LOS ANGELES COUNTY

METROPOLITAN TRANSPORTATION AUTHORITY

LIGHT RAIL VEHICLE

P2550

RUNNING MAINTENANCE AND SERVICE MANUAL

SECTION 15 AUTOMATIC TRAIN PROTECTION

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 15 - AUTOMATIC TRAIN PROTECTION

SECTION 15

AUTOMATIC TRAIN PROTECTION SYSTEM

PART I

THEORY OF OPERATION

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

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SECTION 15

AUTOMATIC TRAIN PROTECTION SYSTEM

15-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.

The Part III - Maintenance consists of:

- Preventive Maintenance
- Corrective Maintenance
- Consumable Materials
- Test Equipment, Tools & Special Tools

15-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	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

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
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

15-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.

15-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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15-I-02 THEORY OF OPERATION

15-I-02.01 General Description of the System

This Section describes the ATP (Automatic Train Protection) System.

Because of the strong interconnection between the ATP and the TWC System (refer to Section 16), 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 AnsaldoBreda. 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) ADUs are installed in each vehicle, one in each vehicle cab (A-End and B-End).
- Cab-mounted TWC Interface Panel for the vehicle operator (refer to Section 16). 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 vehicle end). Each pair of coils is wired to a junction box.
- Vehicle body-mounted TWC antennas (refer to Section 16). 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 15-I-02.1 shows the ATP/TWC system vehicle-level configuration.

Figure 15-I-02.2 shows the ATP/TWC system functional block diagram.

NOTE: The ATP and the TWC systems are interdependent and strictly integrated, but they are dealt with in two separate sections: Section 15 for the ATP and Section 16 for the TWC. Nevertheless, due to their connections and integration, some of the topics cannot be separated and are treated together. Those topics are repeated in both sections.

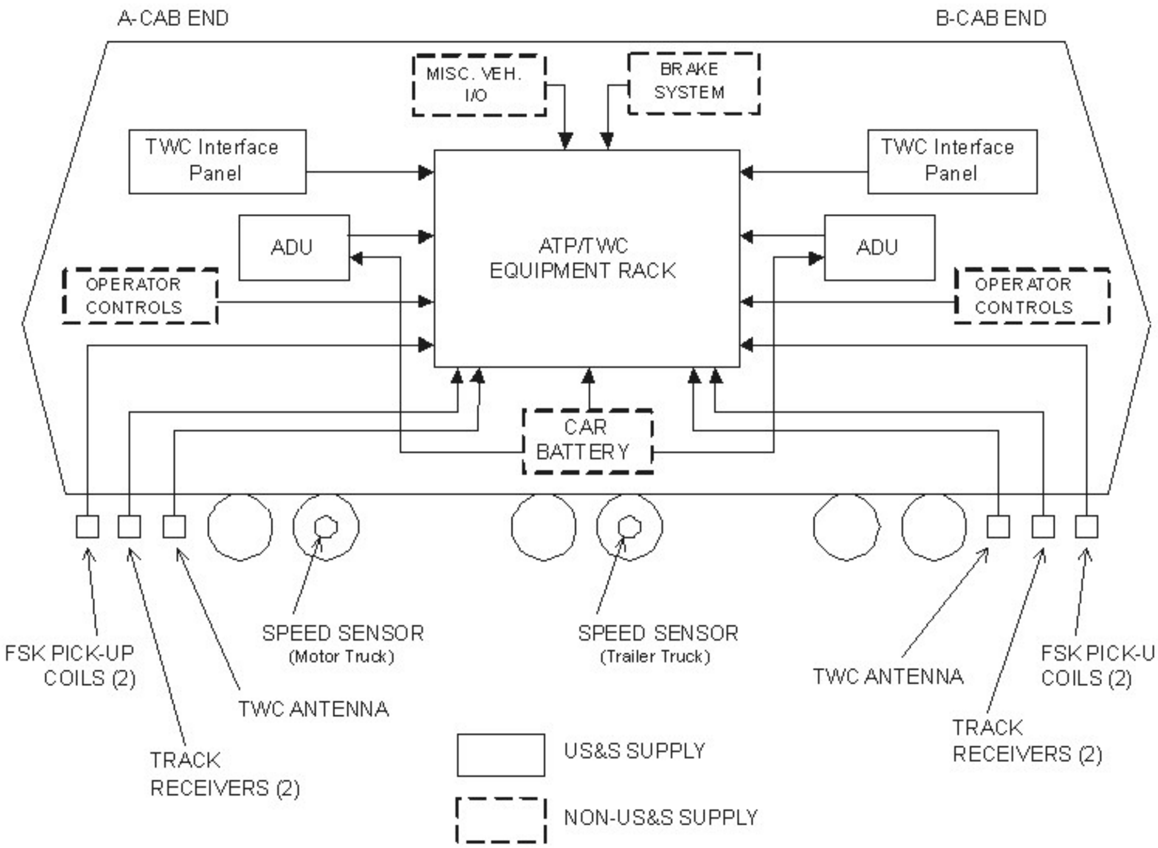


Figure 15-I-02.1 P2550 LRV ATP/TWC System Configuration

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

ATP Peripherals:

- ADU;
- FSK Pick-Up Coils:
- Track Receivers;
- Speed Sensors.
- TWC Peripherals:
- TWC Interface Panel;
- TWC Antennas.

[redacted]

- ATP Functional Overview

The P2550 ATP system is designed for compatible operation on three different metro lines: Metro Blue Line (MBL), Metro Green Line (MGL) and Pasadena Gold Line (PGL). A Line Selector Switch, located in the A Body Section Electronic Locker, configures the ATP system for operation on the desired line.

The ATP performs the following major functions across all three lines:

- Cab Signal Reception and Decoding;
- Vehicle Speed Determination;
- Over speed Protection;
- Braking and Propulsion Control;
- Input/Output Processing;
- Door Control;
- ATP Operating Modes;
- Departure Test;

The above mentioned functions are described in detail in paragraph 15-I-02.03 of this section.

i. System-Vehicle Relationship

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

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

For the description of these connections refer to paragraph 15-I-02.03.
The LVDS Relay Logic is an important way to interface the ATP with the other vehicle Systems.

Through the LVDS, the ATP System acquires the Power Supply and the signals listed below (refer to Figure 15-I-02.13):

- Forward and Reverse Mode; -
Cab Enable;
- Track Brake Applied;
- Speed Limit (35mph, e.g. for a bypassed system); -
No Power;
- No Power request;
- By Pass Active;
- LH and RH Door closed;
- Friction Brake Fault;
- TWC By Passed;
- EB Applied;
- Friction Brake Applied;
- ATP Reset Switch.

The ATP System implements the commands listed below through the LVDS Relay Logic (refer to Figure 15-I-02.15):

- RH and LH Door Enabling;
- Emergency Brake Application;
- Propulsion Enabling;
- FSB Application;

The ATP interfaces the vehicle TCMS via the LONWorks network.

The ATP provides the TCMS with specific fault information about the following categories of system events:

- Emergency Brake Applications;
- Full Service Brake Applications;
- Brake Assurance Failures;
- Interface Communication Failures;
- ATP Subsystem Failures;
- System Crosscheck Failures;
- Departure Test Failures.

Thanks to the LONWorks Bus, the ATP communicates with the Propulsion System (TCU) and sends the ATP Status to the TCMS and the IDUs (refer to Section 18).

The ATP uses the LONWorks Bus also to interconnect the ATP Equipment Enclosure with the two relevant ADUs (Aspect Display Unit - refer to paragraph ii).

Figure 15-I-02.3 shows the ATP Datasets exchanged through the LONWorks bus. The complete list of the LONWorks datasets and of their signals is presented in Section 18.

[redacted]

The ATP System and the TWC System Electronic Boards are located in the same ATP/TWC Equipment Enclosure.

Thanks to this common location these two systems can exchange several data.

[redacted]

Figure 15-I-02.4 System-Equipment Relationship

The ATP System is made up of three main sub-systems:

1. The ATP Equipment Enclosure: the ATP rack with the electronic boards is located in the Electronic Locker of the A Body Section (refer to Figure 15-I-02.5). The ATP Equipment Enclosure is hierarchically the most important ATP sub-system: it is the “brain” of the ATP, receives signals from the other sub-systems and from the other vehicle systems and manages the actual Train Protections. In a train consist, only the ATP located in the vehicle with the enabled Cab is active.
2. Two ADUs (Aspect Display Unit - one in each Operator cab. Refer to Figure 15-I-02.6): they are ATP Equipment Enclosure peripherals; they interface the ATP system with the Operator.
3. The ATP Components mounted on the underframe are the peripherals of the ATP Equipment Enclosure:
   - Two Speed Sensors mounted on axle#2 and axle#4 for Section A and Section C respectively;
   - Two FSK Pickup Coils per Body Section for the Metro Green Line (refer to Figure 15-I-02.11);
   - Two 100/250Hz Track Receivers per Body Section for the Metro Blue Line and the Pasadena Gold Line (refer to Figure 15-I-02.1)

The Two Speed Sensors, the Receivers and the Coils are directly connected to the ATP Equipment Enclosure.

All of them are connected to the P1 connector of the ATP Equipment Enclosure.

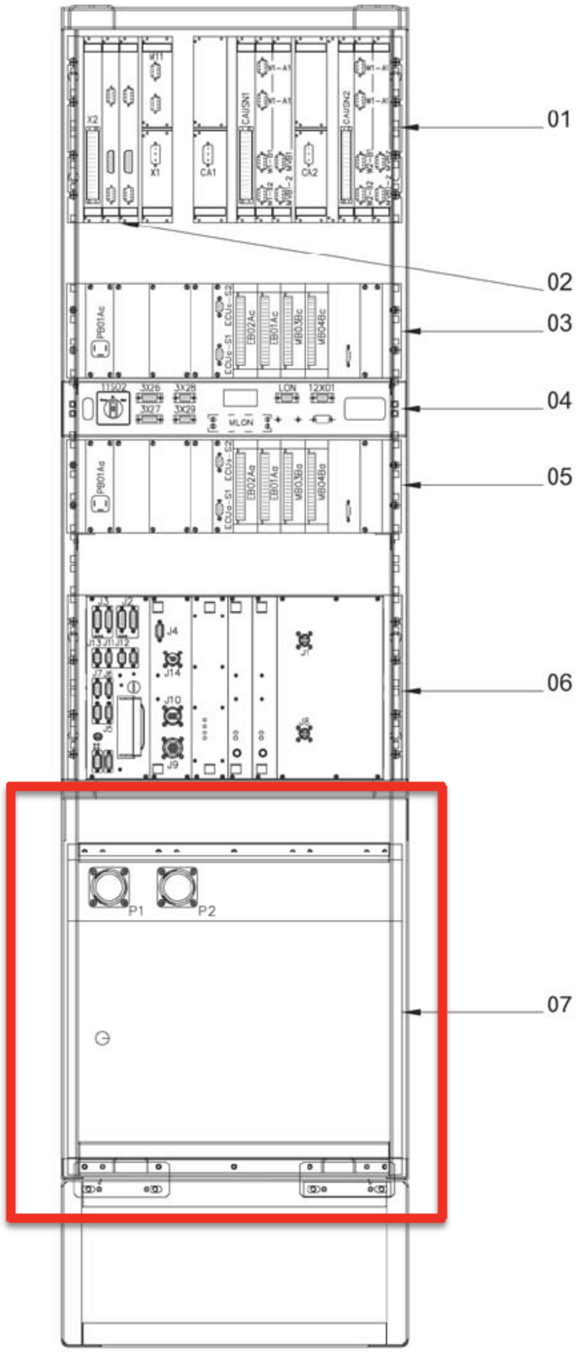
The two ADUs have a double connection with the ATP Enclosure:

- Connection through the LVDS: four (4) LV line;
- Connection through the TCMS: by means of the LONWorks Bus.

The ADUs are connected with the P2 connector of the ATP Equipment Enclosure.

Refer to Figure 15-I-02.14 for ATP Cardfile and ADUs connections.

Refer to Figure 15-I-02.15 for ATP Cardfile and Antennas connections.



CAR "A"

01. GATEWAY
04. DATA DOWNLOAD PANEL
07. ATP/TWC
02. EDU
05. ECU A
08. ECU B
03. ECU C
06. COMMUNICATIONS

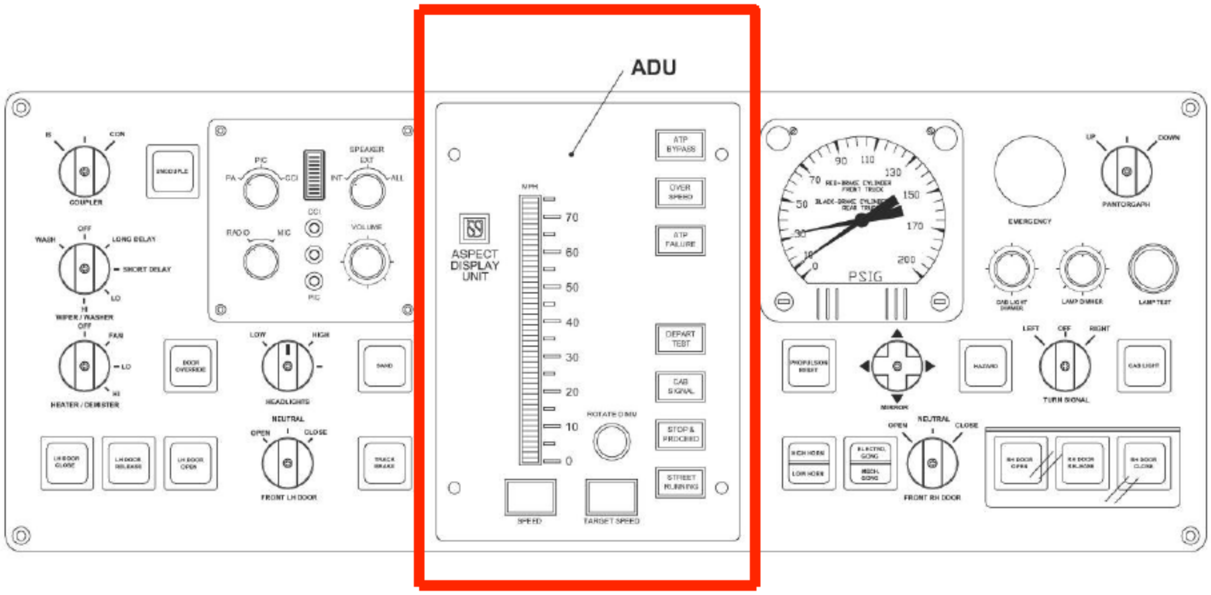
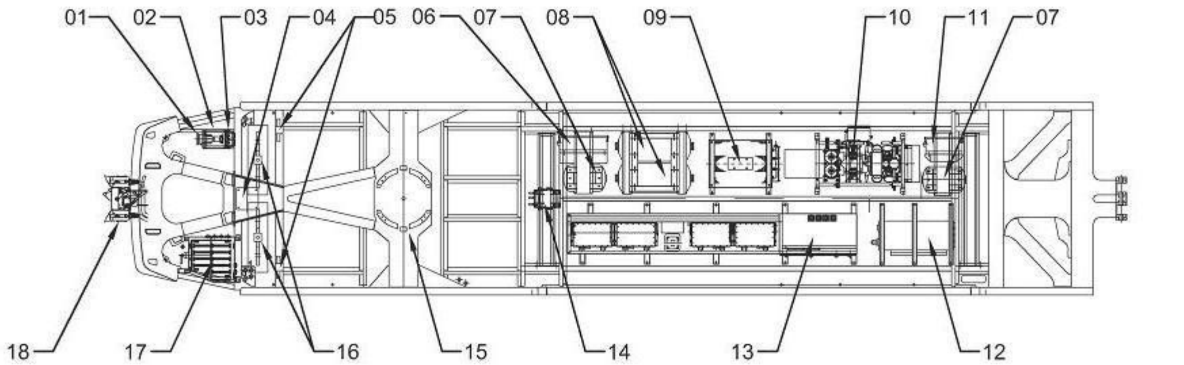
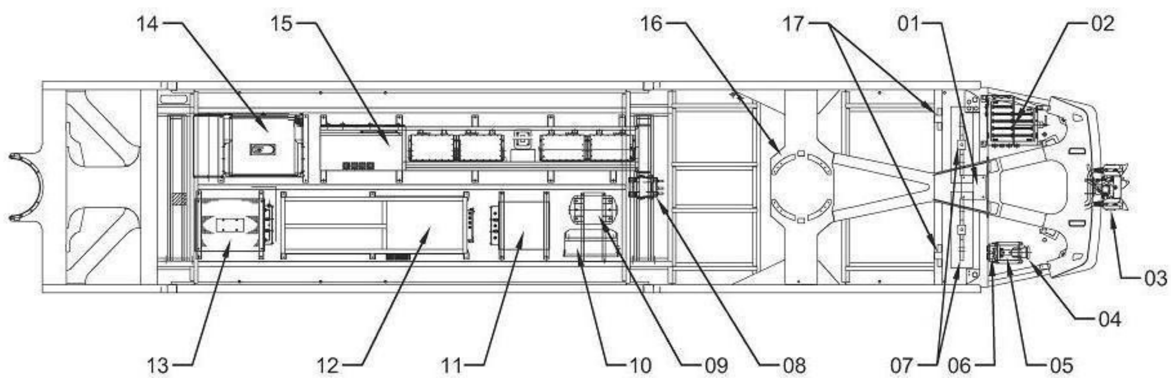


Figure 15-I-02.6 The ADU on the Operator Console



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 15-I-02.7 FSK Pick Up Coils and Track Receivers (ATP Antennas)

iii. System Performances and Characteristics

ATP/TWC Rack:

- ATP/TWC Rack dimensions:

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

- ATP/TWC Equipment Enclosure Input Voltage:

    - The enclosure operates from 25 to 42 Vdc vehicle battery power; - Nominal Input Voltage: 37.5Vdc.

Track Receiver Pick-Up Coil:

- dimensions:

    - Length: 30 inches;
    - Width: 6-1/16 inches.

- Working frequency:

    - 100Hz
    - 250Hz

15-I-02.02 The ATP System Components

15-I-02.02.01 ATP/TWC Equipment Enclosure

15-I-02.02.01.01 Enclosure Housing

The MicroCab® Enclosure consists of a welded steel enclosure designed for mounting in the P2550 vehicle equipment rack (refer to Figure 15-I-02.8 and Table 15-I-02.1).

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 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.

15-I-02.02.01.02 Cardfile and PCBs

The cardfile contains the system's controlling vital logic (hardware and software) and interfacing circuits between the logic and peripheral devices/circuits both within the enclosure and with external devices.

The logic and interfacing circuits are incorporated in twelve (12) plug-in printed circuit boards with integral front control/display panels.

Each PCB is secured with top and bottom machine screws, and extracted with top and bottom ejector levers.

The boards are installed in a 16-slot cardfile with internal backplane connectors for board-to-board communications, distribution of PCB operating power, and electrical interfaces to external circuits/equipment.

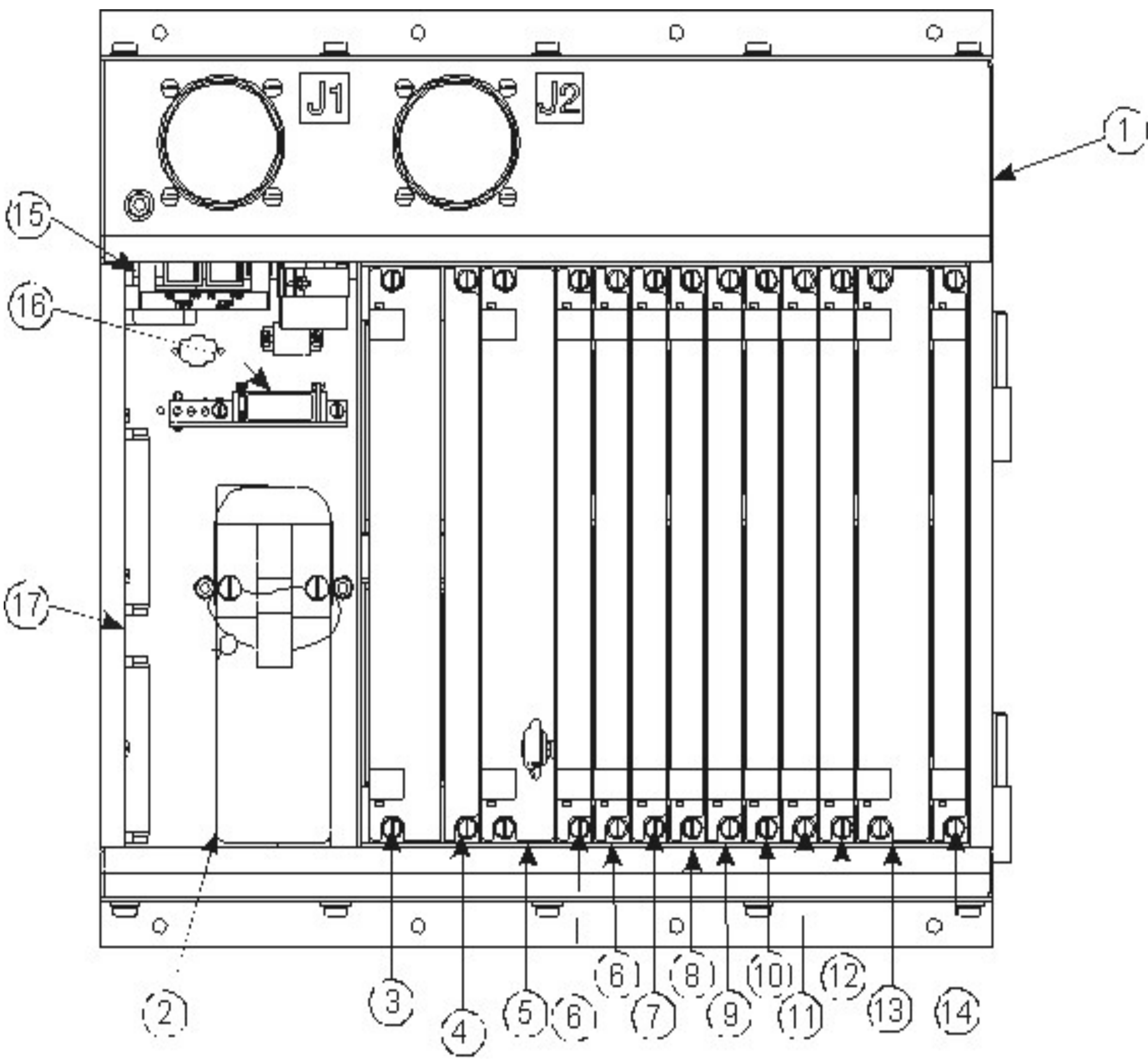


Figure 15-I-02.8 ATP Equipment Enclosure

Table 15-I-02.1 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

15-I-02.02.01.03 Cardfile PCB Descriptions

Table 15-I-02.2 and Table 15-I-02.3 describe the Cardfile PCB Configuration Settings.

Table 15-I-02.2 Cardfile PCB Configuration Settings 1

Jumper or Switch	TWC Control PCB	Main Logic CPU PCB	Main Logic CPU Daughterboard	Multifunction PCB	Decoder PCB
JP1	OUT	2-3	1-2	2-3	2-3
JP2	IN	N/I	1-2	1-2	1-2
JP3	OUT	2-3	1-2	1-2	--
JP4	--	2-3	1-2	1-2	--
JP5	--	N/I	1-2	1-2	--
JP6	--	2-3[s]	1-2	1-2	--
JP7	--	1-2	1-2	1-2	--
JP8	--	1-2	D	--	--
JP9	--	1-2	D	--	--
JP10	--	2-3	D	--	--
JP11	--	1-2	D	--	--
JP12	--	1-2	D	--	--
JP13	--	2-3	D	--	--
JP14	--	1-2	D	--	--
JP15	--	1-2	D	--	--
JP16	--	1-2	D	--	--
JP17	--	1-2	D	--	--
JP18	--	1-2	1-2	--	--
JP19	--	--	1-2	--	--
JP20	--	2-3	D-S	--	--
JP21	--	2-3	--	--	--
JP22	--	2-3	--	--	--
JP23	--	2-3	--	--	--
JP24	--	2-3	--	--	--
JP25	--	2-3	--	--	--
JP26	--	2-4	--	--	--
JP27	--	1-2	--	--	--
JP28	--	1-2	--	--	--
JP29	--	1-2	--	--	--
JP-30	--	1-2*	--	--	--
JP-31	--	1-2	--	--	--
JP-32	--	1-2	--	--	--
JP-33	--	1-2	--	--	--
JP-34	--	1-2	--	--	--

Table 15-I-02.2 Cardfile PCB Configuration Settings 1

Jumper or Switch	TWC Control PCB	Main Logic CPU PCB	Main Logic CPU Daughterboard	Multifunction PCB	Decoder PCB
JP-35	--	2-3	--	--	--
JP-36	--	2-3	--	--	--
SW1	4, 5, 6 - Closed Only	ALL OPEN	--	--	--
SW5	--	--	--	--	--

Table 15-I-02.3 Cardfile PCB Configuration Settings 2

Jumper or Switch	100 Hz Filter PCB	250 Hz Filter PCB	FSK Receiver PCB	FSK CPU PCB
JP1	1-2	1-2	2-3	1-2
JP2	N/I	N/I	2-3	1-2
JP3	1-2	1-2	1-2	1-2
JP4	1-2	1-2	1-2	1-2
JP5	1-2	1-2	1-2	1-2
JP6	1-2	1-2	1-2	1-2
JP7	1-2	1-2	--	N/I
JP8	1-2	1-2	--	N/I
JP9	N/I	N/I	--	N/I
JP10	N/I	N/I	--	2-3
JP11	N/I	N/I	--	2-3
JP12	N/I	N/I	--	1-2
JP13	N/I	N/I	--	2-3
JP14	N/I	N/I	--	--
JP15	1-2	1-2	--	--
JP16	N/I	N/I	--	--
JP17	N/I	N/I	--	--
JP18	2-3	2-3	--	--
JP19	2-3	2-3	--	--
JP20	1-2	1-2	--	--
JP21	--	1-2	--	--
JP22	--	1-2	--	--
JP23	--	1-2	--	--
JP24	--	2-3	--	--
JP25	--	--	--	--
JP26	--	--	--	--
JP27	--	--	--	--
JP28	--	--	--	--

Table 15-I-02.3 Cardfile PCB Configuration Settings 2

Jumper or Switch	100 Hz Filter PCB	250 Hz Filter PCB	FSK Receiver PCB	FSK CPU PCB
JP29	--	--	--	--
JP-30	--	--	--	--
JP-31	--	--	--	--
JP-32	--	--	--	--
JP-33	--	--	--	--
JP-34	--	--	--	--
JP-35	--	--	--	--
JP-36	--	--	--	--
SW1	--	--	--	--
SW5	--	--	--	1 ON, 2 - 8 OFF
Notes	* = When software has finished loading		S = Soldered	
	-- = Not on Board		N/I = Not Installed	

a) Main Logic CPU PCB

This PCB contains the ATP system's vital logic software and is primarily responsible for managing the system's vital overspeed protection function.

Key functions of this board include:

- Processing code rate (cab signal aspect) information and monitoring vehicle speed
- Operating the indicators on the ADU
- Monitoring vital inputs and controlling vital outputs (e.g. brake system control)
- Conducting and monitoring the automated Departure Test
- Managing user diagnostic and event data downloading procedures
- Storing routine event and fault data in memory
- User controls and displays on the Main Logic CPU PCB include:
- Two (2) alpha-numeric LED displays for showing stored data and programming menus
- Sixteen (16) discrete LEDs for monitoring individual PCB channels and functions
- One momentary pushbutton for manually resetting the system
- Four (4) two-position toggle switches for stepping through and selecting programming options

b) FSK CPU PCB

The FSK CPU PCB is responsible for decoding and validating the vital wayside message from the data demodulated by the FSK Receiver.

Once validated, the cab signal message is sent to the Main Logic CPU via Dual-Ported Random Access Memory (DPRAM).

The FSK CPU controls three distinct but identical channels (or filters) on the FSK Receiver PCB.

The FSK CPU assigns a role to each of these channels, and varies that role over time. The logical roles assumed by the three physical channels include *Active* channel, *Next* channel and *Test* channel.

Wayside messages are received through the *Active* channel by tuning it to the frequency of the current track circuit.

The *Next* channel is tuned to the frequency of the track circuit that lies ahead. Finally, hardware diagnostics are performed on the *Test* channel.

The FSK CPU also has an algorithm for detecting a track circuit bond crossing. Specifically, events are sent to the ATP for the signal level increasing for the next track circuit frequency and the signal level decreasing for the current track circuit frequency.

The signal detection levels are calibrated to detect signals above and below a predefined level based on the nominal rail current.

If the *Active* channel is not tuned to the frequency of the current track circuit, the FSK CPU scans for all possible carrier frequencies (from 9.5 to 16.5 kHz) when commanded by the Main Logic CPU.

c) FSK Receiver PCB

The FSK Receiver PCB contains the circuitry to perform carrier frequency selection and FSK demodulation of vital data transmitted by the wayside AF-900 track circuits.

The board contains three digitally tuned filters (or channels) that are tuned to the appropriate frequency by the FSK CPU.

Signal levels on each channel are monitored and provided to the FSK CPU. When a carrier frequency is detected on a particular channel, the data is demodulated and passed to the FSK CPU.

d) Decoder CPU PCB

The Decoder CPU PCB is responsible for reading the input channels provided by the 100 Hz and 250 Hz Filter PCBs and determining the dominant code rate detected by the track receiver coils.

The Decoder CPU PCB, which incorporates its own microprocessor, performs tests on the 100 Hz and 250 Hz Filter PCBs before transmitting the decoded speed signals to the Main Logic CPU PCB.

User front panel devices on the Decoder CPU PCB include five (5) discrete LEDs for monitoring board circuits and functions, and a momentary pushbutton for manually resetting the board.

There is also a serial communications port (9-pin) on the front panel for factory diagnostics use only.

e) Vital Input PCBs

Two Vital Input PCBs provide monitoring of cab control, vehicle status, and closed-loop inputs. Additionally, the PCBs communicate these input conditions to the Main Logic CPU PCB through a standard, G64, US&S interface bus.

Each Vital Input PCB accepts and processes up to 16 bipolar inputs from external circuits.

The board has individually monitored input sections that are software controlled through the standard bus interface.

User front panel devices include 16 discrete LEDs for monitoring individual input channels.

f) 100 Hz Filter Demodulator PCB

The 100 Hz Filter Demodulator PCB processes the 100 Hz cab signals derived from the track receivers. Its circuitry has band-pass filters to prevent any frequencies other than the desired one from passing.

The board contains two separate channels:

One for low energy (processing channel) and one for test.

The PCB is tested every three (3) seconds using a periodic sequence of tests to verify its operation.

The test approach relies on agreement of the outputs of the processing and test channels.

The agreement is expected after the test channel circuitry has correctly responded to a sequence of diagnostic conditions.

The diagnostics are performed to verify proper operation of the test circuit hardware (comprised of active components that are dissimilar to those on the processing channel).

Should disagreement between channels occur or the test channel diagnostics fail, a “No Code” is passed to the ATP until the two channels are in agreement or the test channel diagnostics are successful.

Specific failures of the PCB tests are logged in the ATP event logs.

A summary 100 Hz Filter PCB failure status indication will be sent to the vehicle TCMS.

A failure of any of the PCB tests results in the passing of a “No Code” to the Main Logic CPU (see Section 15-I-02.04.01.02c) Dominant Code Rate Determination).

g) 250 Hz Filter Demodulator PCB

The 250 Hz Filter Demodulator PCB processes the 250 Hz cab signals received by the track receivers. Its circuitry has band-pass filters to prevent any frequencies other than the desired one from passing.

The board contains two separate channels: one for low energy (processing channel) and one for test.

The PCB is tested every three (3) seconds using a periodic sequence of tests to verify its operation.

The test approach relies on agreement of the outputs of the processing and test channels.

The agreement is expected after the test channel circuitry has correctly responded to a sequence of diagnostic conditions.

The diagnostics are performed to verify proper operation of the test circuit hardware (comprised of active components that are dissimilar to those on the processing channel).

Should disagreement between channels occur or the test channel diagnostics fail, a “No Code” is passed to the ATP until the two channels are in agreement or the test channel diagnostics are successful.

Specific failures of the PCB tests are logged in the ATP event logs.

A summary 250 Hz Filter PCB failure status indication will be sent to the vehicle TCMS.

Since the 250 Hz carrier is used as a qualifier in determining the presence of a dualcode rate, no restrictive action is taken if failures are detected on the 250 Hz Filter PCB (see Section 15-I-02.04.01.02c) Dominant Code Rate Determination).

h) Multi-Function PCB

The Multi-Function PCB performs these functions:

- Departure Test - Generates modulated-carrier cab test signals for use in the MBL and PGL Departure Tests. The PCB contains circuits that send these test signals to the track receiver input via the track receiver coils.
- Decelerometer - Provides signal conditioning and interface with the decelerometer. The output from the decelerometer is an AC signal proportional to how fast the vehicle is slowing down (decelerates). The PCB contains circuits that convert this AC signal into a DC signal for processing by the Main Logic CPU PCB.
- Speed Sensor Input - The PCB contains circuitry to process two isolated single-channel speed sensor inputs. Pulses from the speed sensors are decoded, and speed information is sent to the Main Logic CPU PCB.

- Vital Outputs - The PCB provides the ATP system with eight (8) vital outputs. One output is used to control the vital relay. The remaining seven (7) outputs are not currently used.
- Non-Vital Outputs - The PCB provides the ATP system with eight (8) optically isolated non-vital outputs. Six (6) outputs are used to control safety relays on the Relay PCB. The remaining two outputs are not currently used.

User front panel indicators on the Multi-Function PCB include eight discrete LEDs for monitoring the non-vital outputs, and eight additional discrete LEDs for monitoring vital outputs.

i) Conditional Power Supply PCB

The Conditional Power Supply (CPS) PCB provides isolated 32 Vdc power for the ATP vital circuits.

The CPS receives vehicle battery power and a “conditional” (or enable) signal from the Main Logic CPU.

During normal operation, the Main Logic CPU maintains the 500 Hz enable signal to the CPS.

If the CPU fails or the system detects a safety-related fault, the CPU PCB removes the enable signal, which turns off the CPS PCB output.

Removal of CPS output causes an immediate system request for emergency brake.

User front-panel devices on CPS PCB include nine female test jacks for field and shop testing of board circuitry, and one (1) discrete LED to indicate the presence of the 32 Vdc CPS output.

j) 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.

k) TWC Control PCB

This Board is completely dedicated to the TWC System, refer to Section 16.

15-I-02.02.01.04 Non-Cardfile Components

a) 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 Departure Test.

The other transformer couples received FSK signals from the selected track receivers to the 100 Hz and 250 Hz Filter PCBs (the FSK (MGL) uses 9.5 to 16.5 KHz).

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.

b) 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.

c) EEPROM PCBs

Two Electrically-Erasable Programmable Read Only Memory (EEPROM) PCBs store critical vehicle-specific parameters, such as ATP wheel diameter settings and TWC Permanent Vehicle Identification (PVID).

Each PCB mounts to the Enclosure, above the rear of the cardfile, and connects to its associated controller PCB through a Serial Peripheral Interface (SPI) communications link. Storing vehicle-specific parameters in EEPROM PCBs allows changing out the associated controller boards without reprogramming the vehicle-specific parameters.

d) Decelerometer

The decelerometer measures actual braking rate (deceleration) of the vehicle and reports this information to the Main Logic CPU PCB.

If the LRV has oversped and the minimum required braking rate is not achieved, the ATP system requests Full Service Brake (FSB).

e) Vital Relay

The US&S PN-159B vital relay provides a direct interface between the ATP and the vehicle emergency brake trainilne.

When the ATP detects an emergency brake condition, the vital relay is de-energized, and its contacts open to interrupt the vehicle Emergency Brake Trainline and put the vehicle into Emergency Brake.

15-I-02.02.02 Peripheral Equipment

15-I-02.02.02.01 Aspect Display Unit (ADU)

The MicroCab® ADU provides visual and audible ATP indications to the vehicle operator.

The ADU also allows the operator to select ATP operating modes and system tests. One ADU is mounted in each operating cab.

Because the P2550 vehicles will operate on three different Metro lines, the ADU is designed to provide a single, integrated display to the operator.

Figure 15-I-02.9 shows the front panel layout of the ADU controls and indications. Table 15-I-02.4 summarizes the ADU controls and indications.

The ADU provides for external control of the Lamp Test feature, using the Lamp Test pushbutton on the Operators Console.

The ADU not only serves as the operator interface for the ATP system, but as the primary speed display for the vehicle operator.

When not communicating with the ATP, speed is received via the vehicle LON network and displayed on both the analog and digital speed displays on the ADU.

The ATP communicates with each ADU through the vehicle Train Control and Monitoring System (TCMS) LONWorks network.

Only one ADU is powered at a time depending upon which cab end is keyed on.

The units are designed to be interchangeable between cab ends.

The ADU will self-configure itself upon power-up as to whether it is operating as the

A-End or B-End ADU through the use of a wire jumper provided in the vehicle mating connection.

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

The initial factory setting for the output level is about 80 dB.

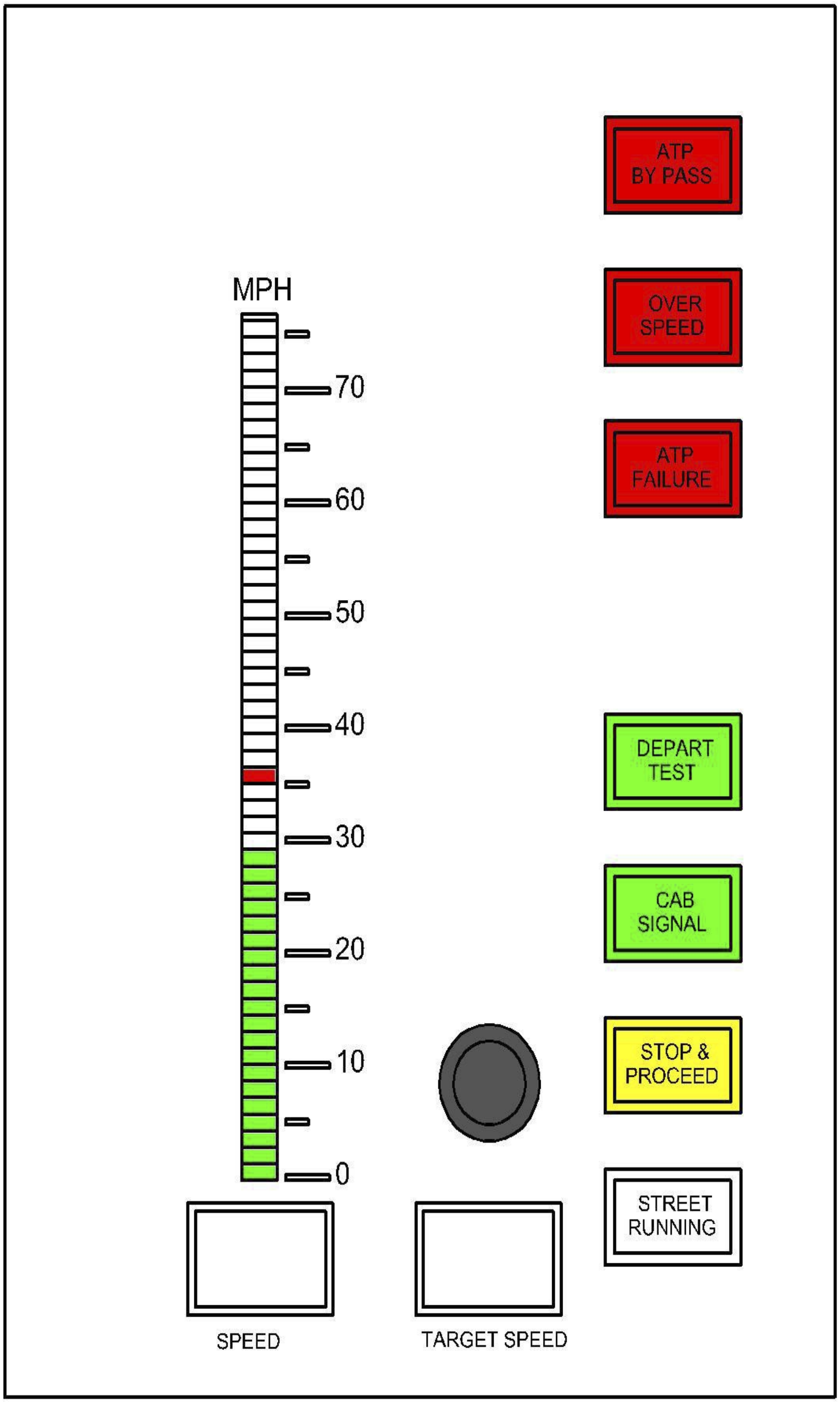


Figure 15-I-02.9 Aspect Display Unit (ADU) Front Panel Layout

Table 15-I-02.4 ADU Controls and Indications

Name	Function	Device Type
Speed/Speed Limit Display Bar	Analog display of vehicle speed and ATP determined line speed limit (mph).	Vertical bar of 51 bi-color LED lamps (Green/Red)
Speed	Digital display of vehicle speed (mph).	Two LED seven-segment displays (Red)
TARGET SPEED	Digital display of ATP determined target speed limit (mph).	Two LED seven-segment displays (Red)
ATP BYPASS	Indicate that ATP control and supervision is bypassed.	LED lamp (Red)
OVERSPEED	Indicates an ATP over speed condition.	LED lamp (Red)
ATP FAILURE	Indicate that the ATP system has failed.	LED lamp (Red)
DEPART TEST	Departure Test initiation and status indication.	Combination momentary PB switch and LED lamp (Green)
CAB SIGNAL	Indicates that a valid Cab Signal is being received and decoded by the ATP.	LED lamp (Green)
STOP & PROCEED	Initiates and indicates Stop & Proceed operation.	Combination momentary PB switch and LED lamp(Yellow)
STREET RUNNING	Initiates and indicates Street Running operation.	Combination momentary PB switch and LED lamp (White)
ROTATE DIM	ADU display intensity level control.	Rotary potentiometer
Alarm	Audible alert of overspeed conditions or other appropriate conditions.	Piezoelectric alarm

15-I-02.02.02.02 100/250 Hz Track Receivers

The MicroCab® system uses a pair of track receivers (MBL and PGL only) at each end of the vehicle (four total) to detect continuous cab signal current circulating through the running rails.

The track receivers couple these signals to the 100 Hz and 250 Hz Filter Demodulator PCBs in the ATP/TWC enclosure through a junction box and vehicle wiring.
Figure 15-I-02.10 shows the general dimensions and layout of a track receiver.

Refer to Figure 15-I-02.7 for the Track Receiver location in the vehicle underframe.

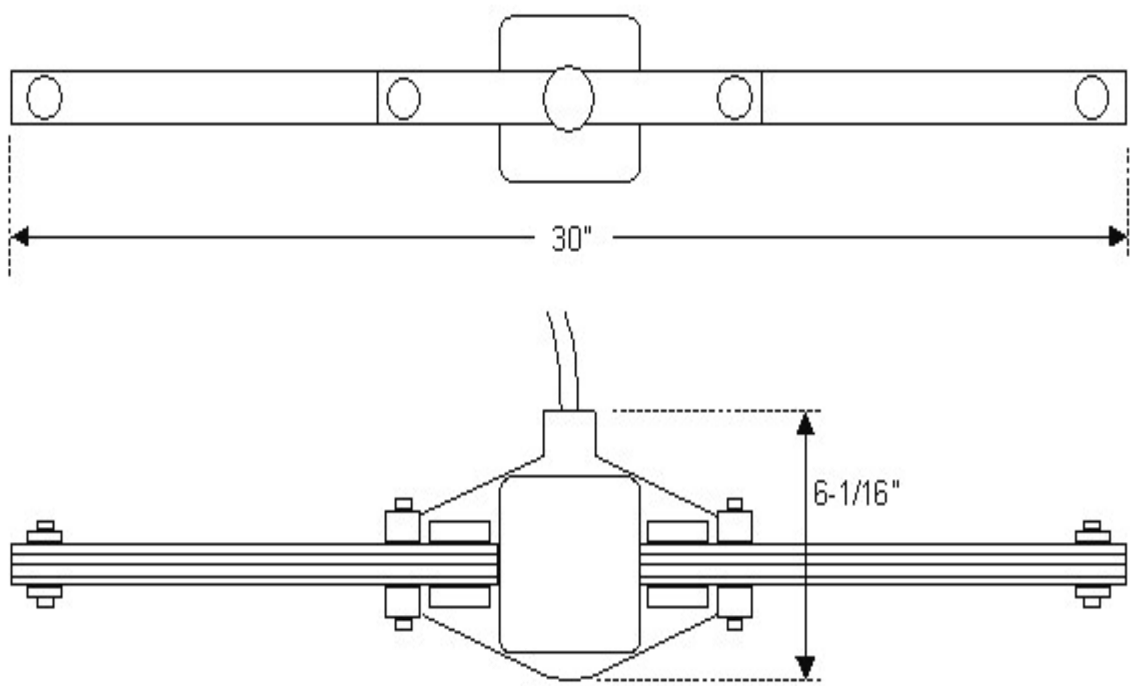


Figure 15-I-02.10 Track Receiver

15-I-02.02.02.03 FSK Pickup Coils

The MicroCab® system uses a pair of truck-mounted FSK pickup coils (MGL only) at each end of the vehicle (four total) to detect FSK cab signals.

The pickup coils couple the carrier signal received from the rails to the FSK Receiver PCB in the ATP/TWC enclosure through a junction box and the vehicle wiring.

Figure 15-I-02.11 shows a general view of a pickup coil.

Refer to Figure 15-I-02.7 for the FSK Pickup Coil location in the vehicle underframe.

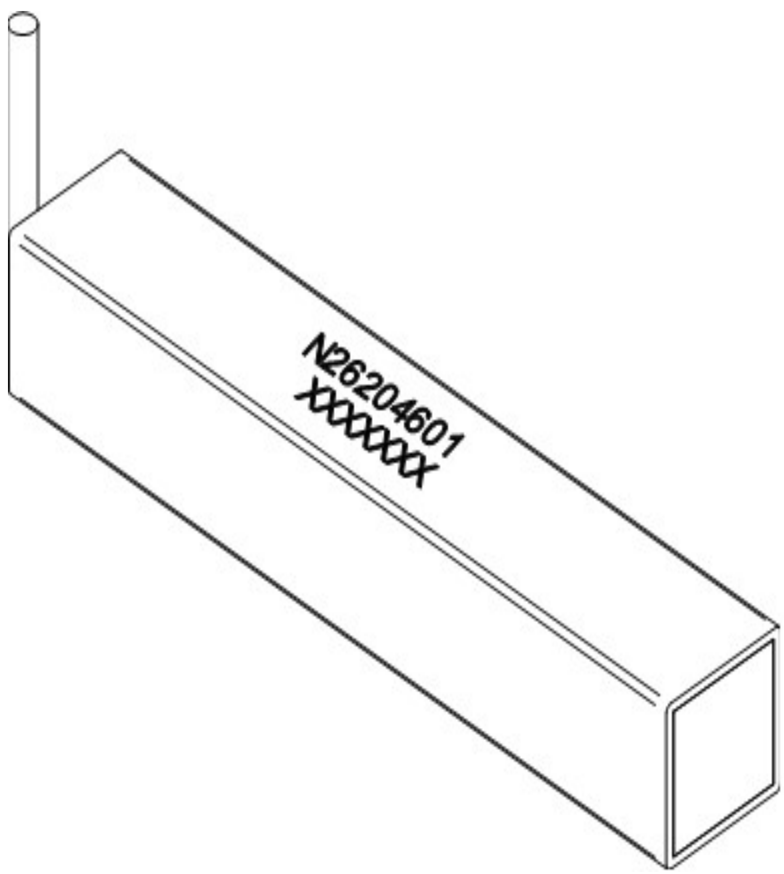


Figure 15-I-02.11 FSK Pickup Coil

15-I-02.02.02.04 Speed Sensors

The MicroCab® system uses a pair of active speed sensors to provide vital monitoring of vehicle speed and to detect wheel spin/slide conditions.

One sensor mounts on the axle of a Motor Truck (Axle 2).

The second sensor mounts on an axle of the Trailer Truck (Axle 4).

Inputs from both sensors are fed to the ATP/TWC enclosure through the vehicle wiring. Figure 15-I-02.12 shows a general view and mounting arrangement of a speed sensor.

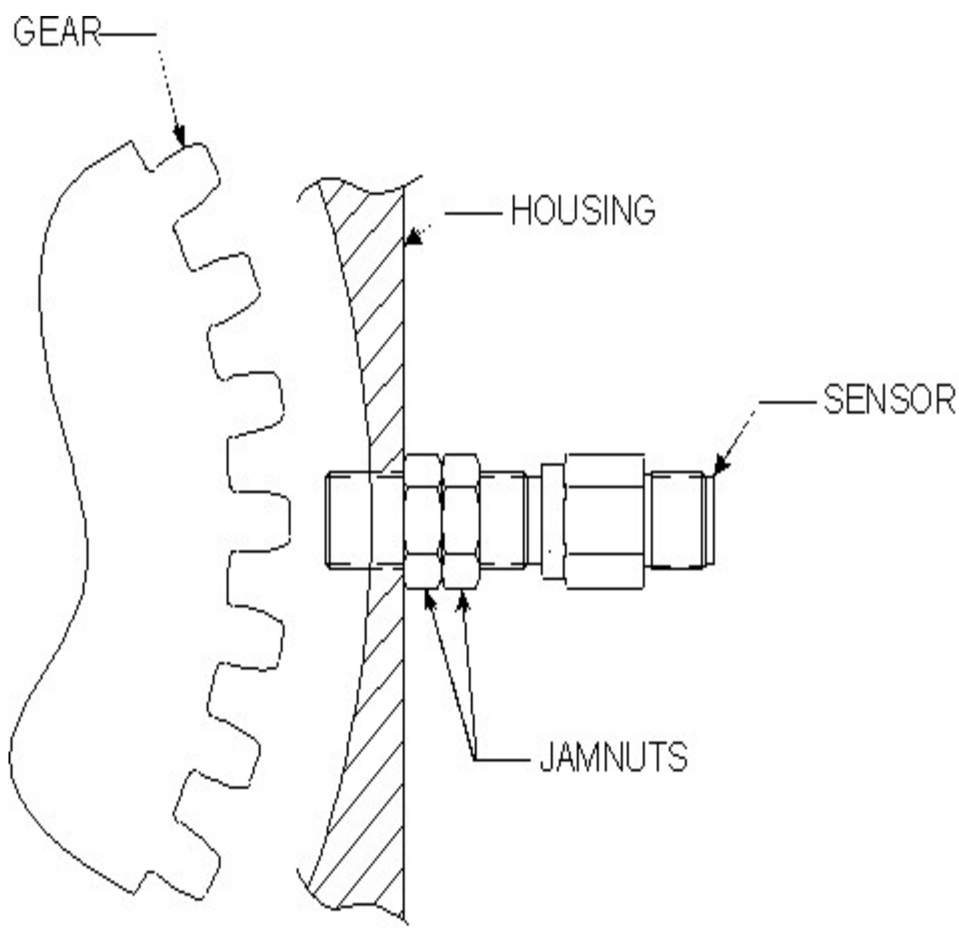


Figure 15-I-02.12 Speed Sensor

[redacted]

[redacted]

[redacted]

[redacted]

15-I-02.04 ATP Functional Description

15-I-02.04.01 Cab Signal Reception and Decoding

Track circuits provide a mechanism for the wayside to detect the presence of vehicles and transmit control signals to vehicles.

Each wayside track circuit continuously transmits vital data to the vehicle, generally referred to as Cab Signal.

The Cab Signal data within each track circuit provides much of the information needed to determine the current safe speed of the vehicle.

The Metro Blue Line (MBL) and Pasadena Gold Line (PGL) use one Cab Signal technology. The Metro Green Line (MGL) uses a different Cab Signal technology.

The ATP System on the P2550 vehicles is compatible with both Cab Signal technologies, so that any P2550 LRV can operate on all three lines.

The signal decoding method used by the ATP is determined by the position of the vehicle Line Selector switch.

The MGL uses a profile-based system based on digital audio-frequency (AF) FSK technology. With this system, Cab Signal reception and decoding is a function of the FSK subsystem.

The MBL and PGL use a non-profile-based step system based on traditional modulated, coded carrier technology.

With this system, Cab Signal reception and decoding is a function of the Decoder subsystem.

15-I-02.04.01.01 Cab Signal Reception and Decoding (MGL)

The vital data transmitted by the wayside AF track circuits is a digitally formatted data message using FSK-modulated signals.

Eight carrier frequencies are used, ranging from 9.5 to 16.5 kHz and spaced at 1 kHz intervals.

The Mark and Space (high and low state) frequency separation is 400 Hz (base carrier ± 200 Hz).

The FSK subsystem selects a carrier by tuning one of three digitally tuned filters to the appropriate frequency for the current track circuit.

A second filter is tuned to the frequency of the next track circuit, based on the vehicle's current position and route.

Each message contains speed commands, track circuit identification, and next track circuit frequency data.

The ATP receives the wayside messages via the FSK pick-up coils mounted on the end truck at the lead end of the LRV, based on the current active cab end.

The coils inductively couple to the rail current and provide a signal to the ATP FSK Receiver.

The FSK Receiver performs carrier frequency selection and FSK demodulation.

Signal level thresholds are used to determine when a vehicle crosses into the next track circuit.

The signal detection level is calibrated to detect signals above a predefined level, based on the nominal rail current.

The demodulated data is then passed to the FSK CPU, where the message is decoded and validated.

Once validated, the data is then forwarded to the Main Logic CPU.

a) Cab Signal Message

The vital information transmitted to the vehicle and decoded by the vehicle's FSK subsystem is a digital message of 72 bits.

The message contains a total of 61 bits of information plus 11 bits used for rounding the message to the 72-bit total.

The first 8 bits - the header bits - have a fixed pattern (01111110), and are used for synchronizing the onboard decoding function. The next 37 bits contain data to be used by the ATP.

The final 16 bits of the message frame are the Cyclic Redundancy Check (CRC) bits for error detection.

The data is transmitted at 200 bits per second. A complete FSK message takes 360 milliseconds to transmit.

Table 15-I-02.5 shows the bit structure of the data message.

Table 15-I-02.5 MGL Cab Signal Message Data Bits

Data Description	Bits
Track Circuit ID (Binary)	12
Line Speed	4
Target Speed	4
Distance-to-go	6
Direction Control (East or West)	2
Next Carrier Frequency	3
Berthed Indication	1
Coupling/Uncoupling (not used)	2 (Ignored)
Out of Correspondence between direction and active coil (used only by Wayside Controller)	1 (Ignored)
Primary/Backup (used only by Wayside Controller)	1 (Ignored)
Spare	1
Total	37

For the MGL, the following information is contained in the message sent from the TWC to the ATP:

- Track Circuit ID: tells the vehicle which track circuit the vehicle is traversing. Using 12 bits allows 4096 unique track circuit ID numbers.

Three parameters are involved in controlling train speed: Line Speed, Target Speed, and Distance-to-Go.

Line Speed - is the maximum vehicle speed permitted while the current message is applicable.

- Target Speed - is the desired speed of the vehicle when it reaches the target.
- Distance-To-Go - represents the distance from the beginning of the current track circuit to the target. This defines the position of the target.

These three parameters use encoded values to represent actual values.

The 16 encoded Line and Target speed values represent 0, 1, 5, 8, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, and 65 mph.

Distance-to-go has 128 encoded distances. They represent from 0 to 9000 feet. The increments vary from 25 to 1000 feet.

For conservatism, the actual physical distance is converted to the next lowest (or equal) of the available distance values.

- Direction Control: Tells the vehicle which direction (East or West) is allowed to move. If both or neither of the bits are set, the vehicle will not be allowed to move in either direction. The two bits are never both set (both bits are 1) at the same time.
- Next Carrier Frequency: These three bits indicate which of the eight possible track circuit frequencies is used in the next track circuit the vehicle will enter.
- Berthed Indication: Sent when the vehicle is at a station platform or in some Control and Maintenance Center (CMC) area track circuits if the exit and approach tracks are unoccupied. The bit tells the vehicle if it has cleared the entrance track, and is used to permit door opening while in these tracks.

A valid FSK cab signal message contains:

- A valid Track circuit ID
- The East or West bits set (not both set or both clear)

A non-zero cab signal message is one that contains a non-zero line speed.

b) Loss of Cab Signal

Two consecutive, identical new messages must be received before the ATP can use the decoded data as valid new cab signaling data.

The worst-case time for the decoding of changed cab signal data received is three (3) worst-case message periods; less than 1.2 seconds for three 72-bit messages.

Cab signaling data is continually sent to the ATP process, at least once each ATP process cycle, as long as consecutive messages of identical valid content are continuously and consecutively received by the FSK decoder CPU.

If a message in the sequence is not valid, (failed Cyclic Redundancy Check (CRC or checksum), and/or has non-identical content), the last decoded message is retained until a 2.75 second vital timer expires or until it can update the cab signaling data (at the current frequency or the decoded next frequency).

If valid cab signal data is decoded within the timed interval, the new data is passed to the ATP process, and the train continues as indicated.

If the vital timer expires, a Loss of Cab Signal is declared and all-zero data are sent to the ATP process.

The ATP reacts by displaying a zero speed limit and turning off the Cab Signal indicator on the ADU.

This creates an Over speed if the vehicle is moving, and the Operator is then required to stop the vehicle using the Operator rules for Over speed.

The ATP continues waiting for Cab Signal on the “lost” frequency, and also on the next frequency indicated in the last valid cab signal data.

If Cab Signal is received before the vehicle is completely stopped, the ATP displays the received speed code.

The Over speed remains active until the vehicle is below the Maximum Allowable Speed (MAS) and the Operator requests Coast or Brake.

With no Cab Signal present, the Operator has the option of entering Stop and Proceed mode (see Section 15-I-02.04.07.01a) Stop & Proceed).

When the system is in Stop and Proceed mode and a loss of cab signal has been declared, the ATP scans all valid track frequencies searching for a valid cab signal message.

The ATP will also scan all valid track frequencies under the following situations:

- System power-up or reset
- Line selection change to MGL
- An operating mode change from an inactive to an active mode
- When no valid cab signal is present while in Bypass mode The

ATP removes any scan requests if any of the following occur:

- Receipt of a valid Cab Signal with a non-zero line speed when in an active mode (This latch condition, LS=0, helps attain proper speed limits at station turn-backs)
- Receipt of a valid Cab Signal when in Bypass mode
- Entry into Off mode
- Line selection change to MBL or PGL

15-I-02.04.01.02 Cab Signal Reception and Decoding (MBL/PGL)

The vital data transmitted by the wayside track circuits on the MBL/PGL is in the form of a coded (100 Hz or alternating 100/250 Hz) carrier, modulated at one of the following code rates to define the current speed limit (see 15-I-02.04.04.02 Current Speed Limit Determination (MBL and PGL)):

- No Code or Constant Carrier
- 50 CPM @ 100 Hz
- 75 CPM @100 Hz
- 120 CPM @ 100 Hz
- 180 CPM @ 100 Hz
- 270 CPM @ 100 Hz
- 270 CPM @ 100/250 Hz
- 410 CPM @ 100 Hz

The ATP receives the wayside signals via the Track Receiver coils mounted on the underbody of the LRV in front of the leading truck at each end.

The ATP selects the appropriate receiver pair according to the current active cab end. The coils inductively couple to the rail current and provide a signal to the ATP Filter Demodulator PCBs, which remove any out-of-band noise, and demodulate the coded carrier.

For reliable operations, the signal detection level is calibrated to detect signals within a predefined range based on the nominal rail current.

The received signal is subjected to validation checks for signal amplitude, period, and duty cycle.

The ATP Decoder CPU PCB determines and validates the dominant code rate.

When validated, the determined code rate is sent to the vital Main Logic CPU for interpretation.

a) New Code Detection

The actual detection or recognition of a defined code rate is based on meeting two conditions.

For a code rate to be declared, its drop timer must be running and its period detect counter must have reached the minimum number of cycles to detect value before the associated drop timer expires.

A code rate’s drop timer is started when the first valid period corresponding to the code rate is detected.

A period detect counter is used for each code rate to tally the number of valid code periods that have been detected for the associated code rate.

This counter is incremented each time that the corresponding valid code rate is detected.

A new code rate is declared after the minimum number of cycles is detected within the drop time and it is the most restrictive code rate present.

b) Maintaining Established Code Rate

The continued detection or recognition of an existing code rate is based on meeting one condition: its drop timer must not be expired.

If this condition is satisfied when a valid cycle is detected, the associated drop timer is reset.

The drop timer is not affected if the detected cycle is not valid, and continues to count down. If the drop timer expires, the code is discontinued.

c) Dominant Code Rate Determination

The coded carrier channel may have up to eight (8) code rates defined.

If two code rates are detected on the same channel, only the more restrictive code rate is sent to the host Main Logic CPU as signal aspect data.

With a Cab Signal established, a change to a more permissive aspect is delayed until the currently running drop timer expires.

If a No Code or a more restrictive aspect is received, the new code will be displayed and enforced immediately after the minimum number of cycles has been detected.

15-I-02.04.02 Vehicle Speed Determination

Determining vehicle speed is a critical and vital function of the ATP.

The ATP uses two independent speed sensors installed on the vehicle.

One sensor is installed on an axle of the non-powered trailer truck.

The other sensor is installed on an axle of an end powered truck.

The ATP determines vehicle speed using the received speed sensor signals and the stored wheel size for each monitored axle.

The output from each sensor is a pulse train with a frequency proportional to the rotational velocity of the monitored drive.

Each truck axle houses a 100-tooth gear that rotates along with the wheel.

The speed sensors detect each gear tooth as the axle rotates, creating a pulse train signal to the ATP.

The ATP converts these pulses into linear distance using wheel diameter data.

Speed for each sensor is then calculated as the linear distance per unit of time.

The calculated speeds are mapped into two separate speed parameters used by the ATP.

The vital parameter System Speed is the higher of the two calculated speed values, unless a spin or slide condition exists.

This parameter is used for all vital functions conducted by the ATP.

The non-vital parameter ADU Speed is used for the Operator speed display.

During a Spin condition, vehicle speed is determined using the speed sensor on the non-powered truck (Trailer Truck).

During a Slide condition, vehicle speed and/or speed related decisions are based on the last known good speed (non-spin) and decelerometer measurements.

In the event of a declared slide condition, or in a condition in which the speed sensors cannot be considered reliable, the ATP maintains an additional speed parameter that is adjusted by means of the decelerometer device.

An additional non-vital speed parameter “ADU Speed” is used for speed display to the operator via the ADU.

15-I-02.04.02.01 Speed Sensors

The speed sensors can reliably detect speeds as low as near zero mph.

Two speed sensors are needed to protect against singularly undetectable failures and to reduce the possibility of common mode failures.

Each sensor is powered by an independent supply.

The sensors are used in determining vehicle motion parameters such as:

- Vehicle Speed
- Spin/Slide
- Vehicle V-zero state
- Vehicle No Motion state
- Vehicle Position (MGL only)

15-I-02.04.02.02 Wheel Wear Compensation

A wheel wear adjustment function is provided in the ATP for use in determining vehicle speed.

The system allows for input of the actual wheel diameter to ensure accurate measurement of vehicle speed.

This vital value can be adjusted between the nominal new wheel diameter of 28.25 inches to the minimum allowable wheel diameter of 26 inches, in 0.25 inch increments.

Both speed sensor equipped axles are required to have a wheel diameter value set and verified by a qualified maintainer.

After measuring the wheel(s) associated with each speed sensor, the appropriate value(s) are entered into ATP using the function switches and alphanumeric displays on the front of the Main Logic CPU.

The ATP will only permit entry of the wheel diameter values if the ATP is in an inactive mode.

If an active mode is entered during the data entry process, the ATP will exit the entry session and revert back to using the current stored value.

After the input is made, the wheel diameter values are retained in the ATP EEPROM until authorized maintenance personnel adjust it.

On startup, the ATP uses the maximum wheel diameter setting to compute speed, until the stored data is retrieved from the EEPROM.

The largest wheel diameter setting is also used if the stored wheel diameter setting is corrupt (i.e., value out of range, EEPROM failure, etc.).

The wheel wear calibration is necessary at the following times:

- During each periodic inspection
- After truing any wheel for which a speed sensor is associated
- After replacement of a truck for which a speed sensor is associated

15-I-02.04.02.03 V-zero Speed Determination

A V-zero (velocity = zero) state is determined as a stopped and stable condition that is used as a latch for various ATP utilities.

A V-zero state is declared when all of the following conditions are met:

- “System Speed” is calculated to be 0 mph for two (2) seconds continuous
- A Loss of Sensors error is not active

The system exits the V-zero state when the “System Speed” is exceeds zero (0) mph for one (1) second continuous.

15-I-02.04.02.04 No Motion Determination

A No Motion state is determined so that the ATP can enable doors.
On the MGL, the vehicle must also be berthed to enable doors.
A No Motion state is declared when all of the following conditions are met:

- “System Speed” is one (1) mph or less;
- No active Slide condition exists;
- A Loss of Sensors error is not active;

The system exits the No Motion state when “System Speed” exceeds one (1) mph.

15-I-02.04.02.05 Loss of Speed Sensor Signal

The ATP performs three types of vital crosschecks on the speed sensing circuits: loss of sensors while stopped, loss of sensors while moving, and speed mismatch between sensors.

a) V-zero/Decelerometer Crosscheck

The V-zero/Decelerometer crosscheck is performed during a static V-zero state with the ATP in any operating mode.

V-zero is checked against acceleration/deceleration, as measured by the decelerometer, to verify that both speed sensors are electrically present before vehicle motion begins.

Any observed acceleration (forward movement) or deceleration (reverse movement) is accumulated during a V-zero state.

If the accumulated acceleration or deceleration is equivalent to a speed of ten (10) mph or more without a valid speed sensor signal present, a V-zero/Decelerometer error is declared.

The V-zero/Decelerometer error is cleared when pulses are detected from either speed sensor or the ATP transitions between operating modes.

When a V-zero/Decelerometer error is active with the system in an active operating mode, a Penalty Brake application is requested.

The Penalty Brake request is cleared when the V-zero/Decelerometer error is no longer active, or when the ATP system transitions to an inactive operating mode (e.g., OFF).

If the decelerometer is in a failed condition, its output is set to a zero (0) mph/s equivalent and the V-zero/Decelerometer crosscheck is disabled.

In this case, a secondary speed crosscheck is invoked.

The secondary check requires that a valid speed signal be received within 10 seconds of indication that propulsion is applied (No Power input de-energized).

If a valid speed signal is not observed by the ATP, a Motion without Speed crosscheck error is declared and Penalty Brake is requested.

b) dV/dT Crosscheck

A dV/dT event is declared any time that the speed calculated from either speed sensor input drops by five (5) mph or more within one (1) second.

No dV/dT event is declared for a similar increase in calculated speed.

This event may be caused by, and is intended to detect, a Slide condition (refer to Paragraph 15-I-02.04.02.07, Slide Detection).

Slide detection is used to determine when the speed calculated from the speed sensor inputs is not valid because the wheels are sliding along the rails.

During a Slide condition, the ATP must use decelerometer readings to determine speed- or position-related ATP action.

c) Loss of Sensors Crosscheck

The Loss of Sensors crosscheck is performed while the vehicle is moving (not in a V-zero state) and the ATP is in any operating mode.

This crosscheck is used to detect the loss of both speed sensor signals while the train is moving.

If both speed sensors were indicating at least six (6) mph and then drop to zero for ten (10) seconds or more continuous, a Loss of Sensors error is declared.

A Loss of Sensors error clears when the indication from either speed sensor exceeds three (3) mph for at least one (1) second, or the ATP transitions between operating modes.

If the vehicle stops before regaining indication from either speed sensor, the error can only be cleared by pressing the ATP Reset pushbutton.

When a loss of sensors error is declared, a Penalty Brake is requested if the ATP is in an active operating mode.

The Penalty Brake request is cleared when the loss of sensors error is cleared or when the ATP transitions into an inactive operating mode.

d) Speed Mismatch Crosscheck

A Speed Mismatch crosscheck is performed when the ATP is in any operating mode. This crosscheck is used to detect a problem with or loss of signal from a single speed sensor.

The ATP compares the calculated speed from each sensor.

If there is a difference of more than six (6) mph, a Speed Mismatch event is declared. If the event continues for 16 seconds or more, a Speed Mismatch error is declared.

If the ATP is in an active operating mode, a Penalty Brake is requested.

The Penalty Brake request continues until the Speed Mismatch error clears or the ATP transitions to an inactive operating mode.

The Speed Mismatch error clears when the difference between the two calculated speeds is six (6) mph or less for at least one (1) second.

15-I-02.04.02.06 Spin Detection

Spin detection is performed at all times when in an active operating mode.

Spin detection is independent of all other speed sensor input checks.

Spin detection is used to determine when the speed calculated from the Motor Truck speed sensor input is not valid because the wheels are spinning on the rails.

When a Spin condition is active, “System Speed” is determined using only the Trailer Truck speed sensor input.

The state of the vehicle No Power trainline determines when the ATP monitors for spin.

When the vehicle is in Power mode, the ATP compares (each software cycle) the rate of change in speed calculated from the two speed sensor inputs.

If the Motor Truck accelerates two (2) mph/s (or more) faster than the Trailer Truck, a Spin condition is declared.

The Spin condition is cleared when the rate of increase in calculated speed from both speed sensors drops to less than two (2) mph/s for at least one (1) second.

15-I-02.04.02.07 Slide Detection

Slide detection is performed at all times when in an active operating mode.

Detection of slide is independent of all other speed sensor input checks.

Slide detection is used to determine when the speed calculated from the speed sensor inputs is not valid because the wheels are sliding along the rails.

The ATP system declares a Slide condition whenever a dV/dT event is declared (refer to Paragraph 15-I-02.04.02.05b dV/dT Crosscheck).

A Slide condition is cleared when all of the following conditions are met:

- No active dV/dT Event exists
- No Speed Sensor Mismatch Event exists
- No Loss of Sensors Event exists
- No Over speed condition exists

15-I-02.04.03 Vehicle Position Determination (MGL Only)

The vehicle ATP contains topographic data for the mapping of track circuit ID to specific track circuit parameters stored as tables in the EEPROM PCB.

15-I-02.04.03.01 Position Determination

The vehicle must determine its position vitally with respect to the track circuit currently occupied, and to its position within the entire MGL system.

The ATP identifies which track circuit it currently occupies using track circuit ID and direction control data received in the cab signal messages sent from the wayside to the vehicle.

It checks that the sequence of track circuit IDs is consistent with the direction of travel. It also vitally determines its position within the current track circuit using the track circuit boundaries as reference points.

Safe separation between vehicles, speed limit protection, and station platform door control all require the train to accurately and vitally account for its position and direction of travel.

Crossing from one track circuit to the next provides the point of reference for position determination.

Bonds are used to mark the boundaries of each track circuit.

The FSK subsystem continually monitors the amplitude of the signal in the current track circuit. As the vehicle reaches the end of a track circuit, the signal amplitude of the current received frequency begins to fall.

The FSK subsystem provides a “Bond Detect” indication to the ATP when the amplitude of the next frequency is greater than the Next Frequency Threshold (THnxt) and:

- The amplitude of the current signal falls below 75% of its peak, or
- The amplitude of the current signal falls below the Must Not Detect Threshold (THmnd).

Upon crossing the bond of a track circuit, the ATP resets its relative position to zero. Zero position is taken at the West end of each track circuit regardless of the direction of travel.

This convention is consistent with the elevation profile data stored in the track circuit tables for each track circuit.

As the train proceeds into the track circuit, the speed sensor pulses accumulated since the boundary detection event are converted to distance and used to determine the current position in the track circuit.

If any of the following events occur, the position is set to the end of the current track circuit (this is the most restrictive case):

- The bonds at consecutive track circuit boundaries are missed;
- Initial detection of a track circuit upon vehicle power up;
- Cab signal is regained after a loss;
- A track circuit is out of sequence;
- Vehicle direction is changed (by the cab signal direction control bits);
- The bond at a track circuit boundary is missed and the track circuit exited is a special-length track circuit.

During a spin condition, the ATP updates its position using pulses from the speed sensor on the non-powered truck.

During a slide condition, the ATP updates its position using data from the decelerometer, compensating for the grade stored in the on-board track tables.

The ATP crosschecks the track circuit information received with its locally stored track circuit tables. The following functional checks are performed:

- Track Circuit Validity: The received (cab signal) track circuit IDs must exist in the locally stored track circuit tables; otherwise, a Penalty Brake is requested and a loss of cab signal is declared.
- Track Circuit Sequence: The received (cab signal) track circuit IDs must follow the expected sequence, allowing for any crossover circuits at switches. If not, a Penalty Brake is requested.
- Vital Berthing Positions: Station stop vital berthing positions must be recognized and be utilized in safe berthing and door control.

Table 15-I-02.6 shows the typical data for positive alignments using the current track circuit ID and direction.

Assume that the vehicle in

Figure 15-I-02.17 is in Track Circuit 1550 and receiving an East direction bit.

From Table 15-I-02.6, the ATP knows the next track circuit ID to look for based on its location in Track Circuit 1550.

If the vehicle is taking the crossover, the next Track Circuit ID is 1920.

If the vehicle was not taking the crossover, the next Track Circuit ID is 1551.

If the vehicle was receiving the West direction bit, the next Track Circuit ID to expect is 1549 (not shown in diagram).

NOTE: Figure 15-I-02.17 and Table 15-I-02.6 use fictional track circuit ID numbers as examples.

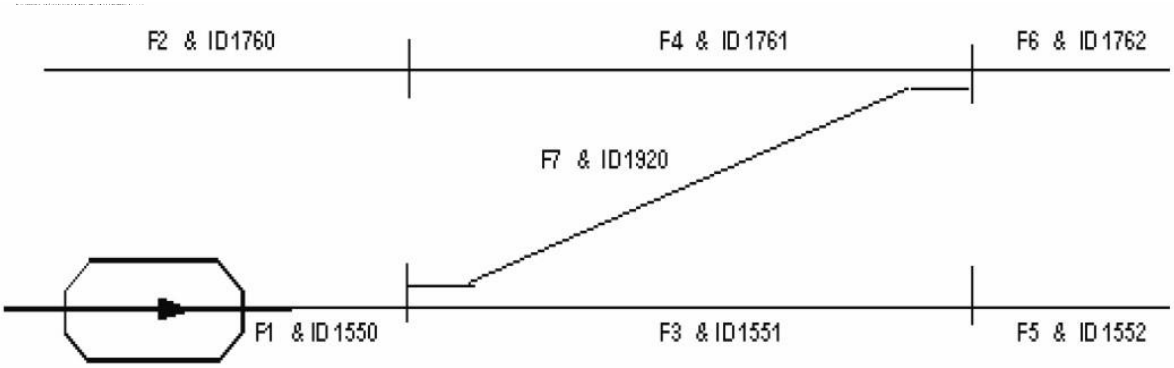


Figure 15-I-02.17 Track Circuits and Frequency Assignments - Crossover

Table 15-I-02.6 Track Circuit ID

Track ID	East Direction Bit		West Direction Bit	
	Normal Next ID	Crossover Next ID	Normal Next ID	Crossover Next ID
1550	1551	1920	1549	-
1551	1552	-	1550	-
1920	1762	-	1550	-
1760	1761	-	1759	-
1761	1762	-	1760	-
1762	1763	-	1761	1920

15-I-02.04.04 Over speed Protection

When operating on the MGL, speed limits are mainly derived from the interpretation of the speed codes received from the FSK subsystem.

These speed limits are enforced by the ATP through the use of speed-vs.-distance profiles.

The profiles are constructed based on the Safe Braking Distance (SBD) model established for the Metro Green Line.

When operating on the MBL or the PGL, speed limits are mainly derived from the interpretation of the code rates received from the Decoder subsystem.

In addition to the information received from Cab Signal data, other factors can also affect which speed limit is currently in effect.

These factors include special operational modes, such as Stop & Proceed, Street Running, or Car Wash, and the detection of certain vehicle failures or cutouts, which would impose speed restrictions on vehicle operation.

Once the speed limit has been established, the ATP constantly monitors the current speed of the vehicle and compares it to the speed limit.

Should the vehicle speed exceed the over speed set point of the effective speed limit, the ATP will take appropriate action to bring the vehicle back into compliance should the Operator fail to do so.

15-I-02.04.04.01 Current Speed Limit Determination (MGL)

The ATP receives Line Speed (LS), Target Speed (TS) and Distance-To-Go (DTG) information in the cab signal messages sent from the wayside.

Line Speed is the maximum speed permitted by the train within the control line.

Target Speed is the desired speed at the end of the control line.

Distance-To-Go is the distance to the target speed, referenced to the origin of the current track circuit. Information is updated continuously to the vehicle anywhere along the track circuit as conditions change.

The ATP uses this information along with grade, based on topographical information tabled in the ATP memory, to calculate speed limits along the Safe Braking Distance model braking profile to the target speed.

These profile speeds are enforced to ensure that the vehicle can safely meet the upcoming target speed within the allotted distance.

a) Safe Braking Distance Model

To calculate the braking profile, the effect of gravity (based on height above a reference point*)* and a constant vehicle braking deceleration *(*braking rate over a distance*)* are combined as a total deceleration function.

The final velocity is the initial velocity, adjusted by this deceleration function, times its respective height and distance-to-go.

Therefore, different braking rates can generate various braking profiles.

Figure 15-I-02.18 shows the speed vs. distance-to-go profile used on the MGL for a constant grade over the entire Distance-to-Target.

The ATP calculates a "Time to Profile" using the current vehicle speed and the FSB profile. Specifically, this is the time until the ATP expects to cut propulsion and apply FSB *unless* the operator takes appropriate action.

The ATP alerts the operator (refer to Figure 15-I-02.18) that the train must be slowed down within “Time-to-Profile” or the ATP will intervene.

b) Current Speed Limits

Using the SBD model as the basis for determining speed limits for overspeed enforcement, an Over speed Limit (OSL), an Enforced Speed Limit (ESL), and a Beep Speed Limit (BSL) are calculated.

In general, the OSL determines when Emergency Brake is applied, the ESL determines when propulsion is cut and FSB is applied, and the BSL is the speed limit shown on the ADU (accompanied by a beep alarm when exceeded).

See Section 15-I-02.04.04.04 Over speed Determination (MGL) for further details on how the ATP uses these speed limits.

The EB profile (or SBD profile) is a calculated curve of speed versus distance-to-go defined by a grade compensated 1.12 mph/s slowing-down curve to the target point. The OSL is set to this speed limit unless overridden by a special condition (refer to Table 15-I-02.7).

The FSB profile is time displaced from the EB profile by the FSB Brake Assurance and Operator Reaction time.

The FSB speed limit during the constant part of the profile is the same as the Line Speed. The ESL is set to this speed limit unless overridden by a special condition (refer to Table 15-I-02.7).

Fixed speed limit values are used for special operating modes. Table 15-I-02.7 shows the SBD-model based and fixed speeds limits.

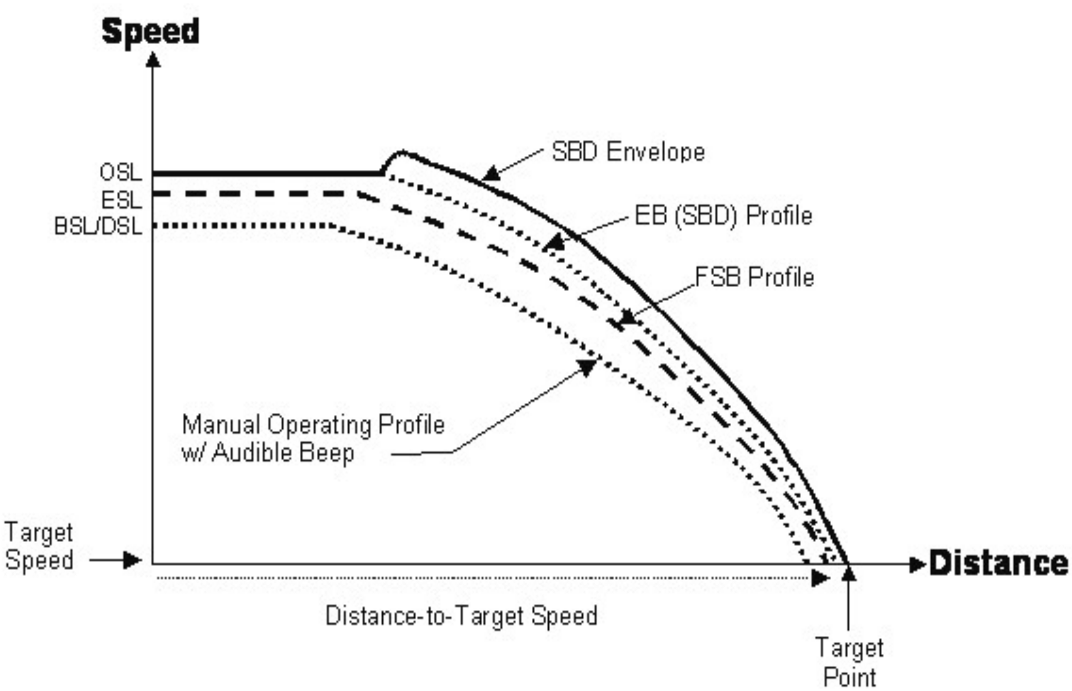


Figure 15-I-02.18 Speed vs. Distance Profiles

Table 15-I-02.7 MGL Speed Limits and Tolerances

Speed Limit or Mode	Beep Speed Limit (BSL)	Displayed Speed Limit (DSL)	Enforced Speed Limit (ESL)	Over Speed Limit (OSL)	Under speed Set Point
0 mph	0 mph	0 mph	0 mph	0 mph	0 mph
All other Speed Limits	ESL - 2.0 mph	ESL - 2.0 mph	FSB Profile	EB Profile	ESL - 2.0 mph
Car Wash	5 mph	5 mph	5 mph	N/A	0 mph
Stop and Proceed	8 mph	8 mph	9.5 mph	N/A	0 mph
Speed Limit Control	ESL - 2.0 mph	ESL - 2.0 mph	FSB Profile (37 mph max.)	EB Profile	DSL - 1 mph
Friction Brake Fault	ESL - 2.0 mph	ESL - 2.0 mph	FSB Profile (12 mph max.)	EB Profile	DSL - 1 mph

15-I-02.04.04.02 Current Speed Limit Determination (MBL and PGL)

The current speed limit is determined by examining the combination of any code rate received from the Decoder subsystem, any operating modes that are in effect, and the status of the No Speed Limit Control input.

The only exception is Car Wash mode. When Car Wash mode is in effect, the Car Wash speed limit will supersede all other speed limit indications (including any received Cab Signal indications).

If Car Wash Mode is not in effect, then the ATP will determine speed limit based on whether Street Running or Stop and Proceed mode is in effect.

If neither of these two modes is in effect, the speed limit is determined based on the Code Rate received from the Decoder subsystem.

In the special case where the No Speed Limit Control input is active, the ATP will enforce the more restrictive speed limit (ESL) of all of the speed limit sources (see Paragraph 15-I-02.04.04.03a), Speed Limit Control).

Table 15-I-02.8 MBL and PGL Speed Limits and Tolerances defines the speed limits and tolerances for the Code Rates and Operating Modes.

Any Code Rate other than what is listed in Table 15-I-02.8 MBL and PGL Speed Limits and Tolerances is considered non-valid by the ATP, and interpreted as a "No Code."

Table 15-I-02.8 MBL and PGL Speed Limits and Tolerances

Code Rate/Mode	Displayed Speed Limit (DSL)	Enforced Speed Limit (ESL)	Under Speed Set Point
No Code	0 mph	0 mph	0 mph
Constant Carrier	0 mph	0 mph	0 mph
50 CPM @ 100 Hz	10 mph	12 mph	DSL - 1.0 mph
75 CPM @ 100 Hz	25 mph	27 mph	DSL - 1.0 mph
120 CPM @ 100 Hz	35 mph	37 mph	DSL - 1.0 mph
180 CPM @ 100 Hz	45 mph	47 mph	DSL - 1.0 mph
270 CPM @ 100 Hz	55 mph	57 mph	DSL - 1.0 mph
270 CPM @ 100/250 Hz	65 mph	67 mph	DSL - 1.0 mph
410 CPM @ 100 Hz (Street Running)	35 mph	37 mph	DSL - 1.0 mph
Car Wash	5 mph	5 mph	0 mph
Stop and Proceed	10 mph	13 mph	0 mph
Speed Limit Control	35 mph (max)	37 mph (max)	DSL - 1.0 mph
Friction Brake Fault	10 mph (max)	12 mph (max)	DSL - 1.0 mph

15-I-02.04.04.03 Special Speed Limits

a) Speed Limit Control

The ATP interfaces to the vehicle Speed Limit Control trainline.

During normal operation, the ATP monitors the No Speed Limit Control input from the vehicle.

The ATP will not establish Speed Limit Control until the input is active (de-energized) for six (6) seconds continuous.

When Speed Limit Control is active, the ATP will continue to enforce any speed limit that is more restrictive than the Speed Limit Control speed limit, and the ADU will appear normal.

If a speed limit is in effect that is the same as Speed Limit Control speed limit, the ATP will always enforce the speed limit with the more restrictive ESL value.

If a speed limit is in effect that is less restrictive than the Speed Limit Control speed limit, the ATP will enforce the Speed Limit Control speed limit.

In this case, the ATP will display a speed limit of thirty-five (35) mph on the ADU, and enforce a maximum speed limit of thirty-seven (37) mph.

When Speed Limit Control is active, the ATP responds normally to an Over speed condition.

b) Stop & Proceed

When the ATP is in Manual (ON) mode, the ADU can enable Stop and Proceed operation.

When manually requested without a valid speed command, the ATP will enforce the corresponding Stop & Proceed ESL for the currently configured line (refer to Table 15-I-02.7).

When Stop & Proceed mode is active, the ATP responds normally to an Over speed condition. The ATP will bring the vehicle to a complete stop, and then release Stop & Proceed mode.

The presence of a valid, non-zero speed command will supersede the speed limit.

The request for Stop and Proceed is a non-vital function; however, the speed limit is vitally enforced.

c) Car Wash

The ATP has an indirect interface to the Car Wash pushbutton on the Operator's Console via the vehicle LONWorks network.

The ATP receives activation and deactivation commands from the network in response to a press of the Car Wash pushbutton.

When the ATP has established Car Wash mode (see Paragraph 15-I-02.04.07.01c)), a speed limit of five (5) mph is displayed on the ADU, and a maximum speed limit of five (5) mph will be enforced.

When Car Wash mode is active, the ATP responds normally to an Over speed condition also, the TCU only allows the train to move 1.5 mph and the train is allow to go on reverse mode.

d) No Friction Brake Fault

The ATP receives a No Friction Brake Fault input from the vehicle when friction brakes have been cutout.

When the No Friction Brake Fault input is de-activated (energized), the ATP will respond by displaying and blinking a 10 mph speed limit on the ADU, and enforcing a 12 mph Over speed limit if all of the following conditions exist:

- The ATP is not in Street Running mode
- A speed limit with a more permissive ESL is being received or is in effect

No restriction is imposed if Street Running mode has been established. In all situations, the ATP will log an internal event when the No Friction Brake Fault input becomes active.

When the No Friction Brake Fault input is active, the ATP responds normally to Over speed, with the No Friction Brake Fault active.

15-I-02.04.04.04 Over speed Determination (MGL)

Over speed detection is enabled during any active operating mode. When operating on the MGL and the "System Speed" exceeds the BSL, the ATP system will "beep" the ADU alarm.

The ATP will not activate the ADU Beep alarm again until the train speed drops below the BSL and then exceeds it again.

When the "System Speed" exceeds the ESL, the ATP:

- Requests a propulsion cut;
- Requests Over speed Penalty Brake;
- Requests a continuous ADU alarm;
- Turns on the OVER SPEED indicator on the ADU; -

Initiate a brake assurance session.

When the train speed exceeds the OSL (unless caused by a sudden speed downgrade) or Brake Assurance fails, the ATP requests Emergency Brake.

When a sudden speed downgrade (OSL dropping more than 1.5 mph/s between processing cycles), the ATP responds as above except:

- If the vehicle speed exceeds the OSL, EB is not requested unless Brake Assurance fails
- The sudden speed downgrade condition clears when the "System Speed" is below the ESL

The Over speed is cleared when the "System Speed" reaches the under speed set point and the operator requests Coast or Brake (any).

When the Over speed clears, the ATP removes the propulsion cut request, Over speed Penalty Brake request, and EB request.

The ATP also ends brake assurance and turns off the ADU OVER SPEED indicator.

The ATP turns off the continuous ADU alarm for any of the following conditions:

- The Over speed condition clears
- A breaking rate of at least 1.12 mph/s is being achieved, and the operator requests Coast or Brake
- An EB has been requested, and the operator requests Coast or Brake

To avoid an EB application caused by the vehicle operator not requesting Coast or Brake upon Over speed detection (runaway), the ATP declares an “early” EB application should either of the following conditions exist:

- Speed is within one (1) mph of the ESL and vehicle acceleration is one mph/s or more
- Speed is within two (2) mph of the ESL, and vehicle acceleration is 1.43 mph/s or more

15-I-02.04.04.05 Over speed Determination (MBL and PGL)

Over speed detection is enabled when the ATP is in an active operating mode.

The ATP declares Over speed when the “System Speed” exceeds the ESL.

When Over speed is declared, the ATP requests a propulsion cut, activates the ADU alarm, turns on the ADU OVER SPEED indicator, and initiates brake assurance (see Paragraph 15-I-02.04.05.02, Brake Assurance).

Under normal conditions (no speed sensor errors present and no slide condition declared), the ATP clears the Over speed when the “System Speed” is less than or equal to the Under speed set point and the operator requests Coast or any Brake level.

If a slide condition is active, the ATP uses Decelerometer Speed to declare and/or clear Over speed.

When the Over speed clears, the ATP removes any Over Speed Penalty Brake and propulsion cut requests, ends brake assurance, deactivates the ADU OVER SPEED, and silences the ADU alarm (if still activated).

For an Over speed declared when the Under speed set point is not zero (0) (i.e., Codeto-Code change), the ATP requests an Over speed Penalty Brake should the brake assurance session fail before the LRV slows to the Under speed set point.

For an Over speed condition declared when the Under speed set point is zero (0) (i.e., Code-to-No-Code change), the ATP skips the initial Brake Assurance session and immediately requests Over speed Penalty Brake.

When an Over speed Penalty Brake is requested, the ATP initiates an additional brake assurance session. If this Brake Assurance session fails, an Emergency Brake is requested.

15-I-02.04.05 Braking and Propulsion Control

The ATP provides the following propulsion and braking control interfaces to the vehicle: Propulsion Enable, Full Service Brake, and Emergency Brake.

Brake assurance is achieved by monitoring the decelerometer output.

Under normal circumstances, the ATP does not use its braking or propulsion controls except to ensure that the vehicle is stopped or to respond to an Over speed Penalty Brake or Emergency Brake condition.

The ATP requests Full Service Brake when the V-zero is declared, the current speed limit is zero (0), and a Departure Test is not in progress.

15-I-02.04.05.01 Propulsion Cut

The ATP prevents excessive acceleration of the LRV by using its Propulsion Enable interface with the vehicle.

The ATP requests a propulsion cut on Over speed, Penalty Brake, or Emergency Brake.

The Propulsion Cut request is removed when the vehicle is Under speed and no active Penalty or Emergency Brake condition exists.

To protect against a possible runaway condition when operating on the MBL or PGL, the ATP will enforce a secondary speed threshold set to four (4) mph above the speed at the instant of a request for a cut in propulsion.

If speed increases above the secondary speed threshold, the ATP System initiates a request for Full Service Brake application.

The Full Service Brake request is removed when the vehicle speed reaches the speed at which the propulsion cut was requested.

To protect against a Full Service Brake failure, the ATP will request an Emergency Brake application if the speed of the vehicle increases beyond six (6) mph above the speed at the instant of a request for a cut in propulsion.

The Emergency Brake request is removed when V-zero is declared.

15-I-02.04.05.02 Brake Assurance (MBL and PGL)

Brake Assurance is performed whenever the ATP detects Over speed.

This is to ensure safe braking of the vehicle within the constraints of the block design. The ATP uses the brake rate measured by the decelerometer to monitor the actual braking rate of the vehicle.

After it is initiated, Brake Assurance continues until the vehicle is Underspeed, the ATP has requested Emergency Brake, or V-zero has been achieved.

The Brake Assurance rate for both the MBL and PGL is 2.00 mphps.

a) Code-to-Code Transition

When a train enters a block with a more restrictive cab signal (other than a continuous carrier or no carrier), the Decoder demodulates and decodes the new cab signal within 3.60 seconds (maximum), and sends the new aspect to the ATP within 0.35 seconds. The Decoder monitors how long it actually took to decode the new cab signal, and sends the remaining detection time (3.60 seconds maximum minus the actual decoding time) to the ATP.

On Over speed detection, the ATP initializes a free-run timer to 3.25 seconds plus the remaining detection time, and starts the timer. The timer expires 7.20 seconds after receipt of the more restrictive cab signal (3.60 + 0.35 + 3.25 = 7.20 seconds).

When the timer expires, the ATP initializes the FSB suppression bank with the deceleration rate associated with the difference between the maximum allowable entry speed and the average grade-compensated speed during the free-run period, and begins rate banking.

The instantaneous brake rate is measured each ATP software cycle (0.250 second).

The ATP adjusts the FSB suppression bank for any difference between the measured brake rate and the required brake assurance rate as follows:

- If the instantaneous brake rate measurement exceeds the required brake assurance rate, the difference is added to the FSB suppression bank to extend the suppression time.
- If the instantaneous brake rate measurement is less than the required brake assurance rate, the difference is deducted from the FSB suppression bank to reduce the suppression time. The ATP initiates an FSB request if the amount deducted from the FSB suppression bank to account for the brake assurance rate is not available in the bank during any software cycle.
- If the instantaneous brake rate measurement equals the required brake assurance rate, the FSB suppression bank remains unchanged.

If the ATP initiates an FSB request, a second brake assurance session is initiated with the EB suppression bank initialized to zero.

For the first two seconds of the second BA session, all rate measured is banked in the EB suppression bank during each ATP software cycle (0.250 second).

After the two seconds has expired, the rate banking begins.

For each following ATP software cycle, the instantaneous brake rate is measured.

Any difference between the measured rate and the required brake assurance rate, the EB suppression bank will be adjusted as follows:

- If the instantaneous brake rate measurement is above the required brake assurance rate, the difference is added to the EB suppression bank thereby extending the suppression time.
- If the instantaneous brake rate measurement is below the required brake assurance rate, the difference is deducted from the EB suppression bank thereby reducing the suppression time. If during any cycle, the amount extracted from the suppression bank needed to account for the brake assurance rate is not available, an emergency brake application is initiated by the ATP system.
- If the instantaneous brake rate measurement is equal to the required brake assurance rate, the EB suppression bank is not affected.

Table 15-I-02.9 summarizes the code-to-code Brake Assurance reaction times.

Table 15-I-02.9 Code to Code Transition Brake Assurance Times

timing	Description	Metro Blue Line	Pasadena Gold Line
Code to Code detection time	New code rate detected (max)	3.6	3.6
Over speed detection time	One ATP software cycle + latency (0.350 sec max)	0.350	0..350
Automatic Propulsion Cut	Propulsion cut initiated with secondary speed threshold for runaway @ V + 4 mph	3.95 sec	3.95 sec
Operator reaction time	Code to code operator reaction time (+ indicates additional time based on code detection time remainder)	2.6 +	2.6 +
ATP time to meet BA rate	ATP initializes bank with rate based on difference between Vmax and current V; begins BA (rate averaging with banking) to inhibit EB request	6.55 sec	6.55 sec
Vehicle reaction time	Mode change dead time from ATP FSB request	0.650	0.650
Time to meet BA rate		7.2 sec	7.2 sec
Brake assurance time	ATP banks rate with FSB applied	2.2	2.2
ATP time to meet BA rate	On failure of BA session #2, ATP requests EB	9.4 sec	9.4 sec
Vehicle reaction time	Mode change dead time from ATP EB request	0.400	0.400
Total time to EB		9.8 sec	9.8 sec

b) Code-to-No-Code Transition

When a train enters a block with a more restrictive cab signal (continuous carrier or no carrier), the Decoder declares a No Code after the full 3.60 seconds allotted, and sends the new aspect to the ATP within 0.35 seconds.

On Over speed detection, the ATP initializes a free-run timer to 3.25 seconds plus the remaining detection time (zero in this case), and starts the timer.

The timer expires 7.20 seconds after receipt of the more restrictive cab signal (3.60 + 0.35 + 3.25 = 7.20 seconds).

When the timer expires, the ATP initializes the EB suppression bank with the deceleration rate corresponding to the difference between the maximum allowable entry speed and the average grade-compensated speed during the free-run period, and begins rate banking.

The instantaneous brake rate is measured each ATP software cycle (0.250 second).

The ATP adjusts the EB suppression bank for any difference between the measured brake rate and the required brake assurance rate as follows:

- If the instantaneous brake rate measurement exceeds the required brake assurance rate, the difference is added to the EB suppression bank to extend the suppression time.
- If the instantaneous brake rate measurement is less than the required brake assurance rate, the difference is deducted from the EB suppression bank to reduce the suppression time. The ATP initiates an EB request if the amount deducted from the EB suppression bank to account for the brake assurance rate is not available in the bank during any software cycle.
- If the instantaneous brake rate measurement equals the required brake assurance rate, the EB suppression bank remains unchanged.

Table 15-I-02.10 summarizes the code-to-no-code Brake Assurance reaction times.

Table 15-I-02.10 Code-to-No-Code Transition Brake Assurance Times

Timing	Description	Metro Blue Line	Pasadena Gold Line
Code-to-No-Code detection time	Constant or no carrier detected.	3.6	3.6
Over speed detection time	One ATP software cycle + latency (0.350 sec max)	0.350	0.350
Automatic Brake Application	Propulsion cut and Full Service Brake initiated with secondary speed threshold for runaway @ V + 4 mph	3.95 sec	3.95 sec
Operator reaction time	Code-to-No-code - automatic brake application only	N/A	N/A
Vehicle reaction time	Mode change dead time from ATP FSB request	0.650	0.650
BA delay time	Time before ATP request for EB, if brake rate is not achieved	2.2	2.2
Time to meet BA rate	ATP initializes bank with rate based on difference between Vmax and current V; begins Brake Assurance (rate averaging with banking) to inhibit EB request	6.8 sec	6.8 sec
Vehicle reaction time	Mode change dead time from ATP EB request	0.400	0.400
Total time to EB		7.2 sec	7.2 sec

c) Decelerometer Calibration

Decelerometer calibration requires that the car be positioned on level tangent track with the air bag levelers (if applicable) active.

The car must be in level to within ± 0.1 degree.

Calibration is necessary following installation or any movement of the ATP enclosure, and periodically when the vehicle is in the shop for routing maintenance.

The calibration routine is invoked by the maintainer, with the ATP in an inactive operating mode. This means train has to be keyed “LOCAL” position in the Enable Cab.

Calibration is performed by using the toggle "key" switches and alphanumeric displays located on the front panel of the Main Logic CPU PCB.

When initiated, the calibration is conducted by removing the mounting screw holding the decelerometer device to the mounting plate and rotating the free end of the device up or down to balance the displayed decelerometer outputs.

When the outputs are balanced (as near as practical), the mounting screw is inserted into the closest mounting hole that maintains the calibration values. A final interaction is required by the maintainer to register the calibration within the ATP memory.

d) Decelerometer Diagnostics

The ATP performs three diagnostic set/reset checks on the decelerometer and its interface circuitry each processing cycle to ensure proper operation:

- The ATP checks the outputs (both directions) to ensure that they sum to the appropriate value (255 ± 5 bits).
- The ATP removes power from the decelerometer and checks the outputs (both directions) with power removed for a null output (0 ± 4 bits).
- The ATP checks the reported state of the analog-to-digital converters.

If any of these checks fail in any given cycle, an error is declared, the error reported to the TCMS, and all Brake Rate calculations for that cycle are forced to zero (0) mph/s.

If the error continues for three (3) consecutive processing cycles, the ATP declares the decelerometer failed, solidly lights the ATP Fail indicator on the ADU, and requests a Penalty Brake application to prevent further movement of the vehicle.

A fourth diagnostic check is performed to detect catastrophic decelerometer failure and is non-recoverable.

The diagnostic monitors the decelerometer outputs (both directions), which should be opposite but of similar variance during vehicle movement.

If not, the decelerometer is declared unstable and reported to the TCMS, all brake rate calculations are forced to zero (0) mph/s, and a Penalty Brake is requested.

This Penalty Brake remains in effect even after the vehicle has completely stopped, and the ATP system must be put in Bypass to release the brakes.

The Valid Decelerometer Calibration flag (stored in EEPROM) is cleared to prevent normal ATP operation until a calibration (presumably after decelerometer replacement) is performed.

15-I-02.04.05.03 Over speed Penalty Brake

An ATP Over speed Penalty Brake includes both Propulsion Cut and Full Service Brake requests.

Both requests are cancelled when the Over speed Penalty Brake condition clears.

15-I-02.04.05.04 Penalty Brake

For all Penalty Brake requests, the ATP performs the following actions:

- Requests Full Service Brake;
- Requests Propulsion Cut;
- Makes the ADU ATP FAILURE lamp blink after the vehicle reaches zero speed.

The Full Service Brake is released, the Propulsion Cut is removed, and the ADU ATP FAILURE lamp is turned off when the Penalty Brake request has cleared, the vehicle reaches V-zero, and the operator has acknowledged the penalty by activating the cab ATP Reset switch.

15-I-02.04.05.05 Emergency Brake

For all Emergency Brake requests, the ATP performs the following actions:

- Requests Emergency Brake;
- Requests Propulsion Cut;
- Makes the ADU ATP FAILURE lamp blink after the vehicle reaches zero speed.

The Emergency Brake is released, the Propulsion Cut is removed, and the ADU ATP FAILURE lamp is turned off when the Emergency Brake Request has cleared, the vehicle reaches V-zero, and the operator presses and releases the cab ATP Reset switch.

15-I-02.04.06 Door Control and Protection

The ATP controls only the enabling or disabling of the doors.

The safe opening, or release for opening, of the doors is always a manual operation for which the Operator - under strict operating rules - must depress the appropriate Doors Right/Left Release, Doors Right/Left Open and Doors Right/Left Close buttons on the vehicle Operator's Console. Safe door opening is a vital assurance function of the vehicle, but not of the ATP.

The ATP monitors the correct control of the doors in all passenger service situations.

When in an active mode on the MGL, the ATP enables the correct doors to open upon arriving at a station, coming to a complete stop, assuring no motion and brakes applied, and being properly aligned with the platform (berthed).

The berthed bit from the platform track circuit informs the ATP that the train is completely within the platform area of the station.

When in OFF mode (on any line), or when in an active mode on the MBL and the PGL, the ATP enables all (Right and Left) doors for opening at any time after assuring no motion and brakes applied.

This permits the opening of any doors when stopped anywhere on the line.

15-I-02.04.06.01 General Door Control (MGL)

Under normal circumstances, the ATP will not enable any doors for opening in any location other than when properly berthed at a station platform, yard transfer track, or cleaning track.

At a station platform, the door control function is primarily used for passenger loading and unloading.

While in a station platform, the ATP assures no motion and brakes applied, verifies berthing and platform orientation information, and then enables the appropriate doors for manual opening by the Operator.

Whether the right or left side doors are enabled is based on vehicle orientation and the locally stored, tabled station and track data.

With the doors enabled, the Operator can open and close doors as desired, or release the doors for passenger control.

Once the doors have been enabled, the Operator receives indication via the TWC Interface Panel that it is time to depart (see Section 15).

The ATP provides berthing information to the TWC system via the ATP to TWC serial link in support of this function.

The ATP removes the door enable command when it detects that vehicle propulsion has been requested and the vehicle is no longer stopped.

When the ATP removes the Door Enable command, all doors that are closed will remain closed, unless the Operator overrides the enable function using the Door Override pushbutton on the vehicle Operator's Console.

a) Vehicle Orientation Determination

In each cab signal message received, the ATP receives commands from the wayside regarding the direction that the vehicle should be traveling.

For the ATP to properly interpret the direction command from the wayside, it must first establish the orientation of the vehicle.

The term “orientation” refers to the direction a designated end of the train is facing.

The ATP attempts to determine its orientation when in an active operating mode if the orientation is not already established, and while receiving a valid cab signal with a nonzero line speed (traffic direction is inconclusive for a zero line speed).

Orientation can be determined automatically while the vehicle remains stationary and properly berthed at a platform track.

If orientation cannot be automatically determined, it can only be determined when the train crosses into the next track circuit.

For example, orientation is East if the A-End is the head of the train, traffic is East, and the train crosses into a track circuit that is East of the previous valid track circuit.

The ATP retains its orientation unless it is completely powered down, cab signal is lost, any inactive operating mode is entered, or Car Wash mode is entered.

The ATP determines its orientation according to Table 15-I-02.11.

The vehicle’s keyed cab is used as the reference point to determine orientation. However, the ATP will report its orientation to the vehicle Operator and to the control center referenced to the vehicle’s A-End (required to support existing functionality on the MGL).

Because the ATP selects only the pickup coils at the keyed cab end of the LRV, the Operator must key down the current cab and key up the opposite cab when traffic is reversed by the wayside.

The ATP sends its orientation to the TCMS through the LONWorks network, which then sends the orientation to the IDU for Operator display.

The vehicle in turn displays the status to the Operator on the vehicle IDU.

The ATP also sends its orientation status to the control center via the TWC system.

Table 15-I-02.11 Determining Vehicle Orientation

Lead End	Traffic Direction	Orientation	Reported Orientation*
A-End	East	East	East
A-End	West	West	West
B-End	East	East	West
B-End	West	West	East

* Reported orientation referenced to the A-End of the LRV

On entry into an active operating mode, the ATP enforces a maximum of the Stop & Proceed speed limit until orientation is established.

Orientation is not needed as part of the normal operations of the vehicle. However, the ATP will not be able to enable the doors until orientation has been established.

Because the vehicle can be moved without having an established orientation, the Operator must always know the proper direction of traffic when moving the vehicle.

b) Direction Assurance

The wayside gives the direction command to the vehicle as part of the Cab Signal message.

The ATP interprets the command continuously, and performs a vital check to confirm it is traveling in the correct direction.

The ATP expects to receive track circuit IDs in a particular order when it is traveling West, and in reverse order when traveling East.

If there is a conflict between the expected track circuit ID order and the direction command, the ATP requests a Penalty Brake application.

The ATP also request a Penalty Brake application if a valid cab code is received without a valid direction (both East and West bits are the same value).

c) Vehicle Berthing

At a station stop, the vehicle must be properly aligned with the platform before it can open its doors for passenger loading and unloading.

This aligning operation is called berthing.

A berthed indication is provided by the wayside in the Cab Signal message, which informs the ATP that the train is completely in the platform area of the station.

Berthing is assured in a fail-safe manner so that vehicle doors can be opened safely, and must be verified before the ATP enables the appropriate doors.

15-I-02.04.06.02 General Door Control (MBL and PGL)

Under normal circumstances, the ATP will not enable any door opening while the vehicle is in motion. At a station platform or otherwise, the ATP assures no motion and brakes applied, and then enables <u>both</u> the right and left doors for manual opening by the Operator.

With the doors enabled, the Operator can open and close the doors as desired, or release the doors for passenger control. The ATP will remove the door enable command when it detects that vehicle propulsion has been requested and the vehicle is no longer in stopped.

When the ATP removes the door enable command, all doors that are closed will remain closed unless the Operator overrides the enable function using the Door Override pushbutton on the vehicle Operator’s Console.

15-I-02.04.06.03 Unplanned Door Opening

When the door enable command is removed and all doors indicate closed, the ATP monitors the Doors Closed trainlines so that if the doors open unexpectedly, an event is logged to capture the occurrence.

The ATP will take no further action since vital assurance of door opening is a function of the vehicle logic. Non-ATP subsystems apply the brakes when the doors are open.

15-I-02.04.07 ATP Modes of Operation

The ATP unit on each vehicle has several basic modes of operation:

- Manual (On) (active)
- OFF (inactive)
- Bypass (inactive)

A mode change to any mode, other than Bypass, can only happen from a V-zero condition.

If the vehicle is moving when the mode is changed, a Penalty Brake is applied to bring the LRV to a stop, and then the mode change is implemented.

The ATP will log an internal event any time a mode change is attempted while in motion.

Additionally, the ATP will log internal events for mode change transitions to indicate the current active mode.

15-I-02.04.07.01 Manual (On) Mode

This is the normal operating mode for the ATP. It is considered to be an active mode. All specified functions are available in this operating mode.

Initially, entry into this mode occurs after the Transfer Switch has been placed into the ON position and the ATP Bypass switch is in a non-bypass position.

In Manual (On) mode, the Operator is given the maximum allowable speed along with the ATP determined speed of the LRV on the ADU.

Depending on which line that the LRV is configured to be operating on, speed limits are determined from code rates received from the Decoder subsystem and from speed codes received from the FSK subsystem.

The ATP then actively participates in supervising the safe operation of the LRV by performing Over speed and Brake Assurance functions.

While operating in this mode, Stop & Proceed, Street Running, and Car Wash special operations are available. Also, the ATP will permit reverse operation, but only when operating in Car Wash mode.

a) Stop & Proceed Mode

Stop and Proceed operation is available on all three lines and is only permitted to avoid stranding the vehicle due to loss of valid speed code data, or zero speed code from a track circuit.

This function is considered to be a fully Operator-responsible action under strict operating rules.

During Stop and Proceed operation, the ATP limits vehicle speed in the absence of a valid speed command.

If Overspeed is detected, the vehicle is brought to a stop using a Penalty Brake application and Stop & Proceed mode is released.

Stop & Proceed operation can be requested by pressing & releasing the Stop & Proceed pushbutton on the ADU front panel.

The ATP will permit Stop & Proceed operation if all of the following conditions exist:

- The vehicle is at V-zero;
- The Master Controller is in a Coast or any Brake position;
- The vehicle indicates that no propulsion is requested and Friction Brakes are applied;
- A loss of Cab Signal is declared, or a valid Cab Signal is being received with a speed limit of two (2) mph or less;

NOTE: Stop & Proceed operation is permitted as a special case on the MGL for received cab signal speed limits up to and including two (2) mph. The effect of the stated condition for the MBL & PGL is that Stop & Proceed will not be permitted for received cab signal speed limits above 0 mph (no speed limits between 0 and 10 mph exist on these lines).

- Not in Street Running Mode;
- Not in Car Wash Mode;

When Stop & Proceed has been established, the ATP limits vehicle speed to the appropriate Stop & Proceed speed limit, and indicates this mode by lighting the Stop & Proceed indicator on the ADU.

When operating in Stop & Proceed mode on the MGL, the ATP scans for a valid FSK message on all assigned track frequencies while a loss of cab signal is declared (see Paragraph 15-I-02.04.01.01b).

Once established, Stop & Proceed is released on any of the following conditions:

- Valid Cab Signal is received with a valid speed code of at least 2 mph

NOTE: For operation on the MGL only - If Stop & Proceed mode is released due to the reception of valid Cab Signal messages with permissive control line information, the ATP retains the Stop & Proceed mode speed limit until a bond crossing is detected, or until the vehicle is berthed. Either of these events ensures that the vehicle is not receiving falsely permissive control line data due to current dividing of the Cab Signal between two trains in the same circuit.

- V-zero is obtained after a Penalty Brake due to Over speed
- Street Running Mode is activated
- Car Wash Mode is activated
- The Stop & Proceed pushbutton on the ADU is pressed and released (at V-zero or in motion)
- The ATP is placed into an inactive operating mode (i.e., Off, or Bypass)

b) Street Running Mode

Street Running operation is permitted only when the LRV is configured for operation on the MBL or the PGL.

Street Running mode is automatically activated whenever the ATP receives a 410 Code from the Decoder subsystem.

If the system fails to automatically enter Street Running mode, the operator can enter this mode by pressing and holding the Street Running push button on the ADU, then pressing and releasing the cab ATP Reset push button, and then releasing the Street Running push button on the ADU.

After Street Running operation has been established, the ATP limits vehicle speed to the Street Running speed limit, and indicates this mode by lighting the Street Running indicator on the ADU.

The ATP will end any active Street Running Mode when any of the following occur:

- The ATP receives a valid non-410 code rate (including Constant Carrier);
- A Decoder communications failure is detected;
- The Operator requests Car Wash operation (see Paragraph c)).

c) Car Wash Mode

The ATP provides a special function for car wash operations when the LRV is configured for operation on the MGL, MBL, or PGL.

During normal car wash, or coupling/uncoupling operations, the vehicle propulsion system regulates vehicle speed at 1.5 mph.

The ATP supervises a fixed speed limit and provides Over speed protection against a failure of the propulsion system to properly regulate the vehicle speed.

Activation and deactivation of Car Wash mode is accomplished via the Car Wash pushbutton on the vehicle Operator Console.

The ATP receives a command to activate or deactivate Car Wash mode via the LONWorks network interface.

The vehicle activates Car Wash mode when the Car Wash pushbutton is pressed while the vehicle is at a full stop, and the Master Controller is in FSB.

The vehicle deactivates Car Wash mode when the Car Wash pushbutton is pressed again with the vehicle fully stopped and the Master Controller in FSB.

On receipt of the activation command from the vehicle, the ATP enters Car Wash mode when the ATP has declared V-zero, the friction brakes are applied, and the Master Controller is in Coast or any Brake position.

After Car Wash mode has been entered, the ATP displays and limits vehicle speed to the Car Wash speed limit.

The ATP releases Car Wash mode when the deactivation command is received from the vehicle, the ATP has declared V-zero, the friction brakes are applied, and the Master Controller is in Coast or any Brake position.

The ATP will implement Car Wash mode regardless of cab signal status (i.e., valid cab signal received, or lost cab signal).

While in Car Wash mode, the ATP will indicate that valid Cab Signal is being received by making the Cab Signal indicator on the ADU blink.

d) Reverse Operation

Reverse operation is permitted only when operating in Car Wash mode or Stop and Proceed mode.

The ATP monitors the state of the Reverser Switch located on the Operator's Console. When the Reverser Switch is set to Reverse, the ATP requests both a propulsion cut and a Full Service Brake application if Car Wash Mode Stop and Proceed mode is not established.

If Car Wash mode is established when the driver places the Reverser Switch into the Reverse position, the ATP continues to provide Over speed protection in the reverse direction by supervising the Car Wash speed limit.

NOTE: Reverse operation should be updated because the new ATP software update allows. Reverse operation in Stop & Proceed, Street Running and Car Wash mode respectively.

15-I-02.04.07.02 Off Mode

In this mode, the ATP is considered inactive.

The ATP enters Off mode when power is applied to the ATP (either cab Transfer Switch set to LOCAL) with no cab activated. All ADU indicators are off and brakes are applied in this mode.

The ATP does provide door enabling functions when in this mode (see Paragraph 15-I-02.04.06, Door Control and Protection).

15-I-02.04.07.03 Bypass Mode

If the Operator selects Bypass mode (by activating the sealed ATP Bypass switch), the Operator has full responsibility for the proper and safe operation of the vehicle.

During Bypass operation, the Operator can operate the vehicle from the local cab, under LACMTA operating rules.

No ATP protection is provided in this mode because all ATP propulsion and braking controls are “bypassed” by the ATP bypass switch.

The ATP de-energizes all of its propulsion and braking control relays.

The ADU reverts to basic speedometer-only operation, displaying vehicle speed as reported to the TCMS from non-ATP vehicle subsystems.

Bypass Mode is entered if the ATP Bypass switch is set to Bypass.

The ATP indicates this mode by lighting the ATP Bypass indicator on the ADU (see Paragraph 15-I-02.04.08.01b), ATP Bypass Indicator.

During operating in this mode, the ADU continues to display speed (see Paragraph 15-I-02.04.08.01a) Speed and Speed Limit Displays) and continues to indicate the status of Cab Signal reception (see Paragraph 15-I-02.04.08.01f), Cab Signal Indicator.

All other ADU indicators are turned off.

If the ATP fails, the Operator must to use the ATP Bypass to operate the LRV.

15-I-02.04.08 ATP Driver Interfaces

15-I-02.04.08.01 Aspect Display Unit (ADU)

The ADU is the primary driver interface to the ATP subsystem.

The ADU consists of displays, indicators, alarms, and controls that allow the Operator to monitor and control certain ATP functions when operating on any of the specified lines (see Paragraph 15-I-02.02.02.01, Aspect Display Unit (ADU)).

All displays, indicators, and controls on the ADU are non-vital.

The ADU provides the driver with the following displays, indicators, and controls:

- Analog and Digital Speed/Speed Limit Displays;
- ATP Bypass Indicator;
- Over Speed Indicator;
- ATP Fail Indicator;
- Departure Test Control/Indicator;
- Cab Signal Indicator;
- Stop & Proceed Control/Indicator;
- Street Running Control/Indicator;
- Display Dimmer Control;
- Audible Alarm.

a) Speed and Speed Limit Displays

The ADU contains both analog and digital speed displays.

The analog display consists of a vertical bar using bicolor (red/green) LEDs, and has a range of 0 to 75 mph in 1.5 mph increments.

The digital display consists of a pair of two-digit, seven-segment display units, with each unit ranging from 0 to 99 mph in 1 mph increments.

When the ATP is in an active operating mode, is not failed, and is properly communicating with the ADU, the ADU displays the ATP determined Speed Limit, Target Speed (limit), and vehicle Speed.

The Speed Limit is shown on the vertical bar only, as a single red LED at the Speed Limit.

The Target Speed (limit) is shown only on the two-digit Target Speed display (for MBL and PGL, the Target Speed (limit) equals the Speed Limit). Vehicle speed is shown on both the vertical bar (as green LEDs up to the Speed Limit and red LEDs above the Speed Limit) and the two-digit Target Speed (limit) display.

If ATP-ADU communication is lost, the ATP is failed, or the ATP is in an inactive operating mode, the ADU displays vehicle speed from non-ATP vehicle subsystems (as reported to the vehicle Information Display Unit).

The ADU will show vehicle speed on the vertical speed bar and the two-digit Speed display.

b) ATP Bypass Indicator

This red indicator lights solid to alert the driver that ATP supervision and control is bypassed (see Paragraph 15-I-02.04.07.03, Bypass Mode).

The ability to illuminate the Bypass Indicator on the ADU can be affected by the general health of the ATP, and the integrity of the communications between the ATP and the ADU.

Conditions that could result in the Bypass indicator not being illuminated when the vehicle Bypass switch is in the Bypass condition include:

- Power is removed from the ATP system.
- The ATP System is in an unrecoverable failed state, which requires a hard reset.
- A problem has developed with the LON network or with one of the LON components on the ATP or ADU resulting in the interruption of communications between the ATP and ADU.

c) Overspeed Indicator

This red indicator lights solid to alert the driver that ATP has detected Over speed (see Paragraph 15-I-02.04.04.04, Over speed Determination (MGL) and 15-I-02.04.04.05, Over speed Determination (MBL and PGL)).

d) ATP Failure Indicator

This red indicator lights solid to alert the driver that the ATP is in a failed condition, or that communications have been lost between the ATP and ADU.

The following specific conditions will light the ATP Failure indicator:

- A problem has developed with the LON network or that one of the LON components on the ATP or ADU has interrupted ATP-ADU communication.
- There is a persistent failure with a vital output, which prevents safe operation.
- When any of the following crosscheck errors is declared:

Line Selection Crosscheck	Full Service Brake
Keyed Cabs Crosscheck	Left or Right Doors Enable
Forward-Reverse Crosscheck	Speed Mismatch
Propulsion Enable	Loss of Sensors
Emergency Brake Crosscheck error	Vzero/Decelerometer Crosscheck Error
Departure Test Relay is active	

When blinking, this indicator alerts the driver that an ATP Reset acknowledgement is required after the vehicle is completely stopped (V-zero) before resuming normal operation.

e) Departure Test Switch/Indicator

This combination switch and indicator allows the driver to initiate an ATP Departure Test (if conditions are met, see paragraph 15-I-02.06.02), cancel a test that is inprogress, and monitor the test results.

As the Departure Test runs, the green indicator lamp blinks.

If the switch is pressed and released while a test is in progress, the test is cancelled.

If the test completes successfully, the green indicator lamp lights steady and remains lit for as long as the ATP is in an active mode.

The indicator goes dark after 5 seconds of successfully completing the Departure Test.
If the test does not complete successfully, the indicator goes dark.
Pressing and releasing the pushbutton again once a test has been run (successful or not) will result in the initiation of another Departure Test, if the proper conditions exist.
Pressing and releasing the pushbutton while a Departure Test is in progress will cancel the test.

A “stuck button” check will be performed on the pushbutton.

If the pushbutton is indicated to be pressed for 30 seconds or more continuous, then the pushbutton press will be ignored, and an event will be logged and reported to the TCMS.

f) Cab Signal Indicator

This green indicator alerts the driver when the ATP is receiving valid Cab Signal on any of the three lines.

The green indicator lamp lights solid (Manual (On) mode) or blinks (Bypass or Car Wash mode) when the ATP is receiving valid Cab Signal.

g) Stop & Proceed Switch/Indicator

This combination switch and indicator allows the driver to initiate Stop and Proceed operation on any of the three lines.

Under the appropriate conditions, pressing and releasing the switch will initiate or cancel Stop and Proceed operation (see Paragraph 15-I-02.04.07.01a), Stop & Proceed Mode).
The yellow indicator lamp lights solid to alert the driver that the ATP is in Stop and Proceed mode.

h) Street Running Switch/Indicator

This combination switch and indicator, along with the cab ATP Reset switch, allows the driver to initiate Street Running operation (see Paragraph 15-I-02.04.07.01b), Street Running Mode on the MBL and PGL lines.

The white indicator lamp lights solid to alert the driver that the ATP has accepted the request and is in Street Running mode.

i) Display Dimmer Control

This rotary control allows the driver to adjust the brightness of the ADU displays and indicators.

Turning the control clockwise increases brightness, counter-clockwise decreases brightness.

j) Audible Alarm

The ATP uses an audible alarm to alert the Operator to any significant change or condition in the ATP system.

The ATP produces several types of audible alarms. These include:

- Continuous - Continuous sounding of the alarm.
- Chirp - Periodic on/off cycling of the alarm; 100 milliseconds ON; 50 milliseconds OFF.
- Beep - Single cycle of the alarm; on for 500 milliseconds, then off.

Table 15-I-02.12 shows the conditions for which the alarm is sounded and released and the type of alarm that is used.

Table 15-I-02.12 Alarm Conditions and Types

Alarm Condition	Alarm Type	Release
Speed Code Change (MBL and PGL) (Note: the code change can be upward or downward)	Beep	500 milliseconds
Over speed	Continuous	Rate achieved or Under speed and driver acknowledged EB Applied, and driver acknowledged
Time to Profile less than 5 seconds (MGL only)	Beep	3 seconds (3 beeps)
Speed greater than BSL (MGL only)	Chirp	500 milliseconds
Target Speed Change (MGL only)	Beep	500 milliseconds

k) ADU Lamp Test

The ADU panel is non-vital and therefore will not prevent the ATP from operating correctly.

However, the proper operation of the LRV depends on the correct interpretation of ATP information by the driver.

The ADU provides an interface to the Lamp Test switch on the vehicle's operator console to check the ADU panel indicators and displays.

While the Lamp Test switch is pressed, all indicators and seven-segment display elements light.

The ADU also lights each of the bi-color LEDs on the vertical Speed/Speed Limit display bar in a red/green, alternating pattern.

The driver must observe that all of display elements of the ADU are working correctly and report any malfunction to maintenance personnel before entering revenue service.

The audible alarm is not checked during the Lamp Test, but is checked during the ATP Departure Test (see Paragraph 15-I-02.06.02).

For the lamp test to activate, the ADU must be receiving a zero (0) or no speed value (i.e., after a communications time-out) from the ATP.

The ADU reverts back to normal display when the Lamp Test pushbutton is released.

15-I-02.04.08.02 Operator's Console

The ATP receives certain control inputs from the vehicle Operator's Console in each cab end.

These inputs include the Transfer Switch, the Reverser Switch, the Master Controller, the Car Wash pushbutton, the Lamp Test pushbutton, and the ATP Reset switch.

15-I-02.04.08.03 Equipment Locker

In addition to the ADU and the Operator's Console, the ATP receives certain control inputs from the vehicle equipment locker.

These inputs include the Line Selector, TWC Bypass, and ATP Bypass switches.

15-I-02.04.08.04 Line Selection Determination

The ATP has the ability to self configure its operation based upon the Line Selector inputs.

The Line Selector inputs provide the ATP with the position status of the Line Selector Switch located in the LRV equipment locker. On power-up, the ATP system defaults with no line selected.

The ATP begins monitoring the state of the Line Selector inputs. If no Line Selector Crosscheck error is active (see Paragraph 15-I-02.04.09.03a), Line Selector Crosscheck, the ATP will configure itself for the indicated line after a valid line selector input has been stable for one (1) second continuous.

The ATP only permits a Line Selection change from a V-zero condition.

If the vehicle is moving when a change to a valid Line Selection is determined, a Penalty Brake is applied to bring the LRV to a stop, and then the Line Selection change is implemented.

15-I-02.04.08.05 TWC Bypass Switch

The ATP receives an input from the vehicle indicating the position of the TWC Bypass switch.

The ATP simply monitors the state of this input and report the status to the vehicle TCMS for display on the vehicle IDU.

15-I-02.04.09 ATP Maintenance and Diagnostics

15-I-02.04.09.01 ATP Maintenance

Maintenance procedures primarily involve general checkout of the system to test its operational readiness, isolate faults, and replace major components for the ATP system.

There are two ATP components that require maintenance attention.

First, the Vital Relay used for Emergency Brake Release needs re-calibrated every six (6) years based on U.S. FRA guidelines.

Second, the decelerometer needs calibration at initial installation or initial delivery of the LRV to the MTA, whenever the decelerometer module is replaced or remounted, after any modification to the ATP enclosure mounting, or when required during periodic inspections.

15-I-02.04.09.02 ATP Diagnostics

The ATP performs extensive internal diagnostics through the use of self-tests as well as continual safety and functional tests.

The tests verify proper operation on the system hardware and software.

US&S ATP systems control vital speed applications on transit vehicles in a vital manner.

Because of the safety constraints of the system, the ATP constantly monitors internal circuitry to ensure safe operations.

During each CPU processing cycle (250 milliseconds), a number of CPU diagnostics and I/O crosschecks are performed. If an error is detected, the system will fail safely. Because the ATP system has the ability to monitor and check itself constantly, the use of an external test module is not required.

All events that can compromise system integrity are logged as internal events and can be retrieved using a Portable Test Unit (PTU).

Specific fault information is also reported to the Train Control and Monitoring System (TCMS).

15-I-02.04.09.03 ATP Crosschecks

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

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

Refer to Paragraph 15-I-02.04.02.05, Loss of Speed Sensor Signal for information regarding crosschecks performed on the speed sensor inputs.

All crosscheck failures are reported to the TCMS.

a) Line Selector Crosscheck

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

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

When a Line Selector Crosscheck error is declared, the ATP latches the last known valid Line Selector Switch indication for continued use by the ATP system.

The ATP will take no restrictive action if a Line Selector Crosscheck error is declared while the vehicle is in motion. However, the ATP will apply a Penalty Brake if a Line Selector Crosscheck error is declared or active with the vehicle at V-zero.

The ATP also requests Penalty Brake if a valid Line Selector Switch indication has not been previously established on declaration of a Line Selector Crosscheck error.

The Line Selector Crosscheck error and Penalty Brake request are cleared when a single Line Selector input is active.

The Line Selector Crosscheck is enabled in the Manual (ON) and OFF Operating Modes, but disabled in Bypass mode.

b) Keyed Cabs Crosscheck

The ATP performs a crosscheck between the A-Cab in Control and B-Cab in Control inputs.

Only one of these inputs should be active at one time. If both inputs are active for one (1) second continuous, a Keyed Cab Crosscheck error is declared and Penalty Brake is requested.

The Keyed Cab Crosscheck error and Penalty Brake request are cleared when either one Cab in Control input is active or neither Cab in Control input is active.

The Keyed Cabs Crosscheck is disabled when the Operating Mode is Bypass.

c) Forward-Reverse Crosscheck

The ATP performs a crosscheck between the Forward and Reverse inputs.

Only one of these inputs should be active at one time.

If both inputs are active for one (1) second continuous, a Forward-Reverse Crosscheck error is declared and Penalty Brake is requested.

The Forward-Reverse Crosscheck error and Penalty Brake request are cleared when only one of the Reverser inputs is active. The Forward-Reverse Crosscheck is active only when in an active operating mode.

d) Propulsion Enable Crosscheck

The ATP performs a crosscheck between the Propulsion Enable output and the Propulsion Enable Check-back input.

The input should always be in the opposite state of the output. If both are in the same state for three (3) cycles (750 milliseconds) continuous, a Propulsion Enable Crosscheck error is declared.

If the error is declared while requesting a Propulsion Cut, a Penalty Brake is also requested.

The ATP takes no restrictive action if the error is declared when not requesting a Propulsion Cut; however, the error is internally logged and reported to the TCMS.

The Propulsion Enable Crosscheck error and Penalty Brake (if requested) are cleared when the states are opposite of one another.

The Propulsion Enable Crosscheck is active only when in an active operating mode.

e) Full Service Brake Crosscheck

The ATP performs a crosscheck between the Full Service Brake output and the Full Service Brake Check-back input.

The input should always be in opposite state of the output. If both are in the same state for three (3) cycles (750 milliseconds) continuous, a Full Service Brake Crosscheck error is declared.

The ATP takes no restrictive action when a Full Service Brake Crosscheck error is declared; however, the error is internally logged and reported to the TCMS.

The Full Service Brake Crosscheck error is cleared when the states are opposite of one another.

The Full Service Brake Crosscheck is active only when in an active operating mode.

f) Emergency Brake Relay Crosscheck

For diagnostic purposes, the ATP is configured to monitor the Emergency Brake Applied trainline to detect vehicle Emergency Brake applications.

The ATP performs a crosscheck between the ATP commanded Emergency Brake output and the state of the Emergency Brake Applied trainline when an ATP EB request is active.

If the ATP EB request state and the EBA trainline State are the same for three (3) cycles (750 milliseconds) continuous, the ATP declares an EB Crosscheck Error, and deactivates the vital CPS voltage to ensure the ATP EB application.

Also, the error is internally logged and reported to the TCMS.

The EB Crosscheck Error is not removed unless a hard reset (from the Main Logic CPU PCB) to the system has occurred.

The Emergency Brake Crosscheck is active only when in an active operating mode and an ATP EB request is active.

g) Left Doors Enable Crosscheck

The ATP performs a crosscheck between the Left Door Enable output and the Left Door Enable Checkback input.

The input should always be in the opposite state of the output.

If both are in the same state for three (3) cycles (750 milliseconds) continuous, the ATP declares and latches a Left Doors Enable Crosscheck error.

The ATP takes no restrictive action when a Left Doors Enable Crosscheck error is declared; however, the error is internally logged and reported to the TCMS.

The Left Doors Enable Crosscheck error is cleared when the states are opposite of one another.

The Left Doors Enable Crosscheck is active only when in an active operating mode.

h) Right Doors Enable Crosscheck

The ATP performs a crosscheck between the Right Door Enable output and the Right Door Enable Checkback input.

The input should always be in the opposite state of the output. If both are in the same state for three (3) cycles (750 milliseconds) continuous, the ATP declares and latches a Right Doors Enable Crosscheck error.

The ATP takes no restrictive action when a Right Doors Enable Crosscheck error is declared; however, the error is internally logged and reported to the TCMS.

The Right Doors Enable Crosscheck error is cleared when the states are opposite of one another. The Right Doors Enable Crosscheck is active only when in an active operating mode.

i) Departure Test Relay Crosscheck

The ATP performs a crosscheck between the Departure Test Relay output and the Departure Test Relay Checkback input.

The input should always be in the opposite state of the output.

If both are in the same state for three (3) cycles (750 milliseconds) continuous, the ATP declares and latches a Departure Test Relay Crosscheck error.

The ATP takes no restrictive action when a Departure Test Relay Crosscheck error is declared during operation on the MGL; however, the ATP does request Penalty Brake during operation unless a Departure Test is running.

In all cases, the error is internally logged and reported to the TCMS.

The Departure Test Relay Crosscheck error clears when the states are opposite of one another.

The Penalty Brake request is removed when the Departure Test Relay Crosscheck error clears, or if the operating line changes.

The Departure Test Relay Crosscheck is active only when in an active operating mode.

15-I-02.04.09.04 ATP Event Logging

A diagnostic function is available within the ATP system to allow maintenance personnel to obtain detailed information on the state of the system.

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

The ATP also saves a “snapshot” of the system state along with each event or fault that is stored.

The event logs can be extracted through an RS-232 diagnostic communications port on the front panel of the ATP Main Logic CPU using a Portable Test Unit (PTU).

The PTU enables the end user to transfer, display, and manage the event log data. Limited event log information can also be viewed and managed using the toggle "key" switches and alphanumeric displays located on the front panel of the Main Logic CPU.

The ATP stores all significant system events in non-volatile memory. Each time an event is recorded, a time and date stamp is stored along with the event occurrence and associated snapshot data.

The time and date of the ATP system is set via the Master Clock information received from the vehicle TCMS. Additionally, the time and date of the ATP system can be set and updated via the PTU in the absence of the Master Clock information.

The types of events that are logged include (but not limited to):

- Penalty brake applications;
- Vehicle Over speed;
- ATP failure or fault conditions.

In addition to the event log data, the ATP also collects and stores continuous real-time data.

The ATP system can collect and store up to 24 hours (minimum) of internal state data - continuously sampled every 250 milliseconds - in a circular buffer.

This data can be extracted from the ATP system using the PTU.

The PTU enables the end user to transfer, display and manage the real time data.

The real time data also has a time and date stamp associated with it.

This information can be cross-referenced to the event log data time and date stamp in order to provide detailed information surrounding ATP System event occurrences.

15-I-02.05 System Configuration and Monitoring

A maintainer can configure and monitor the Vehicle ATP system by the use of menus and toggle switches on the front panel of the Main Logic CPU PCB.

15-I-02.05.01 Configured Parameters

The front panel switches are used to configure the following:

- The current wheel size for each of the two speed sensors;
- The decelerometer (calibration).

15-I-02.05.02 Monitored Parameters

A maintainer can use the front panel switches to change wheel sizes 1 and 2, calibrate decelerometer, and to get the following information:

- Active Cab (A-End or B-End);
- Conditional Power Supply (CPS) PCB Status;
- Operating mode;
- Vehicle Speed;
- System Events.

15-I-02.05.03 Event Logging

There is an event logging diagnostic function available in the ATP system 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 Main Logic CPU using a Portable Test Unit (PTU).

Additionally, limited event log information can be viewed and managed using the toggle "key" switches and alphanumeric displays located on the front panel of the Main Logic CPU PCB.

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

Each time an event is recorded, a time and date stamp is stored along with the event occurrence.

The time and date of the ATP system can be set and updated via the PTU.

The types of events that are logged include (but not limited to):

- Penalty brake applications;
- Vehicle over speed;
- ATP failure or fault conditions.

These events can be extracted from the ATP system through the PTU.

The PTU enables the end user to transfer, display, and manage the event log data.

In addition to the event log data, the ATP collects and stores continuous real-time data. The ATP system is capable of collecting and storing up to 24 hours minimum of internal state data - continuously sampled every 250 ms max. - in a circular buffer. This data can be extracted from the ATP system through the PTU.

The PTU enables the end user to transfer, display, and manage the real time data.

The real time data also has a time and date stamp associated with it.

This information can be cross-referenced to the event log data time and date stamp in order to provide detailed information surrounding ATP System event occurrences.

15-I-02.05.04 Main Logic CPU Front Panel Interface

The Main Logic CPU front panel has switches and displays that are used in order to change the vehicle configuration parameters stored in EEPROM (e.g., wheel size) and for any necessary hardware calibration (e.g., decelerometer).

The front panel is also used to view system events and event count data, as well as other diagnostic information.

Maintenance personnel use this data to diagnose system problems.

Figure 15-I-02.19 illustrated the user displays and switches available on the front of the Main Logic CPU PCB. Table 15-I-02.13 explains the use of the front panel devices.

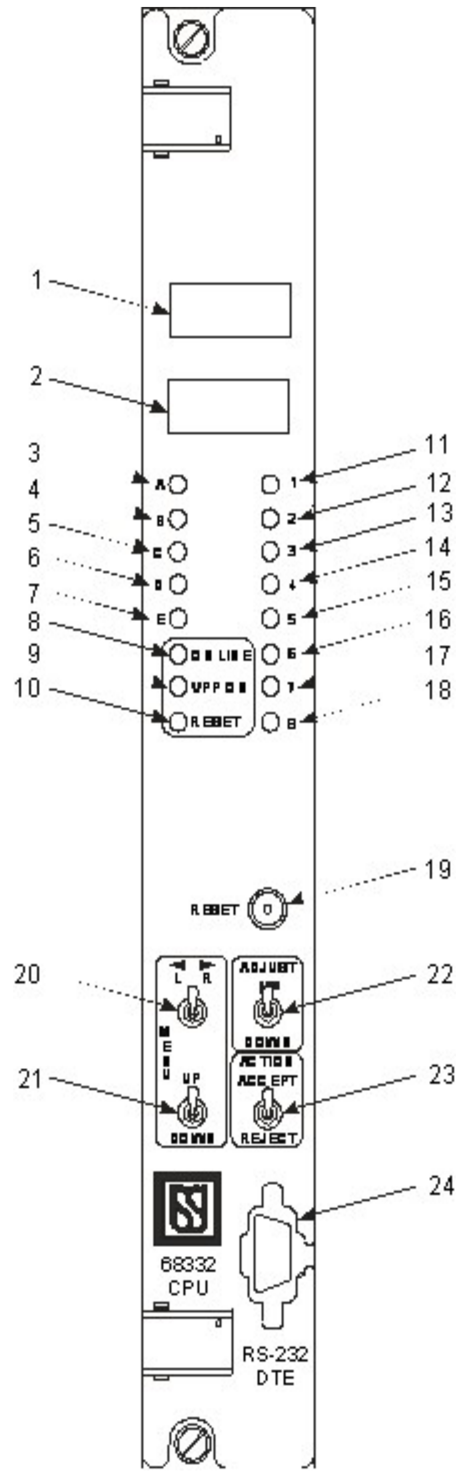


Figure 15-I-02.19 Main Logic CPU Front Panel Layout

Table 15-I-02.13 Main Logic CPU Front Panel Devices

ITEM Fig. 15-02-18 #	Label	Device	Purpose
1	A, B, C, D	4-character alphanumeric display	Character A - Cab Activation Status Character B - Operating Mode Character C - CPS Status Character D - Lower Display Parameter (Refer to Table 15-I-02.14 for details)
2	1, 2, 3, 4	4-character alphanumeric display	Characters 1 - 4 = Data Display When “D” = “S” - Speed When “D” = “L - Line Selection (Refer to Table 15-I-02.14 for details)
3 - 7	A, B, C, D, E	LEDs (yellow)	LED A - FSK Frequency Fail LED B - FSK Frequency Rise LED C - FSK Bond Detect LED D - Valid Cab Signal Indicator LED E - Valid Decoder Aspect Received
11 - 18	1, 2, 3, 4, 5, 6, 7, 8	LEDs (red)	LED 1 - FSK Communication Status LED 2 - Decoder Communication Status LED 3 - LON-ATP Communication Status LED 4 - TWC Communication Status LED 5 - PTU Communication Status LED 6 - BA Status ON = BA Rate Achieved Blinking = Decelerometer Error or invalid Calibration LED 7 - V-zero LED 8 - Watchdog

Table 15-I-02.13 Main Logic CPU Front Panel Devices

ITEM Fig. 15-02-18 #	Label	Device	Purpose
8	ON LINE	LED (green)	When lit, indicates normal system operation (successful diagnostics)
9	VPP ON	LED (green)	When lit, indicates EEPROM +5 or +12V programming power enabled (via board jumper).
10	RESET	LED (green)	When lit, indicates system is in reset mode.
19	RESET	Momentary push-button	When pressed, resets system.
20	Menu, l-r	3-position (return to the center) toggle switch	Pressed in direction (left- right) of configuration Menu path as shown on alphanumeric displays.
21	Menu, UP-DOWN	3-position (return to the center) toggle switch	Pressed in direction (up-down) of configuration Menu path as shown on alphanumeric displays.
22	ADJUST, UP-DOWN	3-position (return to the center) toggle switch	NOT USED.
23	ACTION, ACCEPT-REJECT	3-position (return to the center) toggle switch	Used to accept decelerometer and decoder settings after Calibration.
24	DTE	DB-9 Connector	Interface IBM-compatible laptop PC to board for software programming and data retrieval.

15-I-02.05.05 Navigating the CPU PCB Front Panel Menu System

15-I-02.05.05.01 Front Panel Displays

A maintainer can view menu information in the two alphanumeric displays (windows) at the top of the front panel of the Main Logic CPU PCB.

Each window displays four characters at any one time. The display is controlled by the toggle switches at the bottom of the panel.

15-I-02.05.05.02 Toggle Switches

On the front of the Main Logic CPU PCB there are two (2) Menu toggle switches used to navigate through the menus, and two (2) other toggle switches used to set and confirm values (see Figure 15-I-02.19). Each toggle switch is spring-return to the center position.

<u>Navigation Toggle Switches:</u>

Menu L/R: (Upper left toggle switch)

This switch is the only left-right switch.

Toggling this switch to the right or to the left enables a user to move from the top level of one menu to the top level of another menu.

On most menus, this switch is also used for navigating between menu levels (after entering the second level by using the Menu Up/Down switch).

Menu Up/Down: (Lower left toggle switch)

This is an up-down switch used to move from the top level of a menu to the second level (and back). It is also used to take various actions within a level.

<u>Confirmation Toggle Switches:</u>

Action Accept/Reject: (Lower right toggle switch)

This is an up-down switch Used to accept decelerometer and decoder settings after calibration.

Adjust Up/Down: (Upper right toggle switch)

This switch is not used in the LACMTA P2550 vehicle ATP system.

15-I-02.05.05.03 Main Logic CPU Menus

The Main Logic CPU front panel menu system consists of six top-level menus:

- Line Selection (or Main) Menu
- Event Menu
- Revisions Menu
- Configuration Menu
- CPU Menu
- LON Menu

The default menu displayed when the ATP system powers-up is the Line Selection (or Main) Menu.

This menu summarizes the status of the ATP system, such as cab, ATP mode, Conditional Power Supply Status, operating mode, and other selected information. Navigate from the this top level menu to other top level menus by pressing the Menu L/R switch to the Right or Left.

Starting at the Line Selection (Main Menu), pressing the Menu L/R switch to the Right will display, in succession, the Event Menu, Revisions Menu, Configuration Menu, and CPU Menu, and LON Menu.

Moving to the Left will wrap around the end and move through the menus in the opposite order. See Figure 15-I-02.20.

[redacted]

15-I-02.05.05.04 Line Selection (or Main) Menu

The Line Selection (or Main) Menu shows a summary of the current train status.

This summary (from left to right) shows the current train status (first character), ATP mode (second window), Conditional Power Supply status (third character), and the system data selected for display in the lower window (fourth character).

The top level of this menu displays when the system is powered up.

If the system is displaying the top level of any other menu, this menu can be reached by toggling the Menu L/R switch (either way) until this menu is shown.

Table 15-I-02.14 Line Selection (or Main) Menu

Fig. 15-02-19#	Label	Device	Purpose
1	A, B, C, D	4-character alphanumeric display	Character A -Train Status “A” = A Cab Activated “B” = B Cab Activated “-“ = No Cab Activated “?” = Non-valid input Character B - ATP Mode “X” = Off “B” = Bypass “M” = Manual “P” = Stop and Proceed “S” = Street Running “W” = Carwash Character C - CPS Status “A” = CPS Active “I” = CPS Inactive Character D - Lower Window Displays “S” = Speed “L” = Line Selection

Table 15-I-02.14 Line Selection (or Main) Menu

Fig. 15-02-19#	Label	Device	Purpose
2	1, 2, 3, 4	4-character alphanumeric display	When “D” = “S” (Speed) Characters 1-2 = System Speed (mph) Characters 3-4 = Speed Limit (mph) When “D” = “L (Line Selection) “????” = Non-valid input “GOLD” = Pasadena Gold Line “BLUE” = Metro Blue Line “GRN” = Metro Green Line
	Example 1	Upper: “-XIL” Lower: “BLUE”	“-“ No Cab Active “X” ATP in OFF Mode “I” CPS Inactive “BLUE” Metro Blue Line Selected
	Example 2	Upper: “BMAA” Lower: “GRN”	“B“ B Cab Active “M” ATP in Manual Mode “A” CPS Active “GRN” Metro Green Line Selected

To view ATP (measured) speed, toggle the Menu Up/Down switch DOWN until “S” appears in the last position in Window 1.

The value in Window 2 is the current speed in xx.x mph format.

To view the aspect (speed command), toggle the Menu Up/Down switch DOWN until “A” appears in the last position in Window 1. The value in Window 2 is the current aspect in xx.x mph format.

To return to the top-level menu toggle the Menu Up/Down switch UP until “L” appears in the last position in Window 1.

15-I-02.05.05.05 Event Menu

Use the Event Menu to view active events (events occurring at the present time), clear the event queue (list of active events), see a count of events (how many times each event have occurred since the count was last cleared), and clear the event counts.

Examples of the types of events that are logged include penalty stops, overspeeds, full service brake applications, and ATP failure conditions.

To display the Event Menu from the Line Selection (or Main) Menu, toggle the Menu L/R switch once to the right.

The upper and lower alphanumeric displays indicate:

- Event Menu.

a) Event Queue

From the Event Menu, enter the Event Queue submenu by toggling the Menu Up/Down switch to Down once.

The alphanumeric displays indicate:

- Evnt Que.

To display the event code of the currently active event in the upper window, toggle the Menu Up/Down switch to DOWN once.

Use the Menu L/R switch to cycle through multiple active events.

To display a text description of any active event in the lower window, toggle the Menu Up/Down switch to DOWN once. Use the Menu L/R switch to cycle through the text description of the events.

To return to the Event Queue submenu, toggle the Menu Up/Down switch to Up until [Evnt/Que] is displayed.

To return to the Event Menu, toggle the Menu Up/Down switch to Up until [Evnt/Menu] is displayed.

b) Clear Queue

To enter the Clear Queue submenu from the Event Queue submenu, toggle the Menu R/L switch to the Right.

The alphanumeric displays indicate:

- Clr Que

To clear the event queue, toggle the Menu Up/Down switch to DOWN once.

The alphanumeric displays will show the question: [AreU/Sure].

To confirm clearing the event queue, toggle the Action Accept/Reject switch up to ACCEPT.

This action will clear the event que and return back to the Clear Queue submenu.

To cancel clearing the event queue, toggle the Action Accept/Reject switch down to REJECT.

This action will return back to the Clear Queue submenu.

To return to the Event Menu, toggle the Menu Up/Down switch to Up until [Evnt/Menu] is displayed.

c) Event Counts

To display the Event Counts submenu from the Clear Queue submenu, toggle the Menu R/L switch to the Right.

The alphanumeric displays indicate:

- Evnt Cnts

To display an event code and the number of times that event was logged (since the counts were last cleared), toggle the Menu Up/Down switch to DOWN once.

The upper window will display the event code.

The lower menu will display that event's count.

Use the Menu L/R switch to cycle through events.

To display a text description of an event in the upper window, toggle the Menu Up/Down switch to DOWN once.

Use the Menu L/R switch to cycle through the text description of the events, by toggling the Menu L/R switch Right or Left.

To return to the Event Count submenu, toggle the Menu Up/Down switch Up until [Evnt/Cnts] is displayed.

To return to the Event Menu, toggle the Menu Up/Down switch Up until [Evnt/Menu] is displayed.

d) Clear Counts

To display the Clear Counts submenu from the Event Counts submenu, toggle the Menu R/L switch to the Right.

The alphanumeric displays shows:

- Clr Cnts

To clear (reset) the event counts, toggle the Menu Up/Down switch to DOWN once.

The alphanumeric displays will display the question [AreU/Sure].

To confirm that you want to clear the event counts, toggle the Action Accept/Reject switch up to ACCEPT.

This will clear the stored event counts and return to the Clear Count submenu.

To cancel clearing the event counts, toggle the Action Accept/Reject switch down to REJECT.

This will maintain the event counts and return back to the Clear Count submenu.

To return to the Event Menu, toggle the Menu Up/Down switch Up until [Evnt/Menu] is displayed.

15-I-02.05.05.06 Revisions Menu

The Revisions Menu option indicates the revision number of the software currently loaded in the Vehicle ATP and FSK subsystems. You can also see the software revisions for the Decoder, Main Logic CPU LON.

The format for all software versions is X.Y, where X represents the major revision number and Y represents the minor revision number.

To display the Revisions Menu from the Line Selection (or Main) Menu, toggle the Menu L/R twice to the Right.

The alphanumeric displays indicate:

- Revs Menu

a) Main Logic CPU Software

To view the version of the Main Logic CPU software from the Revisions Menu, press the Menu Up/Down switch to DOWN once.

The front panel display indicates:

- ATP X.Y

b) FSK PCB

To view the version of the FSK PCB software from the ATP software revision submenu, press the Menu L/R switch to the Right once.

The front panel display indicates:

- FSK X.Y

To return to the Revisions Menu, toggle the Menu Up/Down switch Up until [Revs/Menu] is displayed.

15-I-02.05.05.07 Configuration Menu

The Configuration Menu is used to verify and set the wheel size for each of the speed sensors and to calibrate the decelerometer.

To display the Configuration Menu from the Line Selection (Main) Menu, toggle the Menu L/R switch to the Right three (3) times.

The alphanumeric displays indicate:

- Cfg Menu

a) Entering Configuration Data

To enter configuration data, the vehicle must be in a no motion state with the ATP system in OFF mode.

b) Wheel Wear Adjustment

The correct wheel diameter must be entered from the Main Logic CPU PCB front panel so that the system can accurately determine vehicle speed and distance traveled.

Wheel diameters are vital information, and must be entered correctly for the ATP system to work safely and properly.

Wheel diameters entered into the ATP system must be equal to or greater than the measured diameter of the wheel associated with each ATP speed sensor.

The ATP wheel diameters can be set between 28.25 inches (maximum) to 26.00 inches (minimum), in ¼-inch increments.

NOTE: On the CPU display, the decimal point will not be displayed (e.g., 28.25 will be displayed as 2825).

Two wheel size settings must be entered; one for each speed sensor. Wheel size calibration is necessary:

- During each Periodic Inspection
- After truing any wheel associated with an ATP speed sensor
- After replacing a truck associated with an ATP speed sensor

Setting Wheel Size1 (Axle #2):

1. To move to the WSIZE1 submenu from the Configuration Menu, toggle the Menu Up/Down switch to DOWN once. The current wheel size setting is displayed in the bottom window.
2. To show an adjustable wheel size in the upper window, toggle the Menu Up/Down switch to DOWN once.

Both the upper and lower windows now show the current wheel size.

NOTE: If a condition exists that prevents the wheel size from being adjusted (e.g., the vehicle is moving), the windows will display [Failed/Reason for failure]. In this case, press the Menu Up/Down switch Up until [Cfg/Menu] is displayed. Correct the condition that is preventing the adjustment, and start the process over again.

3. To select a new wheel size, toggle the Menu L/R switch to the Right or Left until the correct wheel size is shown in the upper window.
4. The display will change in ¼- inch increments, and wrap around from highest to lowest or lowest to highest when the maximum or minimum limit is reached. The wheel size can be adjusted from 28.25 inches to 26.00 inches.
5. To set the new size:

- Hold DOWN the Menu Up/Down switch until the upper window is blinking.
- Toggle the Action Accept/Reject switch Up to accept the setting.

6. To return to the Configuration Menu, toggle the Menu Up/Down switch Up until [Cfg/Menu] is displayed.

Setting Wheel Size 2 (Axle #4):

1. To move to the WSIZE2 submenu from the WSIZE1 submenu, toggle the Menu L/R switch to the Right once. The current wheel size setting is now displayed in the bottom window.
2. To display both the current wheel size and a size that can be set, toggle the Menu Up/Down switch DOWN once. The current wheel size is now displayed in the lower window and a wheel size that can be set is displayed in the upper window.

NOTE: If a condition exists that prevents the wheel size from being adjusted (e.g., the vehicle is moving), the windows will display [Failed/Reason for failure]. In this case, press the Menu Up/Down switch Up until [Cfg/Menu] is displayed. Correct the condition that is preventing the adjustment, and start the process over again.

3. To select a new wheel size, toggle the Menu L/R switch to the Right or Left until the correct wheel size is shown in the upper window. The display will change in ¼- inch increments, and wrap around from highest to lowest or lowest to highest when the maximum or minimum limit is reached. The wheel size can be adjusted from 28.25 inches to 26.00 inches.
4. To set the new size:

- Hold DOWN the Menu Up/Down switch until the upper window is blinking.
- Toggle the Action Accept/Reject switch Up to accept the setting.

5. To return to the Configuration Menu, toggle the Menu Up/Down switch Up until [Cfg/Menu] is displayed.

c) Decelerometer Calibration

NOTE: For Decelerometer calibration the vehicle must be on level tangent track, and train enable Cab Master controller must be in “LOCAL” position the ATP subsystem must be in Off Mode.

1. Toggle the MENU L/R switch to the Right or the Left until the display indicates [Decl/Cal].
2. Toggle the MENU UP/DOWN switch to DOWN once, [### / ###l] is displayed in the upper and lower alphanumeric display windows, where ### represents numbers.

NOTE: If a condition exists that prevents the decelerometer from being adjusted (e.g., the vehicle is moving), the windows will display [Warn/Decel not level]. In this case, press the Menu Up/Down switch Up until the [Cfg/ Menu] is displayed. Correct the condition that is preventing the adjustment, and start the calibration process over again.

3. Locate the decelerometer, mounted above and behind the vital relay (see Figure 3 1, item 16). Loosen the mounting screw to the right of the decelerometer, then remove the adjustment screw, lock washer, and washer to the left of the decelerometer.
4. Toggle the MENU L/R switch to the Right or the Left until the display indicates [Decl/Cal].
5. Pivot the left end of the decelerometer up or down while observing the numbers in the upper and lower alphanumeric display windows.
6. Reinstall the adjustment screw, lock washer, and washer when the adjustment holes are aligned and a reading as close to [128/128] is achieved. Tighten the hardware on both sides of the decelerometer to secure it in place.
7. Toggle the Action Accept/Reject switch Up to ACCEPT the calibration setting and return to the [Decl/Cal] display.
8. To return to the Configuration Menu, toggle the Menu Up/Down switch Up until [Cft/Menu] is displayed.

If the decelerometer calibration is not successful because the adjustment is wrong or a required condition for calibration has been removed or changed (ATP mode is active or the vehicle is moving), [Warn/Decel not level] is displayed.

Toggle the Menu Up/Down switch Up once to display the [Decl/Cal] menu, and begin to recalibrate the decelerometer as described above.

Toggle the Action Accept/Reject switch to ACCEPT to finish decelerometer cailbration. This returns the display to the [Decl/Cal] menu.

Toggle the Menu Up/Down switch Up until the Configuration Menu is displayed.

15-I-02.05.05.08 CPU Menu

The CPU Menu indicates the status of inputs and outputs on the system's input and output boards.

It also indicates the amount of time the system is taking for executing instructions during each cycle. Since a cycle is 250 ms, the execution time must be less than that.

Inputs and outputs can also be verified by checking the LEDs on each board.

To display the CPU Menu from the Train Status Display menu, toggle the Menu L/R to the Right four times.

The alphanumeric displays indicate:

- CPU Menu

a) Vital Input Board 1

To view the status of the Vital Input Board 1 (VIB1) from the CPU Menu, toggle the Menu Up/Down switch Down once.
The front panel display indicates:

- VIB1 XXXX

where XXXX is a hexadecimal representation of the board LED status.

b) Vital Input Board 2

To view the status of the Vital Input Board 2 (VIB2) from the VIB1 submenu, toggle the Menu Left/Right switch to the Right once.
The front panel display indicates:

- VIB2 XXXX

where XXXX is a hexadecimal representation of the board LED status.

c) Non-Vital Outputs (Multifunction PCB)

To view the status of the non-vital outputs on the Multifunction PCB (NVOB) from the VIB2 submenu, press the Menu R/L switch to the Right once.
The front panel display indicates:

- NVOB XXXX

where X will be either 0 or 1, depending on the status of the single output.

d) Vital Outputs (Multifunction PCB)

To view the status of the vital outputs on the Multifunction PCB (VOB) from the NVOB submenu, press the Menu R/L switch to the Right once.
The front panel display indicates:

- VOB XXXX

where X will be either 0 or 1, depending on the status of the single output.

e) Sensors (SNRS)

To view the speed (mph) from each speed sensor, toggle the Menu R/L switch to the Right once.
The front panel display indicates:

- SNRS XXYY

where XX is the speed from Sensor 1 (motored truck) and YY is the speed from Sensor 2 (non-motored truck), both in whole mph.

f) Execution Time

To view the Execution Time (in milliseconds) from the Sensors submenu, toggle the Menu R/L switch to the Right once.
The front panel display indicates:

- Execution Time XXXX

where XXXX is the execution time in milliseconds.

g) Cycle Time

To view the software cycle time (in milliseconds) from the Execution Time submenu, toggle the Menu R/L switch to the Right once.
The front panel display indicates:

- Cycle Time (ms) XXXX

where XXXX is the cycle time, 250 milliseconds.

15-I-02.06 TESTING

Two tests must be carried out before departure on the ATP System:

- ADU Lamp Test;
- ATP Departure Test.

15-I-02.06.01 ADU Lamp Test

The ADU provides an interface to the Lamp Test momentary pushbutton located on the vehicle's operator console.

This interface invokes a check of the ADU panel indicators and displays.

While the Lamp Test pushbutton is pressed, all indicators and seven-segment display elements are illuminated.

The ADU will also illuminate all of the bi-color LEDs on the vertical bar in a red/green, alternating pattern.

The person performing the test should observe that all of elements are operating correctly and to report any malfunction before entering revenue service.

The audible alarm is not activated while the Lamp Test pushbutton is pressed.

The audible alarm is tested during the normal course of the departure test sequence.

For the lamp test to activate, the ADU must receive a zero or no speed value from the ATP.

The ADU reverts back to normal display after the Lamp Test pushbutton is released.

15-I-02.06.02 ATP Departure Test

The ATP provides for the performance of a Departure Test, which can be performed prior to the vehicle entering main line service. Initiation of a daily test will be conducted through interaction with the Departure Test switch on the ADU (see Paragraph 15-I-02.04.08.01).

An observer is required to monitor speed and aspect indications on the ADU, audible alarm activation and de-activation, and each brake application.

A Lamp Test is also necessary to exercise the remaining indicators on the ADU.

The observer can observe the status of the Departure Test by monitoring the Departure Test lamp on the ADU.

On system power-up or transition to an inactive mode, the Departure Test lamp is dark.

The lamp blinks while the Departure Test is running, and goes dark if a failure occurs during the test sequence.

On successful completion of the Departure Test, the lamp will lights solid.

The lamp remains lit solid until power is cycled, an inactive mode is entered, or the Line Selector Switch is changed.

The observer can abort the Departure Test at any time by pressing and releasing the Departure Test pushbutton.

15-I-02.06.02.01 Departure Test Sequence (MGL)

For operation on the MGL, the on-board Departure Test exercises the following areas of the system to verify proper operation:

- FSK module health
- Functional ADU interface
- Valid Cab Signal detection
- Alarm activation (operator verified)
- Full Service Brake application
- Emergency Brake application
- Door Enable function

In addition to pressing the Departure Test pushbutton on the front panel of the ADU, the following initial conditions are required for a Departure Test to begin:

- The ATP is in an active mode
- V-zero is satisfied
- The Reverser is in forward
- The Master Controller is in minimum brake (observer verified)
- No propulsion request and friction brakes applied
- No Penalty or EB requests active
- The EB is not applied by the vehicle (verified via the EBA input)
- An ADU Lamp Test is not active (observer verified)
- No calibration utility is active
- No cross check errors are active

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
- 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

On initiation of the Departure Test, the ATP issues a “Departure Test Start” indication to the TCMS.

This indication is necessary to allow the vehicle to release the Holding Brake, which applies a Full Service Brake.

The ATP delays the start of the first test for three (3) seconds to allow release of the Holding Brake and brake pressure to stabilize to the Minimum Brake level.

If all individual tests pass, the Departure Test passes and the ATP lights the Departure Test lamp on the ADU.

If the Departure Test is performed in a location not equipped with Cab Signal, the Valid Cab Signal Detection test will fail as indicated by the Departure Test lamp and the Cab Signal lamp being dark. Regardless of a Valid Cab Signal Detection failure, all other tests will be performed. Any individual test failure is reported to the TCMS.

When the Departure Test is performed in a location equipped with Cab Signal, the Valid Cab Signal Detection test will either pass or fail as indicated by the Cab Signal indicator on the ADU being lit (pass) or dark (fail).

If the Valid Cab Signal Detection test or any other test fails, the specific failure will be reported to the TCMS.

The following is a brief description of the tests that are performed when a Departure Test is initiated:

- **FSK Module Health** - This test passes if the communications link between the ATP and FSK subsystem is established.
- **Functional ADU Interface** - This test passes if the communications link between the ATP and ADU is established. Note that the integrity of the Lon network is not verified, but only the communication link between the ATP and the Lon device that interfaces to the network.
- **Door Enable** - The ATP enables both the right and left doors for two (2) seconds. While the doors are enabled, the ATP monitors the Right Doors Enable Crosscheck and the Left Doors Enable Crosscheck. This test fails if either crosscheck declares an error.

- **Valid Cab Signal Detection** - This test passes if valid cab signal messages are received from the FSK subsystem. If valid cab signal messages are being received, the Cab Signal lamp on the ADU lights.
- **Alarm Activation** - The ATP commands a continuous alarm during the Full Service Brake Application Test. An observer verifies alarm activation.
- **Full Service Brake Application** - The ATP requests Full Service Brake for five (5) seconds. During the FSB request, the ATP monitors the Full Service Brake Crosscheck. An observer verifies that Full Service Brake is applied on the vehicle by monitoring brake cylinder pressure for the appropriate FSB response. The test fails if a crosscheck error is declared.
- **Emergency Brake Application** - The ATP requests Emergency Brake for five (5) seconds. An observer verifies the EB application by monitoring brake pipe pressure for the appropriate EB response.
- **Emergency Brake Crosscheck and Operator Acknowledge** - The ATP requests Emergency Brake and blinks the ATP Failure lamp on the ADU for ten (10) seconds. During this time, the ATP monitors the Emergency Brake Crosscheck, and the observer must acknowledge all verifications by pressing and releasing the cab ATP Reset switch (this also ends the Departure Test). The test fails if a crosscheck error is declared or the observer fails to acknowledge all verifications within the allotted time.

The observer needs to verify the following:

- ATP alarm activation and de-activation;
- Full Service Brake application;
- Emergency Brake application;
- Cab Signal lamp on the ADU.

15-I-02.06.02.02 Departure Test Sequence (MBL and PGL)

The on-board Departure Test exercises the following areas of the system to verify proper operation:

- Decoder module health;
- Functional ADU interface;
- Street Running operations;
- Code Rate Detection;
- Downward code change recognition and ATP alarm activation;
- Aspect display;

- Over speed Detection;
- Alarm activation (operator verified);
- Full Service Brake application;
- Emergency Brake application;
- Door Enable function.

a) Departure Test: Description

Prior to the Departure test, visually inspect the ATP equipment.
Track receivers must be inspected for alignment and obvious damage.
All wiring and junction box covers must be free from obvious damage and secured.
A Departure test is initiated through interaction with the ADU. An observer is required to monitor various elements of the test as follows:

- Alarm activation and de-activation;
- Full Service Brake application;
- Emergency Brake application;
- All aspects;
- Street Running cut out and cut in.

b) Departure Test: ATP Control and Test Sequence

Initial Conditions:

- The ATP must be in an active mode
- V-zero must be met
- The Reverser must be in Forward
- No Cab Signal is present (including constant carrier)
- The Master Controller must be in the Minimum Brake position (observer verified)
- The Master Controller indicates that no propulsion requested
- Vehicle friction brakes are applied
- No Over speed Penalty, Penalty, or Emergency Brake request is active
- The EB is not applied by the vehicle (verified via the EBA input)
- An ADU Lamp Test is not active (observer verified)
- No calibration utility is active
- No crosscheck errors are active

ATP Control and Test Sequence:

Press and release the DEPART TEST pushbutton on the ADU to begin testing.

The test will progress automatically.

On initiation of the Departure Test, the ATP issues a “Departure Test Start” indication to the TCMS.

This indication is necessary to allow the vehicle to release the Holding Brake, which applies a Full Service Brake.

The ATP delays the start of the first test for three (3) seconds to allow release of the Holding Brake and brake pressure to stabilize to the Minimum Brake level.

After the initial delay, the test begins and progresses as follows:

1. The ATP checks the communications link between the ATP and Decoder subsystems. This test fails if the communications link is not established.
2. The ATP checks the communications link between the ATP and ADU. This test fails if the communications link is not established. Note that the integrity of the Lon Network is not verified, but only the communications link between the ATP system and the Lon device which interfaces to the Lon network.
3. The ATP enables both the right and left doors for two (2) seconds. While the doors are enabled, the ATP monitors the Right Doors Enable Crosscheck and the Left Doors Enable Crosscheck. This test fails if either crosscheck declares an error.
4. The ATP generates a 410 code rate, sends a 35 mph aspect to the ADU, and beeps the alarm for the code change. The observer verifies the alarm beep and ADU aspect display.
5. The ATP generates a 100 Hz constant carrier, sends a zero (0) mph aspect to the ADU, and beeps the alarm for the code change. The observer verifies the alarm beep, ADU aspect display, and that the STREET RUNNING lamp is lit.
6. The ATP generates a dual 270 code rate, sends a 65 mph aspect to the ADU, and beeps the alarm for the code change. The observer verifies the alarm beep and the ADU aspect display.
7. The ATP generates a 100 Hz 270 code rate, sends a 55 mph aspect to the ADU, and beeps the alarm for the code change. The observer verifies the alarm beep and ADU aspect display.
8. The ATP generates a 180 code rate, sends a 45 mph aspect to the ADU, and beeps the alarm for the code change. The observer verifies the alarm beep and ADU aspect display.

9. The ATP generates a 120 code rate, sends a 35 mph aspect to the ADU, and beeps the alarm for the code change. The observer verifies the alarm beep and ADU aspect display.
10. The ATP generates a 75 code rate, sends a 25 mph aspect to the ADU, and beeps the alarm for the code change. The observer verifies the alarm beep and ADU aspect display.
11. The ATP generates a 50 code rate, sends a 10 mph aspect to the ADU, and beeps the alarm for the code change. The test observer verifies the alarm beep and ADU aspect display.
12. The ATP generates a No Code, sends a zero (0) mph aspect to the ADU, and beeps the alarm for the code change. The observer verifies the alarm beep and ADU aspect display.
13. The ATP generates and maintains a 28 mph system speed to initiate Over speed. The ATP requests Full Service Brake (due to Overspeed), and then Emergency Brake (due to failure of Brake Assurance).
    - During the FSB request, the ATP monitors the FSB Crosscheck, and the test fails if the crosscheck declares an error. The observer verifies the ADU speed display and that FSB is applied on the vehicle (brake cylinder pressure appropriate for FSB).
    - During the Emergency Brake, the observer verifies that EB is applied on the vehicle (brake pipe pressure appropriate for EB).
    - If the ATP does not issue an Emergency Brake request within six (6) seconds of Over speed, the test fails.
14. The ATP Failure lamp on the ADU blinks for ten (10) seconds. During this time, the ATP monitors the Emergency Brake Crosscheck, and the observer must acknowledge all verifications by pressing and releasing the cab ATP Reset switch (this also ends the Departure Test). The test fails if a crosscheck error is declared or the observer does not acknowledge all verifications within the allotted time.

The test observer must confirm the following:

- Alarm activation and de-activation
- Full Service Brake application
- Emergency Brake application
- All aspects
- Speed indications on the ADU
- Street Running lamp on the ADU
- Cab Signal lamp on the ADU.

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.

LOS ANGELES COUNTY

METROPOLITAN TRANSPORTATION AUTHORITY

LIGHT RAIL VEHICLE

P2550

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RUNNING MAINTENANCE
AND
SERVICE MANUAL

VOLUME M-01
PART II
TROUBLESHOOTING
SECTION 15 - AUTOMATIC TRAIN PROTECTION

SECTION 15

AUTOMATIC TRAIN PROTECTION SYSTEM

PART II

TROUBLESHOOTING

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

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SECTION 15

AUTOMATIC TRAIN PROTECTION SYSTEM

15-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.

The Part III - Maintenance consists of:

- Preventive Maintenance
- Corrective Maintenance
- Consumable Materials
- Test Equipment , Tools & Special Tools

15-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	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

Abbreviation	Meaning
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
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

15-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.

15-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	Mill 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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15-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 described in the following 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 old one.

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.

15-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.

15-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 altogether the ATP and the TWC (refer to section 16).

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 15-II-02.1 and Table 15-II-02.2. Another dataset, called “nvoAduStatus,” contains the ADU status.

(refer to Table 15-II-02.3).

Table 15-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

Table 15-II-02.1 “nvoATPStatus” LONWorks Bus dataset

byte	bit	Signal	Scale	Description
2	0	ATP-ADU Communications Failure	0 = false 1 = true	The communication link between the ATP and the ADU is failed.
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 15-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.

Table 15-II-02.1 "nvoATPStatus" LONWorks Bus dataset

byte	bit	Signal	Scale	Description
5	4	Multi-Function Board Error	0 = false 1 = true	An error has been detected with the Multi-Function Board an emergency brake is requested by the ATP and HSCB opens.
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	2	Departure Test Status(cont'd)		
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.

Table 15-II-02.1 “nvoATPStatus” LONWorks Bus dataset

byte	bit	Signal	Scale	Description
7	0	Spare		Not Used
7	1	Spare		Not Used
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 15-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 15-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.

15-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 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 15-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.

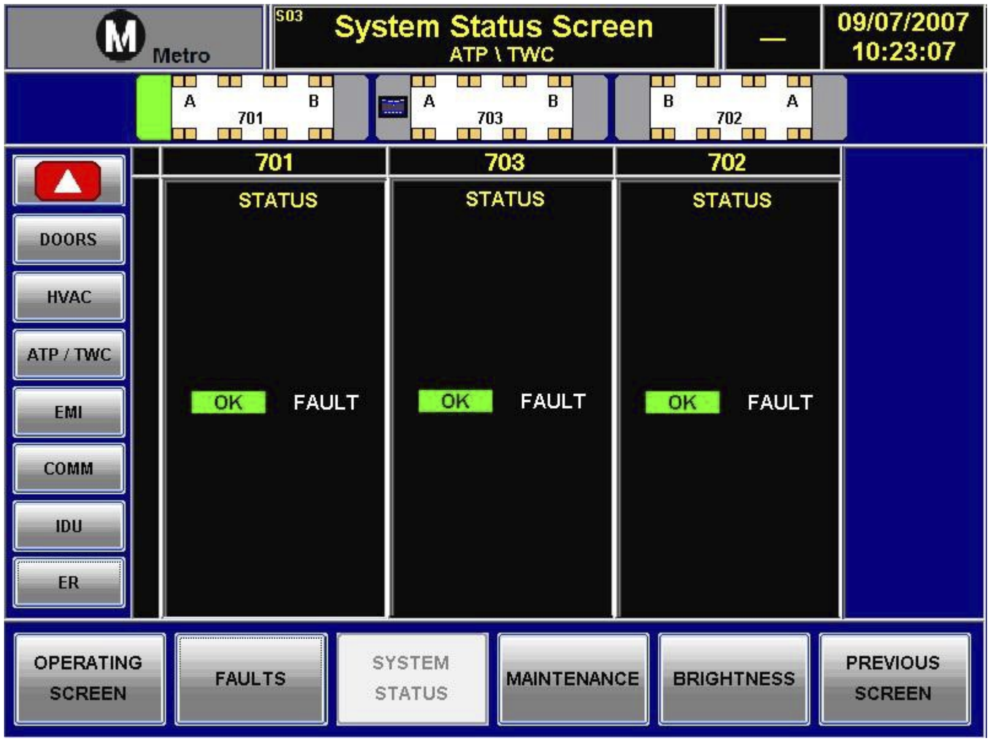


Figure 15-II-02-1 ATP/TWC System Status Screen (Operating Mode)

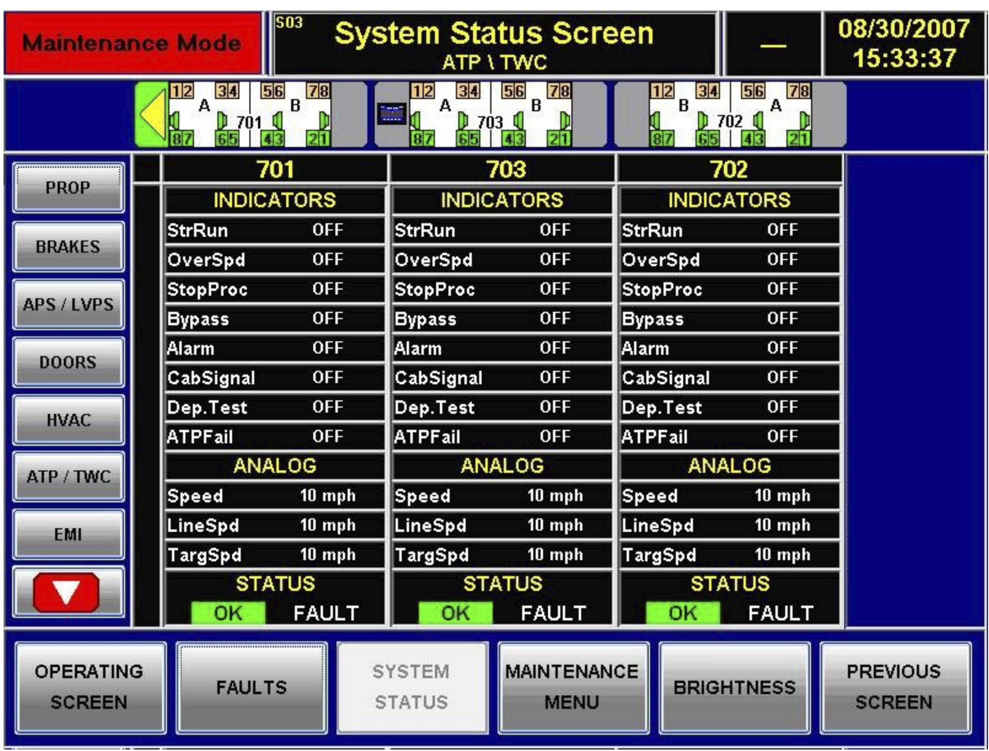


Figure 15-II-02-2 ATP/TWC System Status Screen (Maintenance Mode)

15-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 15-II-02-3 LONWorks Bus Life Signals

15-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 “activated” - 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.

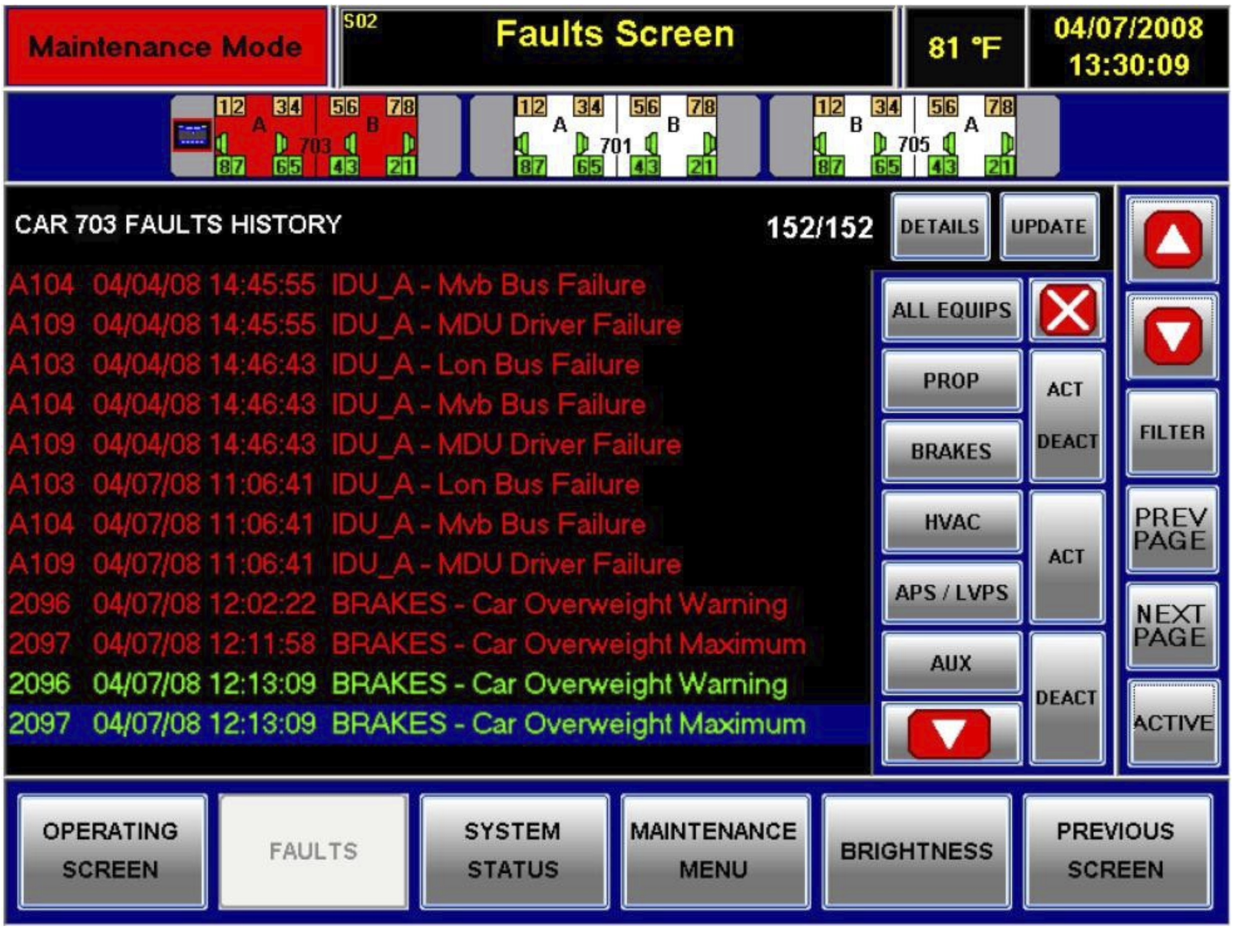


Figure 15-II-02-4 IDU Faults Screen

The "Complete ATP/TWC IDU Fault List and Reference Diagram" paragraph in Appendix 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 15-II-02-4).

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

This PTU is used for both ATP and TWC systems, but they have different software interface monitor their I/O respectively.

15-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.

15-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 15-II-02-5).

15-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.

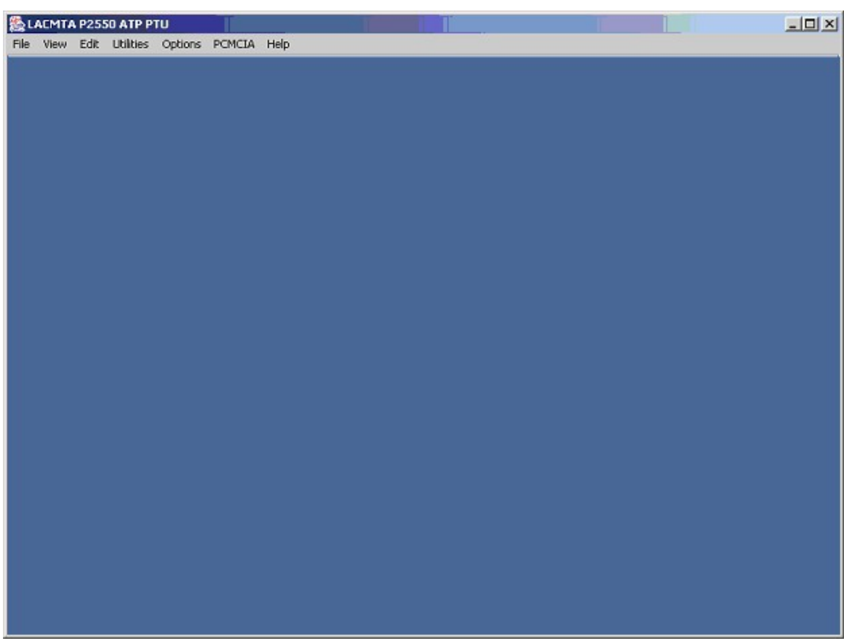


Figure 15-II-02-5 PTU Desktop Screen

15-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.

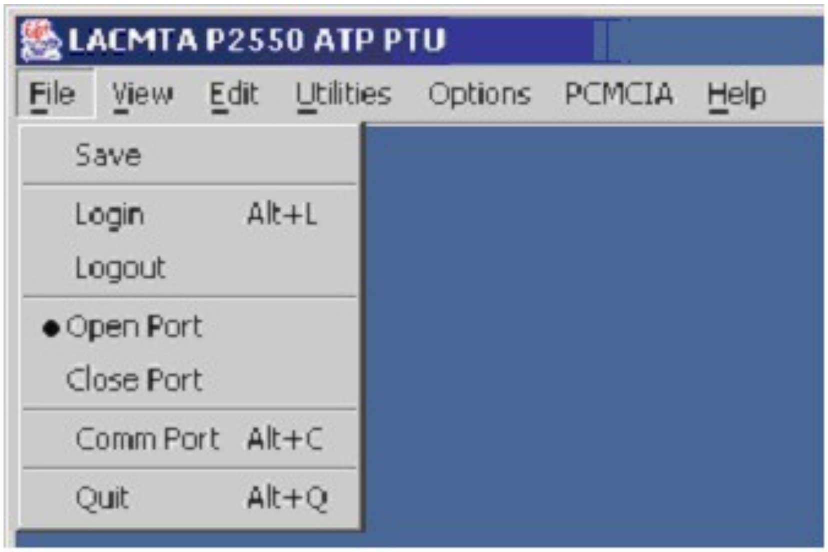


Figure 15-II-02-6 File Menu Screen

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 15-II-02-7 Login Screen

Passwords are administratively assigned to gain access to different PTU functions (see Paragraph 15-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 UTILITIES menu:

- Enter Date and Time

Under PCMCIA menu:

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

Under VIEW menu:

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

Under OPTIONS menu:

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

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 below.

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 15-II-02.03.03.02b) for further use of this function.

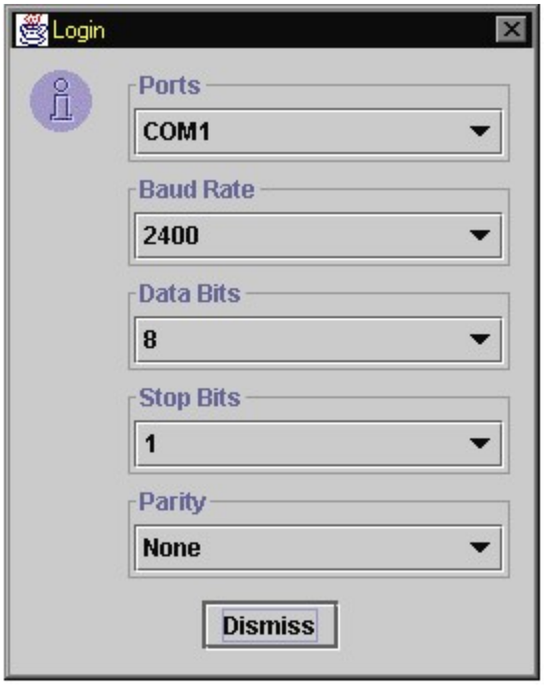


Figure 15-II-02-8 File Comm Port Screen

15-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.

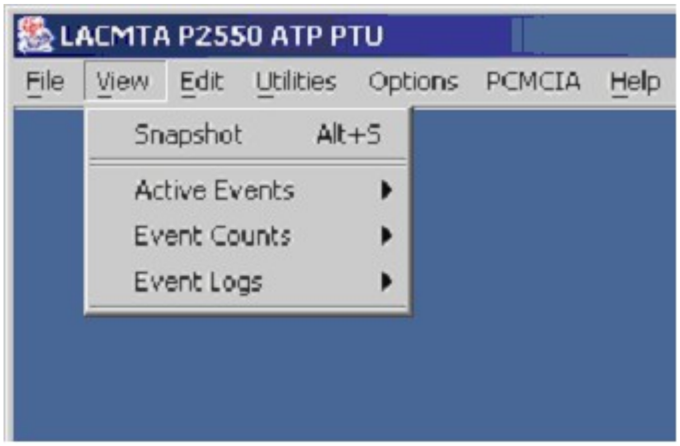


Figure 15-II-02-9 View Screen

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.

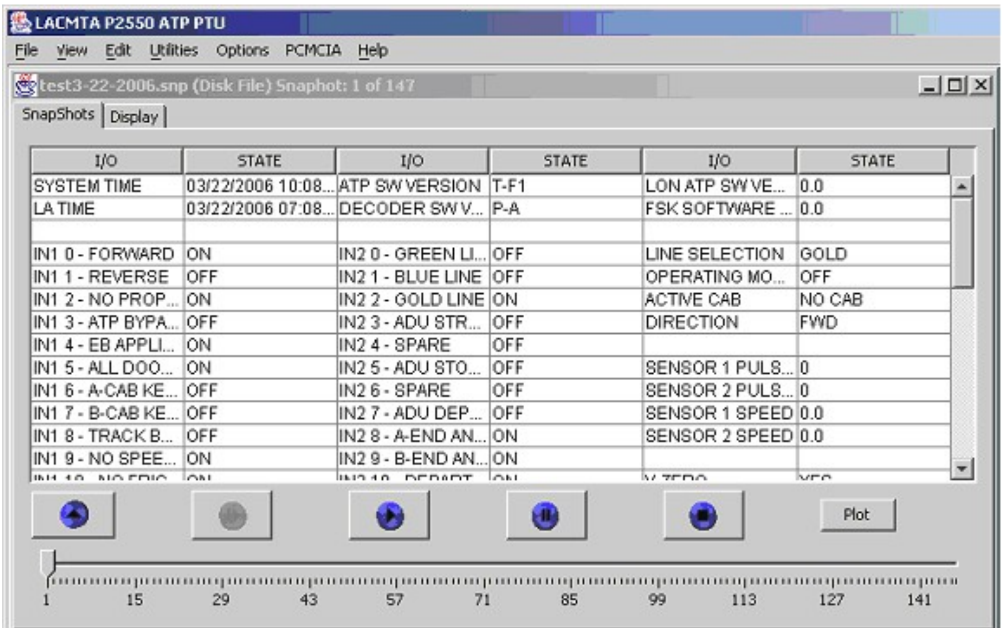


Figure 15-II-02-10 Continuous Snapshot Screen

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 cannot 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 CANNOT 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.

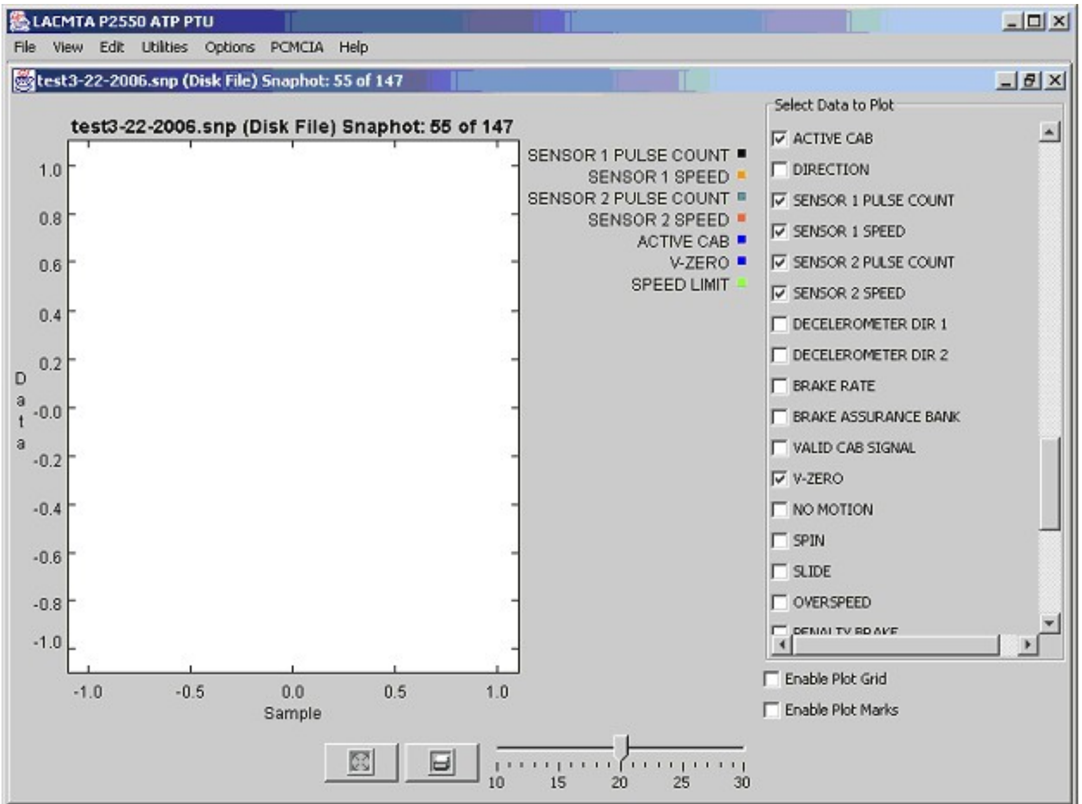


Figure 15-II-02-11 Snapshot Plotting Screen

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.

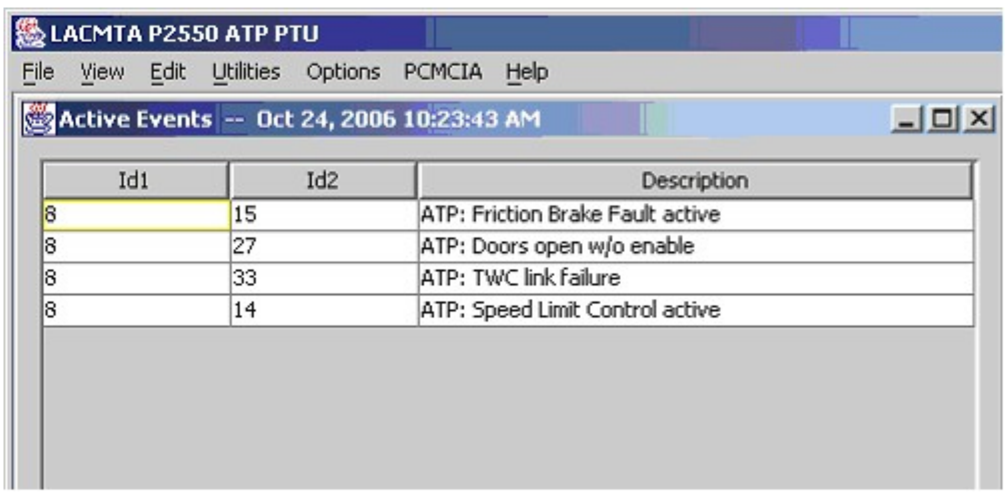


Figure 15-II-02-12 Active Events Screen

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 cannot 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.).

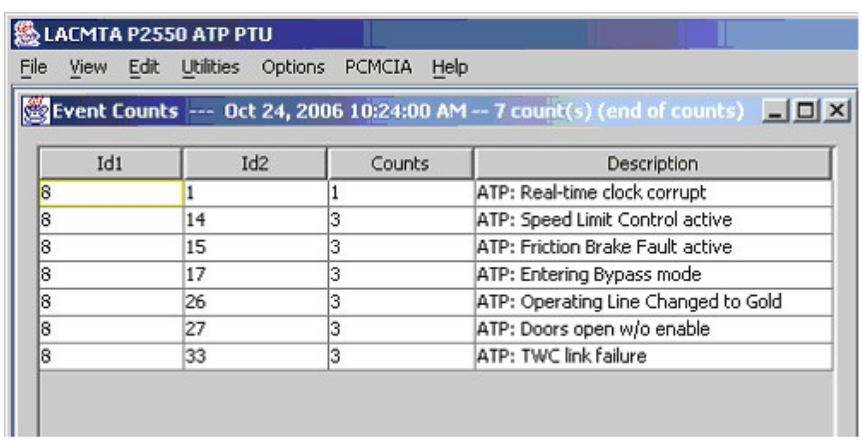
e) Event Counts

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 15-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 submenu item.

Select the System sub-menu item. After System is selected, the PTU will open an Event Counts frame and initiate communications with the MicroCab system.

It 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.

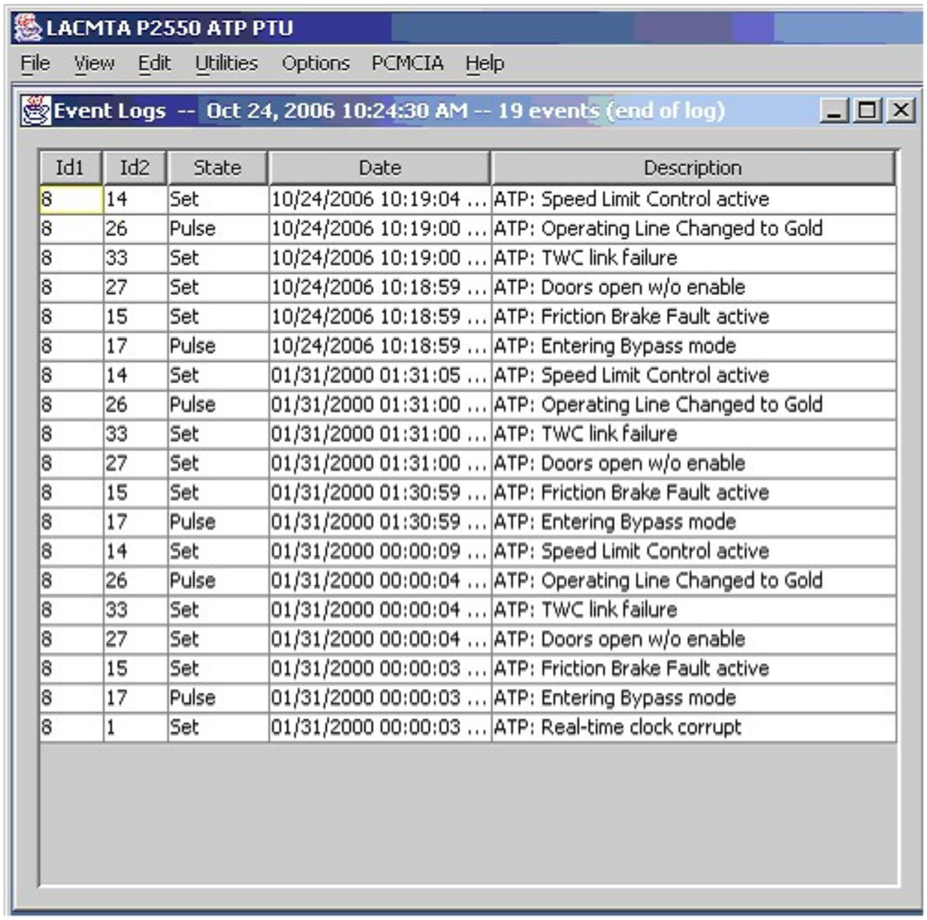
Once a file is opened (DISK) or communications with the system is established (SYSTEM), information is displayed as a table and contains an events Id1, Id2, counts, and a description.

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 15-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 submenu item.

Select the System sub-menu 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 cannot 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 submenu 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 15-II-02.03.03.02d) Saving and Printing Event Information for more information on saving and printing Event Logs.

15-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.

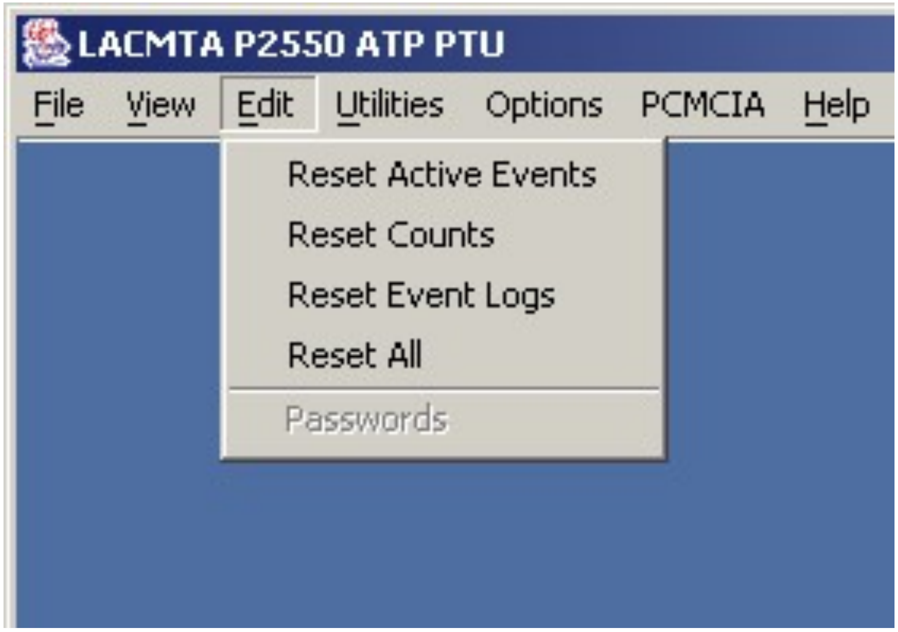


Figure 15-II-02-15 Edit Menu Screen

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:

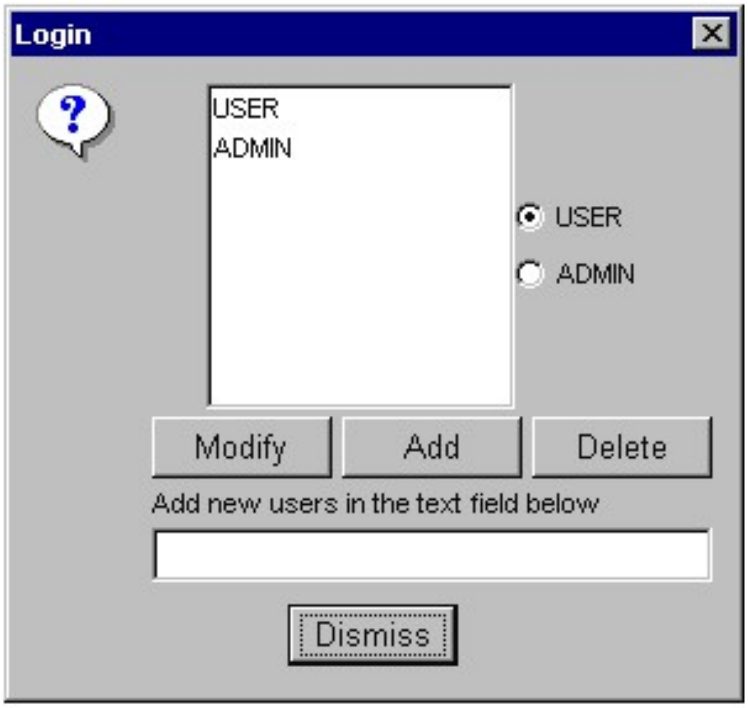


Figure 15-II-02-16 Password Dialog Box

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 2.3.1.1 Login for PTU rights granted to the different access levels.

15-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.

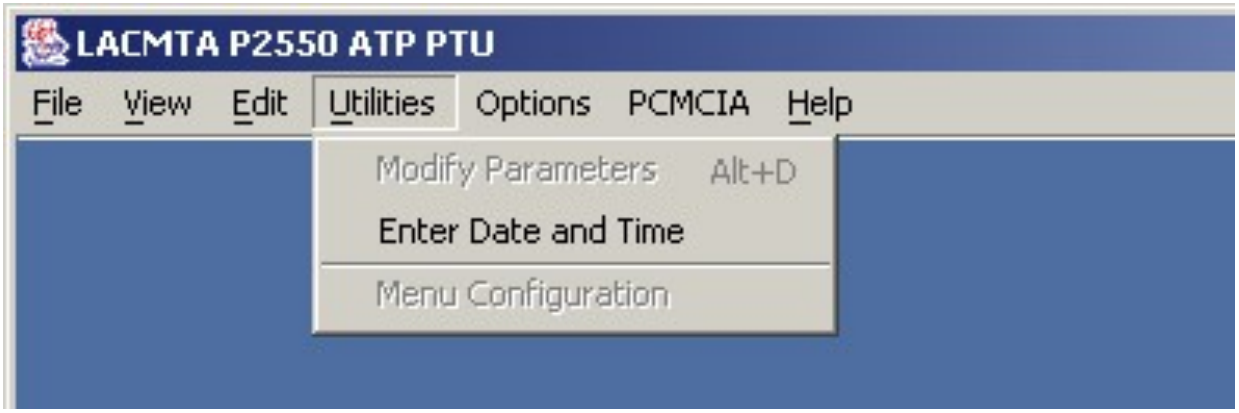


Figure 15-II-02-17 Utilities Menu Screen

15-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.

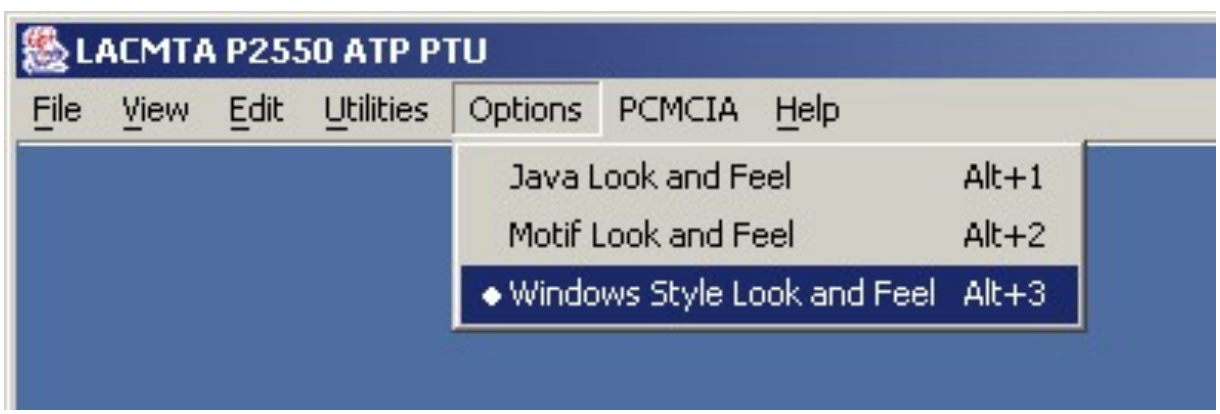


Figure 15-II-02-18 Options Menu Screen

15-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.

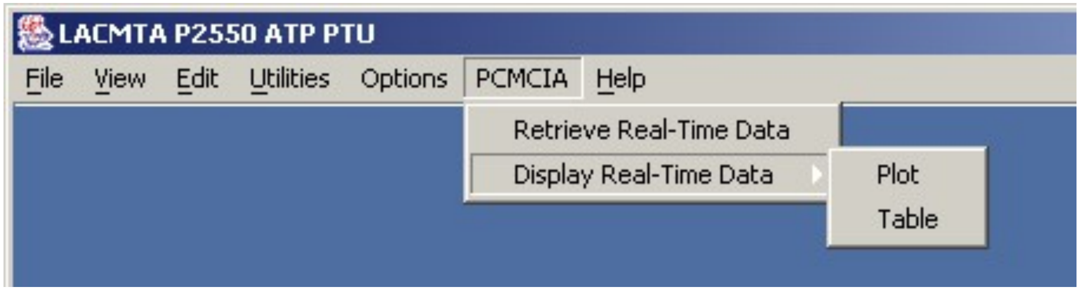


Figure 15-II-02-19 PCMCIA Menu Options

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.

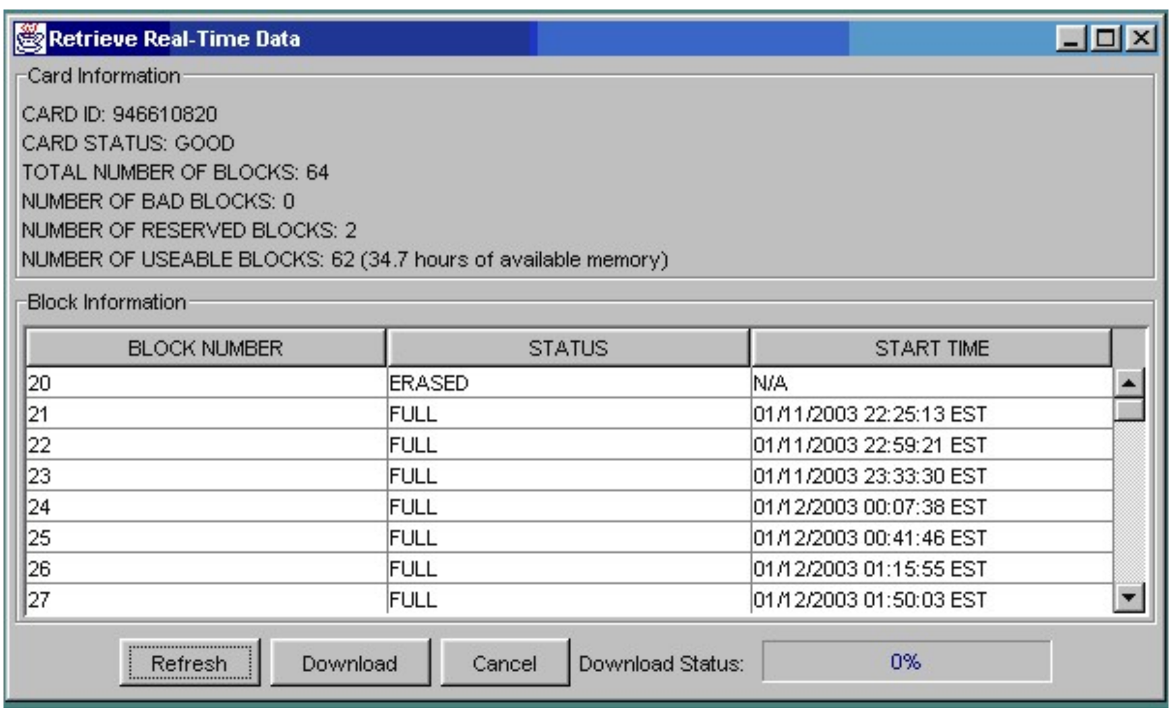


Figure 15-II-02-20 PCMCIA Retrieve Real-Time Data Screen

If communication 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.

15-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.

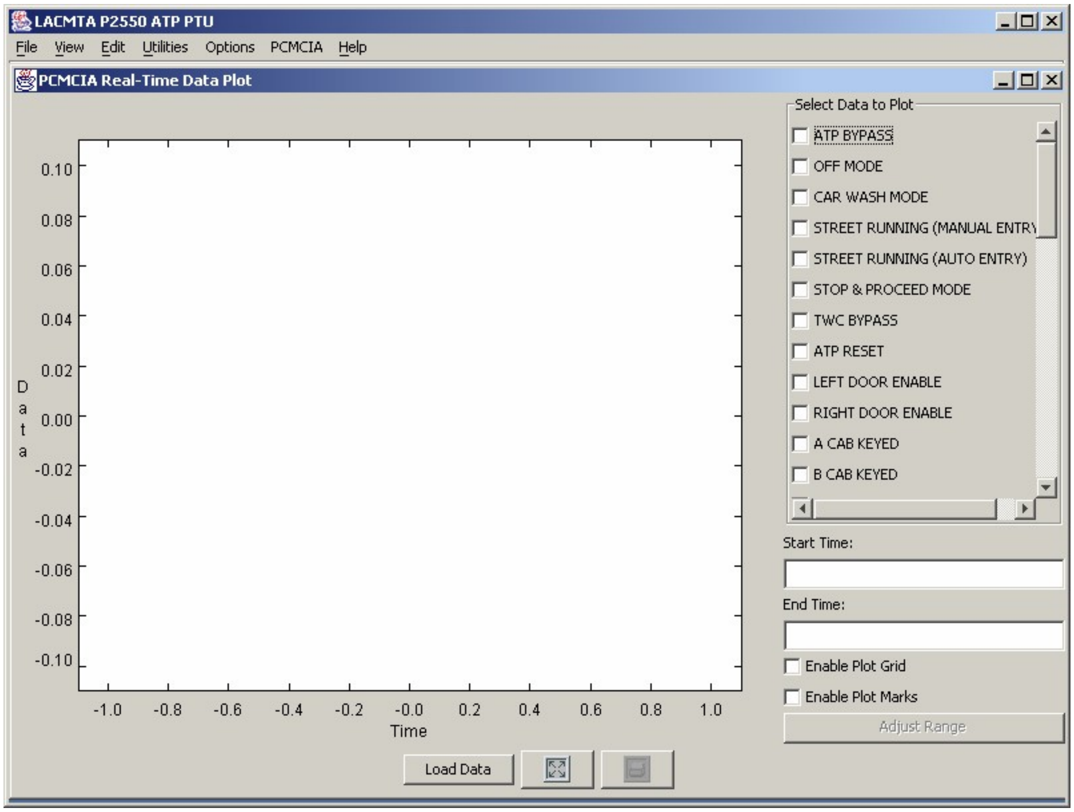


Figure 15-II-02-21 PCMCIA Real-Time Data Plotting Screen

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.

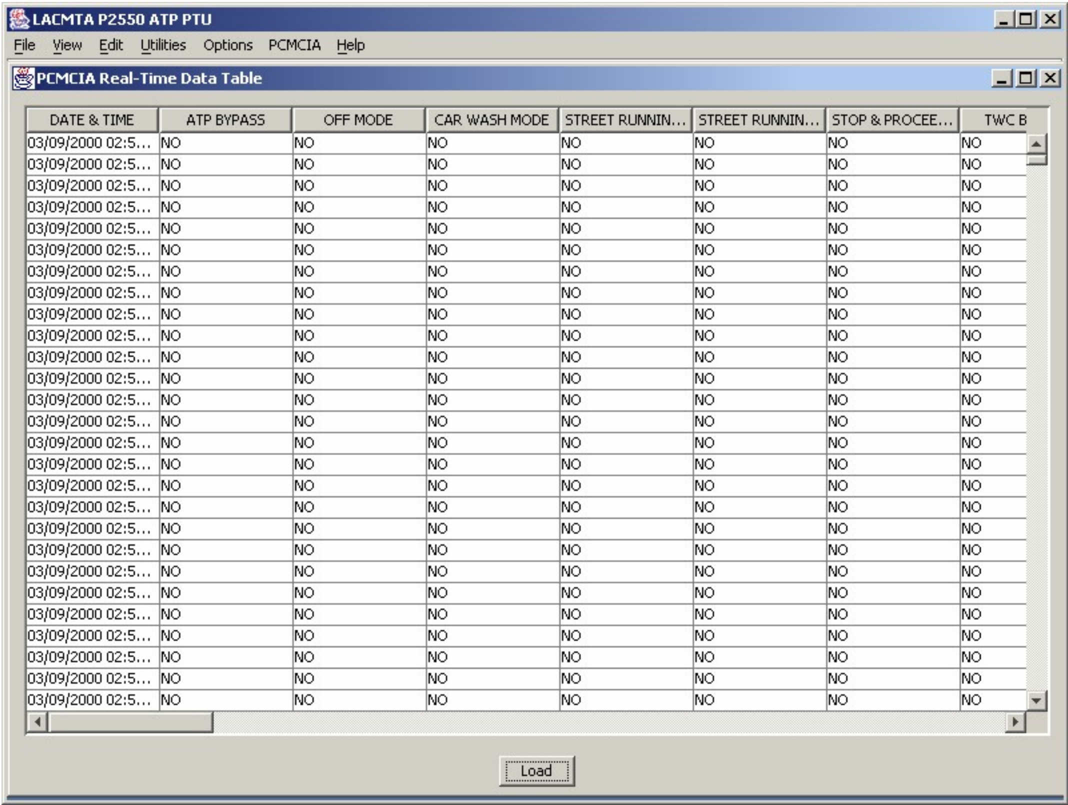


Figure 15-II-02-22 PCMCIA Real-Time Data Table

15-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 15-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.

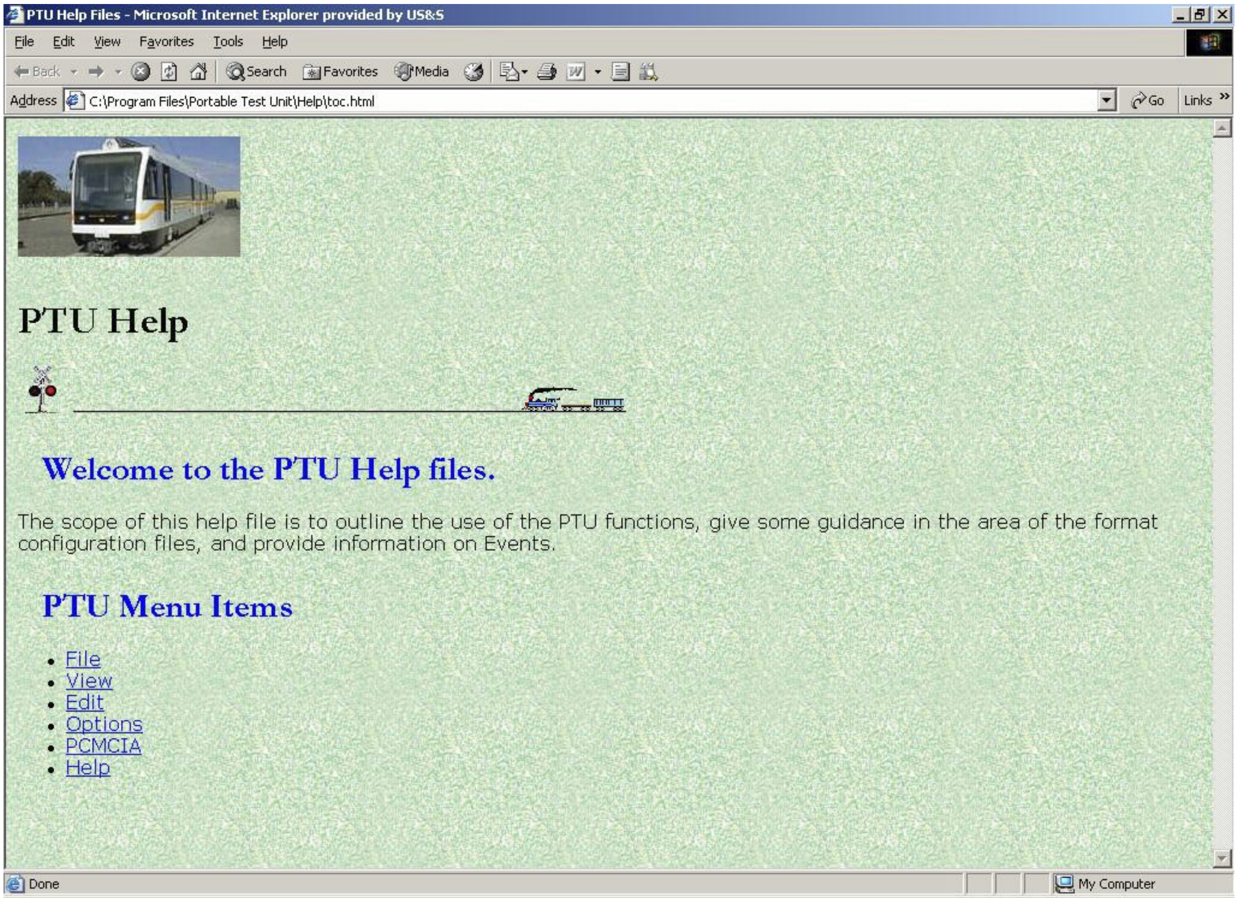


Figure 15-II-02-24 Help Window Screen

15-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 15-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 0).

2. 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 0).

3. 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 15-II-02.05.02).

4. 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 15-II-02.05.03).

15-II-02.05 Troubleshooting Procedures

NOTE: Prior to following any of these procedures, perform the General Troubleshooting Guidelines in paragraph 15-II-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.

15-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.

15-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.

15-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.

15-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.

15-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.

15-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.

15-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.

15-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.

15-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.

15-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.

15-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.

15-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.

15-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 Paragraph 15-II-02.05, Troubleshooting Procedures.

Table 15-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
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 15-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
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

Table 15-II-02.5 Vital Input (VIB1) Faults/Events

Event #	Event Description	Function	Default State	Log Type	Event Level
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
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 15-II-02.6 Vital Input (VIB2) Faults/Events

Event #	Event Description	Function	Default Status	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
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

Table 15-II-02.6 Vital Input (VIB2) Faults/Events

Event #	Event Description	Function	Default Status	Log Type	Event Level
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
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 15-II-02.7 Multifunction PCB Faults/Events

Event #	Event Description	Function	Default Status	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
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 15-II-02.8 Decoder CPU Faults/Events

Event #	Event Description	Function	Default Status	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	N/A	N/A	Pulsed	Sys_Err
504	failure DEC: double load failure	N/A	No Code	Pulsed	Default
505	DEC: double-path compare	N/A	No Code	Pulsed	Default
506	failure 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	N/A	No Code	Pulsed	Default
513	address 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	N/A	No Code	Pulsed	Default
519	failure 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
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	N/A	No Code	Pulsed	Default
533	error DEC: DPRAM CRC error	N/A	No Code	Pulsed	Default

Table 15-II-02.8 Decoder CPU Faults/Events

Event #	Event Description	Function	Default Status	Log Type	Event Level
534	DEC: DPRAM semaphore	N/A	No Code	Pulsed	Default
535	errorDEC: host communication	N/A	No Code	Pulsed	Default
536	fail 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 15-II-02.9 100 Hz Filter Faults/Events

Event #	Event Description	Function	Default Status	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 15-II-02.10 250 Hz Filter PCB Faults/Events

Event #	Event Description	Function	Default Status	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 15-II-02.11 ATP Logic Faults/Events

Event #	Event Description	Function	Default Status	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
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 15-II-02.12 ATP Crosscheck Faults/Events

Event #	Event Description	Function	Default Status	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
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 15-II-02.13 FSK Interface Faults/Events

Event #	Event Description	Function	Default Status	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 15-II-02.14 FSK CPU Faults/Events

Event #	Event Description	Function	Default Status	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 15-II-02.15 FSK Filter Process Faults/Events

Event #	Event Description	Function	Default Status	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
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 15-II-02.16 Vital Variable Faults/Events

Event #	Event Description	Function	Default Status	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 15-II-02.17 SPI Driver Faults/Events

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

Table 15-II-02.18 PCMCIA Faults/Events

Event #	Event Description	Function	Default Status	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 15-II-02.19 Calibration Faults/Events

Event #	Event Description	Function	Default Status	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 15-II-02.20 Tachometer Faults/Events

Event #	Event Description	Function	Default Status	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 15-II-02.21 Departure Test Faults/Events

Event #	Event Description	Function	Default Status	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

15-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 Troubleshooting Procedures, Paragraph 15-II-02.05.

Table 15-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

15-II-03 APPENDIX

15-II-03.01 IDU Fault List

15-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 Tables, 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 15-II-03.1 for Operating Mode Fault List

Refer to Table 15-II-03.2 for Operating Mode Fault Details

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

Table 15-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 15-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					

15-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 Tables.

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 15-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 15-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 15-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 15-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. Check ATP and ADU LON wiring. Replaced ATP CPU board. Replaced ADU					

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.					

Table 15-II-03.5 Maintenance Mode Fault Details (cont'd)

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. Check Decoder software version. Replaced Decoder.					

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. Replaced Decoder board.					

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 15-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. Determine which speed sensor using ATP logs. Check speed sensor wiring. Replaced speed sensor.					

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 15-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. Replace Multi - function board					

Table 15-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 15-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 15-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 15-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).					

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LOS ANGELES COUNTY

METROPOLITAN TRANSPORTATION AUTHORITY

LIGHT RAIL VEHICLE
P2550

RUNNING MAINTENANCE
AND
SERVICE MANUAL

VOLUME M-01-I
PART III
MAINTENANCE
SECT 15 AUTOMATIC TRAIN
PROTECTION

SECTION 15

AUTOMATIC TRAIN PROTECTION

PART III

MAINTENANCE

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SECTION 15

AUTOMATIC TRAIN PROTECTION

TABLE OF CONTENTS

Section / Para | Title | Page

LIST OF ILLUSTRATIONS

LIST OF TABLES

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SECTION 15

AUTOMATIC TRAIN PROTECTION

15-III-02 INTRODUCTION

The Automatic Train Protection Part III

- Maintenance consists of:
    - Preventive Maintenance
    - Corrective Maintenance
    - Consumable Materials
    - Test Equipment & Special Tools

15-III-02.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 OnlyMemory
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 TransportationAuthority
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-PMM	Running Preventive Maintenance Matrix
R-PMR	Running Preventive Maintenance Report
R-PMS	Running Preventive Maintenance Sheet
R-TESTL	Running Test Equipment & Special Tools List
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

15-III-02.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
Front door	The door close to the Operator's Cab
Rear door	The door close to the Articulation Section
MC Handle	Master Controller Handle
"A" Cab (or Cab A)	Operator Cab in the A body section
"B" Cab (or Cab B)	Operator Cab in the B body section

15-III-02.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)

15-III-02.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*
UPDATING	*00-07*
MANUAL CONTENT	*00-08*
MANUAL ILLUSTRATIONS	*00-09*
REFERENCE TO MAINTENANCE MANUALS SET	*00-10*
MTA PHILOSOPHY OF MAINTENANCE	**00-11**
SAFETY	**00-12**
Vehicle Hazard Areas	**00-12.01**
General Safety Precautions	**00-12.02**
Safety Precautions around Electrical Equipment	**00-12.03**
Safety & Environmental Precautions with Chemicals	**00-12.04**
GENERAL MAINTENANCE GUIDE	**00-13**
Hardware	**00-13.01**
Cable Ties (Tie Wraps)	**00-13.02**
Wiring	**00-13.03**
Fuses	**00-13.04**
Lubrication and Cleaning	**00-13.05**
ELECTROSTATIC DISCHARGE	**00-14**
Description	**00-14.01**
Methods of Protection	**00-14.02**
STORAGE AND HANDLING	**00-15**
General Storage Requirements	**00-15.01**
Special Storage Requirements	**00-15.02**
P2550 SOFTWARE CONFIGURATION	**00-21**
P2550 PTU /LAPTOP SOFTWARE LIST	**00-22**
P2550 STANDARD TORQUE LIST	**00-23**
HOW TO USE IPC	**00-24**
HOW TO USE THE FUNCTIONAL SCHEMATICS	**00-25**
HOW TO USE THE TOPOGRAPHIC SCHEMATICS	**00-26**
HOW TO USE THE ANSALDOBREDA DATABASE	**00-27**

15-III-03 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

15-III-04 RUNNING -PREVENTIVE MAINTENANCE

15-III-04.01 Running -Preventive Maintenance Matrixes (R-PMM)

The Automatic Train Protection Running -Preventive Maintenance Matrix (R-PMM) provides the Preventive Maintenance Plan of the Automatic Train Protection up to 120,000 Miles.

The Automatic Train Protection (R-PMM) is provided in two different arrangements as follows:

- **R-PMM Component Based**

It lists the Automatic Train Protection 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 Automatic Train Protection 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 Users 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.

15-III-04.01.01 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.

15-III-04.01.02 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.

15-III-04.01.03 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.

15-III-04.01.04 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 15-III-04.03.01 for Running- Preventive Maintenance Sheet (R-PMS) Form for detailed explanation.

15-III-04.01.05 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 15-III-04.1 for Running - Preventive Maintenance Matrix (R-PMM) (Component Based)
- Table 15-III-04.2 for Running - Preventive Maintenance Matrix (R-PMM) (Mileage Based)

15-III-04.01.06 Running Preventive Maintenance Matrix (Component Based)

Table 15-III-04.1 Running Preventive Maintenance Matrix (Component Based)

SYSTEM 15 AUTOMATIC TRAIN PROTECTION

SUBSYSTEM ASSY/UNIT/COMPONENT	TASK	SCPM	INSPECTION INTERVAL MILES					SHEET CODE
			Daily	10K	30K	60K	120K	
-ATP SYSTEM	INSPECTION					●		R-P-15-01-00-00/I-00
-ATP SYSTEM	INSPECTION	☑					●	R-P-15-01-00-00/I-01

15-III-04.01.07 Running Preventive Maintenance Matrix (Mileage Based)

Table 15-III-04.2 Running Preventive Maintenance Matrix (Mileage Based)

SYSTEM 15 AUTOMATIC TRAIN PROTECTION

SUBSYSTEM	TASK	SCPM	PERSON HOURS	SHEET CODE
60,000 MILES				
-ATP SYSTEM	INSPECTION		0.5	R-P-15-01-00-00/I-00
120,000 MILES				
-ATP SYSTEM	INSPECTION	☑	0.8	R-P-15-01-00-00/I-01

15-III-04.02 Running -Preventive Maintenance Reports (R-PMR/Job Cards)

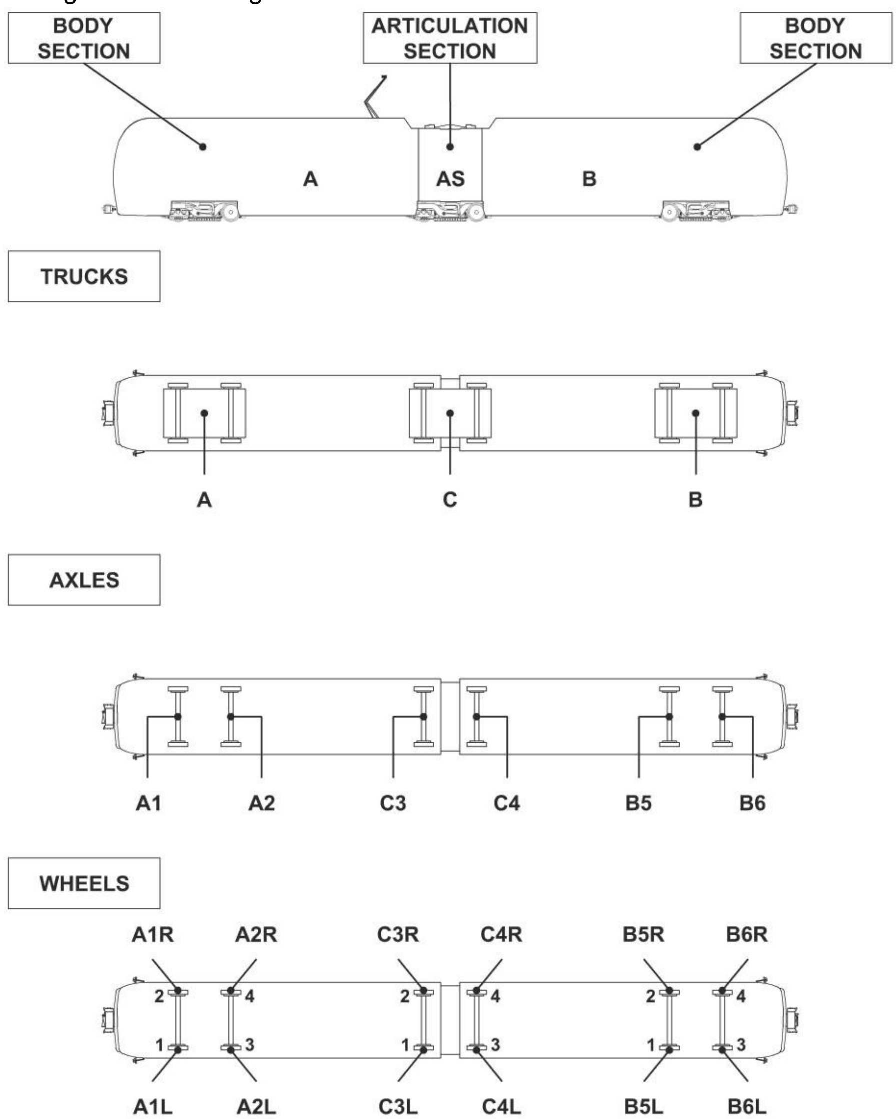
This paragraph describes the contents of the Automatic Train Protection Running -Preventive Maintenance Reports (R-PMR/Job Cards) for the Running - Preventive Maintenance Tasks.

15-III-04.02.01 R-PMR/Job Card Form Content

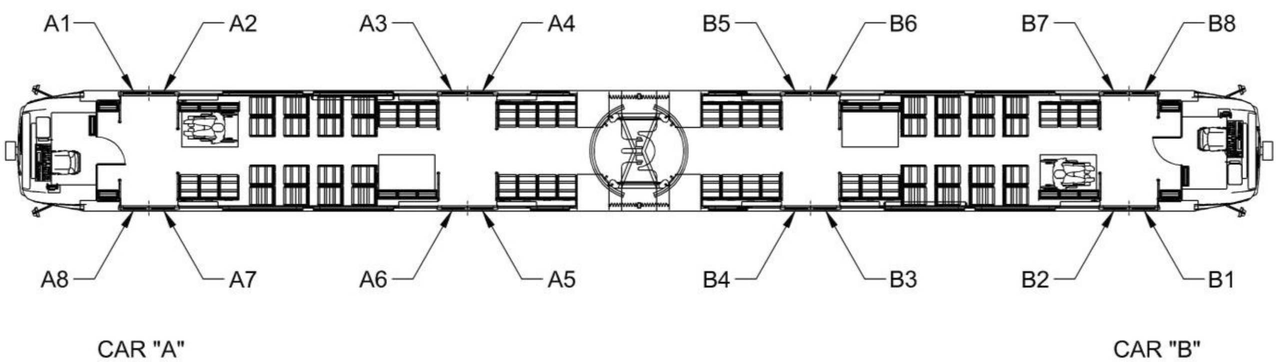
The R-PMR/JOB CARDS are broken down into two main topics:

Specific Data and R-PM Data
Refer to Figure 15-III-04.1 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)

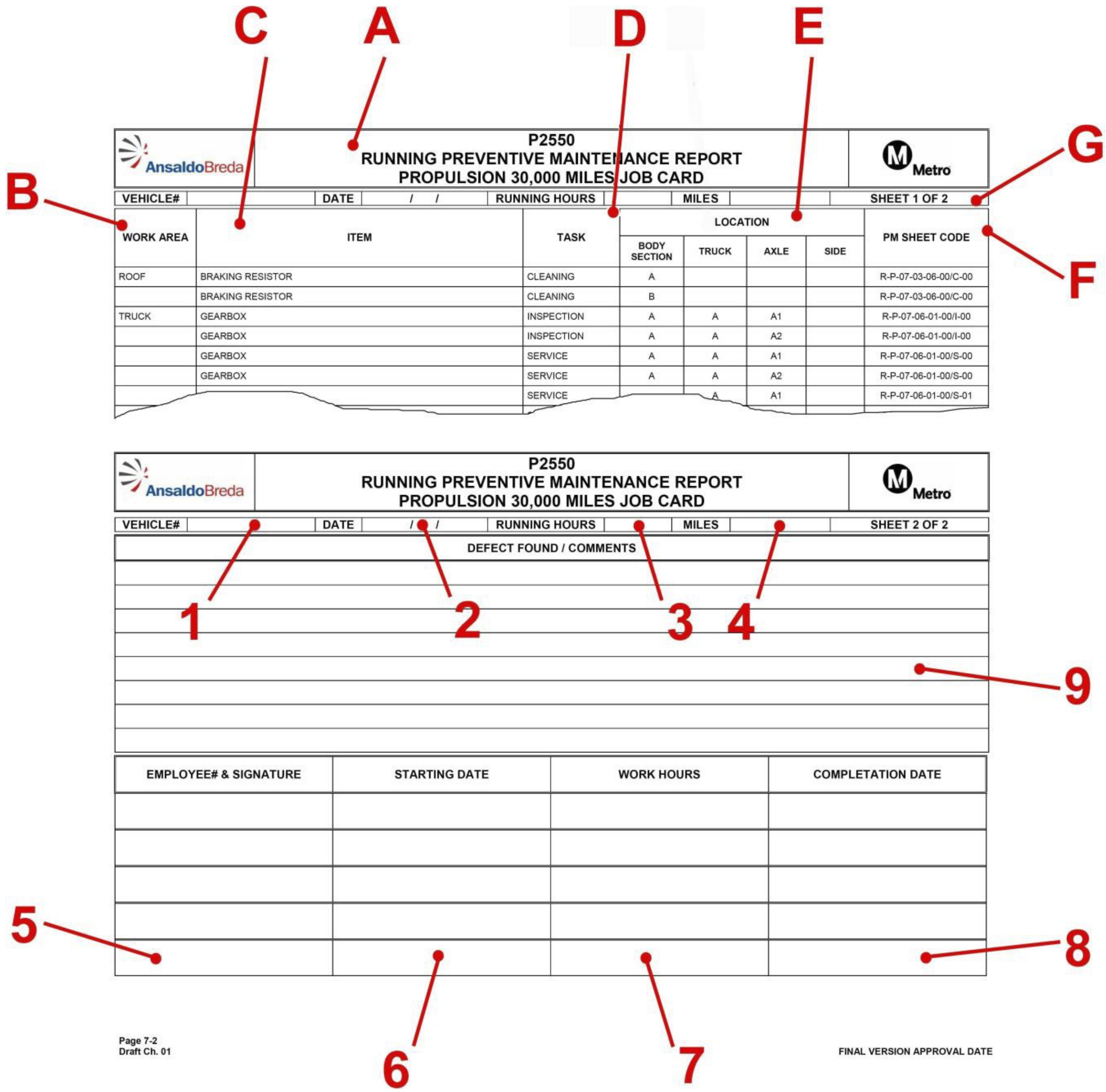
RUNNING PREVENTIVE MAINTENANCE REPORTS (R-PMR/JOB CARDS) FORM		
SPECIFIC DATA TO BE FILLED IN BY THE MAINTAINER		
ITEM #	**TITLE**	**EXPLANATORY NOTE**
C	**ITEM**	This column lists the Subsystem/Assembly, Unit, Component to be maintained
D	**TASK**	This column lists the R-PM tasks to be performed for 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


P2550
RUNNING PREVENTIVE MAINTENANCE REPORT
PROPULSION 30,000 MILES JOB CARD

VEHICLE# | DATE / / | RUNNING HOURS | MILES | SHEET 1 OF 2

WORK AREA	ITEM	TASK	LOCATION BODY SECTION	LOCATION TRUCK	LOCATION AXLE	LOCATION SIDE	PM SHEET CODE
ROOF	BRAKING RESISTOR	CLEANING	A				R-P-07-03-06-00/C-00
	BRAKING RESISTOR	CLEANING	B				R-P-07-03-06-00/C-00
TRUCK	GEARBOX	INSPECTION	A	A	A1		R-P-07-06-01-00/I-00
	GEARBOX	INSPECTION	A	A	A2		R-P-07-06-01-00/I-00
	GEARBOX	SERVICE	A	A	A1		R-P-07-06-01-00/S-00
	GEARBOX	SERVICE	A	A	A2		R-P-07-06-01-00/S-00
		SERVICE		A	A1		R-P-07-06-01-00/S-01

P2550
RUNNING PREVENTIVE MAINTENANCE REPORT
PROPULSION 30,000 MILES JOB CARD

VEHICLE# | DATE / / | RUNNING HOURS | MILES | SHEET 2 OF 2

DEFECT FOUND / COMMENTS

EMPLOYEE# & SIGNATURE	STARTING DATE	WORK HOURS	COMPLETATION DATE

Page 7-2
Draft Ch. 01

FINAL VERSION APPROVAL DATE

Figure 15-III-04.1 R-PMR/Job Card Form -Example

15-III-04.02.02 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

15-III-04.02.03 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

15-III-04.02.04 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.

15-III-04.02.05 Running Preventive Maintenance Reports R-PMR/Job Cards

AUTOMATIC TRAIN PROTECTION

Running - Preventive Maintenance Reports

R-PMR/JOB CARDS

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AUTOMATIC TRAIN PROTECTION
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	AUTOMATIC TRAIN PROTECTION	ATP SYSTEM RACK	INSPECTION	A				R-P-15-01-00-00/I-00
TRUCK	AUTOMATIC TRAIN PROTECTION	ATP SYSTEM PICK-UP COIL	INSPECTION	A	A		RH	R-P-15-01-00-00/I-00
			INSPECTION	A	A		LH	R-P-15-01-00-00/I-00
		ATP SYSTEM SPEED SENSORS	INSPECTION	A	A	A2	LH	R-P-15-01-00-00/I-00
			INSPECTION	AS	C	C4	LH	R-P-15-01-00-00/I-00
		ATP SYSTEM PICK-UP COIL	INSPECTION	B	B		RH	R-P-15-01-00-00/I-00
			INSPECTION	B	B		LH	R-P-15-01-00-00/I-00
UNDERCAR	AUTOMATIC TRAIN PROTECTION	ATP SYSTEM TRACK RECEIVERS	INSPECTION	A			RH	R-P-15-01-00-00/I-00
			INSPECTION	A			LH	R-P-15-01-00-00/I-00
			INSPECTION	B			RH	R-P-15-01-00-00/I-00
			INSPECTION	B			LH	R-P-15-01-00-00/I-00

DEFECT FOUND / COMMENTS

EMPLOYEE # & SIGNATURE	STARTING DATE	WORK HOURS	COMPLETION DATE

AUTOMATIC TRAIN PROTECTION
RUNNING PREVENTIVE MAINTENANCE REPORT
120,000 MILES JOB CARD

VEHICLE #		DATE		RUNNING HOURS		MILES		SHEET 1 OF 2

WORK AREA	SYSTEM	ITEM	TASK	LOCATION				PM SHEET CODE
				BODY SECT	TRUCK	AXLE	SIDE	
INTERIOR	AUTOMATIC TRAIN PROTECTION	ATP SYSTEM RACK	INSPECTION	A				R-P-15-01-00-00/I-00
		ATP SYSTEM ADU	INSPECTION	A				R-P-15-01-00-00/I-01
		ATP SYSTEM RACK	INSPECTION	A				R-P-15-01-00-00/I-01
		ATP SYSTEM ADU	INSPECTION	B				R-P-15-01-00-00/I-01
TRUCK	AUTOMATIC TRAIN PROTECTION	ATP SYSTEM PICK-UP COIL	INSPECTION	A	A		RH	R-P-15-01-00-00/I-00
		ATP SYSTEM PICK-UP COIL	INSPECTION	A	A		LH	R-P-15-01-00-00/I-00
		ATP SYSTEM PICK-UP COIL	INSPECTION	A	A		RH	R-P-15-01-00-00/I-01
		ATP SYSTEM PICK-UP COIL	INSPECTION	A	A		LH	R-P-15-01-00-00/I-01
		ATP SYSTEM PICK-UP COIL	INSPECTION	A	A	A2	LH	R-P-15-01-00-00/I-01
		ATP SYSTEM SPEED SENSORS	INSPECTION	A	A	A2	LH	R-P-15-01-00-00/I-00
		ATP SYSTEM PICK-UP COIL	INSPECTION	AS	C	C4	LH	R-P-15-01-00-00/I-01
		ATP SYSTEM SPEED SENSORS	INSPECTION	AS	C	C4	LH	R-P-15-01-00-00/I-00
		ATP SYSTEM PICK-UP COIL	INSPECTION	B	B		RH	R-P-15-01-00-00/I-00
		ATP SYSTEM PICK-UP COIL	INSPECTION	B	B		LH	R-P-15-01-00-00/I-00
		ATP SYSTEM PICK-UP COIL	INSPECTION	B	B		RH	R-P-15-01-00-00/I-01
		ATP SYSTEM PICK-UP COIL	INSPECTION	B	B		LH	R-P-15-01-00-00/I-01
UNDERCAR	AUTOMATIC TRAIN PROTECTION	ATP SYSTEM TRACK RECEIVERS	INSPECTION	A			RH	R-P-15-01-00-00/I-00
			INSPECTION	A			LH	R-P-15-01-00-00/I-00
			INSPECTION	B			RH	R-P-15-01-00-00/I-00
			INSPECTION	B			LH	R-P-15-01-00-00/I-00
			INSPECTION	A			RH	R-P-15-01-00-00/I-01
			INSPECTION	A			LH	R-P-15-01-00-00/I-01
			INSPECTION	B			RH	R-P-15-01-00-00/I-01
			INSPECTION	B			LH	R-P-15-01-00-00/I-01

(cont'd)

(cont'd)

AUTOMATIC TRAIN PROTECTION - RUNNING PREVENTIVE MAINTENANCE REPORT - 120,000 MILES JOB CARD(								
VEHICLE #		DATE		RUNNING HOURS		MILES		SHEET 2 OF 2

DEFECT FOUND / COMMENTS

EMPLOYEE # & SIGNATURE	STARTING DATE	WORK HOURS	COMPLETION DATE

15-III-04.03 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.

15-III-04.03.01 Running- Preventive Maintenance Sheet (R-PMS) Form

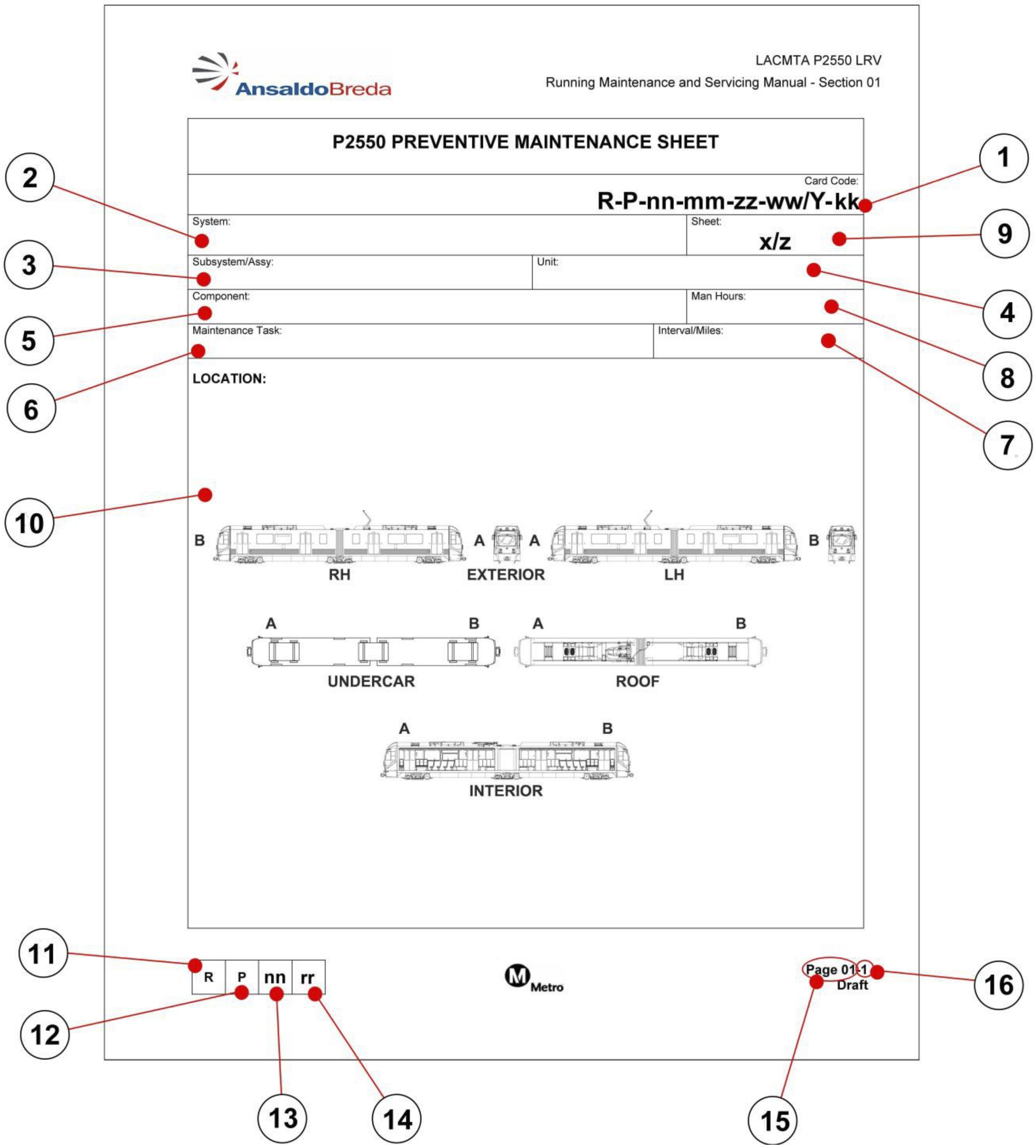
The R-PMS Form (refer to Figure 15-III-04.2) consists of several fields containing the following data/ information:

<table>
<tr><th colspan="4">RUNNING -PREVENTIVE MAINTENANCE SHEET (RPMS) Form</th></tr>
<tr><th>ITEM #</th><th>TITLE</th><th>CONTENT</th><th>EXPLANATORY NOTES</th></tr>
<tr><td>1</td><td>Card code</td><td>Sheet code</td><td>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 = Running P= Preventive
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=Cleaning I =Inspection L = Lubrication
R=Replacement S=Service T=Test
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</td></tr>
<tr><td>2</td><td>System</td><td>System name</td><td>This field indicates the System to which the Assembly/Unit/Component belongs.</td></tr>
<tr><td>3</td><td>Subsystem/ Assembly</td><td>Subsystem/ Assembly name</td><td>This field indicates the Subsystem/Assembly to which the Unit/Component belongs.</td></tr>
<tr><td>4</td><td>Unit</td><td>Unit name</td><td>This field indicates the Unit to which the Component belongs.</td></tr>
<tr><td>5</td><td>Component</td><td>Component name</td><td>This field indicates the Component the Maintenance Task is referring to</td></tr>
<tr><td>6</td><td>Maintenance Task</td><td>Maintenance Task name</td><td>This field indicates the Maintenance Task to be performed.</td></tr>
<tr><td>7</td><td>Interval Miles</td><td>Number</td><td>This field indicates the maintenance Interval Miles.
It may be DAILY, 10,000 Miles, 30,000 Miles,
60,000 Miles, 120,000 Miles</td></tr>
</table>

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 •
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.


LACMTA P2550 LRV
Running Maintenance and Servicing Manual - Section 01

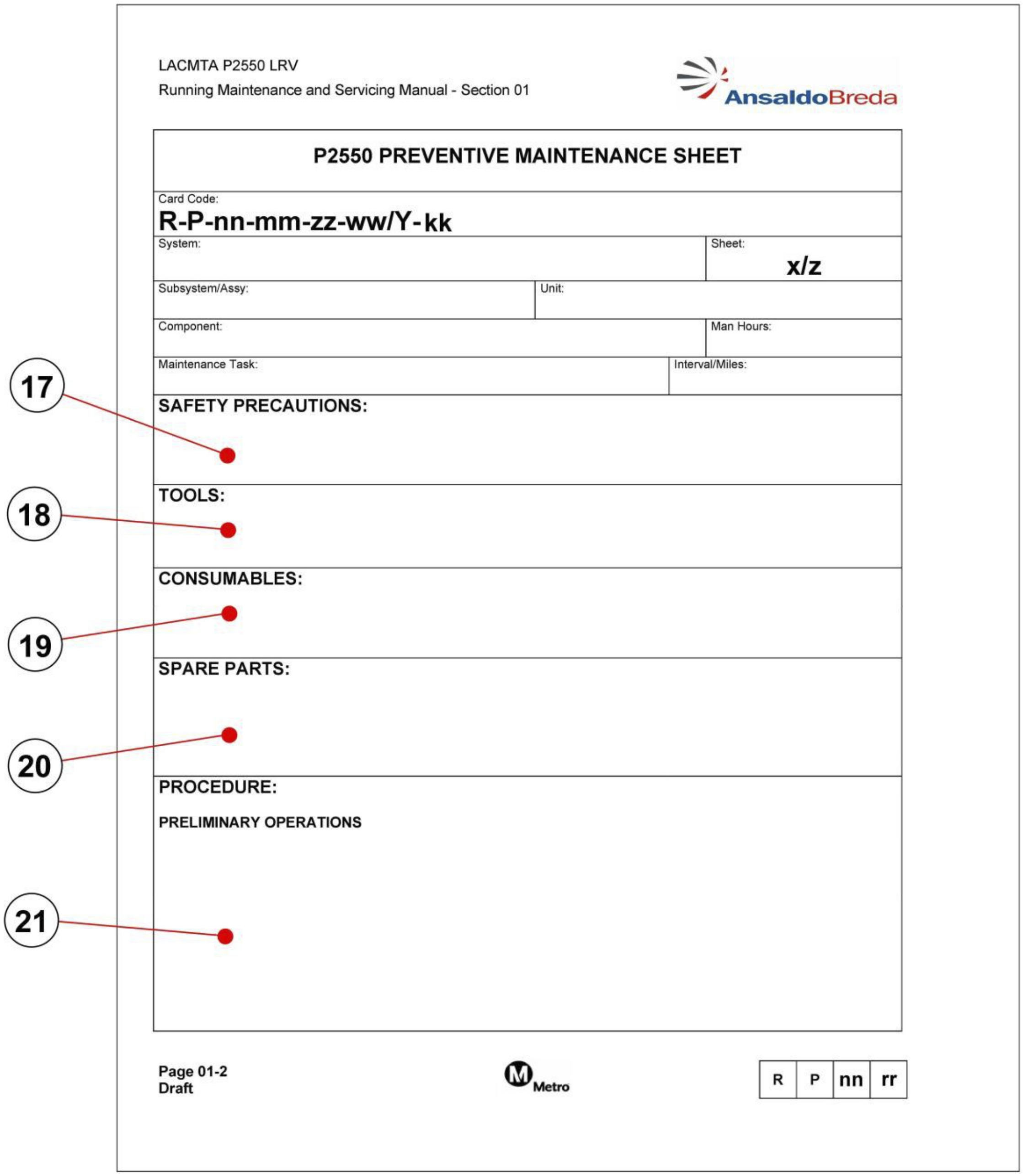
P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-nn-mm-zz-ww/Y-kk

System:
Sheet:
x/z
Subsystem/Assy:
Unit:
Component:
Man Hours:
Maintenance Task:
Interval/Miles:

LOCATION:

Figure 15-III-04.2 R-PMS Form
(Sheet 1 of 2)



LACMTA P2550 LRV

Running Maintenance and Servicing Manual - Section 01

AnsaldoBreda

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: R-P-nn-mm-zz-ww/Y-kk	
System:	Sheet: x/z
Subsystem/Assy:	Unit:
Component:	Man Hours:
Maintenance Task:	Interval/Miles:

SAFETY PRECAUTIONS:

TOOLS:

CONSUMABLES:

SPARE PARTS:

PROCEDURE:

PRELIMINARY OPERATIONS

Page 01-2
Draft

Metro

R	P	nn	rr

Figure 15-III-04.2 R-PMS Form
(Sheet 2 of 2)

15-III-04.03.02 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:

Ø **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 .

Ø **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)**

15-III-04.03.03 Running- Preventive Maintenance Sheet (R-PMS) List

The Automatic Train Protection 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 15-III-04.3 Running Preventive Maintenance Sheets List

<table>
<tr><th colspan="6">SYSTEM 15 AUTOMATIC TRAIN PROTECTION</th></tr>
<tr><th>SUBSYSTEM/ ASSY</th><th>ASSY /UNIT/ COMPONENT</th><th>SCPM</th><th>TASK</th><th>MAINTEN. INTERVAL (MILES)</th><th>SHEET CODE</th></tr>
<tr><td rowspan="2">ATP SYSTEM</td><td rowspan="2">ATP SYSTEM</td><td></td><td>INSPECTION</td><td>60,000</td><td>R-P-15-01-00-00/I-00</td></tr>
<tr><td>☑</td><td>INSPECTION</td><td>120,000</td><td>R-P-15-01-00-00/I-01</td></tr>
</table>

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AUTOMATIC TRAIN PROTECTION

Running - Preventive Maintenance Sheets

R-PMS

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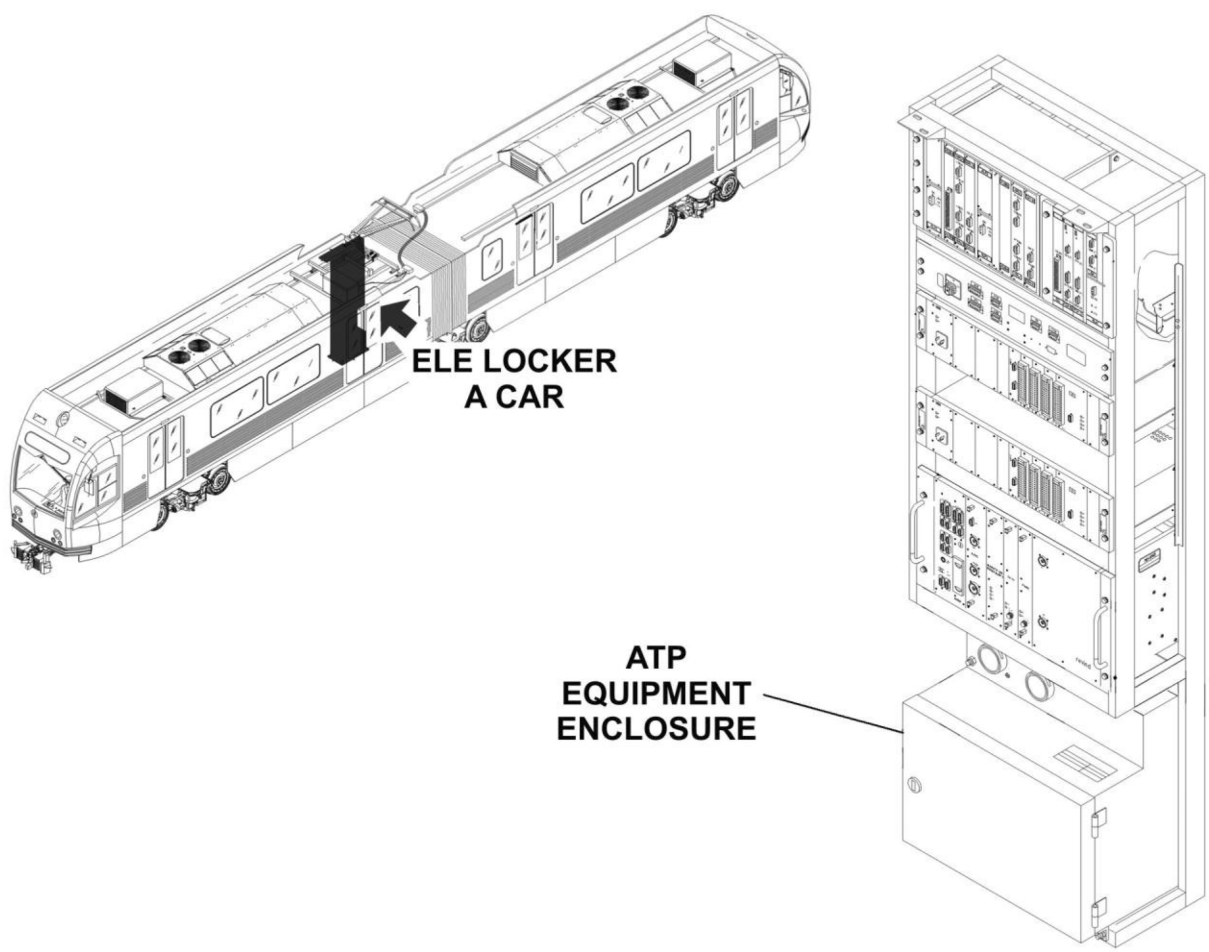
P2550 PREVENTIVE MAINTENANCE SHEET

	Card Code: **R-P-15-01-00-00/I-00**
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **1/10**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component:	Man Hours: **0.5**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

LOCATION:



P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-00-00/I-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **2/10**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component:	Man Hours: **0.5**
Maintenance Task: **INSPECTION**	Interval/Miles: **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
19M socket and wrench, 15/16” socket
Soft bristle brush

CONSUMABLES:

Lint-free rags
Compressed air in aerosol can
Cleaner for Electronic Equipment
Contact cleaner CRC 2000 or equivalent

SPARE PARTS:

N/A

P2550 PREVENTIVE MAINTENANCE SHEET

	Card Code: **R-P-15-01-00-00/I-00**
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **3/10**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component:	Man Hours: **0.5**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

PROCEDURE (CONT'D):

To perform the Task proceed as follows:

PRELIMINARY OPERATIONS

1. Set the vehicle in safety condition in accordance with LACMTA Maintenance Shop Regulations.
2. Make sure the Parking Brakes are applied and the Wheels chocked.

INSPECTION WORK AREA: INTERIOR

To perform the Task proceed as follows:

1 Gain access to the ATP Enclosure installed in the (A) ELE Locker, by opening the relevant ELE Locker Door using Maintenance Key.

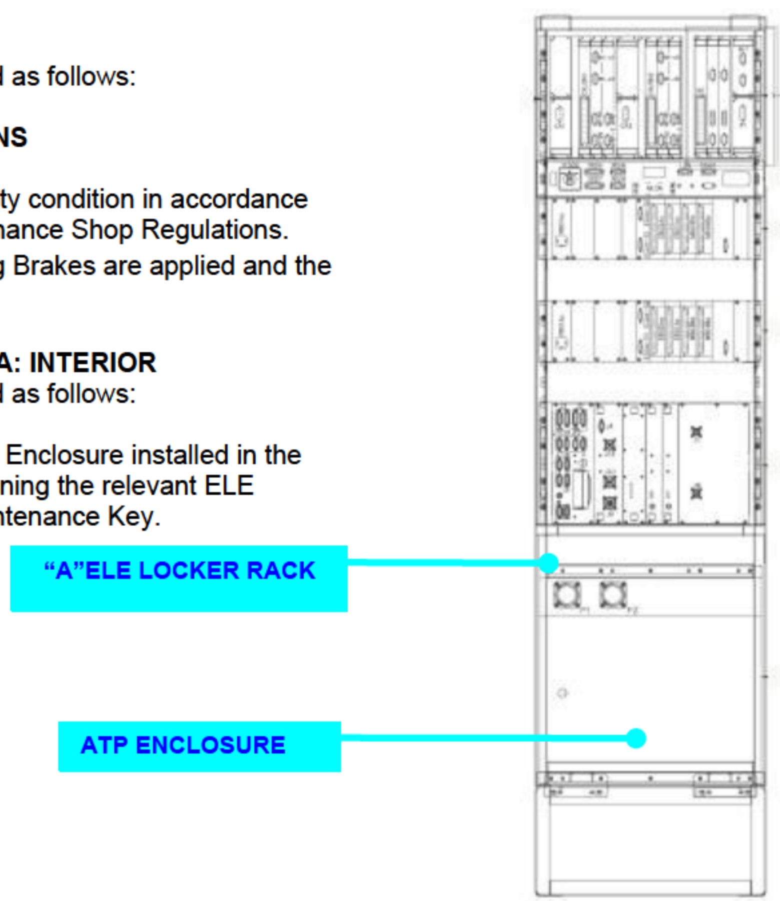


FIG 1 ATP LOCATION

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-00-00/I-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **4/10**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component:		Man Hours: **0.5**
Maintenance Task: **INSPECTION**		Interval/Miles: **60,000**

PROCEDURE (CONT'D):

INSPECTION WORK AREA: INTERIOR(CONT'D)

2 Check that Interface Connectors are tight and Cables are free of nicks, cuts, and fraying.
3 Open the Door Panel of ATP Enclosure
4 Perform the following inspections:
  a. Inspect for any signs of damage or 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-15-01-01-00/R-00
  c. Visual check the Board's Connectors for visible damage
  d. Note any areas / items requiring Corrective Maintenance.
5 Clean the ATP box as needed.

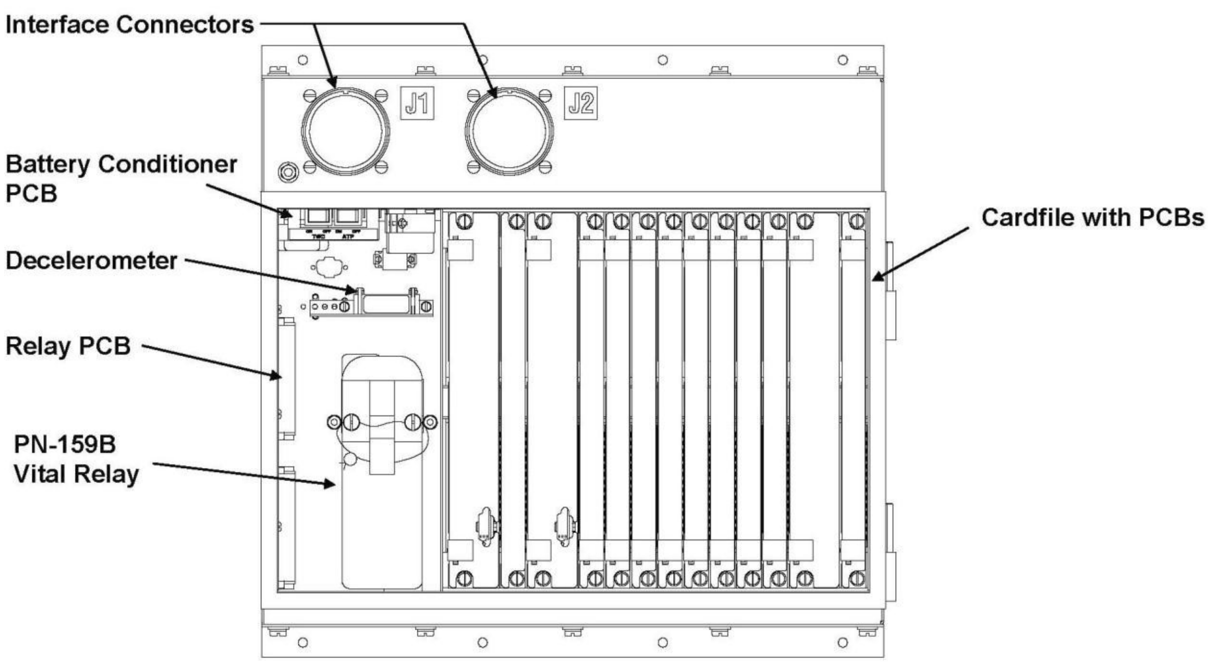


FIG 2 ATP ENCLOSURE & CARDFILE COMPONENTS

P2550 PREVENTIVE MAINTENANCE SHEET

	Card Code: **R-P-15-01-00-00/I-00**
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **5/10**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component:	Man Hours: **0.5**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

PROCEDURE (CONT'D):
INSPECTION WORK AREA: INTERIOR(CONT'D)

FIG 3 ATP ENCLOSURE & CARDFILE

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-00-00/I-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **6/10**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component:	Man Hours: **0.5**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

PROCEDURE (CONT'D):
INSPECTION WORK AREA: INTERIOR

6 Go in the A/B Cabs by opening the Cab Door using Maintenance Key

7 In each Cab:

- Check the ADU for visible damage /missing hardware.
- Clean the ADU using recommended cleaner and lint-free rags
- Note any areas / items requiring Corrective Maintenance.

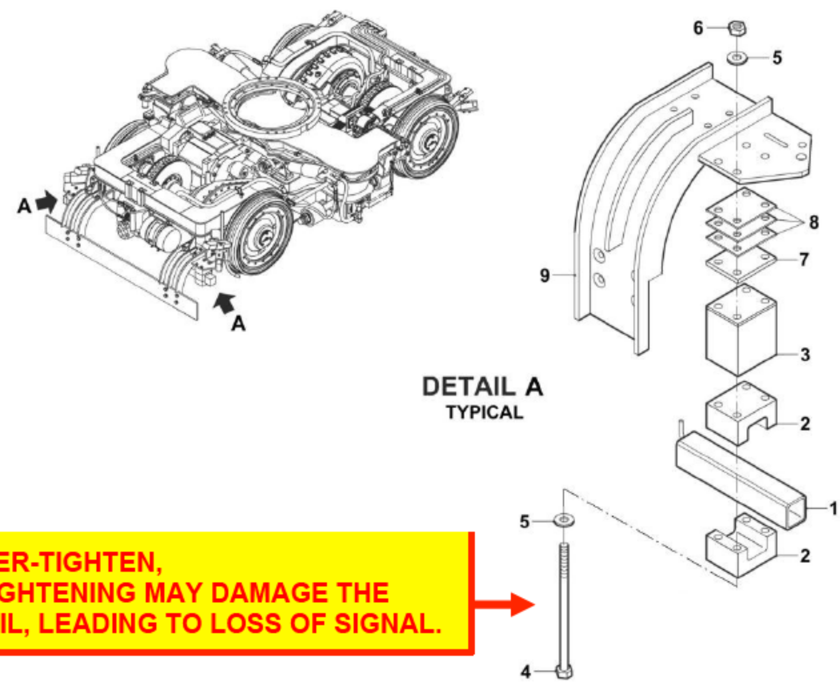
8 Leave the Cab. Close the Cab Door and lock it using Maintenance Key

FIG 4 ATP ASPECT DISPAY UNIT (ADU)

P2550 PREVENTIVE MAINTENANCE SHEET

	Card Code: **R-P-15-01-00-00/I-00**
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **7/10**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component:	Man Hours: **0.5**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

PROCEDURE (CONT'D):
INSPECTION WORK AREA: PIT



**DO NOT OVER-TIGHTEN,
AS OVER-TIGHTENING MAY DAMAGE THE
PICK-UP COIL, LEADING TO LOSS OF SIGNAL.**

FIG 5 ATP PICK UP COIL LOCATION AND COMPONENTS

9 Inspect the Pick Up Coil (FSK): as follows:

- Check the Pick Up Coil Assy for damage and proper installation
- Check Mounting Hardware. Torque to **34.5 in.-lb** if needed
- Check the Pick Up Coil Antenna Cable and Connector for damage, proper installation and safely tightening.
- Replace Pick Up Coil Assy as per Check Result according to Sheet R-C-15-01-15-00/R-00

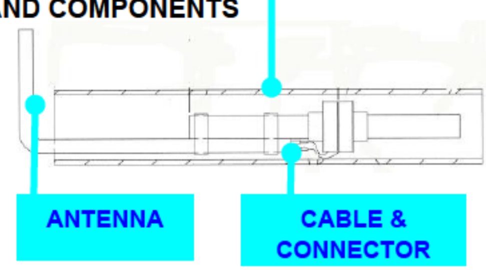


FIG 6 ATP PICK UP COIL DETAIL

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-00-00/I-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **8/10**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component:		Man Hours: **0.5**
Maintenance Task: **INSPECTION**		Interval/Miles: **60,000**

PROCEDURE (CONT'D):
INSPECTION WORK AREA: PIT
14 (cont'd)

- Using a clean lint-free cloth dampened with a solution of water and recommended cleaner remove accumulated dirt and grime from pick-up coil, spacer blocks and associated cable. Dry surfaces with a clean, lint-free cloth
- Note any areas / items requiring Corrective Maintenance.

15. Stay in the Pit under A/B Truck and locate the **Track Receivers**

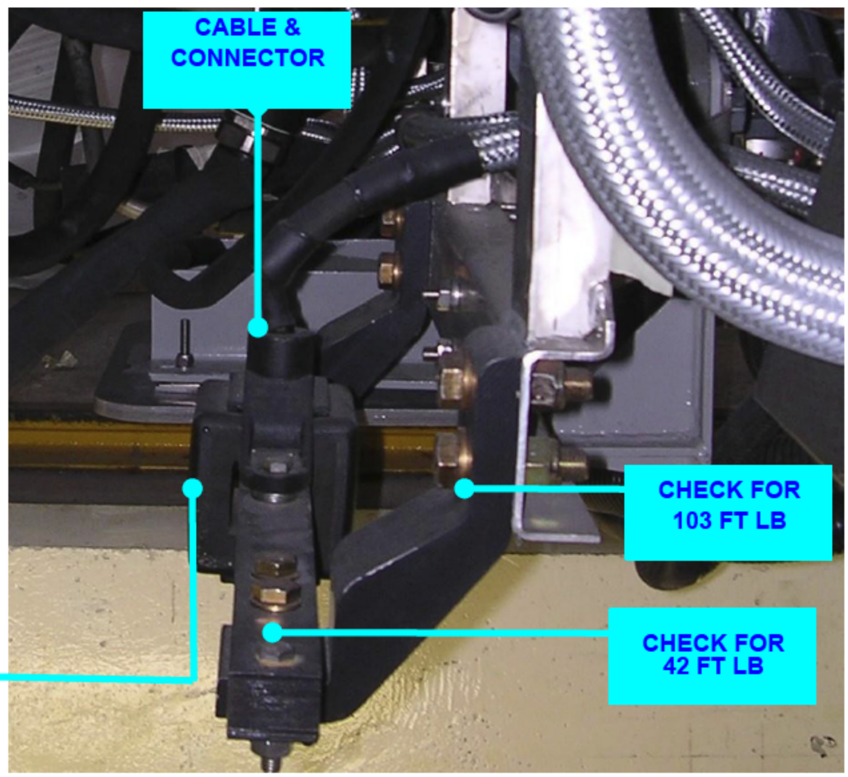


FIG 7 ATP TRACK RECEIVER (FSK) INSPECTION

16. For each Track Receiver:

- Check the Track Receiver Assy and relevant Junction Box for damage and that are tight
- Check Track Receiver Assy Fixing Hardware for **42 lb-ft** proper tightening
- Check the Clamp fixing the Track Receiver to the Underframe structure for damage and for **103 ft-lb** proper tightening
- Check the Cable and Connectors on Track Receiver and on Junction Box for damage, proper installation and safely tightening.
- Replace the Track Receiver Assy as per Check Result according to Sheet R-C-15-01-16-00/R-00
- Thoroughly clean the Track Receiver Assy Components with soft bristle brush, air compressed and lint-free rags.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-00-00/I-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **9/10**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component:	Man Hours: **0.5**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

PROCEDURE (CONT'D):

INSPECTION WORK AREA: PIT

1. Locate the Propulsion Speed Sensor Device to be inspected (see Fig 8).
2. Thoroughly clean the visible part of the Propulsion Speed Sensor Device using recommended cleaning agent and lint-free rags.
3. Inspect the Electrical Connector for visible damage and loose / missing parts.
4. Verify cable is tight at the speed sensor.
5. Thoroughly clean and dry the Electrical Connector.

If there is a Speed Sensor fault on the IDU or the Speed Sensor is loosen proceed as follows:

1. Loose the Loocking Nut, then gently screw the Speed Sensor into the Ground Conctact Device housing until it makes contact with the Gear.
2. Back the Speed Sensor out ¾ of turn.
3. Lock the Speed Sensor in place using the Jam Nuts. Torque to 20 ft-lb.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-00-00/I-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **10/10**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component:	Man Hours: **0.5**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

PROCEDURE (CONT'D):
INSPECTION WORK AREA: PIT

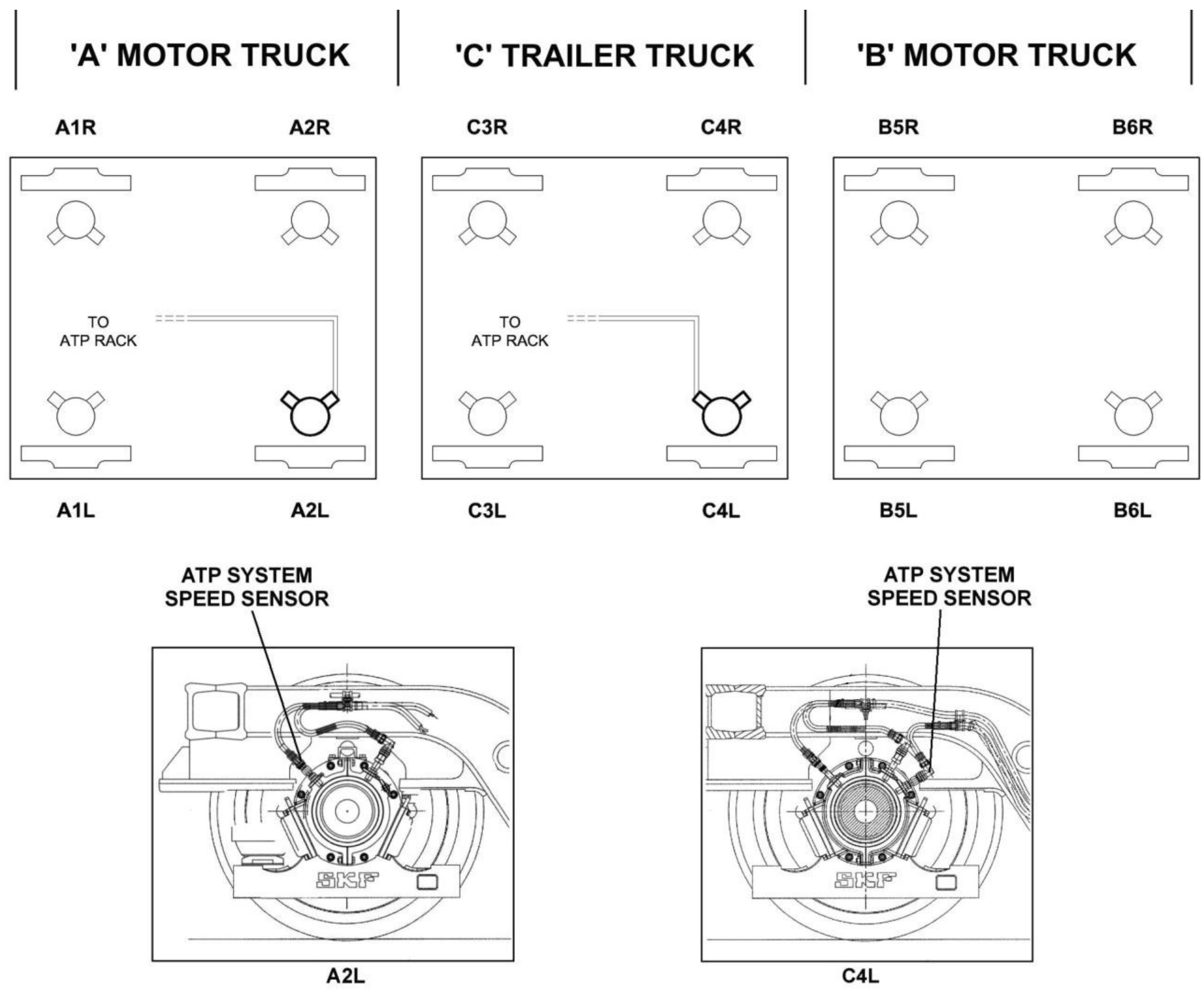
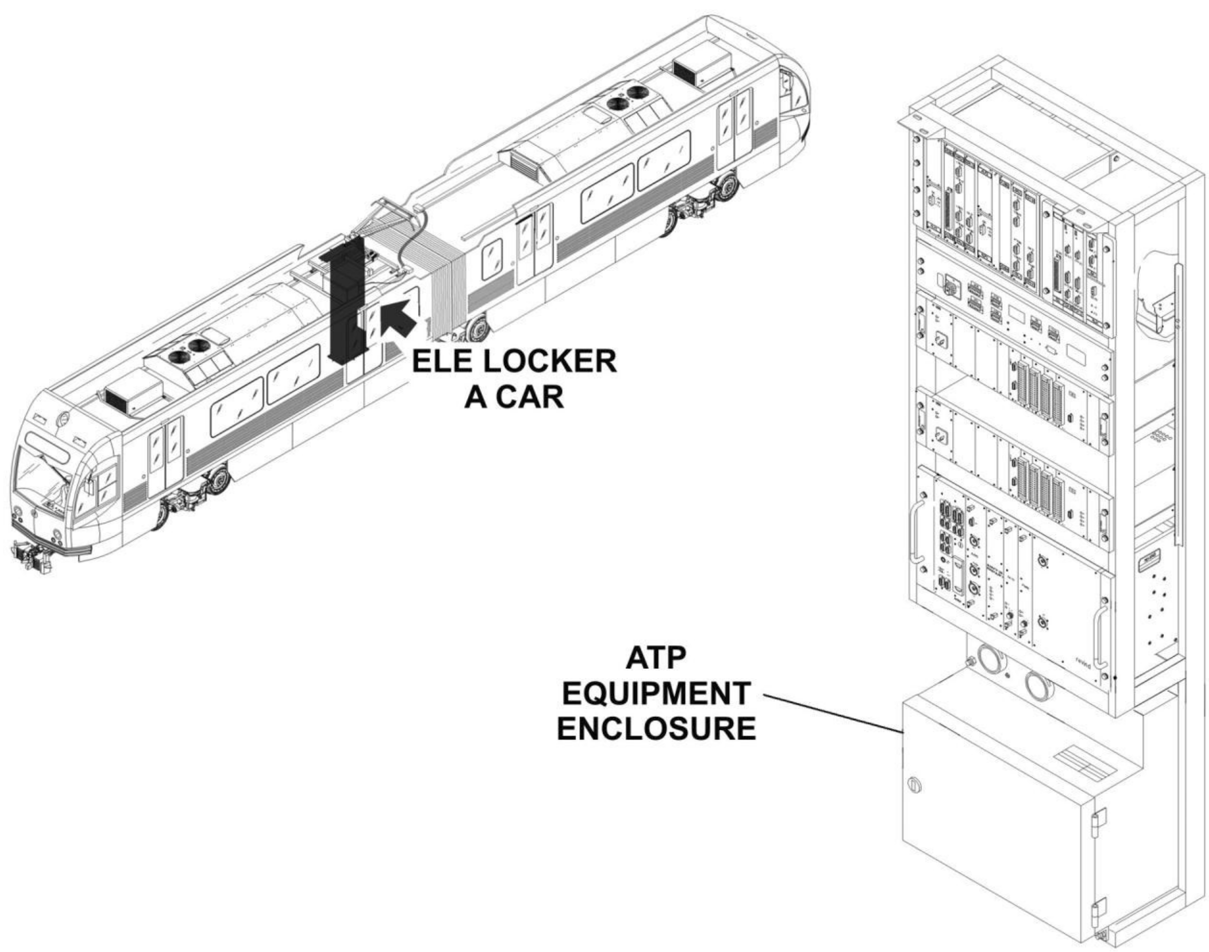


FIG 8 ATP SPEED SENSOR LOCATION

P2550 PREVENTIVE MAINTENANCE SHEET

	Card Code: **R-P-15-01-00-00/I-01**
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **1/22**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component:	Man Hours: **0.8**
Maintenance Task: **INSPECTION**	Interval/Miles: **120,000**

LOCATION:



P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:

R-P-15-01-00-00/I-01

System:	Sheet:
AUTOMATIC TRAIN PROTECTION	**2/22**

Subsystem/Assy:	Unit:
ATP SYSTEM	

Component:	Man Hours:
	0.8

Maintenance Task:	Interval/Miles:
INSPECTION	**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.

CAUTION: WHEN USING COMPRESSED AIR TO BLOW OUT DIRT AND DUST PARTICLES FROM CARDFILES, ALWAYS DIRECT AIR AT AN ANGLE RELATIVE TO THE PCBS. OTHERWISE, LOOSE OR DAMAGED COMPONENTS MAY OCCUR.

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit

Soft bristle brush

CONSUMABLES:

Lint-free rags
Compressed air in aerosol can
Cleaner for Electronic Equipment
Contact cleaner CRC 2000 or equivalent

SPARE PARTS:

N/A

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-00-00/I-01**

System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **3/22**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component:	Man Hours: **0.8**
Maintenance Task: **INSPECTION**	Interval/Miles: **120,000**

PROCEDURE:

To perform the Task proceed as follows:

PRELIMINARY OPERATIONS

1. Set the vehicle in safety condition in accordance with LACMTA Maintenance Shop Regulations.
2. Make sure the Parking Brakes are applied and the Wheels chocked.
3. Set the Transfer Switch to "OFF" Position.
4. Place to "OFF" position the following Circuit Breakers:

CB 11F02
located in the “A“&“B“ LV Lockers

CB 11F01
located in the “A“ LV Locker

CB 11S01,
located in the “A“Cab By Pass Panel,

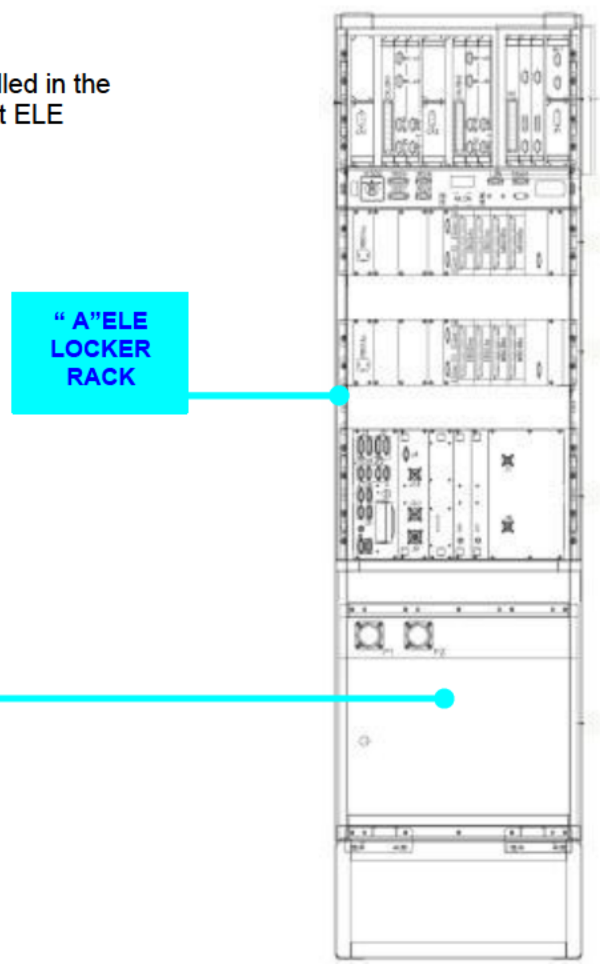
P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-00-00/I-01**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **4/22**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component:		Man Hours: **0.8**
Maintenance Task: **INSPECTION**		Interval/Miles: **120,000**

PROCEDURE (CONT'D):

INSPECTION WORK AREA: INTERIOR
To perform the Task proceed as follows:

1 Gain access to the ATP Enclosure installed in the (A) ELE Locker, by opening the relevant ELE Locker Door using Maintenance Key.



2. Locate the **ATP Enclosure**

P2550 PREVENTIVE MAINTENANCE SHEET

	Card Code: **R-P-15-01-00-00/I-01**
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **5/22**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component:	Man Hours: **0.8**
Maintenance Task: **INSPECTION**	Interval/Miles: **120,000**

PROCEDURE (CONT'D):

INSPECTION WORK AREA: INTERIOR (CONT'D)

3. Check that Interface Connectors are tight and Cables are free of nicks, cuts, and fraying.
4. Open the Door Panel of ATP 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-15-01-01-00/R-00.
   c. Visual check the Board's Connectors for visible damage.
6. Place the CB 11F01 (located in the "A" LV Locker) and the CB 11F02 (located in the "A"&"B" LV Lockers) to ON and check that the LEDs of each PCB are GREEN, indicating that the relevant Board works properly.
   Particularly check that the LED indicating the Charge Level of the 3.6V Lithium Backup Battery installed in the Main Logic CPU Daughterboard PCB is GREEN.
   As per check result, replace the Backup Battery according to Sheet R-C-15-01-01-00/R-00.

7. Replace the CB 11F01 and CB 11F02 to OFF.
8. Perform accurate cleaning as follows:
   a) Remove dust and dirt from accessible surfaces using soft bristle brush.
   b) Blow out dust and dirt from inaccessible areas around the Cardfiles, Power Supply and Terminal Boards using compressed air.
   c) Wipe Enclosure exterior and interior Surfaces (not exposed electrical conductors) with a lint-free cloth dampened with a solution of water and recommended cleaner (mixed according to manufacturer's directions) so that dirt and foreign matter are removed.
   d) Dry surfaces with a clean, lint-free cloth.

   CAUTION: WHEN USING COMPRESSED AIR TO BLOW OUT DIRT AND DUST PARTICLES FROM CARDFILES, ALWAYS DIRECT AIR AT AN ANGLE RELATIVE TO THE PCBS. OTHERWISE, LOOSE OR DAMAGED COMPONENTS MAY OCCUR.

   e) Using compressed air or soft bristle brush, remove dust and dirt particles from Cardfile.
   f) Dry surfaces with a clean, lint-free cloth.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-00-00/I-01**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **6/22**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component:	Man Hours: **0.8**
Maintenance Task: **INSPECTION**	Interval/Miles: **120,000**

PROCEDURE (CONT'D):
INSPECTION   WORK AREA: INTERIOR (CONT'D)

FIG 2   ATP ENCLOSURE & CARDFILE

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-00-00/I-01

System:
AUTOMATIC TRAIN PROTECTION

Sheet:
7/22

Subsystem/Assy:
ATP SYSTEM

Unit:

Component:

Man Hours:
0.8

Maintenance Task:
INSPECTION

Interval/Miles:
120,000

PROCEDURE (CONT'D):

INSPECTION WORK AREA: INTERIOR (CONT'D)

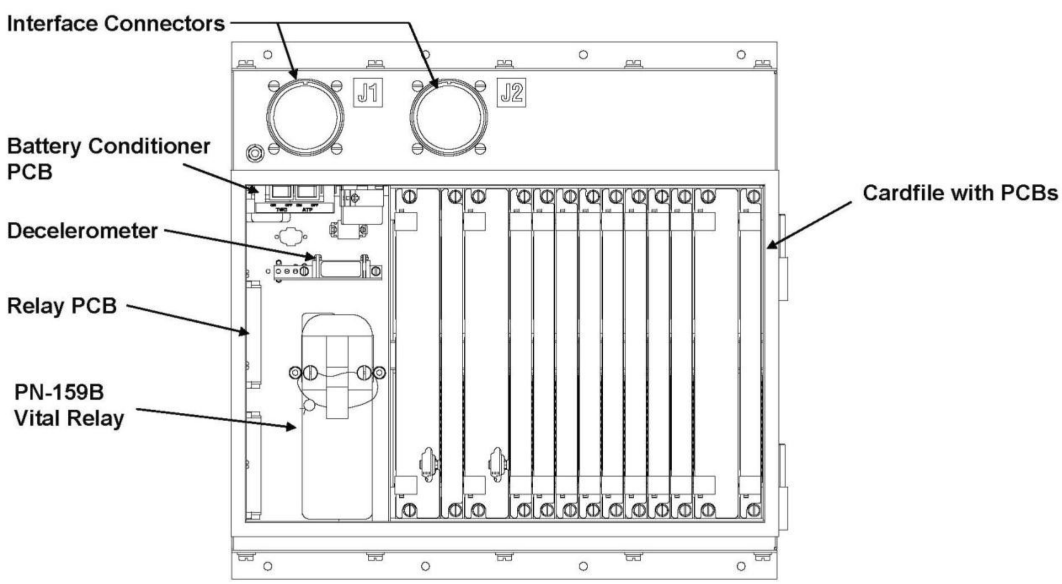


FIG 3 ATP ENCLOSURE & CARDFILE COMPONENTS

9 Check the Vital Relay for damage, missing hardware and signs of overheating.

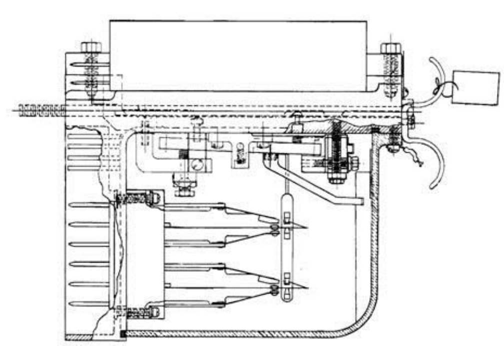
10 Check the sealing of the two Fixing Screws for proper installation and working

11 Check the Fixing Screws tightening

12 Note any areas / items requiring Corrective Maintenance.

13 Check the Label in front of the relay for Calibration Date Expiration

As per check result return the Relay to US&S or perform the Calibration according to the Instructions provided in the US&S Service Manual 4551W, *PN-159B Biased D.C. Car Carried Plug-In Relay*.



ATP VITAL RELAY
(Rh Side Of Enclosure Lh Compartment)

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-00-00/I-01

System:	Sheet:
AUTOMATIC TRAIN PROTECTION	**8/22**

Subsystem/Assy:	Unit:
ATP SYSTEM	

Component:	Man Hours:
	0.8

Maintenance Task:	Interval/Miles:
INSPECTION	**120,000**

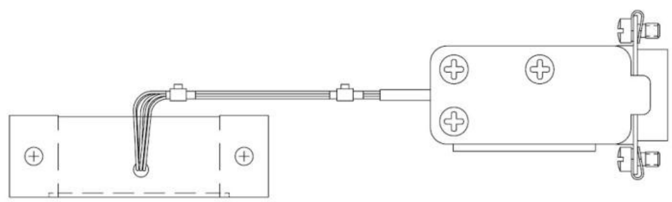
PROCEDURE (CONT'D):
INSPECTION WORK AREA: INTERIOR (CONT'D)

14 Check the Decelerometer for damage and missing hardware.

15 Check the Fixing Screws tightening.

16 Note any areas / items requiring Corrective Maintenance.

17 Check the Label in front of the Decelerometer for Calibration Date Expiration.
As per check result, perform the Calibration according to the Instructions provided in the
Sheet R-C-15-01-13-00/R-00.



ATP DECELEROMETER
(Rh Side Of Enclosure Lh Compartment)

18 Close the Door Panel of ATP Enclosure.

19 Leave the ELE Locker.

20 Close the relevant Door and lock it using the Maintenance Key.

21 Go in the A/B Cabs by opening the Cab Door using Maintenance Key.

22 In each Cab:

- Check the ADU for visible damage /missing hardware.
- Clean the ADU using recommended cleaner and lint-free rags.
- Note any areas / items requiring Corrective Maintenance.

23 Leave the Cab. Close the Cab Door and lock it using Maintenance Key.

FIG 4 ATP ASPECT DISPAY UNIT (ADU)

P2550 PREVENTIVE MAINTENANCE SHEET		
		Card Code: **R-P-15-01-00-00/I-01**
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **9/22**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component:		Man Hours: **0.8**
Maintenance Task: **INSPECTION**		Interval/Miles: **120,000**

PROCEDURE (CONT'D):

INSPECTION WORK AREA: PIT

24 Go in the Pit, under A/B Truck and locate the Pick Up Coils

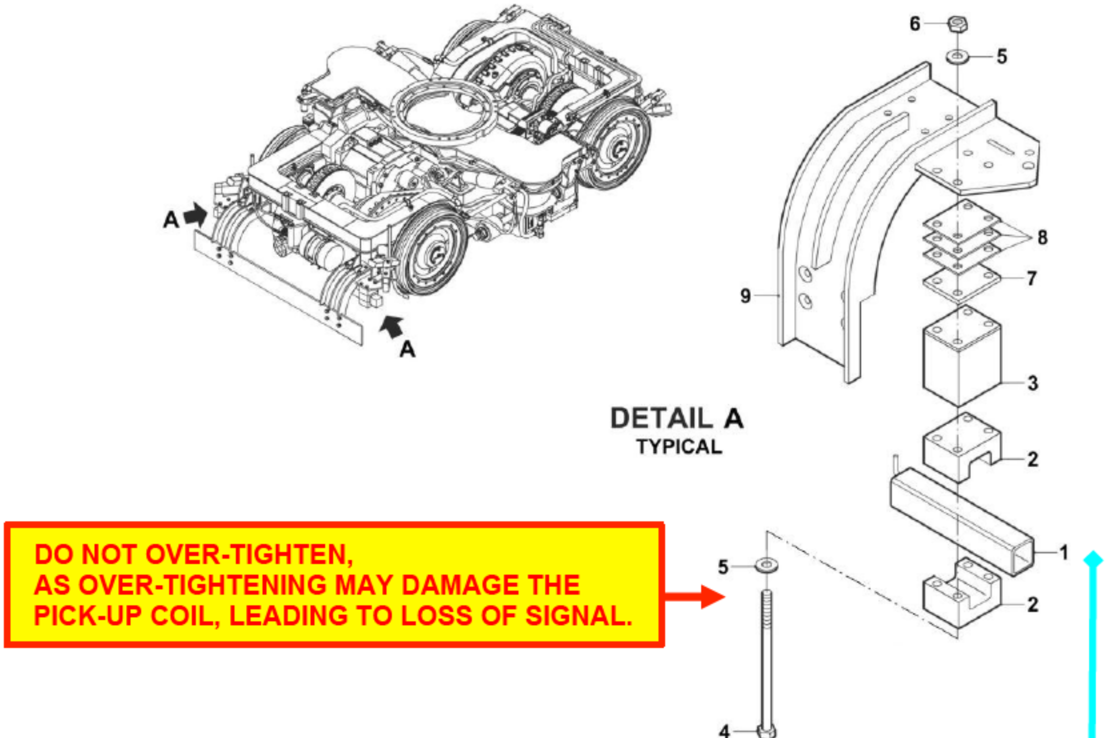


FIG 5 ATP PICK UP COIL LOCATION AND COMPONENTS

25 For each Pick Up Coil:

- Check the Pick Up Coil Assy for damage and proper installation
- Check Mounting Hardware for **34.5 in.-lb** proper tightening
- Check the Pick Up Coil Antenna Cable and Connector for damage, proper installation and safely tightening.
- Replace Pick Up Coil Assy as per Check Result according to Sheet R-C-15-01-15-00/R-00

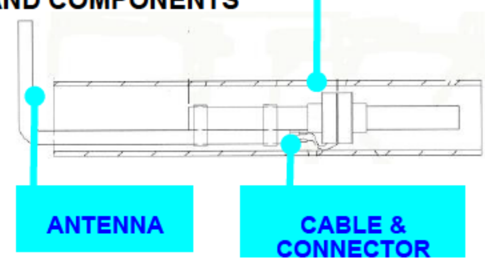


FIG 6 ATP PICK UP COIL DETAIL

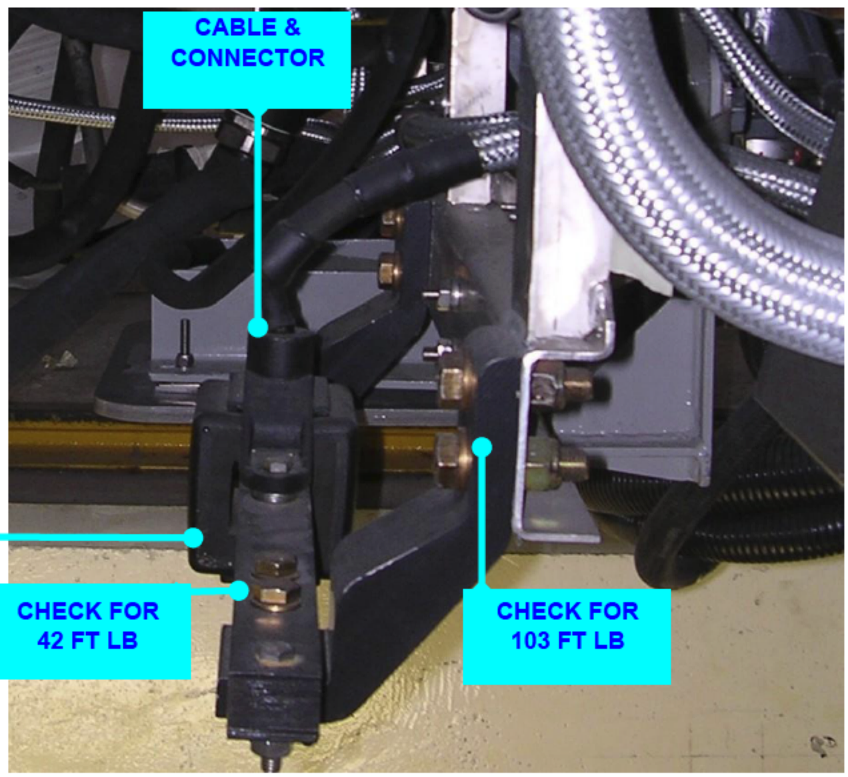
P2550 PREVENTIVE MAINTENANCE SHEET		
Card Code: **R-P-15-01-00-00/I-01**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **10/22**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component:		Man Hours: **0.8**
Maintenance Task: **INSPECTION**		Interval/Miles: **120,000**

PROCEDURE (CONT'D):
INSPECTION WORK AREA: PIT (CONT'D)
25 (cont'd)

- Using a clean lint-free cloth dampened with a solution of water and recommended cleaner, remove accumulated dirt and grime from pick-up coil, spacer blocks and associated cable. Dry surfaces with a clean, lint-free cloth

26 Stay in the Pit under A/B Truck and locate the

Track Receiver



27 For each Track Receiver:

FIG 7 ATP TRACK RECEIVER INSPECTION

- Check the Track Receiver Assy and relevant Junction Box for damage and that are tight.
- Check Track Receiver Assy Fixing Hardware for **42 lb-ft** proper tightening.
- Check the Clamp fixing the Track Receiver to the Underframe structure for damage and for **103 ft-lb** proper tightening.
- Check the Cable and Connectors on Track Receiver and on Junction Box for damage, proper installation and safely tightening.
- Replace the Track Receiver Assy as per Check Result according to Sheet R-C-15-01-16-00/R-00
- Thoroughly clean the Track Receiver Assy Components with soft bristle brush, air compressed and lint-free rags.

P2550 PREVENTIVE MAINTENANCE SHEET

	Card Code: **R-P-15-01-00-00/I-01**
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **11/22**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component:	Man Hours: **0.8**
Maintenance Task: **INSPECTION**	Interval/Miles: **120,000**

PROCEDURE (CONT'D):

INSPECTION WORK AREA: PIT (CONT'D)

28 Stay in the Pit under A / C Truck and locate the ATP Speed Sensors

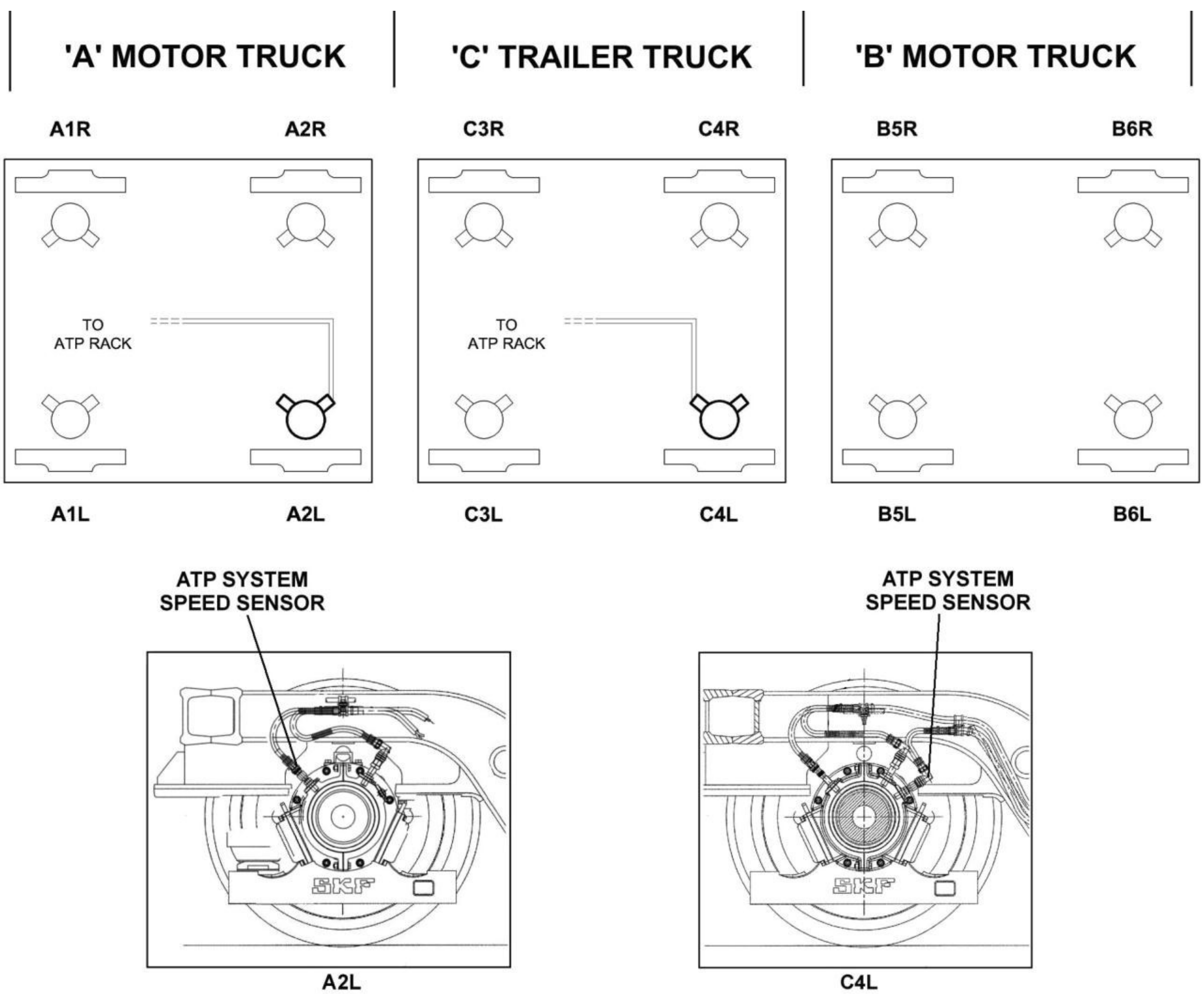


FIG 8 ATP SPEED SENSOR LOCATION

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-00-00/I-01**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **12/22**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component:	Man Hours: **0.8**
Maintenance Task: **INSPECTION**	Interval/Miles: **120,000**

PROCEDURE (CONT'D):

INSPECTION WORK AREA: PIT (CONT'D)

29. Perform ATP Speed Sensors accurate cleaning as follows:
   a) Using a clean lint-free cloth dampened with a solution of water and recommended cleaner remove accumulated dirt and grime from speed sensors and associated cables.
   b) Spray Speed Sensors with an aerosol can of recommended electrical contact cleaner so that all dirt and foreign matter is removed.
   c) Dry surfaces with a clean, lint-free cloth.

30. Inspect the Electrical Connector for visible damage and loose / missing parts.

31. Inspect Cable for installation.

32. Disconnect the Electrical Connector and inspect both male and female connectors for damage to pins or missing pins.

33 Thoroughly clean and dry the Electrical Connector using recommended agents.

34. Inspect the Marker Lines (Yellow) between the Nut and the Adapter

35. As per Marker Lines Inspection results proceed as follows:
   a. **Marker Lines perfectly aligned between the Nut and the Adapter:**
      1. Reinstall the Electrical Connector and tighten as required
   b. **Marker Lines not aligned between the Nut and the Adapter:**
      1. Investigate the trouble probable causes
      2. Adjust or Replace the ATP Speed Sensor Gap as follows:

ATP SPEED SENSOR GAP ADJUSTING

NOTE: 1-The Gap between the Face of ATP Speed Sensor and the highest Wheel Tooth should be to **0.060 ± 0.015 inch**

NOTE: 2-One complete turn of the Speed Sensor in its holder changes the Gap of **0.056 inch**

1 Gently screw the Speed Sensor into the Ground Contact Device housing until it makes contact with the Gear.

2. Back the Speed Sensor out 1 ± 1/4 turn, stopping when the Speed Sensor is properly aligned with the Gear.

3. Lock the Speed Sensor in place using the Jam Nuts. Torque the Nuts to **20 ft-lb**.

4. Install the Electrical Connector on Speed Sensor

ATP SPEED SENSOR REPLACEMENT

1 Replace the ATP Speed Sensor Assy complete according to Sheet R C 15-01-18-00-R / 00

P2550 PREVENTIVE MAINTENANCE SHEET

	Card Code: **R-P-15-01-00-00/I-01**
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **13/22**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component:	Man Hours: **0.8**
Maintenance Task: **INSPECTION**	Interval/Miles: **120,000**

PROCEDURE (CONT'D):
INSPECTION WORK AREA: PIT (CONT'D)

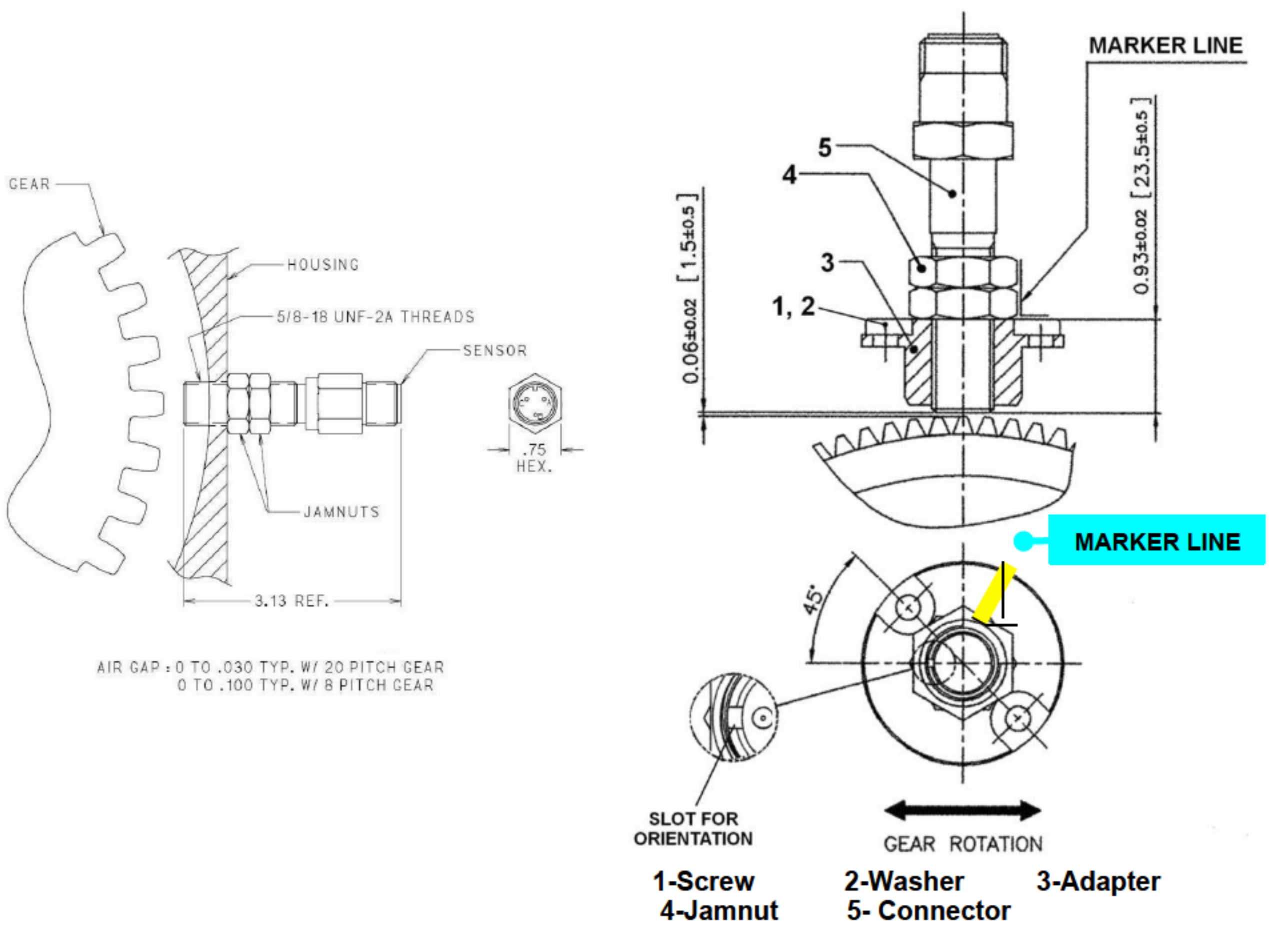


FIG 9 ATP SPEED SENSOR ADJUSTMENT

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P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-00-00/I-01**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **14/22**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component:	Man Hours: **0.8**
Maintenance Task: **INSPECTION**	Interval/Miles: **120,000**

PROCEDURE (CONT'D):

INSPECTION WORK AREA: INTERIOR

36 Leave the Pit

37 Go back inside the Vehicle and reinstate Electrical Power to ATP System by placing to ON:

- the CB 11F01 (located in the "A" LV Locker)
- the CB 11F02 (located in the "A"&"B" LV Lockers)

38. Reach A/B Cabs by opening the Cab Door using Maintenance Key

39. Key ON the Vehicle and perform the following ATP Tests:

ADU LAMP TEST

40. In each Cab perform the ADU Lamp Test as follows:

a) Confirm that the Lay-up Operator's Switch is set to **LAYUP**.
b) Make sure the ATP Cutout Switch is set to **NORMAL**.
c) Set the Lay-up Operator's Switch to **OPERATE**.
d) Set the Transfer Switch to **FORWARD** or **REVERSE** to select the direction.
This activates the ATP mode and initiates the Lamp Test.

Completion -

a) An LRV audible alarm "chirps" at the start of the Indicator Light Test.
b) The MAS display, displays 88, and the Overspeed, Cab and Non-Cab indicators light for 5 seconds.
c) As per Test result replace the Fault Indicator Light(s)

41. Once completed the ADU Lamp Test perform in each Cab the Departure Test as follows:

DEPARTURE TEST - MGL

Initial Conditions

NOTE: The Initial Conditions must be maintained while a Departure Test is in progress.
If any Initial Condition is changed during the Departure Test, the Test will terminate and it is logged as a failure.

Ensure the following Initial Conditions are satisfied:

- ATP in an Active mode
- Vzero is satisfied

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-00-00/I-01**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **15/22**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component:	Man Hours: **0.8**
Maintenance Task: **INSPECTION**	Interval/Miles: **120,000**

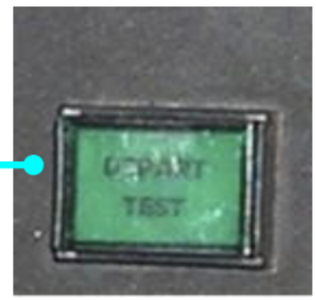
PROCEDURE (CONT'D):

INSPECTION WORK AREA: INTERIOR(cont'd)
MGL DEPARTURE TEST (cont'd)

42. Press the

Depart Test pushbutton

located on the ADU



NOTE: The Departure Test is aborted if the "Depart Test" pushbutton on the ADU is pressed while the Departure Test is in progress.

MGL DEPARTURE TEST Sequence

During the Departure Test, the following individual checks are performed by the ATP System:

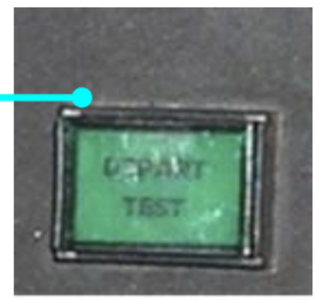
- **Full Service Brake Application** - At the start of this test, the ATP System requests a Full Service Brake application and commands the ADU audible alarm to beep. The system verifies that the brake has been requested by checking the Full Service brake relay. If the brake request is not verified, then this test fails. At the end of this test the ATP System removes the Full Service Brake application and ADU audible alarm.
- **FSK Module Health** - This test is passed if the communications link between the ATP and FSK subsystem is established.
- **Valid Cab Signal Detection** - This test is passed if valid cab signal messages are being received from the FSK subsystem. If valid cab signal messages are being received, the Cab Signal indicator on the ADU is illuminated.
- **Function ADU Interface** - This test is passed if the communications link between the ATP and ADU is established.
- **No Crosscheck Errors Present** - This test is passed if the ATP System is not reporting any crosscheck errors.
- **No Penalty Brake Applications Active** - This test is passed if the ATP System is not requesting any penalty brake applications.
- **No Emergency Brake Applications Active** - This test is passed if the ATP System is not requesting any emergency brake applications.

NOTE: All individual Tests must pass for the Departure Test to be successful.
The failure of any individual Test will cause the "Depart Test" indication on the ADU to go dark. Specific Test failures are reported to the IDU.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-00-00/I-01**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **16/22**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component:		Man Hours: **0.8**
Maintenance Task: **INSPECTION**		Interval/Miles: **120,000**

PROCEDURE (CONT'D):
INSPECTION WORK AREA: INTERIOR(cont'd)
MGL DEPARTURE TEST (cont'd)



43. Depress the **Depart Test pushbutton** on the ADU.

44. Verify:

a) Depart Test pushbutton / indicator flashes
b) ADU alarm annunciates
c) Full Service Brake initiation

45. Upon successful completion of the Test, verify:

a) Depart Test pushbutton / indicator illuminates steadily
b) ADU alarm is silenced
c) Full Service Penalty Brake is released

46. Record MGL Departure Test completion status on the Defect Report Card for administrative and maintenance planning.

DEPARTURE TEST - MBL & PGL

Initial Conditions

NOTE: The Initial Conditions (except No Code indication by the Decoder) must be maintained while a Departure Test is in progress. If any Initial Condition is changed during the Departure Test, the Test will terminate and it is logged as a failure.

Ensure the following Initial Conditions are satisfied:

- ATP in an Active mode
- Vzero is satisfied
- No crosscheck errors are active
- No Code is indicated by the Decoder

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-00-00/I-01**

System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **17/22**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component:	Man Hours: **0.8**
Maintenance Task: **INSPECTION**	Interval/Miles: **120,000**

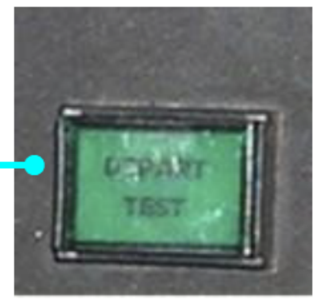
PROCEDURE (CONT'D):

INSPECTION WORK AREA: INTERIOR(cont'd)
MBL & PGL DEPARTURE TEST (cont'd)

47. Press the

Depart Test pushbutton

located on the ADU



NOTE: The Departure Test is aborted if the "Depart Test" pushbutton on the ADU is pressed while the Departure Test is in progress.

MBL & PGL DEPARTURE TEST Sequence

During the Departure Test sequence, simulated Speed Signals and Cab Signal Code Rates are generated by System Software, and the following Individual Checks are performed by the ATP System:

- **Cab Signal Detection Sensitivity** - The Cab Signal Carrier Thresholds are examined to determine if they are within a valid range. If they are not, the Departure Test fails. A 50 CPM code rate is generated at a signal level 10% less than the Cab Signal Carrier Threshold. If a 50 code rate is detected by the ATP, the Departure Test fails.
- **Code Rate Detection** - The System generates each of the following code rates: No Code, 50, 75, 120, 180, 270, and Dual 270 at a level 10% greater than the Cab Signal Carrier Threshold. If the Code Rate is not detected, the Departure Test fails.
- **Street Running Response** - A 410 Code rate is generated at a level 10% greater than the Cab Signal Carrier Threshold. If Street Running Mode is not detected, the Departure Test fails. The System then produces a No Code condition and verifies that Street Running Mode is maintained.
- **Overspeed Detection -** The System produces an Overspeed Condition by simulating a speed one (1) mph above the Street Running Mode Speed Limit. The System then simulates Brake Rate to satisfy Brake Assurance. If the Overspeed is not detected or a Brake Application is detected, the Departure Test fails. The System then produces a speed at the Under Speed Set Point. The System verifies that the Under Speed is satisfied.

  The System flashes the Cab Signal indicator informing the operator to terminate the Street Running Mode. The System then generates a 100 Hz constant carrier and maintains the Speed at the Street Running Mode Under Speed Set Point. If Street Running Mode is not terminated or the Code Rate is not detected, the Departure Test fails.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-00-00/I-01**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **18/22**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component:	Man Hours: **0.8**
Maintenance Task: **INSPECTION**	Interval/Miles: **120,000**

PROCEDURE (CONT'D):
INSPECTION WORK AREA: INTERIOR (cont'd)
MBL & PGL DEPARTURE TEST (cont'd)
MBL & PGL DEPARTURE TEST Sequence (cont'd)

- **Full Service Brake Application**

  After the transition out of Street Running Mode occurs, the System will be in an Overspeed Condition and Running Brake Assurance.
  Brake Rate is simulated to forestall the Full Service Brake request for a period of five (5) seconds.
  After the time expires, simulated Brake Rate is discontinued and an Overspeed Penalty Brake is requested.
  The System verifies the Full Service Brake request by checking the Full Service Brake Relay. If the Brake Request is not verified, the Departure Test fails.

- **Completion**

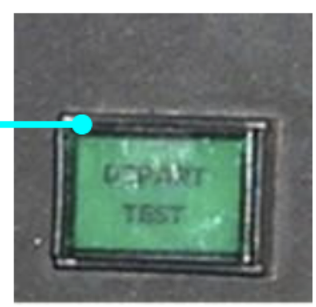
  Once the Full Service Brake Request has been verified, the System reduces the Simulated Speed to 0 mph (Vzero).
  The System verifies that the Brake Request is released.
  If the Brake Request is not released, the Departure Test fails. Otherwise, the Departure Test is completed and is considered successful.

NOTE: All individual Tests must pass for the Departure Test to be successful.
The failure of any individual Test will cause the "Depart Test" indication on the ADU to go dark. Specific Test failures are reported to the IDU

48 Depress the

Depart Test pushbutton

on the ADU.



49. Verify that the
Depart Test pushbutton/indicator flashes.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-00-00/I-01**			
System: **AUTOMATIC TRAIN PROTECTION**			Sheet: **19/22**
Subsystem/Assy: **ATP SYSTEM**	Unit:		
Component:			Man Hours: **0.8**
Maintenance Task: **INSPECTION**		Interval/Miles: **120,000**	

PROCEDURE (CONT'D):

INSPECTION WORK AREA: INTERIOR(cont'd)
MBL & PGL DEPARTURE TEST (cont'd)

50 Verify on the ADU**:**

a **TARGET SPEED** indicates **65 mph** and the **CAB SIGNAL** indicator on the ADU illuminates.

b **TARGET SPEED i**ndicates **55 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm**.

c **TARGET SPEED** indicates **45 mph** and the ADU alarm annunciates. **Acknowledge the ADU alarm.**

d **TARGET SPEED** indicates **35 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**

e **TARGET SPEED** indicates **25 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**

f **TARGET SPEED** indicates **10 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**

g **TARGET SPEED** indicates **0 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**

h **TARGET SPEED** indicates **35 mph,** the ADU alarm annunciates **Acknowledge the ADU alarm.**, and the **STREET RUNNING** Indicator **illuminates.**

i **TARGET SPEED** indicates **0 mph,** the ADU alarm annunciates **Acknowledge the ADU alarm**. and the **STREET RUNNING** Indicator **remains illuminated.**

j **SPEED** indicates **36 mph**, the ADU alarm annunciates **Acknowledge the ADU alarm**. and the **OVERSPEED** indication **illuminates.**

k **SPEED** indicates **(ESL - 1 mph)** and the **OVERSPEED** indication is deactivated.

l the **CAB SIGNAL** Indicator **flashes** and **SPEED remains at (ESL - 1 mph)**.

51 Depress the Street Running pushbutton and verify on the ADU:

a the ADU alarm **annunciates**, the **CAB SIGNAL** Indicator **remains illuminated**, and the **STREET RUNNING** Indicator is **deactivated**.

b the **OVERSPEED** indicator is **illuminated** and, after approximately five (5) seconds, verify Full Service Penalty Brake initiation.

c **SPEED** indicates **0 mph** and the **OVERSPEED** indicator is **deactivated.**

d the Full Service Brake is **released.**

e the **DEPART TEST** pushbutton/indicator **illuminates steadily**

52 Record MBL & PGL Departure Test completion status on the Defect Report Card for administrative and maintenance planning.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-00-00/I-01**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **20/22**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component:		Man Hours: **0.8**
Maintenance Task: **INSPECTION**		Interval/Miles: **120,000**

PROCEDURE (CONT'D):

INSPECTION WORK AREA: INTERIOR
DEPARTURE TEST (cont'd)

53 As per Test Result perform Troubleshooting with IDU or PTU.
Refer to Part II of this Section, paragraphs 15-II-02.2 and 15-II-02.3 respectively
Next Figures 10, 11 and 12 provide, respectively:

- the ATP/TWC SYSTEM STATUS SCREEN (Operating Mode)
- the ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)
- the PTU & ATP CONNECTIONS

54 Key OFF the Vehicle, Leave the Cab and close the Cab Door using Maintenance Key

55 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 15-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-15-01-00-00/I-01

System:	Sheet:
AUTOMATIC TRAIN PROTECTION	**21/22**

Subsystem/Assy:	Unit:
ATP SYSTEM	

Component:	Man Hours:
	0.8

Maintenance Task:	Interval/Miles:
INSPECTION	**120,000**

PROCEDURE (CONT'D):

INSPECTION WORK AREA: INTERIOR

DEPARTURE TEST (cont'd)

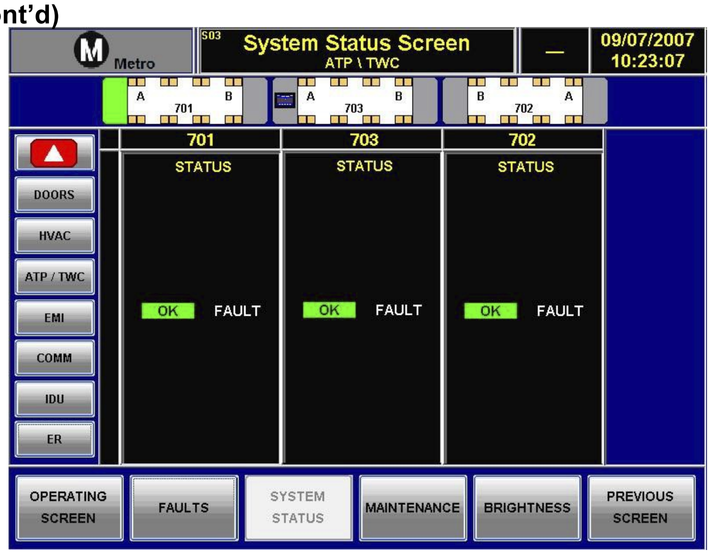


FIG 10 ATP/TWC SYSTEM STATUS SCREEN (Operating Mode)

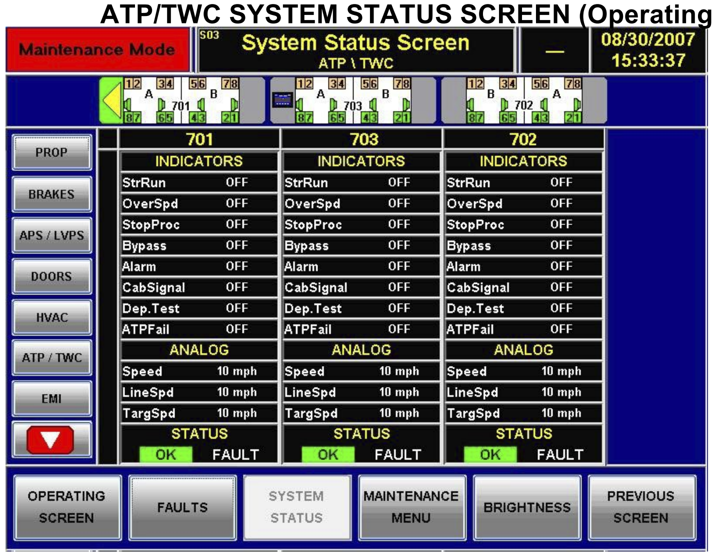


FIG 11 ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-00-00/I-01**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **22/22**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component:	Man Hours: **0.8**
Maintenance Task: **INSPECTION**	Interval/Miles: **120,000**

PROCEDURE (CONT'D):
INSPECTION   WORK AREA: INTERIOR
MBL & PGL DEPARTURE TEST (cont'd)

Fig 12 PTU & ATP CONNECTIONS

15-III-05 RUNNING -CORRECTIVE MAINTENANCE

15-III-05.01 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.

15-III-05.01.01 Running- Corrective Maintenance Sheet (R-CMS) Form

The R-CMS Form (refer to Figure 15-III-05.1) 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.

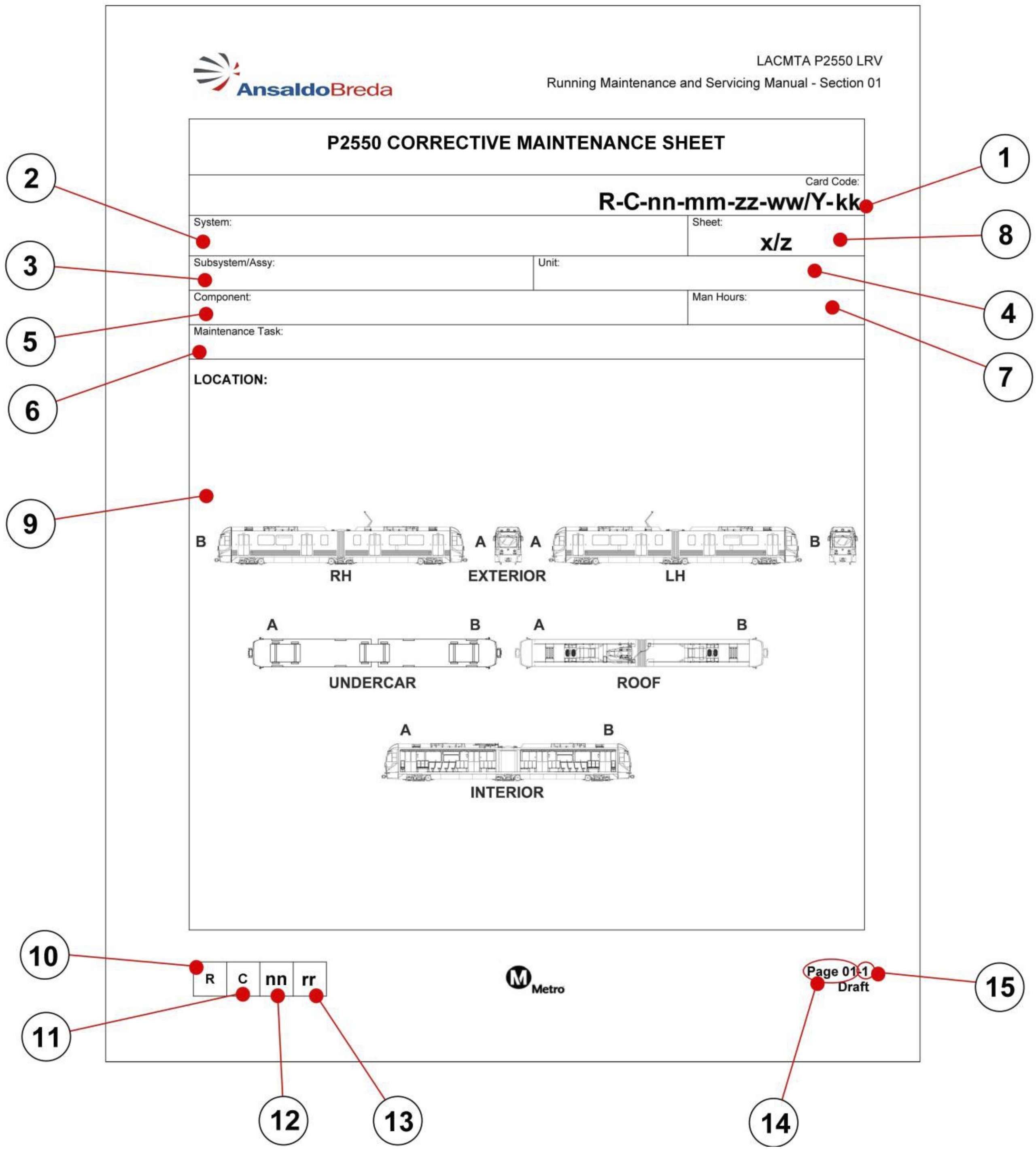
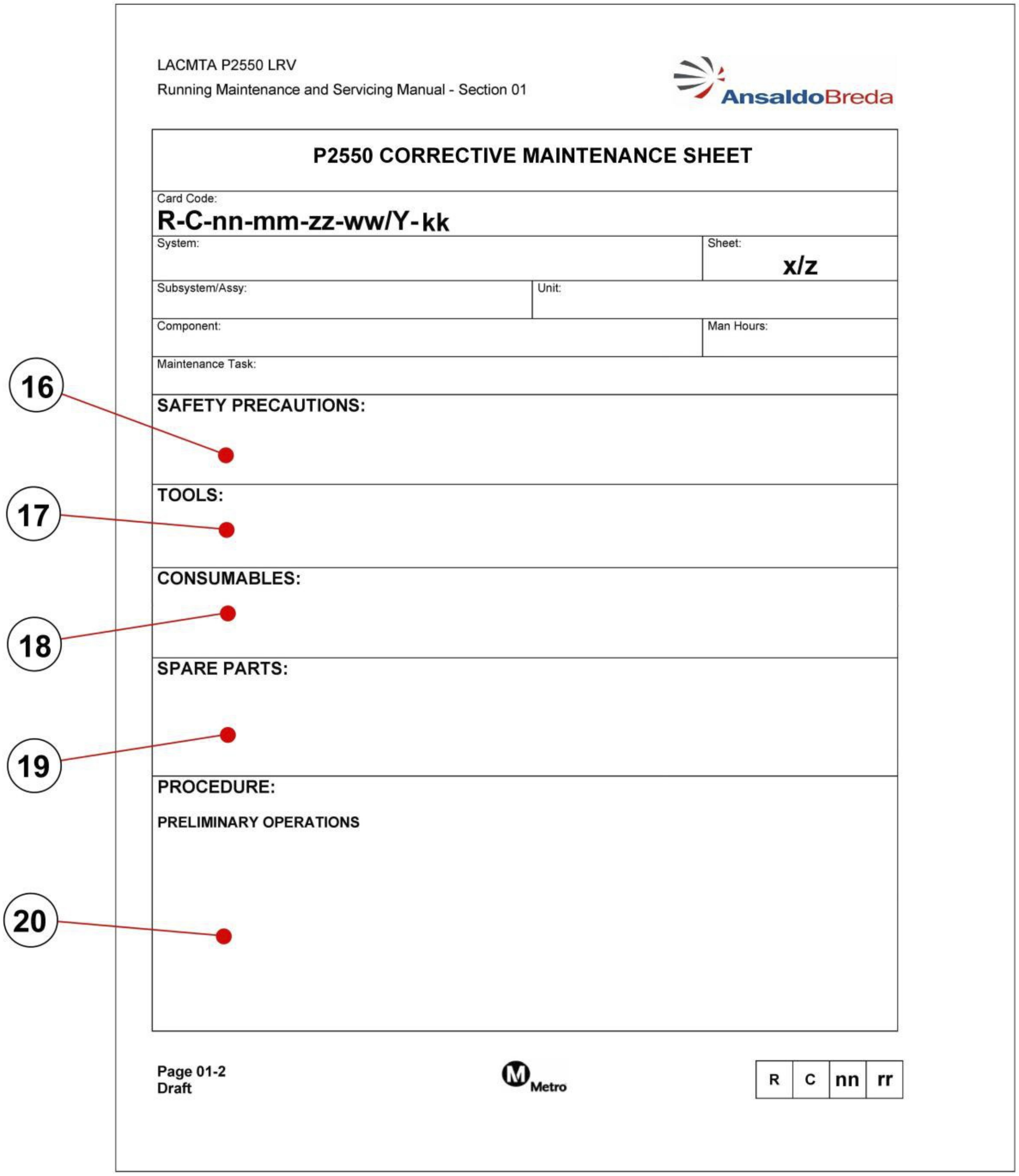


Figure 15-III-05.1 R-CMS Form
(Sheet 1 of 2)



LACMTA P2550 LRV
Running Maintenance and Servicing Manual - Section 01

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: R-C-nn-mm-zz-ww/Y-kk	
System:	Sheet: x/z
Subsystem/Assy:	Unit:
Component:	Man Hours:
Maintenance Task:	

SAFETY PRECAUTIONS:

TOOLS:

CONSUMABLES:

SPARE PARTS:

PROCEDURE:

PRELIMINARY OPERATIONS

Page 01-2
Draft

Metro

R	C	nn	rr

Figure 15-III-05.1 R-CMS Form
(Sheet 2 of 2)

15-III-05.01.02 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:

<u>**NOTE**</u>: 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)**

15-III-05.01.03 Running- Corrective Maintenance Sheet (R-CMS) List

The Automatic Train Protection Running- Corrective Maintenance Sheets (R-CMS) List is provided in the following Table 15-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 15-III-05.1 Running Corrective Maintenance Sheets List

SYSTEM 15 AUTOMATIC TRAIN PROTECTION				
SUBSYSTEM / ASSY	**UNIT**	**COMPONENT**	**TASK**	**SHEET CODE**
ATP SYSTEM	ATP CIRCUITRY	CIRCUIT BREAKER TYPE S280	REPLACEMENT	R-C-15-00-00-00/R-00
ATP SYSTEM		SWITCH	REPLACEMENT	R-C-15-00-00-00/R-01
ATP SYSTEM	ATP ENCLOSURE & CARDFILE	BOARDS	REPLACEMENT	R-C-15-01-01-00/R-00
ATP SYSTEM	ATP ENCLOSURE	VITAL RELAY	REPLACEMENT	R-C-15-01-10-00/R-00
ATP SYSTEM		DECELEROMETER	REPLACEMENT	R-C-15-01-13-00/R-00
ATP SYSTEM		PICKUP COIL	REPLACEMENT	R-C-15-01-15-00/R-00
ATP SYSTEM		TRACK RECEIVER	REPLACEMENT	R-C-15-01-16-00/R-00
ATP SYSTEM	ASPECT DISPLAY UNIT		REPLACEMENT	R-C-15-01-17-00/R-00
ATP SYSTEM		SPEED SENSORS	REPLACEMENT	R-C-15-01-18-00/R-00

AUTOMATIC TRAIN PROTECTION

Running - Corrective Maintenance Sheets

R-CMS

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P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-15-00-00-00/R-00

System:
AUTOMATIC TRAIN PROTECTION

Sheet:
1/8

Subsystem/Assy:
ATP SYSTEM

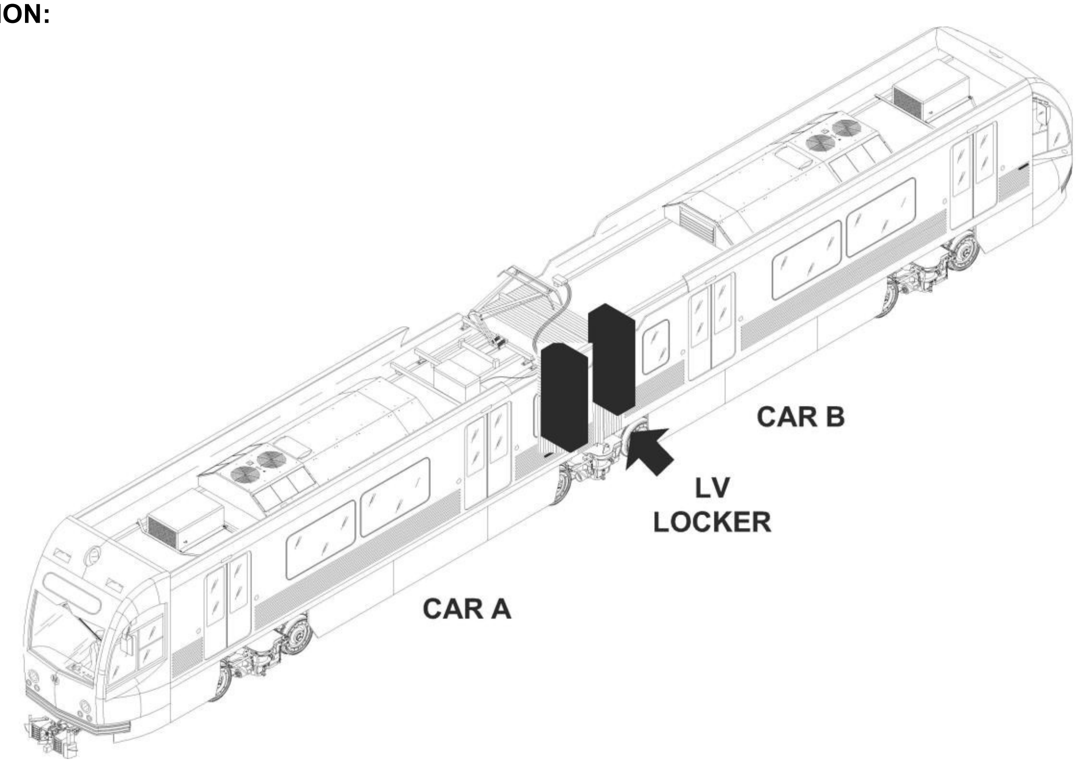
Unit:
ATP CIRCUITRY

Component:
CIRCUIT BREAKER TYPE S280

Man Hours:
1.0

Maintenance Task:
REPLACEMENT (TYPICAL)

LOCATION:



APPLICABILITY:
This Replacement procedure is applicable to the following Items:

TABLE 1 CIRCUIT BREAKERS IDENTIFICATION & LOCATIONS

LABEL	DESCRIPTION	TYPE	P/N	CAR	LOCATION	FUNCTIONAL DIAGRAMS	
						SCHEMATICS	SHEET#
11F01	ATP PROTECTION SWITCH	S281 C 10A	211EK22984B03	A	LV LOCKER	LV	110
11F02	ATP DISPLAY PROTECTION SWITCH	S281 K 2A	211EK22984B13	A/B	LV LOCKER	LV	111
11F03	TWC PROTECTION SWITCH	S281 C 10A	211EK22984B03	A	LV LOCKER	LV	112

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-00-00-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **2/8**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CIRCUITRY**
Component: **CIRCUIT BREAKER TYPE S280**	Man Hours: **1.0**
Maintenance Task: **REPLACEMENT (TYPICAL)**	

SAFETY PRECAUTIONS:

LACMTA Maintenance Shop Safety Rules & Regulations

CAUTION: SWITCH OFF THE 3F02 CB (BATTERY BOX) BEFORE STARTING TO PERFORM THE REPLACEMENT OF ANY CB LISTED IN THE PREVIOUS TABLE 1

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit

CONSUMABLES:

CRC 2000 Contact Cleaner

SPARE PARTS:

Refer to Table 1 Circuit Breakers Identification & Locations

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-00-00-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **3/8**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CIRCUITRY**
Component: **CIRCUIT BREAKER TYPE S280**	Man Hours: **1.0**
Maintenance Task: **REPLACEMENT (TYPICAL)**	

PROCEDURE:

PRELIMINARY OPERATIONS

Set the Vehicle in safety conditions in accordance with LACMTA Maintenance Shop Regulations:

1. Place the Vehicle in the Maintenance Shop.
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. Remove Electrical Power from Vehicle by lowering the Pantograph.
5. Turn the Transfer Switch to OFF.
6. Set the Pantograph Control Motor Switch (5F02 CB LV Locker "A" Section) to OFF.
7. Lock out and tag out the Switch in accordance with all LACMTA Safety Rules, Regulations, Policies, and Procedures

NOTE The tag must indicate the name of the person who removed Power. That person knows why the Power was removed and when it safe to restore it. Only the individual whose name appears on the tag or a person with his approval should remove the tag and restore Power.

CAUTION: SWITCH OFF THE 3F02 CB (BATTERY BOX) BEFORE STARTING TO PERFORM THE REPLACEMENT OF ANY CB LISTED IN THE PREVIOUS TABLE 1

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-00-00-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **4/8**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CIRCUITRY**
Component: **CIRCUIT BREAKER TYPE S280**	Man Hours: **1.0**
Maintenance Task: **REPLACEMENT (TYPICAL)**	

PROCEDURE (CONT'D):

REMOVAL

To perform the Task proceed as follows:

1. Locate the Circuit Breaker to be replaced according to the Label identification and the Location provided in the previous Table 1

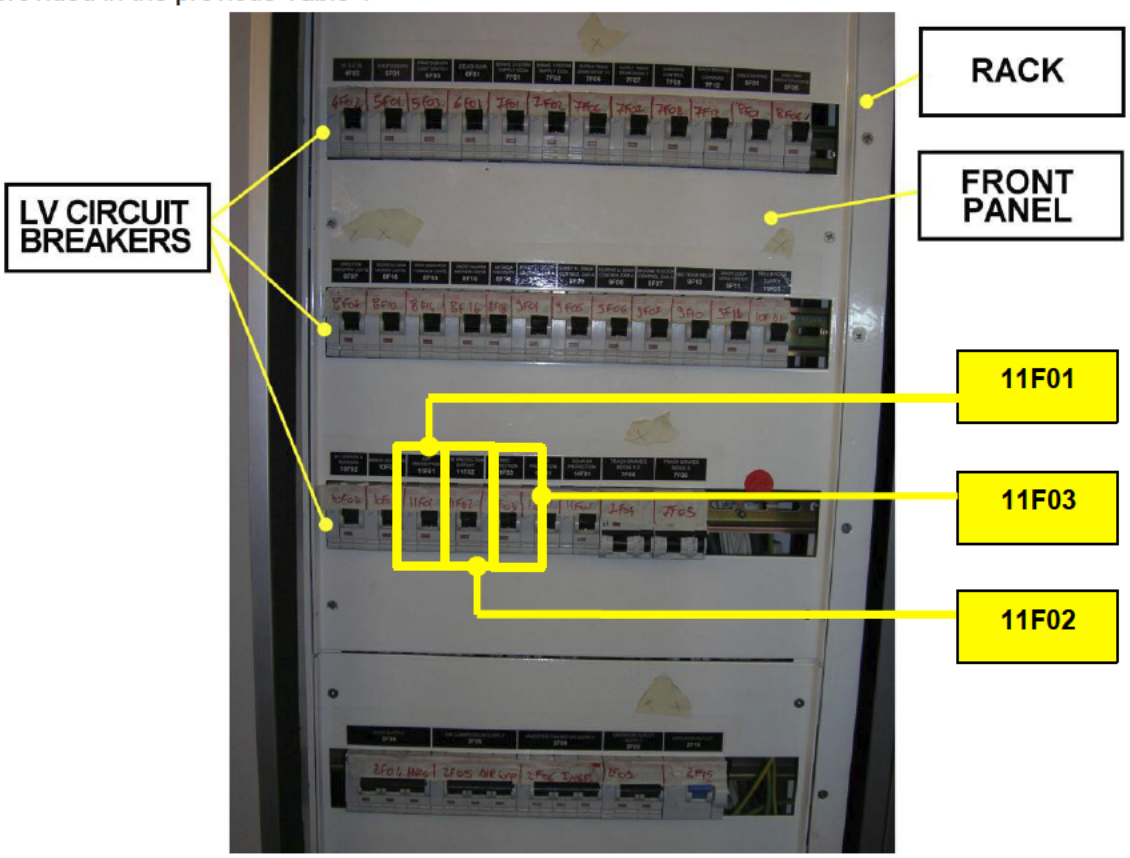


FIG 1 LV LOCKER CB LOCATION

P2550 CORRECTIVE MAINTENANCE SHEET

	Card Code: **R-C-15-00-00-00/R-00**
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **5/8**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CIRCUITRY**
Component: **CIRCUIT BREAKER TYPE S280**	Man Hours: **1.0**
Maintenance Task: **REPLACEMENT (TYPICAL)**	

PROCEDURE (CONT'D):

2. Remove the Circuit Breaker Front Panel by loosening the relevant Fixing Screws. Retain them for later use

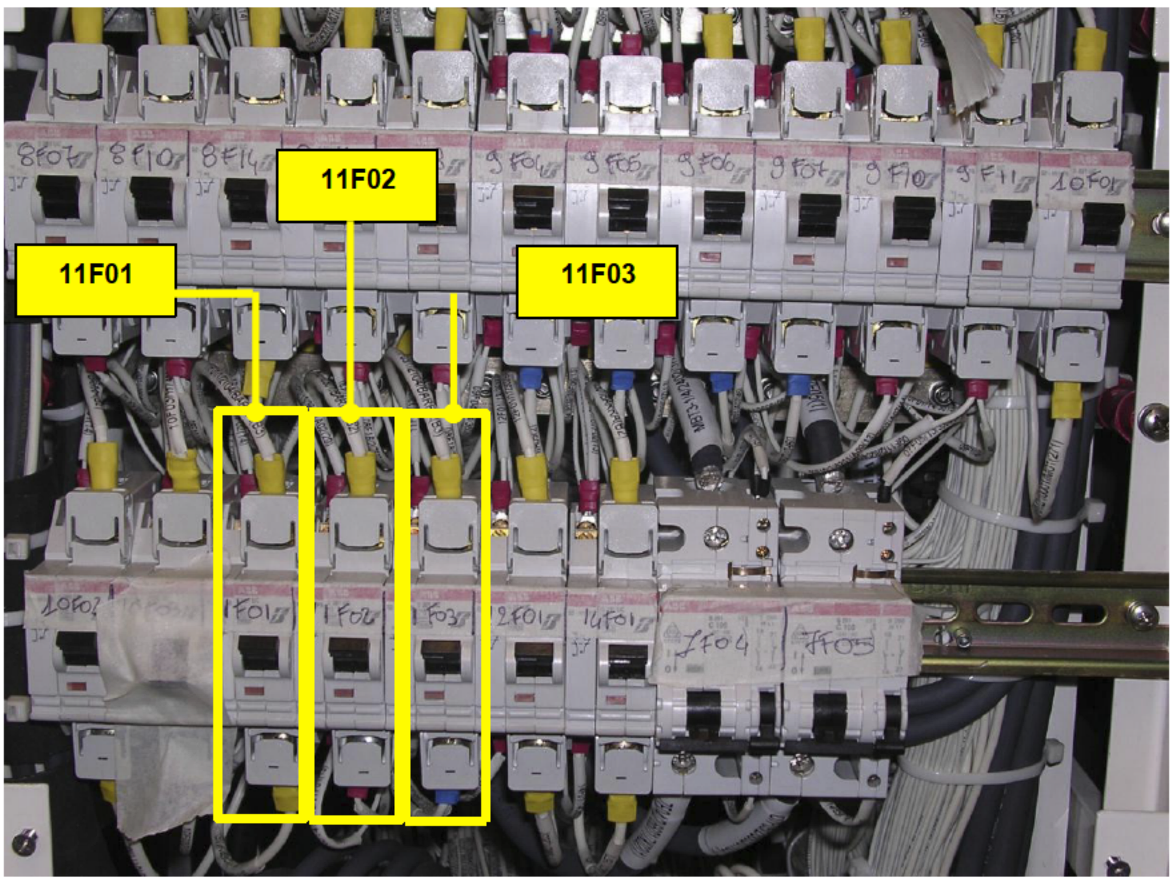


FIG 2 LV CB CONNECTIONS

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-00-00-00/R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **6/8**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CIRCUITRY**	
Component: **CIRCUIT BREAKER TYPE S280**		Man Hours: **1.0**
Maintenance Task: **REPLACEMENT (TYPICAL)**		

PROCEDURE:

3. Remove and discard the Circuit Breaker according to the Instructions provided in the following figure 3

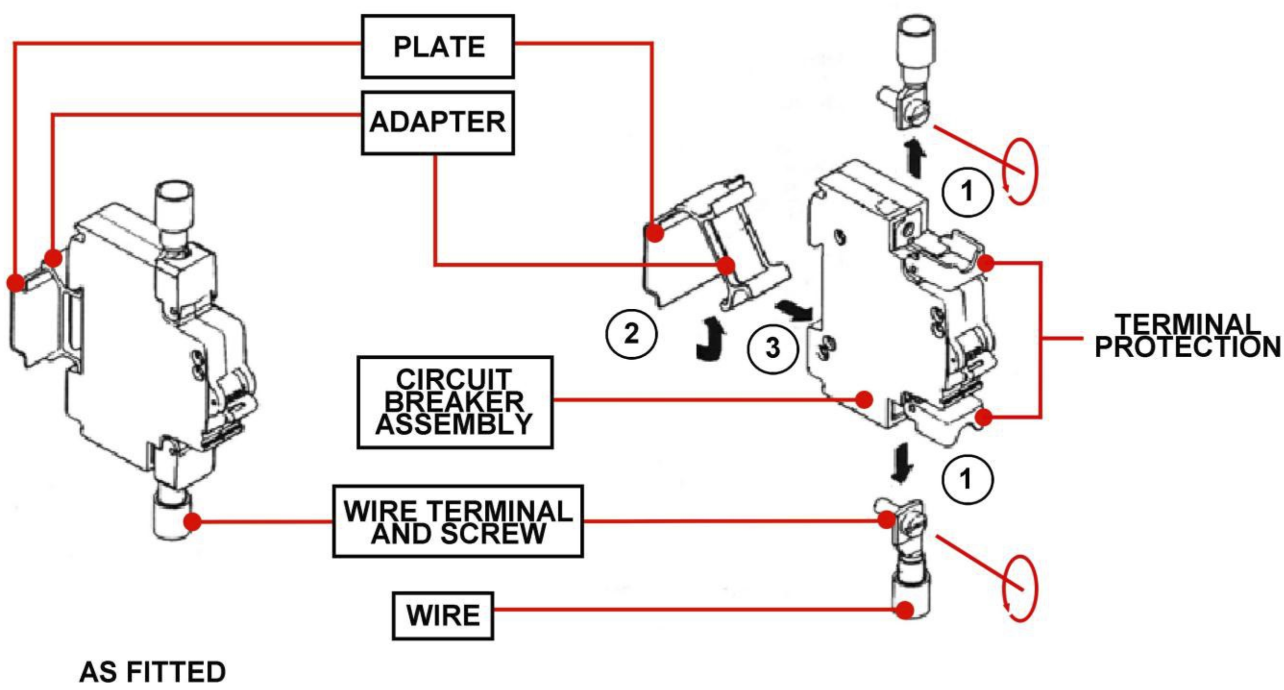


FIGURE 3 -CIRCUIT BREAKER REMOVAL

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-00-00-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **7/8**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CIRCUITRY**
Component: **CIRCUIT BREAKER TYPE S280**	Man Hours: **1.0**
Maintenance Task: **REPLACEMENT (TYPICAL)**	

PROCEDURE (CONT'D):

INSTALLATION

To perform the Task proceed as follows:

1. Clean the Circuit Breaker Seat using recommended Cleaner / Agent and lint-free rags.
2. Check CB Plate for installation / missing / loose Hardware. Torque, as per check result, to **15.2 ft-lb**.
3. Check Wires and Wire Terminals for signs of overheating.
4. Install the "new " Circuit Breaker according to the instructions provided in the following figure 4.

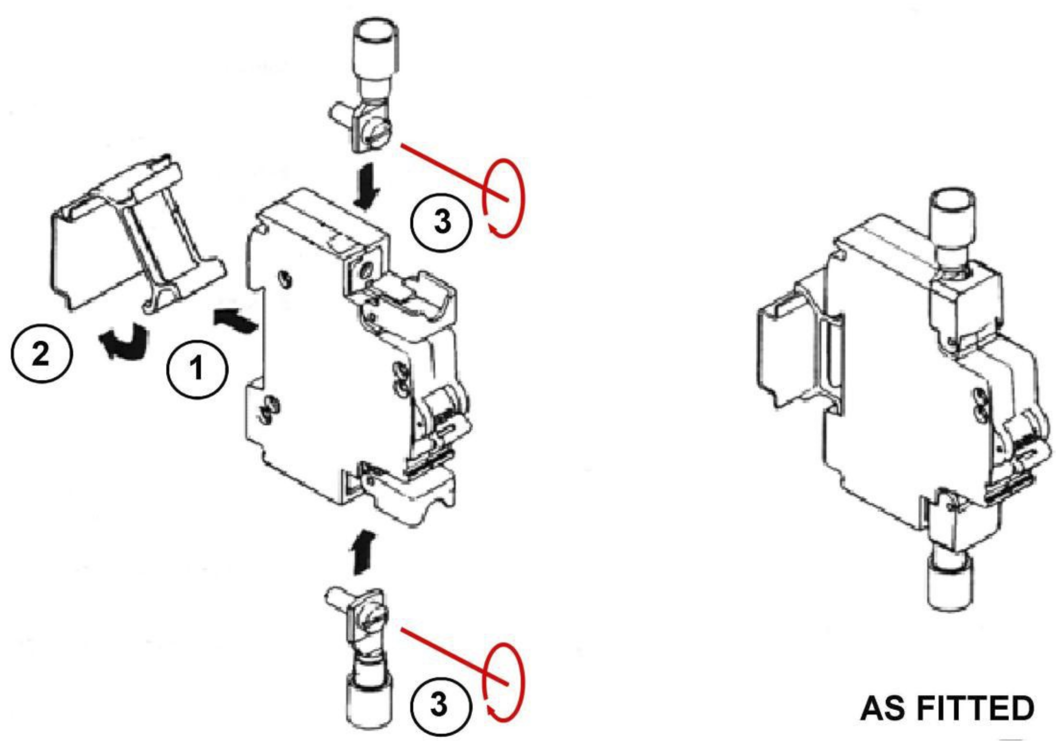


FIGURE 4 -CIRCUIT BREAKER INSTALLATION

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-00-00-00/R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **8/8**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CIRCUITRY**	
Component: **CIRCUIT BREAKER TYPE S280**		Man Hours: **1.0**
Maintenance Task: **REPLACEMENT (TYPICAL)**		

PROCEDURE (CONT'D):

5. Torque the Wires Terminals Screws according to the following Values:

	MAIN CONTACTS	AUX CONTACTS
SCREW	**M5**	**M3**
TORQUE	**5 ft-*lb**	**4 ft-*lb**

6 Install the Circuit Breakers Front Panel and secure it by installing and tightening the relevant Fixing Screws.

7 Switch on the "new" installed CB.

8 Restore Electrical Power.

9 Record Task 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 replaced Equipment pertains.

Refer to **HOW TO USE THE R-CM SHEETS** (para 15-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-15-00-00-00/R-01

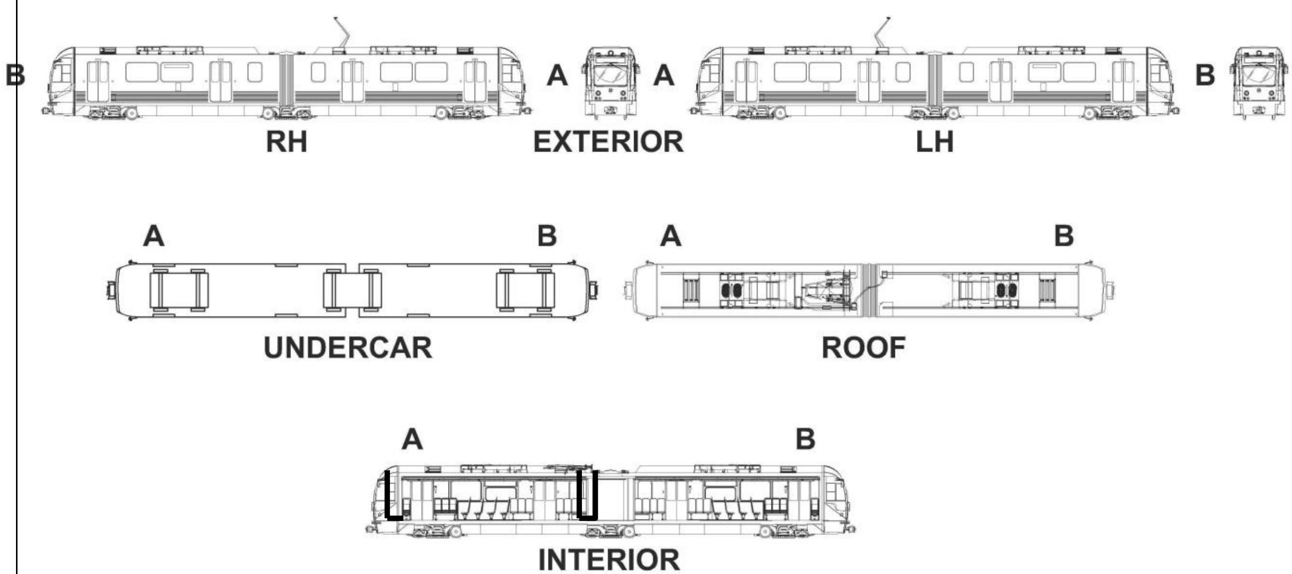
System:	Sheet:
AUTOMATIC TRAIN PROTECTION	**1/6**

Subsystem/Assy:	Unit:
ATP SYSTEM	**ATP CIRCUITRY**

Component:	Man Hours:
SWITCH	**0.5**

Maintenance Task:
REPLACEMENT (TYPICAL)

LOCATION:



APPLICABILITY

This Replacement procedure is applicable to the following Items:

TABLE 1 SWITCHES IDENTIFICATION & LOCATIONS

LABEL	DESCRIPTION	TYPE	MFR P/N	CAR	LOCATION	FUNCTIONAL DIAGRAMS	
						SCHEMATICS	SHEET#
11S01	ATP/ TWC BY-PASS SWITCH	2 Stable Positions Rotary Switch	211VQ00840B	A	CAB BY PASS PANEL	LV	114
11S02	ATP LINE SELECTOR	3 Stable Positions Rotary Switch	V750D/3	A	ELE LOCKER DATA DOWNLOAD PANEL	LV	111

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-00-00-00/R-01**			
System: **AUTOMATIC TRAIN PROTECTION**			Sheet: **2/6**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CIRCUITRY**		
Component: **SWITCH**			Man Hours: **0.5**
Maintenance Task: **REPLACEMENT (TYPICAL)**			

SAFETY PRECAUTIONS:

LACMTA Maintenance Shop Safety Rules & Regulations

CAUTION: SWITCH OFF THE 3F02 CB (BATTERY BOX) BEFORE STARTING TO PERFORM THE REPLACEMENT OF ANY SWITCH LISTED IN THE PREVIOUS TABLE 1

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit

CONSUMABLES:

CRC 2000 Contact Cleaner

SPARE PARTS:

Refer to previous Table 1 Switches Identification & Locations

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-15-00-00-00/R-01

System:
AUTOMATIC TRAIN PROTECTION

Sheet:
3/6

Subsystem/Assy:
ATP SYSTEM

Unit:
ATP CIRCUITRY

Component:
SWITCH

Man Hours:
0.5

Maintenance Task:
REPLACEMENT (TYPICAL)

PROCEDURE (CONT'D):

CAB A

FIG 1 11S01 ATP BY PASS SWITCH

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-00-00-00/R-01**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **4/6**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CIRCUITRY**
Component: **SWITCH**	Man Hours: **0.5**
Maintenance Task: **REPLACEMENT (TYPICAL)**	

PROCEDURE:

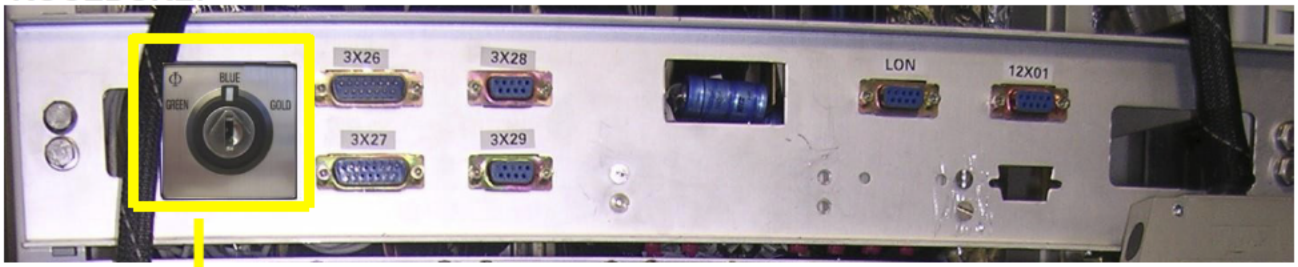


FIG 2 ELE LOCKER "A" DATA DOWN LOAD PANEL

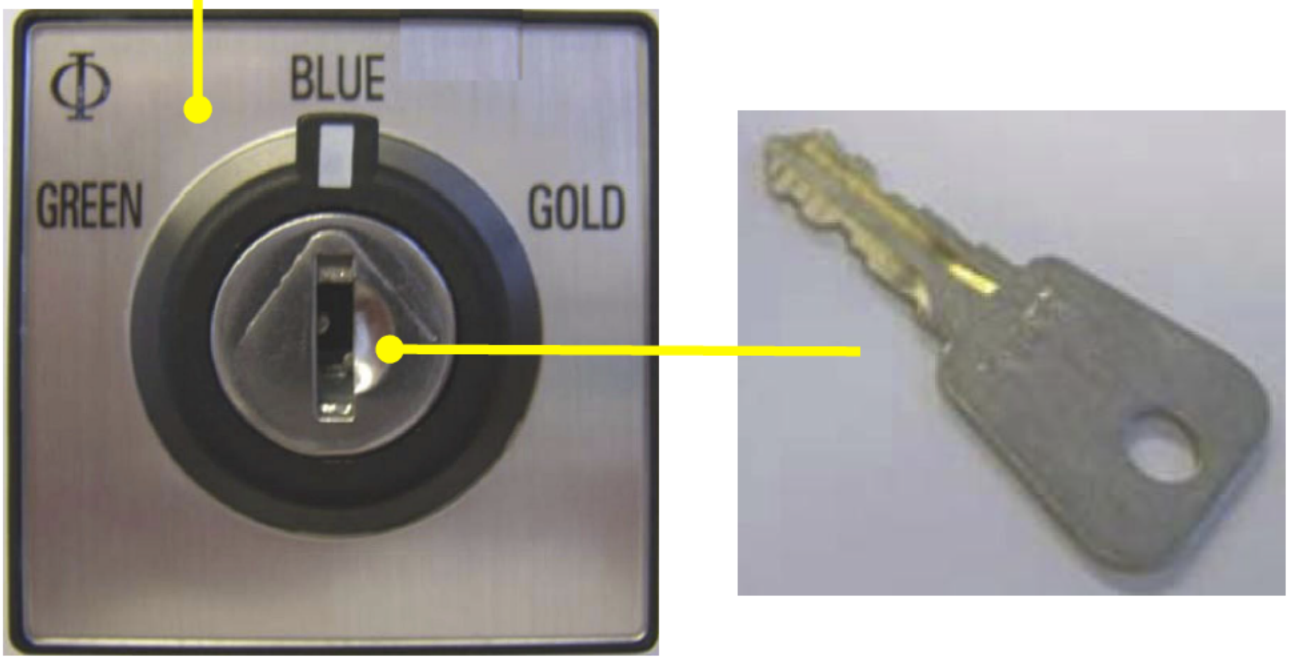


FIG 3 11S02 ATP LINE SELECTOR WITH KEY ACTUATOR

PRELIMINARY OPERATIONS

1. Set the Vehicle in safety conditions in accordance with LACMTA Maintenance Shop Regulations:

CAUTION: SWITCH OFF THE 3F02 CB (BATTERY BOX) BEFORE STARTING TO PERFORM THE REPLACEMENT OF ANY SWITCH LISTED IN THE PREVIOUS TABLE 1

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: R-C 15 00 00 00/R

System:	Sheet:
AUTOMATIC TRAIN PROTECTION	**5/6**

Subsystem/Assy:	Unit:
ATP SYSTEM	**ATP CIRCUITRY**

Component:	Man Hours:
SWITCH	**0.5**

Maintenance Task:
REPLACEMENT (TYPICAL)

PROCEDURE (CONT'D):

REPLACEMENT

To perform the Switch Replacement proceed as follows

1. **Removal**
   a) Locate the Switch to be replaced
   b) Gain access to the rear of the Panel Assy where the relevant Switch is installed on, by unscrewing and removing the relevant Panel Assy attaching hardware (Screws and Washers)
      NOTE: It is advised to retain the attaching Hardware for later use
   c) On the rear of the Panel Assy, locate the Switch Body to be replaced and its Electrical Connections.
   d) Note the Switch Body Wiring Identification Labels
   e) Disconnect the Switch Body electrical Connections
   f) Disengage the Switch Assy from its seat
   g) Remove the Switch Assy by pushing it from the rear toward the front of the Panel Assy

2. **Installation**
   a) Install and engage on its seat the Switch Assy to be installed
   b) Connect the Switch Body Electrical Connections according to the previously noted Wiring Identification Labels
   c) Refer to the Functional Schematic Sheet listed in the previous Table 1 for complete Wiring Details
   d) Position the Panel Assy on which the relevant "new "Switch have been installed
   e) Install and tighten the Panel Assy attaching Hardware
   f) Insert the Key in the Actuator and select a Line.
   g) Key on the Vehicle and check that the " new" Switch works properly
   h) Remove the Key from the Actuator from any of the Positions shown and give it to MTA Project Manager

   i) Record Task results 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 replaced Equipment pertains.

      Refer to **HOW TO USE THE R-CM SHEETS** (para 15-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-15-00-00-00/R-01**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **6/6**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CIRCUITRY**	
Component: **SWITCH**		Man Hours: **0.5**
Maintenance Task: **REPLACEMENT (TYPICAL)**		

PROCEDURE (CONT'D):

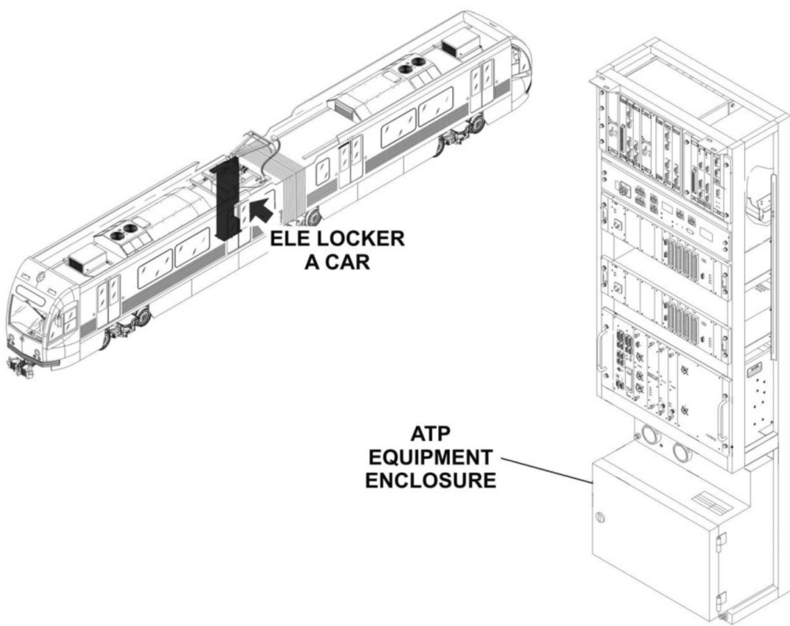
**INTENTIONALLY
LEFT BLANK**

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-15-01-01-00/R-00

System: AUTOMATIC TRAIN PROTECTION	Sheet: 1/18
Subsystem/Assy: ATP SYSTEM	Unit: ATP CARDFILE
Component: ATP BOARDS	Man Hours: 1.00
Maintenance Task: REPLACEMENT	

LOCATION:



APPLICABILITY

This Replacement procedure is applicable to the following Items:

TABLE 1 ATP BOARDS IDENTIFICATION & LOCATIONS

DESCRIPTION	MFR P/N	Q.TY	CAR	LOCATION
MAIN LOGIC CPU PCB	N17061322	1	A	ATP CARDFILE
VITAL INPUT PCB	N21260103	2	A	ATP CARDFILE
250 HZ FILTER DEMODULATOR PCB	N21266405	1	A	ATP CARDFILE
100 HZ FILTER DEMODULATOR PCB	N21266407	1	A	ATP CARDFILE
FSK CPU PCB	N21270404	1	A	ATP CARDFILE
MULTIFUNCTION PCB	N21272402	1	A	ATP CARDFILE
BLANK PANEL	N4518502902	1	A	ATP CARDFILE
CONDITIONAL POWER SUPPLY PCB	N4519100802	1	A	ATP CARDFILE
FSK RECEIVER PCB	N4519105402	1	A	ATP CARDFILE
DECODER CPU PCB	N4519105507	1	A	ATP CARDFILE

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-15-01-01-00/R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **2/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CARDFILE**	
Component: **ATP 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.

WARNING: LITHIUM BATTERY IS A FIRE, EXPLOSION, AND SEVERE BURN HAZARD. DO NOT RECHARGE, DISASSEMBLE, HEAT ABOVE 212 °F, OR EXPOSE CONTENTS TO WATER.

CAUTION: OBSERVE POSITIVE LITHIUM BATTERY POLARITY WITH RESPECT TO LABELING (+) ON PCB.

CAUTION: WHEN USING COMPRESSED AIR TO BLOW OUT DIRT AND DUST PARTICLES FROM CARDFILES, ALWAYS DIRECT AIR AT AN ANGLE RELATIVE TO THE PCBS. OTHERWISE,
LOOSE OR DAMAGED COMPONENTS MAY OCCUR.

TOOLS:
LACMTA Maintenance Shop Standard Tools Kit

CONSUMABLES:
Lint-free rags
Compressed air in aerosol can

SPARE PARTS:
Refer to previous Table 1 ATP Boards Identification & Locations

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-15-01-01-00/R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **3/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CARDFILE**	
Component: **ATP BOARDS**		Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**		

PROCEDURE:

To perform the Task proceed as follows:

PRELIMINARY OPERATIONS

1. Set the vehicle in safety condition in accordance with LACMTA Maintenance Shop Regulations.
2. Make sure the Parking Brakes are applied and the Wheels chocked.
3. Set the Transfer Switch to "OFF" Position.
4. Place to "OFF" position the following Circuit Breakers:

CB 11F02
located in the “A“&“B“ LV Lockers

CB 11F01
located in the “A“ LV Locker

CB 11S01,
located in
the “A“ Cab By Pass Panel,

AnsaldoBreda

P2550 CORRECTIVE MAINTENANCE SHEET

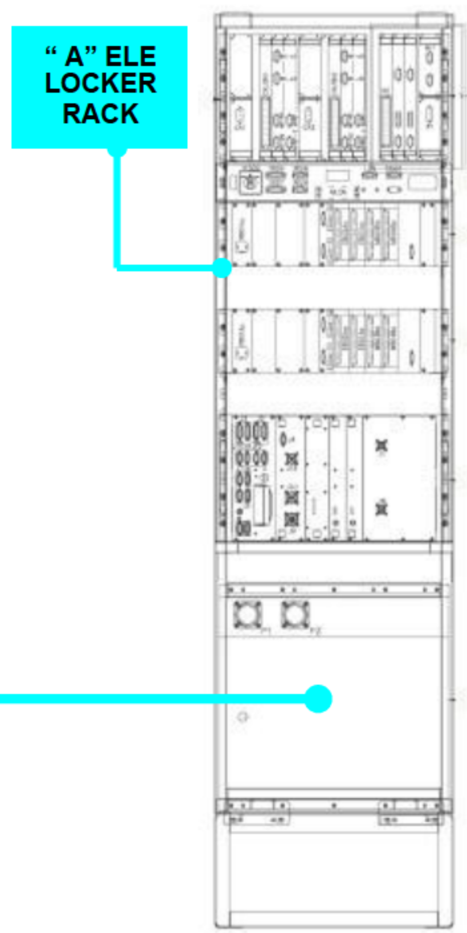
Card Code: **R-C-15-01-01-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **4/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CARDFILE**
Component: **ATP BOARDS**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

REMOVAL

To perform the Task proceed as follows:

1. Gain access to the ATP Enclosure installed in the (A) ELE Locker, by opening the relevant ELE Locker Door using Maintenance Key.



2. Locate the **ATP Enclosure**
3. Open the Door Panel of ATP Enclosure
4. Locate the Item to be replaced

FIG 1 ATP ENCLOSURE LOCATION

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-01-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **5/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CARDFILE**
Component: **ATP BOARDS**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

A) PCB REMOVAL

1. To remove the ATP 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

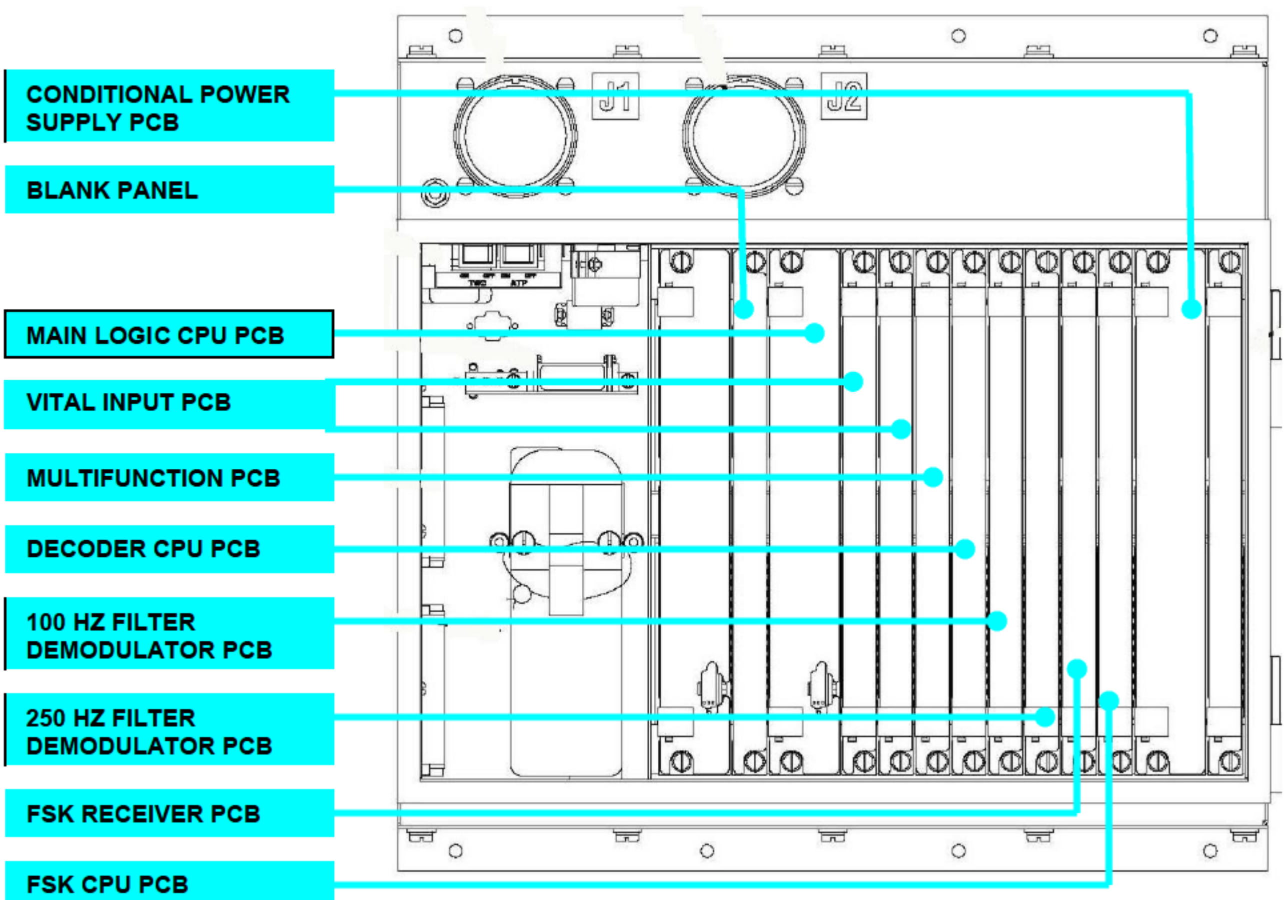


FIG 2 ATP CARDFILE PCBs LOCATION

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-15-01-01-00/R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **6/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CARDFILE**	
Component: **ATP BOARDS**		Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**		

PROCEDURE:

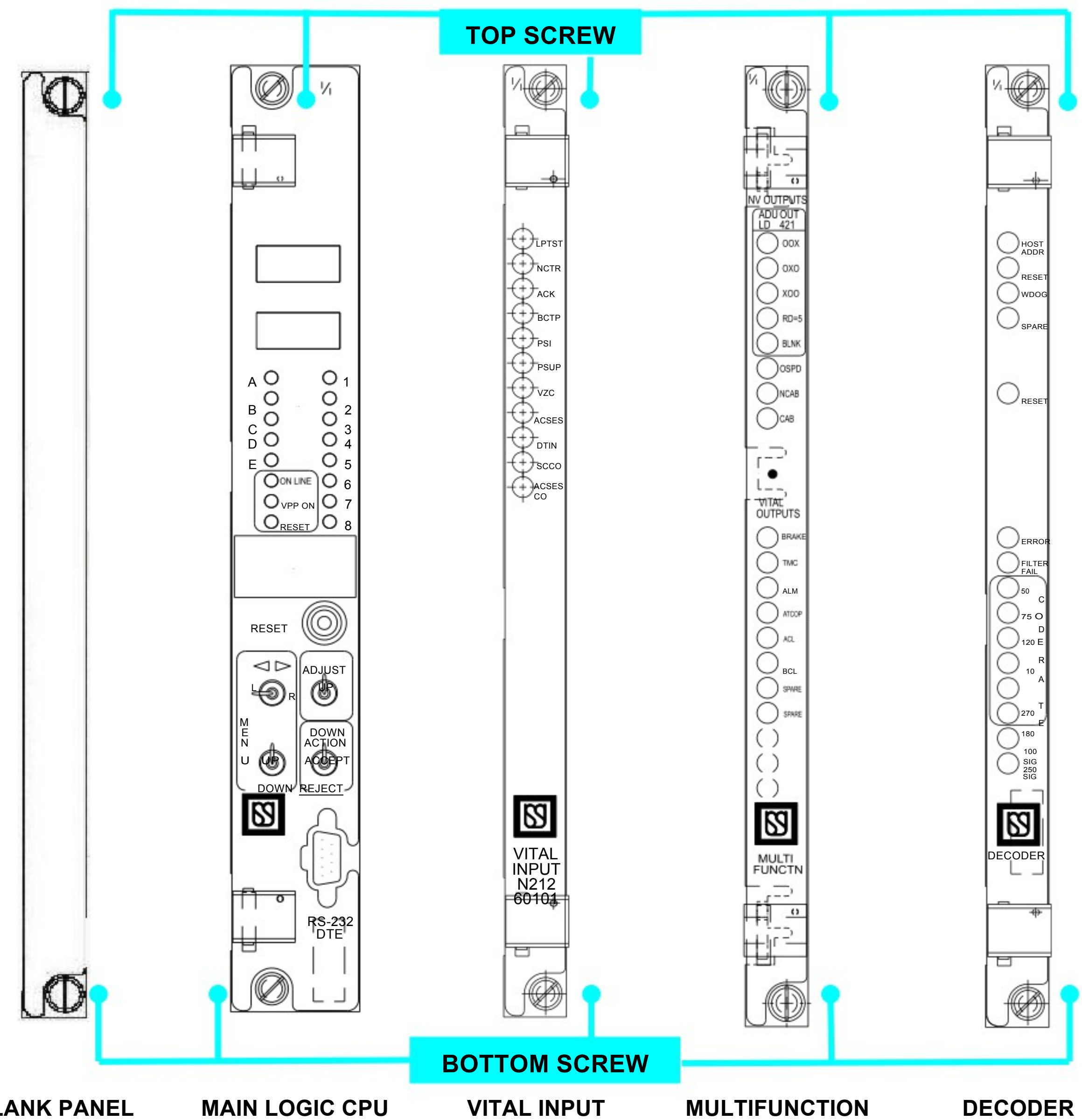
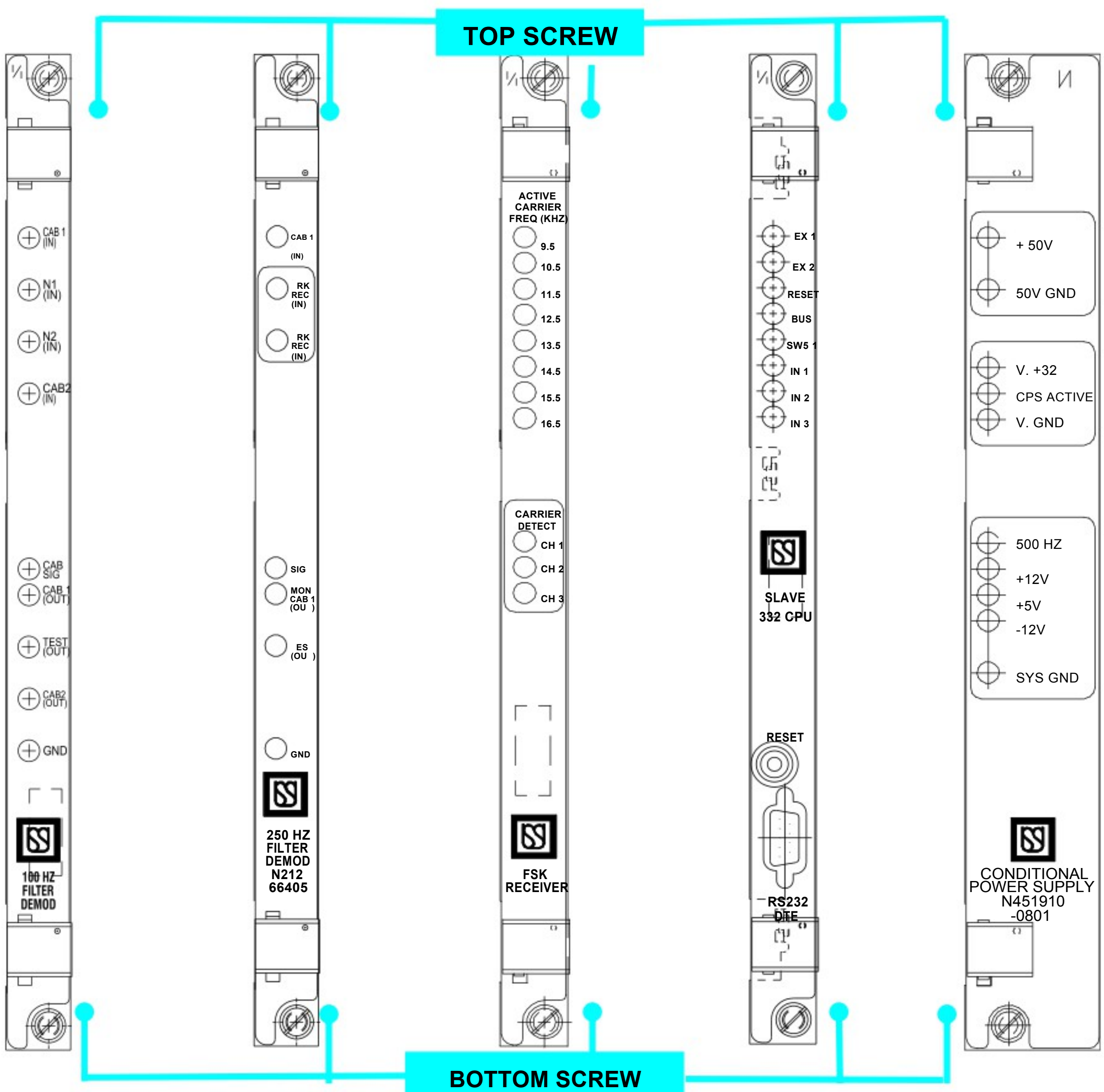


FIG 3   ATP PCBs FIXING HARDWARE

P2550 CORRECTIVE MAINTENANCE SHEET	
Card Code: **R-C-15-01-01-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **7/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CARDFILE**
Component: **ATP BOARDS**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:



100 HZ FILTER DEMODULATOR — 250 HZ FILTER DEMODULATOR — FSK RECEIVER — FSK CPU — CONDITIONAL POWER SUPPLY

FIG 4 ATP PCBs FIXING HARDWARE

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-01-00/R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **8/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CARDFILE**	
Component: **ATP BOARDS**		Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**		

PROCEDURE:

B) BLANK PANEL REMOVAL

1. To remove the Blank Panel proceed as follows:
   a) Using a large-blade screwdriver, loosen the Top and Bottom Blank Panel Retaining Screws.
   b) Withdraw the Blank Panel straight out from the Cardfile Guides and remove it.

C) BACKUP BATTERY REMOVAL

1. To remove the Backup Battery installed in the Main Logic CPU Daughterboard PCB proceed as follows:

WARNING: LITHIUM BATTERY IS A FIRE, EXPLOSION, AND SEVERE BURN HAZARD. DO NOT RECHARGE, DISASSEMBLE, HEAT ABOVE 212 °F, OR EXPOSE CONTENTS TO WATER.

   a) Remove the ATP Main Logic CPU from the Cardfile.as per previous Step A.
   b) Clip and remove the Battery Tie Strap from around the Backup (Lithium) Battery.
   c) Remove the Backup (Lithium) Battery from the Battery Holder on the PCB.
   d) Discard the Backup (Lithium) Battery.

INSTALLATION
PRELIMINARY OPERATIONS

1. Be sure that any Jumper settings are correct for the ATP PCB to be installed.
2. Verify that the ATP CB 11F01 and CBs 11F02 are in OFF position. Set they accordingly.

A) PCB INSTALLATION

1. To install the ATP PCB proceed as follows:
   a) Install the “new” ATP PCB in the PCB Guides of the assigned Slot position.
   b) Slide the ATP 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.

B) BLANK PANEL INSTALLATION

1. To install the Blank Panel proceed as follows:
   a) Position the “ new “ Blank Panel on the Cardfile Guides.
   b) Install the Top & Bottom Fixing Screws.
   c) Tighten the Fixing Screws using a large-blade screwdriver.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-15-01-01-00/R-00

System:	Sheet:
AUTOMATIC TRAIN PROTECTION	**9/18**

Subsystem/Assy:	Unit:
ATP SYSTEM	**ATP CARDFILE**

Component:	Man Hours:
ATP BOARDS	**1.00**

Maintenance Task:
REPLACEMENT

PROCEDURE:

C) BACKUP BATTERY INSTALLATION

1. To install the Backup Battery in the Main Logic CPU Daughterboard PCB proceed as follow

CAUTION: OBSERVE POSITIVE LITHIUM BATTERY POLARITY WITH RESPECT TO LABELING (+) ON PCB.

a) Position the Backup (Lithium) Battery into PCB Battery Holder.
b) Position the Tie Strap around the Battery and Battery Holder through the PCB.
c) Secure the Tie Strap with the Buckle on the side of the Battery.
d) Trim the excess from the Tie Strap.
e) Install the PCB in the Cardfile as per previous Step A.

FINAL OPERATIONS

1. Reinstate Electrical Power to the ATP by switching ON the CB 11F01 and CB 11F02.
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 ATP Enclosure.
5. Close and lock the ELE Locker Door using Maintenance Key.
6. Perform ATP Functional Test as indicated in the Annex 1 of this Sheet:
7 Key OFF the Vehicle, leave the Cab and close the Cab Door using Maintenance Key.
8 Record inspection result on the Defect Report Card for administrative and maintenance planning.

NOTE: At Task Completion it is recommended to make sure proper software version is updated and/or functions of the Subsystem to which the maintained Equipment pertains.

Refer to **HOW TO USE THE R-CM SHEETS** (para 15-III-04-01-02 of this Section) and follow the prescriptions provided at Step 3 **“At every Task Completion.”**

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-01-00/ R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **10/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CARDFILE**	
Component: **ATP BOARDS**		Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**		

PROCEDURE (CONT'D):

Annex 1

ATP FUNCTIONAL TEST

1 Supply Electrical Power to ATP System by placing to ON:
- The CB 11F01 (located in the "A" LV Locker)
- The CB 11F02 (located in the "A"&"B" LV Lockers)

2. Enter the A / B Cabs by opening the Cab Door using Maintenance Key.
3. Key ON the Vehicle.

ADU LAMP TEST

4. In each Cab perform the ADU Lamp Test as follows:

a) Confirm that the Lay-up Operator's Switch is set to **LAYUP**.

b) Make sure the ATP Cutout Switch is set to **NORMAL**.

c) Set the Lay-up Operator's Switch to **OPERATE**.

d) Set the Transfer Switch to **FORWARD** or **REVERSE** to select the direction.
   i. This activates the ATP mode and initiates the Lamp Test.

Completion

a) An LRV audible alarm "chirps" at the start of the Indicator Light Test.
b) The MAS display, displays 88, and the Overspeed, Cab and Non-Cab indicators light for 5 seconds.
c) As per Test result replace the Fault Indicator Light(s).

5. Once completed the ADU Lamp Test perform in each Cab the Departure Test as follows:

DEPARTURE TEST - MGL

Initial Conditions

NOTE: The Initial Conditions must be maintained while a Departure Test is in progress. If any Initial Condition is changed during the Departure Test, the Test will terminate and it is logged as a failure.

Ensure the following Initial Conditions are satisfied:
- ATP in an Active mode
- Vzero is satisfied

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-01-00/ R-00

System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **11/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CARDFILE**
Component: **ATP BOARDS**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

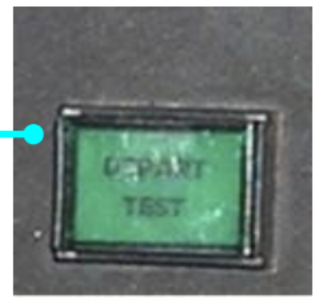
PROCEDURE (CONT'D):

MGL DEPARTURE TEST (cont'd)

6 Press the

Depart Test pushbutton

located on the ADU



NOTE: The Departure Test is aborted if the "Depart Test" pushbutton on the ADU is pressed while the Departure Test is in progress.

MGL DEPARTURE TEST Sequence

During the Departure Test, the following individual checks are performed by the ATP System:

- **Full Service Brake Application** - At the start of this test, the ATP System requests a Full Service Brake application and commands the ADU audible alarm to beep. The system verifies that the brake has been requested by checking the Full Service brake relay. If the brake request is not verified, then this test fails. At the end of this test the ATP System removes the Full Service Brake application and ADU audible alarm.
- **FSK Module Health** - This test is passed if the communications link between the ATP and FSK subsystem is established.
- **Valid Cab Signal Detection** - This test is passed if valid cab signal messages are being received from the FSK subsystem. If valid cab signal messages are being received, the Cab Signal indicator on the ADU is illuminated.
- **Function ADU Interface** - This test is passed if the communications link between the ATP and ADU is established.
- **No Crosscheck Errors Present** - This test is passed if the ATP System is not reporting any crosscheck errors.
- **No Penalty Brake Applications Active** - This test is passed if the ATP System is not requesting any penalty brake applications.
- **No Emergency Brake Applications Active** - This test is passed if the ATP System is not requesting any emergency brake applications.

NOTE: All individual Tests must pass for the Departure Test to be successful. The failure of any individual Test will cause the "Depart Test" indication on the ADU to go dark. Specific Test failures are reported to the IDU

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-01-00/ R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **12/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CARDFILE**	
Component: **ATP BOARDS**		Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**		

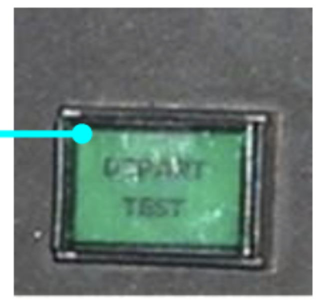
PROCEDURE (CONT'D):

MGL DEPARTURE TEST (cont'd)

7. Depress the

   Depart Test pushbutton

   on the ADU.



8. Verify:
   a) Depart Test pushbutton / indicator flashes
   b) ADU alarm annunciates
   c) Full Service Brake initiation
9. Upon successful completion of the Test, verify:
   a) Depart Test pushbutton / indicator illuminates steadily
   b) ADU alarm is silenced
   c) Full Service Penalty Brake is released
10. Record MGL Departure Test completion status on the Defect Report Card for administrative and maintenance planning.

DEPARTURE TEST - MBL & PGL

Initial Conditions

NOTE: The Initial Conditions (except No Code indication by the Decoder) must be maintained while a Departure Test is in progress.
If any Initial Condition is changed during the Departure Test, the Test will terminate and it is logged as a failure.

Ensure the following Initial Conditions are satisfied:

- ATP in an Active mode
- Vzero is satisfied
- No crosscheck errors are active
- No Code is indicated by the Decoder

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-01-00/ R-00

System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **13/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CARDFILE**
Component: **ATP BOARDS**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

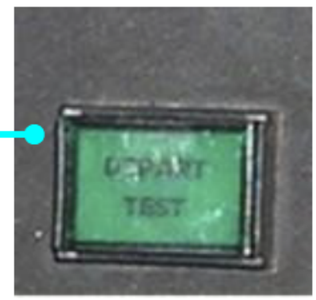
PROCEDURE (CONT'D):

MBL & PGL DEPARTURE TEST (cont'd)

11. Press the

Depart Test pushbutton

located on the ADU



NOTE: The Departure Test is aborted if the "Depart Test" pushbutton on the ADU is pressed while the Departure Test is in progress.

MBL & PGL DEPARTURE TEST Sequence

During the Departure Test sequence, simulated Speed Signals and Cab Signal Code Rates are generated by System Software, and the following Individual Checks are performed by the ATP System:

- **Cab Signal Detection Sensitivity** - The Cab Signal Carrier Thresholds are examined to determine if they are within a valid range. If they are not, the Departure Test fails. A 50 CPM code rate is generated at a signal level 10% less than the Cab Signal Carrier Threshold. If a 50 code rate is detected by the ATP, the Departure Test fails.
- **Code Rate Detection** - The System generates each of the following code rates: No Code, 50, 75, 120, 180, 270, and Dual 270 at a level 10% greater than the Cab Signal Carrier Threshold. If the Code Rate is not detected, the Departure Test fails.
- **Street Running Response** - A 410 Code rate is generated at a level 10% greater than the Cab Signal Carrier Threshold. If Street Running Mode is not detected, the Departure Test fails. The System then produces a No Code condition and verifies that Street Running Mode is maintained.
- **Overspeed Detection -** The System produces an Overspeed Condition by simulating a speed one (1) mph above the Street Running Mode Speed Limit. The System then simulates Brake Rate to satisfy Brake Assurance. If the Overspeed is not detected or a Brake Application is detected, the Departure Test fails. The System then produces a speed at the Under Speed Set Point. The System verifies that the Under Speed is satisfied.

  The System flashes the Cab Signal indicator informing the operator to terminate the Street Running Mode. The System then generates a 100 Hz constant carrier and maintains the Speed at the Street Running Mode Under Speed Set Point. If Street Running Mode is not terminated or the Code Rate is not detected, the Departure Test fails.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-01-00/ R-00

System:
AUTOMATIC TRAIN PROTECTION

Sheet:
14/18

Subsystem/Assy:
ATP SYSTEM

Unit:
ATP CARDFILE

Component:
ATP BOARDS

Man Hours:
1.00

Maintenance Task:
REPLACEMENT

PROCEDURE (CONT'D):

MBL & PGL DEPARTURE TEST (cont'd)

MBL & PGL DEPARTURE TEST Sequence (cont'd)

- **Full Service Brake Application**

  After the transition out of Street Running Mode occurs, the System will be in an Overspeed Condition and Running Brake Assurance.

  Brake Rate is simulated to forestall the Full Service Brake request for a period of five (5) seconds.

  After the time expires, simulated Brake Rate is discontinued and an Overspeed Penalty Brake is requested.

  The System verifies the Full Service Brake request by checking the Full Service Brake Relay. If the Brake Request is not verified, the Departure Test fails.

- **Completion**

  Once the Full Service Brake Request has been verified, the System reduces the Simulated Speed to 0 mph (Vzero).

  The System verifies that the Brake Request is released.

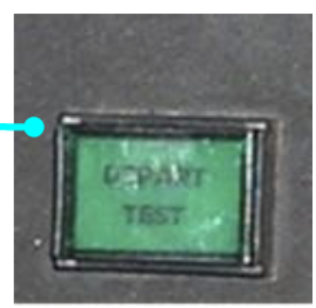
  If the Brake Request is not released, the Departure Test fails. Otherwise, the Departure Test is completed and is considered successful.

  NOTE: All individual Tests must pass for the Departure Test to be successful.
  The failure of any individual Test will cause the "Depart Test" indication on the ADU to go dark. Specific Test failures are reported to the IDU.

12 Depress the

Depart Test pushbutton

on the ADU.



13. Verify that the

Depart Test pushbutton/indicator flashes.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-01-00/ R-00

System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **15/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CARDFILE**	
Component: **ATP BOARDS**		Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**		

PROCEDURE (CONT'D):

MBL & PGL DEPARTURE TEST (cont'd)

14 Verify on the ADU**:**

- **a** **TARGET SPEED** indicates **65 mph** and the **CAB SIGNAL** indicator on the ADU illuminates.
- **b** **TARGET SPEED i**ndicates **55 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm**.
- **c** **TARGET SPEED** indicates **45 mph** and the ADU alarm annunciates**. Acknowledge the ADU alarm.**
- **d** **TARGET SPEED** indicates **35 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**
- **e** **TARGET SPEED** indicates **25 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**
- **f** **TARGET SPEED** indicates **10 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**
- **g** **TARGET SPEED** indicates **0 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**
- **h** **TARGET SPEED** indicates **35 mph,** the ADU alarm annunciates **Acknowledge the ADU alarm.**, and the **STREET RUNNING** Indicator **illuminates.**
- **i** **TARGET SPEED** indicates **0 mph,** the ADU alarm annunciates **Acknowledge the ADU alarm**. and the **STREET RUNNING** Indicator **remains illuminated.**
- **j** **SPEED** indicates **36 mph**, the ADU alarm annunciates **Acknowledge the ADU alarm**. and the **OVERSPEED** indication **illuminates.**
- **k** **SPEED** indicates **(ESL - 1 mph)** and the **OVERSPEED** indication is deactivated.
- **l** the **CAB SIGNAL** Indicator **flashes** and **SPEED remains at (ESL - 1 mph)**.

15 Depress the Street Running pushbutton and verify on the ADU:

- **a** the ADU alarm **annunciates**, the **CAB SIGNAL** Indicator **remains illuminated**, and the **STREET RUNNING** Indicator is **deactivated**.
- **b** the **OVERSPEED** indicator is **illuminated** and, after approximately five (5) seconds, verify Full Service Penalty Brake initiation.
- **c** **SPEED** indicates **0 mph** and the **OVERSPEED** indicator is **deactivated.**
- **d** the Full Service Brake is **released.**
- **e** the **DEPART TEST** pushbutton/indicator **illuminates steadily**

16 Record MBL & PGL Departure Test completion status on the Defect Report Card for administrative and maintenance planning.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-01-00/ R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **16/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CARDFILE**	
Component: **ATP BOARDS**		Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**		

PROCEDURE (CONT'D):

DEPARTURE TEST (cont'd)

17 As per Test Result perform Troubleshooting with IDU or PTU.
Refer to Part II of this Section, paragraphs 15-II-02.2 and 15-II-02.3 respectively
Next Figures (A), (B) and (C) provide, respectively:

- The ATP/TWC SYSTEM STATUS SCREEN (Operating Mode)
- The ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)
- The PTU & ATP CONNECTIONS

18 Key OFF the Vehicle, leave the Cab and close the Cab Door using Maintenance Key.

19 Record inspection result on the Defect Report Card for administrative and maintenance planning.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-01-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **17/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CARDFILE**
Component: **ATP BOARDS**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

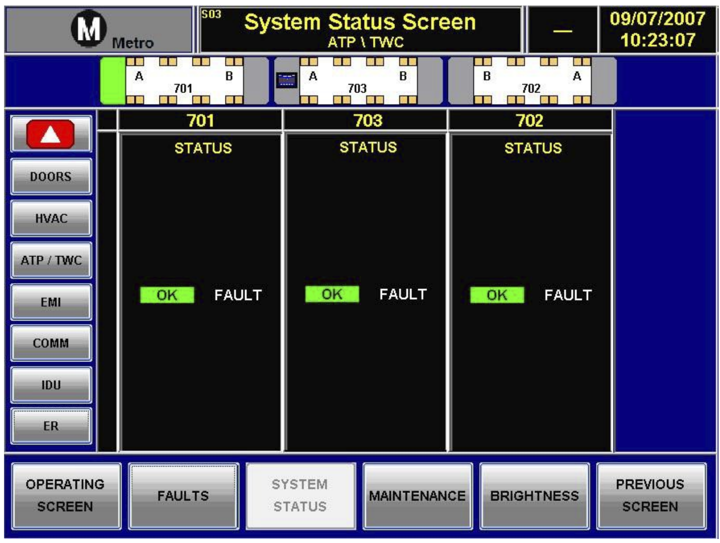


FIG (A) ATP/TWC SYSTEM STATUS SCREEN (Operating Mode)

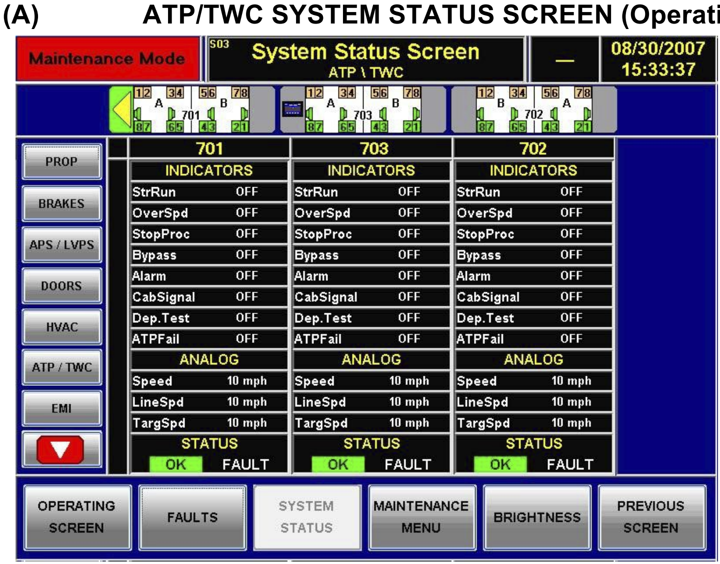


FIG (B) ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-01-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **18/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP CARDFILE**
Component: **ATP BOARDS**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

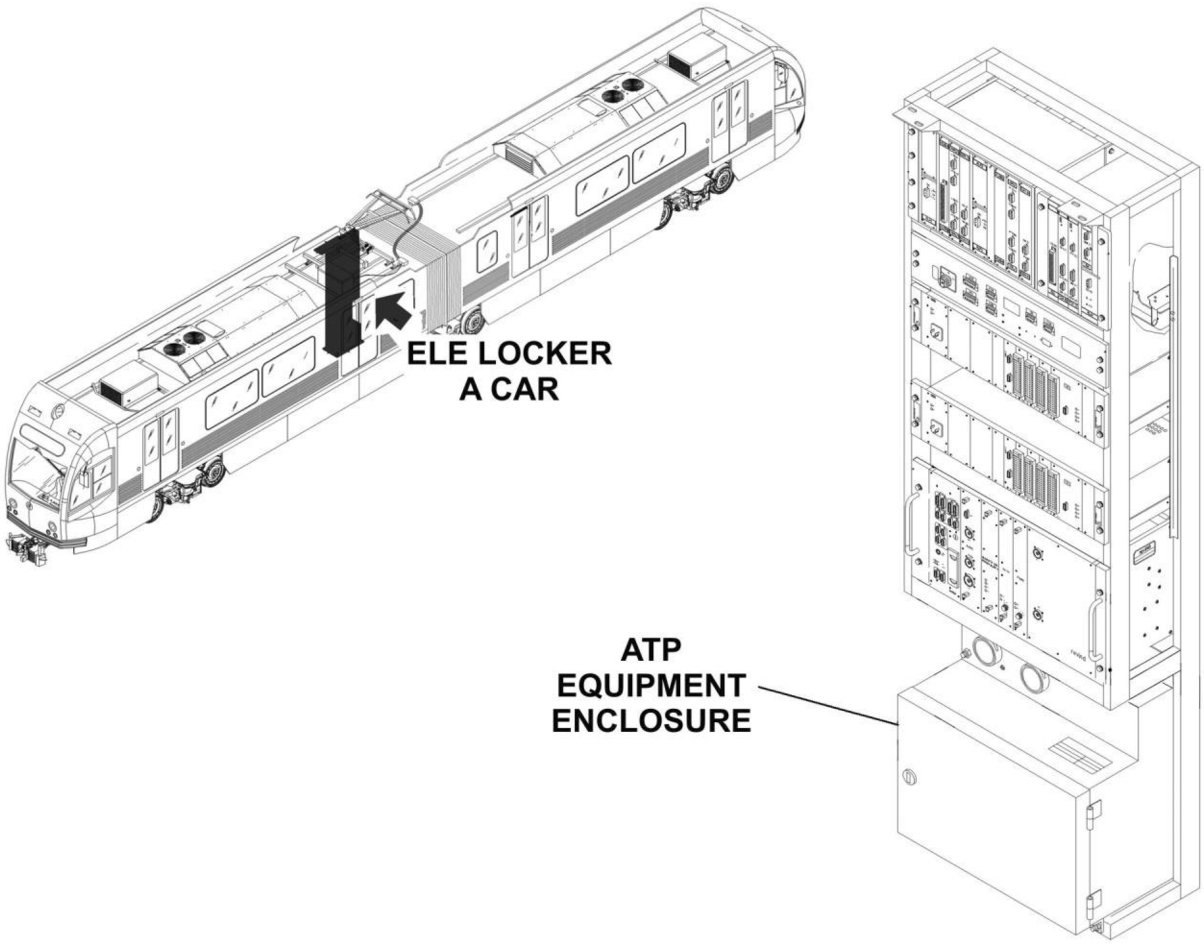
PROCEDURE:

Fig (C) PTU & TWC CONNECTIONS

P2550 CORRECTIVE MAINTENANCE SHEET

	Card Code: **R-C-15-01-10-00/R-00**
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **1/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**
Component: **VITAL RELAY (159B)**	Man Hours: **1.0**
Maintenance Task: **REPLACEMENT**	

LOCATION:



P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-10-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **2/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**
Component: **VITAL RELAY (159B)**	Man Hours: **1.0**
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:

NA

SPARE PARTS:

Vital Relay (159B) P/N N436788

P2550 CORRECTIVE MAINTENANCE SHEET

	Card Code: **R-C-15-01-10-00/R-00**
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **3/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**
Component: **VITAL RELAY (159B)**	Man Hours: **1.0**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

To perform the Task proceed as follows:

PRELIMINARY OPERATIONS

1. Set the vehicle in safety condition in accordance with LACMTA Maintenance Shop Regulations.
2. Make sure the Parking Brakes are applied and the Wheels chocked.
3. Set the Transfer Switch to "OFF" Position.
4. Place to "OFF" position the following Circuit Breakers:

CB 11F02

located in the “A“&“B“ LV Lockers

CB 11F01
located in the “A“ LV Locker

CB 11S01,
located in
the “A“ Cab By Pass Panel,

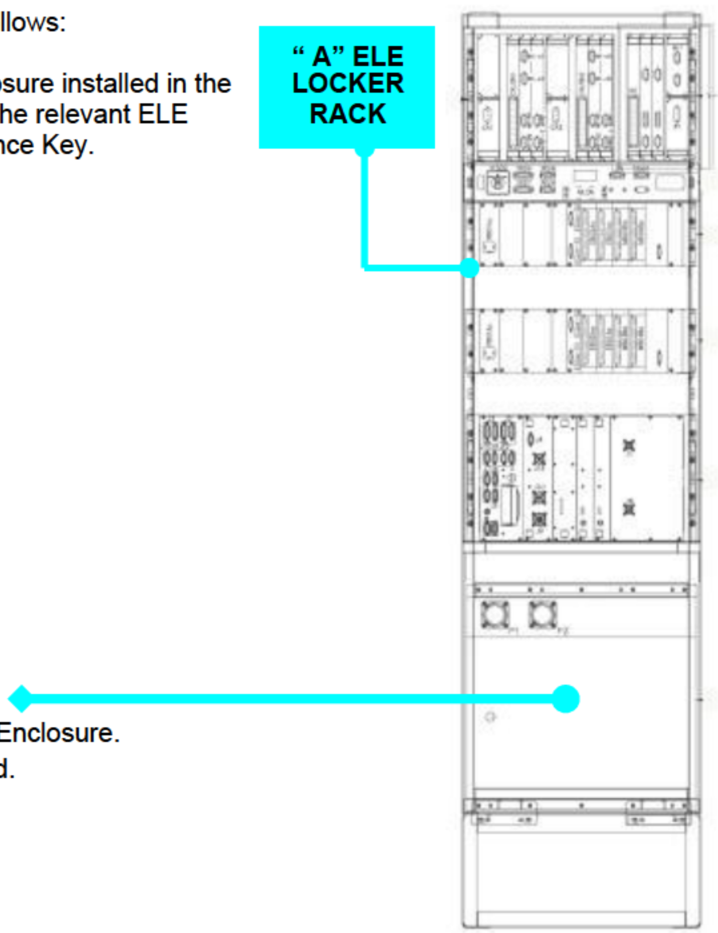
P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-10-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **4/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**
Component: **VITAL RELAY (159B)**	Man Hours: **1.0**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:
REMOVAL

To perform the Task proceed as follows:

1. Gain access to the ATP Enclosure installed in the (A) ELE Locker, by opening the relevant ELE Locker Door using Maintenance Key.



2. Locate the **ATP Enclosure.**
3. Open the Door Panel of ATP Enclosure.
4. Locate the Item to be replaced.

FIG 1 ATP ENCLOSURE LOCATION

P2550 CORRECTIVE MAINTENANCE SHEET

	Card Code: **R-C-15-01-10-00/R-00**
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **5/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**
Component: **VITAL RELAY (159B)**	Man Hours: **1.0**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

5. To remove the Vital Relay proceed as follows:
   a) Remove the two (2) Bolts holding the Relay in place.
   b) Using both hands, one under the Relay for support, gently rock the Relay from side to side and pull the Relay outward to disconnect it from the Mounting Base.
   c) Remove the Relay from the Enclosure.

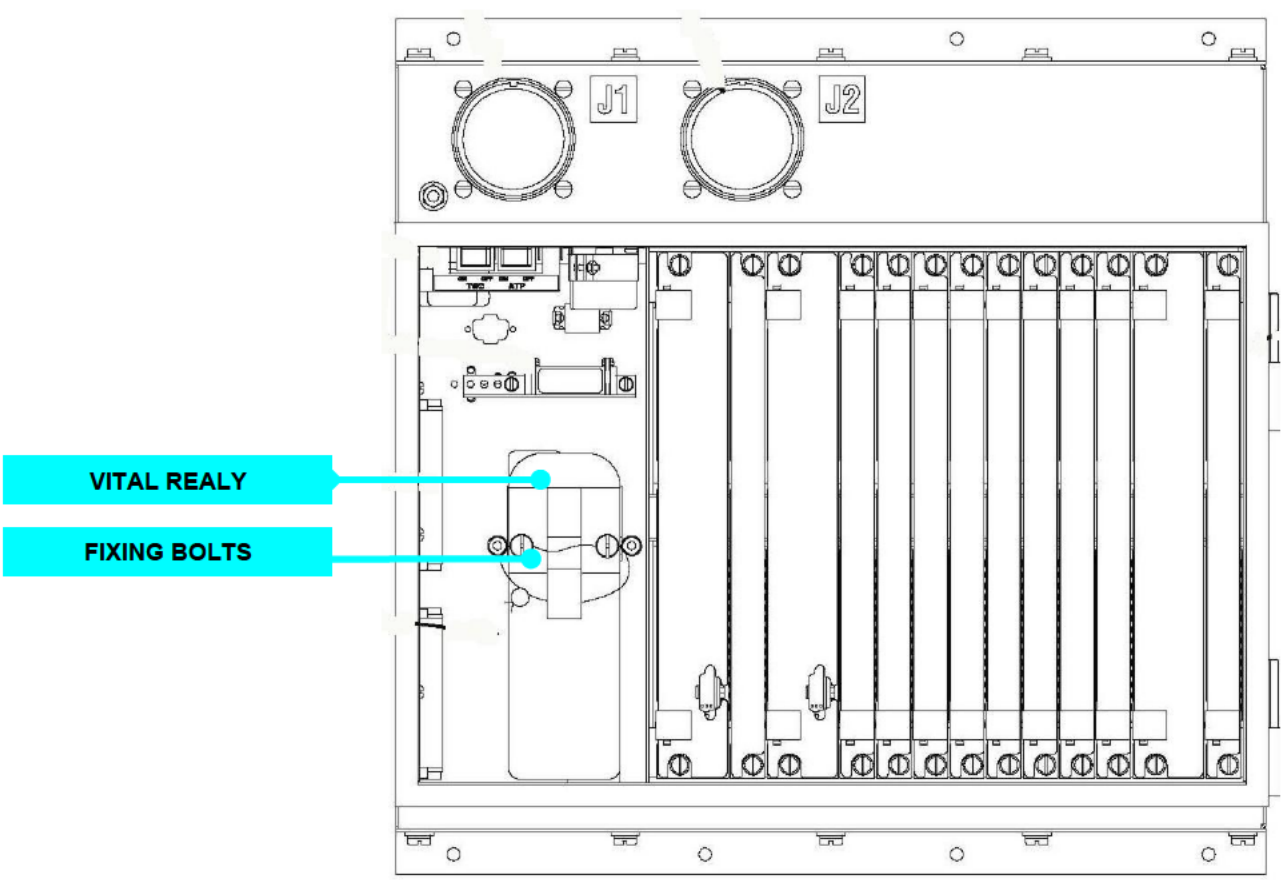


FIG 2 ATP ENCLOSURE VITAL RELAY LOCATION

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-10-00/R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **6/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**	
Component: **VITAL RELAY (159B)**		Man Hours: **1.0**
Maintenance Task: **REPLACEMENT**		

PROCEDURE:

INSTALLATION

To perform the Task proceed as follows

1. Verify that the ATP CB 11F01 and CBs 11F02 are in OFF position. Set they accordingly.
2. With one hand under the Relay for support, align the Relay with its Mounting Base, then plug the Relay into the Base.
3. Push the Relay firmly against the Mounting Base.

WARNING: THE RELAY MOUNTING BOLTS MUST BE TORQUED AS SPECIFIED TO ENSURE PROPER CALIBRATION.

4. Tighten both Relay Mounting Bolts just enough to hold the Relay in position
5. Torque the mounting Bolts to **25 (20-25) inch-pounds**.

CAUTION: DO NOT UNDER OR OVER-TORQUE THE BOLTS

6. Seal one Relay Mounting Bolt to the other Relay Mounting Bolt.
   Place the wire through the hole in each Bolt, and wrap the wire around the two Bolts to form a figure eight, then seal the wire using a lead pellet and compression tool.

FINAL OPERATIONS

1. Reinstate Electrical Power to the ATP by switching ON the CB 11F01 and CB 11F02.
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 ATP Enclosure.
5. Close and lock the ELE Locker Door using Maintenance Key.
6. Perform ATP Functional Test as indicated in the Annex 1 of this Sheet:
7 Key OFF the Vehicle, leave the Cab and close the Cab Door using Maintenance Key.
8 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 15-III-04-01-02 of this Section) and follow the prescriptions provided at Step 3 **"At every Task Completion."**

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-10-00/ R-00

System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **7/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**
Component: **VITAL RELAY (159B)**	Man Hours: **1.0**
Maintenance Task: **REPLACEMENT**	

PROCEDURE (CONT'D):

Annex 1

ATP FUNCTIONAL TEST

1 Supply Electrical Power to ATP System by placing to ON:
- The CB 11F01 (located in the "A" LV Locker)
- The CB 11F02 (located in the "A"&"B" LV Lockers)

2. Enter the A / B Cabs by opening the Cab Door using Maintenance Key
3. Key ON the Vehicle

ADU LAMP TEST

4. In each Cab perform the ADU Lamp Test as follows:

e) Confirm that the Lay-up Operator's Switch is set to **LAYUP**.

f) Make sure the ATP Cutout Switch is set to **NORMAL**.

g) Set the Lay-up Operator's Switch to **OPERATE**.

h) Set the Transfer Switch to **FORWARD** or **REVERSE** to select the direction.
   i. This activates the ATP mode and initiates the Lamp Test.

Completion

d) An LRV audible alarm "chirps" at the start of the Indicator Light Test.
e) The MAS display, displays 88, and the Overspeed, Cab and Non-Cab indicators light for 5 seconds.
f) As per Test result replace the Fault Indicator Light(s).

5. Once completed the ADU Lamp Test perform in each Cab the Departure Test as follows:

DEPARTURE TEST - MGL

Initial Conditions

NOTE: The Initial Conditions must be maintained while a Departure Test is in progress. If any Initial Condition is changed during the Departure Test, the Test will terminate and it is logged as a failure.

Ensure the following Initial Conditions are satisfied:
- ATP in an Active mode
- Vzero is satisfied

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-10-00/ R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **8/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**
Component: **VITAL RELAY (159B)**	Man Hours: **1.0**
Maintenance Task: **REPLACEMENT**	

PROCEDURE (CONT'D):

MGL DEPARTURE TEST (cont'd)

6 Press the

Depart Test pushbutton

located on the ADU

NOTE: The Departure Test is aborted if the "Depart Test" pushbutton on the ADU is pressed while the Departure Test is in progress.

MGL DEPARTURE TEST Sequence

During the Departure Test, the following individual checks are performed by the ATP System:

- **Full Service Brake Application** - At the start of this test, the ATP System requests a Full Service Brake application and commands the ADU audible alarm to beep. The system verifies that the brake has been requested by checking the Full Service brake relay. If the brake request is not verified, then this test fails. At the end of this test the ATP System removes the Full Service Brake application and ADU audible alarm.
- **FSK Module Health** - This test is passed if the communications link between the ATP and FSK subsystem is established.
- **Valid Cab Signal Detection** - This test is passed if valid cab signal messages are being received from the FSK subsystem. If valid cab signal messages are being received, the Cab Signal indicator on the ADU is illuminated.
- **Function ADU Interface** - This test is passed if the communications link between the ATP and ADU is established.
- **No Crosscheck Errors Present** - This test is passed if the ATP System is not reporting any crosscheck errors.
- **No Penalty Brake Applications Active** - This test is passed if the ATP System is not requesting any penalty brake applications.
- **No Emergency Brake Applications Active** - This test is passed if the ATP System is not requesting any emergency brake applications.

NOTE: All individual Tests must pass for the Departure Test to be successful. The failure of any individual Test will cause the "Depart Test" indication on the ADU to go dark. Specific Test failures are reported to the IDU

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-10-00/ R-00

System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **9/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**
Component: **VITAL RELAY (159B)**	Man Hours: **1.0**
Maintenance Task: **REPLACEMENT**	

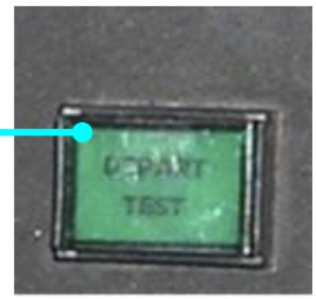
PROCEDURE (CONT'D):

MGL DEPARTURE TEST (cont'd)

7. Depress the

   Depart Test pushbutton

   on the ADU.



8. Verify:
   a) Depart Test pushbutton / indicator flashes
   b) ADU alarm annunciates
   c) Full Service Brake initiation
9. Upon successful completion of the Test, verify:
   a) Depart Test pushbutton / indicator illuminates steadily
   b) ADU alarm is silenced
   c) Full Service Penalty Brake is released
10. Record MGL Departure Test completion status on the Defect Report Card for administrative and maintenance planning.

DEPARTURE TEST - MBL & PGL

Initial Conditions

NOTE: The Initial Conditions (except No Code indication by the Decoder) must be maintained while a Departure Test is in progress.
If any Initial Condition is changed during the Departure Test, the Test will terminate and it is logged as a failure.

Ensure the following Initial Conditions are satisfied:

- ATP in an Active mode
- Vzero is satisfied
- No crosscheck errors are active
- No Code is indicated by the Decoder

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-10-00/ R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **10/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**
Component: **VITAL RELAY (159B)**	Man Hours: **1.0**
Maintenance Task: **REPLACEMENT**	

PROCEDURE (CONT'D):

MBL & PGL DEPARTURE TEST (cont'd)

11. Press the

Depart Test pushbutton

located on the ADU

NOTE: The Departure Test is aborted if the "Depart Test" pushbutton on the ADU is pressed while the Departure Test is in progress.

MBL & PGL DEPARTURE TEST Sequence

During the Departure Test sequence, simulated Speed Signals and Cab Signal Code Rates are generated by System Software, and the following Individual Checks are performed by the ATP System:

- **Cab Signal Detection Sensitivity** - The Cab Signal Carrier Thresholds are examined to determine if they are within a valid range. If they are not, the Departure Test fails. A 50 CPM code rate is generated at a signal level 10% less than the Cab Signal Carrier Threshold. If a 50 code rate is detected by the ATP, the Departure Test fails.
- **Code Rate Detection** - The System generates each of the following code rates: No Code, 50, 75, 120, 180, 270, and Dual 270 at a level 10% greater than the Cab Signal Carrier Threshold. If the Code Rate is not detected, the Departure Test fails.
- **Street Running Response** - A 410 Code rate is generated at a level 10% greater than the Cab Signal Carrier Threshold. If Street Running Mode is not detected, the Departure Test fails. The System then produces a No Code condition and verifies that Street Running Mode is maintained.
- **Overspeed Detection -** The System produces an Overspeed Condition by simulating a speed one (1) mph above the Street Running Mode Speed Limit. The System then simulates Brake Rate to satisfy Brake Assurance. If the Overspeed is not detected or a Brake Application is detected, the Departure Test fails. The System then produces a speed at the Under Speed Set Point. The System verifies that the Under Speed is satisfied.

  The System flashes the Cab Signal indicator informing the operator to terminate the Street Running Mode. The System then generates a 100 Hz constant carrier and maintains the Speed at the Street Running Mode Under Speed Set Point. If Street Running Mode is not terminated or the Code Rate is not detected, the Departure Test fails.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-10-00/ R-00

System:	Sheet:
AUTOMATIC TRAIN PROTECTION	**11/16**

Subsystem/Assy:	Unit:
ATP SYSTEM	**ATP ENCLOSURE**

Component:	Man Hours:
VITAL RELAY (159B)	**1.0**

Maintenance Task:
REPLACEMENT

PROCEDURE (CONT'D):

MBL & PGL DEPARTURE TEST (cont'd)
MBL & PGL DEPARTURE TEST Sequence (cont'd)

- **Full Service Brake Application**

  After the transition out of Street Running Mode occurs, the System will be in an Overspeed Condition and Running Brake Assurance.

  Brake Rate is simulated to forestall the Full Service Brake request for a period of five (5) seconds.

  After the time expires, simulated Brake Rate is discontinued and an Overspeed Penalty Brake is requested.

  The System verifies the Full Service Brake request by checking the Full Service Brake Relay. If the Brake Request is not verified, the Departure Test fails.

- **Completion**

  Once the Full Service Brake Request has been verified, the System reduces the Simulated Speed to 0 mph (Vzero).

  The System verifies that the Brake Request is released.

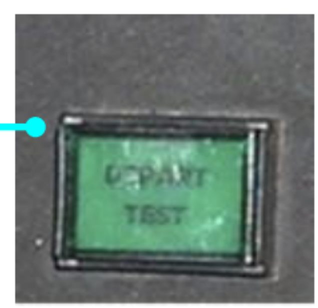
  If the Brake Request is not released, the Departure Test fails. Otherwise, the Departure Test is completed and is considered successful.

  NOTE: All individual Tests must pass for the Departure Test to be successful.
  The failure of any individual Test will cause the "Depart Test" indication on the ADU to go dark. Specific Test failures are reported to the IDU

12 Depress the

Depart Test pushbutton

on the ADU.



13. Verify that the

Depart Test pushbutton/indicator flashes.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-10-00/ R-00

System:
AUTOMATIC TRAIN PROTECTION

Sheet:
12/16

Subsystem/Assy:
ATP SYSTEM

Unit:
ATP ENCLOSURE

Component:
VITAL RELAY (159B)

Man Hours:
1.0

Maintenance Task:
REPLACEMENT

PROCEDURE (CONT'D):

MBL & PGL DEPARTURE TEST (cont'd)

14 Verify on the ADU**:**

a **TARGET SPEED** indicates **65 mph** and the **CAB SIGNAL** indicator on the ADU illuminates.

b **TARGET SPEED i**ndicates **55 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm**.

c **TARGET SPEED** indicates **45 mph** and the ADU alarm annunciates. **Acknowledge the ADU alarm.**

d **TARGET SPEED** indicates **35 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**

e **TARGET SPEED** indicates **25 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**

f **TARGET SPEED** indicates **10 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**

g **TARGET SPEED** indicates **0 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**

h **TARGET SPEED** indicates **35 mph,** the ADU alarm annunciates **Acknowledge the ADU alarm.**, and the **STREET RUNNING** Indicator **illuminates.**

i **TARGET SPEED** indicates **0 mph,** the ADU alarm annunciates **Acknowledge the ADU alarm**. and the **STREET RUNNING** Indicator **remains illuminated.**

j **SPEED** indicates **36 mph**, the ADU alarm annunciates **Acknowledge the ADU alarm**. and the **OVERSPEED** indication **illuminates.**

k **SPEED** indicates **(ESL - 1 mph)** and the **OVERSPEED** indication is deactivated.

l the **CAB SIGNAL** Indicator **flashes** and **SPEED remains at (ESL - 1 mph)**.

15 Depress the Street Running pushbutton and verify on the ADU:

a the ADU alarm **annunciates**, the **CAB SIGNAL** Indicator **remains illuminated**, and the **STREET RUNNING** Indicator is **deactivated**.

b the **OVERSPEED** indicator is **illuminated** and, after approximately five (5) seconds, verify Full Service Penalty Brake initiation.

c **SPEED** indicates **0 mph** and the **OVERSPEED** indicator is **deactivated.**

d the Full Service Brake is **released.**

e the **DEPART TEST** pushbutton/indicator **illuminates steadily**

16 Record MBL & PGL Departure Test completion status on the Defect Report Card for administrative and maintenance planning.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-10-00/ R-00

System: AUTOMATIC TRAIN PROTECTION		Sheet: 13/16
Subsystem/Assy: ATP SYSTEM	Unit: ATP ENCLOSURE	
Component: VITAL RELAY (159B)		Man Hours: 1.0
Maintenance Task: REPLACEMENT		

PROCEDURE (CONT'D):

DEPARTURE TEST (cont'd)

17 As per Test Result perform Troubleshooting with IDU or PTU.
Refer to Part II of this Section, paragraphs 15-II-02.2 and 15-II-02.3 respectively
Next Figures (A), (B) and (C) provide, respectively:

- The ATP/TWC SYSTEM STATUS SCREEN (Operating Mode)
- The ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)
- The PTU & ATP CONNECTIONS

18 Key OFF the Vehicle, leave the Cab and close the Cab Door using Maintenance Key

19 Record inspection result on the Defect Report Card for administrative and maintenance planning.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-10-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **14/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**
Component: **VITAL RELAY (159B)**	Man Hours: **1.0**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

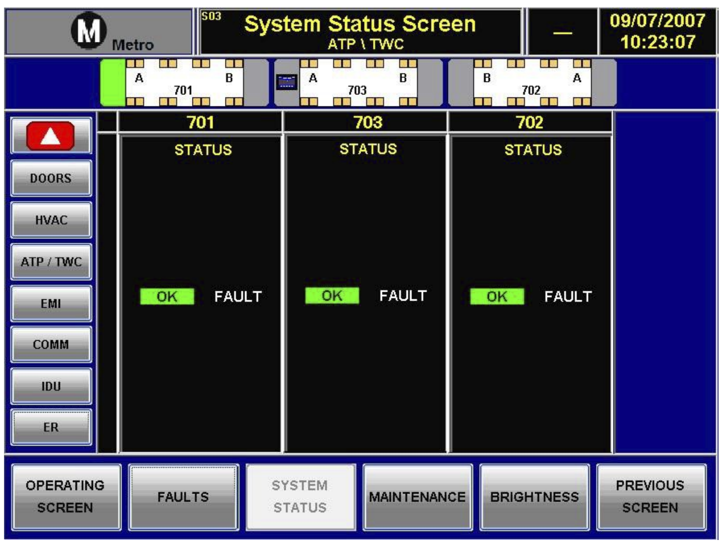


FIG (A) ATP/TWC SYSTEM STATUS SCREEN (Operating Mode)

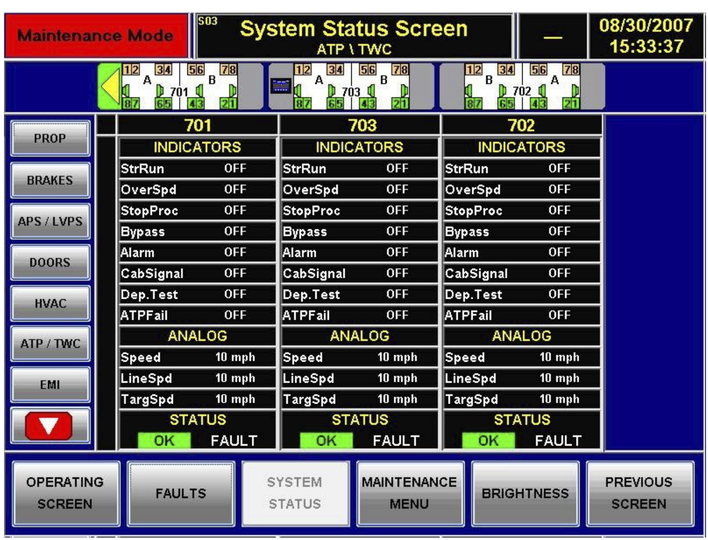


FIG (B) ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-10-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **15/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**
Component: **VITAL RELAY (159B)**	Man Hours: **1.0**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

Fig (C) PTU & TWC CONNECTIONS

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:		
R-C-15-01-10-00/R-00		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **16/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**	
Component: **VITAL RELAY (159B)**		Man Hours: **1.0**
Maintenance Task: **REPLACEMENT**		

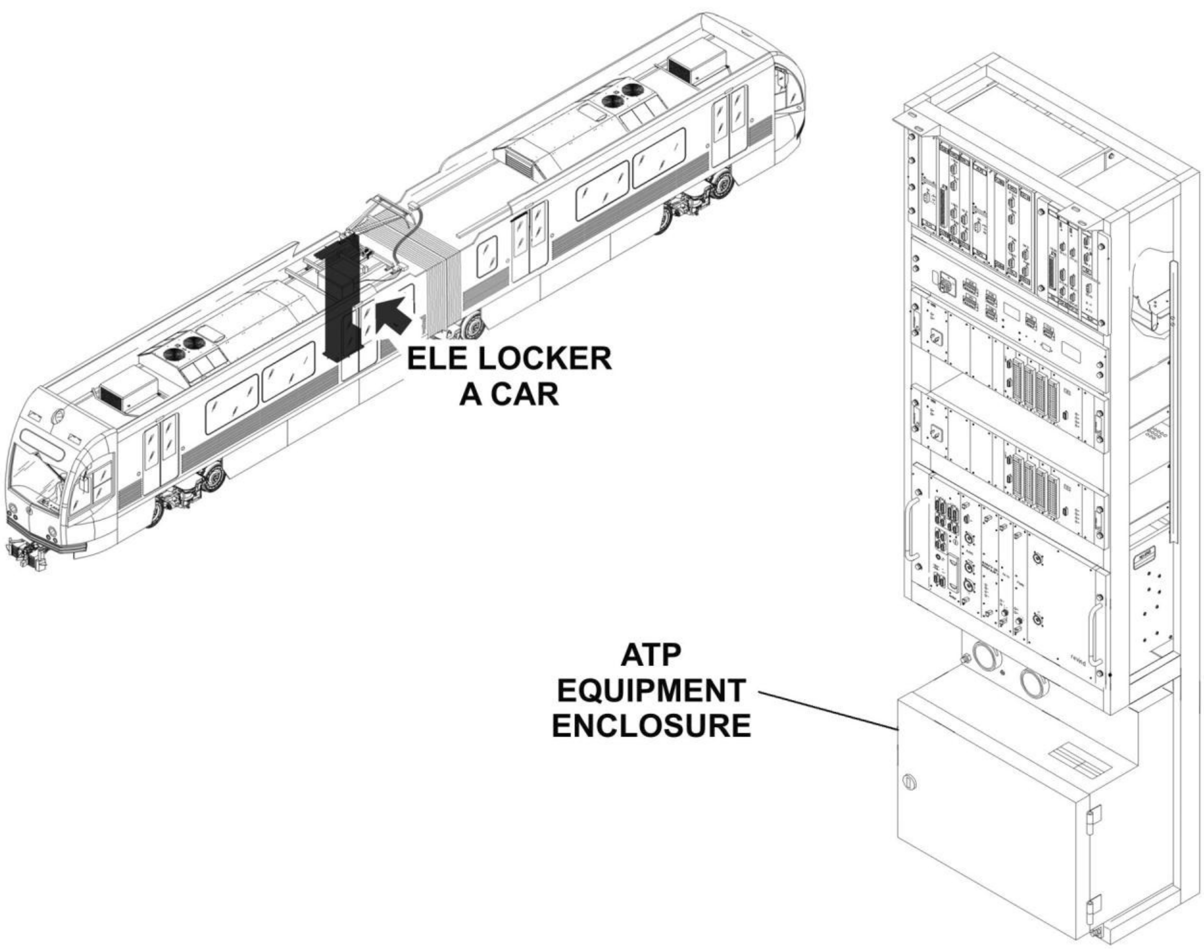
PROCEDURE:

INTENTIONALLY LEFT BLANK

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-13-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **1/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**
Component: **DECELEROMETER**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

LOCATION:



P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-15-01-13-00/R-00

System:	Sheet:
AUTOMATIC TRAIN PROTECTION	**2/18**

Subsystem/Assy:	Unit:
ATP SYSTEM	**ATP ENCLOSURE**

Component:	Man Hours:
DECELEROMETER	**1.50**

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:

NA

SPARE PARTS:

Decelerometer P/N N210688001

P2550 CORRECTIVE MAINTENANCE SHEET

	Card Code: **R-C-15-01-13-00/R-00**
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **3/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**
Component: **DECELEROMETER**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

To perform the Task proceed as follows:

PRELIMINARY OPERATIONS

1. Set the vehicle in safety condition in accordance with LACMTA Maintenance Shop Regulations.
2. Make sure the Parking Brakes are applied and the Wheels chocked.
3. Set the Transfer Switch to "OFF" Position.
4. Place to "OFF" position the following Circuit Breakers:

CB 11F02

located in the “A“&“B“ LV Lockers

CB 11F01

located in the “A“ LV Locker

CB 11S01,

located in the “A“ Cab By Pass Panel,

P2550 CORRECTIVE MAINTENANCE SHEET

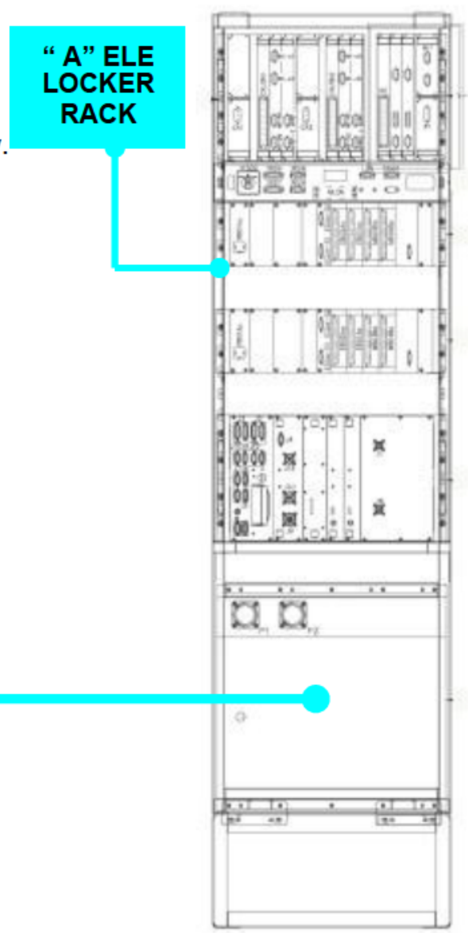
Card Code: **R-C-15-01-13-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **4/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**
Component: **DECELEROMETER**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

REMOVAL

To perform the Task proceed as follows:

1. Gain access to the ATP Enclosure installed in the (A) ELE Locker, by opening the relevant ELE Locker Door using Maintenance Key.



2. Locate the **ATP Enclosure.**
3. Open the Door Panel of ATP Enclosure.
4. Locate the Item to be replaced.

FIG 1 ATP ENCLOSURE LOCATION

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-15-01-13-00/R-00

System:	Sheet:
AUTOMATIC TRAIN PROTECTION	**5/18**

Subsystem/Assy:	Unit:
ATP SYSTEM	**ATP ENCLOSURE**

Component:	Man Hours:
DECELEROMETER	**1.50**

Maintenance Task:
REPLACEMENT

PROCEDURE:

5. To remove the Vital Relay proceed as follows:

   NOTE: Removing the Vital Relay will allow easier access to the Decelerometer mounting hardware.

   a) Remove the Vital Relay according to Sheet R-C-15-01-10-00/R-00.
   b) Disconnect the Decelerometer Connector Plug at the Chassis Wiring Receptacle.
   c) Remove two (2) 6-32x5/16 Pan Head Screws, Lock Washers and Plate Washers.
   d) Remove the Decelerometer (with mounting bracket) from the Enclosure.
   e) Remove two (2) 4-40 Lock Nuts and Flat Washers holding the Decelerometer to the Mounting Bracket.
   f) Lift the Decelerometer off the Studs on the Mounting Plate.

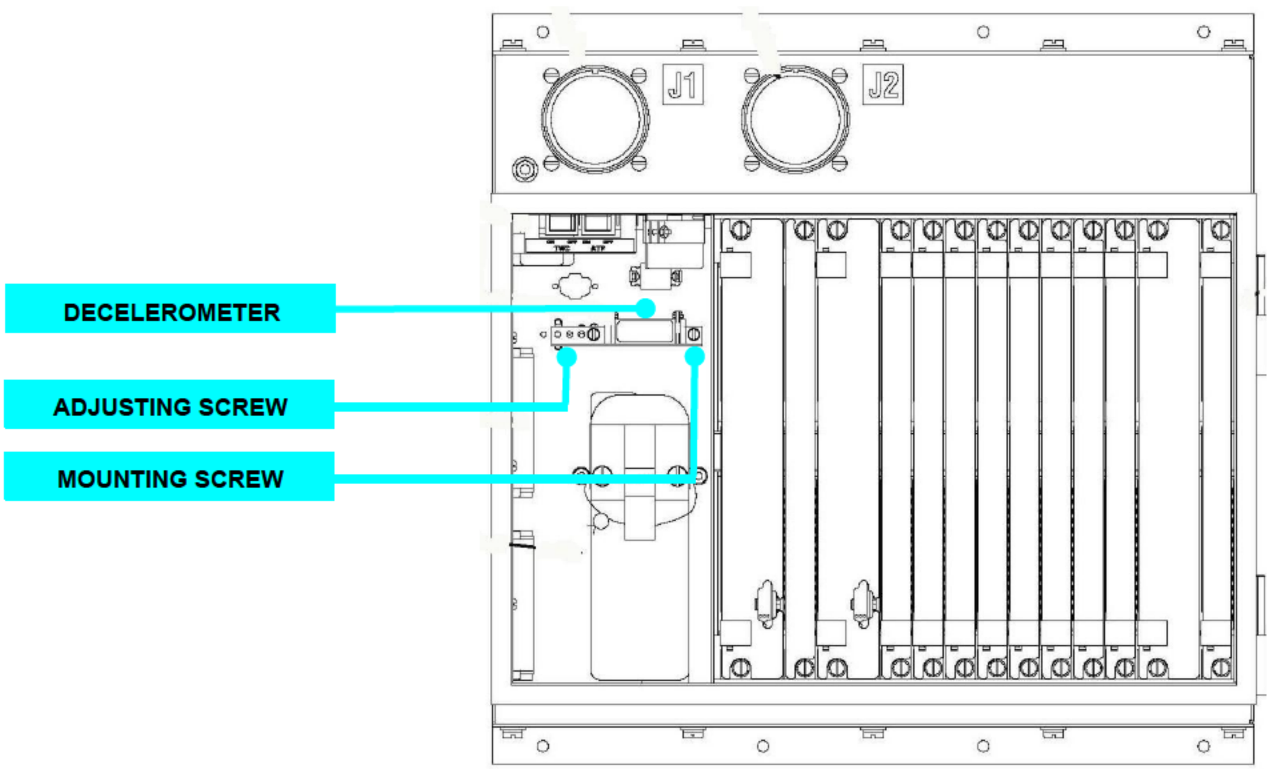


FIG 2 ATP ENCLOSURE DECELEROMETER LOCATION

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-13-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **6/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**
Component: **DECELEROMETER**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

INSTALLATION

To perform the Task proceed as follows

1. Verify that the ATP CB 11F01 and CBs 11F02 are in OFF position. Set they accordingly.
2. Slide the Decelerometer over the Studs on the Mounting Bracket.
3. Secure the Decelerometer using two (2) 4-40 Lock Nuts and Flat Washers.
4. Set the Decelerometer (with mounting bracket) into place in the Enclosure.
5. Install two (2) 6-32x5/16 Pan Head Screws, Lock Washers, and Plate Washers. Leave the Mounting Hardware snug, but do not tighten.
6. Reconnect the Decelerometer connector plug at the chassis wiring receptacle.
7. Reinstall the Vital Relay according to Sheet R-C-15-01-10-00/R-00.
8. Perform the Decelerometer Calibration as follows:

EXPLANATORY NOTE

- Decelerometer Calibration requires that the Vehicle must be positioned on level tangent track with the Air Suspension System active.
- The Vehicle must be in level to within ± **0.1 degree**.
- Calibration is necessary after Decelerometer installation or after any movement of the ATP enclosure
- The Calibration routine is invoked by the maintainer, with the ATP in an **inactive operating mode**.
- Calibration is performed by using the Toggle "Key" Switches and Alphanumeric Displays located on the Front Panel of the Main Logic CPU PCB.
- When initiated, the Calibration is conducted by removing the Mounting Screw holding the Decelerometer Device to the Mounting Plate and rotating the free end of the Device up or down to balance the displayed Decelerometer Outputs.
- When the Outputs are balanced (as near as practical), the Mounting Screw is inserted into the closest mounting holes that maintains the Calibration Values.
- A final interaction is required by the maintainer to register the Calibration within the ATP memory.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-13-00/ R-00

System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **7/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**	
Component: **DECELEROMETER**		Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**		

PROCEDURE (CONT'D):

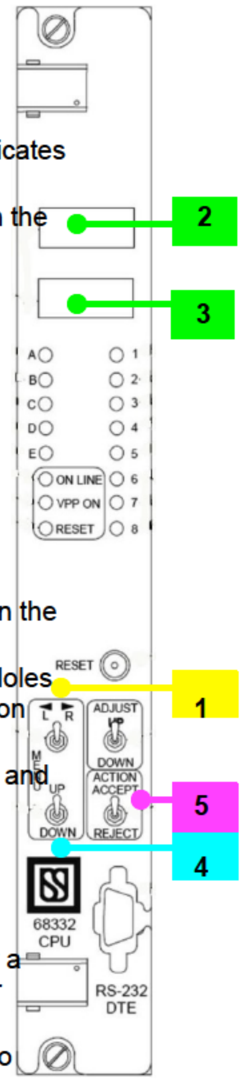
DECELEROMETER CALIBRATION

The Front Panel Switches of the Main Logic CPU PCB are used to perform the Decelerometer Calibration.

NOTE: For Decelerometer Calibration the Vehicle must be on Level Tangent Track and the ATP Subsystem must be in OFF Mode.

1. Toggle the **MENU L/R** switch **(1)** to the **R**ight or the **L**eft until the displays **(2, 3)** indicates **[Decl/Cal]**.
2. Toggle the **MENU UP/DOWN** switch **(4)** to **DOWN** once, **[### / ###l]** is displayed in the Upper and Lower Alphanumeric Display Windows, where ### represents numbers.

   NOTE: If a condition exists that prevents the Decelerometer from being adjusted (e.g. the Vehicle is moving), the Windows will display **[Warn/Decel not level]**. In this case, press the **Menu Up/Down** switch **Up** until the **[Cfg/ Menu]** is displayed.Correct the condition that is preventing the adjustment, and start the calibration process over again.
3. Loosen the Mounting Screw to the Right of the Decelerometer, then remove the Adjustment Screw, Lock Washer, and Washer to the Left of the Decelerometer.
4. Toggle the **MENU L/R** switch **(1)** to the **R**ight or the **L**eft until the Displays indicates **[Decl/Cal]**.
5. Pivot the Left End of the Decelerometer Up or Down while observing the numbers in the Upper and Lower Alphanumeric Display Windows.
6. Reinstall the Adjustment Screw, Lock Washer, and Washer when the Adjustment Holes are aligned and a reading as close to [128/128] is achieved. Tighten the Hardware on both sides of the Decelerometer to secure it in place.
7. Toggle the **Action Accept/Reject** switch **(5)** Up to **ACCEPT** the Calibration setting and return to the **[Decl/Cal]** display.
8. To return to the Configuration Menu, toggle the **Menu Up/Down** switch Up until **[Cft/Menu]** is displayed.



MAIN LOGIC CPU PCB

Completion

If the Decelerometer Calibration is **not successful** because the Adjustment is wrong or a required condition for Calibration has been removed or changed (ATP mode is active or the Vehicle is moving), **[Warn/Decel not level]** is displayed.

Toggle the **Menu Up/Down** switch Up once to display the **[Decl/Cal]** menu, and begin to recalibrate the Decelerometer as described above.

Toggle the **Action Accept/Reject** switch to **ACCEPT** to finish Decelerometer calibration.

This returns the display to the **[Decl/Cal]** menu.

Toggle the **Menu Up/Down** switch Up until the Configuration Menu is displayed.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-13-00/ R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **8/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**
Component: **DECELEROMETER**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

PROCEDURE (CONT'D):

FINAL OPERATIONS

1. Reinstate Electrical Power to the ATP by switching ON the CB 11F01 and CB 11F02.
2. Check that all the LEDs of the Cardfile PCBs are GREEN, indicating that the each Board works properly.
3. Close and lock the Door Panel of ATP Enclosure.
4. Close and lock the ELE Locker Door using Maintenance Key.
5. Perform ATP Functional Test as indicated in the Annex 1 of this Sheet:
6 Key OFF the Vehicle, leave the Cab and close the Cab Door using Maintenance Key.
7 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 15-III-04-01-02 of this Section) and follow the prescriptions provided at Step 3 **"At every Task Completion."**

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-13-00/ R-00

System: AUTOMATIC TRAIN PROTECTION		Sheet: 9/18
Subsystem/Assy: ATP SYSTEM	Unit: ATP ENCLOSURE	
Component: DECELEROMETER		Man Hours: 1.50
Maintenance Task: REPLACEMENT		

PROCEDURE (CONT'D):

Annex 1

ATP FUNCTIONAL TEST

1 Supply Electrical Power to ATP System by placing to ON:
- The CB 11F01 (located in the "A" LV Locker)
- The CB 11F02 (located in the "A"&"B" LV Lockers)

2. Enter the A / B Cabs by opening the Cab Door using Maintenance Key

3. Key ON the Vehicle

ADU LAMP TEST

4. In each Cab perform the ADU Lamp Test as follows:

i) Confirm that the Lay-up Operator's Switch is set to **LAYUP**.

j) Make sure the ATP Cutout Switch is set to **NORMAL**.

k) Set the Lay-up Operator's Switch to **OPERATE**.

l) Set the Transfer Switch to **FORWARD** or **REVERSE** to select the direction.
   i. This activates the ATP mode and initiates the Lamp Test.

Completion

g) An LRV audible alarm "chirps" at the start of the Indicator Light Test.
h) The MAS display, displays 88, and the Overspeed, Cab and Non-Cab indicators light for 5 seconds.
i) As per Test result replace the Fault Indicator Light(s)

5. Once completed the ADU Lamp Test perform in each Cab the Departure Test as follows:

DEPARTURE TEST - MGL

Initial Conditions

NOTE: The Initial Conditions must be maintained while a Departure Test is in progress. If any Initial Condition is changed during the Departure Test, the Test will terminate and it is logged as a failure.

Ensure the following Initial Conditions are satisfied:
- ATP in an Active mode
- Vzero is satisfied

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-13-00/ R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **10/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**	
Component: **DECELEROMETER**		Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**		

PROCEDURE (CONT'D):

MGL DEPARTURE TEST (cont'd)

6 Press the

Depart Test pushbutton

located on the ADU

NOTE: The Departure Test is aborted if the "Depart Test" pushbutton on the ADU is pressed while the Departure Test is in progress.

MGL DEPARTURE TEST Sequence

During the Departure Test, the following individual checks are performed by the ATP System:

- **Full Service Brake Application** - At the start of this test, the ATP System requests a Full Service Brake application and commands the ADU audible alarm to beep. The system verifies that the brake has been requested by checking the Full Service brake relay. If the brake request is not verified, then this test fails. At the end of this test the ATP System removes the Full Service Brake application and ADU audible alarm.
- **FSK Module Health** - This test is passed if the communications link between the ATP and FSK subsystem is established.
- **Valid Cab Signal Detection** - This test is passed if valid cab signal messages are being received from the FSK subsystem. If valid cab signal messages are being received, the Cab Signal indicator on the ADU is illuminated.
- **Function ADU Interface** - This test is passed if the communications link between the ATP and ADU is established.
- **No Crosscheck Errors Present** - This test is passed if the ATP System is not reporting any crosscheck errors.
- **No Penalty Brake Applications Active** - This test is passed if the ATP System is not requesting any penalty brake applications.
- **No Emergency Brake Applications Active** - This test is passed if the ATP System is not requesting any emergency brake applications.

NOTE: All individual Tests must pass for the Departure Test to be successful. The failure of any individual Test will cause the "Depart Test" indication on the ADU to go dark. Specific Test failures are reported to the IDU

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-13-00/ R-00

System: AUTOMATIC TRAIN PROTECTION		Sheet: 11/18
Subsystem/Assy: ATP SYSTEM	Unit: ATP ENCLOSURE	
Component: DECELEROMETER		Man Hours: 1.50
Maintenance Task: REPLACEMENT		

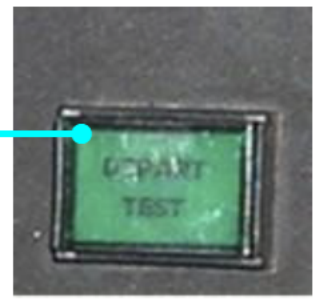
PROCEDURE (CONT'D):

MGL DEPARTURE TEST (cont'd)

7. Depress the

Depart Test pushbutton

on the ADU.



8. Verify:
- a) Depart Test pushbutton / indicator flashes
- b) ADU alarm annunciates
- c) Full Service Brake initiation

9. Upon successful completion of the Test, verify:
- a) Depart Test pushbutton / indicator illuminates steadily
- b) ADU alarm is silenced
- c) Full Service Penalty Brake is released

10. Record MGL Departure Test completion status on the Defect Report Card for administrative and maintenance planning.

DEPARTURE TEST - MBL & PGL

Initial Conditions

NOTE: The Initial Conditions (except No Code indication by the Decoder) must be maintained while a Departure Test is in progress.
If any Initial Condition is changed during the Departure Test, the Test will terminate and it is logged as a failure.

Ensure the following Initial Conditions are satisfied:

- ATP in an Active mode
- Vzero is satisfied
- No crosscheck errors are active
- No Code is indicated by the Decoder

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-13-00/ R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **12/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**
Component: **DECELEROMETER**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

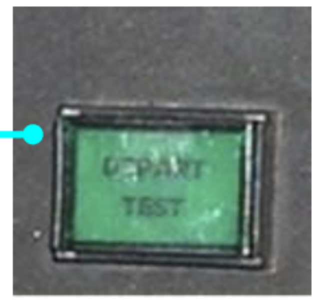
PROCEDURE (CONT'D):

MBL & PGL DEPARTURE TEST (cont'd)

11. Press the

Depart Test pushbutton

located on the ADU



NOTE: The Departure Test is aborted if the "Depart Test" pushbutton on the ADU is pressed while the Departure Test is in progress.

MBL & PGL DEPARTURE TEST Sequence

During the Departure Test sequence, simulated Speed Signals and Cab Signal Code Rates are generated by System Software, and the following Individual Checks are performed by the ATP System:

- **Cab Signal Detection Sensitivity** - The Cab Signal Carrier Thresholds are examined to determine if they are within a valid range. If they are not, the Departure Test fails. A 50 CPM code rate is generated at a signal level 10% less than the Cab Signal Carrier Threshold. If a 50 code rate is detected by the ATP, the Departure Test fails.
- **Code Rate Detection** - The System generates each of the following code rates: No Code, 50, 75, 120, 180, 270, and Dual 270 at a level 10% greater than the Cab Signal Carrier Threshold. If the Code Rate is not detected, the Departure Test fails.
- **Street Running Response** - A 410 Code rate is generated at a level 10% greater than the Cab Signal Carrier Threshold. If Street Running Mode is not detected, the Departure Test fails. The System then produces a No Code condition and verifies that Street Running Mode is maintained.
- **Overspeed Detection -** The System produces an Overspeed Condition by simulating a speed one (1) mph above the Street Running Mode Speed Limit. The System then simulates Brake Rate to satisfy Brake Assurance. If the Overspeed is not detected or a Brake Application is detected, the Departure Test fails. The System then produces a speed at the Under Speed Set Point. The System verifies that the Under Speed is satisfied.

  The System flashes the Cab Signal indicator informing the operator to terminate the Street Running Mode. The System then generates a 100 Hz constant carrier and maintains the Speed at the Street Running Mode Under Speed Set Point. If Street Running Mode is not terminated or the Code Rate is not detected, the Departure Test fails.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-13-00/ R-00

System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **13/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**
Component: **DECELEROMETER**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

PROCEDURE (CONT'D):

MBL & PGL DEPARTURE TEST (cont'd)

MBL & PGL DEPARTURE TEST Sequence (cont'd)

- **Full Service Brake Application**

  After the transition out of Street Running Mode occurs, the System will be in an Overspeed Condition and Running Brake Assurance.

  Brake Rate is simulated to forestall the Full Service Brake request for a period of five (5) seconds.

  After the time expires, simulated Brake Rate is discontinued and an Overspeed Penalty Brake is requested.

  The System verifies the Full Service Brake request by checking the Full Service Brake Relay. If the Brake Request is not verified, the Departure Test fails.

- **Completion**

  Once the Full Service Brake Request has been verified, the System reduces the Simulated Speed to 0 mph (Vzero).

  The System verifies that the Brake Request is released.

  If the Brake Request is not released, the Departure Test fails. Otherwise, the Departure Test is completed and is considered successful.

  NOTE: All individual Tests must pass for the Departure Test to be successful.
  The failure of any individual Test will cause the "Depart Test" indication on the ADU to go dark. Specific Test failures are reported to the IDU

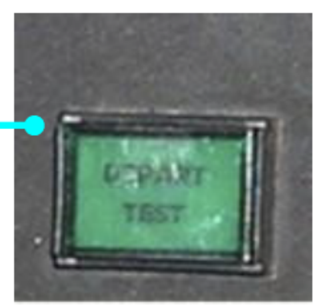
12 Depress the

Depart Test pushbutton

on the ADU.

13. Verify that the

Depart Test pushbutton/indicator flashes.



P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-13-00/ R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **14/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**
Component: **DECELEROMETER**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

PROCEDURE (CONT'D):

MBL & PGL DEPARTURE TEST (cont'd)

14 Verify on the ADU**:**

- **a** **TARGET SPEED** indicates **65 mph** and the **CAB SIGNAL** indicator on the ADU illuminates.
- **b** **TARGET SPEED i**ndicates **55 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm**.
- **c** **TARGET SPEED** indicates **45 mph** and the ADU alarm annunciates. **Acknowledge the ADU alarm.**
- **d** **TARGET SPEED** indicates **35 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**
- **e** **TARGET SPEED** indicates **25 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**
- **f** **TARGET SPEED** indicates **10 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**
- **g** **TARGET SPEED** indicates **0 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**
- **h** **TARGET SPEED** indicates **35 mph,** the ADU alarm annunciates **Acknowledge the ADU alarm.**, and the **STREET RUNNING** Indicator **illuminates.**
- **i** **TARGET SPEED** indicates **0 mph,** the ADU alarm annunciates **Acknowledge the ADU alarm**. and the **STREET RUNNING** Indicator **remains illuminated.**
- **j** **SPEED** indicates **36 mph**, the ADU alarm annunciates **Acknowledge the ADU alarm**. and the **OVERSPEED** indication **illuminates.**
- **k** **SPEED** indicates **(ESL - 1 mph)** and the **OVERSPEED** indication is deactivated.
- **l** the **CAB SIGNAL** Indicator **flashes** and **SPEED remains at (ESL - 1 mph)**.

15 Depress the Street Running pushbutton and verify on the ADU:

- **a** the ADU alarm **annunciates**, the **CAB SIGNAL** Indicator **remains illuminated**, and the **STREET RUNNING** Indicator is **deactivated**.
- **b** the **OVERSPEED** indicator is **illuminated** and, after approximately five (5) seconds, verify Full Service Penalty Brake initiation.
- **c** **SPEED** indicates **0 mph** and the **OVERSPEED** indicator is **deactivated.**
- **d** the Full Service Brake is **released.**
- **e** the **DEPART TEST** pushbutton/indicator **illuminates steadily**

16 Record MBL & PGL Departure Test completion status on the Defect Report Card for administrative and maintenance planning.

P2550 PREVENTIVE MAINTENANCE SHEET

		Card Code: **R-P-15-01-13-00/ R-00**
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **15/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**	
Component: **DECELEROMETER**		Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**		

PROCEDURE (CONT'D):

DEPARTURE TEST (cont'd)

17 As per Test Result perform Troubleshooting with IDU or PTU.
Refer to Part II of this Section, paragraphs 15-II-02.2 and 15-II-02.3 respectively
Next Figures (A), (B) and (C) provide, respectively:

- the ATP/TWC SYSTEM STATUS SCREEN (Operating Mode)
- the ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)
- the PTU & ATP CONNECTIONS

18 Key OFF the Vehicle, leave the Cab and close the Cab Door using Maintenance Key

19 Record inspection result on the Defect Report Card for administrative and maintenance planning.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-13-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **16/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**
Component: **DECELEROMETER**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

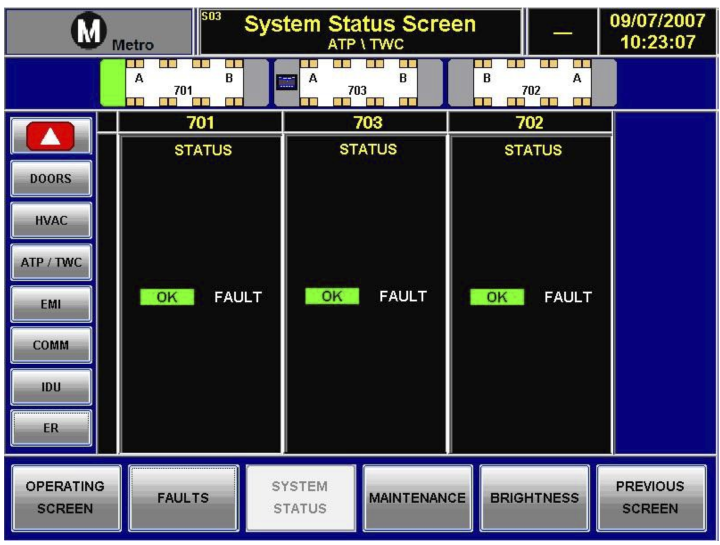


FIG (A) **ATP/TWC SYSTEM STATUS SCREEN (Operating Mode)**

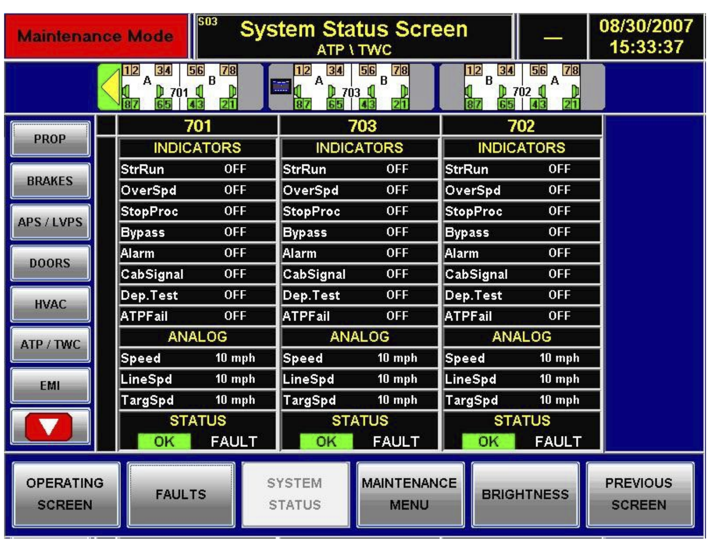


FIG (B) **ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)**

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-13-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **17/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**
Component: **DECELEROMETER**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

Fig (C) PTU & TWC CONNECTIONS

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-15-01-13-00/R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **18/18**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ATP ENCLOSURE**	
Component: **DECELEROMETER**		Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**		

PROCEDURE:

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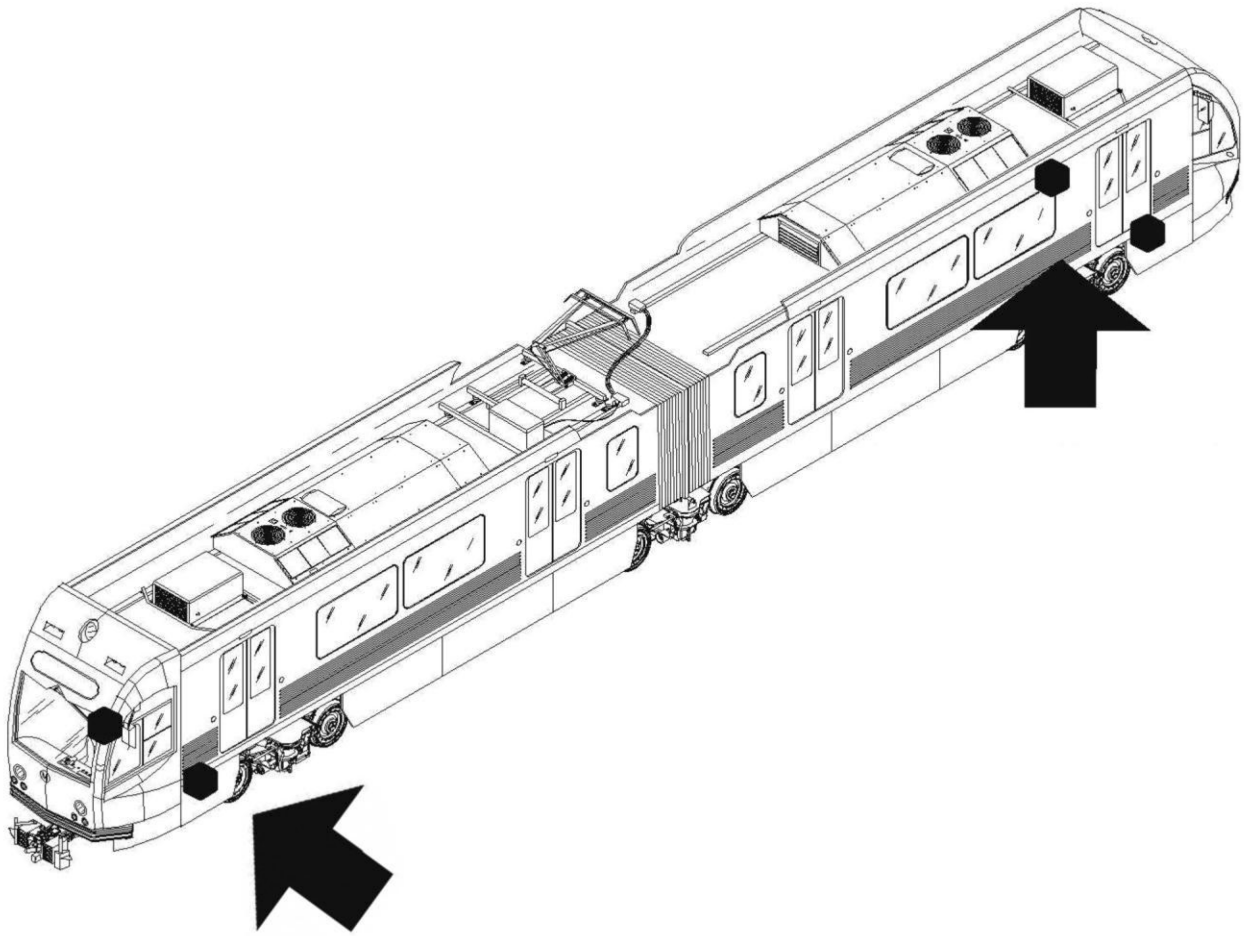
P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-15-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **1/14**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **PICKUP COIL**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

LOCATION:



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P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-15-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **2/14**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **PICKUP COIL**	Man Hours: **1.50**
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: APPLY WHEEL CHOCKS TO PREVENT THE VEHICLE FROM MOVING.

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

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit

CONSUMABLES:

NA

SPARE PARTS:

Receiver Coil	P/N: AA03W92 (N26204601)
Bracket, Clamp	P/N: AA04ND9 (M26204701)
Support	P/N: AA04ND8 (M26204702)
Spacer	PN AA07HBB
Spacer	PN AA04Y9R
Spacer	PN AA07HBC

P2550 CORRECTIVE MAINTENANCE SHEET	
Card Code: **R-C-15-01-15-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **3/14**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **PICKUP COIL**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

To perform the Task proceed as follows:

PRELIMINARY OPERATIONS

1. Set the vehicle in safety condition in accordance with LACMTA Maintenance Shop Regulations.
2. Make sure the Parking Brakes are applied and the Wheels chocked.
3. Set the Transfer Switch to "OFF" Position.
4. Place to "OFF" position the following Circuit Breakers:

CB 11F02
located in the “A“&“B“ LV Lockers

CB 11F01
located in the “A“ LV Locker

CB 11S01,
located in
the “A“ Cab By Pass Panel,

REMOVAL

To perform the task proceed as follows:

NOTE: Perform the task for both 'A' and 'B' Motor Trucks.

1. Remove the Electrical Connections from ATP Junction Box.
2. Remove the fixing Screws (4), Washers (5) and Nuts (6).
3. Remove the Pickup Coil (1) with Clamps (2), Spacer (3) and Shims (7, 8) from Bracket (9).

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:

R-C-15-01-15-00/R-00

System:	Sheet:
AUTOMATIC TRAIN PROTECTION	**4/14**

Subsystem/Assy:	Unit:
ATP SYSTEM	

Component:	Man Hours:
PICKUP COIL	**1.50**

Maintenance Task:

REPLACEMENT

PROCEDURE:

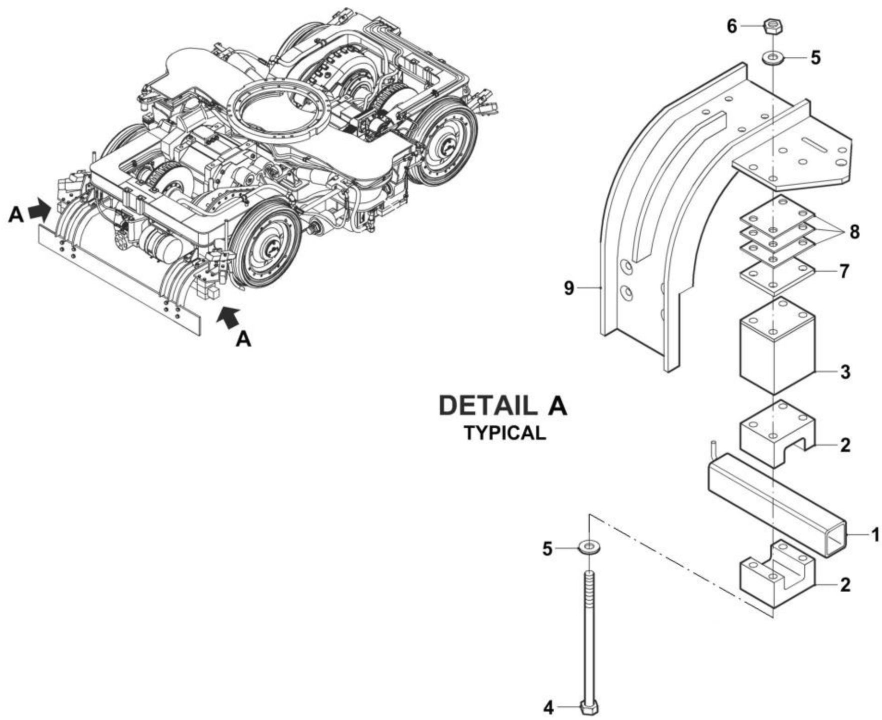


FIGURE 1 - ATP PICKUP COIL REPLACEMENT

INSTALLATION

To perform the Task proceed as follows:

1. Follow the Installation Requirements provided in Fig 2.
2. Position the Pickup Coil (1) with Clamps (2), Spacer (3) and Shims (7, 8) on Bracket (9). Hand-tighten all four clamp Bolts.
3. Install the Fixing Bolts (4), Washers (5) and Nuts (6).
4. Torque all the Bolts (4) to **34.5 inch-pounds**

CAUTION: DO NOT OVER-TORQUE THE CLAMP BOLTS.EXCESSIVE TORQUE MAY DAMAGE THE COIL AND CAUSE LOSS OF SIGNAL.

5. Connect the Electrical Connections to ATP Junction Box.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-15-01-15-00/R-00

System:	Sheet:
AUTOMATIC TRAIN PROTECTION	**5/14**

Subsystem/Assy:	Unit:
ATP SYSTEM	

Component:	Man Hours:
PICKUP COIL	**1.50**

Maintenance Task:
REPLACEMENT

PROCEDURE:

[redacted]

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-15-00/ R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **6/14**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **PICKUP COIL**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

PROCEDURE (CONT'D):

Annex 1

ATP FUNCTIONAL TEST

1 Supply Electrical Power to ATP System by placing to ON:

- the CB 11F01 (located in the "A" LV Locker)
- the CB 11F02 (located in the "A"&"B" LV Lockers)

2. Enter the A / B Cabs by opening the Cab Door using Maintenance Key

3. Key ON the Vehicle

ADU LAMP TEST

4. In each Cab perform the ADU Lamp Test as follows:

m) Confirm that the Lay-up Operator's Switch is set to **LAYUP**.

n) Make sure the ATP Cutout Switch is set to **NORMAL**.

o) Set the Lay-up Operator's Switch to **OPERATE**.

p) Set the Transfer Switch to **FORWARD** or **REVERSE** to select the direction.
   i. This activates the ATP mode and initiates the Lamp Test.

Completion

j) An LRV audible alarm "chirps" at the start of the Indicator Light Test.
k) The MAS display, displays 88, and the Overspeed, Cab and Non-Cab indicators light for 5 seconds.
l) As per Test result replace the Fault Indicator Light(s)

5. Once completed the ADU Lamp Test perform in each Cab the Departure Test as follows:

DEPARTURE TEST - MGL

Initial Conditions

NOTE: The Initial Conditions must be maintained while a Departure Test is in progress. If any Initial Condition is changed during the Departure Test, the Test will terminate and it is logged as a failure.

Ensure the following Initial Conditions are satisfied:

- ATP in an Active mode
- Vzero is satisfied

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-15-00/ R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **7/14**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **PICKUP COIL**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

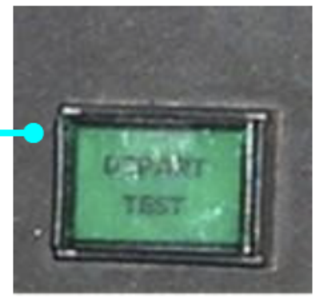
PROCEDURE (CONT'D):

MGL DEPARTURE TEST (cont'd)

6 Press the

Depart Test pushbutton

located on the ADU



NOTE: The Departure Test is aborted if the "Depart Test" pushbutton on the ADU is pressed while the Departure Test is in progress.

MGL DEPARTURE TEST Sequence

During the Departure Test, the following individual checks are performed by the ATP System:

- **Full Service Brake Application** - At the start of this test, the ATP System requests a Full Service Brake application and commands the ADU audible alarm to beep. The system verifies that the brake has been requested by checking the Full Service brake relay. If the brake request is not verified, then this test fails. At the end of this test the ATP System removes the Full Service Brake application and ADU audible alarm.
- **FSK Module Health** - This test is passed if the communications link between the ATP and FSK subsystem is established.
- **Valid Cab Signal Detection** - This test is passed if valid cab signal messages are being received from the FSK subsystem. If valid cab signal messages are being received, the Cab Signal indicator on the ADU is illuminated.
- **Function ADU Interface** - This test is passed if the communications link between the ATP and ADU is established.
- **No Crosscheck Errors Present** - This test is passed if the ATP System is not reporting any crosscheck errors.
- **No Penalty Brake Applications Active** - This test is passed if the ATP System is not requesting any penalty brake applications.
- **No Emergency Brake Applications Active** - This test is passed if the ATP System is not requesting any emergency brake applications.

NOTE: All individual Tests must pass for the Departure Test to be successful. The failure of any individual Test will cause the "Depart Test" indication on the ADU to go dark. Specific Test failures are reported to the IDU

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-15-00/ R-00

System:
AUTOMATIC TRAIN PROTECTION

Sheet:
8/14

Subsystem/Assy:
ATP SYSTEM

Unit:

Component:
PICKUP COIL

Man Hours:
1.50

Maintenance Task:
REPLACEMENT

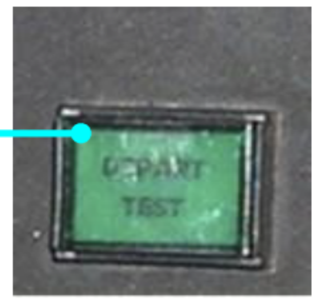
PROCEDURE (CONT'D):

MGL DEPARTURE TEST (cont'd)

7. Depress the

   Depart Test pushbutton

   on the ADU.



8. Verify:
   a) Depart Test pushbutton / indicator flashes
   b) ADU alarm annunciates
   c) Full Service Brake initiation
9. Upon successful completion of the Test, verify:
   a) Depart Test pushbutton / indicator illuminates steadily
   b) ADU alarm is silenced
   c) Full Service Penalty Brake is released
10. Record MGL Departure Test completion status on the Defect Report Card for administrative and maintenance planning.

DEPARTURE TEST - MBL & PGL

Initial Conditions

NOTE: The Initial Conditions (except No Code indication by the Decoder) must be maintained while a Departure Test is in progress.
If any Initial Condition is changed during the Departure Test, the Test will terminate and it is logged as a failure.

Ensure the following Initial Conditions are satisfied:

- ATP in an Active mode
- Vzero is satisfied
- No crosscheck errors are active
- No Code is indicated by the Decoder

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-15-00/ R-00

System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **9/14**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **PICKUP COIL**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

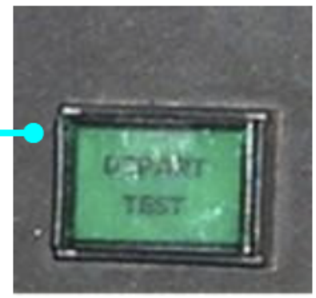
PROCEDURE (CONT'D):

MBL & PGL DEPARTURE TEST (cont'd)

11. Press the

Depart Test pushbutton

located on the ADU



NOTE: The Departure Test is aborted if the "Depart Test" pushbutton on the ADU is pressed while the Departure Test is in progress.

MBL & PGL DEPARTURE TEST Sequence

During the Departure Test sequence, simulated Speed Signals and Cab Signal Code Rates are generated by System Software, and the following Individual Checks are performed by the ATP System:

- **Cab Signal Detection Sensitivity** - The Cab Signal Carrier Thresholds are examined to determine if they are within a valid range. If they are not, the Departure Test fails. A 50 CPM code rate is generated at a signal level 10% less than the Cab Signal Carrier Threshold. If a 50 code rate is detected by the ATP, the Departure Test fails.
- **Code Rate Detection** - The System generates each of the following code rates: No Code, 50, 75, 120, 180, 270, and Dual 270 at a level 10% greater than the Cab Signal Carrier Threshold. If the Code Rate is not detected, the Departure Test fails.
- **Street Running Response** - A 410 Code rate is generated at a level 10% greater than the Cab Signal Carrier Threshold. If Street Running Mode is not detected, the Departure Test fails. The System then produces a No Code condition and verifies that Street Running Mode is maintained.
- **Overspeed Detection -** The System produces an Overspeed Condition by simulating a speed one (1) mph above the Street Running Mode Speed Limit. The System then simulates Brake Rate to satisfy Brake Assurance. If the Overspeed is not detected or a Brake Application is detected, the Departure Test fails. The System then produces a speed at the Under Speed Set Point. The System verifies that the Under Speed is satisfied.

  The System flashes the Cab Signal indicator informing the operator to terminate the Street Running Mode. The System then generates a 100 Hz constant carrier and maintains the Speed at the Street Running Mode Under Speed Set Point. If Street Running Mode is not terminated or the Code Rate is not detected, the Departure Test fails.

P2550 PREVENTIVE MAINTENANCE SHEET		
Card Code: **R-P-15-01-15-00/ R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **10/14**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component: **PICKUP COIL**		Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**		

PROCEDURE (CONT'D):

MBL & PGL DEPARTURE TEST (cont'd)

MBL & PGL DEPARTURE TEST Sequence (cont'd)

- **Full Service Brake Application**

  After the transition out of Street Running Mode occurs, the System will be in an Overspeed Condition and Running Brake Assurance.

  Brake Rate is simulated to forestall the Full Service Brake request for a period of five (5) seconds.

  After the time expires, simulated Brake Rate is discontinued and an Overspeed Penalty Brake is requested.

  The System verifies the Full Service Brake request by checking the Full Service Brake Relay. If the Brake Request is not verified, the Departure Test fails.

- **Completion**

  Once the Full Service Brake Request has been verified, the System reduces the Simulated Speed to 0 mph (Vzero).

  The System verifies that the Brake Request is released.

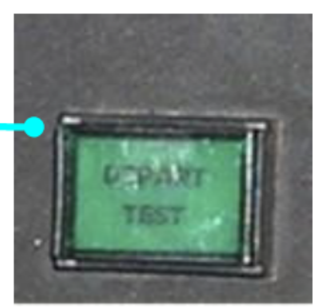
  If the Brake Request is not released, the Departure Test fails. Otherwise, the Departure Test is completed and is considered successful.

  NOTE: All individual Tests must pass for the Departure Test to be successful.
  The failure of any individual Test will cause the "Depart Test" indication on the ADU to go dark. Specific Test failures are reported to the IDU

12 Depress the

Depart Test pushbutton

on the ADU.



13. Verify that the

Depart Test pushbutton/indicator flashes.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-15-00/ R-00**

System: **AUTOMATIC TRAIN PROTECTION**

Sheet: **11/14**

Subsystem/Assy: **ATP SYSTEM**

Unit:

Component: **PICKUP COIL**

Man Hours: **1.50**

Maintenance Task: **REPLACEMENT**

PROCEDURE (CONT'D):

MBL & PGL DEPARTURE TEST (cont'd)

14 Verify on the ADU**:**

a **TARGET SPEED** indicates **65 mph** and the **CAB SIGNAL** indicator on the ADU illuminates.

b **TARGET SPEED i**ndicates **55 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm**.

c **TARGET SPEED** indicates **45 mph** and the ADU alarm annunciates. **Acknowledge the ADU alarm.**

d **TARGET SPEED** indicates **35 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**

e **TARGET SPEED** indicates **25 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**

f **TARGET SPEED** indicates **10 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**

g **TARGET SPEED** indicates **0 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**

h **TARGET SPEED** indicates **35 mph,** the ADU alarm annunciates **Acknowledge the ADU alarm.**, and the **STREET RUNNING** Indicator **illuminates.**

i **TARGET SPEED** indicates **0 mph,** the ADU alarm annunciates **Acknowledge the ADU alarm**. and the **STREET RUNNING** Indicator **remains illuminated.**

j **SPEED** indicates **36 mph**, the ADU alarm annunciates **Acknowledge the ADU alarm**. and the **OVERSPEED** indication **illuminates.**

k **SPEED** indicates **(ESL - 1 mph)** and the **OVERSPEED** indication is deactivated.

l the **CAB SIGNAL** Indicator **flashes** and **SPEED remains at (ESL - 1 mph)**.

15 Depress the Street Running pushbutton and verify on the ADU:

a the ADU alarm **annunciates**, the **CAB SIGNAL** Indicator **remains illuminated**, and the **STREET RUNNING** Indicator is **deactivated**.

b the **OVERSPEED** indicator is **illuminated** and, after approximately five (5) seconds, verify Full Service Penalty Brake initiation.

c **SPEED** indicates **0 mph** and the **OVERSPEED** indicator is **deactivated.**

d the Full Service Brake is **released.**

e the **DEPART TEST** pushbutton/indicator **illuminates steadily**

16 Record MBL & PGL Departure Test completion status on the Defect Report Card for administrative and maintenance planning.

P2550 PREVENTIVE MAINTENANCE SHEET		
Card Code: **R-P-15-01-15-00/ R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **12/14**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component: **PICKUP COIL**		Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**		

PROCEDURE (CONT'D):

DEPARTURE TEST (cont'd)

17 As per Test Result perform Troubleshooting with IDU or PTU.
Refer to Part II of this Section, paragraphs 15-II-02.2 and 15-II-02.3 respectively
Next Figures (A), (B) and (C) provide, respectively:

- The ATP/TWC SYSTEM STATUS SCREEN (Operating Mode)
- The ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)
- The PTU & ATP CONNECTIONS

18 Key OFF the Vehicle, leave the Cab and close the Cab Door using Maintenance Key

19 Record inspection result on the Defect Report Card for administrative and maintenance planning.

P2550 CORRECTIVE MAINTENANCE SHEET

	Card Code: **R-C-15-01-15-00/R-00**
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **13/14**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **PICKUP COIL**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

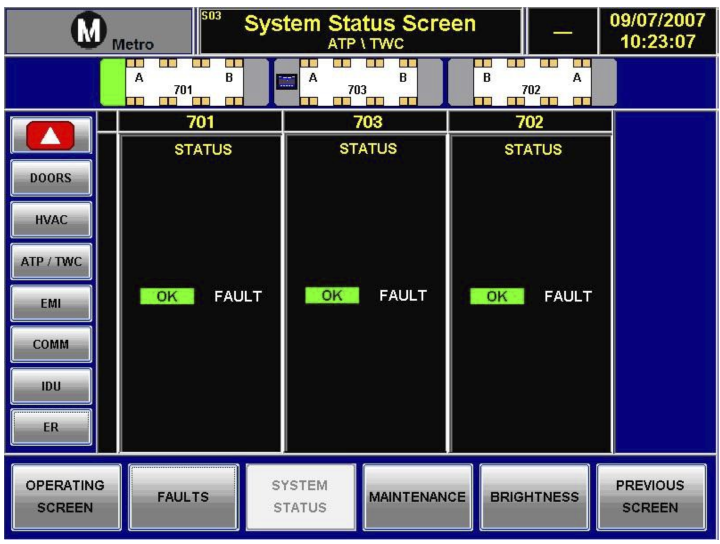


FIG (A) ATP/TWC SYSTEM STATUS SCREEN (Operating Mode)

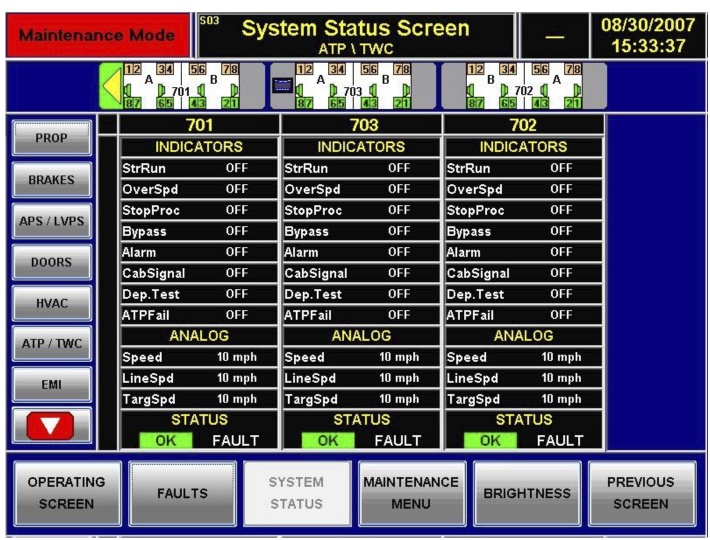


FIG (B) ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-15-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **14/14**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **PICKUP COIL**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

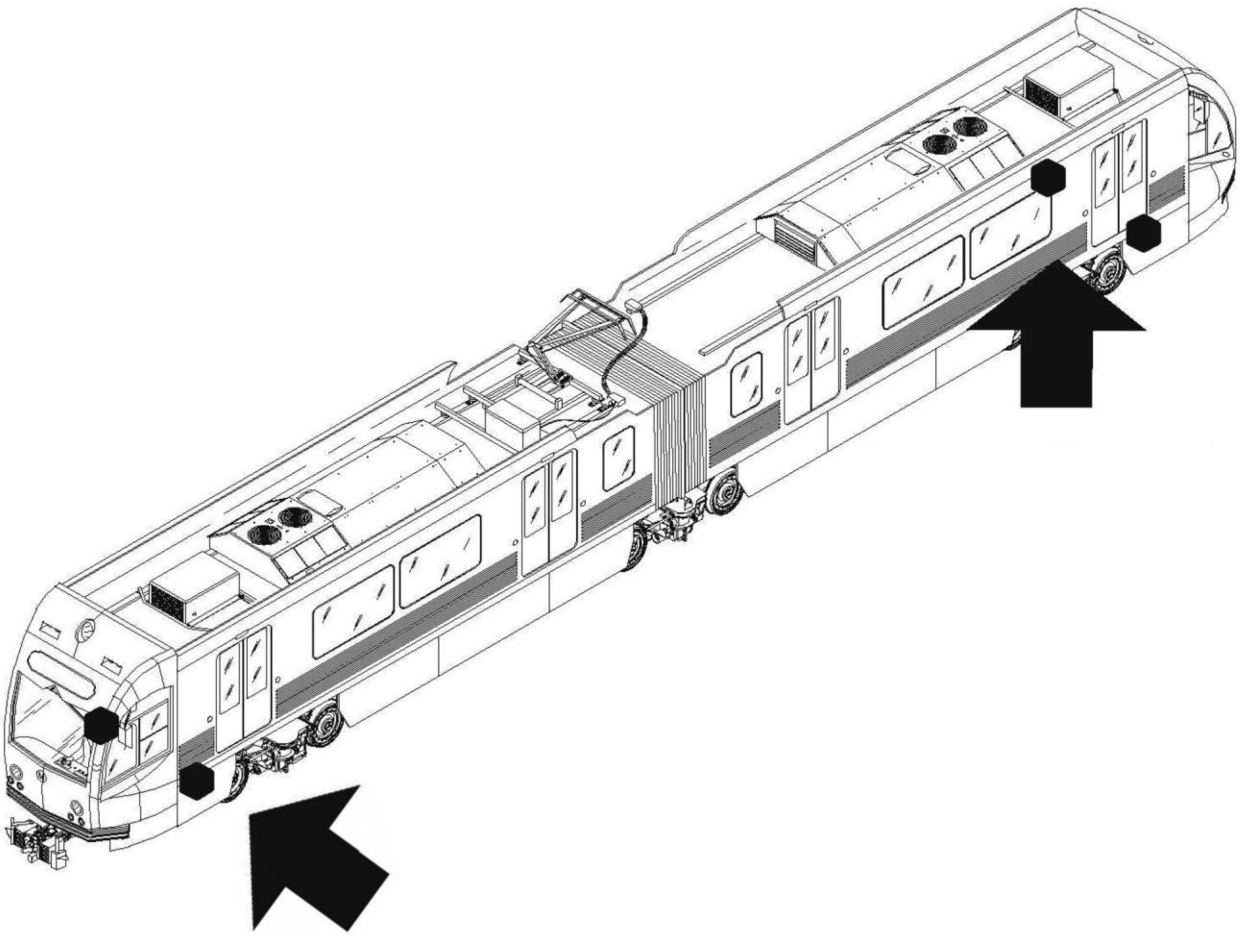
PROCEDURE:

Fig (C) PTU & TWC CONNECTIONS

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-16-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **1/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **TRACK RECEIVER**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

LOCATION:



P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-16-00/R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **2/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component: **TRACK RECEIVER**		Man Hours: **1.50**
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: APPLY WHEEL CHOCKS TO PREVENT THE VEHICLE FROM MOVING.

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:

NA

SPARE PARTS:

Track Receiver	P/N	AA03J4X (N396278)
Support	P/N	AA03P1D (M199455)

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-15-01-16-00/R-00

System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **3/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component: **TRACK RECEIVER**		Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**		

PROCEDURE:

To perform the Task proceed as follows:

PRELIMINARY OPERATIONS

1. Set the vehicle in safety condition in accordance with LACMTA Maintenance Shop Regulations.
2. Make sure the Parking Brakes are applied and the Wheels chocked.
3. Set the Transfer Switch to "OFF" Position.
4. Place to "OFF" position the following Circuit Breakers:

CB 11F02
located in the “A“&“B“ LV Lockers

CB 11F01
located in the “A“ LV Locker

CB 11S01,
located in
the “A“ Cab By Pass Panel,

REMOVAL

To perform the Task proceed as follows:

1. Remove the Electrical Connections from ATP Junction Box.
2. Remove the Fixing Screws (7), Washers (8, 9) and Nuts (10).
3. Remove the Track Receiver Assy and Shims (11) from Bracket (6).
4. Remove the Screws (2), Washers (3) and Nuts (4) to separate the Track Receiver (1) from Supports (5).

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-16-00/R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **4/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component: **TRACK RECEIVER**		Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**		

PROCEDURE:

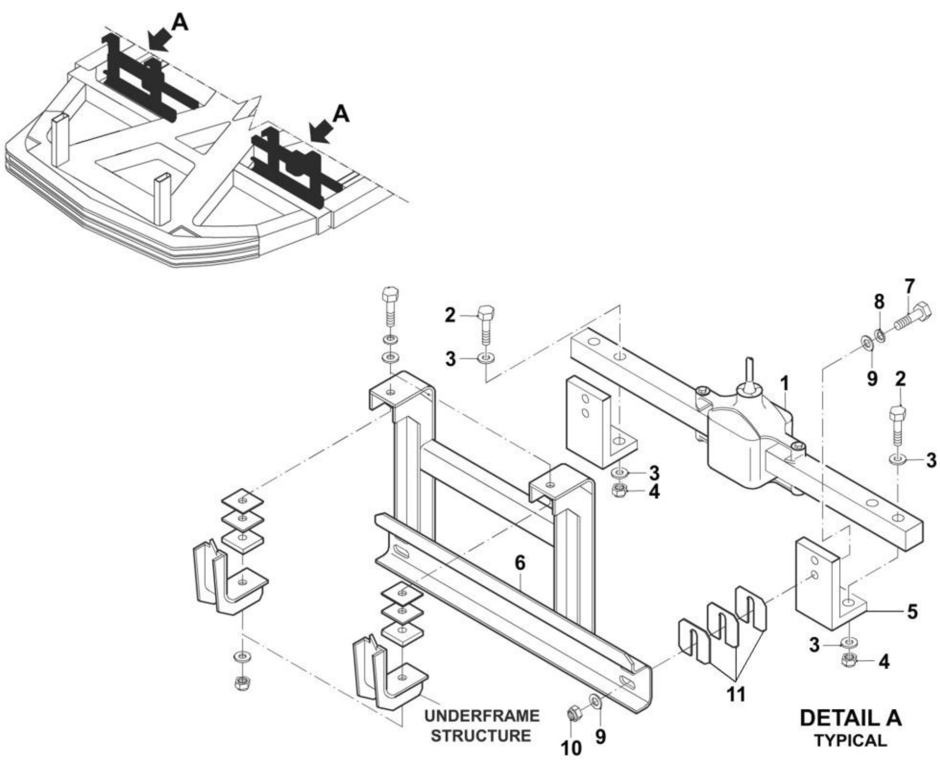


FIGURE 1 - ATP TRACK RECEIVER REPLACEMENT

INSTALLATION

To perform the Task proceed as follows:

1. Install the Track Receiver (1) on Supports (5) by means of the Screws (2), Washers (3) and Nuts (4).
2. Torque the Screws (2) to **42 ft lb.**
3. Position the Track Receiver Assy and Shims (11) on Bracket (6).
4. Install the fixing Bolts (7), Washers (8, 9) and Nuts (10).
5. Torque the Bolts (7) to **103 ft lb.**
6. Connect the Electrical Connections to ATP Junction Box.

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-15-01-16-00/R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **5/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component: **TRACK RECEIVER**		Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**		
PROCEDURE:		

[redacted]

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-15-01-16-00/R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **6/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component: **TRACK RECEIVER**		Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**		

FINAL OPERATIONS

1. Reinstate Electrical Power to the ATP by switching ON the CB 11F01 and CB 11F02.
2. Check that all the LEDs of the Cardfile PCBs are GREEN, indicating that the each Board works properly.
3. Close and lock the Door Panel of ATP Enclosure.
4. Close and lock the ELE Locker Door using Maintenance Key.
5. Perform ATP Functional Test as indicated in the Annex 1 of this Sheet:
6 Key OFF the Vehicle, leave the Cab and close the Cab Door using Maintenance Key.
7 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 15-III-04-01-02 of this Section) and follow the prescriptions provided at Step 3 **"At every Task Completion."**

P2550 PREVENTIVE MAINTENANCE SHEET

	Card Code: **R-P-15-01-16-00/ R-00**
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **7/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **TRACK RECEIVER**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

PROCEDURE (CONT'D):

Annex 1

ATP FUNCTIONAL TEST

1 Supply Electrical Power to ATP System by placing to ON:
- The CB 11F01 (located in the "A" LV Locker)
- The CB 11F02 (located in the "A"&"B" LV Lockers)

2. Enter the A / B Cabs by opening the Cab Door using Maintenance Key

3. Key ON the Vehicle

ADU LAMP TEST

4. In each Cab perform the ADU Lamp Test as follows:

q) Confirm that the Lay-up Operator's Switch is set to **LAYUP**.

r) Make sure the ATP Cutout Switch is set to **NORMAL**.

s) Set the Lay-up Operator's Switch to **OPERATE**.

t) Set the Transfer Switch to **FORWARD** or **REVERSE** to select the direction.
   i. This activates the ATP mode and initiates the Lamp Test.

Completion

m) An LRV audible alarm "chirps" at the start of the Indicator Light Test.
n) The MAS display, displays 88, and the Overspeed, Cab and Non-Cab indicators light for 5 seconds.
o) As per Test result replace the Fault Indicator Light(s)

5. Once completed the ADU Lamp Test perform in each Cab the Departure Test as follows:

DEPARTURE TEST - MGL

Initial Conditions

NOTE: The Initial Conditions must be maintained while a Departure Test is in progress. If any Initial Condition is changed during the Departure Test, the Test will terminate and it is logged as a failure.

Ensure the following Initial Conditions are satisfied:
- ATP in an Active mode
- Vzero is satisfied

P2550 PREVENTIVE MAINTENANCE SHEET		
Card Code: **R-P-15-01-16-00/ R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **8/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component: **TRACK RECEIVER**		Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**		

PROCEDURE (CONT'D):

MGL DEPARTURE TEST (cont'd)

6 Press the

Depart Test pushbutton

located on the ADU

NOTE: The Departure Test is aborted if the "Depart Test" pushbutton on the ADU is pressed while the Departure Test is in progress.

MGL DEPARTURE TEST Sequence

During the Departure Test, the following individual checks are performed by the ATP System:

- **Full Service Brake Application** - At the start of this test, the ATP System requests a Full Service Brake application and commands the ADU audible alarm to beep. The system verifies that the brake has been requested by checking the Full Service brake relay. If the brake request is not verified, then this test fails. At the end of this test the ATP System removes the Full Service Brake application and ADU audible alarm.
- **FSK Module Health** - This test is passed if the communications link between the ATP and FSK subsystem is established.
- **Valid Cab Signal Detection** - This test is passed if valid cab signal messages are being received from the FSK subsystem. If valid cab signal messages are being received, the Cab Signal indicator on the ADU is illuminated.
- **Function ADU Interface** - This test is passed if the communications link between the ATP and ADU is established.
- **No Crosscheck Errors Present** - This test is passed if the ATP System is not reporting any crosscheck errors.
- **No Penalty Brake Applications Active** - This test is passed if the ATP System is not requesting any penalty brake applications.
- **No Emergency Brake Applications Active** - This test is passed if the ATP System is not requesting any emergency brake applications.

  NOTE: All individual Tests must pass for the Departure Test to be successful. The failure of any individual Test will cause the "Depart Test" indication on the ADU to go dark. Specific Test failures are reported to the IDU

P2550 PREVENTIVE MAINTENANCE SHEET

	Card Code: **R-P-15-01-16-00/ R-00**
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **9/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **TRACK RECEIVER**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

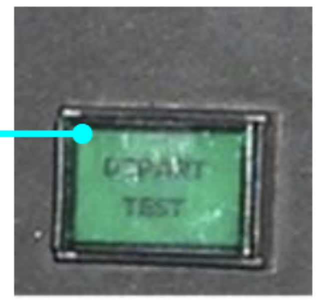
PROCEDURE (CONT'D):

MGL DEPARTURE TEST (cont'd)

7. Depress the

   Depart Test pushbutton

   on the ADU.



8. Verify:
   a) Depart Test pushbutton / indicator flashes
   b) ADU alarm annunciates
   c) Full Service Brake initiation
9. Upon successful completion of the Test, verify:
   a) Depart Test pushbutton / indicator illuminates steadily
   b) ADU alarm is silenced
   c) Full Service Penalty Brake is released
10. Record MGL Departure Test completion status on the Defect Report Card for administrative and maintenance planning.

DEPARTURE TEST - MBL & PGL

Initial Conditions

NOTE: The Initial Conditions (except No Code indication by the Decoder) must be maintained while a Departure Test is in progress.
If any Initial Condition is changed during the Departure Test, the Test will terminate and it is logged as a failure.

Ensure the following Initial Conditions are satisfied:

- ATP in an Active mode
- Vzero is satisfied
- No crosscheck errors are active
- No Code is indicated by the Decoder

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-16-00/ R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **10/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component: **TRACK RECEIVER**		Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**		

PROCEDURE (CONT'D):

MBL & PGL DEPARTURE TEST (cont'd)

11. Press the

Depart Test pushbutton

located on the ADU

NOTE: The Departure Test is aborted if the "Depart Test" pushbutton on the ADU is pressed while the Departure Test is in progress.

MBL & PGL DEPARTURE TEST Sequence

During the Departure Test sequence, simulated Speed Signals and Cab Signal Code Rates are generated by System Software, and the following Individual Checks are performed by the ATP System:

- **Cab Signal Detection Sensitivity** - The Cab Signal Carrier Thresholds are examined to determine if they are within a valid range. If they are not, the Departure Test fails. A 50 CPM code rate is generated at a signal level 10% less than the Cab Signal Carrier Threshold. If a 50 code rate is detected by the ATP, the Departure Test fails.
- **Code Rate Detection** - The System generates each of the following code rates: No Code, 50, 75, 120, 180, 270, and Dual 270 at a level 10% greater than the Cab Signal Carrier Threshold. If the Code Rate is not detected, the Departure Test fails.
- **Street Running Response** - A 410 Code rate is generated at a level 10% greater than the Cab Signal Carrier Threshold. If Street Running Mode is not detected, the Departure Test fails. The System then produces a No Code condition and verifies that Street Running Mode is maintained.
- **Overspeed Detection -** The System produces an Overspeed Condition by simulating a speed one (1) mph above the Street Running Mode Speed Limit. The System then simulates Brake Rate to satisfy Brake Assurance. If the Overspeed is not detected or a Brake Application is detected, the Departure Test fails. The System then produces a speed at the Under Speed Set Point. The System verifies that the Under Speed is satisfied.

  The System flashes the Cab Signal indicator informing the operator to terminate the Street Running Mode. The System then generates a 100 Hz constant carrier and maintains the Speed at the Street Running Mode Under Speed Set Point. If Street Running Mode is not terminated or the Code Rate is not detected, the Departure Test fails.

P2550 PREVENTIVE MAINTENANCE SHEET

	Card Code: **R-P-15-01-16-00/ R-00**
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **11/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **TRACK RECEIVER**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

PROCEDURE (CONT'D):

MBL & PGL DEPARTURE TEST (cont'd)

MBL & PGL DEPARTURE TEST Sequence (cont'd)

- **Full Service Brake Application**

  After the transition out of Street Running Mode occurs, the System will be in an Overspeed Condition and Running Brake Assurance.

  Brake Rate is simulated to forestall the Full Service Brake request for a period of five (5) seconds.

  After the time expires, simulated Brake Rate is discontinued and an Overspeed Penalty Brake is requested.

  The System verifies the Full Service Brake request by checking the Full Service Brake Relay. If the Brake Request is not verified, the Departure Test fails.

- **Completion**

  Once the Full Service Brake Request has been verified, the System reduces the Simulated Speed to 0 mph (Vzero).

  The System verifies that the Brake Request is released.

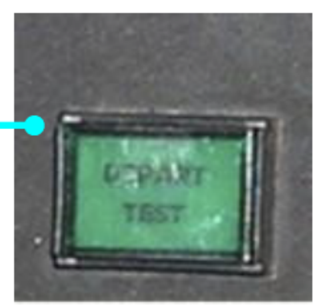
  If the Brake Request is not released, the Departure Test fails. Otherwise, the Departure Test is completed and is considered successful.

  NOTE: All individual Tests must pass for the Departure Test to be successful.
  The failure of any individual Test will cause the "Depart Test" indication on the ADU to go dark. Specific Test failures are reported to the IDU

12 Depress the

Depart Test pushbutton

on the ADU.



13. Verify that the

Depart Test pushbutton/indicator flashes.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-16-00/ R-00

System: **AUTOMATIC TRAIN PROTECTION**

Sheet: **12/16**

Subsystem/Assy: **ATP SYSTEM**

Unit:

Component: **TRACK RECEIVER**

Man Hours: **1.50**

Maintenance Task: **REPLACEMENT**

PROCEDURE (CONT'D):

MBL & PGL DEPARTURE TEST (cont'd)

14 Verify on the ADU**:**

- **a** **TARGET SPEED** indicates **65 mph** and the **CAB SIGNAL** indicator on the ADU illuminates.
- **b** **TARGET SPEED i**ndicates **55 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm**.
- **c** **TARGET SPEED** indicates **45 mph** and the ADU alarm annunciates. **Acknowledge the ADU alarm.**
- **d** **TARGET SPEED** indicates **35 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**
- **e** **TARGET SPEED** indicates **25 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**
- **f** **TARGET SPEED** indicates **10 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**
- **g** **TARGET SPEED** indicates **0 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**
- **h** **TARGET SPEED** indicates **35 mph,** the ADU alarm annunciates **Acknowledge the ADU alarm.**, and the **STREET RUNNING** Indicator **illuminates.**
- **i** **TARGET SPEED** indicates **0 mph,** the ADU alarm annunciates **Acknowledge the ADU alarm**. and the **STREET RUNNING** Indicator **remains illuminated.**
- **j** **SPEED** indicates **36 mph**, the ADU alarm annunciates **Acknowledge the ADU alarm.** and the **OVERSPEED** indication **illuminates.**
- **k** **SPEED** indicates **(ESL - 1 mph)** and the **OVERSPEED** indication is deactivated.
- **l** the **CAB SIGNAL** Indicator **flashes** and **SPEED remains at (ESL - 1 mph)**.

15 Depress the Street Running pushbutton and verify on the ADU:

- **a** the ADU alarm **annunciates**, the **CAB SIGNAL** Indicator **remains illuminated**, and the **STREET RUNNING** Indicator is **deactivated**.
- **b** the **OVERSPEED** indicator is **illuminated** and, after approximately five (5) seconds, verify Full Service Penalty Brake initiation.
- **c** **SPEED** indicates **0 mph** and the **OVERSPEED** indicator is **deactivated.**
- **d** the Full Service Brake is **released.**
- **e** the **DEPART TEST** pushbutton/indicator **illuminates steadily**

16 Record MBL & PGL Departure Test completion status on the Defect Report Card for administrative and maintenance planning.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-16-00/ R-00

System:	Sheet:
AUTOMATIC TRAIN PROTECTION	**13/16**

Subsystem/Assy:	Unit:
ATP SYSTEM	

Component:	Man Hours:
TRACK RECEIVER	**1.50**

Maintenance Task:
REPLACEMENT

PROCEDURE (CONT'D):

DEPARTURE TEST (cont'd)

17 As per Test Result perform Troubleshooting with IDU or PTU.
Refer to Part II of this Section, paragraphs 15-II-02.2 and 15-II-02.3 respectively
Next Figures (A), (B) and (C) provide, respectively:

- The ATP/TWC SYSTEM STATUS SCREEN (Operating Mode)
- The ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)
- The PTU & ATP CONNECTIONS

18 Key OFF the Vehicle, leave the Cab and close the Cab Door using Maintenance Key

19 Record inspection result on the Defect Report Card for administrative and maintenance planning.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-16-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **14/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **TRACK RECEIVER**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

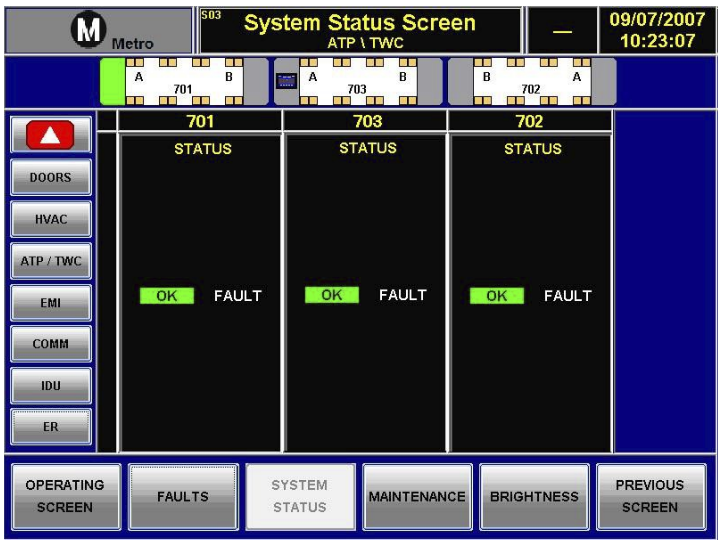


FIG (A) ATP/TWC SYSTEM STATUS SCREEN (Operating Mode)

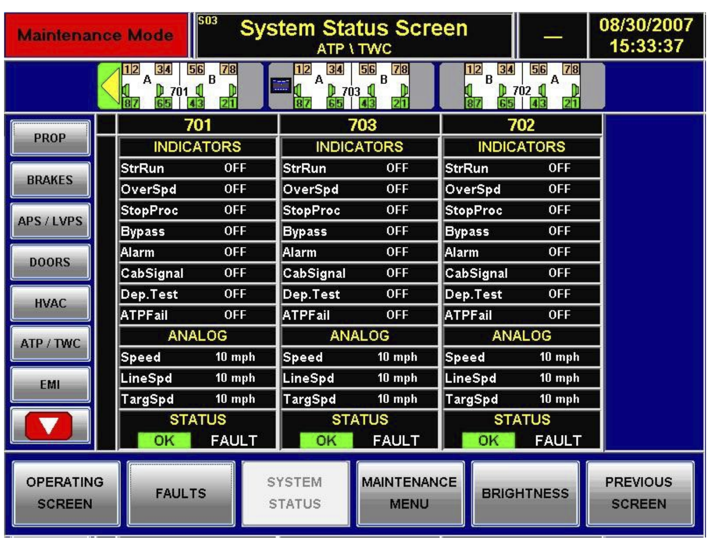


FIG (B) ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-15-01-16-00/R-00

System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **15/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **TRACK RECEIVER**	Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

Fig (C) PTU & TWC CONNECTIONS

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:		
R-C-15-01-16-00/R-00		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **16/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component: **TRACK RECEIVER**		Man Hours: **1.50**
Maintenance Task: **REPLACEMENT**		

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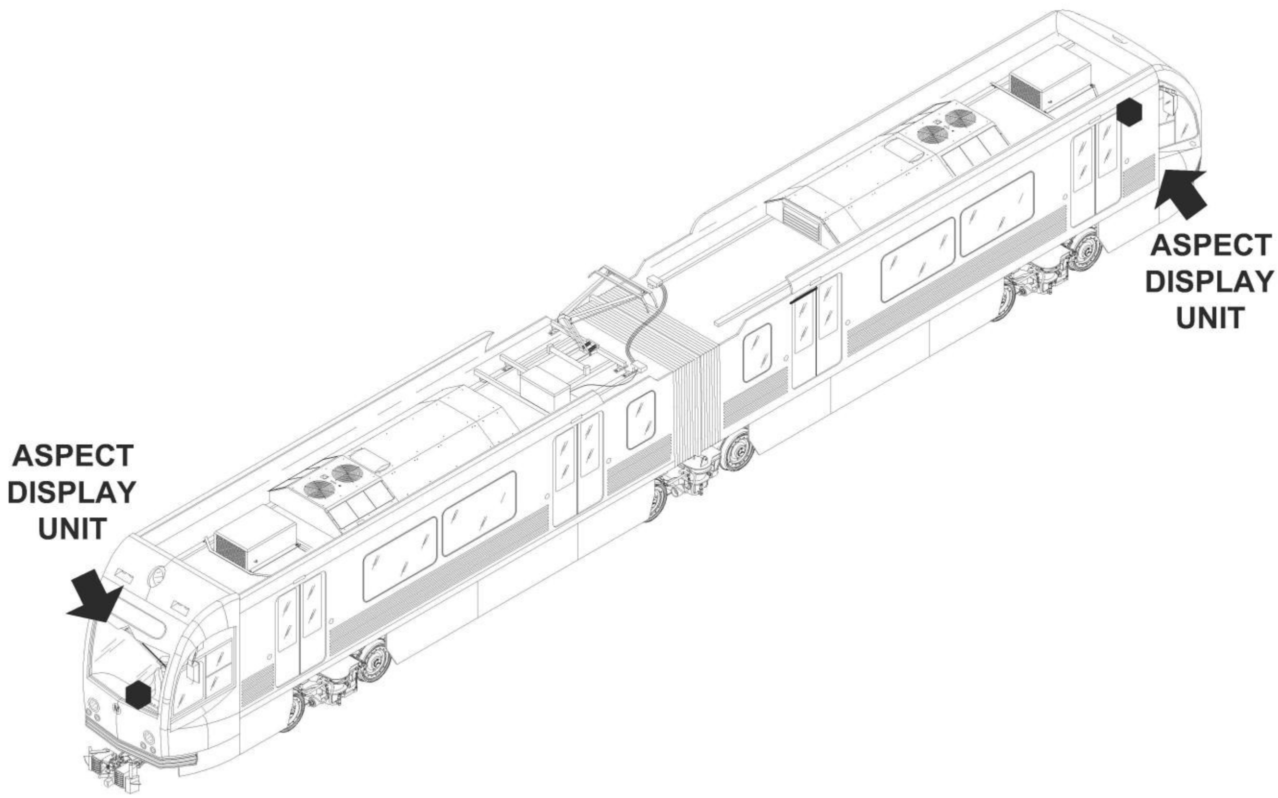
P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-15-01-17-00/R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **1/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ASPECT DISPLAY UNIT**	
Component:		Man Hours: **0.5**
Maintenance Task: **REPLACEMENT**		

LOCATION:



P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-15-01-17-00/R-00

System:	Sheet:
AUTOMATIC TRAIN PROTECTION	**2/16**

Subsystem/Assy:	Unit:
ATP SYSTEM	**ASPECT DISPLAY UNIT**

Component:	Man Hours:
	0.5

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:

N/A

SPARE PARTS:

Aspect Display Unit	P/N	N21912401

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-17-00/R-00**

System:	Sheet:
AUTOMATIC TRAIN PROTECTION	**3/16**

Subsystem/Assy:	Unit:
ATP SYSTEM	**ASPECT DISPLAY UNIT**

Component:	Man Hours:
	0.5

Maintenance Task:
REPLACEMENT

PROCEDURE:

To perform the Task proceed as follows:

PRELIMINARY OPERATIONS

1. Set the vehicle in safety condition in accordance with LACMTA Maintenance Shop Regulations.
2. Make sure the Parking Brakes are applied and the Wheels chocked.
3. Set the Transfer Switch to "OFF" Position.
4. Place to "OFF" position the following Circuit Breakers:

CB 11F02

located in the “A“&“B“ LV Lockers

CB 11F01
located in the “A“ LV Locker

CB 11S01,
located in
the “A“ Cab By Pass Panel,

REMOVAL

To remove the Aspect Display Unit proceed as follows:

NOTE: it is advised to retain Fixing Hardware for later use.

1. Enter the Cab.
2. Locate the ADU to be replaced.
3. Remove the four Fixing Screws from the Console Panel (refer to Figure 1).
4. Remove carefully the Console Panel, sliding it from its location.
5. Remove the four Fixing Nuts and Washers from the ADU Threaded Pins (refer to Figure 2).
6. Disconnect all the Connection Plugs from the Aspect Display Unit.

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-15-01-17-00/R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **4/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ASPECT DISPLAY UNIT**	
Component:		Man Hours: **0.5**
Maintenance Task: **REPLACEMENT**		

PROCEDURE:

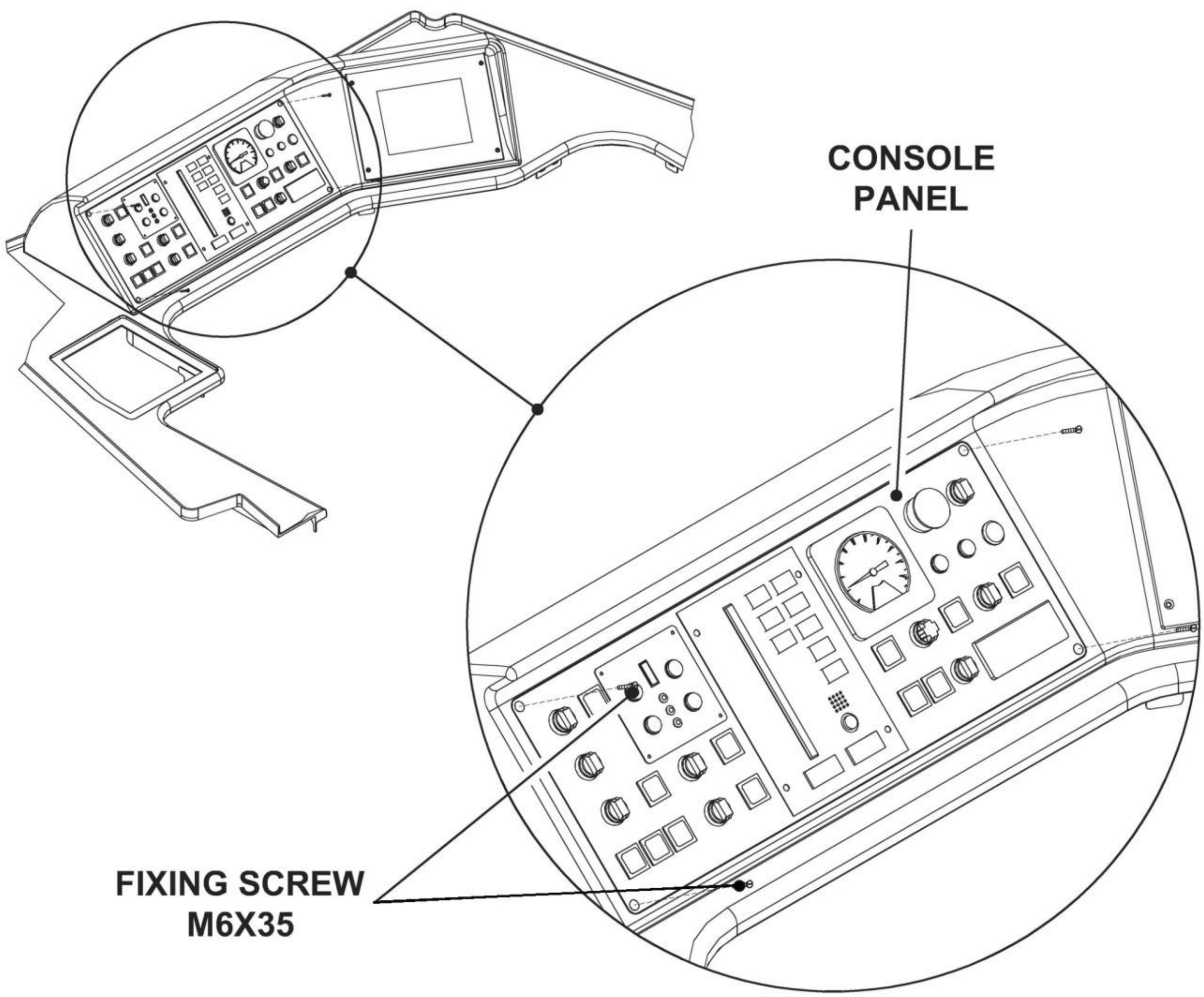


FIGURE 1 - ATP CONSOLE PANEL REMOVAL / INSTALLATION

P2550 CORRECTIVE MAINTENANCE SHEET	
Card Code: **R-C-15-01-17-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **5/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ASPECT DISPLAY UNIT**
Component:	Man Hours: **0.5**
Maintenance Task: **REPLACEMENT**	

PROCEDURE (CONT'D):

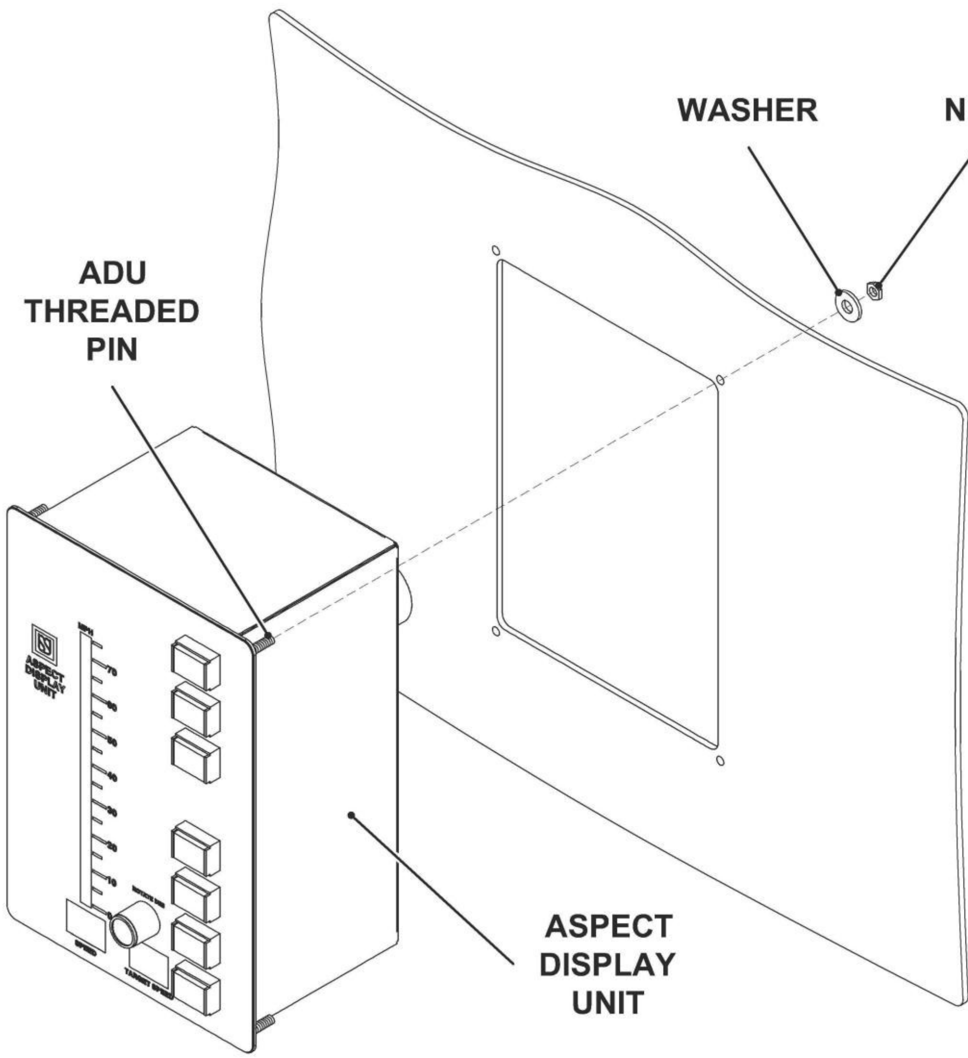


FIGURE 2 - ATP ASPECT DISPLAY UNIT REPLACEMENT

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-17-00/R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **6/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ASPECT DISPLAY UNIT**	
Component:		Man Hours: **0.5**
Maintenance Task: **REPLACEMENT**		

PROCEDURE (CONT'D):

INSTALLATION

To install the Aspect Display Unit proceed as follows:

1. Enter the Cab.
2. Put carefully in the right position the Aspect Display Unit.
3. Connect all the Connection Plugs of the Aspect Display Unit.
4. Position the ADU into its seat.
5. Install and tighten the four Fixing Nuts and Washers on the ADU Threaded Pins (refer to Figure 2).
6. Install and tighten the four Fixing Screws on the Console Panel (refer to Figure 1).

FINAL OPERATIONS

1. Reinstate Electrical Power to the ATP by switching ON the CB 11F01 and CB 11F02.
2. Check that all the LEDs of the Cardfile PCBs are GREEN, indicating that the each Board works properly.
3. Close and lock the Door Panel of ATP Enclosure.
4. Close and lock the ELE Locker Door using Maintenance Key.
5. Perform ATP Functional Test as indicated in the Annex 1 of this Sheet:
6 Key OFF the Vehicle, leave the Cab and close the Cab Door using Maintenance Key.
7 Record inspection result on the Defect Report Card for administrative and maintenance planning.

NOTE: At Task Completion it is recommended to make sure proper LON chip software version is updated and/or functions of the Subsystem to which the maintained Equipment pertains.

Refer to HOW TO **USE THE R-CM SHEETS** (para 15-III-04-01-02 of this Section) and follow the prescriptions provided at Step 3 **"At every Task Completion."**

P2550 PREVENTIVE MAINTENANCE SHEET

	Card Code: **R-P-15-01-17-00/ R-00**
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **7/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ASPECT DISPLAY UNIT**
Component:	Man Hours: **0.5**
Maintenance Task: **REPLACEMENT**	

PROCEDURE (CONT'D):

Annex 1

ATP FUNCTIONAL TEST

1 Supply Electrical Power to ATP System by placing to ON:
- The CB 11F01 (located in the "A" LV Locker)
- The CB 11F02 (located in the "A"&"B" LV Lockers)

2. Enter the A / B Cabs by opening the Cab Door using Maintenance Key

3. Key ON the Vehicle

ADU LAMP TEST

4. In each Cab perform the ADU Lamp Test as follows:

u) Confirm that the Lay-up Operator's Switch is set to **LAYUP**.

v) Make sure the ATP Cutout Switch is set to **NORMAL**.

w) Set the Lay-up Operator's Switch to **OPERATE**.

x) Set the Transfer Switch to **FORWARD** or **REVERSE** to select the direction.
   i. This activates the ATP mode and initiates the Lamp Test.

Completion

p) An LRV audible alarm "chirps" at the start of the Indicator Light Test.
q) The MAS display, displays 88, and the Overspeed, Cab and Non-Cab indicators light for 5 seconds.
r) As per Test result replace the Fault Indicator Light(s).

5. Once completed the ADU Lamp Test perform in each Cab the Departure Test as follows:

DEPARTURE TEST - MGL

Initial Conditions

NOTE: The Initial Conditions must be maintained while a Departure Test is in progress. If any Initial Condition is changed during the Departure Test, the Test will terminate and it is logged as a failure.

Ensure the following Initial Conditions are satisfied:
- ATP in an Active mode
- Vzero is satisfied

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-17-00/ R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **8/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ASPECT DISPLAY UNIT**
Component:	Man Hours: **0.5**
Maintenance Task: **REPLACEMENT**	

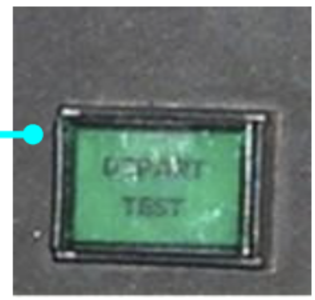
PROCEDURE (CONT'D):

MGL DEPARTURE TEST (cont'd)

6 Press the

Depart Test pushbutton

located on the ADU



NOTE: The Departure Test is aborted if the "Depart Test" pushbutton on the ADU is pressed while the Departure Test is in progress.

MGL DEPARTURE TEST Sequence

During the Departure Test, the following individual checks are performed by the ATP System:

- **Full Service Brake Application** - At the start of this test, the ATP System requests a Full Service Brake application and commands the ADU audible alarm to beep. The system verifies that the brake has been requested by checking the Full Service brake relay. If the brake request is not verified, then this test fails. At the end of this test the ATP System removes the Full Service Brake application and ADU audible alarm.
- **FSK Module Health** - This test is passed if the communications link between the ATP and FSK subsystem is established.
- **Valid Cab Signal Detection** - This test is passed if valid cab signal messages are being received from the FSK subsystem. If valid cab signal messages are being received, the Cab Signal indicator on the ADU is illuminated.
- **Function ADU Interface** - This test is passed if the communications link between the ATP and ADU is established.
- **No Crosscheck Errors Present** - This test is passed if the ATP System is not reporting any crosscheck errors.
- **No Penalty Brake Applications Active** - This test is passed if the ATP System is not requesting any penalty brake applications.
- **No Emergency Brake Applications Active** - This test is passed if the ATP System is not requesting any emergency brake applications.

  NOTE: All individual Tests must pass for the Departure Test to be successful.
  The failure of any individual Test will cause the "Depart Test" indication on the ADU to go dark. Specific Test failures are reported to the IDU

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-17-00/ R-00**

System:	Sheet:
AUTOMATIC TRAIN PROTECTION	**9/16**

Subsystem/Assy:	Unit:
ATP SYSTEM	**ASPECT DISPLAY UNIT**

Component:	Man Hours:
	0.5

Maintenance Task: **REPLACEMENT**

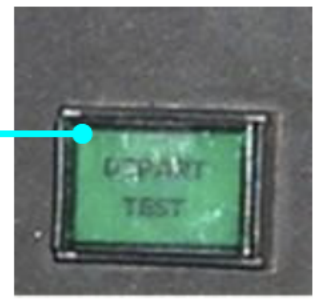
PROCEDURE (CONT'D):

MGL DEPARTURE TEST (cont'd)

7. Depress the

   Depart Test pushbutton

   on the ADU.



8. Verify:
   a) Depart Test pushbutton / indicator flashes
   b) ADU alarm annunciates
   c) Full Service Brake initiation
9. Upon successful completion of the Test, verify:
   a) Depart Test pushbutton / indicator illuminates steadily
   b) ADU alarm is silenced
   c) Full Service Penalty Brake is released
10. Record MGL Departure Test completion status on the Defect Report Card for administrative and maintenance planning.

DEPARTURE TEST - MBL & PGL

Initial Conditions

NOTE: The Initial Conditions (except No Code indication by the Decoder) must be maintained while a Departure Test is in progress.
If any Initial Condition is changed during the Departure Test, the Test will terminate and it is logged as a failure.

Ensure the following Initial Conditions are satisfied:

- ATP in an Active mode
- Vzero is satisfied
- No crosscheck errors are active
- No Code is indicated by the Decoder

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-17-00/ R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **10/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ASPECT DISPLAY UNIT**	
Component:		Man Hours: **0.5**
Maintenance Task: **REPLACEMENT**		

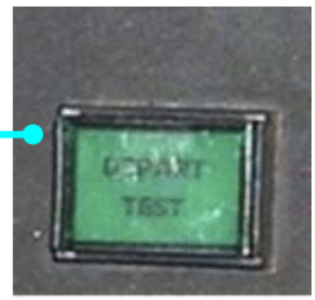
PROCEDURE (CONT'D):

MBL & PGL DEPARTURE TEST (cont'd)

11. Press the

Depart Test pushbutton

located on the ADU



NOTE: The Departure Test is aborted if the "Depart Test" pushbutton on the ADU is pressed while the Departure Test is in progress.

MBL & PGL DEPARTURE TEST Sequence

During the Departure Test sequence, simulated Speed Signals and Cab Signal Code Rates are generated by System Software, and the following Individual Checks are performed by the ATP System:

- **Cab Signal Detection Sensitivity** - The Cab Signal Carrier Thresholds are examined to determine if they are within a valid range. If they are not, the Departure Test fails. A 50 CPM code rate is generated at a signal level 10% less than the Cab Signal Carrier Threshold. If a 50 code rate is detected by the ATP, the Departure Test fails.
- **Code Rate Detection** - The System generates each of the following code rates: No Code, 50, 75, 120, 180, 270, and Dual 270 at a level 10% greater than the Cab Signal Carrier Threshold. If the Code Rate is not detected, the Departure Test fails.
- **Street Running Response** - A 410 Code rate is generated at a level 10% greater than the Cab Signal Carrier Threshold. If Street Running Mode is not detected, the Departure Test fails. The System then produces a No Code condition and verifies that Street Running Mode is maintained.
- **Overspeed Detection -** The System produces an Overspeed Condition by simulating a speed one (1) mph above the Street Running Mode Speed Limit. The System then simulates Brake Rate to satisfy Brake Assurance. If the Overspeed is not detected or a Brake Application is detected, the Departure Test fails. The System then produces a speed at the Under Speed Set Point. The System verifies that the Under Speed is satisfied.

  The System flashes the Cab Signal indicator informing the operator to terminate the Street Running Mode. The System then generates a 100 Hz constant carrier and maintains the Speed at the Street Running Mode Under Speed Set Point. If Street Running Mode is not terminated or the Code Rate is not detected, the Departure Test fails.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-17-00/ R-00

System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **11/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ASPECT DISPLAY UNIT**	
Component:		Man Hours: **0.5**
Maintenance Task: **REPLACEMENT**		

PROCEDURE (CONT'D):

MBL & PGL DEPARTURE TEST (cont'd)

MBL & PGL DEPARTURE TEST Sequence (cont'd)

- **Full Service Brake Application**

  After the transition out of Street Running Mode occurs, the System will be in an Overspeed Condition and Running Brake Assurance.

  Brake Rate is simulated to forestall the Full Service Brake request for a period of five (5) seconds.

  After the time expires, simulated Brake Rate is discontinued and an Overspeed Penalty Brake is requested.

  The System verifies the Full Service Brake request by checking the Full Service Brake Relay. If the Brake Request is not verified, the Departure Test fails.

- **Completion**

  Once the Full Service Brake Request has been verified, the System reduces the Simulated Speed to 0 mph (Vzero).

  The System verifies that the Brake Request is released.

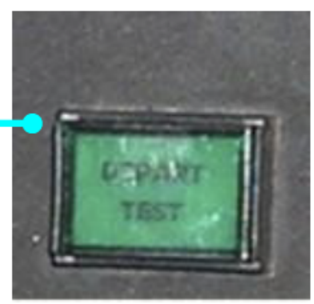
  If the Brake Request is not released, the Departure Test fails. Otherwise, the Departure Test is completed and is considered successful.

  NOTE: All individual Tests must pass for the Departure Test to be successful.
  The failure of any individual Test will cause the "Depart Test" indication on the ADU to go dark. Specific Test failures are reported to the IDU

12 Depress the

Depart Test pushbutton

on the ADU.



13. Verify that the

Depart Test pushbutton/indicator flashes.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-17-00/ R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **12/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ASPECT DISPLAY UNIT**	
Component:		Man Hours: **0.5**
Maintenance Task: **REPLACEMENT**		

PROCEDURE (CONT'D):

MBL & PGL DEPARTURE TEST (cont'd)

14 Verify on the ADU**:**

a **TARGET SPEED** indicates **65 mph** and the **CAB SIGNAL** indicator on the ADU illuminates.

b **TARGET SPEED i**ndicates **55 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm**.

c **TARGET SPEED** indicates **45 mph** and the ADU alarm annunciates. **Acknowledge the ADU alarm.**

d **TARGET SPEED** indicates **35 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**

e **TARGET SPEED** indicates **25 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**

f **TARGET SPEED** indicates **10 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**

g **TARGET SPEED** indicates **0 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**

h **TARGET SPEED** indicates **35 mph,** the ADU alarm annunciates **Acknowledge the ADU alarm.**, and the **STREET RUNNING** Indicator **illuminates.**

i **TARGET SPEED** indicates **0 mph,** the ADU alarm annunciates **Acknowledge the ADU alarm**. and the **STREET RUNNING** Indicator **remains illuminated.**

j **SPEED** indicates **36 mph**, the ADU alarm annunciates **Acknowledge the ADU alarm**. and the **OVERSPEED** indication **illuminates.**

k **SPEED** indicates **(ESL - 1 mph)** and the **OVERSPEED** indication is deactivated.

l the **CAB SIGNAL** Indicator **flashes** and **SPEED remains at (ESL - 1 mph)**.

15 Depress the Street Running pushbutton and verify on the ADU:

a the ADU alarm **annunciates**, the **CAB SIGNAL** Indicator **remains illuminated**, and the **STREET RUNNING** Indicator is **deactivated**.

b the **OVERSPEED** indicator is **illuminated** and, after approximately five (5) seconds, verify Full Service Penalty Brake initiation.

c **SPEED** indicates **0 mph** and the **OVERSPEED** indicator is **deactivated.**

d the Full Service Brake is **released.**

e the **DEPART TEST** pushbutton/indicator **illuminates steadily**

16 Record MBL & PGL Departure Test completion status on the Defect Report Card for administrative and maintenance planning.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-17-00/ R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **13/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ASPECT DISPLAY UNIT**
Component:	Man Hours: **0.5**
Maintenance Task: **REPLACEMENT**	

PROCEDURE (CONT'D):

DEPARTURE TEST (cont'd)

17 As per Test Result perform Troubleshooting with IDU or PTU.
Refer to Part II of this Section, paragraphs 15-II-02.2 and 15-II-02.3 respectively
Next Figures (A), (B) and (C) provide, respectively:

- the ATP/TWC SYSTEM STATUS SCREEN (Operating Mode)
- the ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)
- the PTU & ATP CONNECTIONS

18 Key OFF the Vehicle, leave the Cab and close the Cab Door using Maintenance Key

19 Record inspection result on the Defect Report Card for administrative and maintenance planning.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-15-01-17-00/R-00

System:
AUTOMATIC TRAIN PROTECTION

Sheet:
14/16

Subsystem/Assy:
ATP SYSTEM

Unit:
ASPECT DISPLAY UNIT

Component:

Man Hours:
0.5

Maintenance Task:
REPLACEMENT

PROCEDURE:

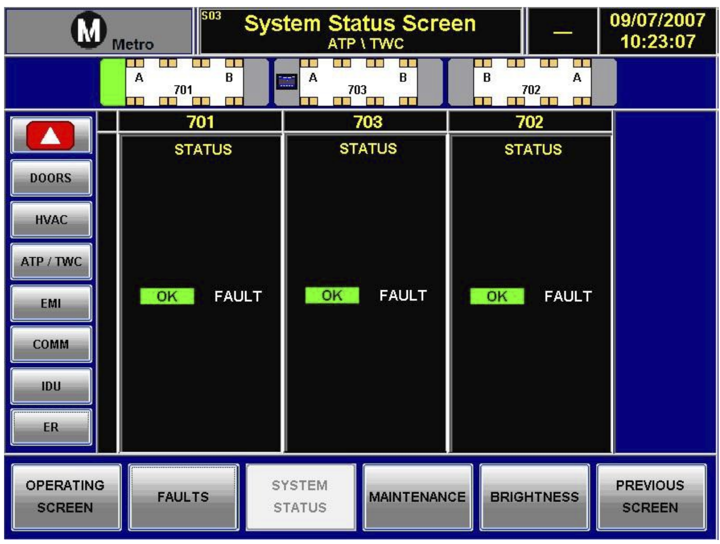


FIG (A) ATP/TWC SYSTEM STATUS SCREEN (Operating Mode)

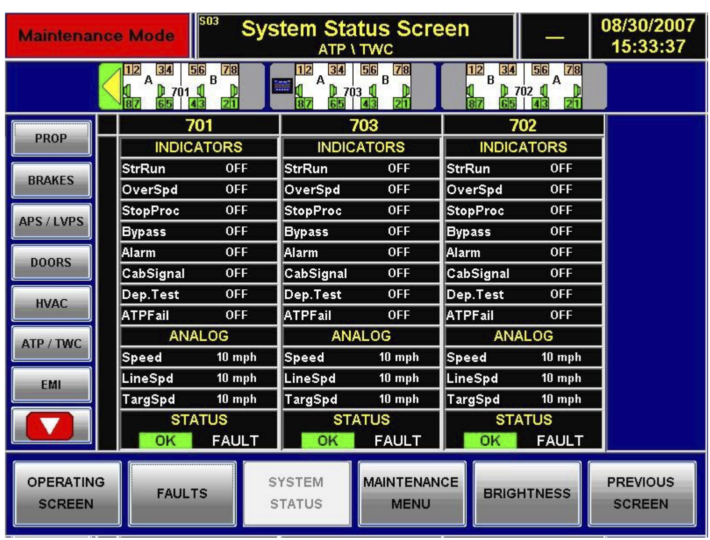


FIG (B) ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-15-01-17-00/R-00

System:	Sheet:
AUTOMATIC TRAIN PROTECTION	**15/16**

Subsystem/Assy:	Unit:
ATP SYSTEM	**ASPECT DISPLAY UNIT**

Component:	Man Hours:
	0.5

Maintenance Task:
REPLACEMENT

PROCEDURE:

Fig (C) PTU & TWC CONNECTIONS

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-17-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **16/16**
Subsystem/Assy: **ATP SYSTEM**	Unit: **ASPECT DISPLAY UNIT**
Component:	Man Hours: **0.5**
Maintenance Task: **REPLACEMENT**	

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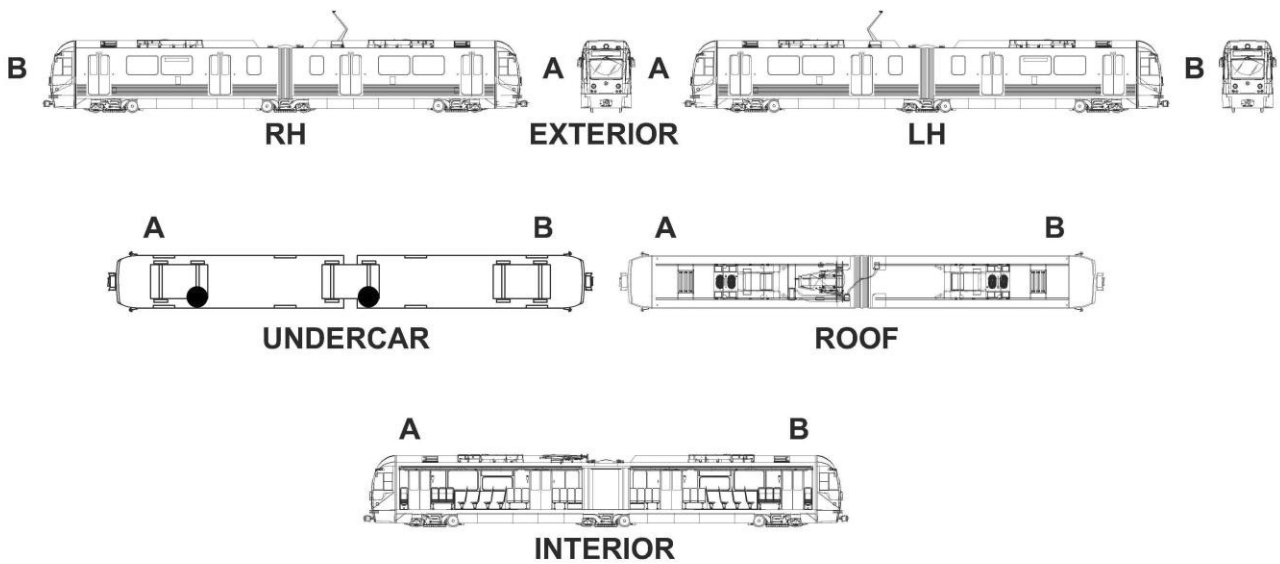
P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-18-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **1/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **SPEED SENSOR**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

LOCATION:



P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-18-00/R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **2/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component: **SPEED SENSOR**		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: APPLY WHEEL CHOCKS TO PREVENT THE VEHICLE FROM MOVING.

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:

NA

SPARE PARTS:

Speed Sensor	P/N	AA042HM
Adapter	P/N	AA05J4C

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-18-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **3/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **SPEED SENSOR**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

To perform the Task proceed as follows:

PRELIMINARY OPERATIONS

1. Set the vehicle in safety condition in accordance with LACMTA Maintenance Shop Regulations.
2. Make sure the Parking Brakes are applied and the Wheels chocked.
3. Set the Transfer Switch to "OFF" Position.
4. Place to "OFF" position the following Circuit Breakers:

CB 11F02

located in the “A“&“B“ LV Lockers

CB 11F01
located in the “A“ LV Locker

CB 11S01,
located in
the “A“ Cab By Pass Panel,

REMOVAL

To perform the Task proceed as follows:

1. Locate the Speed Sensor to be replaced
2. Remove Electrical Connector from Speed Sensor (5).
3. Loose the Fixing Nut (4).
4. Remove the Speed Sensor from Adapter (3) on Ground Contact Device.
5. If necessary remove the Adapter (3) by removing Screws (1) and Lock washers (2).

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-18-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **4/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **SPEED SENSOR**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

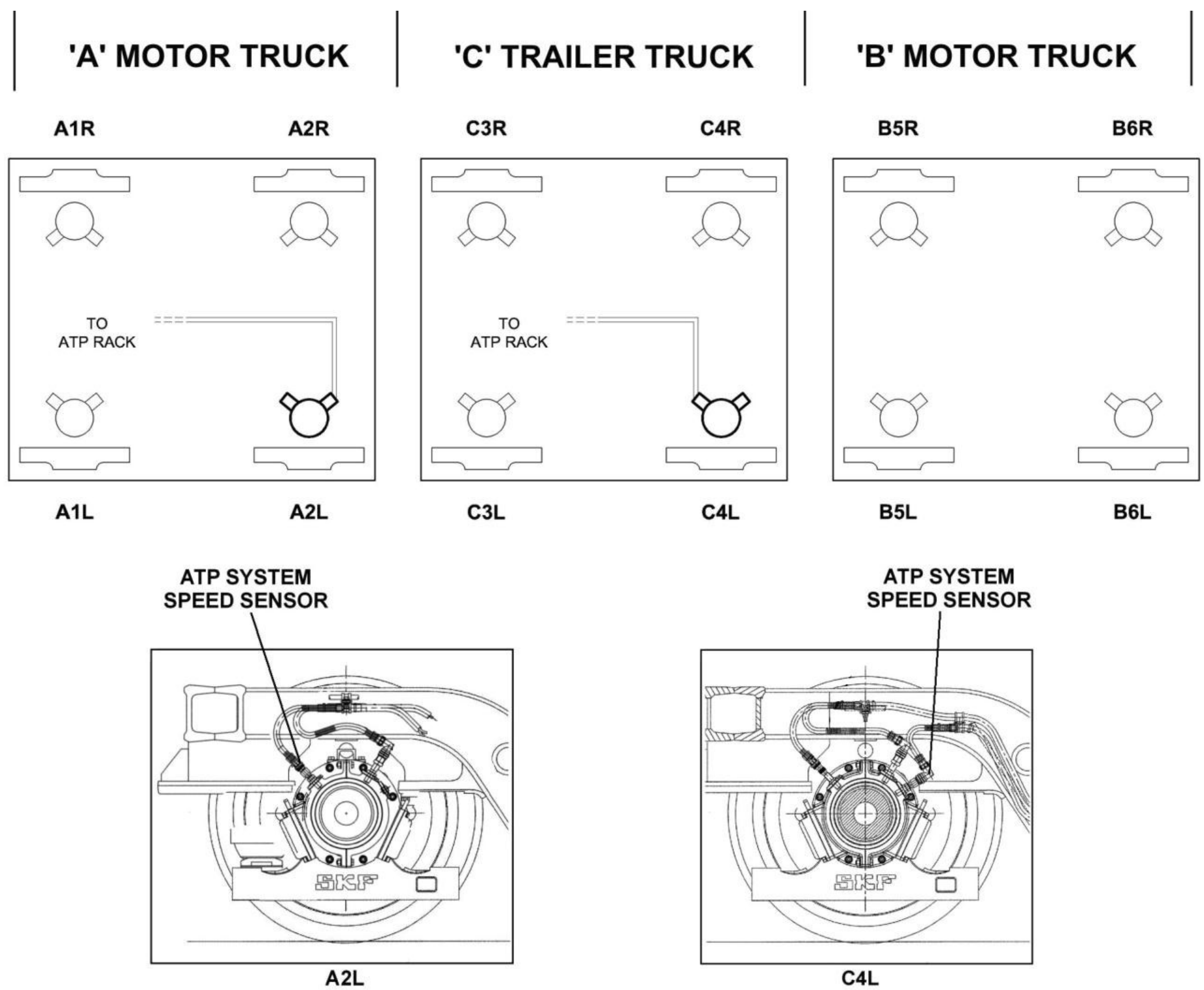


FIGURE 1 - ATP SYSTEM SPEED SENSOR LOCATION

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P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-18-00/R-00**

System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **5/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **SPEED SENSOR**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

INSTALLATION

To perform the task proceed as follows:

1. Thoroughly clean the Speed Sensor mating surface on the Ground Contact Device using recommended cleaner and lint free-rag.
2. If removed install the Adapter (3) on Ground Contact Device by means of fixing Screws (1) and Lock washers (2). Torque the Screws (1) to **7.4 ft-lb**.
3. Install the Speed Sensor on Adapter (3).
4. Set gap between the Face of Speed Sensor and the **highest wheel tooth** to **0.060 ± 0.015 inch** as follows:

   NOTE: one complete turn of the Speed Sensor in its holder changes the gap of **0.056 inch**.

   a. Gently screw the Speed Sensor into the Ground Contact Device housing until it makes contact with the gear.

   b. Back the Speed Sensor out **1 ± 1/4 turn**, stopping when the Speed Sensor is properly aligned with the gear.

   c. Lock the Speed Sensor in place using the Nuts (4).
   Torque the Nuts (4) to **20 ft-lb**.
5. Install the Electrical Connector on Speed Sensor (5).

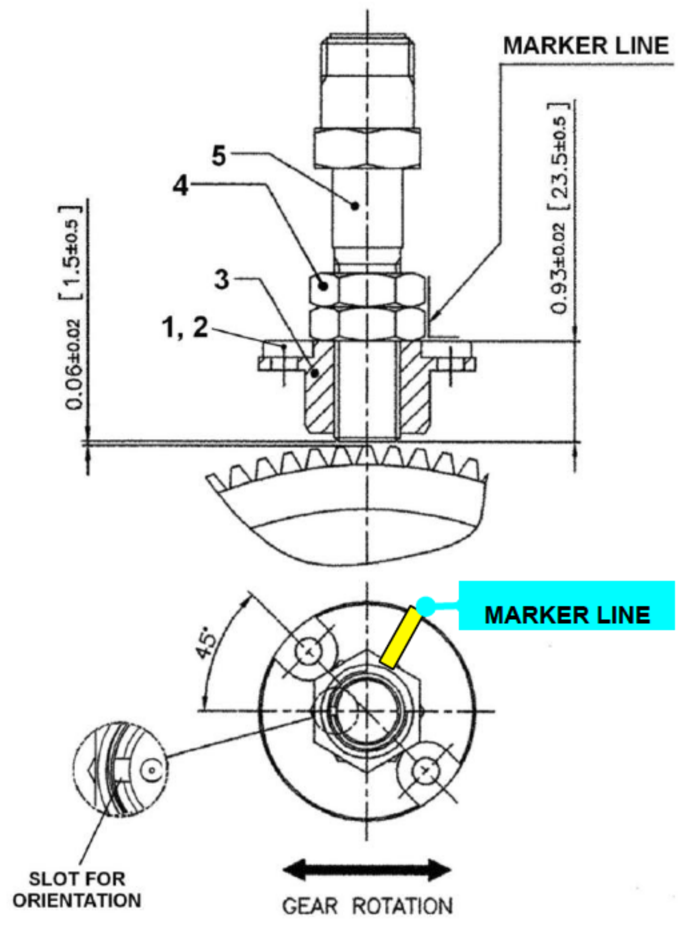

FIGURE 2 - ATP SPEED SENSOR REPLACEMENT

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-15-01-18-00/R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **6/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **SPEED SENSOR**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

FINAL OPERATIONS

1. Reinstate Electrical Power to the ATP by switching ON the CB 11F01 and CB 11F02.

2. Check that all the LEDs of the Cardfile PCBs are GREEN, indicating that the each Board works properly

3. Close and lock the Door Panel of ATP Enclosure

4. Close and lock the ELE Locker Door. using Maintenance Key

5. Perform ATP Functional Test as indicated in the Annex 1 of this Sheet:

6 Key OFF the Vehicle, leave the Cab and close the Cab Door using Maintenance Key

7 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 15-III-04-01-02 of this Section) and follow the prescriptions provided at Step 3 **"At every Task Completion".**

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-18-00/ R-00**

System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **7/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **SPEED SENSOR**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

PROCEDURE (CONT'D):

Annex 1

ATP FUNCTIONAL TEST

1 Supply Electrical Power to ATP System by placing to ON:
- the CB 11F01 (located in the "A" LV Locker)
- the CB 11F02 (located in the "A"&"B" LV Lockers)

2. Enter the A / B Cabs by opening the Cab Door using Maintenance Key
3. Key ON the Vehicle

ADU LAMP TEST

4. In each Cab perform the ADU Lamp Test as follows:

y) Confirm that the Lay-up Operator's Switch is set to **LAYUP**.

z) Make sure the ATP Cutout Switch is set to **NORMAL**.

aa) Set the Lay-up Operator's Switch to **OPERATE**.

bb) Set the Transfer Switch to **FORWARD** or **REVERSE** to select the direction.
i. This activates the ATP mode and initiates the Lamp Test.

Completion

s) An LRV audible alarm "chirps" at the start of the Indicator Light Test.
t) The MAS display, displays 88, and the Overspeed, Cab and Non-Cab indicators light for 5 seconds.
u) As per Test result replace the Fault Indicator Light(s)

5. Once completed the ADU Lamp Test perform in each Cab the Departure Test as follows:

DEPARTURE TEST - MGL

Initial Conditions

NOTE: The Initial Conditions must be maintained while a Departure Test is in progress. If any Initial Condition is changed during the Departure Test, the Test will terminate and it is logged as a failure.

Ensure the following Initial Conditions are satisfied:
- ATP in an Active mode
- Vzero is satisfied

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P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-18-00/ R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **8/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component: **SPEED SENSOR**		Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**		

PROCEDURE (CONT'D):

MGL DEPARTURE TEST (cont'd)

6 Press the

Depart Test pushbutton

located on the ADU

NOTE: The Departure Test is aborted if the "Depart Test" pushbutton on the ADU is pressed while the Departure Test is in progress.

MGL DEPARTURE TEST Sequence

During the Departure Test, the following individual checks are performed by the ATP System:

- **Full Service Brake Application** - At the start of this test, the ATP System requests a Full Service Brake application and commands the ADU audible alarm to beep. The system verifies that the brake has been requested by checking the Full Service brake relay. If the brake request is not verified, then this test fails. At the end of this test the ATP System removes the Full Service Brake application and ADU audible alarm.
- **FSK Module Health** - This test is passed if the communications link between the ATP and FSK subsystem is established.
- **Valid Cab Signal Detection** - This test is passed if valid cab signal messages are being received from the FSK subsystem. If valid cab signal messages are being received, the Cab Signal indicator on the ADU is illuminated.
- **Function ADU Interface** - This test is passed if the communications link between the ATP and ADU is established.
- **No Crosscheck Errors Present** - This test is passed if the ATP System is not reporting any crosscheck errors.
- **No Penalty Brake Applications Active** - This test is passed if the ATP System is not requesting any penalty brake applications.
- **No Emergency Brake Applications Active** - This test is passed if the ATP System is not requesting any emergency brake applications.

  NOTE: All individual Tests must pass for the Departure Test to be successful. The failure of any individual Test will cause the "Depart Test" indication on the ADU to go dark. Specific Test failures are reported to the IDU

P2550 PREVENTIVE MAINTENANCE SHEET

	Card Code: **R-P-15-01-18-00/ R-00**
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **9/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **SPEED SENSOR**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

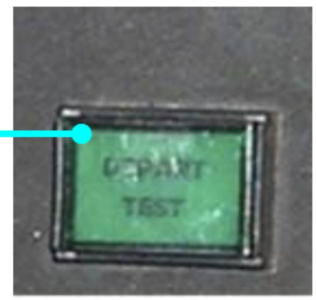
PROCEDURE (CONT'D):

MGL DEPARTURE TEST (cont'd)

7. Depress the

Depart Test pushbutton

on the ADU.



8. Verify:

a) Depart Test pushbutton / indicator flashes
b) ADU alarm annunciates
c) Full Service Brake initiation

9. Upon successful completion of the Test, verify:

a) Depart Test pushbutton / indicator illuminates steadily
b) ADU alarm is silenced
c) Full Service Penalty Brake is released

10. Record MGL Departure Test completion status on the Defect Report Card for administrative and maintenance planning.

DEPARTURE TEST - MBL & PGL

Initial Conditions

NOTE: The Initial Conditions (except No Code indication by the Decoder) must be maintained while a Departure Test is in progress.
If any Initial Condition is changed during the Departure Test, the Test will terminate and it is logged as a failure.

Ensure the following Initial Conditions are satisfied:

- ATP in an Active mode
- Vzero is satisfied
- No crosscheck errors are active
- No Code is indicated by the Decoder

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-15-01-18-00/ R-00**	
System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **10/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **SPEED SENSOR**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

PROCEDURE (CONT'D):

MBL & PGL DEPARTURE TEST (cont'd)

11. Press the

Depart Test pushbutton

located on the ADU

NOTE: The Departure Test is aborted if the "Depart Test" pushbutton on the ADU is pressed while the Departure Test is in progress.

MBL & PGL DEPARTURE TEST Sequence

During the Departure Test sequence, simulated Speed Signals and Cab Signal Code Rates are generated by System Software, and the following Individual Checks are performed by the ATP System:

- **Cab Signal Detection Sensitivity** - The Cab Signal Carrier Thresholds are examined to determine if they are within a valid range. If they are not, the Departure Test fails. A 50 CPM code rate is generated at a signal level 10% less than the Cab Signal Carrier Threshold. If a 50 code rate is detected by the ATP, the Departure Test fails.
- **Code Rate Detection** - The System generates each of the following code rates: No Code, 50, 75, 120, 180, 270, and Dual 270 at a level 10% greater than the Cab Signal Carrier Threshold. If the Code Rate is not detected, the Departure Test fails.
- **Street Running Response** - A 410 Code rate is generated at a level 10% greater than the Cab Signal Carrier Threshold. If Street Running Mode is not detected, the Departure Test fails. The System then produces a No Code condition and verifies that Street Running Mode is maintained.
- **Overspeed Detection -** The System produces an Overspeed Condition by simulating a speed one (1) mph above the Street Running Mode Speed Limit. The System then simulates Brake Rate to satisfy Brake Assurance. If the Overspeed is not detected or a Brake Application is detected, the Departure Test fails. The System then produces a speed at the Under Speed Set Point. The System verifies that the Under Speed is satisfied.

  The System flashes the Cab Signal indicator informing the operator to terminate the Street Running Mode. The System then generates a 100 Hz constant carrier and maintains the Speed at the Street Running Mode Under Speed Set Point. If Street Running Mode is not terminated or the Code Rate is not detected, the Departure Test fails.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-18-00/ R-00

System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **11/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component: **SPEED SENSOR**		Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**		

PROCEDURE (CONT'D):

MBL & PGL DEPARTURE TEST (cont'd)

MBL & PGL DEPARTURE TEST Sequence (cont'd)

- **Full Service Brake Application**

  After the transition out of Street Running Mode occurs, the System will be in an Overspeed Condition and Running Brake Assurance.

  Brake Rate is simulated to forestall the Full Service Brake request for a period of five (5) seconds.

  After the time expires, simulated Brake Rate is discontinued and an Overspeed Penalty Brake is requested.

  The System verifies the Full Service Brake request by checking the Full Service Brake Relay. If the Brake Request is not verified, the Departure Test fails.

- **Completion**

  Once the Full Service Brake Request has been verified, the System reduces the Simulated Speed to 0 mph (Vzero).

  The System verifies that the Brake Request is released.

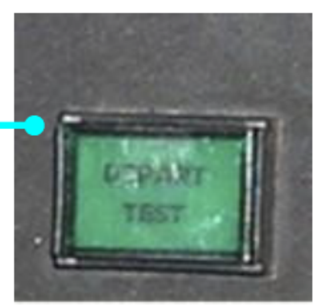
  If the Brake Request is not released, the Departure Test fails. Otherwise, the Departure Test is completed and is considered successful.

  NOTE: All individual Tests must pass for the Departure Test to be successful.
  The failure of any individual Test will cause the "Depart Test" indication on the ADU to go dark. Specific Test failures are reported to the IDU

12 Depress the

Depart Test pushbutton

on the ADU.



13. Verify that the

Depart Test pushbutton/indicator flashes.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:

R-P-15-01-18-00/ R-00

System:	Sheet:
AUTOMATIC TRAIN PROTECTION	**12/16**

Subsystem/Assy:	Unit:
ATP SYSTEM	

Component:	Man Hours:
SPEED SENSOR	**1.00**

Maintenance Task:

REPLACEMENT

PROCEDURE (CONT'D):

MBL & PGL DEPARTURE TEST (cont'd)

14 Verify on the ADU**:**

- **a** **TARGET SPEED** indicates **65 mph** and the **CAB SIGNAL** indicator on the ADU illuminates.
- **b** **TARGET SPEED i**ndicates **55 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm**.
- **c** **TARGET SPEED** indicates **45 mph** and the ADU alarm annunciates. **Acknowledge the ADU alarm.**
- **d** **TARGET SPEED** indicates **35 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**
- **e** **TARGET SPEED** indicates **25 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**
- **f** **TARGET SPEED** indicates **10 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**
- **g** **TARGET SPEED** indicates **0 mph** and the ADU alarm annunciates **Acknowledge the ADU alarm.**
- **h** **TARGET SPEED** indicates **35 mph,** the ADU alarm annunciates **Acknowledge the ADU alarm.**, and the **STREET RUNNING** Indicator **illuminates.**
- **i** **TARGET SPEED** indicates **0 mph,** the ADU alarm annunciates **Acknowledge the ADU alarm**. and the **STREET RUNNING** Indicator **remains illuminated.**
- **j** **SPEED** indicates **36 mph**, the ADU alarm annunciates **Acknowledge the ADU alarm**. and the **OVERSPEED** indication **illuminates.**
- **k** **SPEED** indicates **(ESL - 1 mph)** and the **OVERSPEED** indication is deactivated.
- **l** the **CAB SIGNAL** Indicator **flashes** and **SPEED remains at (ESL - 1 mph)**.

15 Depress the Street Running pushbutton and verify on the ADU:

- **a** the ADU alarm **annunciates**, the **CAB SIGNAL** Indicator **remains illuminated**, and the **STREET RUNNING** Indicator is **deactivated**.
- **b** the **OVERSPEED** indicator is **illuminated** and, after approximately five (5) seconds, verify Full Service Penalty Brake initiation.
- **c** **SPEED** indicates **0 mph** and the **OVERSPEED** indicator is **deactivated.**
- **d** the Full Service Brake is **released.**
- **e** the **DEPART TEST** pushbutton/indicator **illuminates steadily**

16 Record MBL & PGL Departure Test completion status on the Defect Report Card for administrative and maintenance planning.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-15-01-18-00/ R-00

System: **AUTOMATIC TRAIN PROTECTION**	Sheet: **13/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:
Component: **SPEED SENSOR**	Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**	

PROCEDURE (CONT'D):

DEPARTURE TEST (cont'd)

17 As per Test Result perform Troubleshooting with IDU or PTU.
Refer to Part II of this Section, paragraphs 15-II-02.2 and 15-II-02.3 respectively
Next Figures (A), (B) and (C) provide, respectively:

- The ATP/TWC SYSTEM STATUS SCREEN (Operating Mode)
- The ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)
- The PTU & ATP CONNECTIONS

18 Key OFF the Vehicle, leave the Cab and close the Cab Door using Maintenance Key

19 Record inspection result on the Defect Report Card for administrative and maintenance planning.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-15-01-18-00/R-00

System:	Sheet:
AUTOMATIC TRAIN PROTECTION	**14/16**

Subsystem/Assy:	Unit:
ATP SYSTEM	

Component:	Man Hours:
SPEED SENSOR	**1.00**

Maintenance Task:
REPLACEMENT

PROCEDURE:

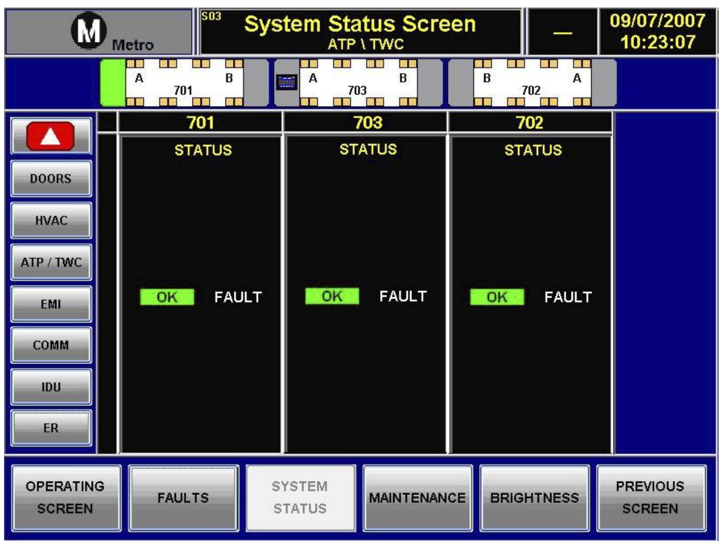


FIG (A) ATP/TWC SYSTEM STATUS SCREEN (Operating Mode)

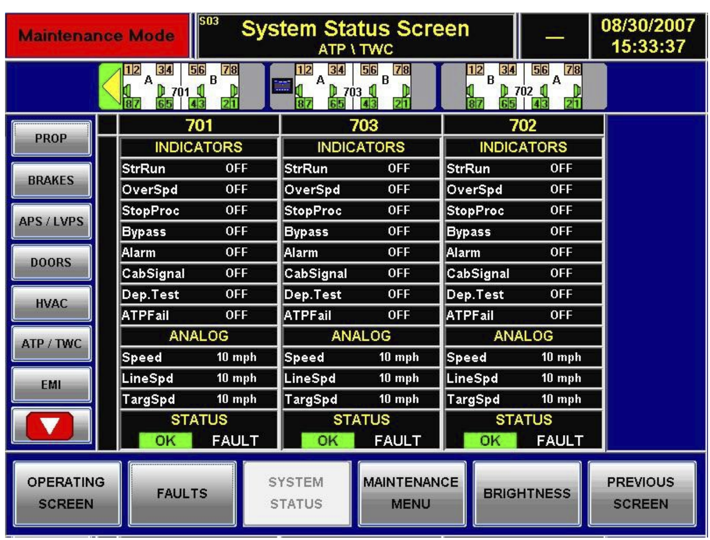


FIG (B) ATP/TWC SYSTEM STATUS SCREEN (Maintenance Mode)

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-15-01-18-00/R-00

System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **15/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component: **SPEED SENSOR**		Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**		

PROCEDURE:

Fig (C) PTU & TWC CONNECTIONS

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-15-01-18-00/R-00**		
System: **AUTOMATIC TRAIN PROTECTION**		Sheet: **16/16**
Subsystem/Assy: **ATP SYSTEM**	Unit:	
Component: **SPEED SENSOR**		Man Hours: **1.00**
Maintenance Task: **REPLACEMENT**		

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15-III-06 CONSUMABLE MATERIALS LIST (R-CML)

The Consumable Materials needed to accomplish the Automatic Train Protection Running Maintenance are listed, sequenced in alphabetical order, by SUBSYSTEM /ASSY -UNIT / COMPONENT, in the following Table 15-III-06.1

Table 15-III-06.1 Running Maintenance Consumable Materials List (R-CML)

SYSTEM 15	AUTOMATIC TRAIN PROTECTION		
SUBSYSTEM /ASSY - UNIT / COMPONENT	**AGENT**	**PN**	**MTA PN**
ATP SYSTEM	Dry Compressed Air for Electronic Equipment	(commercial)	
	Lint-free rug		
	CRC 2000 Contact Cleaner		

15-III-07 TEST EQUIPMENT & SPECIAL TOOLS LIST (R-TESTL)

The Tools and Test Equipment needed to accomplish the Automatic Train Protection Running Maintenance are listed, sequenced in alphabetical order, by SUBSYSTEM /ASSY -UNIT / COMPONENT, in the following Table 15-III-07.1.

Refer to “Tools and Test Equipment Manual” for Special Tools / Test Equipment Description and Maintenance.

Table 15-III-07.1 Running -Test Equipment & Special Tools List (R-TESTL)

SYSTEM 15	AUTOMATIC TRAIN PROTECTION			
SUBSYSTEM /ASSY - UNIT / COMPONENT	**LACMTA STANDARD TOOLS KIT**	**LACMTA WORKSHOP DEVICES**	**SPECIAL TOOL / TEST EQUIPMENT**	**PN**
ATP SYSTEM	X	Soft bristle brush	Cable Certifier (Type LT 8600)	
			Laptop with specific SW installed. Refer to Table 00-22.1 for SW List	

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