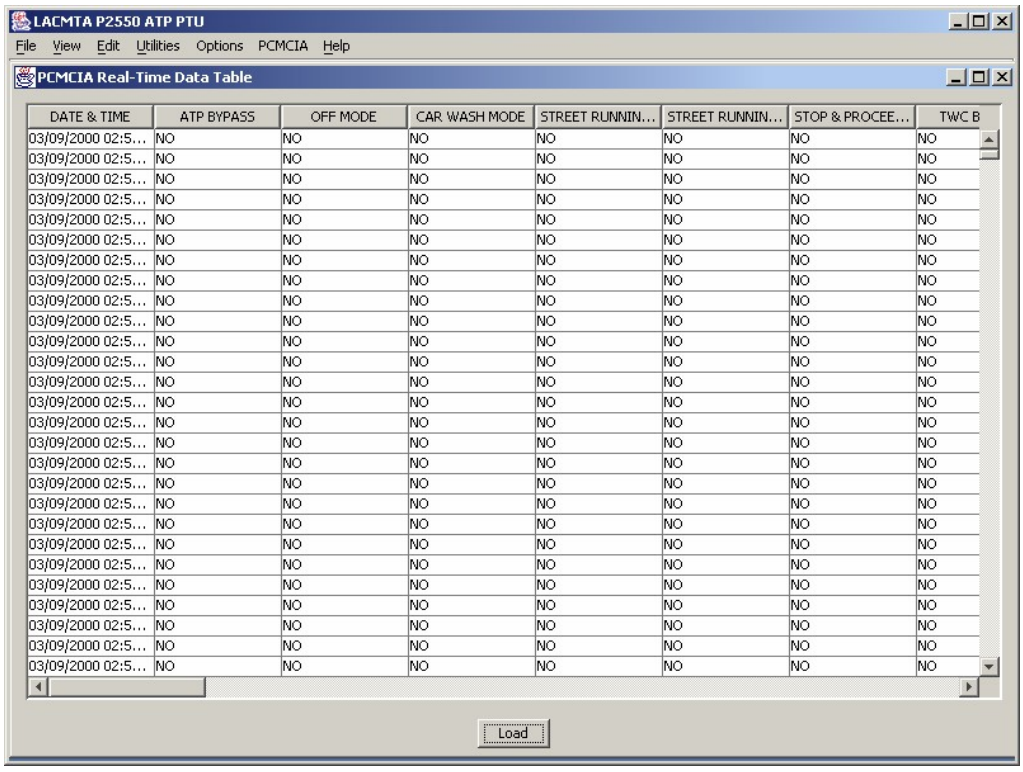


Figure 16-II-02-22 PCMCIA Real-Time Data Table

16-II-02.03.03.08 Help Menu

The Help menu is depicted below and can be displayed by depressing the left mouse button over the Help keyword on the menu bar.

It can also be displayed by using the keyboard shortcut keys [Alt] and [H].

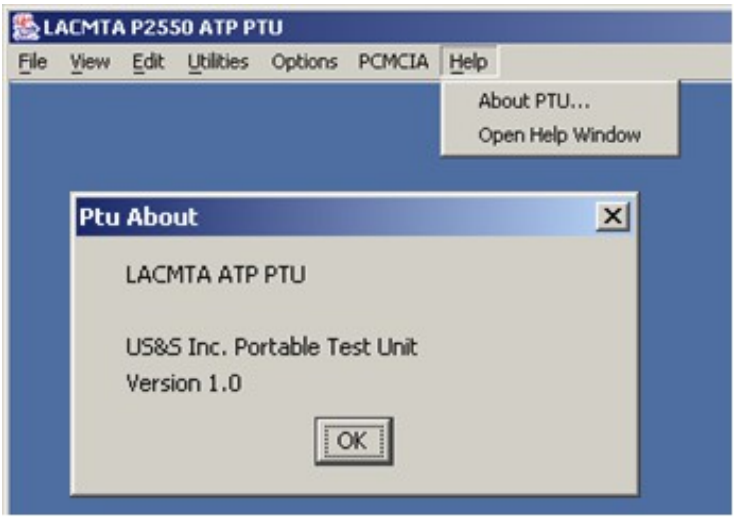


Figure 16-II-02-23 Help About PTU Screen

a) About PTU

The About PTU menu option displays a PTU version statement in a notice window.

b) Open Help Window

The Open Help Window option displays all the PTU Help Files. The Help Files outline the use of the PTU functions.

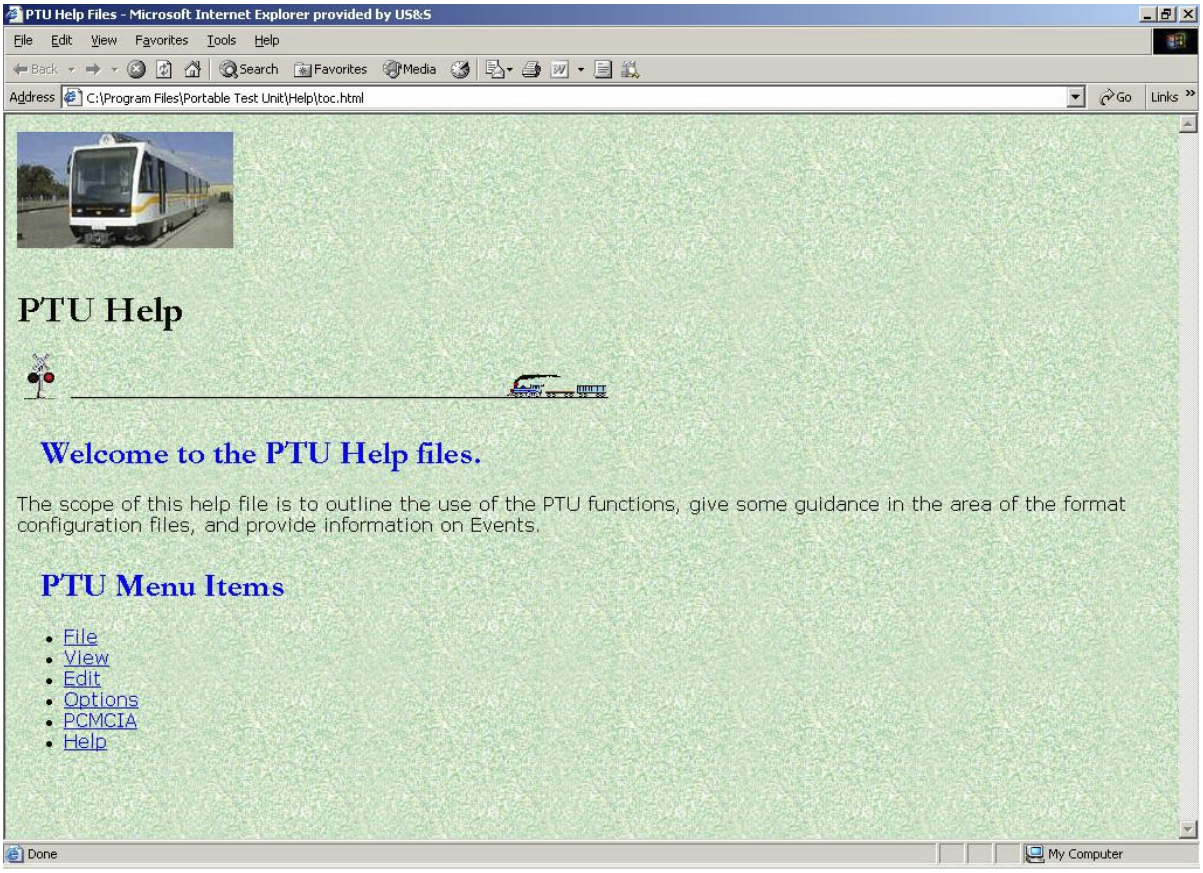


Figure 16-II-02-24 Help Window Screen

16-II-02.04 Troubleshooting from Symptoms

This Paragraph is a guide in tracking down a problem when there is no reliable event information that could help identify it.

The symptoms listed below are representative of what might be observed. Troubleshooting procedures (found in Paragraph 16-II-02.05) are listed that suggest courses of action for resolution of these problems.

1. Completely dead unit

The system indicates no response, no indications, no sign of life.

This is probably due to loss of main power or a major fault in the power distribution circuit.

Loss of power for panel indicators could give the impression of a dead unit. Follow Troubleshooting: Power (refer to Paragraph 16-II-02.05.01)

Partially dead unit

Indications include a loss of LED indications, completely or partially, or by the CPU cycling through reset. Follow Troubleshooting: Power.

(refer to Paragraph 16-II-02.05.01)

2. Nonfunctioning unit

In this condition, the system is not functioning correctly (at least as observed or perceived).

The system may be “locked up" or may simply not be responding to one or more inputs.

Follow Troubleshooting: General ATP Malfunction (refer to Paragraph 16-II-02.05.02).

3. Improper display, but proper function

The system functions correctly (at least as observed or perceived), but the indications are not consistent with performance. (Example: Wrong or no speed displayed.)

Follow Troubleshooting: ADU Malfunction (refer to Paragraph 16-II-02.05.03).

16-II-02.05 Troubleshooting Procedures

NOTE: Prior to following any of these procedures, perform the General Troubleshooting Guidelines in paragraph 16-II-02.02). Otherwise time and effort will be wasted and incorrect conclusions reached.

Instructions: Beginning with Step 1 of the appropriate procedure, continue to the next step until the solution is found.

If the final step does not fix the problem, then the cause is most probably external to the ATP equipment.

16-II-02.05.01 Troubleshooting: Power

CAUTION: DO NOT REMOVE OR INSTALL PCBS WITH POWER APPLIED.

Step 1: Determine the extent of the problem.

Is the problem confined to the ADU or ATP enclosure, or does it affect both? If just the ATP is dead then continue with Step 2. If the problem is confined to the ADU, check the cabling between the ADU and ATP chassis, and between the ADU and vehicle wiring.

Step 2: Measure the 5 Vdc supply.

Measure the +5 Vdc output from the ATP system power supply using test points on the CPS with a digital voltmeter. If less than 5.00 Vdc, replace the system power supply.

Step 3: Measure the input voltage of the power supply.

Measure the incoming voltage and make sure it is within the acceptable range. Ensure the incoming voltage does not drop below 15 Vdc, causing the system to go dead. If the voltage is not proper, check the power switch, power filter, and internal power wiring.

Step 4: Unload the supply.

Remove all circuit boards from the ATP cardfile and disconnect the ADU, then check the power supplies' outputs. If the power supply voltages return to normal, replace the boards sequentially one at a time until the one that affects the power supply output is identified. This board should be replaced.

Step 5: Replace the failed power supply PCB.

Replace the power supply PCB and re-check its outputs. If the problem persists, there may be an excessive load in the system (for example, in the cardfile wiring).

Step 6: Replace the ATP enclosure.

16-II-02.05.02 Troubleshooting: General ATP Malfunction

Step 1: Verify that all boards are properly installed and fully seated in their cardfile slots.

Verify the jumper settings of each board.

Step 2: Verify that all software is the correct version.

Step 3: Verify the ATP inputs and outputs.

Step 4: Continue with Troubleshooting: Power.

16-II-02.05.03 Troubleshooting: ADU Malfunction

NOTE: If one end's ADU operates OK and the other end's ADU is malfunctioning, it is probably a bad ADU.

Step 1: Check the ATP-ADU wiring.

Step 2: Replace the ADU.

Step 3: Continue with Troubleshooting: Power.

16-II-02.05.04 Troubleshooting: Main Logic CPU PCB Anomalies

Step 1: Verify the installation of the Main Logic CPU PCB.

Verify that the CPU board is properly installed into the cardfile. Check all jumper settings and software versions.

Step 2: Replace the Main Logic CPU PCB.

Step 3: Query the event system.

Look for any other board-related fault codes and replace the boards identified by the codes.

Step 4: Replace the ATP enclosure.

16-II-02.05.05 Troubleshooting: FSK CPU PCB/FSK Receiver PCB Anomalies

Step 1: Verify the installation of the FSK CPU PCB.

Verify that the CPU board is properly installed into the cardfile. Check all jumper settings and software versions.

Step 2: Verify the installation of the FSK Receiver PCB.

Verify that the FSK Receiver PCB is properly installed into the cardfile. Check all jumper settings.

Step 3: Check track receivers and track receiver wiring.

Step 4: Replace the FSK CPU PCB.

Step 5: Replace the FSK Receiver PCB.

Step 6: Replace the Relay PCB.

Step 7: Replace the ATP enclosure.

16-II-02.05.06 Troubleshooting: Multifunction PCB Anomalies

Step 1: Verify the installation of the Multifunction PCB.

Verify that the Multifunction PCB is properly installed into the cardfile. Check all jumper settings.

Step 2: Replace the Multifunction PCB.

Step:3: Replace the ATP enclosure.

16-II-02.05.07 Troubleshooting: Decelerometer Failure

Step 1: Verify the installation of the decelerometer.

Verify that the decelerometer is properly installed into the ATP enclosure. Check calibration.

Step 2: Replace the Multifunction PCB.

Step 3: Replace the decelerometer.

Step 4: Replace the ATP enclosure.

16-II-02.05.08 Troubleshooting: Echo and Type Failures

Step 1: Verify the installation of the “faulty” board.

Verify that the board in question is properly installed into the cardfile. Check its jumper settings, if it has any.

Step 2: Replace the “faulty” board.

Step 3: Pull out all other boards except for the Main Logic CPU PCB.

This will cause other faults, but is the original fault still active? If not, is there one board that causes the fault to reappear when it is installed?

Step 4: Check the address and type wiring for the slot.

The cardfile may have a wiring anomaly for the address or type jumpers on the upper backplane.

Step 5: Replace the ATP enclosure.

16-II-02.06 Event Management System and Fault/Event Tables

The US&S Event Management System provides non-vital fault tracing information for trained ATP technicians.

This paragraph details the procedures for troubleshooting with the use of the US&S Event Management System.

Each of the microprocessors in the US&S carborne equipment records the occurrence of noteworthy events.

Then, in order to simplify event viewing, all of these events are routed to the Main Logic CPU PCB. Once there, they are stamped with the time and date and stored in battery-backed memory.

The Main Logic CPU PCB manages the events for itself, the VIB PCB, FSK PCB, and Multifunction PCB.

The following sub paragraphs contain information on the event system, including the types of events and the various restriction levels.

16-II-02.06.01 Event Types

There are two types of events:

- Set/Reset Events: These events have a state, either SET or RESET. When these events are SET, they appear as active events in the Event Menu of the Main Logic CPU PCB front-panel menu system. Both transitions of the event, SET and RESET, will be logged as they occur.
- Pulsed Events: These events are active for just a brief period of time, and therefore will never be seen as an active event. Pulsed events can only be viewed in an event log.

16-II-02.06.02 Event Level Definitions

- Event Level: Defines the severity of an event and the associated system response.
- Sys_Err: Indicates that a catastrophic error has occurred that requires an Emergency Brake application. It is necessary to transfer the ATP into Bypass to move the vehicle.
- Default: Indicates that a non-catastrophic error has occurred and the failed parameter has been placed in a default (safe) state. Normal operations may be possible depending on the relationship of the failed parameter to current operations.
- Record: Indicates that an event of interest has occurred that has no impact on safe and reliable operation of the vehicle.
- Penalty: Indicates that a crosscheck error has occurred that requires a controlled stop under a Penalty Full Service Brake application to assure safety.
- Penalty/CPS: Indicates that a failure has occurred that will not guarantee vital output applications. The system attempts to stop the vehicle under a FSB application, then disables the vital CPS voltage to assure safety. The vital CPS voltage is disabled in motion only if a controlled stop is not possible with a FSB application.
- TCMS: Indicates that an event is reported to the vehicle TCMS as well as being logged internally by the ATP.

16-II-02.06.03 Event Codes

Each ATP event or fault is defined by a unique four-digit code.

The first two digits of the code identify the location within the ATP system that the event or fault originated.

16-II-02.06.04 ATP Fault/Event Tables

The following tables list the faults and events defined for the ATP system.

Events are grouped according to PCB or function, and are listed in numerical order.

For each component or function, a table provides the event code and description, event log type, and event level.

Specific troubleshooting procedures by event code are located in Troubleshooting Procedures, Paragraph 16-II-02.05,

Table 16-II-02.4 Main Logic CPU Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
100	CPU: General Fault	N/A	N/A	N/A	TCMS
101	CPU: branch test failure	N/A	N/A	Pulsed	Sys_Err
102	CPU: register test failure	N/A	N/A	Pulsed	Sys_Err
103	CPU: instruction test failure	N/A	N/A	Pulsed	Sys_Err
104	CPU: stack test failure	N/A	N/A	Pulsed	Sys_Err
105	CPU: ROM test failure	N/A	N/A	Pulsed	Sys_Err
106	CPU: RAM test failure	N/A	N/A	Pulsed	Sys_Err
107	CPU: address bus test	N/A	N/A	Pulsed	Sys_Err
108	CPU: data bus test	N/A	N/A	Pulsed	Sys_Err
109	CPU: stack boundaries corrupted	N/A	N/A	Pulsed	Sys_Err
110	CPU: bad return address	N/A	N/A	Pulsed	Sys_Err
111	CPU: time source failure	N/A	N/A	Pulsed	Sys_Err
112	CPU: task checksum failure	N/A	N/A	Pulsed	Sys_Err
113	CPU: invalid exception	N/A	N/A	Pulsed	Sys_Err
114	CPU: EEPROM write failure	N/A	N/A	Pulsed	Sys_Err
115	CPU: destructor was called	N/A	N/A	Pulsed	Sys_Err
116	CPU: bus error	N/A	N/A	Pulsed	Sys_Err
117	CPU: VI1 task call error	N/A	N/A	Pulsed	Sys_Err
118	CPU: VI2 task call error	N/A	N/A	Pulsed	Sys_Err
119	CPU: MFB task call error	N/A	N/A	Pulsed	Sys_Err

Table 16-II-02.4 Main Logic CPU Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
120	CPU: pure virtual function called	N/A	N/A	Pulsed	Sys_Err
121	CPU: spurious interrupt	N/A	N/A	Pulsed	Sys_Err
122	CPU: Mine Field encountered	N/A	N/A	Pulsed	Sys_Err
123	CPU: database comparison error	N/A	N/A	Pulsed	Sys_Err
124	CPU: database crc error	N/A	N/A	Pulsed	Sys_Err
125	CPU: track circuit not tabled	N/A	N/A	Pulsed	Sys_Err

Table 16-II-02.5 Vital Input (VIB1) Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
200	VIB1: General Fault	N/A	N/A	N/A	TCMS
201	VIB1: echo failure	N/A	N/A	Pulsed	Sys_Err
202	VIB1: type failure	N/A	N/A	Pulsed	Sys_Err
203	VIB1: write verification failure	N/A	N/A	Pulsed	Sys_Err
204	VIB1: input 0 unstable	FWD	0	Set-Reset	Default
205	VIB1: input 1 unstable	REV	0	Set-Reset	Default
206	VIB1: input 2 unstable	No Propulsion Req	0	Set-Reset	Default
207	VIB1: input 3 unstable	ATP Bypass	0	Set-Reset	Default
208	VIB1: input 4 unstable	EBA	0	Set-Reset	Default
209	VIB1: input 5 unstable	ADC	0	Set-Reset	Default
210	VIB1: input 6 unstable	ACABON	0	Set-Reset	Default
211	VIB1: input 7 unstable	BCABON	0	Set-Reset	Default
212	VIB1: input 8 unstable	TBA	0	Set-Reset	Default
213	VIB1: input 9 unstable	No Speed Limit Control	0	Set-Reset	Default
214	VIB1: input 10 unstable	NFBF	0	Set-Reset	Default
215	VIB1: input 11 unstable	FBA	0	Set-Reset	Default
216	VIB1: input 12 unstable	Spare	0	Set-Reset	Default
217	VIB1: input 13 unstable	ATP Reset	0	Set-Reset	Default
218	VIB1: input 14 unstable	NO Power	0	Set-Reset	Default
219	VIB1: input 15 unstable	TWC Bypass	0	Set-Reset	Default
220	VIB1: input 0 shorted	FWD	0	Set-Reset	Default

Table 16-II-02.5 Vital Input (VIB1) Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
221	VIB1: input 1 shorted	REV	0	Set-Reset	Default
222	VIB1: input 2 shorted	No Propulsion Req	0	Set-Reset	Default
223	VIB1: input 3 shorted	ATP Bypass	0	Set-Reset	Default
224	VIB1: input 4 shorted	EBA	0	Set-Reset	Default
225	VIB1: input 5 shorted	ADC	0	Set-Reset	Default
226	VIB1: input 6 shorted	ACABON	0	Set-Reset	Default
227	VIB1: input 7 shorted	BCABON	0	Set-Reset	Default
228	VIB1: input 8 shorted	TBA	0	Set-Reset	Default
229	VIB1: input 9 shorted	No Speed Limit Control	0	Set-Reset	Default
230	VIB1: input 10 shorted	NFBF	0	Set-Reset	Default
231	VIB1: input 11 shorted	FBA	0	Set-Reset	Default
232	VIB1: input 12 shorted	Spare	0	Set-Reset	Default
233	VIB1: input 13 shorted	ATP Reset	0	Set-Reset	Default
234	VIB1: input 14 shorted	NO Power	0	Set-Reset	Default
235	VIB1: input 15 shorted	TWC Bypass	0	Set-Reset	Default
236	VIB1: input 0 monitor failure	FWD	0	Set-Reset	Default
237	VIB1: input 1 monitor failure	REV	0	Set-Reset	Default
238	VIB1: input 2 monitor failure	No Propulsion Req	0	Set-Reset	Default
239	VIB1: input 3 monitor failure	ATP Bypass	0	Set-Reset	Default
240	VIB1: input 4 monitor failure	EBA	0	Set-Reset	Default
241	VIB1: input 5 monitor failure	ADC	0	Set-Reset	Default
242	VIB1: input 6 monitor failure	ACABON	0	Set-Reset	Default
243	VIB1: input 7 monitor failure	BCABON	0	Set-Reset	Default
244	VIB1: input 8 monitor failure	TBA	0	Set-Reset	Default
245	VIB1: input 9 monitor failure	No Speed Limit Control	0	Set-Reset	Default
246	VIB1: input 10 monitor failure	NFBF	0	Set-Reset	Default

Table 16-II-02.5 Vital Input (VIB1) Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
247	VIB1: input 11 monitor failure	FBA	0	Set-Reset	Default
248	VIB1: input 12 monitor failure	Spare	0	Set-Reset	Default
249	VIB1: input 13 monitor failure	ATP Reset	0	Set-Reset	Default
250	VIB1: input 14 monitor failure	NO Power	0	Set-Reset	Default
251	VIB1: input 15 monitor failure	TWC Bypass	0	Set-Reset	Default

Table 16-II-02.6 Vital Input (VIB2) Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
300	VIB2: General Fault	N/A	N/A	N/A	TCMS
301	VIB2: echo failure	N/A	N/A	Pulsed	Sys_Err
302	VIB2: type failure	N/A	N/A	Pulsed	Sys_Err
303	VIB2: write verification failure	N/A	N/A	Pulsed	Sys_Err
304	VIB2: input 0 unstable	GREEN Line	0	Set-Reset	Default
305	VIB2: input 1 unstable	BLUE Line	0	Set-Reset	Default
306	VIB2: input 2 unstable	GOLD Line	0	Set-Reset	Default
307	VIB2: input 3 unstable	Street Run	0	Set-Reset	Default
308	VIB2: input 4 unstable	N/A	0	Set-Reset	Default
309	VIB2: input 5 unstable	Stop & Proceed	0	Set-Reset	Default
310	VIB2: input 6 unstable	Spare	0	Set-Reset	Default
311	VIB2: input 7 unstable	Depart Test	0	Set-Reset	Default
312	VIB2: input 8 unstable	A Coil Select Chk	0	Set-Reset	Default
313	VIB2: input 9 unstable	B Coil Select Chk	0	Set-Reset	Default
314	VIB2: input 10 unstable	Depart Test Chk	0	Set-Reset	Default
315	VIB2: input 11 unstable	FSBR Chk	0	Set-Reset	Default
316	VIB2: input 12 unstable	ERD Chk	0	Set-Reset	Default
317	VIB2: input 13 unstable	ELD Chk	0	Set-Reset	Default
318	VIB2: input 14 unstable	PE Chk	0	Set-Reset	Default
319	VIB2: input 15 unstable	EB Chk	0	Set-Reset	Default

Table 16-II-02.6 Vital Input (VIB2) Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
320	VIB2: input 0 shorted	GREEN Line	0	Set-Reset	Default
321	VIB2: input 1 shorted	BLUE Line	0	Set-Reset	Default
322	VIB2: input 2 shorted	GOLD Line	0	Set-Reset	Default
323	VIB2: input 3 shorted	Street Run	0	Set-Reset	Default
324	VIB2: input 4 shorted	N/A	0	Set-Reset	Default
325	VIB2: input 5 shorted	Stop & Proceed	0	Set-Reset	Default
326	VIB2: input 6 shorted	Spare	0	Set-Reset	Default
327	VIB2: input 7 shorted	Depart Test	0	Set-Reset	Default
328	VIB2: input 8 shorted	A Coil Select Chk	0	Set-Reset	Default
329	VIB2: input 9 shorted	B Coil Select Chk	0	Set-Reset	Default
330	VIB2: input 10 shorted	Depart Test Chk	0	Set-Reset	Default
331	VIB2: input 11 shorted	FSBR Chk	0	Set-Reset	Default
332	VIB2: input 12 shorted	ERD Chk	0	Set-Reset	Default
333	VIB2: input 13 shorted	ELD Chk	0	Set-Reset	Default
334	VIB2: input 14 shorted	PE Chk	0	Set-Reset	Default
335	VIB2: input 15 shorted	EB Chk	0	Set-Reset	Default
336	VIB2: input 0 monitor failure	GREEN Line	0	Set-Reset	Default
337	VIB2: input 1 monitor failure	BLUE Line	0	Set-Reset	Default
338	VIB2: input 2 monitor failure	GOLD Line	0	Set-Reset	Default
339	VIB2: input 3 monitor failure	Street Run	0	Set-Reset	Default
340	VIB2: input 4 monitor failure	N/A	0	Set-Reset	Default
341	VIB2: input 5 monitor failure	Stop & Proceed	0	Set-Reset	Default
342	VIB2: input 6 monitor failure	Spare	0	Set-Reset	Default
343	VIB2: input 7 monitor failure	Depart Test	0	Set-Reset	Default
344	VIB2: input 8 monitor failure	A Coil Select Chk	0	Set-Reset	Default
345	VIB2: input 9 monitor failure	B Coil Select Chk	0	Set-Reset	Default
346	VIB2: input 10 monitor failure	Depart Test Chk	0	Set-Reset	Default
347	VIB2: input 11 monitor failure	FSBR Chk	0	Set-Reset	Default
348	VIB2: input 12 monitor failure	ERD Chk	0	Set-Reset	Default

Table 16-II-02.6 Vital Input (VIB2) Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
349	VIB2: input 13 monitor failure	ELD Chk	0	Set-Reset	Default
350	VIB2: input 14 monitor failure	PE Chk	0	Set-Reset	Default
351	VIB2: input 15 monitor failure	EB Chk	0	Set-Reset	Default

Table 16-II-02.7 Multifunction PCB Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
400	MFB: General Fault	N/A	N/A	N/A	TCMS
401	MFB: echo failure	N/A	N/A	Pulsed	Sys_Err
402	MFB: type failure	N/A	N/A	Pulsed	Sys_Err
403	MFB: VPA compare error	N/A	N/A	Pulsed	Sys_Err
404	MFB: Decel ADC busy	N/A	0 rate	Set-Reset	Penalty / TCMS
405	MFB: Decel bad data	N/A	0 rate	Set-Reset	Penalty / TCMS
406	MFB: Decel data range	N/A	0 rate	Set-Reset	Penalty / TCMS
407	MFB: Decel not near zero	N/A	0 rate	Set-Reset	Penalty / TCMS
408	MFB: Decel unstable	N/A	0 rate	Set-Reset	Penalty / TCMS
409	MFB: Output 1 failure	EBR	0	Set-Reset	Penalty / CPS
410	MFB: Output 2 failure	Spare	0	Set-Reset	Default
411	MFB: Output 3 failure	Spare	0	Set-Reset	Default
412	MFB: Output 4 failure	Spare	0	Set-Reset	Default
413	MFB: Output 5 failure	Spare	0	Set-Reset	Default
414	MFB: Output 6 failure	Spare	0	Set-Reset	Default
415	MFB: Output 7 failure	Spare	0	Set-Reset	Default
416	MFB: Output 8 failure	Spare	0	Set-Reset	Default
417	MFB: Comparitor signal failure	N/A	N/A	Set-Reset	Record
418	MFB: NVOutput 1 failure	FSBR	0	Set-Reset	Default
419	MFB: NVOutput 2 failure	ERD	0	Set-Reset	Default
420	MFB: NVOutput 3 failure	ELD	0	Set-Reset	Default

Event #	Event Description	Function	Default State	Log Type	Event Level
421	MFB: NVOutput 4 failure	PE	0	Set-Reset	Default
422	MFB: NVOutput 5 failure	A Coil Select	0	Set-Reset	Default
423	MFB: NVOutput 6 failure	B Coil Select	0	Set-Reset	Default
424	MFB: NVOutput 7 failure	Depart Test Select	0	Set-Reset	Default
425	MFB: NVOutput 8 failure	Spare	0	Set-Reset	Default

Table 16-II-02.8 Decoder CPU Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
500	DEC: General Fault	N/A	No Code	N/A	TCMS
501	DEC: echo failure	N/A	N/A	Pulsed	Sys_Err
502	DEC: type failure	N/A	N/A	Pulsed	Sys_Err
503	DEC: write verification failure	N/A	N/A	Pulsed	Sys_Err
504	DEC: double load failure	N/A	No Code	Pulsed	Default
505	DEC: double-path compare failure	N/A	No Code	Pulsed	Default
506	DEC: branch test failure	N/A	No Code	Pulsed	Default
507	DEC: instruction test failure	N/A	No Code	Pulsed	Default
508	DEC: VIA register failure	N/A	No Code	Pulsed	Default
509	DEC: task execution failure	N/A	No Code	Pulsed	Default
510	DEC: stack overflow	N/A	No Code	Pulsed	Default
511	DEC: stack underflow	N/A	No Code	Pulsed	Default
512	DEC: FIRQ bad return address	N/A	No Code	Pulsed	Default
513	DEC: illegal FIRQ	N/A	No Code	Pulsed	Default
514	DEC: time source failure	N/A	No Code	Pulsed	Default
515	DEC: diagnostic test failure	N/A	No Code	Pulsed	Default
516	DEC: RAM test failure	N/A	No Code	Pulsed	Default
517	DEC: ROM test failure	N/A	No Code	Pulsed	Default
518	DEC: address bus test failure	N/A	No Code	Pulsed	Default
519	DEC: data bus test failure	N/A	No Code	Pulsed	Default
520	DEC: task checksum failure	N/A	No Code	Pulsed	Default
521	DEC: illegal range	N/A	No Code	Pulsed	Default

Table 16-II-02.8 Decoder CPU Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
522	DEC: ADC busy	N/A	No Code	Pulsed	Default
523	DEC: DAC ramp test failure	N/A	No Code	Pulsed	Default
524	DEC: gain 0 out of range	N/A	No Code	Pulsed	Default
525	DEC: gain 1 out of range	N/A	No Code	Pulsed	Default
526	DEC: gain 2 out of range	N/A	No Code	Pulsed	Default
527	DEC: gain 3 out of range	N/A	No Code	Pulsed	Default
528	DEC: short chan 0 failure	N/A	No Code	Pulsed	Default
529	DEC: short chan 1 failure	N/A	No Code	Pulsed	Default
530	DEC: short chan 2 failure	N/A	No Code	Pulsed	Default
531	DEC: short chan 3 failure	N/A	No Code	Pulsed	Default
532	DEC: DPRAM complement error	N/A	No Code	Pulsed	Default
533	DEC: DPRAM CRC error	N/A	No Code	Pulsed	Default
534	DEC: DPRAM semaphore error	N/A	No Code	Pulsed	Default
535	DEC: host communication fail	N/A	No Code	Pulsed	Default
536	DEC: simultaneous code	N/A	No Code	Pulsed	Default
537	DEC: chan 1 compare error	N/A	No Code	Pulsed	Default
538	DEC: chan 2 compare error	N/A	No Code	Pulsed	Default
539	DEC: chan 1 0 diag error	N/A	No Code	Pulsed	Default
540	DEC: chan 1 1 diag error	N/A	No Code	Pulsed	Default
541	DEC: chan 1 2 diag error	N/A	No Code	Pulsed	Default
542	DEC: chan 1 3 diag error	N/A	No Code	Pulsed	Default
543	DEC: chan 2 0 diag error	N/A	No Code	Pulsed	Default
544	DEC: chan 2 1 diag error	N/A	No Code	Pulsed	Default
545	DEC: chan 2 2 diag error	N/A	No Code	Pulsed	Default
546	DEC: chan 2 3 diag error	N/A	No Code	Pulsed	Default
547	DEC: diag test hung	N/A	No Code	Pulsed	Default

Table 16-II-02.9 100 Hz Filter Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
600	MFB: General Fault	N/A	N/A	N/A	TCMS
601	MFB: echo failure	N/A	N/A	Pulsed	Sys_Err
602	MFB: type failure	N/A	N/A	Pulsed	Sys_Err
603	MFB: VPA compare error	N/A	N/A	Pulsed	Sys_Err

Table 16-II-02.10 250 Hz Filter PCB Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
700	MFB: General Fault	N/A	N/A	N/A	TCMS
701	MFB: echo failure	N/A	N/A	Pulsed	Sys_Err
702	MFB: type failure	N/A	N/A	Pulsed	Sys_Err
703	MFB: VPA compare error	N/A	N/A	Pulsed	Sys_Err

Table 16-II-02.11 ATP Logic Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
801	ATP: Real-time clock corrupted	N/A	N/A	Set-Reset	Record
802	ATP: EEPROM defaults set	N/A	N/A	Pulsed	Record
803	ATP: Decoder compliment mismatch	N/A	N/A	Set-Reset	Record
804	ATP: Incorrect Decoder CRC	N/A	N/A	Set-Reset	Record
805	ATP: Decoder link failure	N/A	N/A	Set-Reset	Record
806	ATP: LON link failure	N/A	N/A	Set-Reset	Record
807	ATP: No Decoder calibration levels	N/A	N/A	Pulsed	Record
808	ATP: ATP Reset stuck button	N/A	N/A	Set-Reset	Record
809	ATP: Stop/Proceed stuck button	N/A	N/A	Set-Reset	Record
810	ATP: Street Run stuck button	N/A	N/A	Set-Reset	Record
811	ATP: Depart Test stuck button	N/A	N/A	Set-Reset	Record
812	ATP: Motion mode change	N/A	N/A	Set-Reset	Record
813	ATP: Motion line change	N/A	N/A	Set-Reset	Record
814	ATP: Speed limit control active	N/A	N/A	Set-Reset	Record
815	ATP: Friction brake fault active	N/A	N/A	Set-Reset	Record
816	ATP: Illegal reverse operation	N/A	N/A	Set-Reset	Record

Table 16-II-02.11 ATP Logic Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
817	ATP: Enter Bypass mode	N/A	N/A	Pulsed	Record
818	ATP: Enter Off mode	N/A	N/A	Pulsed	Record
819	ATP: Enter Manual mode	N/A	N/A	Pulsed	Record
820	ATP: Enter Stop/Proceed mode	N/A	N/A	Pulsed	Record
821	ATP: Enter Street Running mode	N/A	N/A	Pulsed	Record
822	ATP: Enter Car Wash mode	N/A	N/A	Pulsed	Record
823	ATP: Exit Stop/Proceed mode	N/A	N/A	Pulsed	Record
824	ATP: Line change to MGL	N/A	N/A	Pulsed	Record
825	ATP: Line change to MBL	N/A	N/A	Pulsed	Record
826	ATP: Line change to PGL	N/A	N/A	Pulsed	Record
827	ATP: Unplanned door opening	N/A	N/A	Set-Reset	Record
828	ATP: Overspeed limit exceeded	N/A	N/A	Set-Reset	Record
829	ATP: Brake rate not achieved	N/A	N/A	Set-Reset	Record
830	ATP: Prop Cut speed threshold exceeded	N/A	N/A	Pulsed	Penalty
831	ATP: Penalty brake applied	N/A	N/A	Set-Reset	Record
832	ATP: EB applied	N/A	N/A	Set-Reset	Record
833	ATP: TWC link failure	N/A	N/A	Set-Reset	Record
834	ATP: Profile target pos. not reached	N/A	N/A	Pulsed	Record
835	ATP: Enforced Speed Limit Exceeded	N/A	N/A	Set-Reset	Record
836	ATP: Sudden Speed Downgrade Detected	N/A	N/A	Pulsed	Record

Table 16-II-02.12 ATP Crosscheck Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
901	XChk: Keyed Cab Error	N/A	N/A	Set-Reset	Penalty
902	XChk: Line Selector Error	N/A	N/A	Set-Reset	Penalty
903	XChk: EB Crosscheck Error	N/A	N/A	Pulsed	Penalty / CPS
904	XChk: PE Back check Error	N/A	N/A	Set-Reset	Penalty
905	XChk: FSB Back check Error	N/A	N/A	Set-Reset	Record

Table 16-II-02.12 ATP Crosscheck Faults/Events (cont'd)

906	XChk: ELD Back check Error	N/A	N/A	Set-Reset	Record
907	XChk: ERD Back check Error	N/A	N/A	Set-Reset	Record
908	XChk: Depart Test Back check	N/A	N/A	Set-Reset	Penalty
909	XChk: Forward / Reverse Error	N/A	N/A	Set-Reset	Penalty
910	XChk: V-zero-Decel Error	N/A	N/A	Set-Reset	Penalty

Table 16-II-02.13 FSK Interface Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
1000	FSK_DRV: General Fault	N/A	N/A	N/A	TCMS
1001	FSK_DRV: FSK echo failure	N/A	N/A	Pulsed	Sys_Err
1002	FSK_DRV: FSK type failure	N/A	N/A	Pulsed	Sys_Err
1003	FSK_DRV: VPA compare error	N/A	N/A	Pulsed	Sys_Err
1004	FSK_DRV: Input semaphore inaccessible	N/A	No Code	Pulsed	Default
1005	FSK_DRV: Input crc check fail	N/A	No Code	Pulsed	Default
1006	FSK_DRV: Input compliment check fail	N/A	No Code	Pulsed	Default
1007	FSK_DRV: Input seq number unchanged	N/A	No Code	Pulsed	Default
1008	FSK_DRV: Lost Cab Signal	N/A	No Code	Set-Reset	Default
1009	FSK_DRV: Invalid Direction Rcvd	N/A	N/A	Set-Reset	Penalty
1010	FSK_DRV: Nonexistent Track ID Rcvd	N/A	N/A	Pulsed	Penalty
1011	FSK_DRV: Track ID out of Sequence	N/A	N/A	Pulsed	Penalty
1012	FSK_DRV: Obituary Received	N/A	No Code	Pulsed	Default
1013	FSK_DRV: Event Out of Range	N/A	N/A	Pulsed	Record

Table 16-II-02.14 FSK CPU Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
1100	FSK_CPU: Branch test failed	N/A	No Code	Pulsed	Default
1101	FSK_CPU: Register test failed	N/A	No Code	Pulsed	Default
1102	FSK_CPU: Instruction test failed	N/A	No Code	Pulsed	Default
1103	FSK_CPU: Stack test failed	N/A	No Code	Pulsed	Default
1104	FSK_CPU: CRC 16 error flash	N/A	No Code	Pulsed	Default
1105	FSK_CPU: Sum 16 error flash	N/A	No Code	Pulsed	Default
1106	FSK_CPU: Ram test failed	N/A	No Code	Pulsed	Default
1107	FSK_CPU: Addr bus test failed	N/A	No Code	Pulsed	Default
1108	FSK_CPU: Data bus test failed	N/A	No Code	Pulsed	Default
1109	FSK_CPU: Stack bounds test failed	N/A	No Code	Pulsed	Default
1110	FSK_CPU: Local CRC failure	N/A	No Code	Pulsed	Default
1111	FSK_CPU: CPU Diag Call	N/A	No Code	Pulsed	Default
1112	FSK_CPU: CRC Page Cnt	N/A	No Code	Pulsed	Default
1113	FSK_CPU: CKSUM Page Cnt	N/A	No Code	Pulsed	Default
1114	FSK_CPU: RAM Page Cnt	N/A	No Code	Pulsed	Default
1115	FSK_CPU: Inv Ram Device	N/A	No Code	Pulsed	Default
1116	FSK_CPU: CRC Tbl End	N/A	No Code	Pulsed	Default
1117	FSK_CPU: CKSUM Tbl End	N/A	No Code	Pulsed	Default
1118	FSK_CPU: Return Address	N/A	No Code	Pulsed	Default
1119	FSK_CPU: Time Source	N/A	No Code	Pulsed	Default
1120	FSK_CPU: Double Store	N/A	No Code	Pulsed	Default
1121	FSK_CPU: Memory Clear	N/A	No Code	Pulsed	Default
1122	FSK_CPU: DS Compare	N/A	No Code	Pulsed	Default
1123	FSK_CPU:V_Pointer Error	N/A	No Code	Pulsed	Default
1124	FSK_CPU: Up Down Cntr Adj	N/A	No Code	Pulsed	Default
1125	FSK_CPU: Up Down Cntr Cmp	N/A	No Code	Pulsed	Default
1126	FSK_CPU: Stack Semaphore	N/A	No Code	Pulsed	Default
1127	FSK_CPU: Range Chk Error	N/A	No Code	Pulsed	Default
1128	FSK_CPU: Dbl path index	N/A	No Code	Pulsed	Default
1129	FSK_CPU: Task Check Sum	N/A	No Code	Pulsed	Default
1130	FSK_CPU: Invalid exception	N/A	No Code	Pulsed	Default
1131	FSK_CPU: Register Init	N/A	No Code	Pulsed	Default
1132	FSK_CPU: Tst Keys-No Match	N/A	No Code	Pulsed	Default

Table 16-II-02.15 FSK Filter Process Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
1200	FSK_FILTER: A/D Ramp	N/A	No Code	Set-Reset	Default
1201	FSK_FILTER: Gain ch1 Mark	N/A	No Code	Set-Reset	Default
1202	FSK_FILTER: Gain ch1 Space	N/A	No Code	Set-Reset	Default
1203	FSK_FILTER: Gain ch2 Mark	N/A	No Code	Set-Reset	Default
1204	FSK_FILTER: Gain ch2 Space	N/A	No Code	Set-Reset	Default
1205	FSK_FILTER: Gain ch3 Mark	N/A	No Code	Set-Reset	Default
1206	FSK_FILTER: Gain ch3 Space	N/A	No Code	Set-Reset	Default
1207	FSK_FILTER: F discr ch1 Mark	N/A	No Code	Set-Reset	Default
1208	FSK_FILTER: F discr ch1 Space	N/A	No Code	Set-Reset	Default
1209	FSK_FILTER: F discr ch2 Mark	N/A	No Code	Set-Reset	Default
1210	FSK_FILTER: F discr ch2 Space	N/A	No Code	Set-Reset	Default
1211	FSK_FILTER: F discr ch3 Mark	N/A	No Code	Set-Reset	Default
1212	FSK_FILTER: F discr ch3 Space	N/A	No Code	Set-Reset	Default
1213	FSK_FILTER: Antialias ch1 Mark	N/A	No Code	Set-Reset	Default
1214	FSK_FILTER: Antialias ch1 Space	N/A	No Code	Set-Reset	Default
1215	FSK_FILTER: Antialias ch2 Mark	N/A	No Code	Set-Reset	Default
1216	FSK_FILTER: Antialias ch2 Space	N/A	No Code	Set-Reset	Default
1217	FSK_FILTER: Antialias ch3 Mark	N/A	No Code	Set-Reset	Default
1218	FSK_FILTER: Antialias ch3 Space	N/A	No Code	Set-Reset	Default
1219	FSK_FILTER: Tst Ch not detuned	N/A	No Code	Pulsed	Default
1220	FSK_FILTER: Invalid FSK Event 20	N/A	No Code	Pulsed	Default
1221	FSK_FILTER: CritErr TestSwap	N/A	No Code	Set-Reset	Default
1222	FSK_FILTER: CritErr ch1 short	N/A	No Code	Set-Reset	Default
1223	FSK_FILTER: CritErr ch2 short	N/A	No Code	Set-Reset	Default
1224	FSK_FILTER: CritErr ch3 short	N/A	No Code	Set-Reset	Default
1225	FSK_FILTER: FSK Reset	N/A	No Code	Pulsed	Default
1226	FSK_FILTER: Gain low ch1 Mark	N/A	No Code	Set-Reset	Default

Table 16-II-02.15 FSK Filter Process Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
1227	FSK_FILTER: Gain low ch1 Space	N/A	No Code	Set-Reset	Default
1228	FSK_FILTER: Gain low ch2 Mark	N/A	No Code	Set-Reset	Default
1229	FSK_FILTER: Gain low ch2 Space	N/A	No Code	Set-Reset	Default
1230	FSK_FILTER: Gain low ch3 Mark	N/A	No Code	Set-Reset	Default
1231	FSK_FILTER: Gain low ch3 Space	N/A	No Code	Set-Reset	Default
1232	FSK_FILTER: Next Track Circuit Assumed	N/A	N/A	Pulsed	Record

Table 16-II-02.16 Vital Variable Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
1300	Vitals: General Fault	N/A	N/A	N/A	TCMS
1301	Vitals: comparison error	N/A	N/A	Pulsed	Sys_Err
1302	Vitals: out-of-range	N/A	N/A	Pulsed	Sys_Err
1303	Vitals: instantiation failed	N/A	N/A	Pulsed	Sys_Err
1304	Vitals: table corrupted	N/A	N/A	Pulsed	Sys_Err
1305	Vitals: bad pointer	N/A	N/A	Pulsed	Sys_Err
1306	Vitals: check sum error	N/A	N/A	Pulsed	Sys_Err
1307	Vitals: timer corrupted	N/A	N/A	Pulsed	Sys_Err
1308	Vitals: Track table echo failure	N/A	N/A	Pulsed	Sys_Err
1309	Vitals: Table array index out of bounds	N/A	N/A	Pulsed	Sys_Err

Table 16-II-02.17 SPI Driver Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
1401	SPI_DRV: SPI transmit queue overflow	N/A	N/A	Pulsed	Record

Table 16-II-02.18 PCMCIA Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
1500	PCMCIA: General Fault	N/A	N/A	N/A	TCMS
1501	PCMCIA: no card present	N/A	N/A	Pulsed	Default
1502	PCMCIA: attribute error	N/A	N/A	Pulsed	Default
1503	PCMCIA: write error	N/A	N/A	Pulsed	Default
1504	PCMCIA: erase error	N/A	N/A	Pulsed	Default
1505	PCMCIA: invalid address	N/A	N/A	Pulsed	Default
1506	PCMCIA: write protected	N/A	N/A	Pulsed	Default

Table 16-II-02.19 Calibration Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
1601	CAL: Decel Calibration Start	N/A	0 Rate	Pulsed	Default
1602	CAL: Decel Calibration Failed	N/A	0 Rate	Pulsed	Default
1603	CAL: Decel Calibration Passed	N/A	N/A	Pulsed	Record
1604	CAL: Decel Calibration Exited	N/A	N/A	Pulsed	Record
1605	CAL: Decel Calibration Invalid	N/A	0 Rate	Set-Reset	Default

Table 16-II-02.20 Tachometer Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
1701	TACH: Spin Detected	N/A	N/A	Set-Reset	Record
1702	TACH: Slide Detected	N/A	N/A	Set-Reset	Record
1703	TACH: Speed Sensor Mismatch	N/A	N/A	Set-Reset	Penalty / TCMS
1704	TACH: Loss of Sensors detected	N/A	N/A	Set-Reset	Record
1705	TACH: Loss of Sensors error	N/A	N/A	Set-Reset	Penalty / TCMS

Table 16-II-02.21 Departure Test Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
1801	DT: Improper input conditions	N/A	N/A	Pulsed	Record
1802	DT: Depart Test Started	N/A	N/A	Pulsed	Record
1803	DT: Depart Test Passed	N/A	N/A	Pulsed	Record
1804	DT: Depart Test Aborted	N/A	N/A	Pulsed	Record
1805	DT: Decoder/FSK Module error	N/A	N/A	Pulsed	Record
1806	DT: ADU Comm failure	N/A	N/A	Pulsed	Record
1807	DT: Door cycle test failure	N/A	N/A	Pulsed	Record
1808	DT: FAIL 410 Code not achieved	N/A	N/A	Pulsed	Record
1809	DT: FAIL Constant Carrier not achieved	N/A	N/A	Pulsed	Record
1810	DT: FAIL Dual270 Code rate not achieved	N/A	N/A	Pulsed	Record
1811	DT: FAIL 270 Code rate not achieved	N/A	N/A	Pulsed	Record
1812	DT: FAIL 180 Code rate not achieved	N/A	N/A	Pulsed	Record
1813	DT: FAIL 120 Code rate not achieved	N/A	N/A	Pulsed	Record
1814	DT: FAIL 75 Code rate not achieved	N/A	N/A	Pulsed	Record
1815	DT: FAIL 50 Code rate not achieved	N/A	N/A	Pulsed	Record
1816	DT: FAIL No Code not achieved	N/A	N/A	Pulsed	Record
1817	DT: FAIL EB no acknowledge	N/A	N/A	Pulsed	Record
1818	DT: FAIL EB crosscheck	N/A	N/A	Pulsed	Record
1819	DT: FAIL EB crosscheck	N/A	N/A	Pulsed	Record
1820	DT: FAIL EB applied	N/A	N/A	Pulsed	Record
1821	DT: FAIL OS condition	N/A	N/A	Pulsed	Record
1822	DT: FAIL Monitor Conditions Lost	N/A	N/A	Pulsed	Record
1823	DT: FAIL FSK Cab Sig not detected	N/A	N/A	Pulsed	Record

16-II-02.06.05 TWC Fault/Event Tables

The following table lists the faults and events defined for the TWC system. Events and faults are grouped according to function.

For each function, a table provides the event code and description.

Specific troubleshooting procedures by event code are located in Paragraph 16-II-02.05, Troubleshooting Procedures.

Table 16-II-02.22 TWC System Faults/Events

Event Description	Log Type	Event Level
Keyed Cab Crosscheck Error	Set-Reset	TCMS
Keyed Cab State Change	Pulsed	Record
Line Selection Crosscheck Error	Set-Reset	TCMS
Line Selection State Change	Pulsed	Record
PVID Read Error	Set-Reset	Record
PVID Write Error	Set-Reset	Record
TWC-ATP Comm Link Error	Set-Reset	Record
Stuck Button Error	Set-Reset	TCMS
TWC Depart Test Begin	Pulsed	Record
TWC Depart Test Failed	Pulsed	Record
TWC Depart Test Passed	Pulsed	Record
Low SNR	Set-Reset	Record
Lost Carrier	Set-Reset	Record
Invalid Query Pulse Length (PGL)	Set-Reset	Record

16-II-03 APPENDIX

16-II-03.01 IDU Fault List

16-II-03.01.01 Operating Mode

All faults related to the Door System and monitored by the IDU, are listed in the IDU screen and described in the relevant Fault Charts.

The Operating Mode Fault Charts, listed below, include, for each fault, the relevant Operator Guide, which gives the Operator suggestions on how to overcome the fault.

The Operator Guide can be shown by touching the “Detail” button on the screen and is referred to the fault highlighted on the list.

Refer to Table 16-II-03.1 for Operating Mode Fault List.

Refer to Table 16-II-03.2 for Operating Mode Fault Details.

Refer to Table 16-II-03.4 for Operating Mode and Maintenance Mode Fault Relationship.

Table 16-II-03.1 Operating Mode Fault List

Code	Affected Subsystem	Description
6042	ATP/TWC	Bypass / Power Supply Circ Brk Open
6043	ATP/TWC	Fault

Table 16-II-03.2 Operating Mode Fault Details

Fault#	Date	Time	Vehicle#	System	Description
6042	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Power Supply Circuit Breaker Open
Operator Guide Check ATP Power Supply circuit breaker (11F01 - LV Cabinet Car A) and/or Display Power Supply circuit breaker (11F02 - LV Cabinet Car A for Display A - LV Cabinet Car B for Display B) and/or TWC Power Supply circuit breaker (11F03 - LV Cabinet Car A) and/or Bypass Switch (11S01 - Cab Panel Car A).					

Fault#	Date	Time	Vehicle#	System	Description
6043	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Fault
Operator Guide A Fault was detected. Contact Maintenance People.					

16-II-03.01.02 Maintenance Mode

All faults related to the ATP/TWC System and monitored by the IDU in Maintenance Mode are listed in the following Fault Charts.

The Operator Guide pops up by touching the “Detail” button on the screen and is referred to the fault highlighted on the list.

Refer to Table 15-II-03.3 for Maintenance Mode Fault List.

Refer to Table 15-II-03.4 for Operating Mode and Maintenance Mode Fault Relationship.

Refer to Table 15-II-03.5 for Maintenance Mode Fault Details.

Table 16-II-03.3 Maintenance Mode Fault List

Code	Affected Subsystem	Description
6001	ATP/TWC	Overspeed Penalty
6002	ATP/TWC	Request of Penalty Brake
6003	ATP/TWC	TWC Interface Button Error
6004	ATP/TWC	ATP-ADU Communications Failure
6005	ATP/TWC	ATP-FSK Communications Failure
6006	ATP/TWC	ATP-Decoder Communications Failure
6007	ATP/TWC	FSK Module Error
6008	ATP/TWC	Decoder Module Error
6009	ATP/TWC	Vzero-Decelerometer Error
6010	ATP/TWC	dVdT Error
6011	ATP/TWC	Speed Mismatch Error
6012	ATP/TWC	Line Selector Switch Error
6013	ATP/TWC	Keyed Cabs Error
6014	ATP/TWC	Forward Reverse Error
6015	ATP/TWC	Propulsion Enable Checkback Error
6016	ATP/TWC	Full Service Enable Checkback Error
6017	ATP/TWC	Emergency Brake Relay Checkback Error
6018	ATP/TWC	Left Doors Enable Checkback Error
6019	ATP/TWC	Right Doors Enable Checkback Error
6020	ATP/TWC	Multi-Function Board Error
6021	ATP/TWC	Vital Input Board 1 Error
6022	ATP/TWC	Vital Input Board 2 Error
6023	ATP/TWC	100 Hz Filter Board Error
6024	ATP/TWC	250 Hz Filter Board Error

Table 16-II-03.3 Maintenance Mode Fault List (cont'd)

Code	Affected Subsystem	Description
6025	ATP/TWC	FSK Receiver Board Error
6026	ATP/TWC	Decelerometer Error
6027	ATP/TWC	Track Circuit Invalid
6028	ATP/TWC	Track Circuit Out of Sequence
6029	ATP/TWC	ATP-TWC Communications Failure
6030	ATP/TWC	Emergency Brake
6032	ATP/TWC	Loss of Speed Sensors Error
6033	ATP/TWC	FSK/DecoderCommunications Link
6034	ATP/TWC	ATP LON Communications Link
6035	ATP/TWC	Door Cycle Test
6036	ATP/TWC	Cab Signal Detection
6037	ATP/TWC	Overspeed Detection (MBL/PGL only)
6038	ATP/TWC	Full Service Brake Application
6039	ATP/TWC	Emergency Brake Application
6040	ATP/TWC	No Operator Acknowledgement
6041	ATP/TWC	Loss of DT System Conditions
6042	ATP/TWC	Bypass / Power Supply Circ Brk Open

Table 16-II-03.4 Operating Mode and Maintenance Mode Fault Relationship

Operating Mode Fault Codes	Maintenance Mode Fault Codes							
6042	6042							
6043	6001	6002	6003	6004	6005	6006	6007	6008
	6009	6010	6011	6012	6013	6014	6015	6016
	6017	6018	6019	6020	6021	6022	6023	6024
	6025	6026	6027	6028	6029	6030	6032	6033
	6034	6035	6036	6037	6038	6039	6040	6041

Table 16-II-03.5 Maintenance Mode Fault Details

Fault#	Date	Time	Vehicle#	System	Description
6001	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Overspeed Penalty
Operator Guide A Full Service Brake application has been requested because the vehicle speed has surpassed the Enforced Overspeed Limit.					

Fault#	Date	Time	Vehicle#	System	Description
6002	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Request of Penalty Brake
Operator Guide The ATP System has requested a Penalty Brake application.					

Fault#	Date	Time	Vehicle#	System	Description
6003	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	TWC Interface Button Error
Operator Guide One or more pushbuttons on the TWC Interface Panel are considered to be stuck ON.					

Fault#	Date	Time	Vehicle#	System	Description
6004	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	ATP-ADU Communications Failure
Operator Guide The communication link between the ATP and the ADU is failed.					

Table 16-II-03.5 Maintenance Mode Fault Details (cont'd)

Fault#	Date	Time	Vehicle#	System	Description
6005	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	ATP-FSK Communications Failure
Operator Guide The communication link between the ATP and the FSK Module is failed.					

Fault#	Date	Time	Vehicle#	System	Description
6006	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	ATP-Decoder Communications Failure
Operator Guide The communication link between the ATP and the Decoder is failed.					

Fault#	Date	Time	Vehicle#	System	Description
6007	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	FSK Module Error
Operator Guide An error has been detected with the FSK CPU PCB.					

Fault#	Date	Time	Vehicle#	System	Description
6008	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Decoder Module Error
Operator Guide An error has been detected with the Decoder CPU PCB.					

Fault#	Date	Time	Vehicle#	System	Description
6009	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Vzero-Decelerometer Error
Operator Guide The ATP System has detected that the speed sensors are electrically disconnected. A Penalty Brake application is requested.					

Fault#	Date	Time	Vehicle#	System	Description
6010	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	dVdT Error
Operator Guide The ATP System has detected the loss of both speed sensors. A Penalty Brake application is requested.					

Table 16-II-03.5 Maintenance Mode Fault Details (cont'd)

Fault#	Date	Time	Vehicle#	System	Description
6011	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Speed Mismatch Error
Operator Guide The ATP System has detected the loss of a single speed sensor by the speed measurement between the two speed sensors differing excessively. A Penalty Brake application is requested.					

Fault#	Date	Time	Vehicle#	System	Description
6012	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Line Selector Switch Error
Operator Guide More than one or none of the line selector inputs to the ATP are active. A Penalty Brake application is requested.					

Fault#	Date	Time	Vehicle#	System	Description
6013	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Keyed Cabs Error
Operator Guide Both A Cab and B Cab inputs to the ATP are active. A Penalty Brake application is requested.					

Fault#	Date	Time	Vehicle#	System	Description
6014	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Forward Reverse Error
Operator Guide Both Forward and Reverse inputs to the ATP are active. A Penalty Brake application is requested.					

Fault#	Date	Time	Vehicle#	System	Description
6015	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Propulsion Enable Checkback Error
Operator Guide The Propulsion Enable Checkback input is in the same state as the Propulsion Enable output. If propulsion cut is being requested then a Penalty Brake is also requested.					

Table 16-II-03.5 Maintenance Mode Fault Details (cont'd)

Fault#	Date	Time	Vehicle#	System	Description
6016	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Full Service Enable Checkback Error
Operator Guide The Full Service Brake Checkback input is in the same state as the Full Service Brake output.					

Fault#	Date	Time	Vehicle#	System	Description
6017	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Emergency Brake Relay Checkback Error
Operator Guide The Emergency Brake Relay Checkback input is in the same state as the Emergency Brake output.					

Fault#	Date	Time	Vehicle#	System	Description
6018	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Left Doors Enable Checkback Error
Operator Guide The Left Doors Enable Checkback input is in the same state as the Left Doors Enable output.					

Fault#	Date	Time	Vehicle#	System	Description
6019	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Right Doors Enable Checkback Error
Operator Guide The Right Doors Enable Checkback input is in the same state as the Right Doors Enable output.					

Fault#	Date	Time	Vehicle#	System	Description
6020	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Multi-Function Board Error
Operator Guide An error has been detected with the Multi-Function Board.					

Table 16-II-03.5 Maintenance Mode Fault Details (cont'd)

Fault#	Date	Time	Vehicle#	System	Description
6021	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Vital Input Board 1 Error
Operator Guide An error has been detected with Vital Input Board 1.					

Fault#	Date	Time	Vehicle#	System	Description
6022	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Vital Input Board 2 Error
Operator Guide An error has been detected with Vital Input Board 2.					

Fault#	Date	Time	Vehicle#	System	Description
6023	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	100 Hz Filter Board Error
Operator Guide An error has been detected with the 100 Hz Filter Board.					

Fault#	Date	Time	Vehicle#	System	Description
6024	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	250 Hz Filter Board Error
Operator Guide An error has been detected with the 250 Hz Filter Board.					

Fault#	Date	Time	Vehicle#	System	Description
6025	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	FSK Receiver Board Error
Operator Guide An error has been detected with the FSK Receiver Board.					

Fault#	Date	Time	Vehicle#	System	Description
6026	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Decelerometer Error
Operator Guide An error has been detected with the Decelerometer.					

Table 16-II-03.5 Maintenance Mode Fault Details (cont'd)

Fault#	Date	Time	Vehicle#	System	Description
6027	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Track Circuit Invalid
Operator Guide AF-900 Track Circuit ID received is not programmed into the onboard ATP track tables. A Penalty Brake is requested and cab signal is lost.					

Fault#	Date	Time	Vehicle#	System	Description
6028	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Track Circuit Out of Sequence
Operator Guide AF-900 Track Circuit ID received is out of sequence with respect to the onboard ATP track tables. A Penalty Brake is requested					

Fault#	Date	Time	Vehicle#	System	Description
6019	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	ATP-TWC Communications Failure
Operator Guide The communication link between the ATP and TWC is failed.					

Fault#	Date	Time	Vehicle#	System	Description
6030	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Emergency Brake
Operator Guide The ATP System has requested an Emergency Brake application.					

Fault#	Date	Time	Vehicle#	System	Description
6031	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Full Service Brake
Operator Guide The ATP System has requested Full Service Brake application.					

Table 16-II-03.5 Maintenance Mode Fault Details (cont'd)

Fault#	Date	Time	Vehicle#	System	Description
6032	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Loss of Speed Sensors Error
Operator Guide The ATP has detected the loss of both speed sensors while in motion. A Penalty Brake application is requested.					

Fault#	Date	Time	Vehicle#	System	Description
6033	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	FSK/DecoderCommunications Link
Operator Guide FSK (MGL) / Decoder (MBL/PGL) Communications Link Failure					

Fault#	Date	Time	Vehicle#	System	Description
6034	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	ATP LON Communications Link
Operator Guide					

Fault#	Date	Time	Vehicle#	System	Description
6035	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Door Cycle Test
Operator Guide					

Fault#	Date	Time	Vehicle#	System	Description
6036	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Cab Signal Detection
Operator Guide					

Fault#	Date	Time	Vehicle#	System	Description
6037	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Overspeed Detection (MBL/PGL only)
Operator Guide					

Table 16-II-03.5 Maintenance Mode Fault Details (cont'd)

Fault#	Date	Time	Vehicle#	System	Description
6038	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Full Service Brake Application
Operator Guide					

Fault#	Date	Time	Vehicle#	System	Description
6039	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Emergency Brake Application
Operator Guide					

Fault#	Date	Time	Vehicle#	System	Description
6040	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	No Operator Acknowledgement
Operator Guide					

Fault#	Date	Time	Vehicle#	System	Description
6041	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Loss of DT System Conditions
Operator Guide					

Fault#	Date	Time	Vehicle#	System	Description
6042	mm/dd/yy	hh:mm:ss	xxx	ATP/TWC	Loss of DT System Conditions
Operator Guide Check ATP Power Supply circuit breaker (11F01 - LV Cabinet Car A) and/or Display Power Supply circuit breaker (11F02 - LV Cabinet Car A for Display A - LV Cabinet Car B for Display B) and/or TWC Power Supply circuit breaker (11F03 - LV Cabinet Car A) and/or Bypass Switch (11S01 - Cab Panel Car A).					

LOS ANGELES COUNTY

METROPOLITAN TRANSPORTATION AUTHORITY

LIGHT RAIL VEHICLE
P2550

Metro

AnsaldoBreda

RUNNING MAINTENANCE AND SERVICE MANUAL

VOLUME M-01-A
PART III
MAINTENANCE
SECT 16 TWC

SECTION 16

TRAIN-TO-WAYSIDE COMMUNICATION

PART III

MAINTENANCE

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SECTION 16

TRAIN-TO-WAYSIDE COMMUNICATION

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SECTION 16

TRAIN-TO-WAY SIDE COMMUNICATION

16-III-01 INTRODUCTION

The Train-To-Wayside Communication Part III - Maintenance consists of:

- Preventive Maintenance
- Corrective Maintenance
- Consumable Materials
- Test Equipment & Special Tools

16-III-01.a List of Abbreviations, Acronyms & Symbols

The Abbreviations, Acronyms and Symbols commonly used throughout this Section are given below with their relevant meaning.

Abbreviation	Meaning
AB	AnsaldoBreda
AC/DC.	Alternate Current - Direct Current Converter
ADU	Aspect Display Unit
AF	Audio Frequency
AGC	Automatic Gain Control
ATP	Automatic Train Protection
BA	Brake Assurance
BCU	Brake Control Unit
CB	Circuit Breaker
CM	Coast Motoring
CMC	Control and Maintenance Center
CPM.	Cycles Per Minute
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check (Checksum)
DC/AC	Direct Current - Alternate Current Converter
DC/DC	Direct Current - Direct Current Converter
DPRAM	Dual-Ported Random Access Memory
EB	Emergency Brake
ECU	Electronic Control Unit (Brakes)
EEPROM	Electrically Erasable Programmable Read Only Memory
EMI	Electro-Magnetic Interference
FPGA	Field-Programmable Gate Array
FSB	Full Service Brake
FSK	Frequency Shift Keying
H-CML	Heavy Consumable Material List
H-CMS	Heavy Corrective Maintenance Sheet
HRMM	Heavy Repair & Maintenance Manual
HRSB	High Rate Service Brake
HSCB	High Speed Circuit Breaker
HV	High Voltage
HVDS	High Voltage Distribution System
HW	Hardware
I/O	Input / Output
IDU	Integrated Diagnostic Unit
IPC	Illustrated Parts Catalog
KO	Out of Service
LACMTA	Los Angeles County Metropolitan Transportation Authority
LED	Light Emitting Diode
LH	Left Hand Side

(cont'd)

Abbreviation	Meaning
LON	Local Operative Network
LRV	Light Rail Vehicle
LV	Low Voltage
LVDS	Low Voltage Distribution System
LVPD	Low Voltage Power Distribution
LVPS	Low Voltage Power Supply
M	Motoring
MAS	Maximum Allowable Speed
MBL	Metro Blue Line
MPB	Momentary Push-button
MV	Medium Voltage
MVPD	Medium Voltage Power Distribution
OK	Working
PB	Push-button
PCB	Printed Circuit Board
PGL	Pasadena Gold Line
PTU	Portable Test Unit
PVID	Permanent Vehicle Identification
PWM	Pulse-Width Modulation
R-CML	Running Consumable Material List
R-CMS	Running Corrective Maintenance Sheet
RH	Right-Hand Side
RMSM	Running Maintenance & Service Manual
R-PMS	Running Preventive Maintenance Sheet
SB	Service Brake
SCEB	Slide Controlled Emergency Brake
SCPM	Safety Critical Preventive Maintenance
SW	Software
TBS	To Be Supplied
TCMS	Train Control and Monitoring System
TCN	Train Communication Network
TCU	Traction control Unit
TWC	Train-to-Wayside Communication
US&S	Union Switch & Signal, Inc.
VDC	Volts Direct Current
VHDL	VHSIC Hardware Description Language (for FPGA)
V-zero	Velocity = Zero
WTB	Wired Train Bus

16-III-01.b List of Definitions

The Definitions commonly used throughout this Section are given below with their relevant meaning.

Definition	Meaning
'A' body section	The section of an articulated vehicle containing the pantograph
'B' body section	The section of an articulated vehicle not containing the pantograph
AW0	Empty car operating weight
AW1.	Full seated load plus AW0
AW2.	Standees at 4 persons per square meter plus AW1
AW3	Standees at 6 persons per square meter plus AW1
AW4	Standees at 8 persons per square meter plus AW1
Component	(IEEE Std. 610.12-1993) One of the parts that makeup a system. A component may be hardware or software and may be subdivided into other components.
Front door	The door close to the Operator's Cab
LC filter	Filter made up of Inductance and capacity
Non Vital Relay.	The Non-Vital Relay is used in applications where fail-safe operation is not required. It provides no protection against welded contacts and no feed back indication if such a failure occurs.
Rear door	The door close to the Articulation Section
RLC filter	Filter made up of Resistance, Inductance and Capacity
Safety Relay	The operation of the Safety Relay depends on the forced operation of the relays inner contacts. If either of the inner contacts become welded, the normally closed outer contacts remain open. Using the back contacts as a feedback, provides a check that inner contacts have not welded. The Safety Relay differs from the Vital Relay in that the possibility still exists for the inner relay contacts to weld. However, unlike the Non-Vital Relay, a failure due to welded contacts is detectable.
Vital Relay	The Vital Relay is used in vital applications where fail-safe operation is required. Such applications include propulsion, braking, and door opening. The Vital Relay uses gravity for contact break and special contact materials to prevent contacts from welding.

16-III-01.c List of Measurement Units

The Measurement Units commonly used throughout this Section are given below with their relevant meaning.

Definition		Meaning
ft	Foot	(Length)
gal	Gallon	(Volume)
in	Inch	(Length)
kg	Kilogram - approx 2.205 pounds	(Weight)
km	Kilometer - approx 0.621 miles	(Length)
lb	Pound	(Weight)
lb-ft	Pound force	(Force)
m	Meter - approx 3.28 feet	(Length)
mm	Millimeter - approx 0.0394 inches	(Length)
mph	Miles per hour	(Velocity)
Km/h	Kilometers per hour	(Velocity)
s	Seconds	(Time)
V	Volt	(Tension)
Vdc	Direct Voltage	(Tension)
Vac	Alternate Voltage	(Tension)
kVA	Kilo-Volt-Ampere	(Power)
kW	Kilo-Watt	(Power)
W	Watt	(Power)
F	Farad	(Capacity)
H	Henry	(Inductance)
W	Ohm	(Resistance)
°F	Fahrenheit	(Temperature)
°C	Celsius	(Temperature)
A	Ampere	(Current)
Hz	Hertz	(Frequency)
rpm	Revolution per Minute	(Frequency)
N	Newton	(Force)
Nm	Newton-Meter	(Torque)
mphps	Mile Per Hour Per Second	(Acceleration)

16-III-01.d References

Refer to Section 00 of this RMSM for details relevant to the following Topics:

Topic	Paragraph
MANUAL PURPOSE	*00-02*
MANUAL ARRANGEMENT	*00-03*
MANUAL APPLICABILITY	*00-04*
ACQUISITION OF COPIES, REVISIONS AND CHANGES	*00-05*
TECHNICAL PUBLICATIONS DISCREPANCY REPORT	*00-06*
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Fuses	**00-13.04**
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16-III-02 P2550 ANSALDOBREDA MAINTENANCE PLAN

The AB Preventive Maintenance Plan (PMP) has been designed in order to permit a 30-year Structural and Service Vehicle Life with the following basic assumptions:

•Yearly mileage: 120,000 Miles
•Motor and Trailer Truck removal: every 5 years. (600,000 Miles)

The AB Preventive Maintenance Plan (PMP) provides the Preventive Maintenance Tasks to be performed according the following Mileage Intervals:

Running Maintenance		**Heavy Maintenance**	
Daily			
10,000	Miles		
30,000	Miles	600,000	Miles
60,000	Miles	1,200,000	Miles
120,000	Miles	1,800,000	Miles

In accordance with the Preliminary Version of the AB Preventive Maintenance Plan, the Scheduled Maintenance Tasks for the entire Vehicle Life have been grouped into:

- Running Preventive Maintenance
- Heavy Preventive Maintenance

In accordance with the AB Corrective Maintenance Analysis, the Corrective Maintenance Tasks for the entire Vehicle Life have been grouped into:

- Running Corrective Maintenance
- Heavy Corrective Maintenance

16-III-03 RUNNING -PREVENTIVE MAINTENANCE

16-III-03.01 Running -Preventive Maintenance Matrixes (R-PMM)

The Train-To-Wayside Communication Running -Preventive Maintenance Matrix (R-PMM) provides the Preventive Maintenance Plan of this System up to 1,800,000 Miles.

The Train-To-Wayside Communication (H-PMM) is provided in two different arrangements as follows:

- **R-PMM Component Based**

It lists the Train-To-Wayside Communication Running - Preventive Maintenance Tasks ordered by Subsystem /Assemblies / Component break down, followed by the PM Task Description and Scheduled Task Interval and linked to the relevant R-PM Sheet Code.

The R-PMM Component Based provides the Maintainer with the following data:

- SUBSYSTEM /ASSEMBLY/UNIT/COMPONENT
- TASK
- SCPM
- INSPECTION INTERVAL
- SHEET CODE

- **R-PMM Mileage Based**

It lists the Train-To-Wayside Communication Running - Preventive Maintenance Tasks ordered by Scheduled Maintenance Interval and broken down into the related Subsystem /Assemblies/Component followed by the PM Task Description and Person Hours and linked to the relevant R-PM Sheet Code.

The R-PMM Mileage Based provides the Maintainer with the following data:

- INSPECTION INTERVAL
- SYSTEM/SUBSYSTEM /ASSEMBLY/UNIT/COMPONENT
- TASK
- SCPM
- PERSON HOURS
- SHEET CODE

The data listed in this Matrix are the same of those listed in the R-PMM Component Based with the exception of the PERSON HOURS.

16-III-03.01.01 Definitions

The following definitions are applicable to both types of R-PMM

Tasks

Cleaning:	Methods and processes required (Step-By-Step Procedural Instructions) for cleaning specific parts or areas of the Vehicle.
Inspection:	Preventive Maintenance procedures such as those required to ascertain the serviceability of a Part, Assembly, System or the specific interrelationship of Parts that perform a functional operation.
Lubrication:	Provides component lubrication Instructions.
Replacement	Provides the Components / Assemblies and Subassemblies removal & installation in a logical sequential order. Maintenance procedures identified in this topic include Components that are replaced within a 4 hours window.
Service:	Operation performed to replenish Sand, Windshield Wiper Washer Fluid, HVAC Coolant, Gear and Compressor Oil, and Vehicle Lubrication.
Test:	Procedures and Parameters to evaluate the operational efficiency and integrity of a System /Subsystem/Component and the interrelationship of Parts performing functional operations.

16-III-03.01.02 Inspection Intervals

The Running - Preventive Maintenance Intervals for the P2550 LRV Fleet are scheduled as follows:

Daily	10,000 Miles	30,000 Miles	60,000 Miles	120,000 Miles

The marker "●" in the INSPECTIONS INTERVAL column, indicates the periodicity of the corresponding Task.

16-III-03.01.03 Safety Critical Preventive Maintenance (SCPM) Tasks

The marker "☑" in the SCPM column, indicates that the corresponding Task is a Safety Critical Preventive Maintenance (SCPM) Task, as per the results of the Safety Analyses performed, on Vehicle Subsystems, according to Vehicle Specification.

16-III-03.01.04 Sheet Code

The Sheet Code column, indicates the reference to Running -Preventive Maintenance Sheet where the Procedure to be performed is described and illustrated.

THE SHEET CODE IS THE EXPLICIT LINK BETWEEN R-PM MATRIXES, R-PMR /JOB CARDS AND R-PM SHEETS

Refer to Paragraph 16-III-03.03.01 for Running- Preventive Maintenance Sheet (R-PMS) Form for detailed explanation.

16-III-03.01.05 Person Hours

It indicates the time required to perform the corresponding Task with the basic assumption that the Vehicle is on an Inspection Pit or Stand Up Rail and the Consumables, Tools and Spare Parts needed to accomplish the Task are available at the Location of the Equipment to be maintained.

Refer to:

- Table 16-III-03.1 for Running - Preventive Maintenance Matrix (R-PMM) (Component Based)
- Table 16-III-03.2 for Running - Preventive Maintenance Matrix (R-PMM) (Mileage Based)

16-III-03.01.06 Running Preventive Maintenance Matrix (Component Based)

Table 16-III-03.1 Running Preventive Maintenance Matrix (Component Based)

SYSTEM 16 TRAIN-TO-WAYSIDE COMMUNICATION								
SUBSYSTEM ASSY/UNIT/COMPONENT	TASK	SCPM	INSPECTION INTERVAL MILES					SHEET CODE
			Daily	10K	30K	60K	120K	
-TWC SYSTEM	INSPECTION					●		R-P-16-01-00-00/I-00
-TWC SYSTEM	INSPECTION						●	R-P-16-01-00-00/I-01

16-III-03.01.07 Running Preventive Maintenance Matrix (Mileage Based)

Table 16-III-03.2 Running Preventive Maintenance Matrix (Mileage Based)

SYSTEM 16 TRAIN-TO-WAYSIDE COMMUNICATION				
SUBSYSTEM	TASK	SCPM	PERSON HOURS	SHEET CODE
60,000 MILES				
-TWC SYSTEM	INSPECTION		0.2	R-P-16-01-00-00/I-00
120,000 MILES				
-TWC SYSTEM	INSPECTION		0.2	R-P-16-01-00-00/I-01

16-III-03.02 Running -Preventive Maintenance Reports (R-PMR/Job Cards)

This paragraph describes the contents of the Train-To-Wayside Communication Running - Preventive Maintenance Reports (R-PMR/Job Cards) for the Running - Preventive Maintenance Tasks.

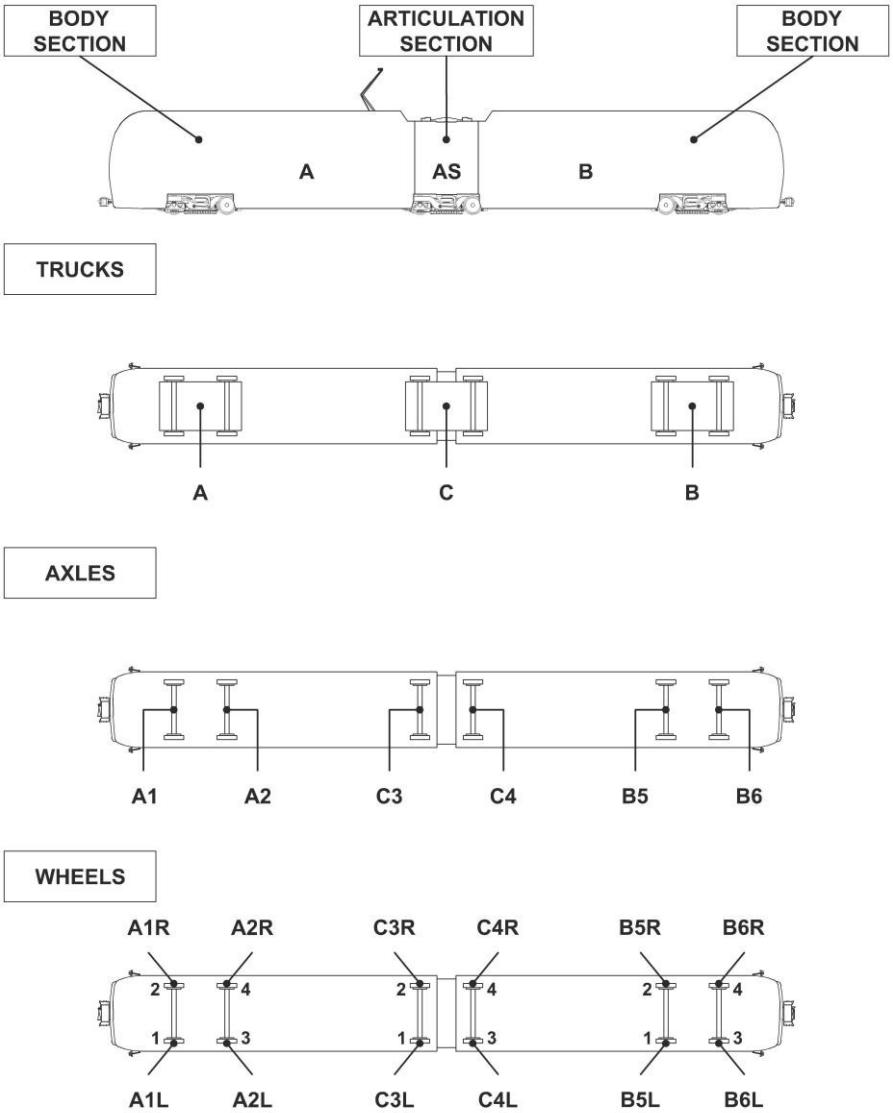
16-III-03.02.01 R-PMR/Job Card Form Content

The R-PMR/JOB CARDS are broken down into two main topics:

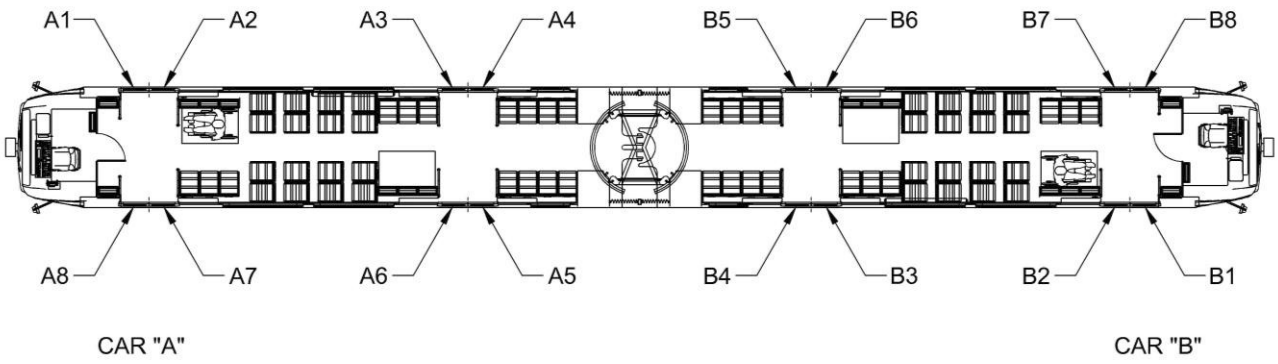
Specific Data and R-PM Data.

Refer to Figure 16-III-03.1 for R-PMR/JOB CARD Form example

RUNNING PREVENTIVE MAINTENANCE REPORTS (R-PMR/JOB CARDS) FORM		
SPECIFIC DATA TO BE FILLED IN BY THE MAINTAINER		
ITEM #	**TITLE**	**EXPLANATORY NOTE**
1	**VEHICLE #**	This field indicates the Vehicle Identification Number
2	**DATE**	This field indicates the Date on which the Vehicle entered the Maintenance Shop
3	**RUNNING HOURS**	This field indicates the Vehicle Running Hours at the above Date
4	**MILES**	This field indicates the Vehicle Running Miles at the above Date.
5	**EMPLOYEE # & SIGNATURE**	This Field indicates the Employee # & Signature of the Maintainer(s) that perform the referred Task(s)
6	**STARTING DATE**	This field indicates the Starting Date of the referred Task(s).
7	**WORK HOURS**	This field indicates the Work duration to perform the referred Task(s).
8	**COMPLETION DATE**	This field indicates the Completion Date of the referred Task(s).
9	**DEFECT FOUND/COMMENTS**	This field indicates the result of the Task(s) execution and/ or note related to any items of the maintained Equipment requiring Corrective Maintenance
A	**P2550 RUNNING PREVENTIVE MAINTENANCE REPORT SYSTEM (Maintenance Interval) JOB CARD**	This field provides R-PMR Title. The R-PM Maintenance Intervals are the following: Daily; 10,000 Miles; 30,000 Miles; 60,000 Miles;120,000 Miles
B	**WORK AREA**	This column lists the On Vehicle Areas where the Equipment to be maintained is located The Work Areas are provided to optimize the jobs organization of the Preventive Maintenance tasks in order to: 1- respect the Safety Precautions to be followed 2- complete the preparation and the availability of the Consumables, Tools and Spare Parts, needed to perform the referred Task. 3- respect the time (PERSON HOURS) established to perform the referred Task (with the basic assumption that the Vehicle is on an Inspection Pit or Stand Up Rail and the Consumables, Tools and Spare Parts are available at the location of the Equipment to be maintained.) The On Vehicle Work Areas are the following: Exterior - Interior - Roof - Truck - Undercar - Vehicle (Vehicle as a whole)

RUNNING PREVENTIVE MAINTENANCE REPORTS (R-PMR/JOB CARDS) FORM		
SPECIFIC DATA TO BE FILLED IN BY THE MAINTAINER		
ITEM #	**TITLE**	**EXPLANATORY NOTE**
C	**ITEM**	This column lists the Subsystem/Assembly, Unit, Component to be maintained
D	**TASK**	This column lists the R-PM tasks to be performed for each Assembly/Unit/Component (i.e., Cleaning, Inspection, Test) The R-PM Tasks are the following: Cleaning - Inspection -Lubrication - Replacement - Service- Test
E	**LOCATION**	This column lists the On Board Vehicle Location of all Equipment to be maintained according to the following Location identification Codes 

RUNNING PREVENTIVE MAINTENANCE REPORTS (R-PMR/JOB CARDS) FORM	
SPECIFIC DATA TO BE FILLED IN BY THE MAINTAINER	
ITEM #	**TITLE**
E (cont'd)	**LOCATION (cont'd)**
EXPLANATORY NOTE	



Door Numbering

ITEM #	TITLE	EXPLANATORY NOTE
F	**PM SHEET CODE**	This column lists the reference to Running-Preventive Maintenance Sheet where the Procedure to be performed is described and illustrated. Refer to Running-Preventive Maintenance Sheet (R-PMS) Form for detailed explanation.
G	**SHEET ….OF……**	This field indicates the progressive sheet page number of each. R-PMR/JOB CARD

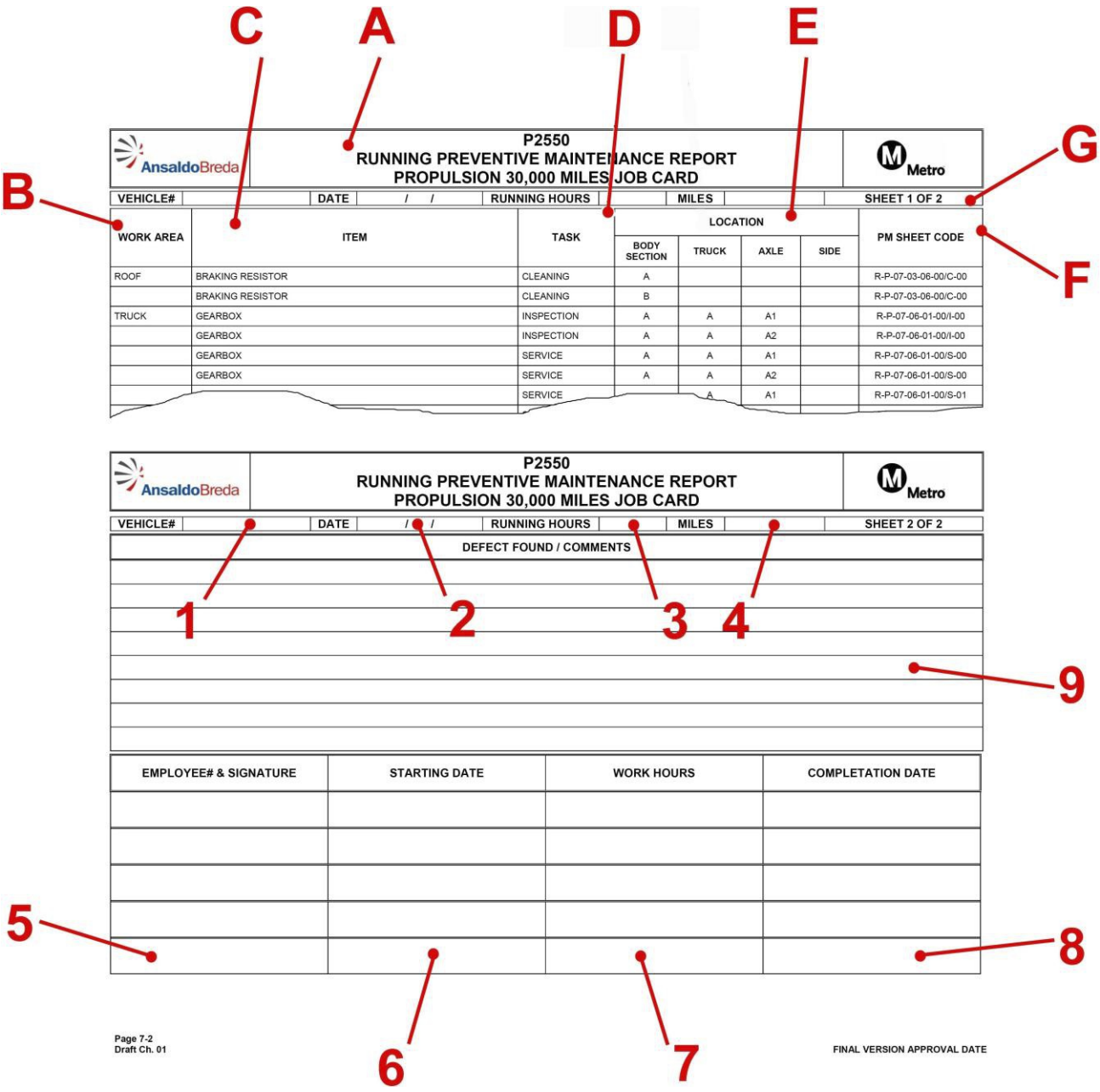


Figure 16-III-03.1 R-PMR/Job Card Form -Example

16-III-03.02.02 R-PMR/Job Card Sequence

The R-PMR/JOB CARDS provided in this Section are grouped according to the following sequence:

Daily 10,000 Miles 30,000 Miles 60,000 Miles 120,000 Miles

16-III-03.02.03 Running -Preventive Maintenance Cycle & R-PMR/Job Card Content

The Running -Preventive Maintenance Cycle and the relevant R-PMR/JOB CARD content are as follows:

MAINTENANCE INTERVAL	PMR /JOB CARD TITLE	PMR /Job Card CONTENT
DAILY	DAILY JOB CARD	• List of Assemblies/Components and related Tasks to be performed **DAILY**
10,000 Miles	10,000 MILES JOB CARD	• DAILY Job Card content + List of Assemblies/Components and related Tasks to be performed at **10,000** Miles
30,000 Miles	30,000 MILES JOB CARD	• DAILY Job Card content + 10,000 Job Card content + List of Assemblies/Components and related Tasks to be performed at **30,000** Miles
60,000 Miles	60,000 MILES JOB CARD	• DAILY Job Card content + 10,000 Job Card content + 30,000 Job Card content + List of Assemblies/Components and related Tasks to be performed at **60,000** Miles
120,000 MILES	120,000 MILES JOB CARD	• DAILY Job Card content + 10,000 Job Card content + 30,000 Job Card content + 60,000 Job Card content + List of Assemblies/Components and related Tasks to be performed at **120,000** Miles

16-III-03.02.04 R-PMR/Job Card Data Presentation Sequence

The Subsystems / Assemblies / Units / Components listed in the ITEMS column of each R-PMR/JOB CARD are grouped by Work Area and Vehicle Systems' and sequenced, in alphabetical order, in conjunction with their On Vehicle Locations and Tasks to be performed.

16-III-03.02.05 Running Preventive Maintenance Reports R-PMR/Job Cards

TRAIN-TO-WAYSIDE COMMUNICATION

Running - Preventive Maintenance Reports

R-PMR/JOB CARDS

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TRAIN-TO-WAYSIDE COMMUNICATION
RUNNING PREVENTIVE MAINTENANCE REPORT
60,000 MILES JOB CARD

VEHICLE #		DATE		RUNNING HOURS		MILES		SHEET 1 OF 1

WORK AREA	SYSTEM	ITEM	TASK	LOCATION				PM SHEET CODE
				BODY SECT	TRUCK	AXLE	SIDE	
INTERIOR	TRAIN TO WAYSIDE COMMUNICATION	TWC SYSTEM	INSPECTION	A				R-P-16-01-00-00/I-00
UNDERCAR	TRAIN TO WAYSIDE COMMUNICATION	TWC SYSTEM ANTENNA	INSPECTION	A				R-P-16-01-00-00/I-00
			INSPECTION	B				R-P-16-01-00-00/I-00

DEFECT FOUND / COMMENTS

EMPLOYEE # & SIGNATURE	STARTING DATE	WORK HOURS	COMPLETION DATE

INTENTIONALLY LEFT BLANK

TRAIN-TO-WAYSIDE COMMUNICATION
RUNNING PREVENTIVE MAINTENANCE REPORT
120,000 MILES JOB CARD

VEHICLE #		DATE		RUNNING HOURS		MILES		SHEET 1 OF 1

WORK AREA	SYSTEM	ITEM	TASK	LOCATION				PM SHEET CODE
				BODY SECT	TRUCK	AXLE	SIDE	
INTERIOR	TRAIN TO WAYSIDE COMMUNICATION	TWC SYSTEM	INSPECTION	A				R-P-16-01-00-00/I-00
			INSPECTION	A				R-P-16-01-00-00/I-01
UNDERCAR	TRAIN TO WAYSIDE COMMUNICATION	TWC SYSTEM ANTENNA	INSPECTION	A				R-P-16-01-00-00/I-00
			INSPECTION	A				R-P-16-01-00-00/I-01
			INSPECTION	B				R-P-16-01-00-00/I-00
			INSPECTION	B				R-P-16-01-00-00/I-01

DEFECT FOUND / COMMENTS

EMPLOYEE # & SIGNATURE	STARTING DATE	WORK HOURS	COMPLETION DATE

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16-III-03.03 Running -Preventive Maintenance Sheets (R-PMS)

Each R-PMS provides the following data consistent with Preventive Maintenance Plan (PMP), AB Design Documentation and Vehicle Systems Functional Tree:

- **R-PM Sheet Code**
- **SYSTEM, SUBSYSTEM /ASSEMBLY, UNIT**, **Component** (Names)
- **SYSTEM, SUBSYSTEM /ASSEMBLY, UNIT**, **Component** (Location)
- **Maintenance Interval** (Miles)
- **Maintenance Task**,
- **Man Hours**, needed to perform the Task
- **SPARE PARTS**, needed to perform the Task

Each R-PMS also provides:

- **SAFETY PRECAUTIONS**, to be followed to safely accomplish the Task
- **TOOLS**, including Special Tools and Test Equipment, needed to accomplish the Task
- **CONSUMABLES**, required to accomplish the Task and consistent with those used by MTA
- **PROCEDURE**, consisting of **Preliminary Operations** and **Procedural Steps**, to be followed while performing Maintenance Tasks.
- **Illustrations** and **Pictures** are inserted in the text to facilitate the understanding of the topics and/or to explain step-by-step procedure.

16-III-03.03.01 Running- Preventive Maintenance Sheet (R-PMS) Form

The R-PMS Form (refer to Figure 16-III-03.2) consists of several fields containing the following data/ information:

RUNNING -PREVENTIVE MAINTENANCE SHEET (RPMS) Form			
ITEM #	**TITLE**	**CONTENT**	**EXPLANATORY NOTES**
1	**Card code**	**Sheet code**	The Sheet Code is an alphanumerical code that identifies each R-PM Sheet. **THE SHEET CODE IS THE EXPLICIT LINK BETWEEN R-PM MATRIXES, R-PMR /JOB CARDS AND R-PM SHEETS** The Sheet Code consists of letters R-P followed by an 11 digit code number as follows: **R-P-nn-mm-zz-ww/Y-kk** **R** = **R**unning **P**= **P**reventive **nn** may vary from 02 to 19, identifying the System/ Manual Section number. **mm-zz-ww** each one may vary from 00 to 99, according to AB System Functional Tree, allowing the identification of the Assembly/Unit/Component **Y** Maintenance Task Code. It may be one of the following: **C**=**C**leaning **I** =**I**nspection **L** = **L**ubrication **R**=**R**eplacement **S**=**S**ervice **T**=**T**est **kk** It may vary from 00 to 99. It is a progressive number allowing the explicit identification of RPMS when one of the following cases occur: 1- same Maintenance Task pertaining to vehicle as a whole or to the same System/Subsystem/Assembly to be performed at same Maintenance Interval in different Vehicle Area (i.e Vehicle as a Whole DAILY Exterior /Interior INSPECTION) 2- same Maintenance Task pertaining to the same Assembly/Unit/Component to be performed at different Maintenance Intervals and for this reason consisting of different Maintenance Procedure
2	**System**	**System name**	This field indicates the System to which the Assembly/Unit/Component belongs.
3	**Subsystem/ Assembly**	**Subsystem/ Assembly name**	This field indicates the Subsystem/Assembly to which the Unit/Component belongs.
4	**Unit**	**Unit name**	This field indicates the Unit to which the Component belongs.
5	**Component**	**Component name**	This field indicates the Component the Maintenance Task is referring to
6	**Maintenance Task**	**Maintenance Task name**	This field indicates the Maintenance Task to be performed.
7	**Interval Miles**	**Number**	This field indicates the maintenance Interval Miles. It may be DAILY, 10,000 Miles, 30,000 Miles, 60,000 Miles, 120,000 Miles

RUNNING -PREVENTIVE MAINTENANCE SHEET (RPMS) Form (cont'd)			
ITEM #	**TITLE**	**CONTENT**	**EXPLANATORY NOTES**
8	**Man Hours**	**Number**	The Man Hour field indicates the time needed to perform the corresponding Maintenance Task, with the basic assumption that the Vehicle is staged on an Inspection Pit/Jacking tracks with the required Consumables, Tools and Materials Available.
9	**Sheet**	**Pages numbering**	This field indicates the progressive R-PMS sheet page number.
10	**LOCATION**	**Illustration**	This field indicates the On Board Location of the Equipment to be maintained The following Graphic Symbols are used for: Assembly/Unit/Component • for System/Subsystem/Vehicle as a Whole ▭
11	**R**	**Letter**	This field indicates that the Sheet pertains to Running Maintenance
12	**P**	**Letter**	This field indicates that the Sheet pertains to Preventive Maintenance
13	**nn**	**Number**	This field indicates the System/Manual Section number to which the Sheet pertains. It may vary from 01 to 19
14	**rr**	**Number**	This field indicates the Sheet Revision number
15	**Page ##**	**Page ##**	This field indicates the RMSM Section Page number
16	**-#**	**Number**	This field indicates the RMSM Section Revision number
17	**SAFETY PRECAUTIONS**	**Text**	This field presents the General and/or specific Safety Precautions to be followed to safely accomplish the relevant Maintenance Tasks.
18	**TOOLS**	**Text**	This field lists the description and the P/N of the Standard tools, Special Tools and Test Equipment needed to accomplish the Maintenance Task. Refer to the TTE Manual for the TE and Special Tools detailed descriptions and tools maintenance.
19	**CONSUMABLES**	**Text**	This field lists the Consumables Materials (consistent with those used by MTA with the related P/N.) needed to accomplish the Maintenance Task. Cleaning agents are included
20	**SPARE PARTS**	**Text**	This field lists the Description and PN of Spare Parts (consistent with Illustrated Parts Catalog) needed to accomplish the Maintenance Task.
21	**PROCEDURE**	**Text**	The Procedure field provides Preliminary Operations and Procedural step by step Instructions to be followed while performing the Maintenance Task. Illustrations and Pictures are inserted in the text to facilitate the understanding of the topics and/or to explain step-by-step procedure.

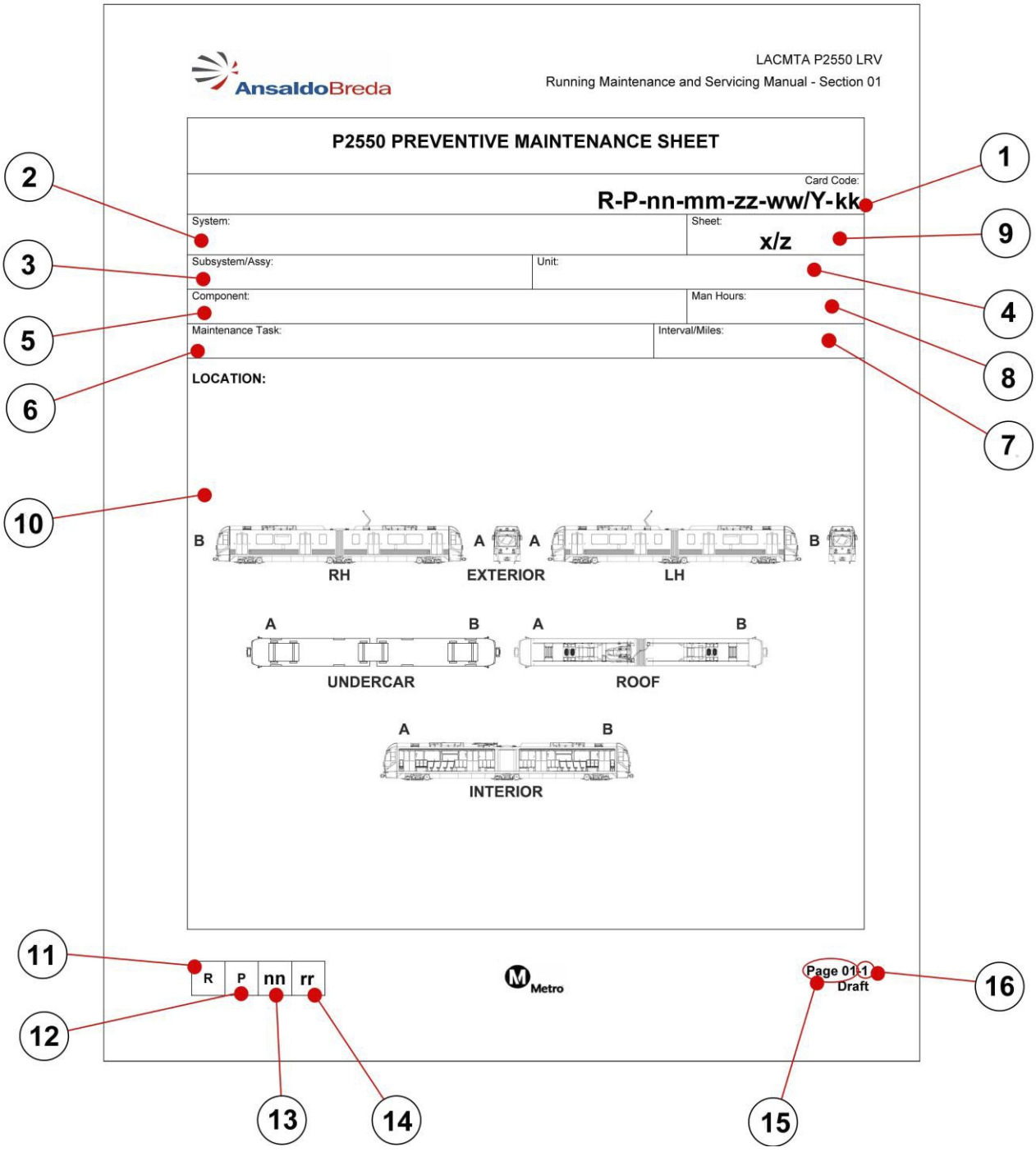

Figure 16-III-03.2 R-PMS Form
(Sheet 1 of 2)

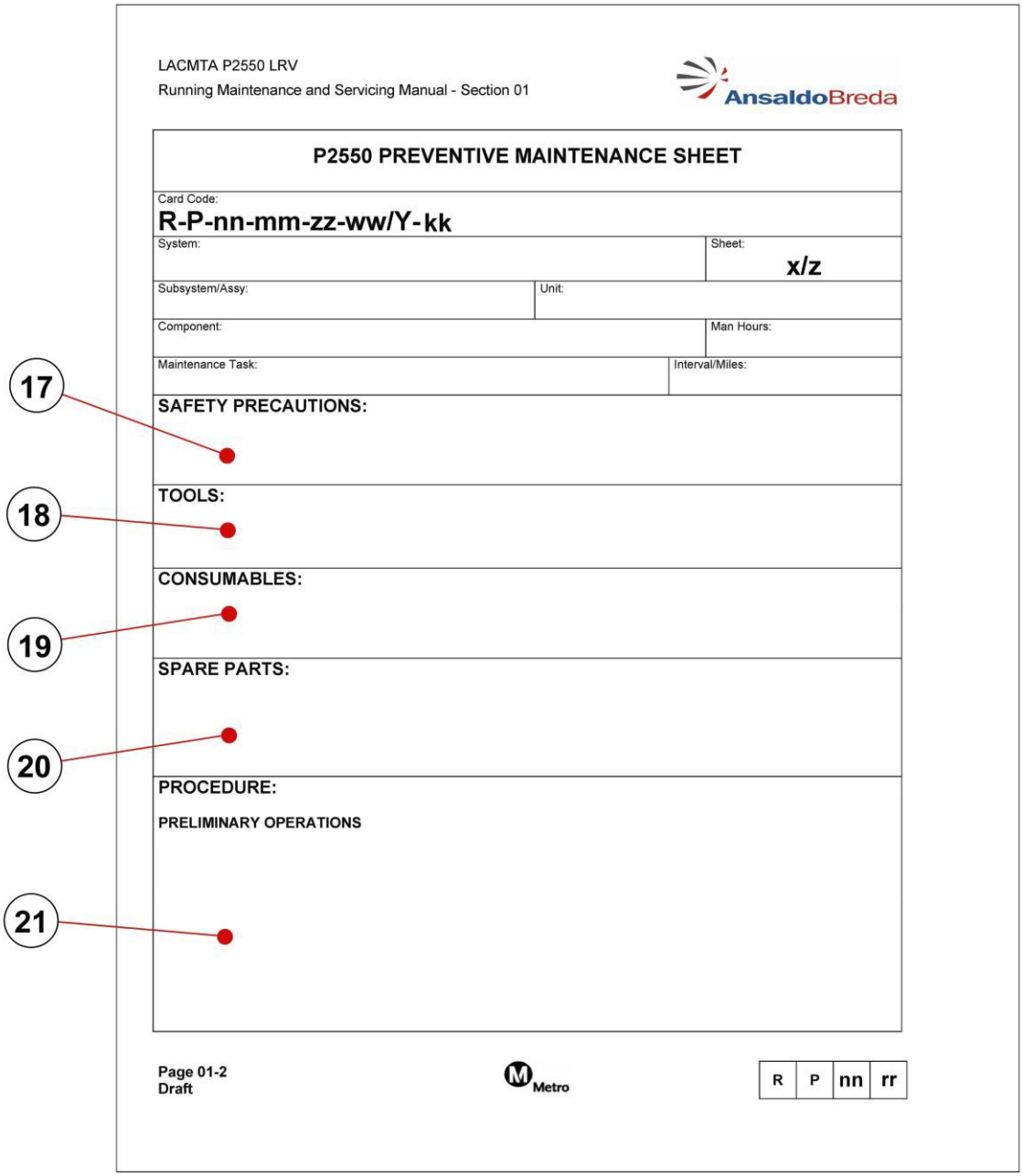

Figure 16-III-03.2 R-PMS Form
(Sheet 2 of 2)

16-III-03.03.02 How to Use the R-PM Sheets and R-PMR /Job Cards

To optimize the job organization, proceed as follows:

1. **At Scheduled Preventive Maintenance Interval Expiration Date**

   a) Use the relevant (Maintenance Interval) R-PMR/JOB CARD where the Subsystems/Assemblies/Units/Components, listed in the ITEMS column, are grouped by Work Area and Vehicle System and sequenced, in alphabetical order, in conjunction with their On Vehicle Location and Task to be performed.

   b) Select the Work Area and the System

   c) Select the first Equipment listed in the ITEMS column and the Sheet Code listed in conjunction with the Task to be performed and gather the relevant Sheet

   d) Read carefully the Sheet to fully understand the provided Data/Instructions.

   e) Carefully read:

   · The Safety Precautions to perform the Task safely;

   · The Preliminary Operations to set the Vehicle in safety conditions according to MTA Maintenance Shop Regulations;

   · The Tools, Consumables and Spare Parts listed in each Sheet which are needed to accomplish the Task, in order to have all of them available next to the location of the Equipment to be maintained before starting the activities.

   f) Fill the R-PMR/JOB CARD with the data required by the Maintainer at the start of the Maintenance Activities

2. **Task Execution**

   a) Follow carefully the prescribed Safety Precautions and Maintenance Procedural Steps provided in the R-PM Sheet.

   b) Perform the Maintenance Task Procedure on the first Equipment (listed in the ITEMS column of the relevant R-PMR /JOB CARD) at its On Vehicle LOCATION, as indicated in the LOCATION column of the R-PMR /JOB CARD.

   c) Upon completing the Maintenance Task on the first Equipment, highlight (with a flag) its LOCATION field on the R-PMR / JOB CARD.

   d) Note Equipment Defect Found and / or your Comments on the End Page of the R-PMR / JOB CARD

   e) Proceed to perform the same Task on the second (same) Equipment listed in the R-PMR / JOB CARD at its On Vehicle LOCATION, (different from the previous one) as indicated in the LOCATION column of the R-PMR /JOB CARD.

   f) Proceed as above to perform the same Task on every Equipment (to which the same Sheet Code refers) listed in the ITEMS column of the relevant (Maintenance Interval) R-PMR /JOB CARD.

   g) During Task execution, note any Areas / Items of the Assembly / Unit/ Component under Preventive Maintenance Process requiring Corrective Maintenance.

   h) Gather as much information about the Equipment as is practical to increase your Equipment knowledge (i.e.; knowledge about the malfunction in terms of correctly operating and incorrectly operating equipment processes).

3. At every Task Completion

a) Follow carefully the prescribed Safety Precautions before restoring Electrical Power to Vehicle.

b) Check the correct operation and/or functions of the Subsystem to which the maintained Equipment pertains.

c) Perform this check on the IDU "A" as follows:

NOTE: Through the IDU you can check if all Systems are exchanging data through the MVB or LonWorks Bus and the Trainlines Status.

The IDU Display also shows in real time the Status of all Vehicle Systems.

Reading the IDU Fault List it is possible to immediately detect a fault Using the IDU in the Operating Mode the Fault Indications are generic.

Using the IDU in Maintenance Mode the same Fault has a detailed description.

For more in depth troubleshooting use the PTU connected to the relevant system that requires further troubleshooting.

1. On IDU "A" access to the Maintenance Menu first and then to the "Faults" Screen by selecting, in sequence, the relevant icons.
2. Check, On IDU "A" through the list of the Current Active Faults shown in the "Faults" Screen, for "Fault" Codes related to the Subsystem to which the maintained Equipment pertains.

   Refer to Section 18 of RMSM for Fault Signals Details.
3. As per "Fault" Codes check results proceed as follows:

   - **No Faults are listed in the "Faults" Screen**

     a) Key OFF the Vehicle.

     b) Record Service and Test results on the Defect Report Card for administrative and maintenance planning.

     c) Fill the R-PMR /JOB CARD with the data required from the Maintainer at the completion of the Maintenance Activities and include your comments

- **Fault Codes are listed in the "Faults" Screen**

a) Investigate/troubleshoot the Equipment previously maintained first and then the System/Subsystem/Assembly/Unit for Fault Probable Causes.

b) Gather as much information about the failure symptoms as is practical.

c) Refer to Section 18 of RMSM for Fault Signals Details.

d) Try to identify the malfunction in terms of correctly operating and incorrectly operating equipment processes.

e) Identify which equipment signals or parameters will best help you to localize the failure.

f) Identify the source of the problem.

g) Repair or replace the defective component.

h) Verify that the repair is effective in eliminating all of the failure symptoms.

i) Evaluate whether or not the defective component was the root cause of the failure.

j) Once the Fault Codes are not found in the "Faults" Screen perform steps from 3-a through 3-c (previous subparagraph **"No Faults are listed in the "Faults" Screen).**

16-III-03.03.03 Running- Preventive Maintenance Sheet (R-PMS) List

The Train-To-Wayside Communication Running- Preventive Maintenance Sheets (R-PMS) List is provided in the following pages.

The R-PM Sheets are listed by Subsystem / Assembly / Unit / Component and sequenced by Maintenance Interval in conjunction with their Sheet Codes and Tasks (including SCPM flag) to be performed.

Table 16-III-03.3 Running Preventive Maintenance Sheets List

SYSTEM 16 TRAIN-TO-WAYSIDE COMMUNICATION					
SUBSYSTEM/ ASSY	**ASSY /UNIT/ COMPONENT**	**SCPM**	**TASK**	**MAINTEN. INTERVAL (MILES)**	**SHEET CODE**
TWC SYSTEM	TWC SYSTEM		INSPECTION	60,000	R-P-16-01-00-00/I-00
			INSPECTION	120,000	R-P-16-01-00-00/I-01

TRAIN-TO-WAYSIDE COMMUNICATION

Running - Preventive Maintenance Sheets

R-PMS

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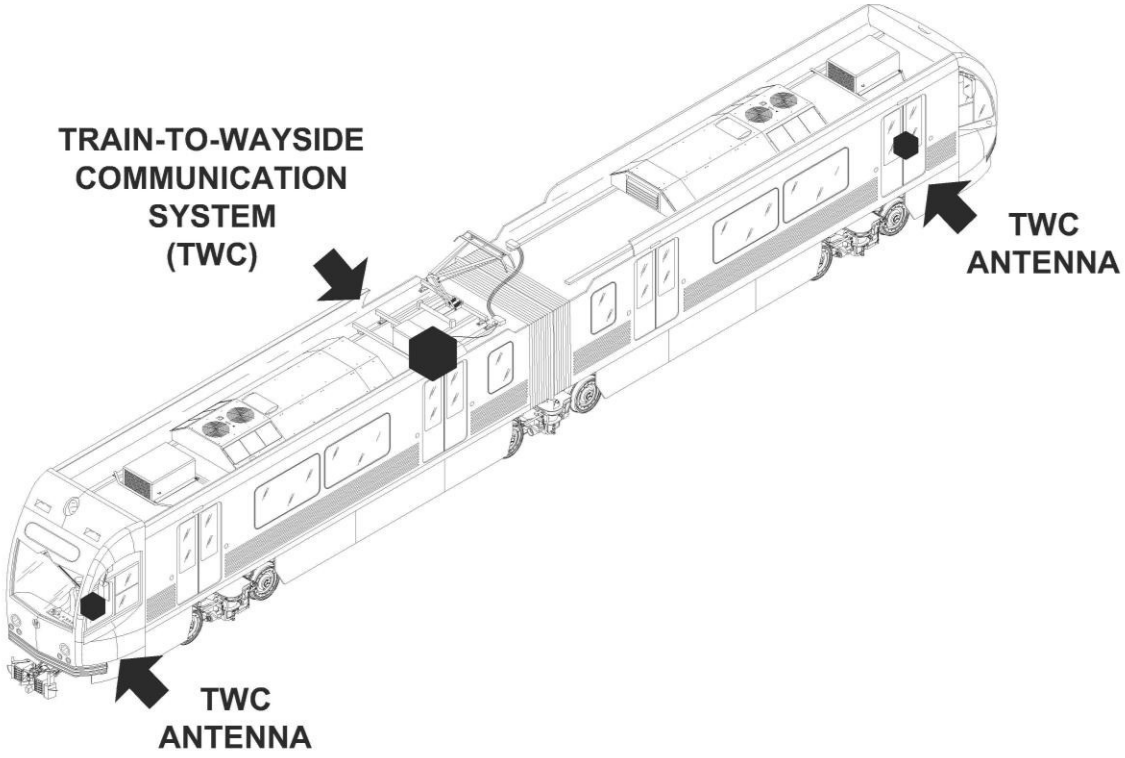
P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-16-01-00-00/I-00

System:	Sheet:
TRAIN-TO-WAYSIDE COMMUNICATION	**1/8**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component:	Man Hours: **0.2**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

LOCATION:



P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-16-01-00-00/I-00

System:	Sheet:
TRAIN-TO-WAYSIDE COMMUNICATION	**2/8**

Subsystem/Assy:	Unit:
TWC SYSTEM	

Component:	Man Hours:
	0.2

Maintenance Task:	Interval/Miles:
INSPECTION	**60,000**

SAFETY PRECAUTIONS:

WARNING: BLUE FLAG THE VEHICLE IN ACCORDANCE WITH ALL LACMTA BLUE FLAG POLICIES, RULES, & PROCEDURES IN ORDER TO WARN THAT MAINTENANCE PERSONNEL ARE WORKING ON, UNDER, OR NEAR ROLLING EQUIPMENT.

WARNING: DISCONNECT THE POWER IF THE SYSTEM WILL BE UNATTENDED. WHILE WORKING ON THE SYSTEM, THE TRAIN COULD UNEXPECTEDLY MOVE, POSSIBLY CAUSING DAMAGE OR INJURY. WARN OTHERS TO STAY CLEAR OF THE TRAIN SINCE IT COULD BECOME ACTIVATED WITHOUT NOTICE.

WARNING: BE CAREFUL TO AVOID PERSONAL INJURY. AVOID DOING ANYTHING THAT COULD PUT ANYONE IN DANGER OF ELECTRICAL SHOCK OR INJURY FROM MOVING EQUIPMENT. EXERCISE EXTREME CAUTION WHEN WORKING AROUND THE SYSTEM WITH THE WIRING AND ELECTRONICS EXPOSED. WARN OTHERS BEFORE LEAVING AN OPEN SYSTEM UNATTENDED.

WARNING: DEPENDING ON THE SEVERITY AND TYPE OF PROBLEM BEING EXPERIENCED, IT MAY BE ADVANTAGEOUS TO DISCONNECT THE ATP/TWC SYSTEM FROM EXTERNAL SYSTEMS SO THAT WORK CAN BE PERFORMED ON THE SYSTEM WITHOUT DANGER.

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit

Soft bristle brush

CONSUMABLES:

Lint-free rags

Compressed air in aerosol can

SPARE PARTS:

N/A

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-16-01-00-00/I-00**

System:	Sheet:
TRAIN-TO-WAYSIDE COMMUNICATION	**3/8**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component:	Man Hours: **0.2**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

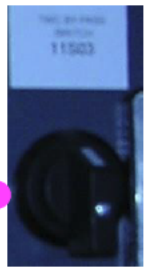
PROCEDURE:

To perform Train-To-Wayside Communication System Inspection Procedure proceed as follows

PRELIMINARY OPERATIONS

1. Set the vehicle in safety condition in accordance with LACMTA Maintenance Shop Regulations.
2. Make sure that the Parking Brake has been applied when the Reverser is in Neutral, and the Wheels chocked.
3. Set the Transfer Switch (located on the Operator's Console) to "OFF" Position.
4. Check that there are in "OFF" position or place accordingly the followings.

- **CB 11F03,** located in the "A" LV Locker,
- **CB 11S03,** located in the "A" Cab By Pass Panel



INSPECTION

To perform the Task proceed as follows:

1 Gain access to theTWC Enclosure installed in the (A) ELE Locker, by opening the relevant ELE Locker Door using Maintenance Key.

2 Locate the **TWC Enclosure**

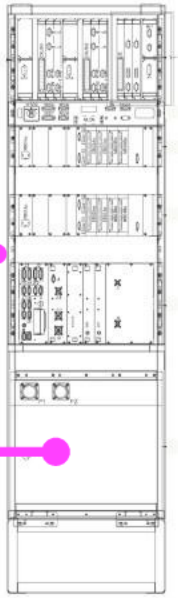


FIG 1 TWC ENCLOSURE LOCATION

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-16-01-00-00/I-00**	
System: **TRAIN-TO-WAYSIDE COMMUNICATION**	Sheet: **4/8**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component:	Man Hours: **0.2**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

INSPECTION (cont'd)

3 Check that interface Connectors are tight and Cables are free of nicks, cuts, and fraying.

4 Open the Door Panel of TWC Enclosure.

5 Perform the following inspections:

- **a**. Cabinet Exterior is clean and free of scratches, chipped paint and spots of corrosion.
- **b**. All PCBs are securely mounted in Cardfile and showing no visible signs of deterioration. Replace as per Check Result according to Sheet R-C-16-01-01-00/R-00.
- **c**. Visual check the Interface Board's Connectors for visible damage.

6 Clean all the Parts with soft bristle brush, air compressed and lint-free rags.

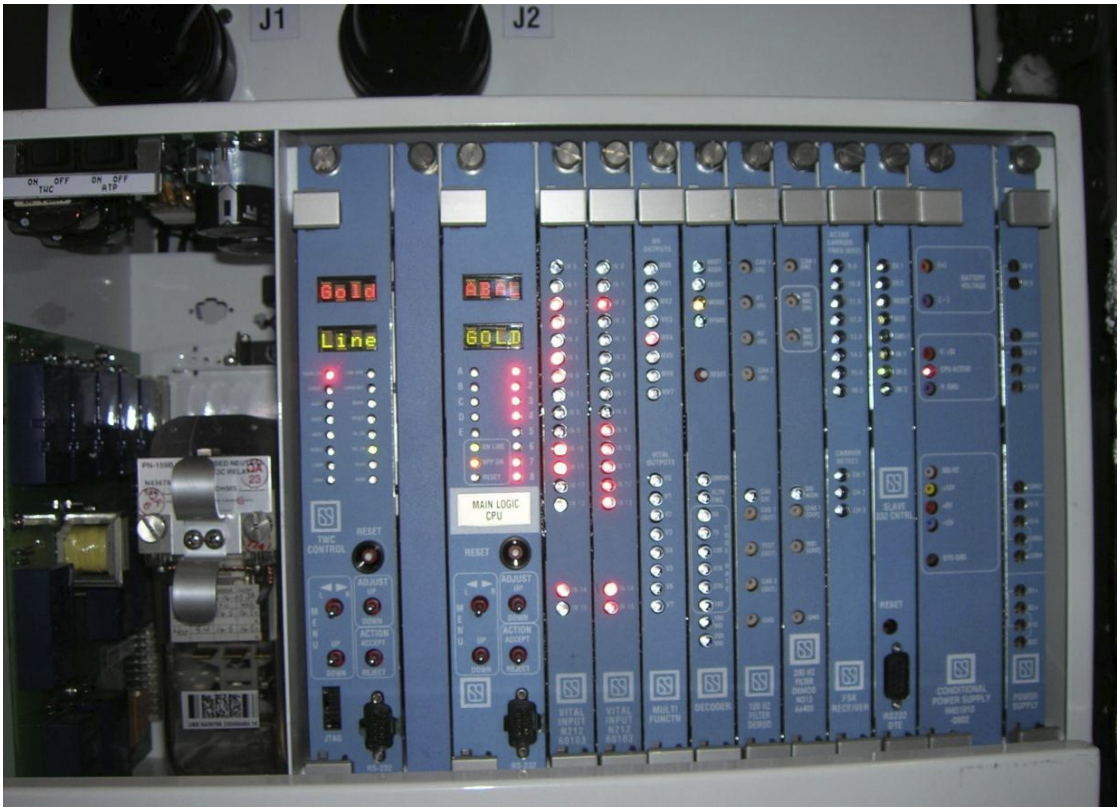


FIG 2 TWC ENCLOSURE & CARDFILE with PCBs

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-16-01-00-00/I-00**

System:	Sheet:
TRAIN-TO-WAYSIDE COMMUNICATION	**5/8**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component:	Man Hours: **0.2**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

INSPECTION (cont'd)

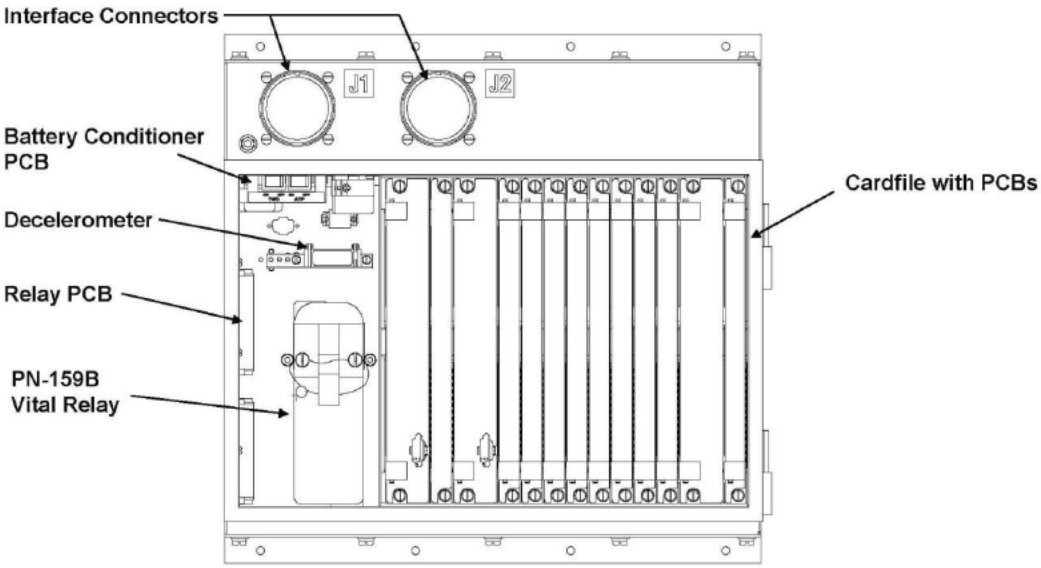


FIG 3 TWC ENCLOSURE & CARDFILE COMPONENTS

7 Insert the Key of Actuator and rotate the

Line Selector Switch

on the Data Download Panel to check proper functioning.

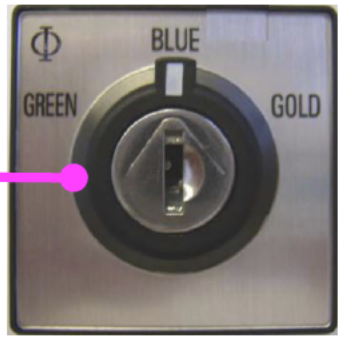


FIG 4 TWC -LINE SELECTOR SWITCH

8 Remove the Key of the Actuator from any of the Positions shown and give it to MTA Project Manager.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-16-01-00-00/I-00**		
System: **TRAIN-TO-WAYSIDE COMMUNICATION**		Sheet: **6/8**
Subsystem/Assy: **TWC SYSTEM**	Unit:	
Component:		Man Hours: **0.2**
Maintenance Task: **INSPECTION**		Interval/Miles: **60,000**

INSPECTION (cont'd)

9 Close the Door Panel of TWC Enclosure and leave the ELE Locker. Close the relevant Door and lock it using the Maintenance Key.

10 Go to A/B Cabs by opening the Cab Door using Maintenance Key.

11 In each Cab:

- Check the TWC Interface Panel for visible damage/missing hardware.
- Clean the TWC Interface Panel using recommended cleaner and lint-free rags

12 Leave the Cab. Close the Cab Door and lock it using Maintenance Key.

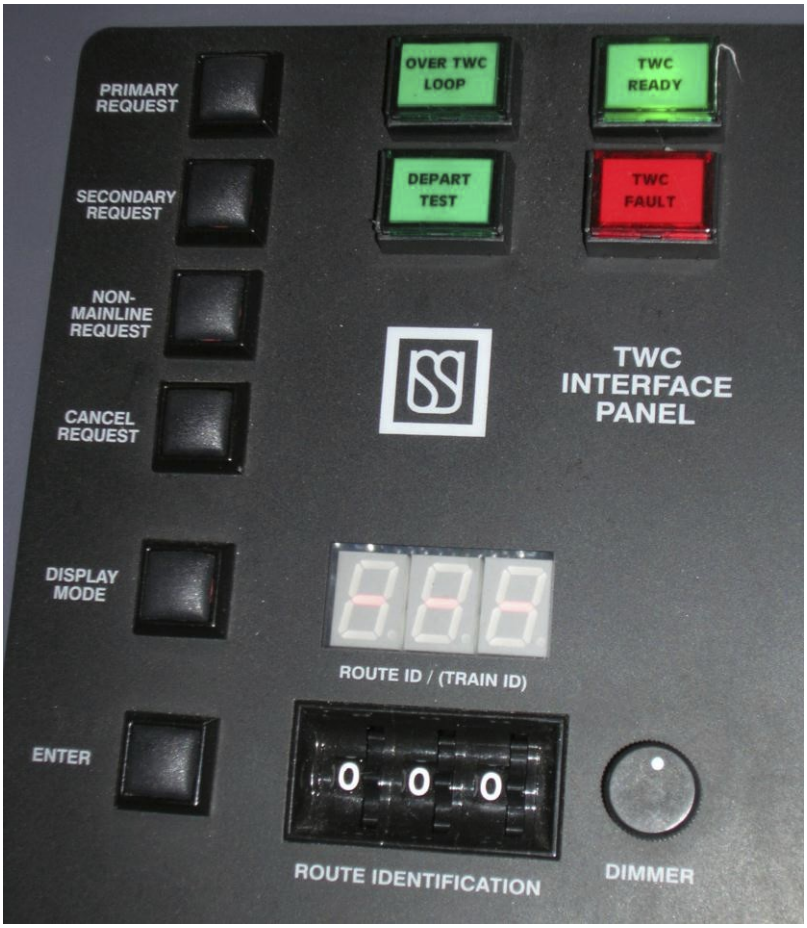


FIG 5 CAB TWC INTERFACE PANEL

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:	**R-P-16-01-00-00/I-00**
System: **TRAIN-TO-WAYSIDE COMMUNICATION**	Sheet: **7/8**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component:	Man Hours: **0.2**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

INSPECTION (cont'd)

13 Go in the Pit, under A/B Truck and locate the TWC Antenna

14 For each TWC Antenna:

- Check the TWC Antenna Cable and Connections for proper installation and safely tightening. Replace as per Check Result according to Sheet R-C-16-01-02-00/R-00.
- Thoroughly clean the TWC Antenna Components with soft bristle brush, air compressed and lint-free rags.

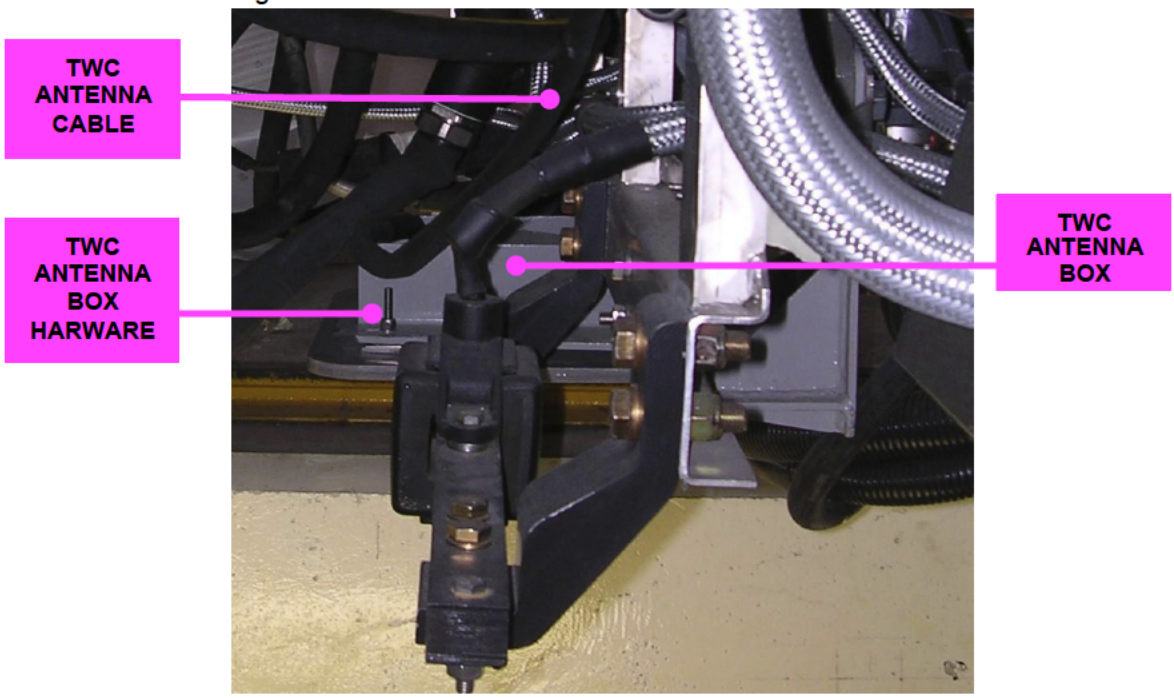


FIG 6 TWC ANTENNA LOCATION

15 Reinstate Electrical Power to TWC System by placing the CB 11F03, located in the "A" LV Locker, to ON position.

16 Record inspection result on the Defect Report Card for administrative and maintenance planning.

NOTE: At Task Completion it is recommended to check the correct operation and/or functions of the Subsystem to which the maintained Equipment pertains.

Refer to **HOW TO USE THE R-PM SHEETS** (para 16-III-03-03-02 of this Section) and follow the prescriptions provided at Step 3 **"At every Task Completion."**

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-16-01-00-00/I-00**		
System: **TRAIN-TO-WAYSIDE COMMUNICATION**		Sheet: **8/8**
Subsystem/Assy: **TWC SYSTEM**	Unit:	
Component:		Man Hours: **0.2**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**	

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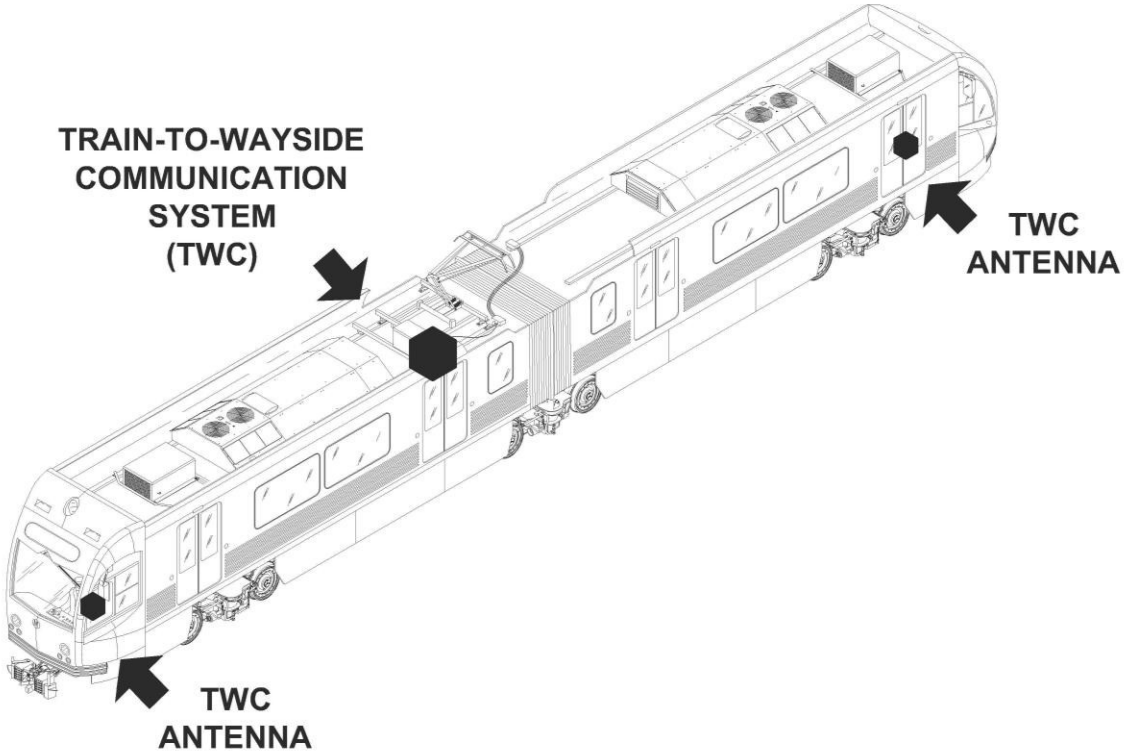
P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-16-01-00-00/I-01

System: **TRAIN-TO-WAYSIDE COMMUNICATION**	Sheet: **1/10**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component:	Man Hours: **0.2**
Maintenance Task: **INSPECTION**	Interval/Miles: **120,000**

LOCATION:



P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-16-01-00-00/I-01**		
System: **TRAIN-TO-WAYSIDE COMMUNICATION**		Sheet: **2/10**
Subsystem/Assy: **TWC SYSTEM**	Unit:	
Component:		Man Hours: **0.2**
Maintenance Task: **INSPECTION**		Interval/Miles: **120,000**

SAFETY PRECAUTIONS:

WARNING: BLUE FLAG THE VEHICLE IN ACCORDANCE WITH ALL LACMTA BLUE FLAG POLICIES, RULES, & PROCEDURES IN ORDER TO WARN THAT MAINTENANCE PERSONNEL ARE WORKING ON, UNDER, OR NEAR ROLLING EQUIPMENT.

WARNING: DISCONNECT THE POWER IF THE SYSTEM WILL BE UNATTENDED. WHILE WORKING ON THE SYSTEM, THE TRAIN COULD UNEXPECTEDLY MOVE, POSSIBLY CAUSING DAMAGE OR INJURY. WARN OTHERS TO STAY CLEAR OF THE TRAIN SINCE IT COULD BECOME ACTIVATED WITHOUT NOTICE.

WARNING: BE CAREFUL TO AVOID PERSONAL INJURY. AVOID DOING ANYTHING THAT COULD PUT ANYONE IN DANGER OF ELECTRICAL SHOCK OR INJURY FROM MOVING EQUIPMENT. EXERCISE EXTREME CAUTION WHEN WORKING AROUND THE SYSTEM WITH THE WIRING AND ELECTRONICS EXPOSED. WARN OTHERS BEFORE LEAVING AN OPEN SYSTEM UNATTENDED.

WARNING: DEPENDING ON THE SEVERITY AND TYPE OF PROBLEM BEING EXPERIENCED, IT MAY BE ADVANTAGEOUS TO DISCONNECT THE ATP/TWC SYSTEM FROM EXTERNAL SYSTEMS SO THAT WORK CAN BE PERFORMED ON THE SYSTEM WITHOUT DANGER.

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit

Soft bristle brush

CONSUMABLES:

Lint-free rags
Compressed air in aerosol can
Cable Certifier (Type LT 8600)

SPARE PARTS:

N/A

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-16-01-00-00/I-01**

System:	Sheet:
TRAIN-TO-WAYSIDE COMMUNICATION	**3/10**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component:	Man Hours: **0.2**
Maintenance Task: **INSPECTION**	Interval/Miles: **120,000**

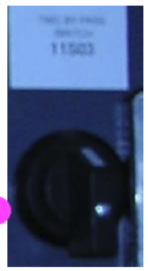
PROCEDURE:

To perform Train-To-Wayside Communication System Inspection Procedure proceed as follows

PRELIMINARY OPERATIONS

1. Set the vehicle in safety condition in accordance with LACMTA Maintenance Shop Regulations.
2. Make sure that the Parking Brake has been applied when the Reverser is in Neutral, and the Wheels chocked.
3. Set the Transfer Switch (located on the Operator's Console) to "OFF" Position.
4. Check that there are in "OFF" position or place accordingly the followings:

- **CB 11F03**, located in the "A" LV Locker,
- **CB 11S03**, located in the "A" Cab By Pass Panel

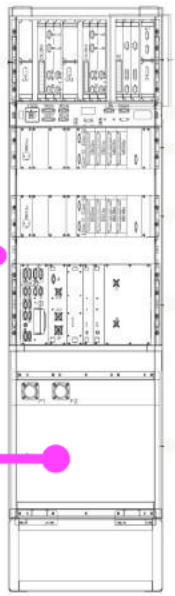


INSPECTION

To perform the Task proceed as follows:

1 Gain access to theTWC Enclosure installed in the (A) ELE Locker, by opening the relevant ELE Locker Door using Maintenance Key.

"A" ELE LOCKER RACK



2 Locate the **TWC Enclosure**

FIG 1 TWC ENCLOSURE LOCATION

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-16-01-00-00/I-01**		
System: **TRAIN-TO-WAYSIDE COMMUNICATION**		Sheet: **4/10**
Subsystem/Assy: **TWC SYSTEM**	Unit:	
Component:		Man Hours: **0.2**
Maintenance Task: **INSPECTION**		Interval/Miles: **120,000**

INSPECTION (cont'd)

3 Open the Door Panel of TWC Enclosure.
4 Check the TWC Components for damage and loosing missing hardware.
5 Check that the Cardfile PC Boards and Interface Connectors are firmly secured on its place.
6 Position the CB 11F03, located in the "A" LV Locker, to ON and check that the Leds of each PCB are GREEN, indicating that the relevant Board works properly. Replace as per Check Result according to Sheet R-C-16-01-01-00/R-00.
7 Reposition the CB 11F03 to OFF.
8 Clean all the Parts with soft bristle brush, air compressed and lint-free rags.

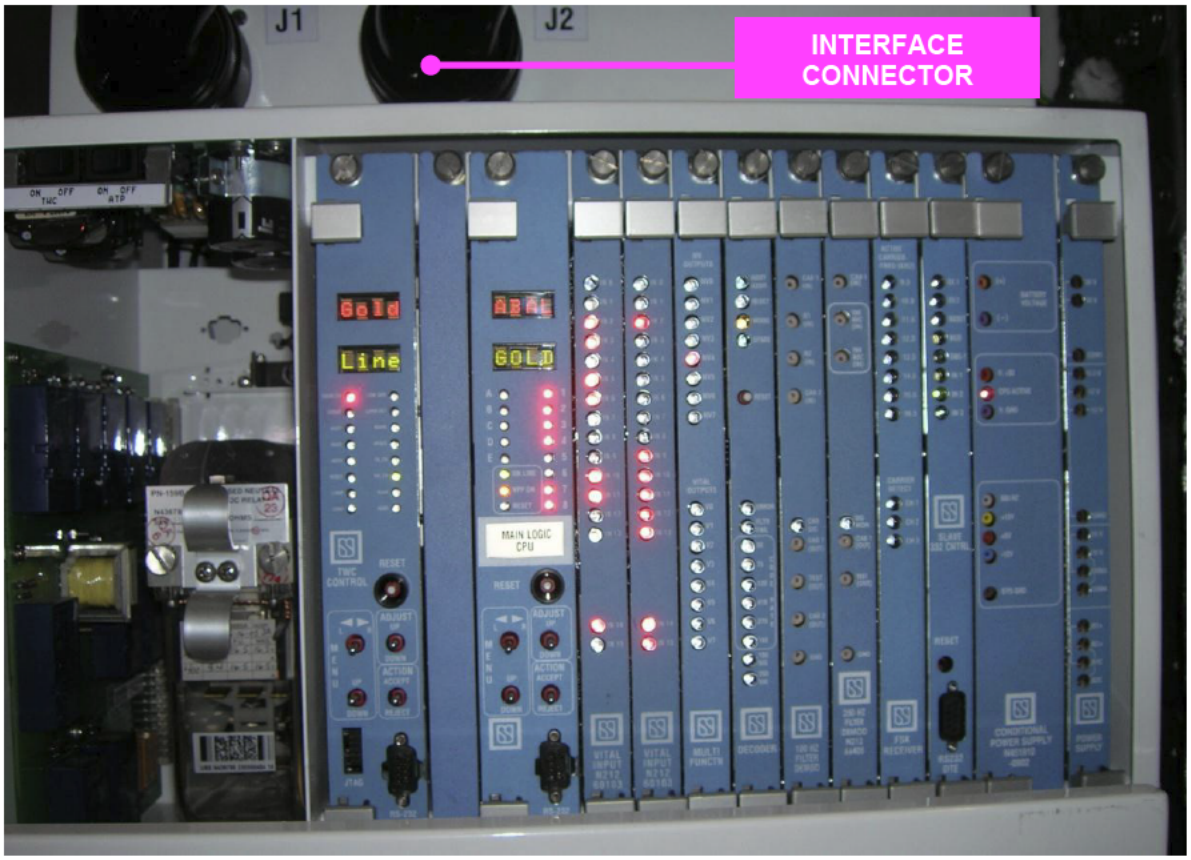


FIG 2 TWC ENCLOSURE & CARDFILE with PCBs

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:	**R-P-16-01-00-00/I-01**
System: **TRAIN-TO-WAYSIDE COMMUNICATION**	Sheet: **5/10**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component:	Man Hours: **0.2**
Maintenance Task: **INSPECTION**	Interval/Miles: **120,000**

INSPECTION (cont'd)

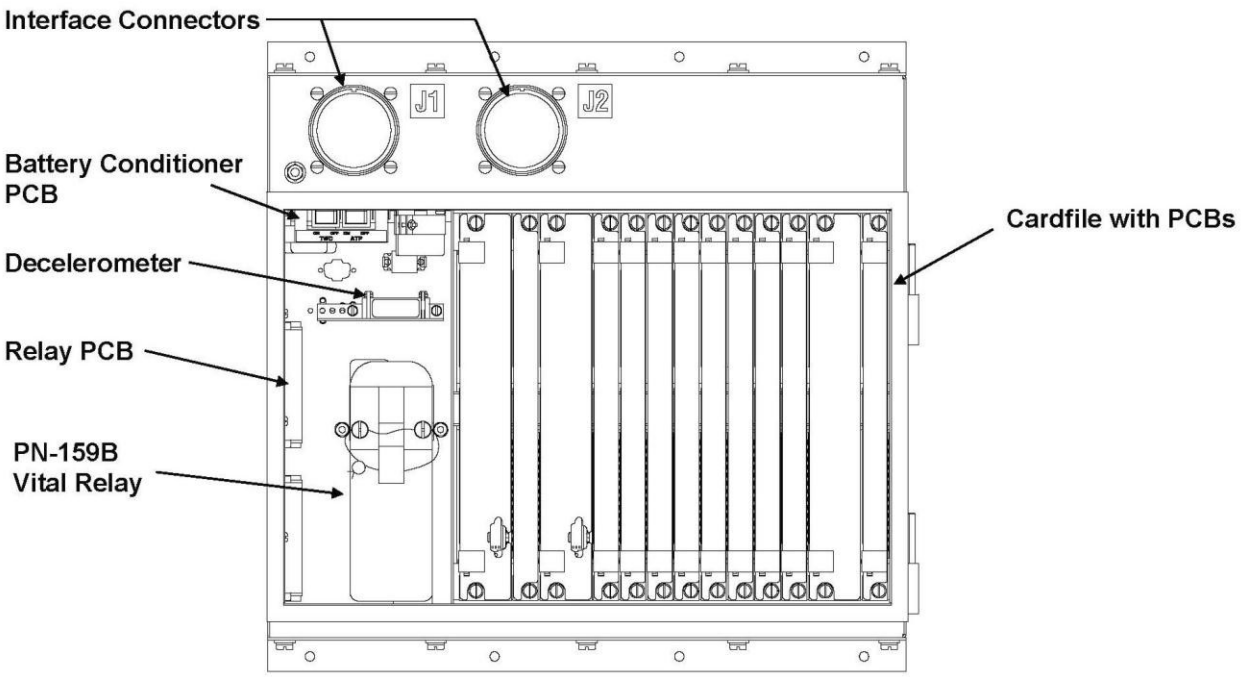


FIG 3 TWC ENCLOSURE & CARDFILE COMPONENTS

9 Close the Door Panel of TWC Enclosure and leave the ELE Locker. Close the relevant Door and lock it by means of the Maintenance Key.

10 Go in the Pit, under A/B Truck and locate the relevant TWC Antenna.

11 Inspect the TWC Antenna as follows:

- Check all cables and connectors for signs of damage and over-heating, tight as needed.
- Thoroughly clean the TWC Antenna Items
- Check the integrity of the Antenna Box Gasket. Replace as needed

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:	**R-P-16-01-00-00/I-01**
System: **TRAIN-TO-WAYSIDE COMMUNICATION**	Sheet: **6/10**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component:	Man Hours: **0.2**
Maintenance Task: **INSPECTION**	Interval/Miles: **120,000**

INSPECTION (cont'd)

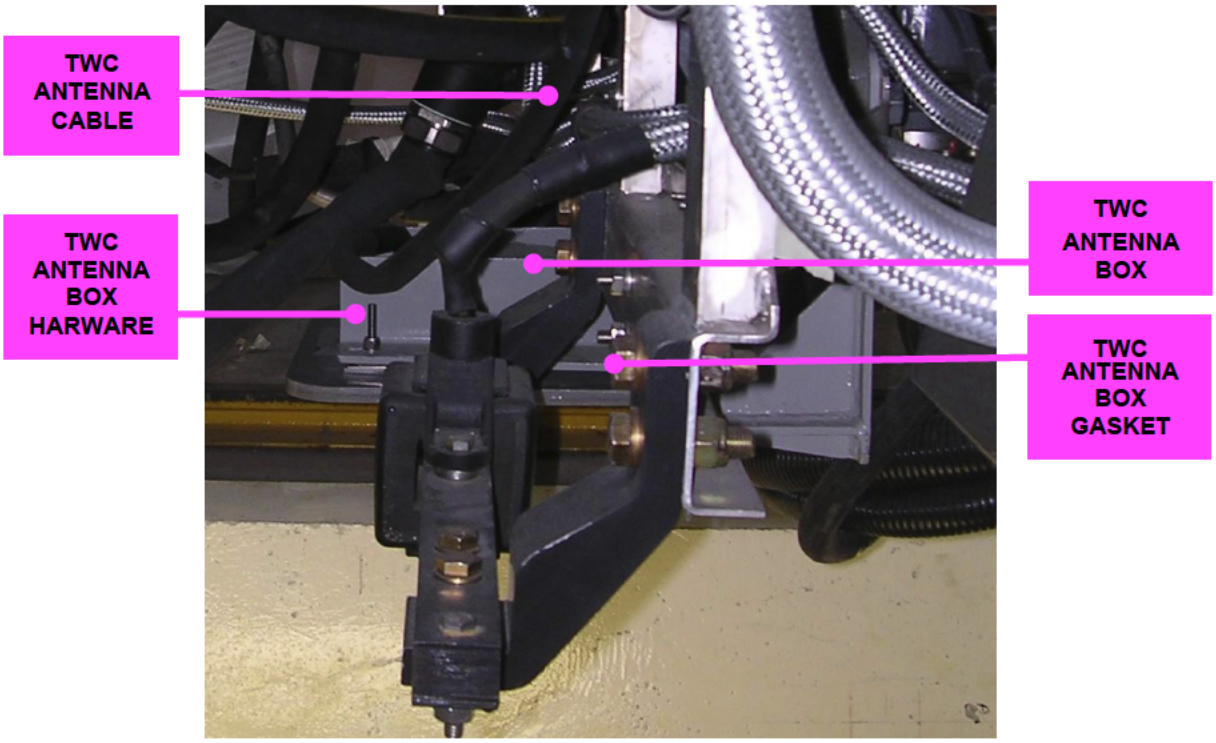


FIG 4 TWC ANTENNA LOCATION

12 Go back inside the Vehicle and position the CB 11F03, located in the "A" LV Locker, to ON.

13 Go in the A Cab by opening the Cab Door using Maintenance Key.

14 Key ON the Vehicle.

15 Check the TWC Interface Panel Indicator Lights by pressing the **Lamp Test Pushbutton (3S04)** located in the Cab Console.
Replace fault Indicator Light(s) as per check result.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-16-01-00-00/I-01

System:
TRAIN-TO-WAYSIDE COMMUNICATION

Sheet:
7/10

Subsystem/Assy:
TWC SYSTEM

Unit:

Component:

Man Hours:
0.2

Maintenance Task:
INSPECTION

Interval/Miles:
120,000

INSPECTION (cont'd)

16 Perform the TWC Departure Test by Pressing the relevant **Depart Test pushbutton** located on the TWC Interface Panel.

INITIAL CONDITIONS

a. The System must be keyed.
b. The LRV must be stopped.
c. The Master Controller must be in a brake position (operator verified).
d. A TWC Lamp Test is not active (operator verified).
e. No crosscheck errors are active.
(Refer to **NOTE** provided in the next page).

TEST SEQUENCE

The test will begin and progress as follows:

a. Press and release the DEPART TEST push button on the TWC Interface Panel to begin testing. The test will progress automatically with each step taking about eight seconds.
b. The TWC will activate and flash the DEPART TEST indicator on the TWC Interface Panel.
c. The TWC will then activate the OVER TWC LOOP indicator.

FIG 5 CAB TWC INTERFACE PANEL

d. The TWC will generate a bit pattern and modulate it relevant to the frequencies and protocol associated with the line selected. The bit stream will be transmitted and coupled from the transmit loop to the receive loop within the currently selected TWC antenna. The data will be processed via the receive channel where it will be demodulated and decoded to produce a matching pattern.
e. The TWC will then select the opposite end TWC antenna, and perform the same bit pattern test, as described in the previous step.
f. The TWC will then activate the TWC READY indicator and indicate a P - - in the ROUTE ID / TRAIN ID window. The test personnel will verify the indications then press and release the PRIMARY REQUEST button. The TWC will verify receipt of the request.
g. The TWC will then indicate a S - - in the ROUTE ID / TRAIN ID window. The test personnel will verify the indication then press and release the SECONDARY REQUEST button. The TWC will verify receipt of the request.
h. The TWC will then indicate a O - - in the ROUTE ID / TRAIN ID window. The test personnel will verify the indication then press and release the NON-MAINLINE REQUEST button. The TWC will verify receipt of the request.
i. The TWC will then indicate a C - - in the ROUTE ID / (TRAIN ID) window. The test personnel will verify the indication then press and release the CANCEL REQUEST button. The TWC will verify receipt of the request.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-16-01-00-00/I-01**	
System: **TRAIN-TO-WAYSIDE COMMUNICATION**	Sheet: **8/10**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component:	Man Hours: **0.2**
Maintenance Task: **INSPECTION**	Interval/Miles: **120,000**

INSPECTION (cont'd)

j. The TWC will then indicate a 555 in the ROUTE ID / TRAIN ID window. The test personnel will verify the indication then set the ROUTE IDENTIFICATION to match and press the ENTER button. The TWC will verify receipt of the ID.

k. The TWC will then activate the TWC FAULT indicator and alarm. The test personnel will verify the indication and alarm activation.

l. The test personnel will acknowledge all observer verifications and terminate the Departure test by setting the route to 000 and pressing and releasing the ENTER button within 15 seconds of the TWC FAULT indication.

m. After completion of the Departure Test, the TWC will de-activate all indications and silence the alarm. The status of the Departure Test is indicated as follows: Departure Test passed - the DEPART TEST indication will be activated solid. Departure Test failed - the DEPART TEST indication will be de-activated

CONFIRMATIONS

The test personnel will confirm operation of the following:

Alarm DEPART TEST Indicator OVER TWC LOOP Indicator TWC READY Indicator
TWC FAULT Indicator ROUTE ID / TRAIN ID Indicator

NOTE

a) The central purpose of this test is to check the ability of the TWC system to properly transmit and receive signals with the configured Wayside, and to test the integrity of the TWC Interface Panel controls..

b) The integrity of TWC Interface Panel indicators is not performed as a part of the TWC Departure Test, but can be tested by pressing the Lamp Test pushbutton on the Operator's Console.

c) The Departure Test is initiated by pressing the DEPART TEST pushbutton on the TWC Interface Panel while the vehicle is stopped.

d) Additionally, the LRV must not be positioned over any TWC wayside loop when operating on the MBL or the PGL.

e) The LRV can be positioned over a TWC wayside loop when operating on the MGL, as communications with the wayside will be suspended during a Departure Test.

f) While the Departure Test is running, the TWC system will flash the DEPART TEST indicator on the Interface Panel.

g) During the Departure Test, the TWC sends a test signal to the currently selected TWC antenna transmit loop and confirms its receipt back through the currently selected receive loop.

h) Once the Departure Test has completed or has been terminated, the TWC will indicate the Test result on the DEPART TEST indicator on the TWC Interface Panel.
The Indicator Light will be:
- steadily lit if the Test successfully completes.
- dark if any part of the Test fails, or the test was terminated

17 Perform the Lamp Test and the Depart Test also from the other Cab Console.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-16-01-00-00/I-01**

System: **TRAIN-TO-WAYSIDE COMMUNICATION**

Sheet: **9/10**

Subsystem/Assy: **TWC SYSTEM**

Unit:

Component:

Man Hours: **0.2**

Maintenance Task: **INSPECTION**

Interval/Miles: **120,000**

INSPECTION (cont'd)

18 As per Test Result perform Troubleshooting with IDU or PTU.
Refer to Part II of this Section, paragraphs 16-II-02.2 and 16-II-02.3 respectively
Figures 6, 7 and 8 provide, respectively:

- the ATP/TWC SYSTEM STATUS SCREEN (Operating Mode
- the ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)
- the PTU & TWC CONNECTIONS

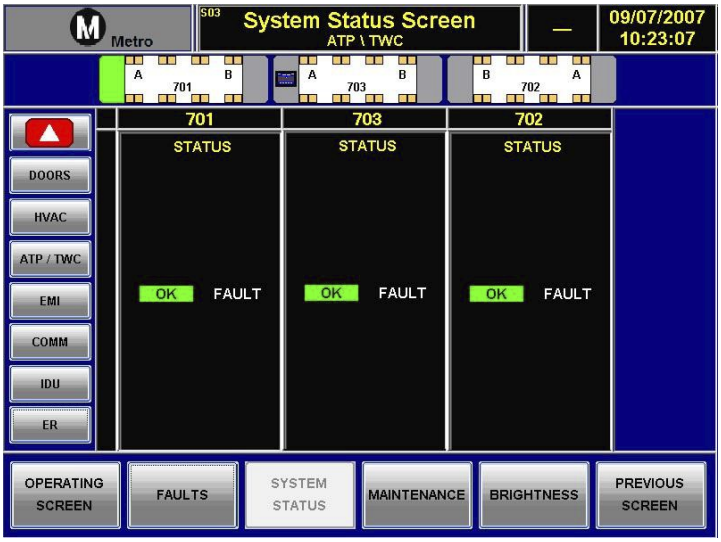


FIG 6 ATP/TWC SYSTEM STATUS SCREEN (Operating Mode)

19 Leave the Cab and close the Cab Door using Maintenance Key.

20 Record inspection result on the Defect Report Card for administrative and maintenance planning.

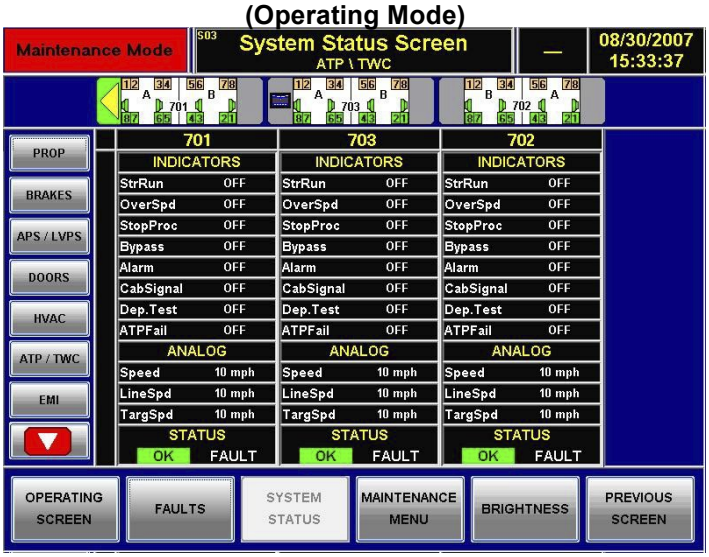


FIG 7 ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:	**R-P-16-01-00-00/I-01**
System: **TRAIN-TO-WAYSIDE COMMUNICATION**	Sheet: **10/10**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component:	Man Hours: **0.2**
Maintenance Task: **INSPECTION**	Interval/Miles: **120,000**

INSPECTION (cont'd)

Fig 8 PTU & TWC CONNECTIONS

16-III-04 RUNNING -CORRECTIVE MAINTENANCE

16-III-04.01 Running -Corrective Maintenance Sheets (R-CMS)

Each R-CMS provides the following data consistent with Corrective Maintenance Analysis (CMA), AB Design Documentation and Vehicle Systems Functional Tree:

- **R-CM Sheet Code**
- **SYSTEM, SUBSYSTEM /ASSEMBLY, UNIT, Component** (Names)
- **SYSTEM, SUBSYSTEM /ASSEMBLY, UNIT, Component** (Location)
- **Maintenance Task,**

  The following definitions are applicable to the R-CM Tasks

Inspection:	Maintenance procedures such as those required to ascertain the serviceability of a Part, Assembly, System or the specific interrelationship of Parts that perform a functional operation.
Leveling:	Procedure to adjust the distance between the Vehicle Floor to the Top Of Rail and the designated Vehicle Height.
Replacement:	Provides the Components / Assemblies and Subassemblies removal & installation in a logical sequential order.
Re-Profiling:	Provides the procedure to maintain the safe and proper "wheel Profile."
Repair:	Provides detailed procedures for the repair of a specific Equipment / Component
Service:	Operation performed to replenish Sand, Windshield Wiper Washer Fluid, HVAC Coolant, Gear and Compressor Oil, and Vehicle Lubrication.

- **Man Hours,** needed to perform the Task
- **SPARE PARTS,** needed to perform the Task

Each R-CMS also provides:

SAFETY PRECAUTIONS, to be followed to safely accomplish the Task

- **TOOLS,** including Special Tools and Test Equipment, needed to accomplish the Task
- **CONSUMABLES,** required to accomplish the Task and consistent with those used by MTA
- **PROCEDURE,** consisting of Preliminary Operations and Procedural Steps, to be followed while performing Maintenance Tasks.
- **Illustrations and Pictures** are inserted in the text to facilitate the understanding of the topics and/or to explain step-by-step procedure**.**

Each R-CM Sheet refers to one Task and consists of several pages where Safety Precautions and Maintenance Instructions to perform safely the Task are provided by Procedural Steps in conjunction with Illustrations and Pictures.

16-III-04.01.01 Running- Corrective Maintenance Sheet (R-CMS) Form

The R-CMS Form (refer to Figure 16-III-04.1) consists of several fields containing the following data/ information:

RUNNING -CORRECTIVE MAINTENANCE SHEET (R-CMS) Form			
ITEM #	**TITLE**	**CONTENT**	**EXPLANATORY NOTES**
1	**Card code**	**Sheet code**	The Sheet Code is an alphanumerical code that identifies each R-CM Sheet. **THE SHEET CODE IS EXPLICIT** The Sheet Code consists of letters **R-C** followed by an 11 digit code number as follows: **R-C-**nn-mm-zz-ww/Y-kk **R = Running** **C= Corrective** **nn** may vary from 02 to 19, identifying the System/ Manual Section number. **mm-zz-ww** each one may vary from 00 to 99, according to AB System Functional Tree, allowing the identification of the Assembly/Unit/Component **Y** Maintenance Task Code. It may be one of the following: **I =** **I**nspection **LL =L**eveling **R =** **R**eplacement **RP=** **R**e-**P**rofiling **RR** = **R**epair **S** = **S**ervice **SP** = **S**afety **P**recautions **kk** It may vary from 00 to 99. It is a progressive number allowing the explicit identification of R-CMS **NOTE:** The code R-C-nn-00-00-00-R-kk identifies a Typical Replacement Procedure The Typical Replacement Procedure is provided for the following items: Board, Circuit Breaker, Diode, Indicator Lamp, Main Contactor, Switch & Relays.
2	**System**	**System name**	This field indicates the System to which the Assembly/Unit/Component belongs.
3	**Subsystem/ Assembly**	**Subsystem/ Assembly name**	This field indicates the Subsystem/Assembly to which the Unit/Component belongs.
4	**Unit**	**Unit name**	This field indicates the Unit to which the Component belongs.
5	**Component**	**Component name**	This field indicates the Component the Maintenance Task is referring to
6	**Maintenance Task**	**Maintenance Task name**	This field indicates the Maintenance Task to be performed.
7	**Man Hours**	**Number**	The Man Hour field indicates the time needed to perform the corresponding Maintenance Task. with the basic assumption that the Vehicle is staged on an Inspection Pit/Jacking tracks with the required Consumables, Tools and Materials available.

RUNNING -CORRECTIVE MAINTENANCE SHEET (R-CMS) Form (cont'd)			
ITEM #	**TITLE**	**CONTENT**	**EXPLANATORY NOTES**
8	**Sheet**	**Pages numbering**	This field indicates the progressive R-CMS sheet page number.
9	**LOCATION**	**Illustration**	This field indicates the On Board Location of the Equipment to be maintained The following Graphic Symbols are used for: Assembly/Unit/Component • for System/Subsystem/Vehicle as a Whole ▭
10	**R**	**Letter**	This field indicates that the Sheet pertains to Running Maintenance
11	**C**	**Letter**	This field indicates that the Sheet pertains to Corrective Maintenance
12	**nn**	**Number**	This field indicates the System/Manual Section number to which the Sheet pertains. It may vary from 01 to 19
13	**rr**	**Number**	This field indicates the Sheet Revision number
14	**Page ##**	**Page ##**	This field indicates the RMSM Section Page number
15	**-#**	**Number**	This field indicates the RMSM Section Revision number
16	**SAFETY PRECAUTIONS**	**Text**	This field presents the General and/or specific Safety Precautions to be followed to accomplish safely the relevant Maintenance Tasks.
17	**TOOLS**	**Text**	This field lists the description and the P/N of the Standard tools, Special Tools and Test Equipment needed to accomplish the Maintenance Task. Refer to the TTE Manual for the TE and Special Tools detailed descriptions and tools maintenance.
18	**CONSUMABLES**	**Text**	This field lists the Consumables Materials (consistent with those used by MTA with the related P/N.) needed to accomplish the Maintenance Task. Cleaning agents are included
19	**SPARE PARTS**	**Text**	This field lists the Description and PN of Spare Parts (consistent with Illustrated Parts Catalog) needed to accomplish the Maintenance Task.
20	**PROCEDURE**	**Text**	The Procedure field provides Preliminary Operations and Procedural step by step Instructions to be followed while performing the Maintenance Task. Illustrations and Pictures are inserted in the text to facilitate the understanding of the topics and/or to explain step-by-step procedure.

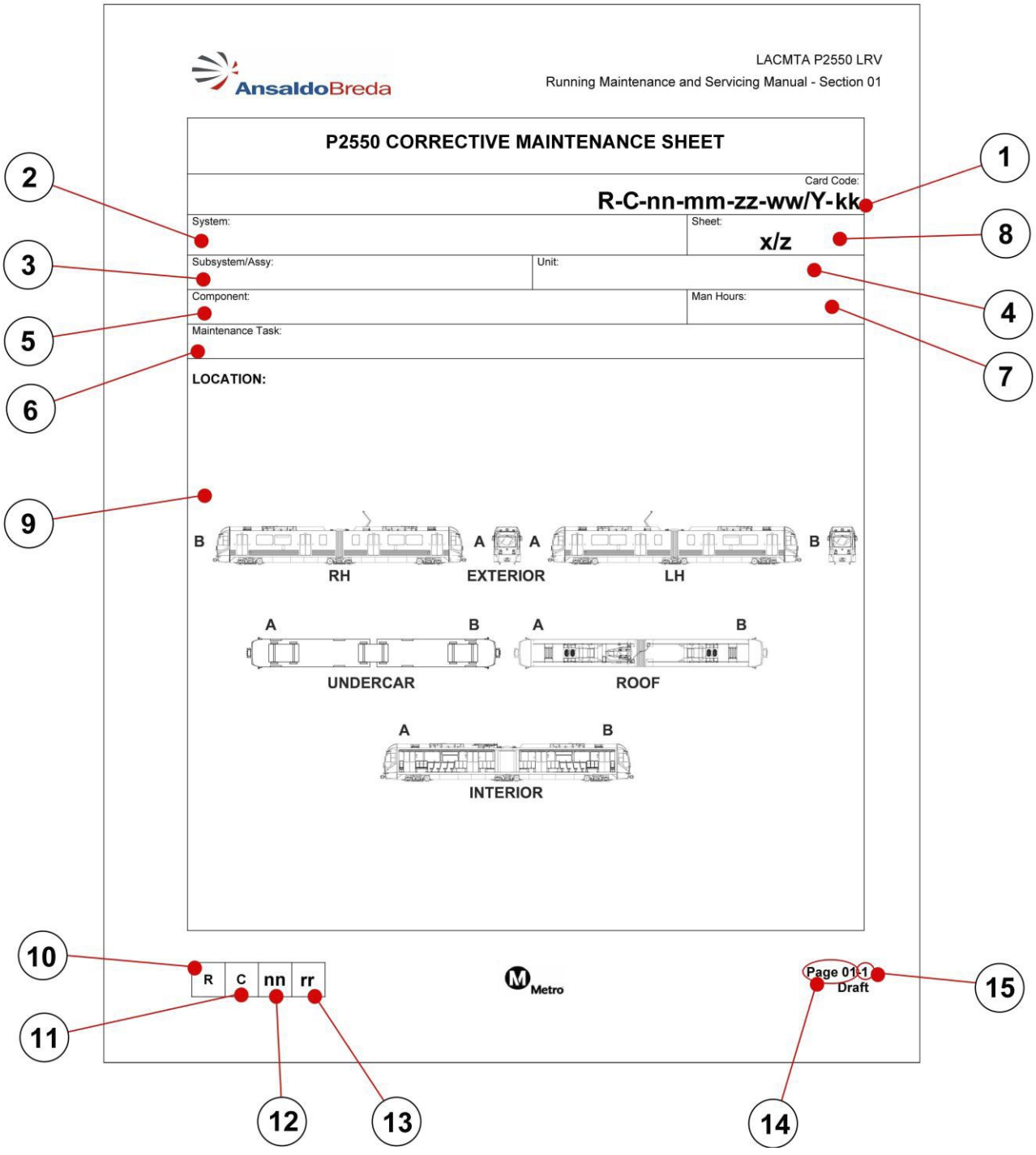


Figure 16-III-04.1 R-CMS Form
(Sheet 1 of 2)

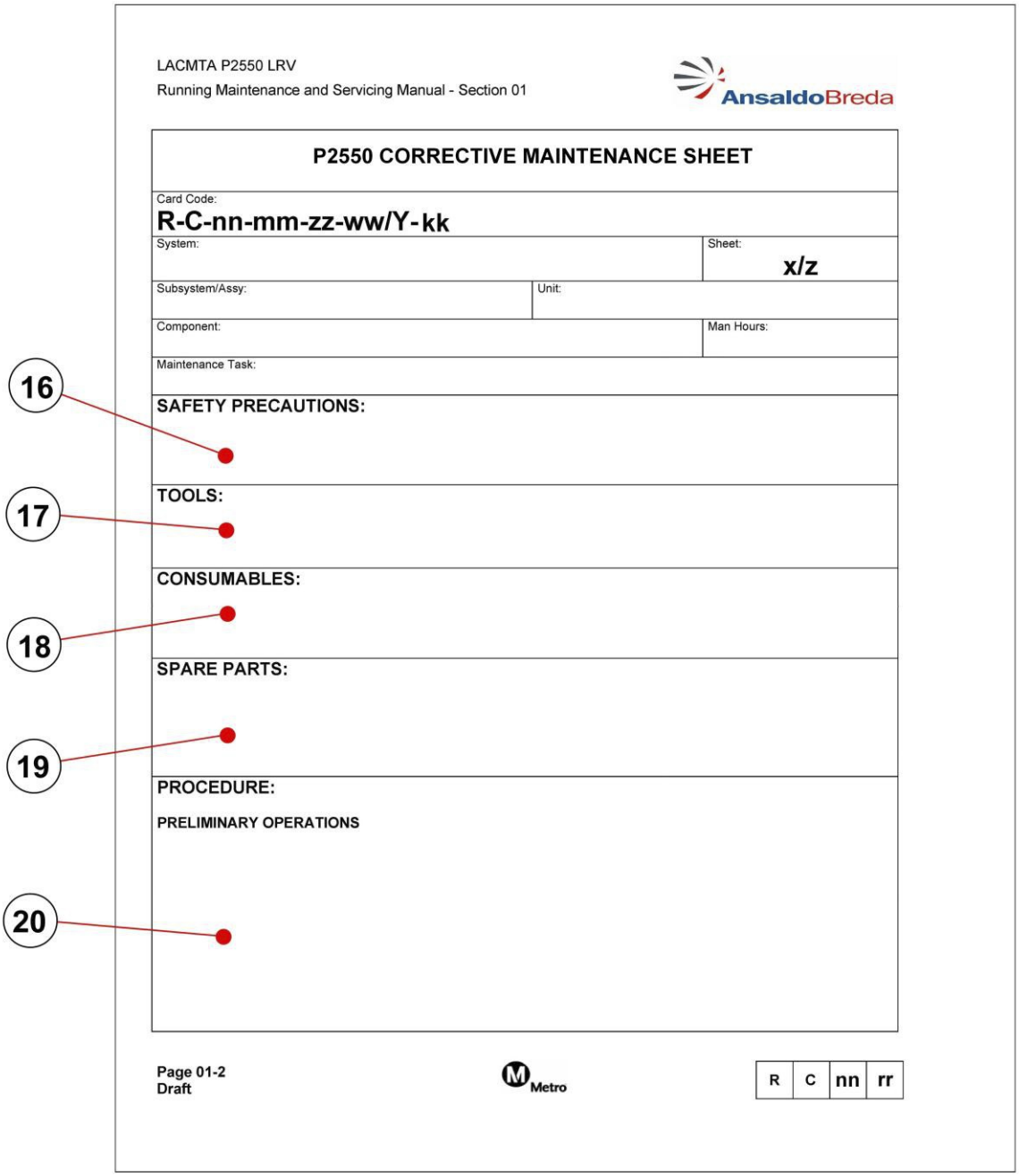


Figure 16-III-04.1 R-CMS Form
(Sheet 2 of 2)

16-III-04.01.02 How to Use the R-CM Sheets

To optimize the job organization it is suggested to proceed as follows:

1. Before Task Execution

a) Carefully read the sheets to ensure that you fully understand all safety precautions, preliminary conditions required, warnings, notes & procedures that will be followed.

b) Particularly read:

- The Safety Precautions to perform safely the Task
- The Preliminary Operations to set the Vehicle in safety conditions according to MTA Maintenance Shop Regulations
- The Tools, Consumables and Spare Parts listed in each Sheet that are needed to accomplish the Task and to have all of them available next the location of the Equipment to be maintained before starting the activities.

2. During Task Execution

a) Follow accurately the prescribed Safety Precautions and Maintenance Procedural Steps.

b) Note any Areas/Items of the Assembly/Unit/Component under Corrective Maintenance Process requiring further Corrective Maintenance.

c) Gather as much information about the Equipment as is practical.

(i e knowledge about the malfunction in terms of correctly operating and incorrectly operating equipment processes) to increase your equipment knowledge.

3. At every Task Completion

a) Carefully follow the prescribed Safety Precautions before restoring the Electrical Power to Vehicle.

b) Check the correct operation and/or functions of the Subsystem to which the maintained Equipment pertains.

c) It is suggested to perform this check on the IDU “A “as follows:

NOTE: Through the IDU you can check if all Systems are exchanging data by MVB or LonWorks Bus and the Trainlines Status.
The IDU Display also shows in real time the Status of all Vehicle Systems.
Reading the IDU Fault List it is possible to immediately detect a fault.
Using the IDU in the Operating Mode the Fault Indications are generic.
Using the IDU in Maintenance Mode the same Fault has a detailed description.

For more in depth troubleshooting use the PTU connected to the relevant system that requires further troubleshooting.

1. On IDU "A" access to the Maintenance Menu first and then to the "Faults" Screen by selecting, in sequence, the relevant icons.
2. Check, On IDU "A" through the list of the Current Active Faults shown in the "Faults" Screen, for Fault Codes related to the Subsystem to which the maintained Equipment pertains.

   Refer to Section 18 of RMSM for Fault Signals Details.
3. As per "Fault" Codes check results proceed as follows:

- **No Faults are listed in the "Faults" Screen**
  a) Key OFF the Vehicle.
  b) Record Service and Test results on the Defect Report Card for administrative and maintenance planning.

- **Fault Codes are listed in the "Faults" Screen**
  a) Investigate/troubleshoot the Equipment previously maintained first and then the System/Subsystem/Assembly/Unit for Fault Probable Causes.
  b) Gather as much information about the failure symptoms as is practical.
  Refer to Section 18 of RMSM for Fault Signals Details.
  c) Try to identify the malfunction in terms of correctly operating and incorrectly operating equipment processes.
  d) Identify which equipment signals or parameters will best help you to localize the failure.
  e) Identify the source of the problem.
  f) Repair or replace the defective component.
  g) Verify that the repair is effective in eliminating all of the failure symptoms.
  h) Evaluate whether or not the defective component was the root cause of the failure.
  i) Once the Fault Codes are not found in the "Faults" Screen perform steps from 3-a through 3-b (previous subparagraph **"No Faults are listed in the "Faults" Screen).**

16-III-04.01.03 Running- Corrective Maintenance Sheet (R-CMS) List

The Train-To-Wayside Communication Running- Corrective Maintenance Sheets (R-CMS) List is provided in the following Table 16-III-04.1.

The R-CM Sheets are listed by Subsystem / Assembly / Unit / Component and sequenced by Sheet Codes and Tasks to be performed.

Table 16-III-04.1 Running Corrective Maintenance Sheets List

SYSTEM 16 TRAIN TO WAYSIDE COMMUNICATION				
SUBSYSTEM / ASSY	**UNIT**	**COMPONENT**	**TASK**	**SHEET CODE**
TWC SYSTEM		TWC BOARDS	REPLACEMENT	R-C-16-01-01-00/R-00
		TWC ANTENNA	REPLACEMENT	R-C-16-01-02-00/R-00

16-III-04.01.04 Running- Corrective Maintenance Sheets (R-CMS)

TRAIN-TO-WAYSIDE COMMUNICATION

Running - Corrective Maintenance Sheets

R-CMS

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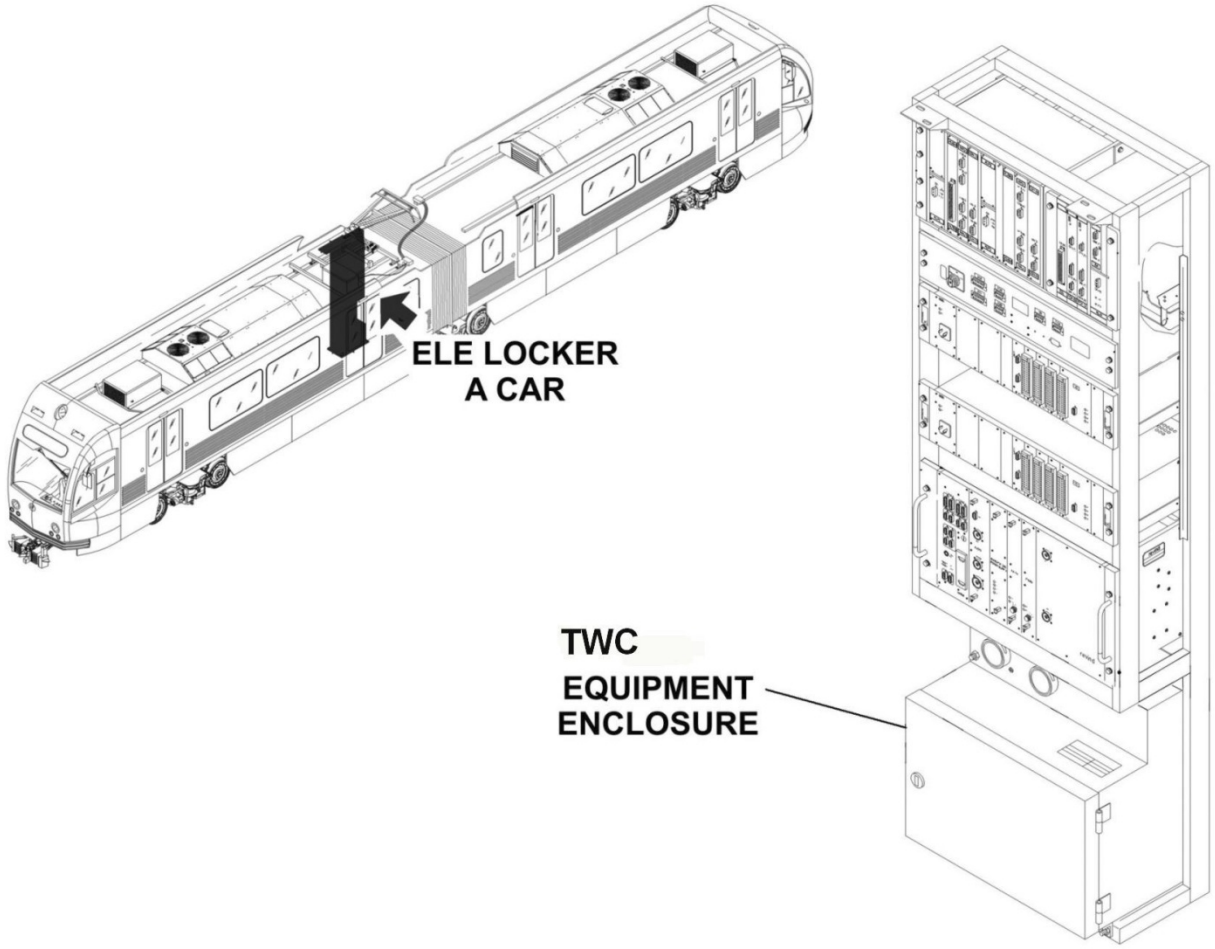
P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-16-01-01-00/R-00

System:	Sheet:
TRAIN-TO-WAYSIDE COMMUNICATION	**1/12**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component: **TWC BOARDS**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

LOCATION:



P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-16-01-01-00/R-00

System:
TRAIN-TO-WAYSIDE COMMUNICATION

Sheet:
2/12

Subsystem/Assy:
TWC SYSTEM

Unit:

Component:
TWC BOARDS

Man Hours:
1.00

Maintenance Task:
REPLACEMENT

SAFETY PRECAUTIONS

WARNING: BLUE FLAG THE VEHICLE IN ACCORDANCE WITH ALL LACMTA BLUE FLAG POLICIES, RULES, & PROCEDURES IN ORDER TO WARN THAT MAINTENANCE PERSONNEL ARE WORKING ON, UNDER, OR NEAR ROLLING EQUIPMENT.

WARNING: DISCONNECT THE POWER IF THE SYSTEM WILL BE UNATTENDED. WHILE WORKING ON THE SYSTEM, THE TRAIN COULD UNEXPECTEDLY MOVE, POSSIBLY CAUSING DAMAGE OR INJURY. WARN OTHERS TO STAY CLEAR OF THE TRAIN SINCE IT COULD BECOME ACTIVATED WITHOUT NOTICE.

WARNING: BE CAREFUL TO AVOID PERSONAL INJURY. AVOID DOING ANYTHING THAT COULD PUT ANYONE IN DANGER OF ELECTRICAL SHOCK OR INJURY FROM MOVING EQUIPMENT. EXERCISE EXTREME CAUTION WHEN WORKING AROUND THE SYSTEM WITH THE WIRING AND ELECTRONICS EXPOSED. WARN OTHERS BEFORE LEAVING AN OPEN SYSTEM UNATTENDED.

WARNING: DEPENDING ON THE SEVERITY AND TYPE OF PROBLEM BEING EXPERIENCED, IT MAY BE ADVANTAGEOUS TO DISCONNECT THE ATP/TWC SYSTEM FROM EXTERNAL SYSTEMS SO THAT WORK CAN BE PERFORMED ON THE SYSTEM WITHOUT DANGER.

TOOLS:

Lacmta Maintenance Shop Standard Tools Kit

CONSUMABLES:

Lint-free rags

Compressed air in aerosol can

SPARE PARTS:

Battery Conditioner Pcb	P/N	N2106801
Power Supply Pcb	P/N	N2127202
Relay Pcb	P/N	N21213301
TWC Control Pcb	P/N	N25560702

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-16-01-01-00/R-00

System:	Sheet:
TRAIN-TO-WAYSIDE COMMUNICATION	**3/12**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component: **TWC BOARDS**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

PRELIMINARY OPERATIONS

1. Place the Vehicle over the Pit.
2. Set Master Controller handle to FSB.
3. Set Reverser switch to NEUTRAL.
4. Make sure that all Parking Brakes are applied.
5. Turn Transfer Switch OFF.
6. Set the following Circuit Breakers to "OFF" position.

- **CB 11F03**, located in the “A“ LV Locker,
- **CB 11S03**, located in the “A“ Cab By Pass Panel

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-16-01-01-00/R-00

System:	Sheet:
TRAIN-TO-WAYSIDE COMMUNICATION	**4/12**

Subsystem/Assy:	Unit:
TWC SYSTEM	

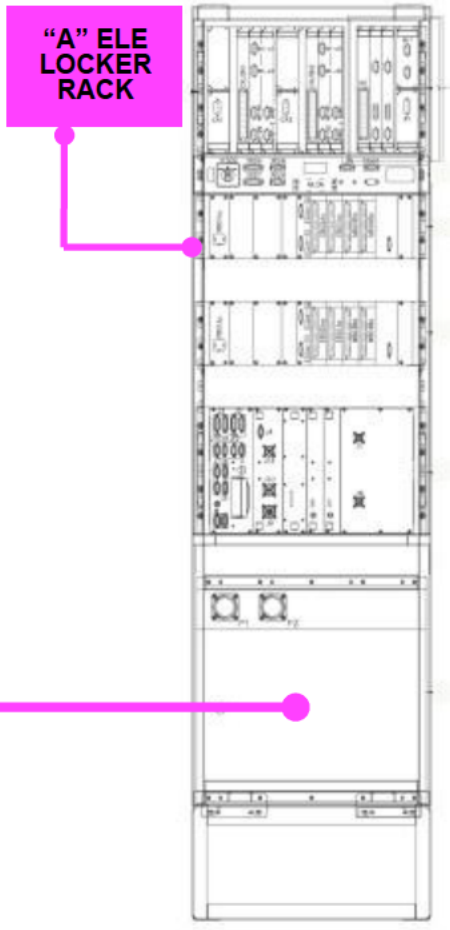
Component:	Man Hours:
TWC BOARDS	**1.00**

Maintenance Task:
REPLACEMENT

PROCEDURE:
REMOVAL

To perform the Task proceed as follows:

1. Gain access to theTWC Enclosure installed in the (A) ELE Locker, by opening the relevant ELE Locker Door using Maintenance Key.



2. Locate the **TWC Enclosure**

FIG 1 TWC ENCLOSURE LOCATION

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-16-01-01-00/R-00

System:	Sheet:
TRAIN-TO-WAYSIDE COMMUNICATION	**5/12**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component: **TWC BOARDS**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

REMOVAL (cont'd)

3. Open the Door Panel of TWC Enclosure.
4. Locate the TWC PCB to be replaced.
5. To remove the **POWER SUPPLY PCB** and/or **TWC CONTROL PCB** proceed as follows:
   a) Using a large-blade screwdriver, loosen the Top and Bottom PCB Retaining Screws.
   b) Using the Upper and Lower PCB Ejector Tabs, press the Tabs outward until the PCB unplugs from the Cardfile backplane Connectors.
   c) Withdraw the PCB straight out from the Cardfile Guides and remove the PCB. to be replaced.

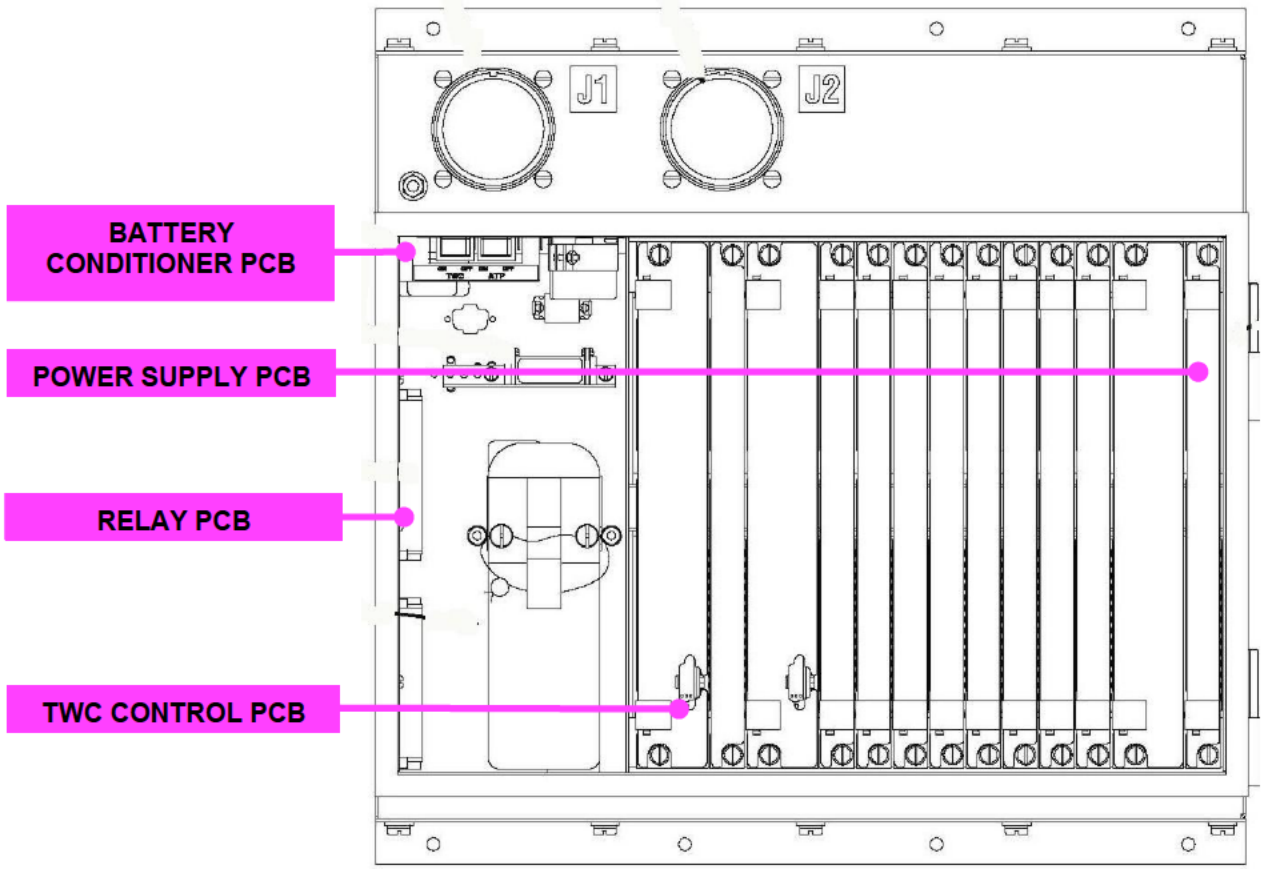


FIG 2 TWC PCBs LOCATION

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-16-01-01-00/R-00

System:
TRAIN-TO-WAYSIDE COMMUNICATION

Sheet:
6/12

Subsystem/Assy:
TWC SYSTEM

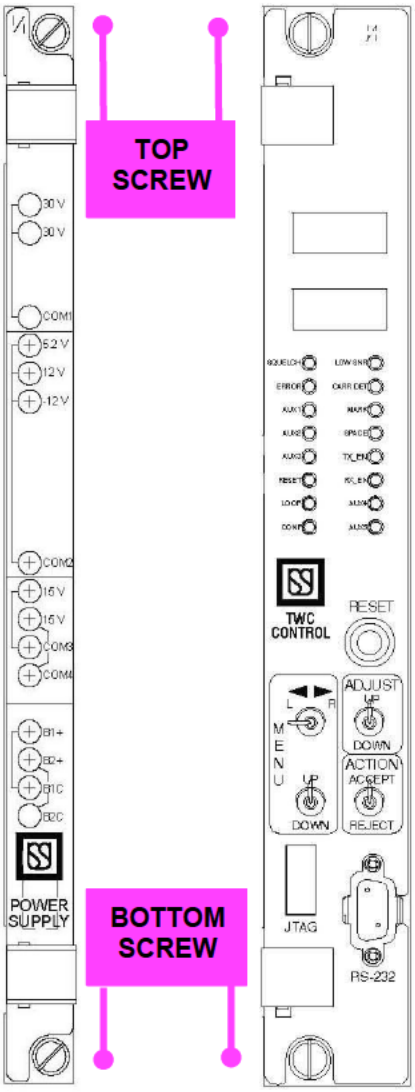
Unit:

Component:
TWC BOARDS

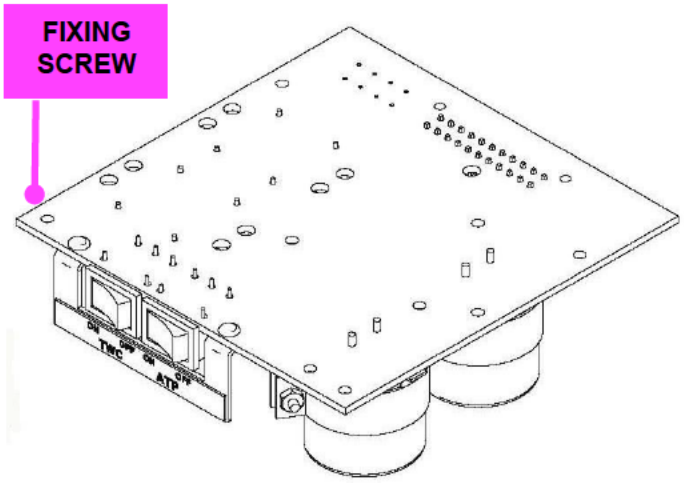
Man Hours:
1.00

Maintenance Task:
REPLACEMENT

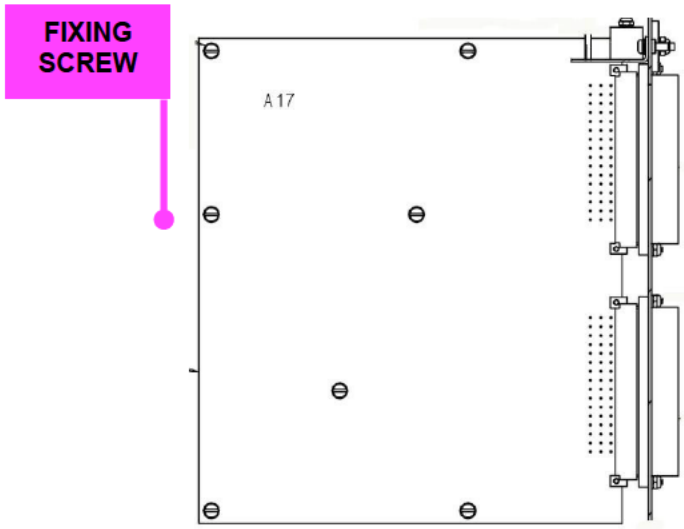
PROCEDURE:
REMOVAL (cont'd)



POWER SUPPLY PCB TWC CONTROL PCB



BATTERY CONDITIONER PCB



RELAY PCB

FIG 3 TWC PCBs FIXING HARDWARE

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-16-01-01-00/R-00

System:	Sheet:
TRAIN-TO-WAYSIDE COMMUNICATION	**7/12**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component: **TWC BOARDS**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

REMOVAL (cont'd)

6. To remove the **BATTERY CONDITIONER PCB** and/or **RELAY PCB** proceed as follows:
   a) Using a small-blade screwdriver, loosen the relevant PCB Retaining Screws.
   b) Remove the 6-32x5/16 Pan-Head Screws, Lock Washers and Plate Washers securing the PCB to the Enclosure.
   c) Gently unplug the PCB from the Enclosure wiring receptacle then remove the PCB from the Enclosure.
   d) Make sure this board has the proper software version updated.

INSTALLATION

To perform the Task proceed as follows:

1. Be sure that any Jumper settings are correct for the TWC PCB to be installed.
2. Verify that the TWC Power Supply CB 11F03, located in the "A" LV Locker, is in OFF position. Set it accordingly.
3. To install the **POWER SUPPLY PCB** and / or **TWC CONTROL PCB** proceed as follows:
   a) Install the "new" TWC PCB in the PCB Guides of the assigned Slot position.
   b) Slide the TWC PCB into the Cardfile and press the PCB front plate firmly to seat the PCB into the Cardfile relevant Slot Connectors.
   c) Tighten the Top and Bottom PCB Retaining Screws using a large-blade screwdriver.
4. To install the **BATTERY CONDITIONER PCB** and / or **RELAY PCB** proceed as follows:
   a) Align the PCB wiring connectors with the Enclosure wiring receptacles, then gently press the PCB into the receptacles until the wiring connectors mate fully.
   b) Insert the PCB 6-32x5/16 fixing pan-head screws, lock washers and plate washer.
   c) Tighten the screws to Secure the PCB to the Enclosure using the a small-blade screwdriver.

FINAL OPERATIONS

1. Reinstate Electrical Power to the TWC by switching ON the CB 11F03, located in the "A" LV Locker.
2. Check that the LEDs of the "new" PCB are GREEN, indicating that the Board works properly.
3. Check that all the other LEDs of the Cardfile PCBs are GREEN, indicating that the each Board works properly.
4. Close and lock the Door Panel of TWC Enclosure.
5. Close and lock the ELE Locker Door. using Maintenance key.

6. Go in the “A “ Cab by opening the Cab Door using Maintenance Key.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-16-01-01-00/R-00

System:	Sheet:
TRAIN-TO-WAYSIDE COMMUNICATION	**8/12**

Subsystem/Assy:	Unit:
TWC SYSTEM	

Component:	Man Hours:
TWC BOARDS	**1.00**

Maintenance Task:
REPLACEMENT

PROCEDURE:
FINAL OPERATIONS (cont'd)

7. Key ON the Vehicle
8. Check the TWC Interface Panel Indicator Lights by pressing the

   Lamp Test Pushbutton (3S04)

   located in the Cab Console.
   Replace fault Indicator Light(s) as per check result.

9. Perform the TWC Departure Test by Pressing the relevant

   Depart Test pushbutton

   located on the TWC Interface Panel.

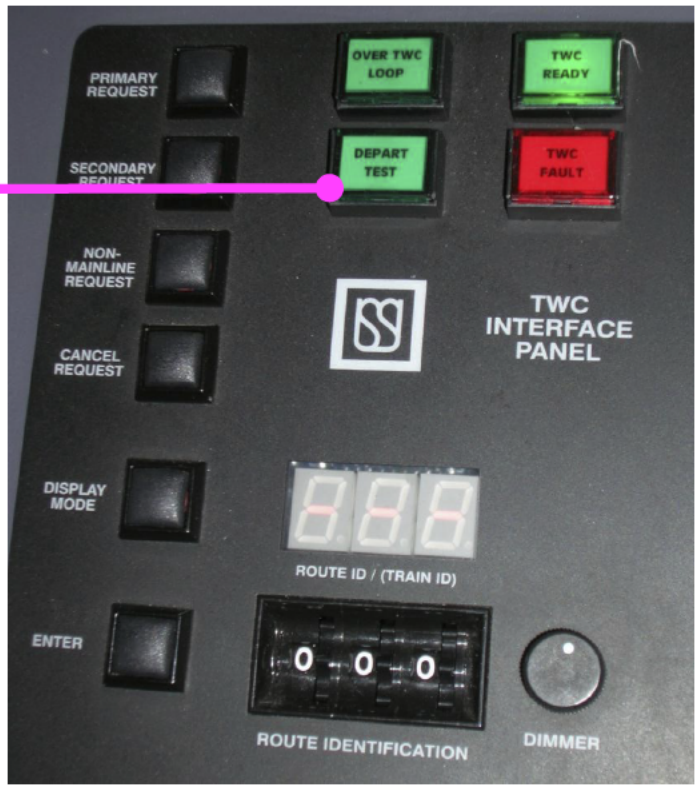


FIG 4 CAB TWC INTERFACE PANEL

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-16-01-01-00/R-00**

System:	Sheet:
TRAIN-TO-WAYSIDE COMMUNICATION	**9/12**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component: **TWC BOARDS**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

PROCEDURE: FINAL OPERATIONS (cont'd)

NOTE

a) The central purpose of the Departure Test is to check the ability of the TWC system to properly transmit and receive signals with the MGL Wayside.

The Departure Test can run only if the Vehicle is stopped and positioned completely within a TWC

b) Equipped Track Circuit (both A-end and B-end Antennas positioned over Loops).

c) The Departure Test will terminate if Vehicle Motion is detected while the Test is in progress

d) While the Departure Test is running, the TWC System will flash the DEPART TEST Indicator Light

e) When the Departure Test has completed, the TWC will indicate the PASS/FAIL Status of the Test.

f) Once activated, the Departure Test suspends transmission of the periodic poll message to the Wayside. It then checks the System for the existence of any crosscheck errors.

g) If any crosscheck error exists, the Departure Test fails.

h) The TWC system will then transmit a single poll message to the Wayside requesting it to go into continuous communication mode for two (2) seconds.

i) The Departure Test fails if the TWC does not see the Wayside respond in Continuous Communication Mode.

j) If successful, the Antenna selection is switched to the opposite end Antenna and the Continuous Mode request is once again made to the Wayside.

k) The Departure Test fails if the TWC does not see the Wayside respond in Continuous Communication Mode. If successful, the Test completes

Once the Departure Test has completed or has been terminated, the TWC will indicate the Test result on the DEPART TEST indicator on the TWC Interface Panel.

l) The Indicator Light will be:

- steadily lit if the Test successfully completes.
- dark if any part of the Test fails, or the test was terminated

10. Repeat steps 7 through 9 in the "B" Cab

11. As per Test Result perform Troubleshooting with IDU or PTU.

Refer to Part II of this Section, paragraphs 16-II-02.2 and 16-II-02.3 respectively

Next Figures 5, 6 and 7 provide, respectively:

- the ATP/TWC SYSTEM STATUS SCREEN (Operating Mode
- the ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)
- the PTU & TWC CONNECTIONS

12. Leave the Cab and close the Cab Door using Maintenance Key

13. Record inspection result on the Defect Report Card for administrative and maintenance planning.

NOTE: At Task Completion it is recommended to check the correct operation and/or functions of the Subsystem to which the maintained Equipment pertains.

Refer to **HOW TO USE THE R-CM SHEETS** (para 16-III-04-01-02 of this Section) and follow the prescriptions provided at Step 3 **"At every Task Completion."**

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-16-01-01-00/R-00

System:
TRAIN-TO-WAYSIDE COMMUNICATION

Sheet:
10/12

Subsystem/Assy:
TWC SYSTEM

Unit:

Component:
TWC BOARDS

Man Hours:
1.00

Maintenance Task:
REPLACEMENT

PROCEDURE: INSTALLATION (cont'd)

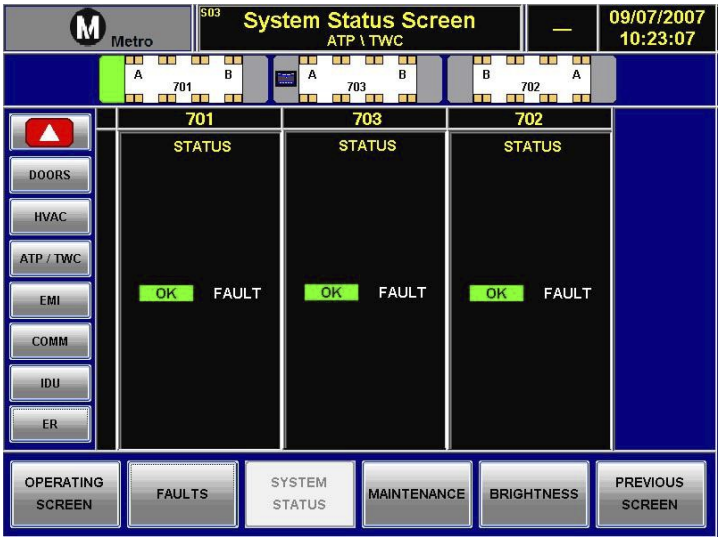


FIG 5 ATP/TWC SYSTEM STATUS SCREEN (Operating Mode)

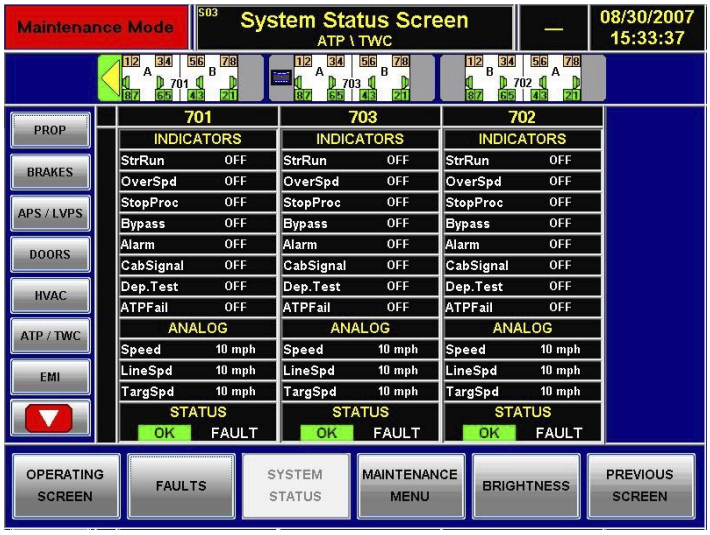


FIG 6 ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-16-01-01-00/R-00

System:	Sheet:
TRAIN-TO-WAYSIDE COMMUNICATION	**11/12**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component: **TWC BOARDS**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:
INSTALLATION (cont'd)

Fig 7 PTU & TWC CONNECTIONS

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-16-01-01-00/R-00**		
System: **TRAIN-TO-WAYSIDE COMMUNICATION**		Sheet: **12/12**
Subsystem/Assy: **TWC SYSTEM**	Unit:	
Component: **TWC BOARDS**		Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**		

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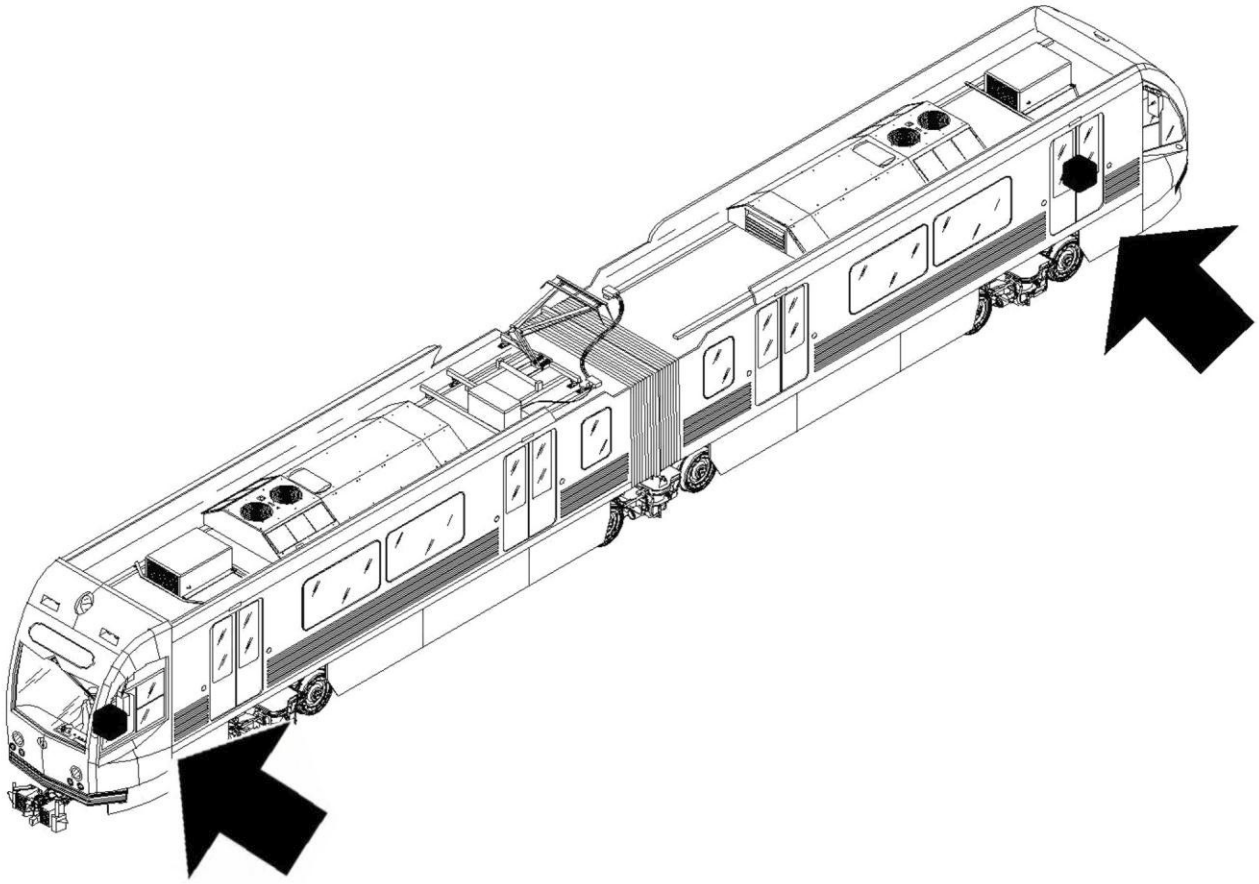
P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-16-01-02-00/R-00

System:	Sheet:
TRAIN-TO-WAYSIDE COMMUNICATION	**1/8**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component: **TWC ANTENNA**	Man Hours: **1.25**
Maintenance Task: **REPLACEMENT**	

LOCATION:



P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-16-01-02-00/R-00

System:	Sheet:
TRAIN-TO-WAYSIDE COMMUNICATION	**2/8**

Subsystem/Assy:	Unit:
TWC SYSTEM	

Component:	Man Hours:
TWC ANTENNA	**1.25**

Maintenance Task:
REPLACEMENT

SAFETY PRECAUTIONS

WARNING: BLUE FLAG THE VEHICLE IN ACCORDANCE WITH ALL LACMTA BLUE FLAG POLICIES, RULES, & PROCEDURES IN ORDER TO WARN THAT MAINTENANCE PERSONNEL ARE WORKING ON, UNDER, OR NEAR ROLLING EQUIPMENT.

WARNING: DISCONNECT THE POWER IF THE SYSTEM WILL BE UNATTENDED. WHILE WORKING ON THE SYSTEM, THE TRAIN COULD UNEXPECTEDLY MOVE, POSSIBLY CAUSING DAMAGE OR INJURY. WARN OTHERS TO STAY CLEAR OF THE TRAIN SINCE IT COULD BECOME ACTIVATED WITHOUT NOTICE.

WARNING: BE CAREFUL TO AVOID PERSONAL INJURY. AVOID DOING ANYTHING THAT COULD PUT ANYONE IN DANGER OF ELECTRICAL SHOCK OR INJURY FROM MOVING EQUIPMENT. EXERCISE EXTREME CAUTION WHEN WORKING AROUND THE SYSTEM WITH THE WIRING AND ELECTRONICS EXPOSED. WARN OTHERS BEFORE LEAVING AN OPEN SYSTEM UNATTENDED.

WARNING: DEPENDING ON THE SEVERITY AND TYPE OF PROBLEM BEING EXPERIENCED, IT MAY BE ADVANTAGEOUS TO DISCONNECT THE ATP/TWC SYSTEM FROM EXTERNAL SYSTEMS SO THAT WORK CAN BE PERFORMED ON THE SYSTEM WITHOUT DANGER.

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit

CONSUMABLES:

Cleaner (commercial)

SPARE PARTS:

TWC Antenna P/N AA03WAL (MFR PN N25402401)

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-16-01-02-00/R-00**

System:	Sheet:
TRAIN-TO-WAYSIDE COMMUNICATION	**3/8**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component: **TWC ANTENNA**	Man Hours: **1.25**
Maintenance Task: **REPLACEMENT**	

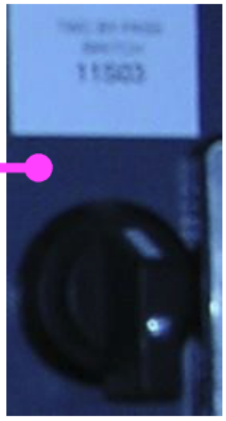
PROCEDURE:

PRELIMINARY OPERATIONS

Set the Vehicle in safety conditions in accordance with LACMTA Maintenance Shop Regulations:

1. Place the Vehicle over the Pit (or Stand Up Rail).
2. Set the Master Controller Handle to FSB position.
3. Make sure that all Parking Brakes are applied (by checking on the IDU "Parking Brake A and B Not Released" and on Indicator Panel "A" "Park / Friction Brake" ON).
4. Set the following Circuit Breakers to "OFF" position.

- **CB 11F03**, located in the “A“ LV Locker,
- **CB 11S03**, located in the “A“ Cab By Pass Panel



REMOVAL

To perform the Task proceed as follows:

1. Remove the Electrical Connector from the TWC Antenna.
2. Loosen and remove the Special Screws (2), Washers (3) and Nuts (4). Retain Attaching Hardware for later use.
3. Remove the TWC Antenna (1) and Shims (5, 6, 7) from Bracket (8).

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-16-01-02-00/R-00

System:	Sheet:
TRAIN-TO-WAYSIDE COMMUNICATION	**4/8**

Subsystem/Assy:	Unit:
TWC SYSTEM	

Component:	Man Hours:
TWC ANTENNA	**1.25**

Maintenance Task:
REPLACEMENT

PROCEDURE:

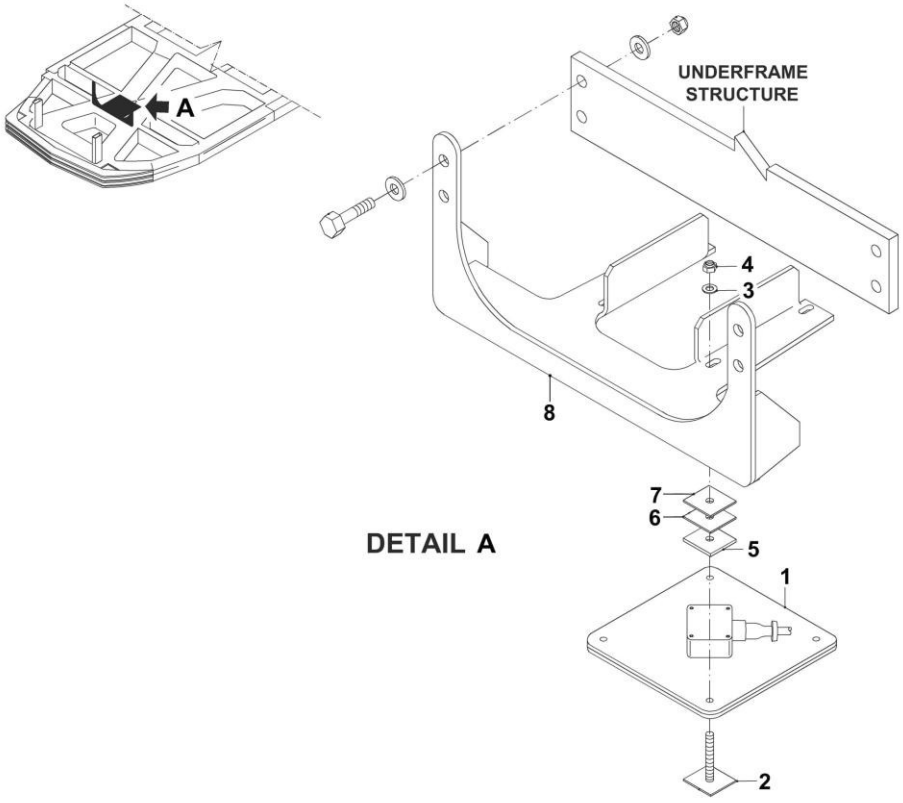


FIG 1 TWC ANTENNA REPLACEMENT

INSTALLATION)

To perform the Task proceed as follows:

1. Clean the TWC Antenna Seat and Electrical Connector using recommended cleaner and cleaning rags.
2. Position the “new “ TWC Antenna (1) and Shims (5, 6, 7) on Bracket (8).
3. Install the Fixing Special Screws (2), Washers (3) and Nuts (4). Torque to **15.2 lb-ft**
4. Connect the Electrical Connector to the TWC Antenna.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-16-01-02-00/R-00

System:	Sheet:
TRAIN-TO-WAYSIDE COMMUNICATION	**5/8**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component: **TWC ANTENNA**	Man Hours: **1.25**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

FINAL OPERATIONS

1. Reinstate Electrical Power to the TWC by switching ON the CB 11F03, located in the "A" LV Locker.
2. Check that the LEDs of the "new" PCB are GREEN, indicating that the Board works properly.
3. Check that all the other LEDs of the Cardfile PCBs are GREEN, indicating that the each Board works properly.
4. Close and lock the Door Panel of TWC Enclosure.
5. Close and lock the ELE Locker Door.using Maintenance key.
6. Go in the "A" Cab by opening the Cab Door using Maintenance Key.
7. Key ON the Vehicle.
8. Check the TWC Interface Panel Indicator Lights by pressing the

   Lamp Test Pushbutton (3S04)

   located in the Cab Console.
   Replace fault Indicator Light(s) as per check result.

9. Perform the TWC Departure Test by Pressing the relevant

   Depart Test pushbutton

   located on the TWC Interface Panel.

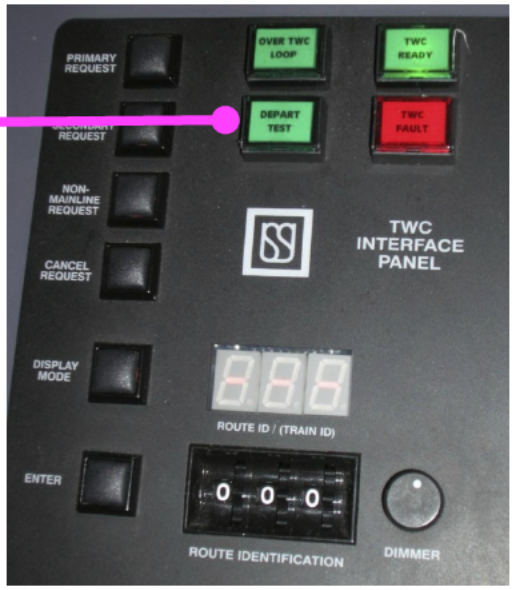


FIG 2 CAB TWC INTERFACE PANEL

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-16-01-02-00/R-00

System:
TRAIN-TO-WAYSIDE COMMUNICATION

Sheet:
6/8

Subsystem/Assy:
TWC SYSTEM

Unit:

Component:
TWC ANTENNA

Man Hours:
1.25

Maintenance Task:
REPLACEMENT

PROCEDURE:

NOTE:
The central purpose of the Departure Test is to check the ability of the TWC system to properly

a) transmit and receive signals with the MGL Wayside.

The Departure Test can run only if the Vehicle is stopped and positioned completely within a TWC

b) Equipped Track Circuit (both A-end and B-end Antennas positioned over Loops).

c) The Departure Test will terminate if Vehicle Motion is detected while the Test is in progress

d) While the Departure Test is running, the TWC System will flash the DEPART TEST Indicator Light

e) When the Departure Test has completed, the TWC will indicate the PASS/FAIL Status of the Test.

Once activated, the Departure Test suspends transmission of the periodic poll message to the

f) Wayside. It then checks the System for the existence of any crosscheck errors.

g) If any crosscheck error exists, the Departure Test fails.

The TWC system will then transmit a single poll message to the Wayside requesting it to go into

h) continuous communication mode for two (2) seconds.

The Departure Test fails if the TWC does not see the Wayside respond in Continuous Communication

i) Mode.

If successful, the Antenna selection is switched to the opposite end Antenna and the Continuous

j) Mode request is once again made to the Wayside.

The Departure Test fails if the TWC does not see the Wayside respond in Continuous Communication

k) Mode. If successful, the Test completes

Once the Departure Test has completed or has been terminated, the TWC will indicate the Test result on the DEPART TEST indicator on the TWC Interface Panel.

l) The Indicator Light will be:

- steadily lit if the Test successfully completes.
- dark if any part of the Test fails, or the test was terminated

10. Repeat steps 7 through 9 in the “B” Cab

11. As per Test Result perform Troubleshooting with IDU or PTU.

Refer to Part II of this Section, paragraphs 16-II-02.2 and 16-II-02.3 respectively

Next Figures 3, 4 and 5 provide, respectively:

- the ATP/TWC SYSTEM STATUS SCREEN (Operating Mode)
- the ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)
- the PTU & TWC CONNECTIONS

12. Leave the Cab and close the Cab Door using Maintenance Key

13. Record inspection result on the Defect Report Card for administrative and maintenance planning.

NOTE: At Task Completion it is recommended to check the correct operation and/or functions of the Subsystem to which the maintained Equipment pertains.

Refer to **HOW TO USE THE R-CM SHEETS** (para 16-III-04-01-02 of this Section) and follow the prescriptions provided at Step 3 **“At every Task Completion.”**

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-16-01-02-00/R-00

System:	Sheet:
TRAIN-TO-WAYSIDE COMMUNICATION	**7/8**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component: **TWC ANTENNA**	Man Hours: **1.25**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

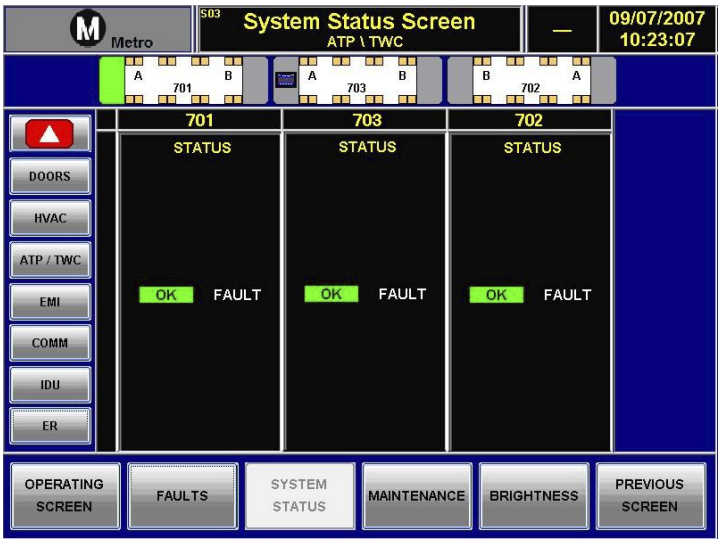


FIG 3 ATP/TWC SYSTEM STATUS SCREEN (Operating Mode)

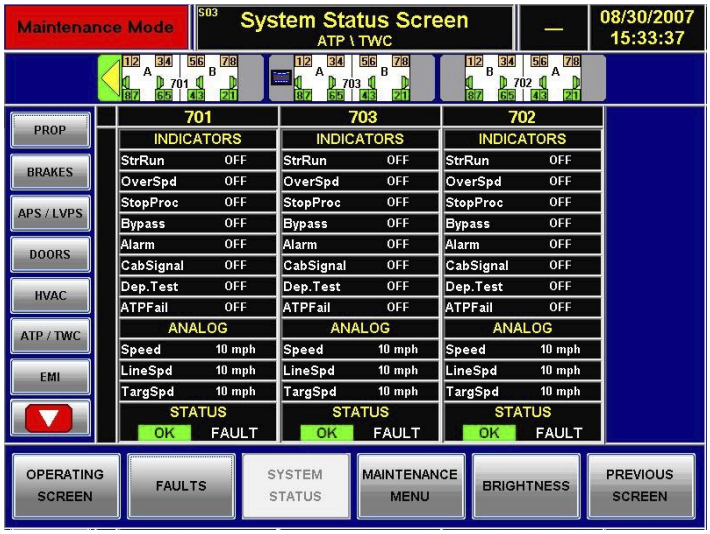


FIG 4 ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-16-01-02-00/R-00**	
System: **TRAIN-TO-WAYSIDE COMMUNICATION**	Sheet: **8/8**
Subsystem/Assy: **TWC SYSTEM**	Unit:
Component: **TWC ANTENNA**	Man Hours: **1.25**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

Fig 5 PTU & TWC CONNECTIONS

NOTE: Make sure this board has the proper software version updated.

16-III-05 CONSUMABLE MATERIALS LIST (R-CML)

The Consumable Materials needed to accomplish the Train-To-Wayside Communication Running Maintenance are listed, sequenced in alphabetical order, by SUBSYSTEM /ASSY - UNIT / COMPONENT, in the following Table 16-III-05.1.

Table 16-III-05.1 Running Maintenance Consumable Materials List (R-CML)

SYSTEM 16	TRAIN TO WAYSIDE COMMUNICATION		
SUBSYSTEM /ASSY - UNIT / COMPONENT	**AGENT**	**PN**	**MTA PN**
TWC SYSTEM	Dry Compressed Air for Electronic Equipment	(commercial)	
	Lint-free rag		
	Cleaner		

16-III-06 TEST EQUIPMENT & SPECIAL TOOLS LIST (R-TESTL)

The Tools and Test Equipment needed to accomplish the Train-To-Wayside Communication Running Maintenance are listed, sequenced in alphabetical order, by SUBSYSTEM /ASSY - UNIT / COMPONENT, in the following Table 16-III-06.1.

Refer to “Tools and Test Equipment Manual” for Special Tools / Test Equipment Description and Maintenance.

Table 16-III-06.1 Running -Test Equipment & Special Tools List (R-TESTL)

SYSTEM 16	TRAIN-TO-WAYSIDE COMMUNICATION			
SUBSYSTEM /ASSY - UNIT / COMPONENT	**LACMTA STANDARD TOOLS KIT**	**LACMTA WORKSHOP DEVICES**	**SPECIAL TOOL / TEST EQUIPMENT**	**PN**
TWC SYSTEM	X	Soft bristle brush		
			Cable Certifier (Type LT 8600)	TBS 1
			PTU (Dell) Laptop with specific SW installed. Refer to Table 00-22.1 for SW List	TBS 2

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