Metro

P3010
Los Angeles LRV

COMMUNICATIONS
(including TOA Equipment)

Section 1402
RUNNING MAINTENANCE & SERVICING MANUAL

LIST OF EFFECTIVE PAGES

Insert latest changed pages; dispose of superseded pages in accordance with applicable regulations.

NOTE: On a changed page, the portion of the text affected by the latest change is indicated by a vertical line.

Total number of pages in this section (1402) is **246** consisting of the following:

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SAFETY SUMMARY

Some of the procedures in this section are preceded by warnings/cautions regarding potential hazards in handling this equipment. These warnings/cautions should be carefully read and understood before proceeding. Failure to observe these precautions may result in serious injury to personnel performing the work and/or bystanders. The key warnings for this equipment are as follows:

Electrical - The electrical equipment described in this section operates at voltages and currents that are extremely dangerous to life. Personnel should closely observe all generally prescribed cautions and warnings before performing any work on the LRV.

Chemicals – Follow safety precautions for handling hazardous chemicals as provided by the manufacturer. The manufacturer's warnings should be closely heeded to avoid personal injury.

Location – Special caution should be taken when accessing or servicing equipment located on the roof and under the car.

Weight – To prevent possible personal injury when attempting to remove or install equipment on the vehicle, adequate support of a lifting device must be used to prevent the equipment from falling. Personnel's failure to heed these warnings could result in severe injury or death and or damage to the equipment.

Contact – Some components in this equipment attain temperatures that can cause severe burns. Closely follow all warnings and recommended procedures for handling these components.

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CHAPTER 1.0

GENERAL DESCRIPTION

1.1 Introduction

The information contained in this section includes a functional description, scheduled maintenance tasks, corrective maintenance / troubleshooting, and component removal and installation information for Communication subsystem components of the integrated Communications System, including TOA and the Vehicle Management System (VMS).

This manual divides the content based on functions of the Communications System. Topics discussed in this manual include the following:

- Public Address System (PA)
- Passenger Intercom System (PIC)
- Automatic Announcement and Display System (AADS)
- Global Positioning System (GPS)
- Wayside Worker Alert System (WWAS)
- Horn
- Radio

In addition to the topics above, information on the independent Communications Ethernet Network (TOA Ethernet Network) is also presented here.

The communications equipment, the monitoring and diagnostic equipment, the vehicle network equipment, the exterior signs, and CCTV system **all** utilize the Ethernet networks on the vehicle for signaling control and data transmission are all cross connected / integrated to form an integral network of dependent devices. All subsystems that have microcontrollers utilize the network infrastructure for communication and sharing of various signals. The TOA Ethernet Network is bridged with the general Vehicle Management System (VMS) network with the Interface Unit (IFU). The WTB / MVB network signals are bridged into the Ethernet network to provide additional signals. The various controllers utilize these signals to perform their intended function. The proper operation of the communications system is extremely dependent upon network connectivity and proper software installation.

The fundamental network infrastructure and troubleshooting are discussed in Section 1700, Data Communications, and the MDS / Train Operator Display are discussed in Section 1800 and CCTV in Section 1900 of the Running Maintenance and Servicing Manual. All of these sections are inter-related.

The following components are shared between the Communication System and other VMS subsystems.

- Monitor and Diagnostic System (MDS)
- Train Operator Display (TOD)
- Ethernet switches
- RIOs
- Wireless LAN Access Point
- TCN Controller
- Event Recorder (ER)
- Trainline Interface Module (EEI)
- Network Video Recorder (NVR)

1.2 Acronyms and Abbreviations

AADS	Automatic Announcement Display System
ACM	Audio Control Modules
ACP	Audio Control Panel
AGC	Automatic Gain Control
APC	Automatic Passenger Counter
CCH	Communication Control Head
CCTV	Closed Circuit Television
CCU	Communication Control Unit
CF Card	Compact Flash Card
cm	Centimeter
COTS	Commercial Off-the-Shelf
EEI	Enhanced Ethernet Interface
ER	Event Recorder
ESNA	Elastic Stop Nut Division
ETH	Ethernet
FDS	Front Destination Sign
GPS	Global Positioning System
GS	Gong Switch
HS	Horn Switch
IC	Intercom
IFU	Interface Unit
in.	Inch
kg.	Kilogram
LACMTA	Los Angeles County Metropolitan Transportation Authority
LAN	Local Area Network
lbs.	Pounds
LED	Light Emitting Diode
LRV	Light Rail Vehicle
MDS	Monitor and Diagnostic System
MHz	Megahertz

MIC	Microphone
MVB	Multifunction Vehicle Bus
NVR	Network Video Recorder
PA	Public Address
PAD	Personal Alert Device
PCB	Printed Circuit Board
PIC	Passenger Intercom
PIDS	Passenger Interior Information Displays
PIS	Passenger Information System
PoE	Power Over Ethernet
PTE	Portable Test Equipment
PTT	Push-to-Talk
PTU	Portable Test Unit
RIO	Remote Input / Output
RME	Route Management Editor
SDS	Side Destination Sign
TCN	Train Communication Network
TOD	Train Operator Display
TWC	Train to Wayside Communication
VDC	Volts, Direct Current
VMS	Vehicle Management System
VNC	Vehicle Network Controller
WTB	Wired Train Bus
WWAS	Wayside Worker Alert System

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CHAPTER 2.0

FUNCTIONAL DESCRIPTION

2.1 Introduction

The Communications System consists of an integrated group of devices arranged to provide the P3010 LRV with capabilities to execute different communication functions. Primary functions of the Communications System are as follows:

- Public Address System (PA)
- Passenger Intercom (PIC)
- Automatic Announcement and Display System (AADS)
- Global Positioning System (GPS)
- Wayside Worker Alert System (WWAS)
- Horn
- Radio

To provide this functionality in an efficient and reliable manner, the devices utilize the Ethernet network infrastructure for communication and sharing various signals. The WTB / MVB network signals are bridged into the Ethernet network to provide additional signals to Ethernet connected devices. RIO Module (Remote Input / Output) devices are used to collect binary (on / off) signals and place them on the network.

The PA, PIC, and AADS communications are handled by the TOA Communications equipment which utilize an isolated Ethernet Network apart from the general Vehicle Management System (VMS) network, referred to as the TOA Ethernet Network. A dedicated device, known as the TOA Interface Unit (IFU), serves the purpose of bridging information between the two networks.

Figures 2-1 and 2-2 show how the communication system devices are functionally connected to other components on the vehicle.

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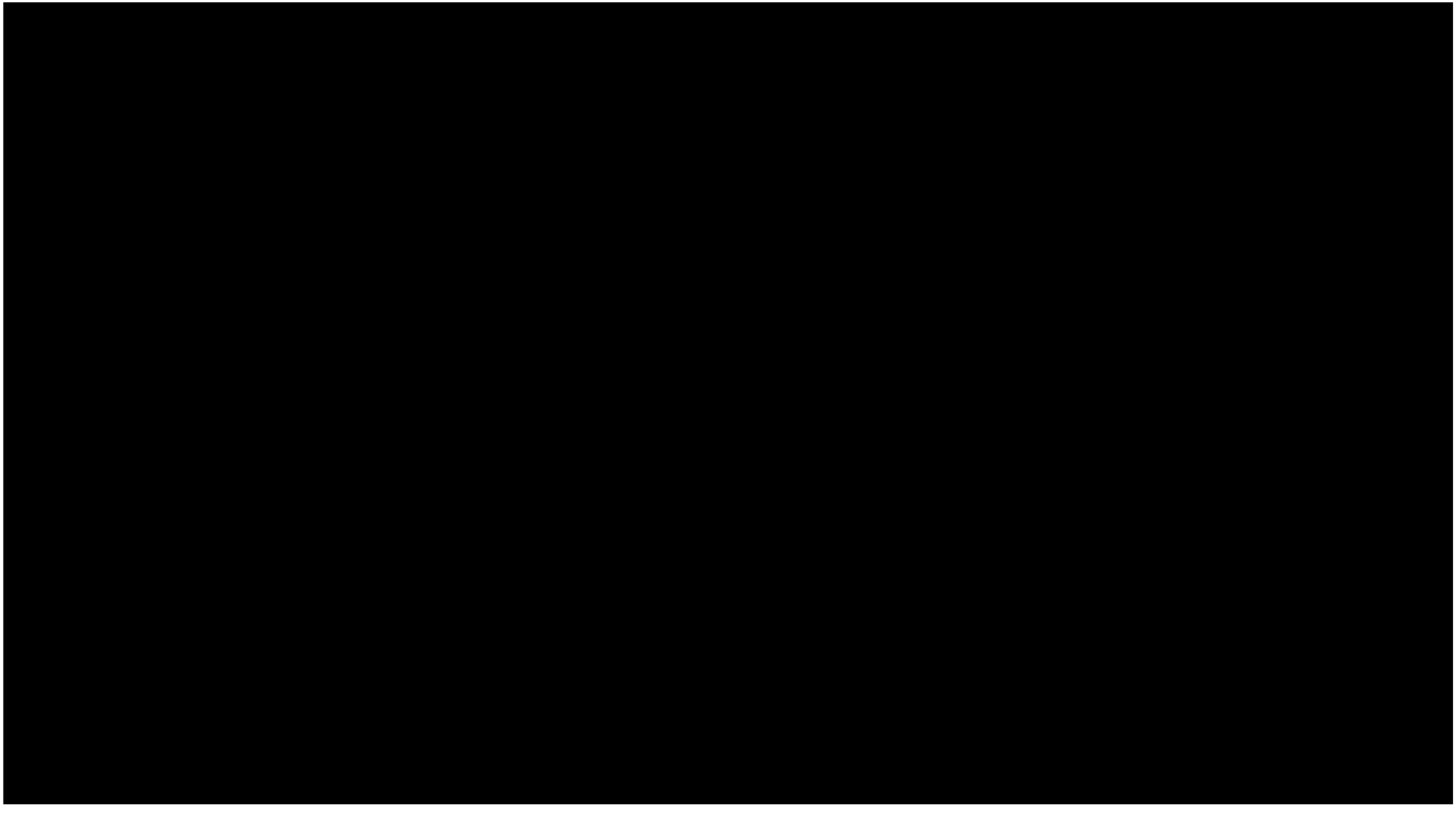


TOA Functions

The following are the functions controlled by the TOA Communications Equipment:

- In-Dash microphone interface to the Audio Control Panels (ACP) for manual announcements / PIC communication by the operator using the PTT functionality,
- Public Address (PA) manually, selective for interior and exterior speakers or both via the Communication Control Head (CCH) or Cab Console buttons as directed by the operator selecting the audio routing via the selector switch,
- Passenger Intercom Communication (PIC), Operator controlled queued conversation,
- Trainline announcements originated from the CCH ("canned messages"),
- Vehicle operator interface to the Communication System modes of operation via the CCH and console buttons,
- Vehicle two-way Radio audio system interface with the vehicle PA system,
- Vehicle operator interface to the Automatic Announcement and Display System (AADS) and Passenger Information Controller via the CCH, including:
    - Automatic Station Announcement Audio, and Text Messages to all signs, for pre-recorded messages, station and route announcements,
    - Passenger Interior Information Displays (PIDs),
    - Exterior Destination Signs control via the control cab TOD,
    - Skip Station functionality.

CCU Functions

The following are functions controlled by the Communication Control Unit (CCU):

- Synchronization of time and date for all subsystems,
- Provides location coordinates (from the GPS) to all subsystems as required.

Communication Priority

There are priorities established for communications system functions. They are illustrated in the System Context Diagram shown in Figure 2-3. They are in importance:

- Radio to Operator
- Train Operator / Passenger Intercom
- Train Operator PA
- Automatic PA announcements

TOA Ethernet Network

The TOA Communication System uses an independent Ethernet trainline network which consists of dedicated TOA Ethernet Switches and Ethernet Interface Modules, which convert the signal and pass it to the next train through the train coupler.

The IFU separates the train network between the existing communication system and the TOA Communication System to isolate transmission signals.

The IFU receives signals of train information through the existing train network and transmits those signals to the TOA Communication System. One of those signals of train information is Timestamp, which the MDS provides.

Figure 2-4 and Figure 2-5 shows the network diagram of the TOA Ethernet Network at Car and Train (Multiple-Cars) Level respectively.

2.2 Public Address System (PA)

The PA system provides the following functions:

- One-way voice communication (PA) from the Operator in the active cab to all passengers on a trainline basis using one of the available Push-to-Talk (PTT) buttons,
- One-way communications of manually CCH pushbutton triggered pre-recorded audio announcements to all passengers on a trainline basis,
- One-way voice communication manually triggered from the Central Control via the vehicle radio (once directed) to all passengers on a trainline basis by holding the PA Mode Selection Switch in the Radio position.

Audio from the above functions can be directed to the interior, exterior or both speaker groups via the speaker mode switch located on the cab console. This is a three (3) position, non-return to center switch.

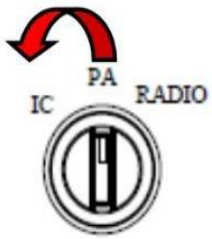
1. Interior Only Speakers Selected

2. Exterior Only Speakers Selected

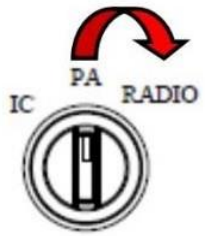
3. Both Interior and Exterior Speakers Selected

The PA mode selection switch is located on the cab console. It is a three (3) position momentary (return to center) switch used to select different modes.

The PA selector switch is shown in the standard position. Audio announcements can be made by the Operator using one of the PTT buttons or the cab's microphone. Pre-recorded announcements can also be initiated by the Operator.



The PA selector switch can be moved to the IC position to answer a PIC call and enter PIC communications mode. The switch will automatically return to the PA position after this initial switch. However, the PA will now be in PIC mode. The switch must again be moved to the IC position and be allowed to return to the PA position to enter the standard PA mode. Refer to Section 2.3 for more details on answering a PIC call.



The PA selector switch can be held in the RADIO position in order to broadcast the vehicle's radio communications over the PA system. The switch automatically returns to the PA position after being released and is no longer in radio mode.

2.3 Passenger Intercom System (PIC)

The PIC function provides two-way communications between passengers and the Train Operator in the active cab. The PIC function consists of communications arbitrated by the Operator. The passenger in any vehicle of the train consist can initiate a PIC call by pressing the Call Button on a PIC station. When a call is initiated by the passenger, the Operator receives a message to acknowledge the button being pressed; the Train Operator will receive a distinctive alarm sound in the cab speaker to indicate that a PIC call is being made. The passenger call station button light will flash until the operator acknowledges the call. The CCH will also display the incoming PIC call, as shown in Figure 2-6.

Figure 2-6: "PIC CALL" Screen 1 (Single) on CCH

To answer the call, the Operator can answer the PIC call by pressing the "PIC" or "SET" button on the CCH or can move the PA Mode Selector momentary switch to "IC", then after acknowledging the call, presses and initiates the communication to the passenger by activating the foot switch or the PTT button on the console. The Operator will then be connected to the PIC station and will hear the passenger's voice over the Cab Speaker. To speak to the passenger, the Operator activates the foot switch, or presses the console Push to Talk (PTT) button and speaks into the console's In-Dash Microphone. The PIC station button light will be solid until the Operator ends the call. The CCH will display "Talking" next to the active PIC call, as shown in Figure 2-7.

Figure 2-7: “PIC CALL” Screen 1 (Single, Active) on CCH

To end the call, the Operator moves the momentary switch to “IC” again. Note that this switch (IC/PA/RADIO) is used to toggle the communication system modes of operation. The default mode of the switch is “PA”. The call can also be terminated by pressing the CCH “CANCEL” button”.

If multiple stations are activated, a “pending PIC call” intermittent alert will sound to announce subsequent calls over the Cab Speaker automatically with no operator intervention. The Operator can select one of the PIC calls by using the arrow buttons and the “SET”/”PIC” buttons on the TOA CCH. If the Operator turns the IC/PA/RADIO selector switch to the “IC” position, the highlighted PIC number is selected automatically.

While the Operator is pressing the PTT switch or the Footswitch, passengers can hear the Operator’s voice from the PIC station. On the other hand, whiles the Operator has released both the PTT switch and the Footswitch, the Operator can hear the passenger’s voice from cab speaker. When PIC talking is finished, the Operator presses the “CANCEL” button on the TOA CCH.

2.4 Automatic Announcement and Display System (AADS)

The Automatic Announcement and Display System (AADS) is a multi-function system which provides passengers with:

- automated station announcements,
- station and connection information via interior display screens,
- destination information via exterior LED signs.

The AADS works based on selecting pre-programmed routes using the CCH. A starting and ending station is chosen prior to train departure. These routes contain distance markers which are used to trigger new audio and visual announcements. Therefore, as the train travels the route, new visual and audible announcements are automatically made to reflect the vehicle’s location.

2.4.1 Passenger Information System (PIDS)

The Passenger Information Display System delivers upcoming station stop and other relevant information to the passengers. The PIDS is part of the automated announcement system which keeps the passengers informed of the Light Rail Vehicle's (LRV) current location status. This interface with the passengers facilitates a visual representation of available information regarding current and upcoming station stops. The PIDS is also capable of displaying Metro configured announcements and additional LRV position triggered messages (ex. connecting transit information).

The PIDS subsystem consists of the following equipment that is similar on both the A-End and B-End of the LRV.

This equipment consists of:

- Controller
- Displays (2 per end)
- VGA extender transmitter (AMP)
- VGA Receiver (AMP)

The Controller provides the basic functionality for the Passenger Information Displays which are monitors located in the passenger compartment. These displays are controlled locally by the PID controllers. VGA extenders are needed to amplify the signal for the long cable runs between displays and controller.

The controllers are mounted in the cab ceiling accessible through the hatch in the cab.

The PIDS is capable of displaying the following information:

- The "Next station" on top of a list of stations.
- Three subsequent stations will be displayed below the next station.
- The last station (terminal destination) will be highlighted and always displayed at the bottom of the next station's list. This terminal station is separated by symbols indicating additional, "hidden" stations between the last station displayed and the final destination. These symbols disappear if all stations to the last stop can be displayed.

Shortly before arriving at the next station, the displayed information changes to the "next station" only on a station stop screen. Instead of showing the upcoming stations, information is displayed such as Points-of-Interest or the connecting routes of other trains/buses at that station.

After the doors have been open for pre-set period of time, the display defaults to displaying the next four (4) stations plus the last station.

Since these signs have dynamic displays, they are also used for public announcements such as safety tips, security information and other announcements that may be necessary.

Example of a typical screen layout is shown in Figure 2-8 below.

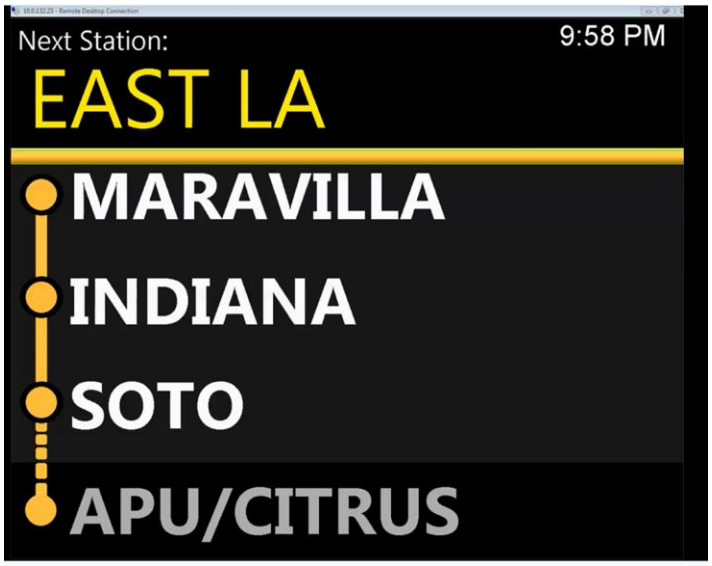


Figure 2-8: Example of PIDS Layout

2.4.2 Automatic Station Announcements

The automatic station announcements make up the audible portion of the AADS. These announcements are played over the interior speakers to notify passengers of the next station, alert them during the arrival at a station, inform them of the vehicle's final destination, and provide Passenger Service Announcements (PSAs) along the way. These announcements work in conjunction with the PIDS to keep passengers informed during their travels.

2.4.3 Exterior Destination Signs

The P3010 LRV is equipped with four (4) exterior destination signs: one at each end of the vehicle and one on each side of the vehicle. The signs are computer controlled and receive their commands from the master ACP via the onboard TOA Ethernet network.

The exterior signs serve the purpose of informing patrons what Metro Line the train is running on / where the train's final destination is prior to boarding. A typical example of the destination sign appearance is shown in Figure 2-9.

Figure 2-9: Example of Destination Sign Appearance

There is an onboard test function on the CCH that can be used to drive test patterns to the exterior signs. Refer to Section 8.3

2.4.3.1 Front Destination Sign

The front destination sign is a single-sided external sign that displays route color code and destination. The destination display is an amber color monochrome LED array capable of displaying 13 characters with a 6 in. (15 cm) character height. Up to 78 characters may be scrolled across the display. It can also display a scrolling six-page message with up to 13 characters per page.

The route code display is a single character full color LED array with a 6 in. (15 cm) high character. At each end of the sign there is a power connection for marker lights. The sign also contains an optical sensor that adjusts the intensity of the display relative to the ambient light.

2.4.3.2 Side Destination Sign

The side destination sign is a single-sided exterior sign mounted on the side wall of each car-pair. The display is an amber-color monochrome LED array that can display 13 characters with a 4 in. (10 cm) character height. Up to 78 characters may be scrolled across the display. It can also display a scrolling six-page message with up to 13 characters per page.

The route code display is a full color LED array displaying a single 4 in. (10 cm) high character. The side destination sign also contains an automatic dimming control that adjusts the intensity of the display relative to the ambient light.

2.5 Global Positioning System (GPS)

Global Positioning System (GPS) is utilized by the P3010 LRV for time synchronization of the onboard systems and to provide GPS coordinates to the required subsystems. The Passenger Counter System receives GPS coordinates for location.

The GPS continuously receives a satellite signal when available. GPS functionality is provided via the GPS receiver in conjunction with the Communications Control Unit (CCU). The CCU communicates with the GPS receiver via a serial port connection. GPS information can be accessed using the TOD under the Settings > GPS Information screen, as shown in Figure 2-10.

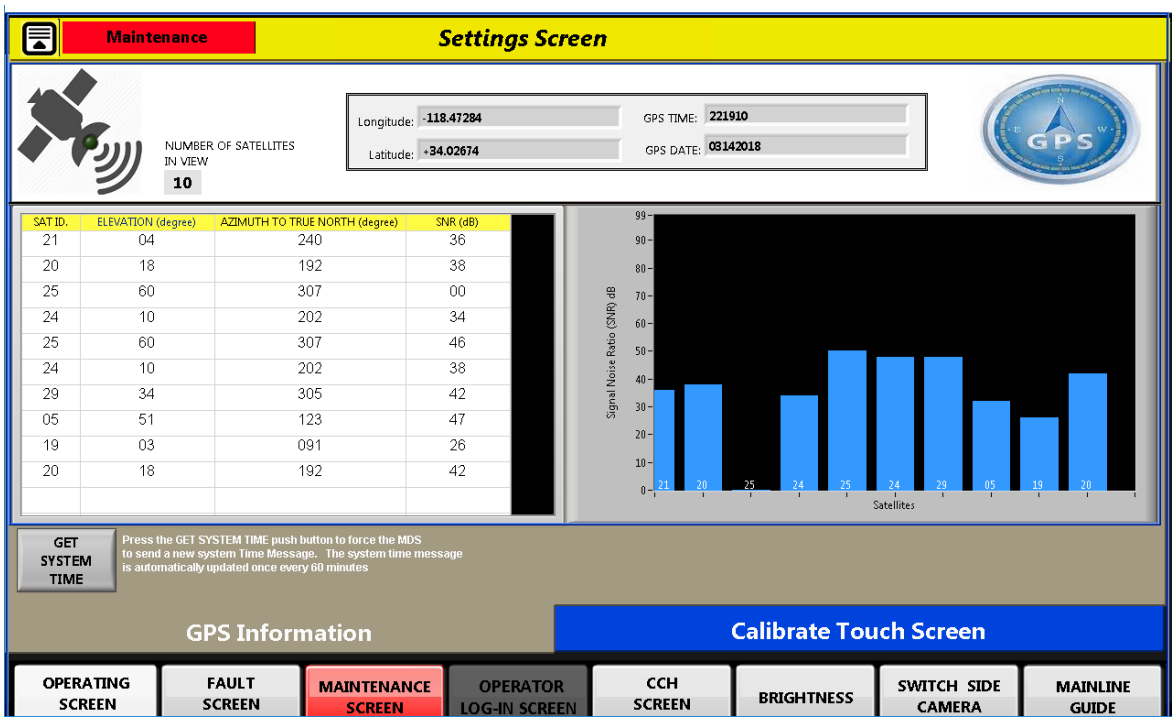


Figure 2-10: GPS Information Screen on TOD

2.6 Wayside Worker Alert System (WWAS)

The Wayside Worker Alert System (WWAS) is utilized as a safety precaution device, providing alert information to train operators. The WWAS also informs properly equipped ground crew of an approaching LRV. The system interfaces with existing ProTran equipment used by LACMTA. This system should be used in conjunction with METRO worker safety practices. It is not fool proof and the responsibility for safety of the wayside worker remains with the personnel on the wayside and operating the LRV. Follow all METRO rules.

LACMTA utilizes this WWAS system and has specified this system by brand to ensure compatibility with the existing equipment presently in use by LACMTA. This system not only interfaces with the existing equipment, it is also integrated into the Train Operator Display (TOD) to remove the previous version of the device from the console and locate it remotely.

Each cab of the Light Rail Vehicle (LRV) is equipped with a ProTran Wayside Worker Alert System (WWAS) module. The spread spectrum radio device is mounted inside of the cab ceiling with an antenna mounted on the forward roof of the cab. The WWAS alerts the train Operator with an audible and visual notification. Personnel equipped with a Personal Alert Device (PAD) within range will trigger the alarm. When the devices are within range of each other, both the train unit and the PAD will alert the PAD user and train operator with audible and visual indications.

The WWAS module is mounted in the ceiling of the cab. The module is not visible to the Operator, so a user interface is required. The user interface is located on the TOD. Figure 2-11 shows the system configuration.

Figure 2-11: Wayside Worker Alert System Configuration Block Diagram

2.6.1 Train Operator Display Interface

The WWAS interfaces with the TOD. Communication with the TOD is accomplished using a RS485 connection. A parallel RS485 connection is run from the WWAS to the right-side TOD. Through this communication, messages will be annunciated to the secondary TOD display. The message will inform the driver of current alarms and status of the WWAS. The alarms must be acknowledged to be cleared from the TOD's screen. The RS485 connection to the primary TOD is used to facilitate communication in case of a failure of the secondary TOD.

A Soft button is located on the TOD for acknowledging WWAS alarms. Acknowledgement will be communicated via RS485. When an alert is activated, this button / notification appears on the right-side TOD, as shown in Figure 2-12. In addition to the visual indication on the TOD, an audible alarm will also sound when the WWAS alerts the Operator. The audible alarm device is located in the console. The device will only sound while there is an alarm and will discontinue once the alarm is acknowledged. This alarm can be bypassed with the Audible Alarm Cutout switch.

Figure 2-12: Wayside Worker Alert Indication on TOD

2.6.2 Event Recorder Logging

The system will log events into the Event recorder. The wayside worker alert alarm signal name to the event recorder is "**WWAS_Alarm**". This facilitates tracking in the event of an incident. A Wayside Worker Alarm will be recorded for the leading LRV if a WWAS alarm is indicated. This alarm can be triggered for the following signals:

- Track worker
- High Rail
- Speed Restriction

These WWAS ALARM will be set at the alarm reference time and remain high until a signal clear message is received.

2.7 Horn

The Horn function is performed by an independent horn control panel that is located in the cab ceiling (both ends), control switches on the console, and the horn speaker located under car. There are no maintainable parts. The controller is programmed with pre-recorded Metro provided sound files for:

- High horn
- Low horn
- High Gong/Bell
- Low Gong/Bell

There is a sound level adjustment on the controller, to be used if required. The panel drives the horn speaker directly. The horn wiring just passes through the Audio Control Panel (ACP) due to a design change which added the independent horn controller. Wiring of the horn is shown in Figure 2-13.

2.7.1 Event Recorder Logging

The Horn and Gong console rocker switches are logged into the Event Recorder via the input feeds to TCN RIOs. This encompasses a total of eight (8) signals: two horn (low / high) and two gong (low / high) for each cab.

2.8 Radio

The Radio system provides two-way communication between the Train Operator and the Metro Central Controller. The radio output can be routed to the PA system via an input feed to the ACP (Audio Control Panel) to broadcast to passengers.

NOTE: The Radio is supplied by Metro and is the responsibility of the Metro Communications department. Contact Rail Comms for radio and radio programming issues.

A wiring diagram of the radio equipment panel and associated equipment is shown in Figure 2-14.

2.9 Communications System Components

2.9.1 TOA Subsystem Equipment

The train-born hardware in the TOA Communication System consists of the Audio Control Panel (ACP), Communications Control Head (CCH), Ethernet Switch, Ethernet Interface Module and Interface Unit (IFU).

TOA's design is comprised of an ACP with an ID plug, CCH, and IFU designed to interface with the existing equipment. The existing equipment includes the Public Address (PA), Passenger Intercom (PIC), Passenger Information Display (PID), and LED sign functions. Figure 2-15 shows the overall system outline and the TOA equipment in context to the overall communications system.

The IFU receives signals of train information through the train network and transmits these signals to the TOA Communication System. One of those signals of train information is Timestamp which the MDS provides. If any fault and PIC status in the TOA Communication System is changed, the IFU transmits the fault information and PIC status information to the MDS. The Train Control Network (TCN) will periodically send the status of the Doors and wheel diameter to the IFU. The IFU periodically checks the status of the PA speaker selector, door close announcement button, and the Push To Talk (PTT) switches to RIO(A) and RIO(B). Note that the IFU will separate the train network between the existing communication system, and the TOA Communication System to isolate transmission signals.

The ACP calculates running distance with a speed pulse signal from a speed pulse generator and triggers pre-recorded announcements and visual text messages. The Operator can also trigger pre-recorded special announcements manually on the CCH. Additionally, the Operator can make manual PA announcements via an in-dash microphone.

Text messages will be displayed on LED signs based on the route selected on the CCH, and signals from the ACP. Route information will be shown on the LCDs with PA announcements, according to the train traveling distance or by manual operation of the CCH in a cab car.

The following functions may be conducted by manual operation of the CCH:

- Select a PIC to answer
- Monitor fault information
- Start Onboard test
- Monitor speaker volume and wheel diameter

Note that the CCHs in trail cars are disabled for operation and display nothing.

The following existing components interface with the TOA Communication System:

- Monitor and Diagnostic System (MDS)
- Ethernet switches
- RIOs
- TCN Controller

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2.9.1.1 Audio Control Panel (ACP)

There are two Audio Control Panels (ACPs) installed on the P3010, one each located in the cab equipment locker. The ACP calculates running distance with a speed pulse signal from the speed pulse generator, and triggers pre-recorded announcements and visual text messages.

The ACP controls the following functions of the TOA Communication system:

- Broadcast PA (automatic announcement, manual PA, radio PA)
- Indicate on PIDS and LED signs (FDS, SDS)
- Conduct PIC communication between operator and passengers
- Calculate running distance
- Trigger against APC functions
- Detect faults in controlled equipment

The ACP in the Active Cab (Key On) becomes the Master ACP and all other ACPs become a Slave ACP. The Master ACP conducts the following functions:

- Interface with CCH
- Manage train information (current station, next station, running distance, running status, and door opening/closing)
- Interface with buttons on the Cab Console Panel via the IFU
- Decode pre-recoded audio stored in CF card

Table 2-1 shows the detail technical specifications of the TOA ACP. Figure 2-16 and Figure 2-17 shows the TOA ACP Appearance and Drawing.

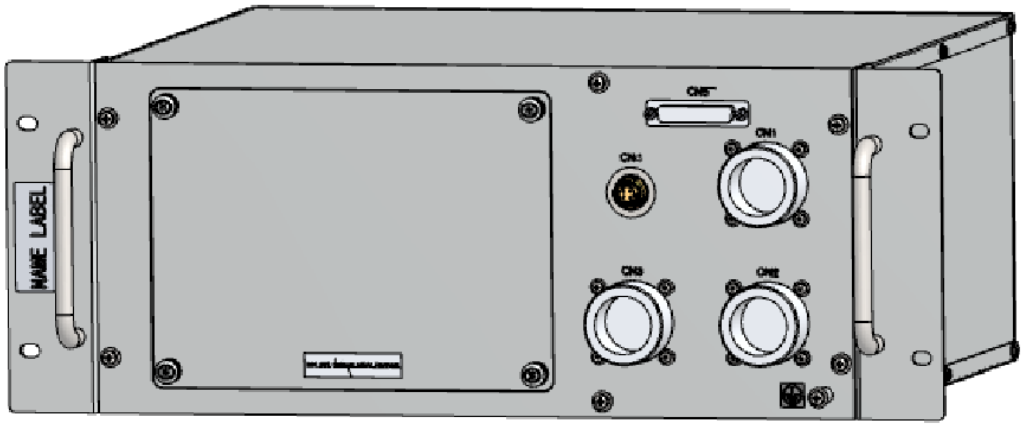


Figure 2-16: ACP Appearance

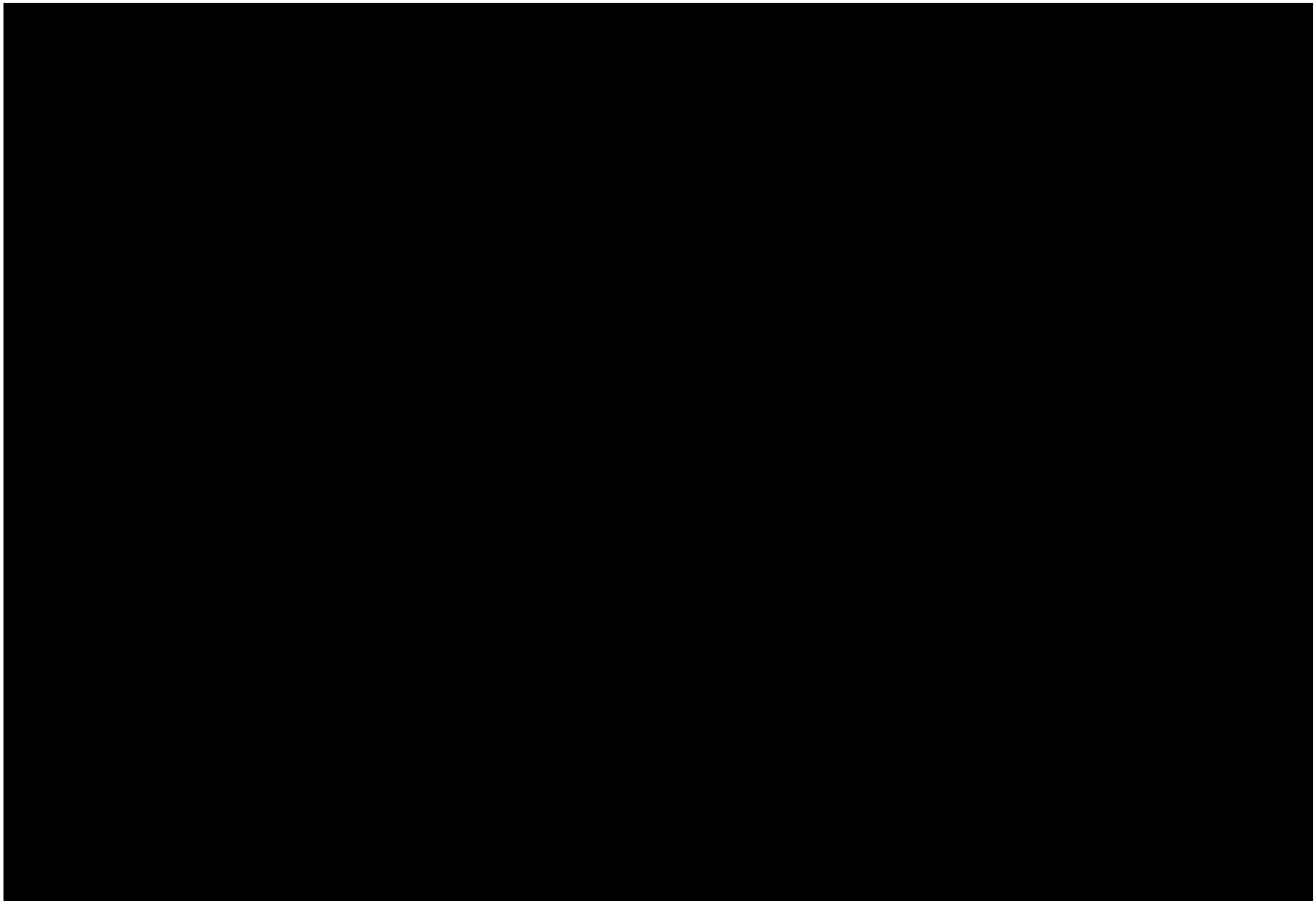


Table 2-1: ACP Technical Specifications

Item	Description
Power Requirements	
Power source	28.5V DC (17V DC to 30V DC)
Input	
Input sensitivity level (from in-dash microphone)	-46 dB +/- 3 dB
Input impedance (from in-dash microphone)	2.2k ohms +/- 10 %
Input sensitivity level (from Train Radio)	Less than 0dBm
Input impedance (from Train Radio)	10k ohms at balanced
Input sensitivity (from PIC)	-57 dB
Audio output	
Speaker output wattage (to cab speaker)	10W
Output impedance (to PIC)	1W
Speaker output	
Output noise level (at no signal input)	Less than -25 dB (IHF A-weighted)
Distortion at 1 kHz, output ration	Less than 1 %
Output level of speaker line	70 V (37dB)
Signal to noise ratio	60 dB
Frequency response	100 Hz to 8 kHz (+/- 4 dB)
Output volume adjustment	25% (min) to 100 % (max)
Amplification	37 dB +/- 2 dB
Wattage	
Amplifier wattage	20W × 1 (interior speaker) 10W × 1 (exterior speaker)
Power Distribution	
Power output to in-dash microphone	1.5V
Storage	
CF card capacity	512 M bytes
Sound recording method	MP3
Bitrate	64 kbps (Constant bit rate)
Sampling frequency	16 kHz
Audio Codec	
PA announcement and IC	G.711
Pre-recorded announcement	MP3
Interface	
Ethernet communication	100BASE-TX
Interface with PIC	Output: LED Control 24V Input: Pushbutton (Contact with Com)
Interface with Speed pulse generator (Odometer)	Digital Input signal (pulse signal)
Interface with train side	Digital Input (28V DC)
Interface (spare line)	Digital output signal
Other	
Outer material	SECC (Electrolytic zinc-coated steel sheets)
Paint color	RAL 1500 Gloss 20% to 30% (Black color)

2.9.1.2 Communication Control Head (CCH)

There are two Communication Control Heads (CCH) installed on the P3010, one each mounted below the right-hand Train Operator Display (TOD) in the two cabs. The CCH provides the operator with an interface to execute functionalities of the Public Address, Passenger Intercom (PIC) and Automatic Announcement and Display System (AADS) Figure 2-18 shows the TOA CCH.

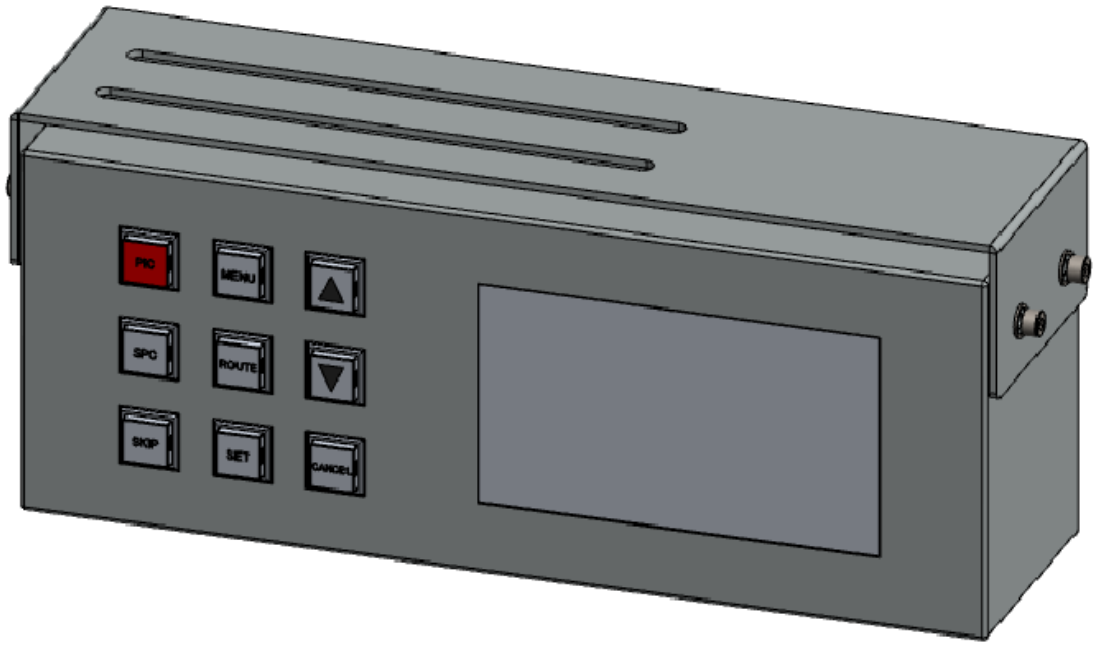


Figure 2-18: TOA CCH Appearance

The Operator can select functions from the TOA CCH only in the cab where the master key has been inserted. When the master key is removed, the master TOA CCH changes to a temporary master TOA CCH, until the master key is inserted in another cab.

On a temporary master TOA CCH, information will be continuously shown, but any pushbutton operation will not be accepted.

On the master CCH, the route, special announcement and other functions may be selected. According to the selected route, the FDS/SDS shows the destination station name and the PID shows the route information. The list of functions for the TOA CCH is shown in Table 2-2.

Table 2-2: TOA CCH Functions

	Function	Description
1	Emergency intercom	When a passenger presses the call button on the PIC station in a car, the "PIC" button on the CCH blinks and an audible alarm is output from the cab speaker. The Operator can acknowledge the emergency call from the master CCH only. Note) Emergency intercom is half-duplex and "point to point."
2	Emergency intercom (Multiple)	When passengers press the call buttons on the PIC stations in the cars, the "PIC" button on the CCH blinks and an audible alarm is output from the cab speaker. The Operator can acknowledge emergency calls one by one from the master CCH.
3	Pre-recorded announcement	The Communication system can broadcast pre-recorded announcements of departure, arrival, door closing, and others according to the route setting on the master CCH. Default mode is "Auto" mode which is triggered automatically according to the train traveling distance. For back-up purpose, "Manual" mode is available, which can be triggered manually.
4	Special message	The Communication system can broadcast special announcements. The Operator can select a special message on the master CCH.
5	Skip station	The Communication system can stop pre-recorded announcements until the train is passing over the next station. After passing over the next station, a normal station announcement can be re-started correctly. (Skip station function is disabled under "Manual" mode.)
6	Volume control	The Operator or maintenance personnel can adjust the volume level of the cab speaker from the CCH.
7	Fault Status information	The Operator or maintenance personnel can check the following fault status information on the master CCH: ACP, IFU, PIC, Interior Speaker, Exterior Speaker, FDS, SDS, MDS, RIO, TCN, PIDS, and Internal Network Switch. Note) These active fault information will also be sent to the Active fault screen of the TODs.
8	Onboard test function	The Communication system can run the Onboard local diagnostic test. The Operator or maintenance personnel can activate the Onboard test and start test message from the master CCH.
9	Destination sign	The Communication System can display the line and destination station name on signs according to the route setting on the master CCH.
10	Route setting	The Operator can select the traveling route for automatic station announcement on the master CCH. In addition, the Operator can also change the current station and destination station if necessary.
11	Passenger information display	The Communication System can display the route information on LCD monitors according to the route setting on the master CCH.

Figure 2-19 and Figure 2-20 shows the TOA CCH screen maps which identify button operation and screen transition sequence under Auto and Manual mode of station announcement (Auto mode is default).

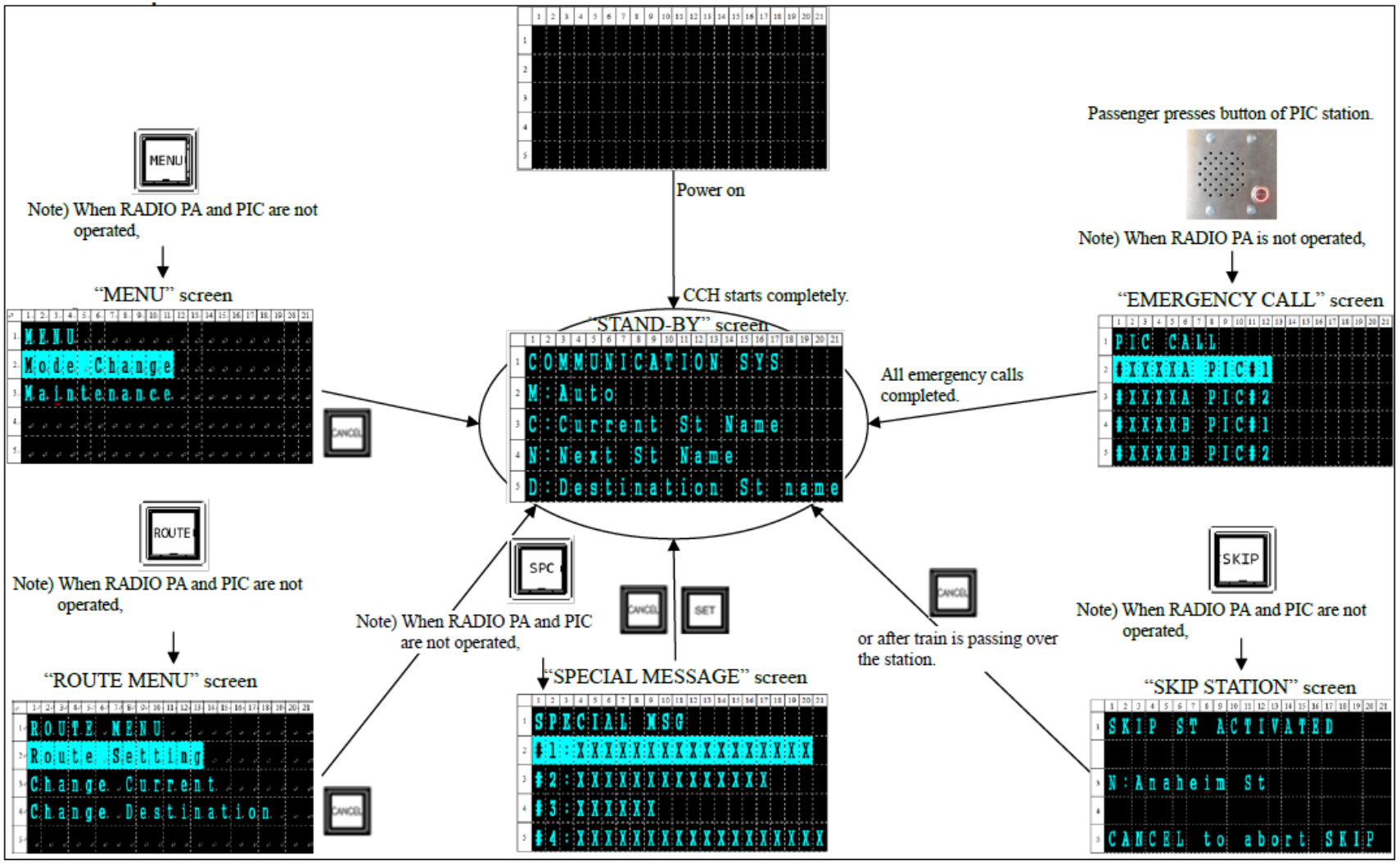


Figure 2-19: TOA CCH Screen Transition Diagram in Auto Mode (Default Mode)

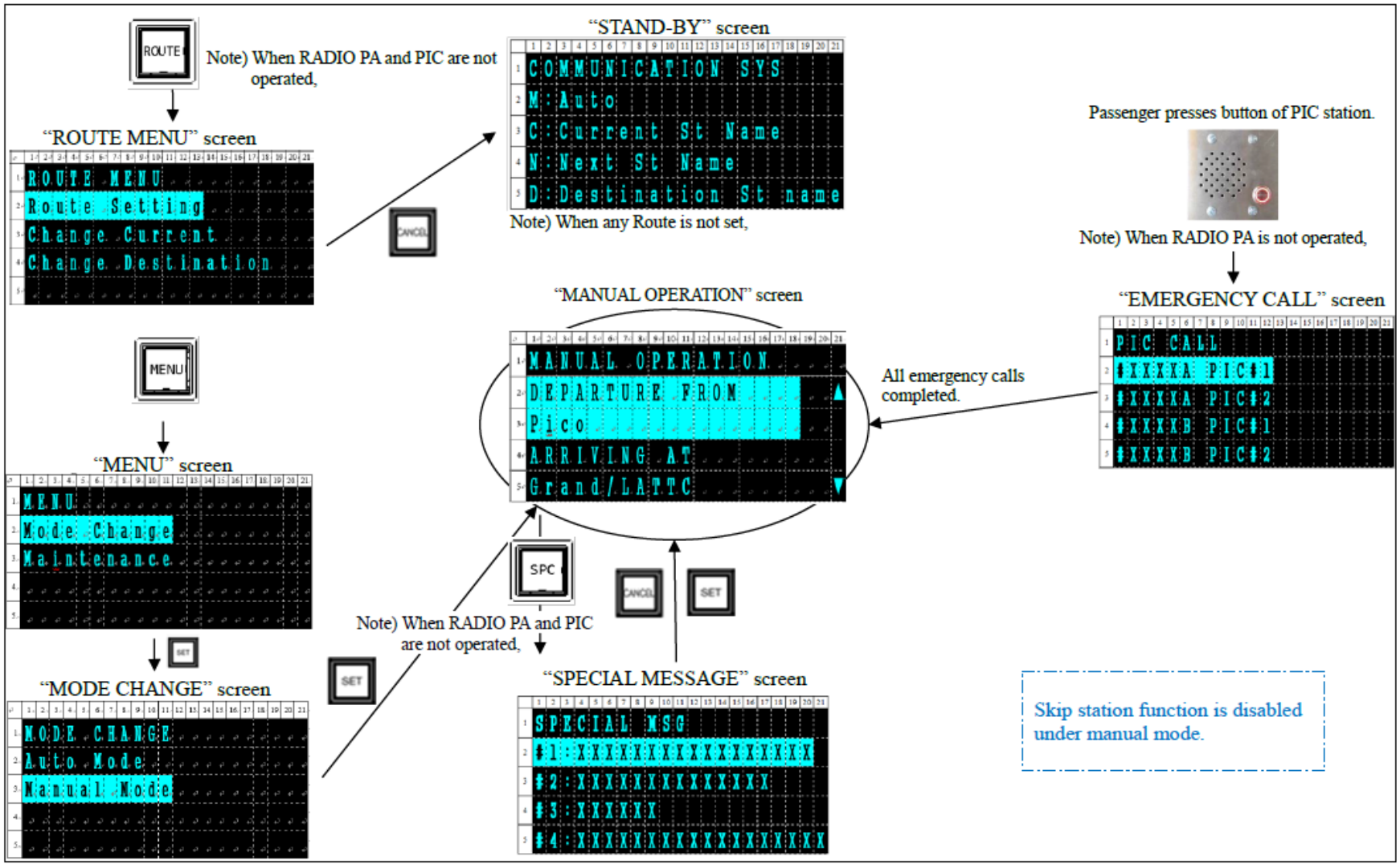
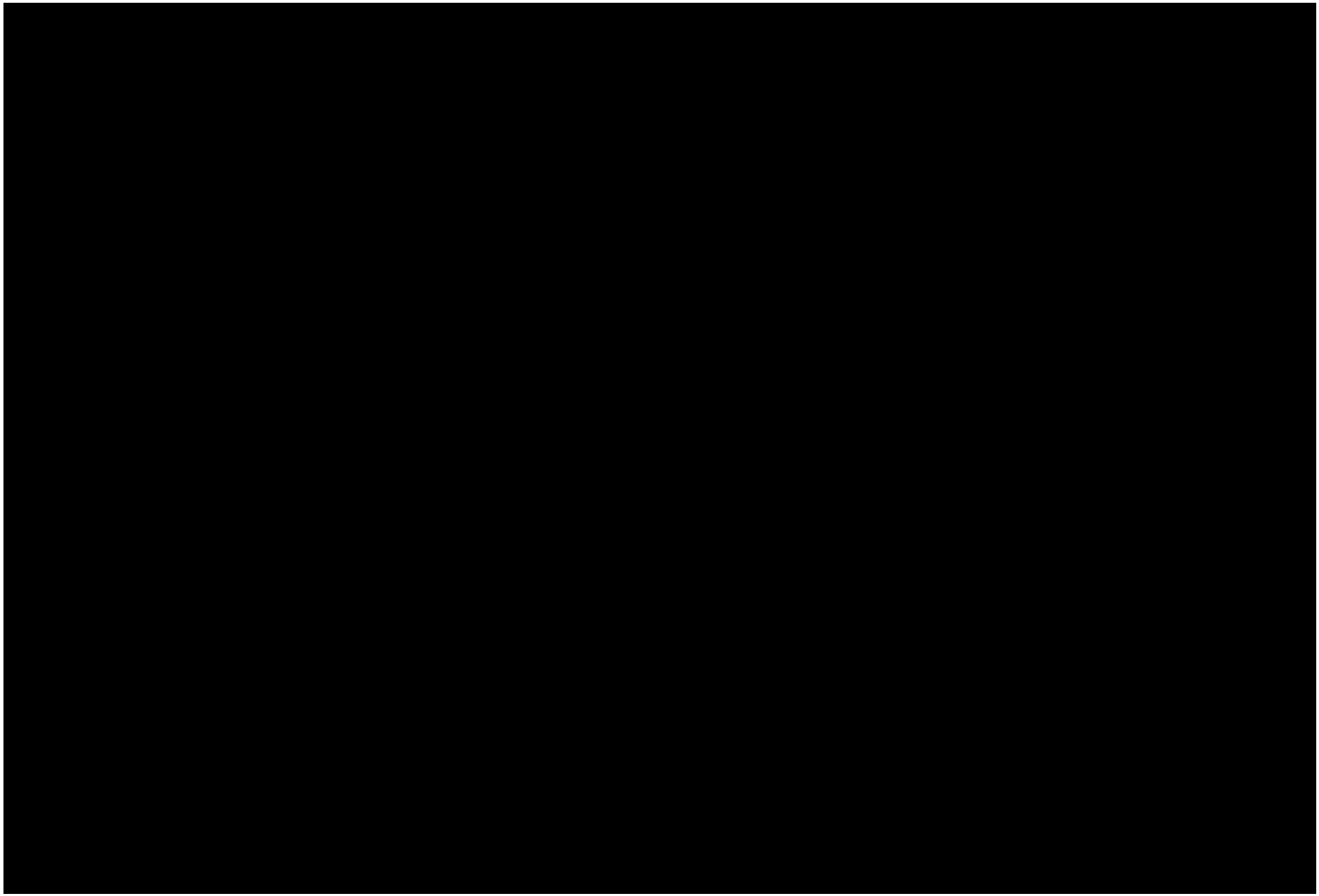


Figure 2-20: TOA CCH Screen Transition Diagram in Manual Mode

Table 2-3 shows the detailed technical specification of the CCH and Figure 2-21 shows the Drawing of the CCH.

Table 2-3: CCH Technical Specifications

Item	Description
Power Requirements	
Power source from ACP	24VDC
Interface	
Serial communication with ACP	RS485
Pushbutton	
Other	
LCD monitor	High-definition fluorescent display tubes 256x128 dot (Dot pitch 0.325x0.325 mm)
Outer material	SECC (Electrolytic zinc-coated steel sheets)
Paint color	RAL 1500 Gloss 20% to 30% (Black color)



2.9.1.3 Interface Unit (IFU)

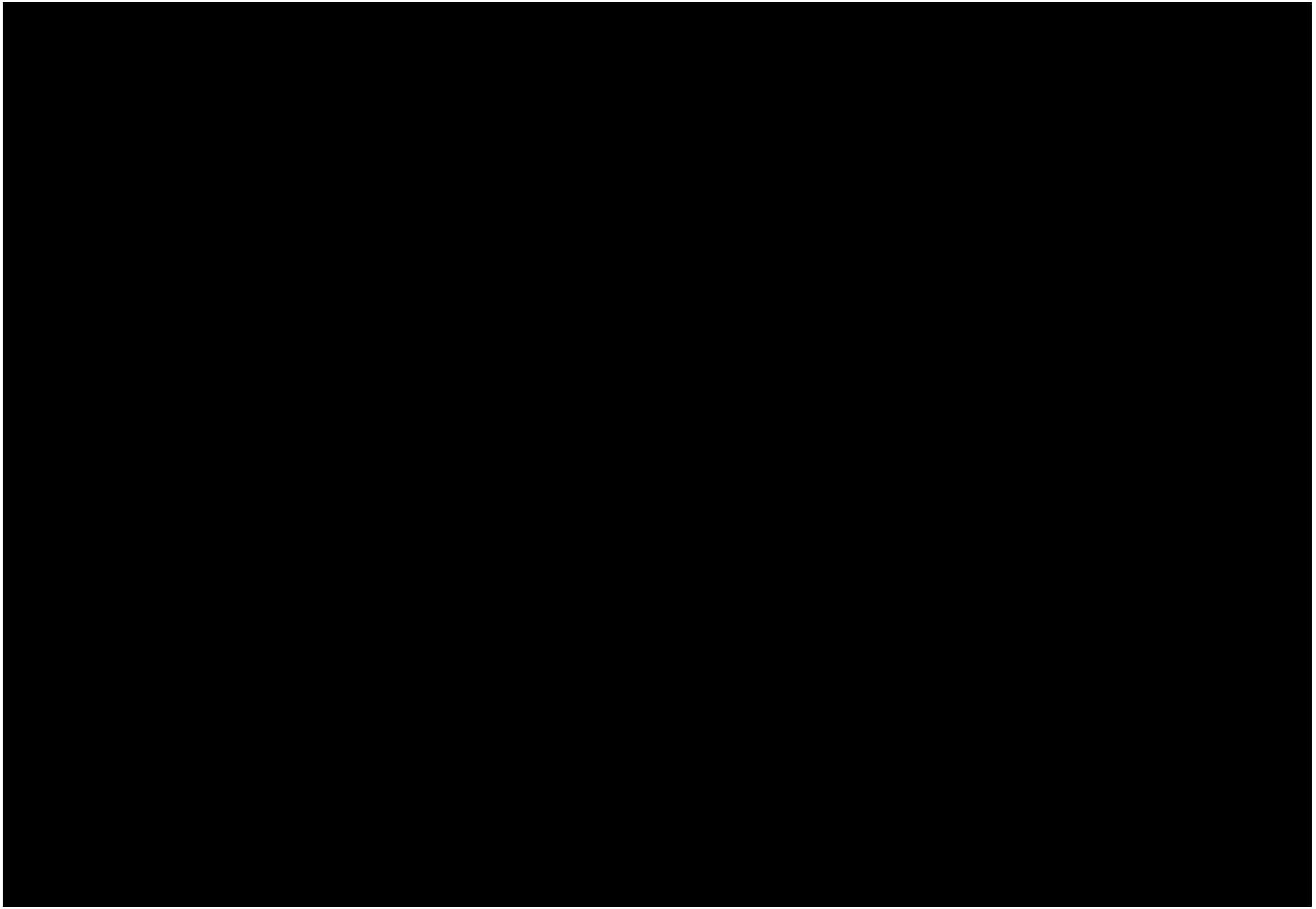
The IFU receives signals of train information through the train network and transmits these signals to the TOA Communication System. One of those signals of train information is Timestamp, which the MDS provides. If any fault and PIC status in the TOA Communication System is changed, the IFU transmits Fault information and PIC status information to the MDS. The TCN sends the Door status and wheel diameter to the IFU periodically. The IFU asks the status of the PA speaker selector, door announcement button, and PTT switches to RIO(A) and RIO(B) periodically.

Table 2-4 shows the detailed technical specifications of the TOA IFU. Figure 2-22 and Figure 2-23 show the appearance and drawing of TOA IFU.

Figure 2-22: IFU – The Appearance of Interface Unit

Table 2-4: IFU Description

Item	Description
Power Requirements	
Power source	28.5 VDC (17VDC to 30 VDC)
Input Current	Typical 200mA (MAX 300mA) @28.5 VDC
Interface	
Ethernet for RTC network	100BASE-TX
Ethernet for TOAE network	100BASE-TX
Protection	1.5 kV magnetic isolation
Protocols	UDP/IP, Modbus TCP/IP
Other	
Outer material	SECC (Electrolytic zinc-coated steel sheets)
Paint color	RAL 1500 Gloss 20% to 30% (Black color)



2.9.1.4 Ethernet Switch, Viper-112A

Table 2-5 shows the detailed technical specifications of the TOA Ethernet Switch. Table 2-6 shows the port configuration of the TOA Ethernet Switch. Figure 2-24 shows the appearance of the TOA Ethernet Switch.

Figure 2-24: The Appearance of TOA Ethernet Switch, Viper-112A

Table 2-5: TOA Ethernet Switch Technical Specifications

Item	Description
Power Requirements	
Rated voltage	24 to 110VDC
Rated current	Max 350mA @ 24V, max 90mA @ 110V
Interface	
X1-X12 Ethernet ports	IEEE std 802.3. 2005 Edition 10 Mbit/s, 100 Mbit/s, manual or auto 8-pin M12 X-code
USB, USB port	USB 2.0 host interface Up to 480 Mbit/s (high-speed mode) Maximum supply current: 500 mA 5-pin M12 female A-code, use Westermo USB plug 3641-0190
CON, Console port	RS-232 115.2 kbit/s 5-pin M12 female B-code, use Westermo cable 1211-2215

Table 2-6: Destination from each Port of the TOA Ethernet Switch

Ethernet Switch (A-Unit LAN A)						
Port No.	Port X1	Port X2	Port X3	Port X4	Port X5	Port X6
Destination	TOA Ethernet Switch B	TOA Ethernet Switch B	ACP A			
Port No.	Port X7	Port X 8	Port X9	Port X10	Port X11	Port X12
Destination		TOA Ethernet Interface Module A1	FDS	SDS	PIDS Controller	TOA Ethernet Interface Module A2
Ethernet Switch (B-Unit LAN B)						
Port No.	Port X1	Port X2	Port X3	Port X4	Port X5	Port X6
Destination	TOA Ethernet Switch A	TOA Ethernet Switch A	ACP B	IFU		
Port No.	Port X7	Port X8	Port X9	Port X10	Port X11	Port X12
Destination		TOA Ethernet Interface Module B1	FDS	SDS	PIDS Controller	TOA Ethernet Interface Module B2

2.9.1.5 Ethernet Interface Module, DDW-002-B1

Table 2-7 shows the detailed technical specification of the TOA Ethernet Interface Module. Figure 2-25 shows the appearance of the TOA Ethernet Interface Module.

Figure 2-25: Ethernet Interface Module, DDW-002-B1

Table 2-7: Ethernet Interface Module Technical Specification

Item	Description
Power Requirements	
Rated voltage	24 to 110VDC
Operating voltage	16.8 to 143 VDC (14.4 VDC for 100 ms, 154 VDC for 1 s)
Rated current	350 mA at 24 VDC and 90 mA at 110 VDC
Interface	
X1	1 x 10/100 Mbit/s
X2	1 x 2-wire interface up to 70 Mbit/s, distance up to 300 m (depending on cable characteristics). The wire may be powered, up to 143 VDC.

2.9.2 Passenger Information System

2.9.2.1 Passenger Information Display (PID)

The PIDs displays are located on the bulkhead wall adjacent to the cab and at the articulation The PIDS LCD display can be seen in Figure 2-26. The LCD display has a single VGA input and is connected directly to the VGA extender transmitter. There is a local VGA connection to the display mounted on the cab wall. There is a multiconductor cable connection to the extender receiver mounted adjacent to the display on the back of the articulation electric locker door. The LCD display has the following specifications:

- 19" 1280X1024 (SXGA) Resolution
- 500 nits (Brightness)
- LED Backlight
- Horizontal (right/left) = 170 degrees
- Vertical (up/down) = 160 degrees
- 1000:1 Contrast Ratio
- 5ms Response Time
- 1 x VGA Video Input (DB-15 Connector)
- Ambient Light Sensor
- Protective 4mm Transparent Lexan Glass (Lexan 9030-112)

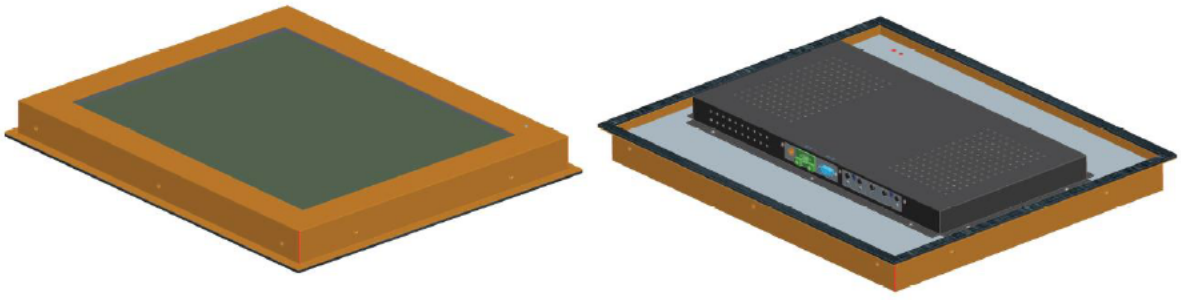


Figure 2-26: PIDs Displays

2.9.2.2 VGA Extender Receive and Send Unit

The VGA extender is made up of a send and a receive module. Both modules have a VGA connection. There is an input VGA on the send module and an output VGA on the receive module. The media in between the modules is Cat5 cable with M12 terminations. These extenders amplify the VGA signal for transmission over long cable runs.

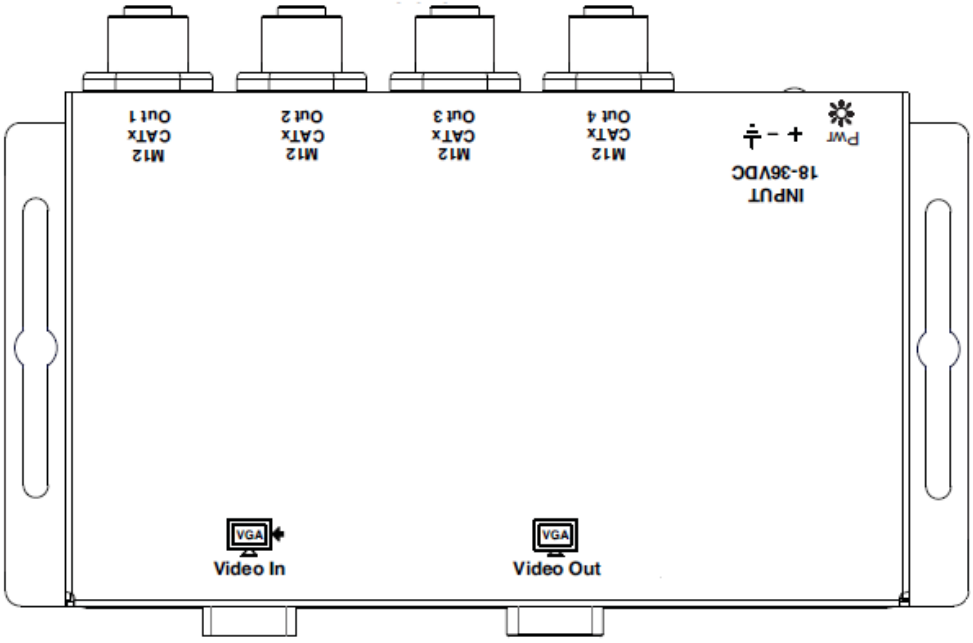


Figure 2-27: VGA Extender (Transmit)

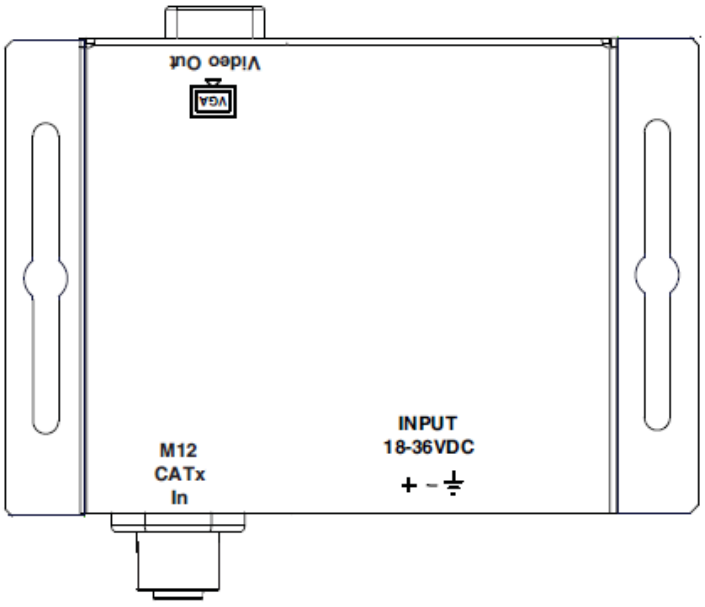


Figure 2-28: VGA Extender (Receive)

2.9.2.3 PID Controllers

The PIDS Controller is an embedded computer used to drive the PID Displays. There are two identical PID Controllers, one each located in the cab ceiling. The PID controller is shown in Figure 2-29 and has the following specs:

- CPU: Intel® Atom™ D525 1.8GHz Dual Core CPU
- System Chipset: Intel® ICH8M
- BIOS: AMI BIOS
- Graphics: Intel Graphics Media Accelerator 3150
- Memory: 1 x 2GB DDR3, 800MHz, SO-DIMM, NON-ECC
- I/O Interfaces: 1 x Gigabit Ethernet (M12 Connector)
  2 x USB2.0 (Type A Connector)
  1 x VGA Video Output (DB-15 Connector)
  1 x 17~30V DC Power Input (Phoenix Connector 2 pin)
- Storage Option: 2.5” SATA Drive Bay
- Switches: Power Switch
- Other: Grounding Stud (M6 Threaded)

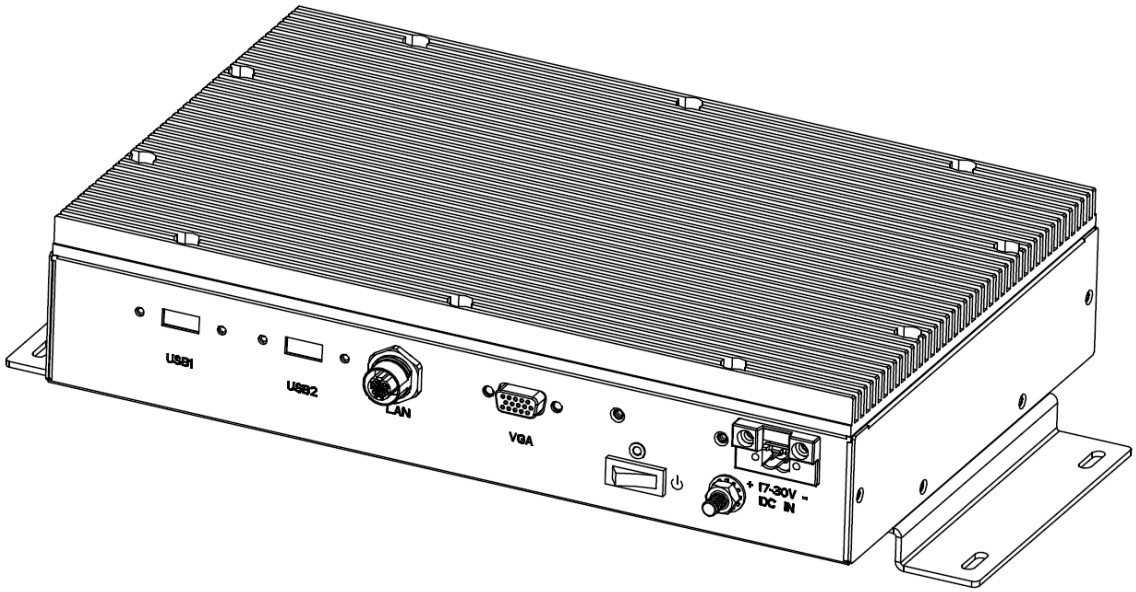


Figure 2-29: Controller

2.9.3 Passenger Intercom (PIC) Stations

Passenger Intercoms are provided at four places in the passenger compartment. They are controlled by the A-end and B-End ACPs, enabling controls the speaker/mic and the indicator light pushbutton.

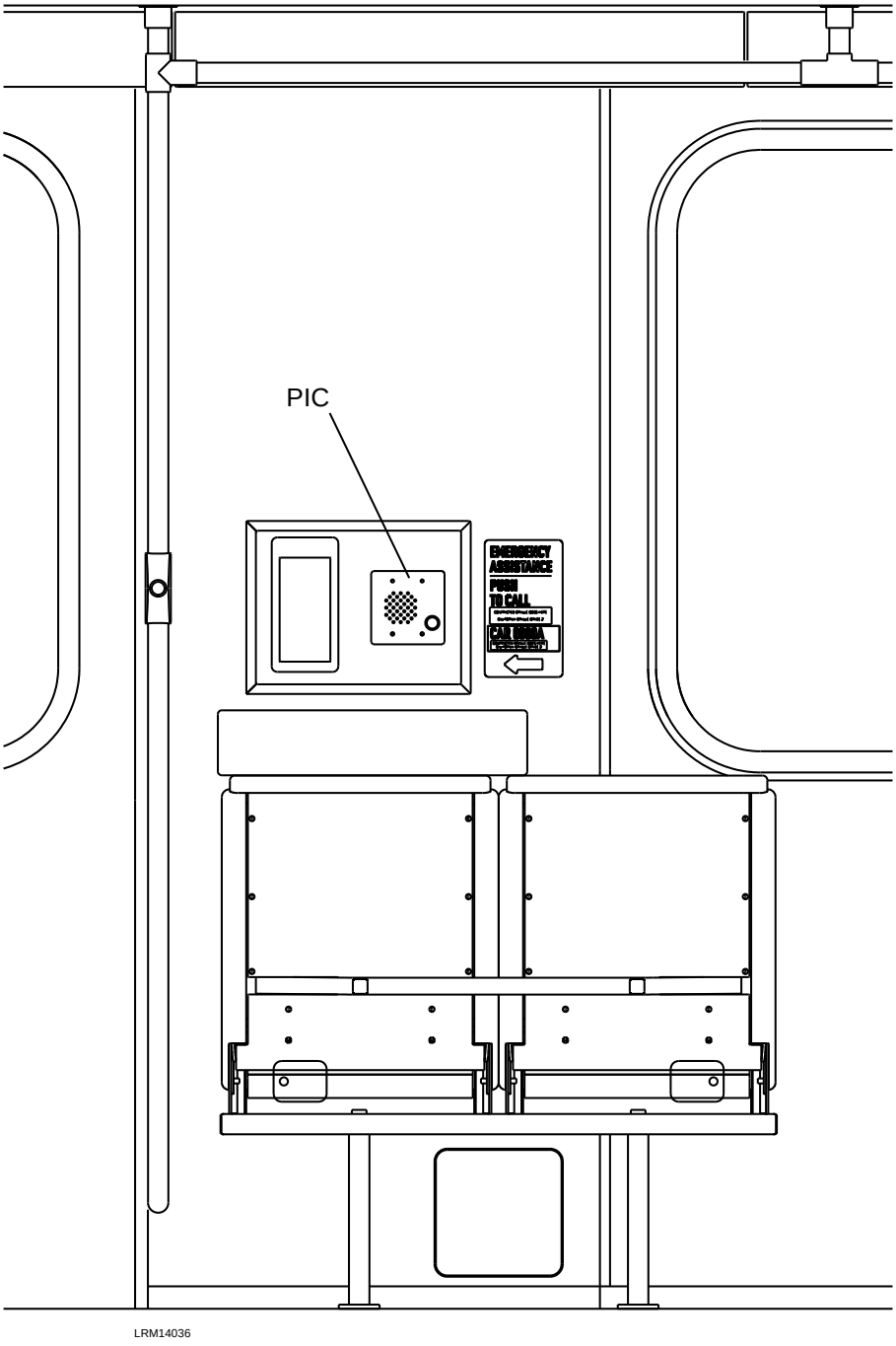


Figure 2-30: Passenger Intercom Station

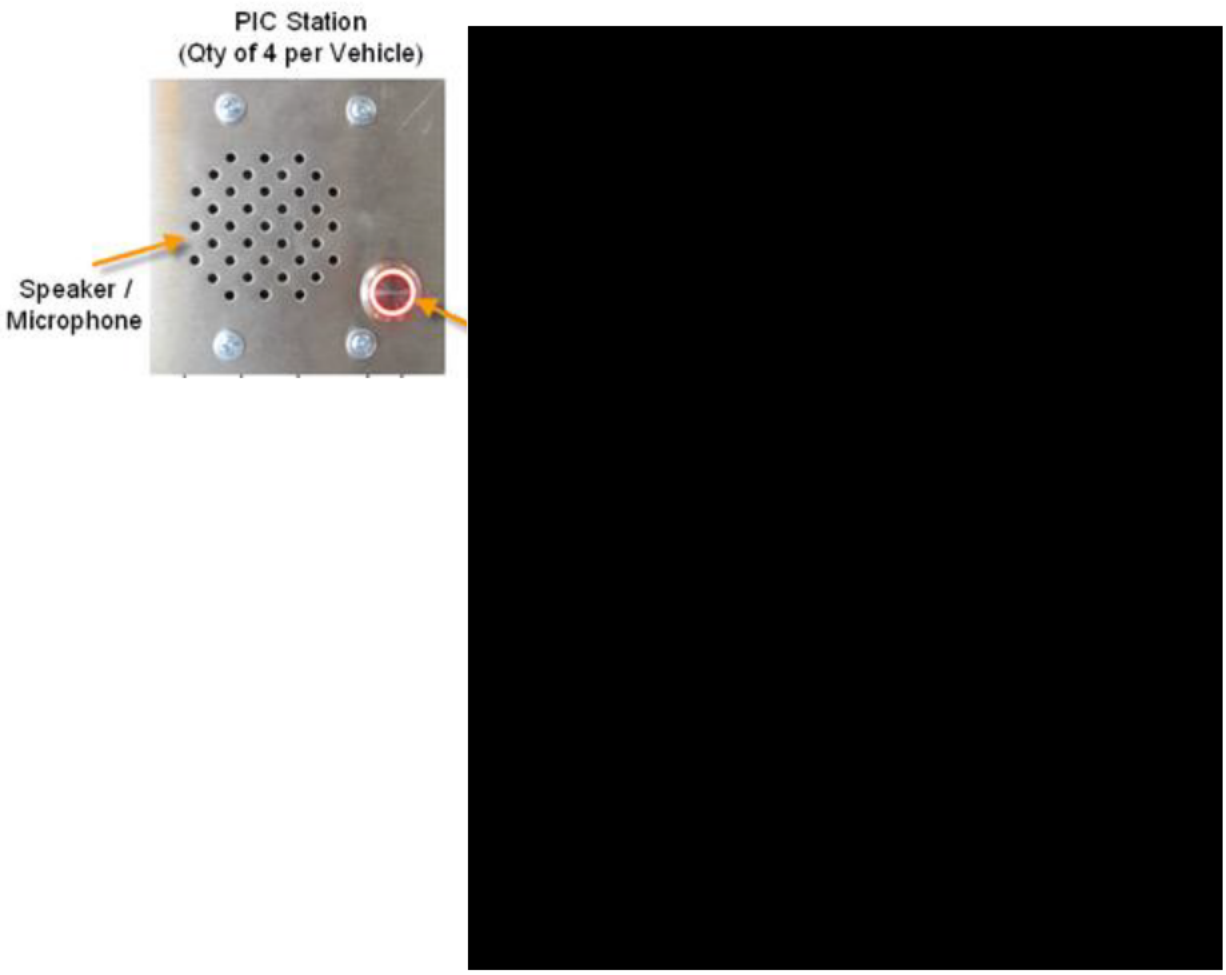


Figure 2-31: Passenger Intercom Station Interconnect Diagram
(Refer to Vehicle Schematic for Actual Wiring)

2.9.4 Exterior Destination Signs

The exterior sign system is computer-controlled and consists of four sign assemblies: one at each end of the vehicle and one on each side of the vehicle. The manufacture of the signs is Teknoware.

2.9.4.1 Front Destination Signs

The front destination sign is a single-sided external sign that displays route color code and destination. The destination display is an amber color monochrome LED array capable of displaying 13 characters with a 6 in. (15 cm) character height. Up to 78 characters may be scrolled across the display. It can also display a scrolling six-page message with up to 13 characters per page.

The route code display is a single character full color LED array with a 6 in. (15 cm) high character. At each end of the sign there is a power connection for marker lights. The sign also contains an optical sensor that adjusts the intensity of the display relative to the ambient light.

The front destination sign contains the following PCB's:

- Amber Message Display PCB – Three PCB's comprise the 6-inch amber display array. Each PCB contains an LED matrix that when connected together displays the programmed message transmitted by the ACPs.
- Color Route Code Display PCB – A single PCB containing an LED matrix that displays the route code transmitted by the ACP.
- Light Sensor PCB – An electronic circuit that automatically adjusts the display intensify based on ambient light.
- Power Supply PCB – Provides a regulated, constant source of power for all electronic components in the sign assembly.
- Control PCB – Communicates with the ACPs using the UDP protocol and controls the displayed information.

Each of the display PCB's has an eight-position DIP switch which is used to set the logical address of the sign. The DIP switch settings for the front destination sign are:

Display PCB 1	Off	Off	Off	Off	Off	Off	Off	Off
Display PCB 2	Off	Off	Off	Off	ON	Off	Off	Off
Display PCB 3	Off	Off	Off	Off	ON	Off	Off	Off

Figure 2-32: Front Destination Sign

2.9.4.2 Side Destination Signs

The side destination sign is a single-sided exterior sign mounted on the side wall of each car-pair. The display is an amber-color monochrome LED array that can display thirteen 4 in. (10 cm) characters. Up to 78 characters may be scrolled across the display.

The route code display is a full color LED array displaying a single 4 in. (10 cm) high character.

The side destination sign also contains an automatic dimming control that adjusts the intensity of the display relative to the ambient light.

The side destination sign contains the following PCB's:

- Amber Message Display PCB – Two PCB's comprise the 4-inch amber display array. Each PCB contains an LED matrix that when connected together displays the programmed message transmitted by the ACPs.
- Color Route Code Display PCB – A single PCB containing an LED matrix that displays the route code transmitted by the ACP.
- Light Sensor PCB – An electronic circuit that automatically adjusts the display intensity based on ambient light.
- Power Supply PCB – Provides regulated, constant source of power for all electronic components in the sign assembly.
- Control PCB – Communicates with the ACPs using the UDP protocol and controls the displayed information.

Each of the display PCB's has an eight-position DIP switch which is used to set the logical address of the sign. The DIP switch settings for the side destination sign are:

Display PCB 1	Off	Off	Off	Off	Off	Off	Off	Off
Display PCB 2	Off	Off	Off	Off	ON	Off	Off	Off

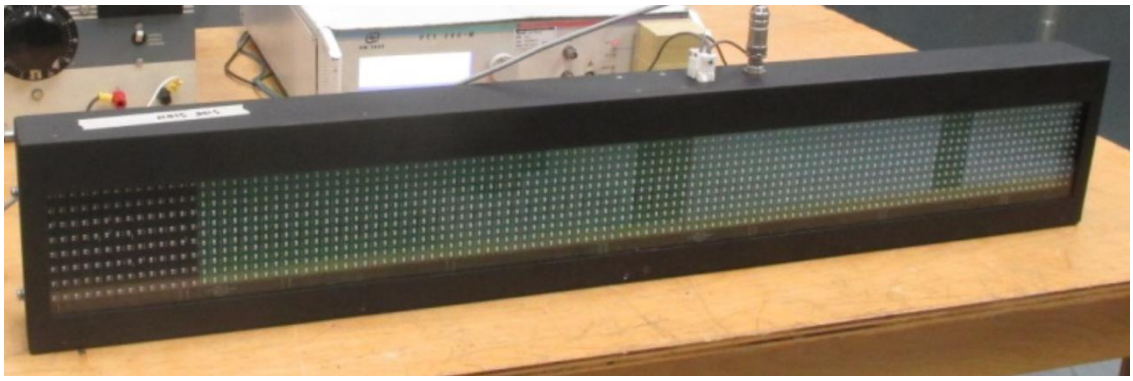
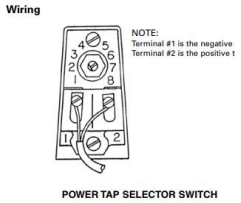


Figure 2-33: Side Destination Sign

2.9.5 Speakers

2.9.5.1 Exterior Speakers

The Exterior Speakers are manufactured by ATLAS Sound and are Model: APF-15T (15 Watts). There are four per side arranged in zones that correspond to the side the speakers are mounted on. The speakers have a Vari-Tap dial arrangement which is set on 4 (7.5 Watts, 666 ohms impedance) for proper sound level @ 70.7 V. This setting was determined through test and should not require adjustment unless speaker is replaced.



Switch Position	Impedance Ω	100V	70.7V	25V
1	5000Ω	2.0 Watts	1.0 Watts	.125 Watts
2	2500Ω	4.0 Watts	2.0 Watts	.25 Watts
3	1300Ω	7.7 Watts	3.8 Watts	.48 Watts
4	666Ω	15.0 Watts	7.5 Watts	.94 Watts
5	333Ω	DO NOT USE	15.0 Watts	1.8 Watts
6	89Ω	ON 100V Line	DO NOT USE	7.5 Watts
7	45Ω	-	ON 70.7V Line	15.0 Watts

Figure 2-34: Exterior Speaker

2.9.5.2 Interior Speakers

The interior speakers are manufactured by Minneapolis Speaker Company (MISCO) and are Model: N9870-1, they are power rated at 12 Watts and use a 70.7 V transformer input tapped at 1 Watt for the P3010 application.

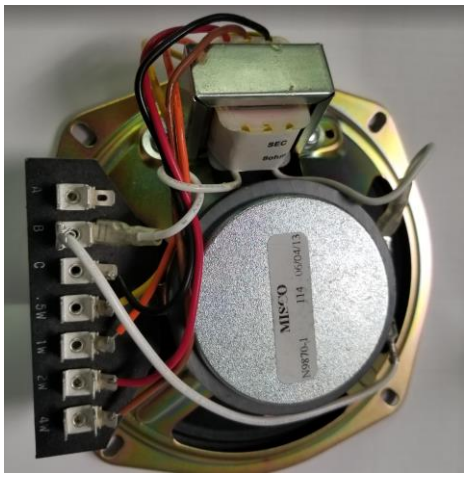


Figure 2-35: Interior Speaker

2.9.5.3 Cab Speakers

The cab and radio speakers manufactured by Minneapolis Speaker Company (MISCO) and are Model: N5929-1. They are power rated at 12 Watts and impedance rated at 8 ohms.

Figure 2-36: Cab Speaker

2.9.6 In-Dash Microphone

The In Dash Microphone is manufactured by JLI electronics and is Model: JLI-52B. There are no user serviceable parts. It is connected directly to the ACPs.

Figure 2-37: In-Dash Microphone

2.9.7 Remote I/O Module

The P3010 uses four (4) ioLogik E1510-T for the MDS Ethernet Remote Digital Input signals, and two (2) ioLogik E1512-T for the CCU and IFU specific Digital Input signals, and driving any indicators. These digital inputs replicate / translate vehicle indications into network messages. There are no user servicable parts inside the unit(s).

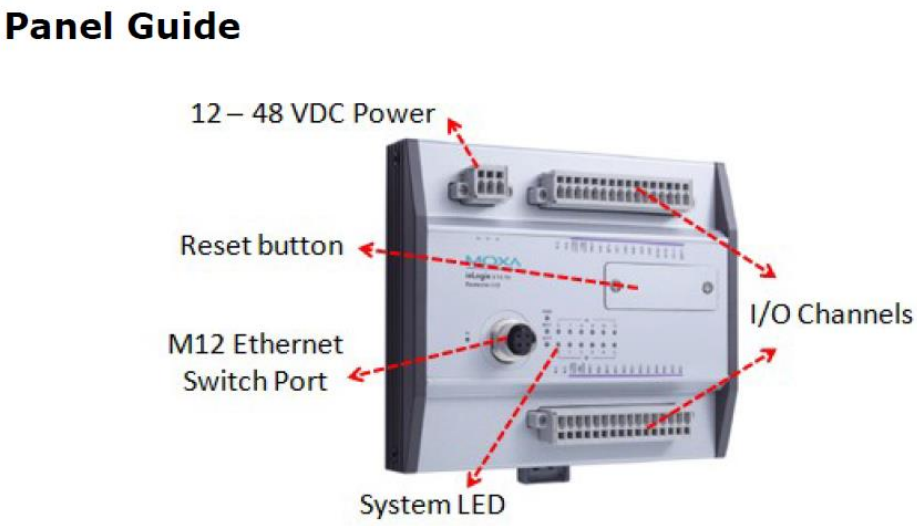


Figure 2-38: Ethernet Remote I/O Module Drawing

The Ethernet RIOs are shown on the circuit diagram, UD01450, in Sheets 815 through 819. Sheets 825 and 818 show the communications related signals gathered from the cab console buttons and switches. I/O signals are functionally labeled.

2.9.8 Communication Control Equipment (CCU)

The CCU/MDS computer is a “box computer” with no user serviceable parts. The differentiation between the CCU and the MDS is the software installation. Software is installed on the device via the PTU. Programming instructions are provided in the ***Communications Equipment Programming Guide*** provided separately. See Figures 2-39, 2-40, and 2-41.

Figure 2-39: CCU / MDS Computer

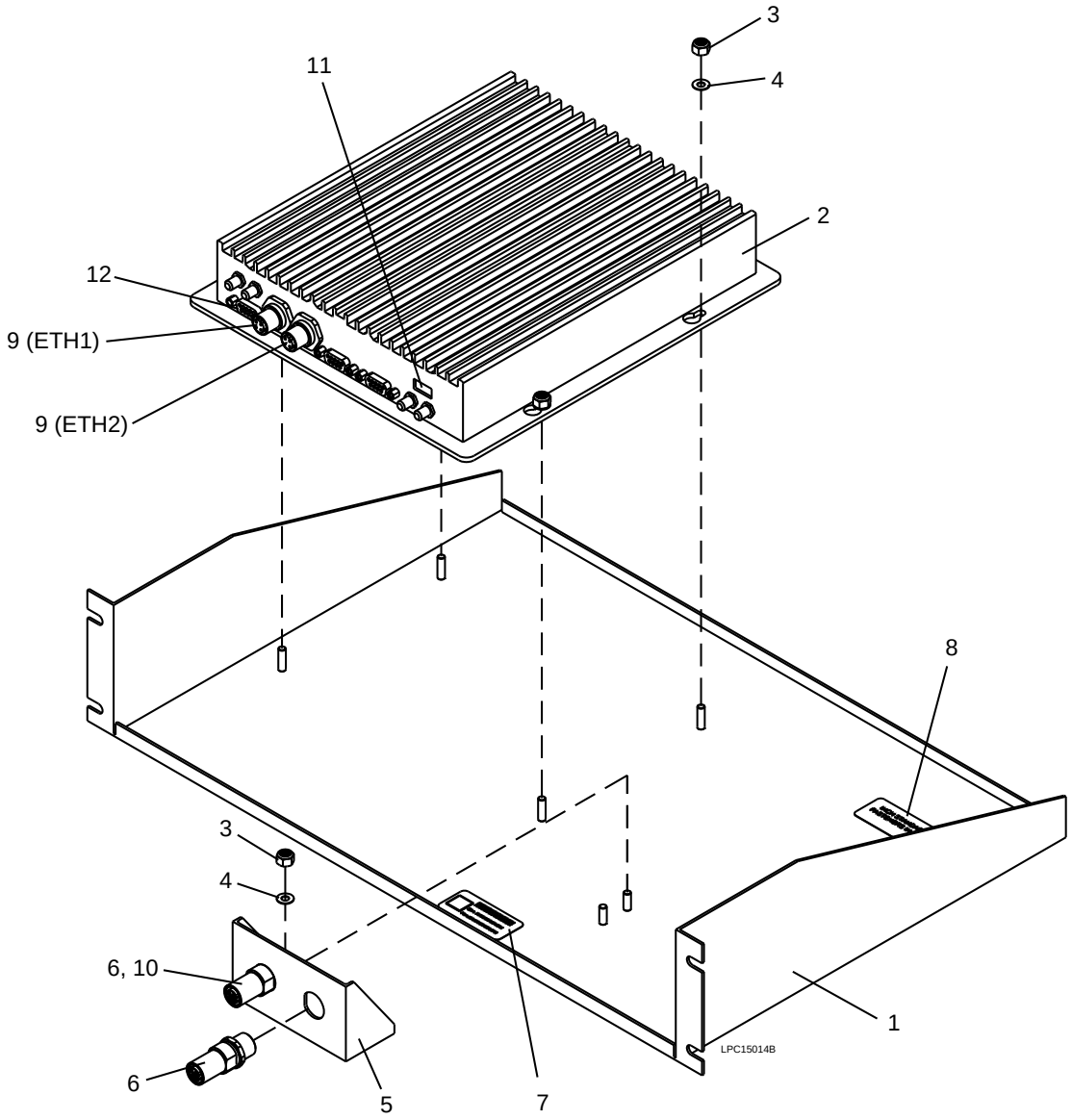


Figure 2-40: CCU / MDS Assembly

A failure of the CCU / MDS computer will cause a massive loss of data control. Also, loss of Ethernet communication with this device will indicate the same symptoms.

LED indicators are provided to indicate the state of the machine. A total of four Ethernet status LEDs, two for each Ethernet channel. They signal the link and activity status. If the Ethernet status LEDs are not illuminated, a connectivity issue between the MDS and the LRV network exists. The LRV circuits can be used to determine network connection locations and failure isolation can begin from this point.

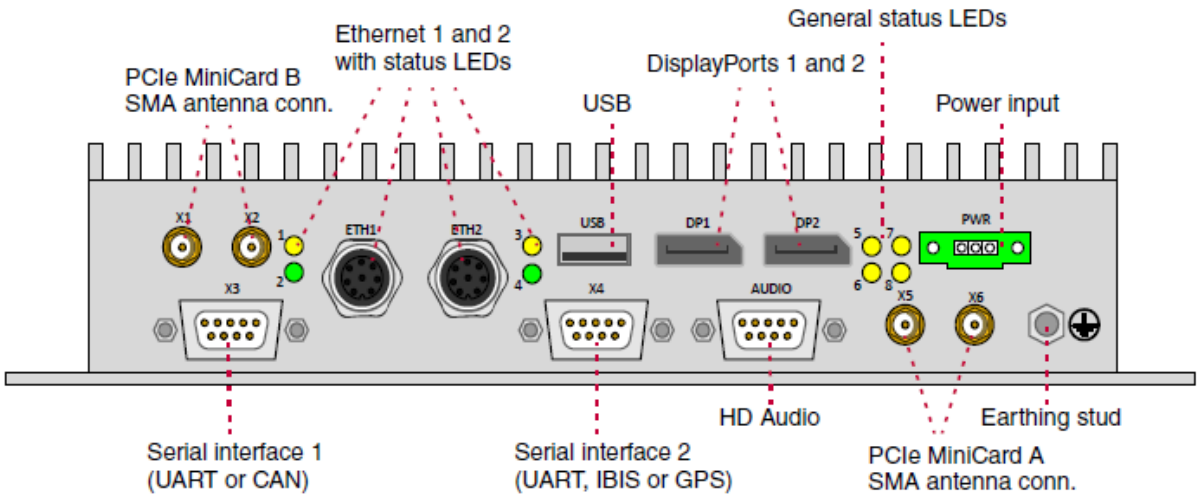


Figure 2-41: CCU Front View

Table 2-8. CCU Error Codes

LED	Description	Color	Function
1	Port 1 link	green	on, when connection established
2	Port 1 activity	yellow	on, when Ethernet communication on Rx or Tx
3	Port 2 link	green	on, when connection established
4	Port 2 activity	yellow	on, when Ethernet communication on Rx or Tx

In addition to the four Ethernet status LEDs, there are four general status LEDs. LED 6 indicates whether input power is applied and LED 7 indicates whether the output power to the SBC board as generated by the unit's on-board DC/DC converter is within valid range. LEDs 5 and 8 are not used in this application.

The status LED (LED6) is connected to the system's board controller.

It has the following behavior:

- off, if system is off.
- on, if system is in on state and BIOS has sent live sign after power-up.
- it flashes repeatedly n times according to an error code and pauses for one second until the system is restarted or completely powered-off, if system is in error condition and error code is n.

See the following table for supported error codes.

Table 2-9: CCU Error Codes

Error Code	Description	Solution
1	+V3.3A Voltage Failure	internal failure
2	Input Voltage Failure	internal failure
3	External Power Supply Failure	check power supply voltage range
4	CPU too hot	check thermal constraints
5	BIOS Live Sign Timeout	internal failure
6	System Reset Timeout	internal failure
7	Platform Reset Failure	internal failure
8	Chipset Handshake Failure	internal failure
9	System Power OK Failure	internal failure
255	Invalid PIC state	internal failure

If an internal failure occurs and powering off the system does not reset the system, the CCU/MDS computer has failed such that it must be returned to the OEM for repair.

2.9.9 Global Positioning System (GPS) Receiver/Antenna

The GPS Receiver Antenna is manufactured by Garmin. It is Model: GPS 19x HVS. It is roof mounted on over the A-End cab. It is wired directly to the CCU via a RS-232 connection.

There are no user serviceable parts. On the TOD on the main screen there is an indication of the GPS connectivity. If the GPS is connected to satellites, it will be indicated. Ensure that there is a clear view of the sky to allow it to acquire the satellites. In the maintenance screens of the TOD there is a screen that is dedicated to GPS receptivity. Access this screen to verify GPS receiver functionality. Refer to Section 8.5 of this manual section.

2.9.10 Wayside Worker Alert System

The Wayside Worker Alert System consists of the following items listed in Table 2-10. Specifications on the system are found in Table 2-11.

Table 2-10: WWAS Hardware

Item	Description	Part Number	Carset Qty.	Comment
1	ProTracker Train Mounted Transceiver	370-31485-LAC	2	Mounted in cab ceiling
2	Custom Rubber Gasket	RTC 2239	2	Roof Mounted
3	Custom Rubber Gasket	RTC 2241	2	
4	Amphenol Connector	SCPH08FJ14S-2S-F80-B2	2	
5	Floyd Bell Alarm	99P-BUZ-004	2	
6	Custom Molded Antenna with Anodized Mounting Block	370-3100-Ant-LA	2	
7	Coaxial Cable 5 m (16.4 ft)	LMR-240	2	
8	Anodized Mounting Block	370-3100-Ant-LA	2	

Table 2-11: WWAS Requirements

Agency Approvals	US (FCC) OUR-XBEEPRO Canada (IC) 4214A-XBEEPRO Europe (CE) ETSI
RF Frequency	Frequency of Operation 902-928 MHz. Spread Spectrum Type Frequency Hopping Unique ID code
Spread Spectrum Type	DSSS (Direct Sequence Spread Spectrum) utilizing 12 direct sequence channels and up to 65,000 available network addresses for each channel.
RF Frequency Saturation	Equipment Immune to RF Frequency Saturation
Collision Avoidance	Allow multiple transmitters and receivers to operate in the same area with zero corruption.
Output Power	100mw Max. Maximum Current at Antenna Connector: 35mA (AC current @ 900 MHz)
Encryption	128-bit AES encryption: Provide 100% secure connections between train and track mounted transmitters' horn/light unit and personal alert devices.
Receive Range	Adjustable 3000 feet or less
Operating Temp	-40C to +85ºC
DC Input	10-36VDC
Enclosure	Polycarbonate/NEMA 4, 4x 12 + 13
Indications	Track Worker High Rail Vehicle Wayside/Speed Restriction
RF Antenna	Each unit shall come with one antenna, capable of operating in the frequency of operation 902-928 MHz

The Train Mounted Unit is a transceiver that transmits and receives RF signals on a dedicated frequency (900 MHz). The Train Mounted Unit communicates with the Personal Alert Device (PAD), Portable Warning Light and Horn (PWLH), Speed Restriction Unit, Trespass Warning System, Platform Intrusion System among other Protran Technology equipment that may be installed or used on the tracks.

Train Mounted Unit

Train Mounted Unit

4" x 4" x 2.5" / 10.16cm x 10.16cm x 6.35cm
Weight 2lbs (.907kg)

Figure 2-43: ProTran WWAS Train Device

The antenna is a directional antenna focusing forward and installed on the front face of the vehicle, optimally at the top center. It is connected with coax cable to the Train Mounted Unit.

Antenna

Directional Antenna
3.25" x 4" x 4 "/ 8.26cm x 10.16cm x 10.16cm

Figure 2-44: ProTran Antenna

2.9.11 Horn

2.9.11.1 Horn Controller

The Hord Controller Panel consists of the Horn Controller and Horn Relay, as shown in Figure 2-45.

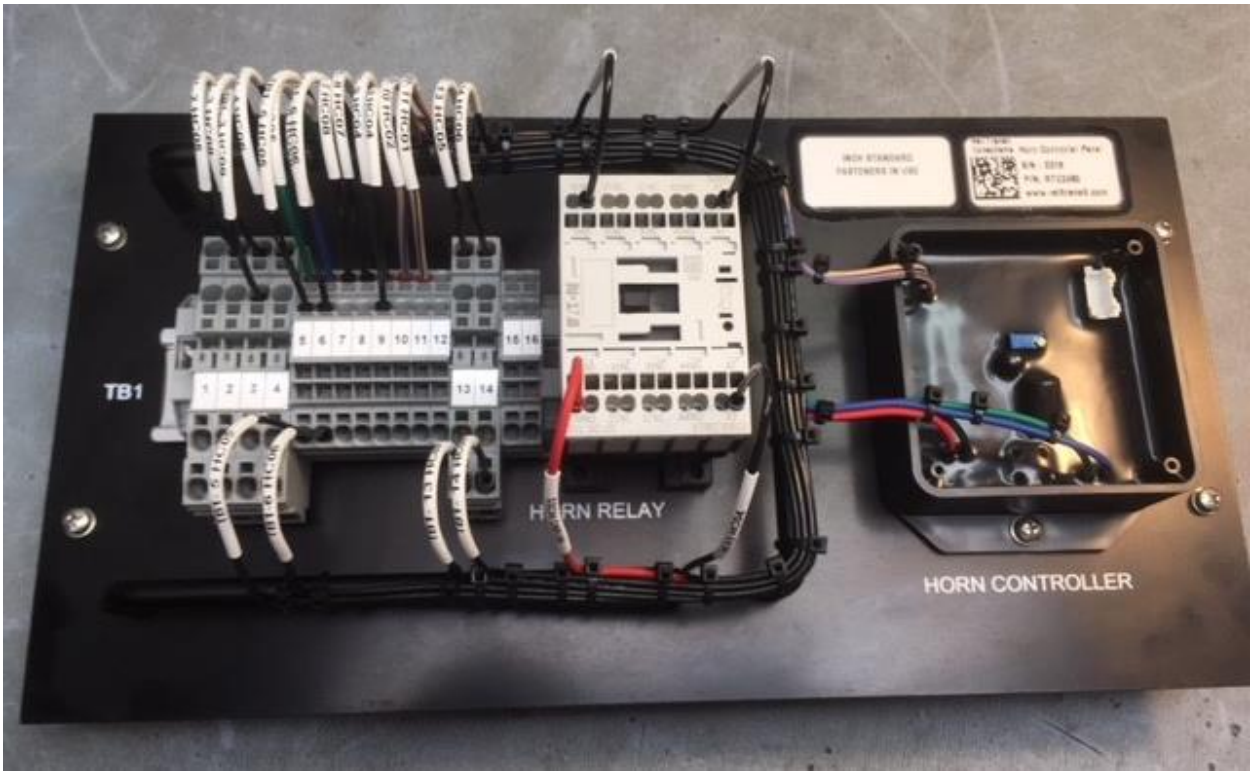


Figure 2-45: Horn Control Panel

2.9.11.2 Horn Speaker

The horn speaker is manufactured by ATLAS Sound. It is Model: HPG-370GA. This speaker is rated at 100 Watts and provides rugged weatherproof construction. It is mounted forward undercar at both ends.

Figure 2-46: Horn Speaker

Table 2-12: Horn Speaker Specifications

SPECIFICATIONS								
MODEL	POWER RATING	IMPEDANCE	FREQUENCY RESPONSE	SOUND LEVEL**	DISPERSION *****	DIMENSIONS W x H x D	FINISH	SHIPPING WEIGHT
HPG-370GA	100 Watts RMS	11 Ohms Nominal	450 - 3800 Hz (± 10dB) Nominal	110dB*** 116dB****	80° x 105° (1 kHz Octave Band)	7⅝" x 5⅜" x 7" (186 x 137 x 178mm)	Black Driver and Bell	6.5 lbs (2.9 kg)

*HPF – High Pass Filtered **Peak (dBA) ***Measured at 1600 Hz rated power, 3 meters on axis. (Ref.: .0002 dynes/cm²)
****Measured at 1 watt, 1 meter. (Ref.: .0002 dynes/cm²) *****2000 Hz octave band, -6dB points

2.9.12 Radio

NOTE The Radio is supplied by Metro and is the responsibility of the Metro Communications department. Contact Rail Comms for radio and radio programming issues.

The radio equipment is mounted on a Radio Equipment Panel that is mounted in the Cab Ceiling locker (both ends wired the same) close to the roof mounted radio antenna. A multi conductor cable is routed to the control head located on the cab console. A Master Key Switch contact is used to provide the ignition sense required by the radio.

The radio power supply provides an isolated 12 Vdc nominal power source to power the radio equipment. A circuit breaker is provided on the radio power supply to the radio to provide over current protection of the radio equipment. The radio power supply also is used to ground the radio silent alarm signal when the Silent Alarm pushbutton is depressed signaling a silent alarm event.

The radio is powered by a Radio Power Supply manufactured by interVOLT. It is Model: SVCi24225G2. There are no user serviceable parts. The radio power supply provides 12 volts isolated to the radio equipment.

The radio power supply, antenna, and interface to the vehicle is covered in this manual. The radio power supply has no user serviceable parts. It provides an isolated source of 12 Vdc power from the vehicle battery voltage input. The antenna is a whip style tuned to the Metro Frequencies.

Figure 2-47: Radio Power Supply

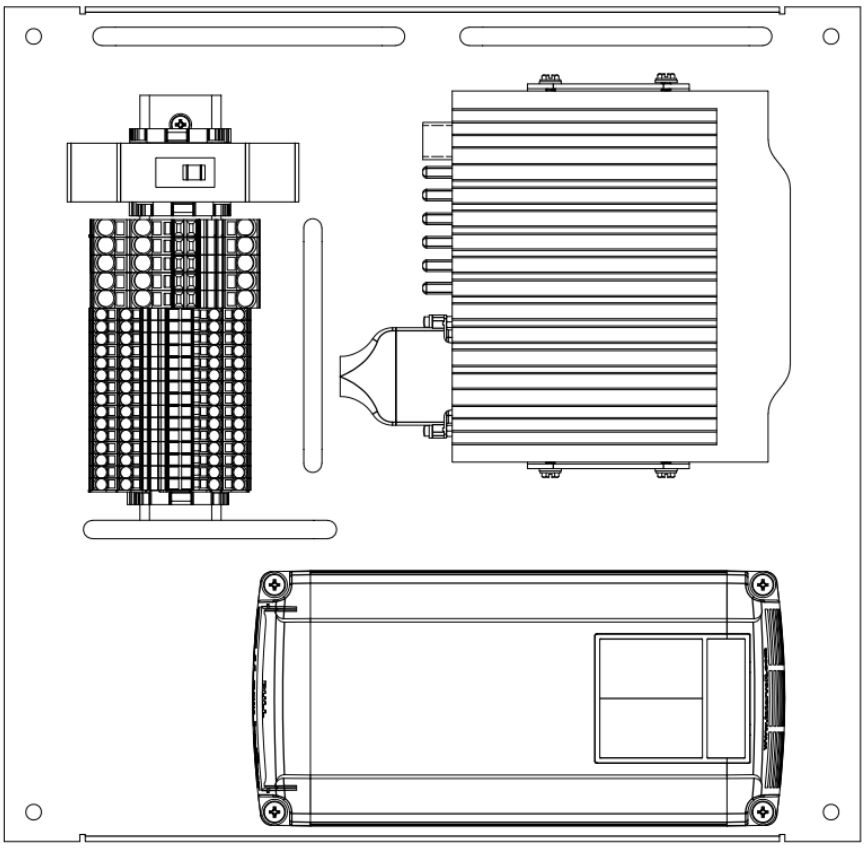


Figure 2-48: Radio Equipment Panel

CHAPTER 3.0

EQUIPMENT MOUNTING LOCATIONS

3.1 Introduction

This chapter describes the Communication equipment used on the Los Angeles LRV.

3.2 Equipment Description

Each item of the Communication equipment is described in the following paragraphs.

3.2.1 TOA Communications Equipment

3.2.1.1 Audio Control Panels (ACP)

The ACP is installed in the right-side locker in the cab as shown Figure 3-1 and Figure 3-2. One is installed in the A car, and another in the B car.

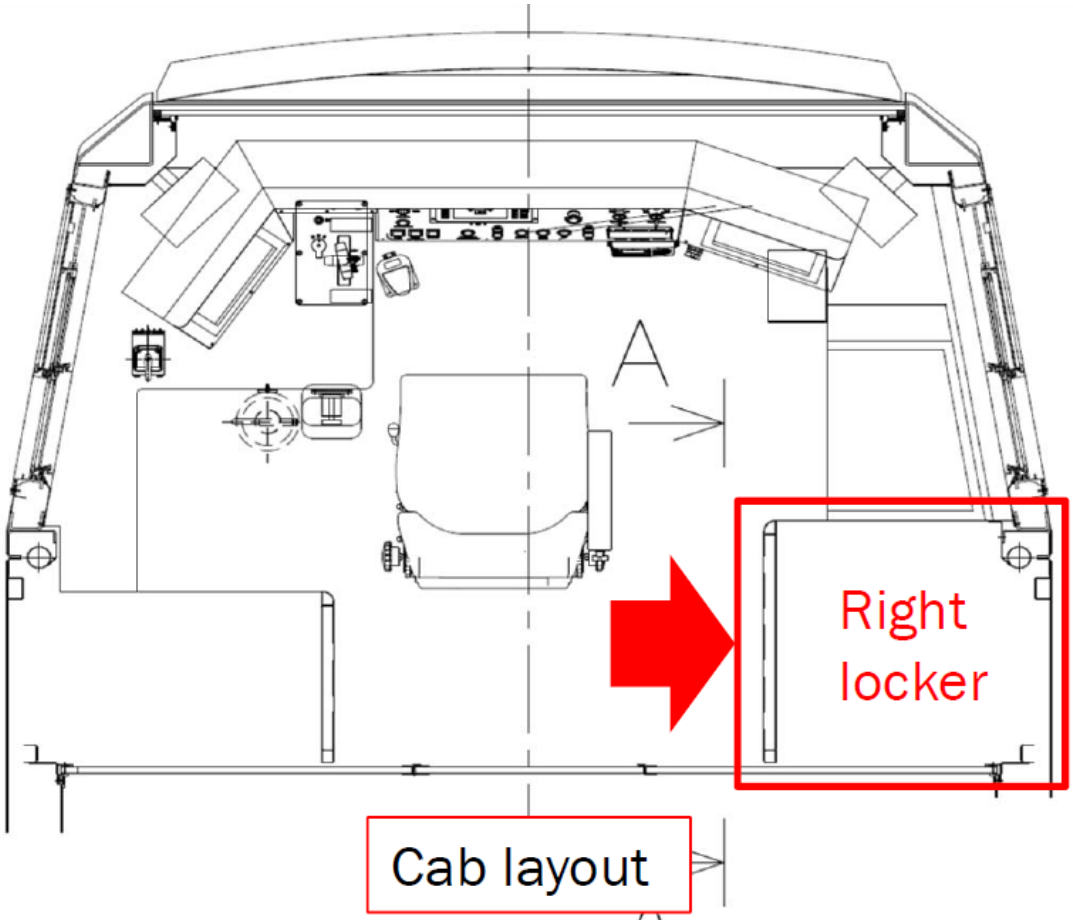


Figure 3-1: Installed ACP Location

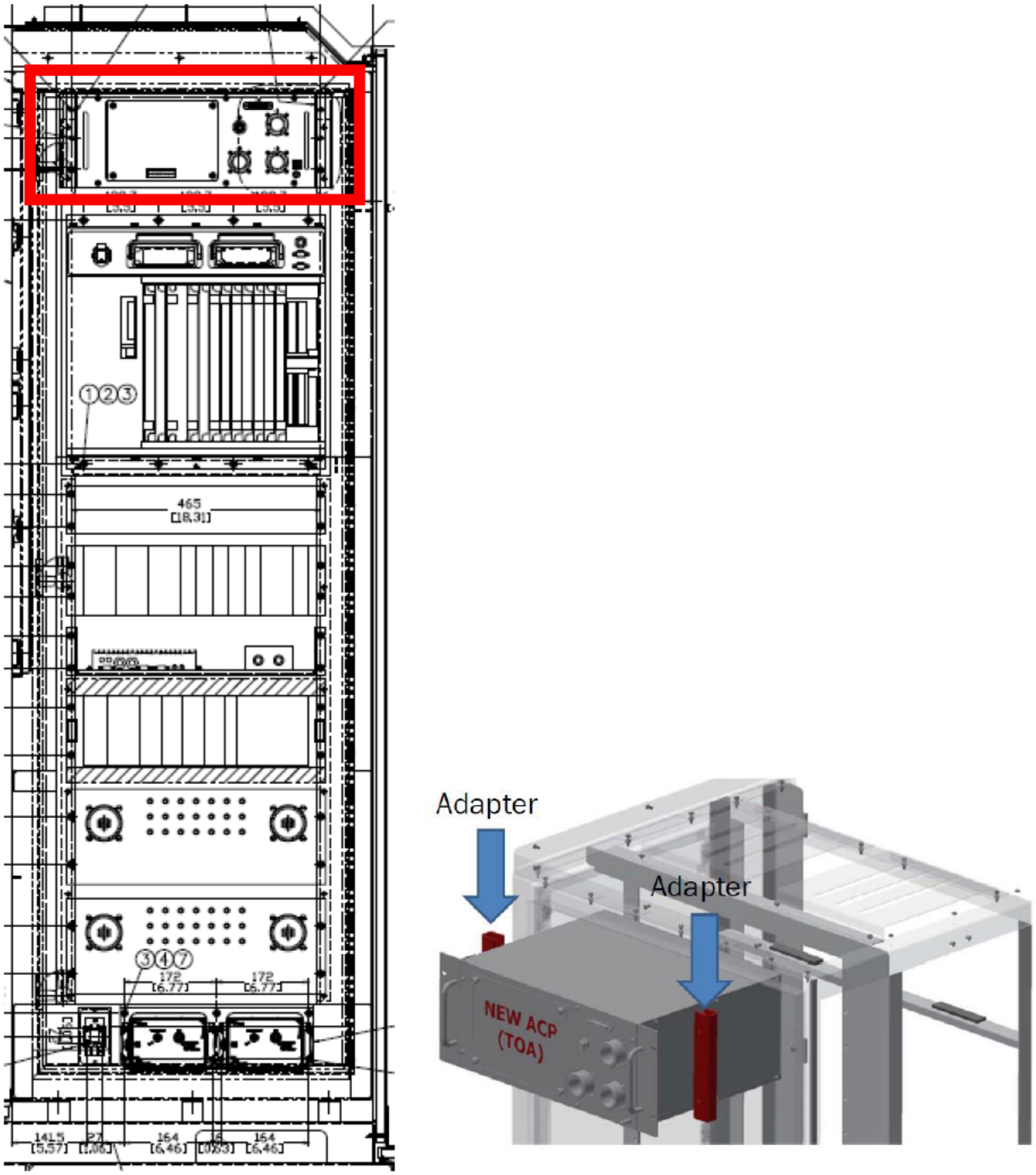


Figure 3-2: Location of ACP in the Right Cabinet

3.2.1.2 Communication Control Head (CCH)

The CCH is installed on the bottom of Console Panel 4 in the cab as shown in Figure 3-3. One CCH is installed in the A car, and another in the B car.

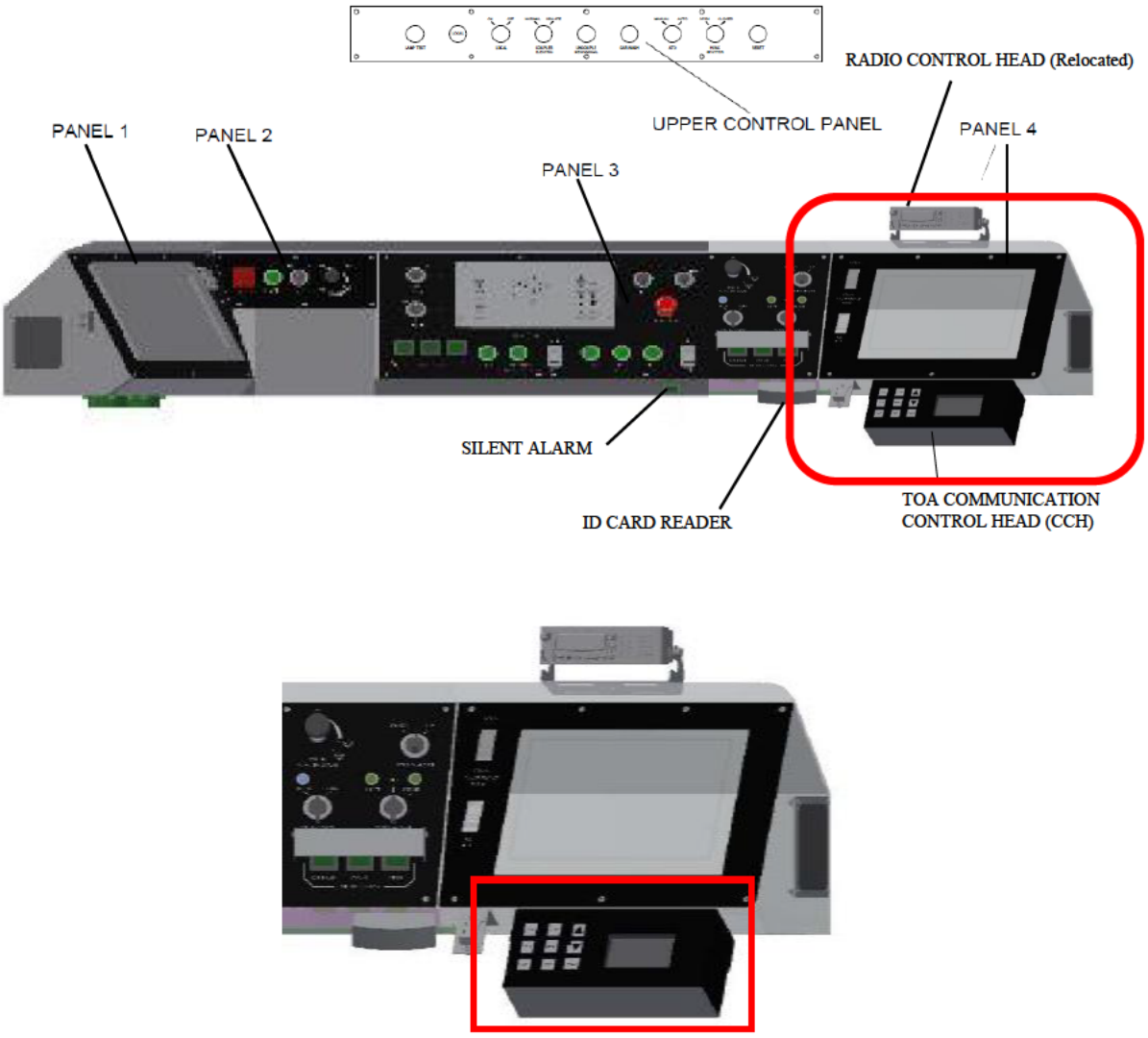


Figure 3-3: Location of CCH Installed

3.2.1.3 Interface Unit (IFU)

The IFU is installed inside the ceiling of the cab in the B car as shown in Figure 3-4.

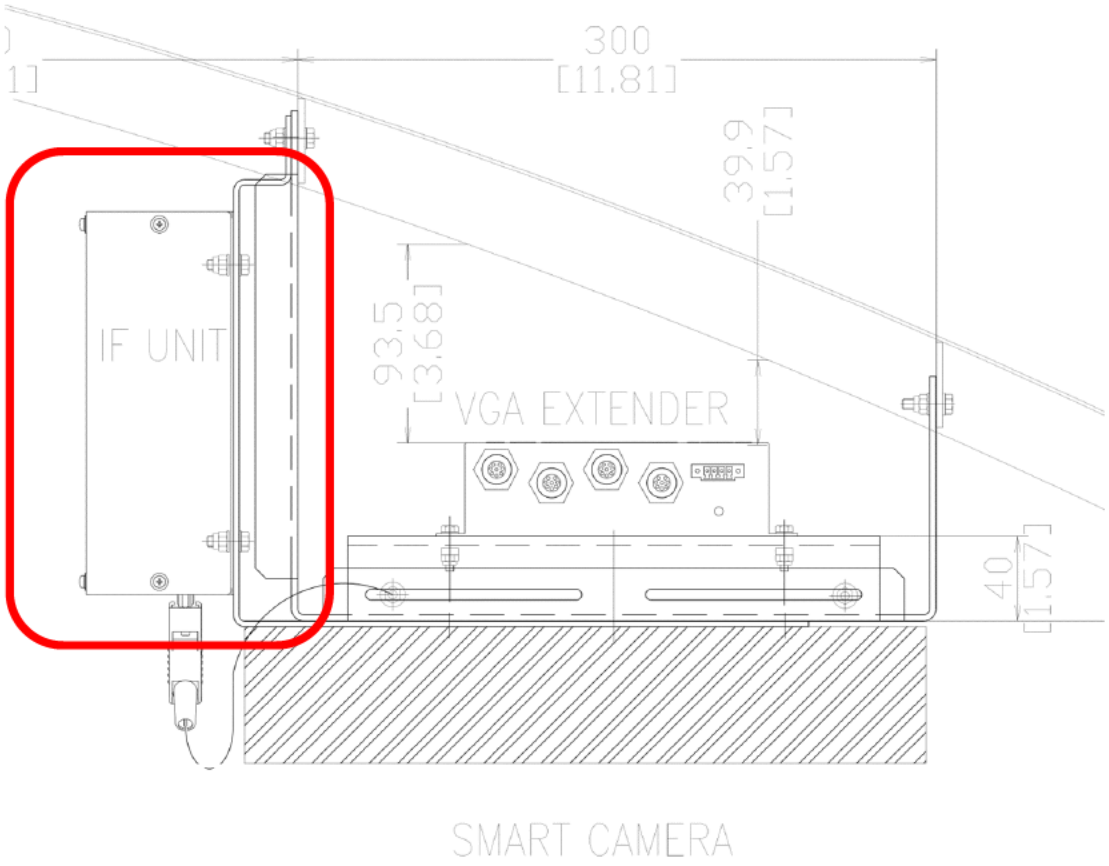


Figure 3-4: Detail View of IFU Installed

3.2.1.4 Ethernet Switch, Viper-112A

The Ethernet switch is installed inside the ceiling of the cab as shown in Figure 3-5 and F igure 3-6. One Ethernet Switch in the A car, and another in the B car.

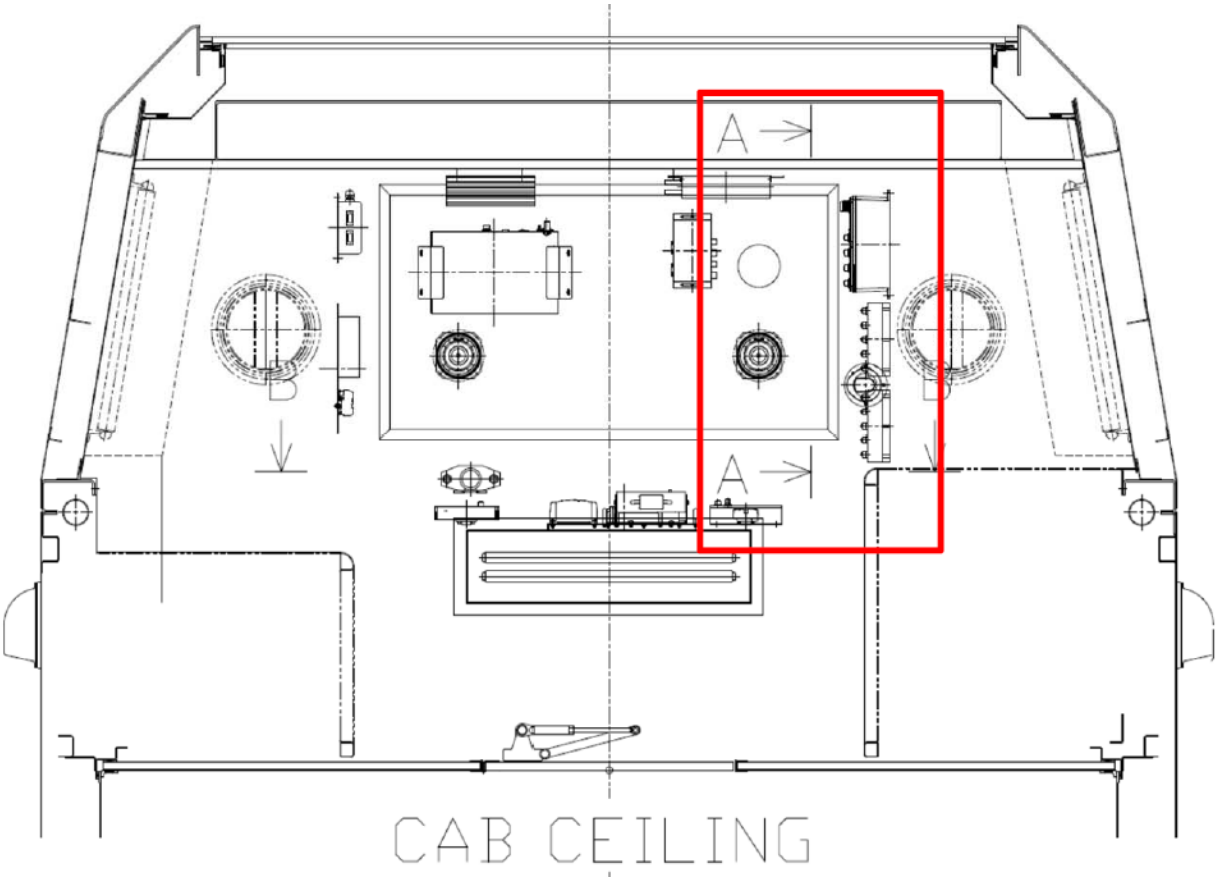


Figure 3-5: Location of Installed Ethernet Switch

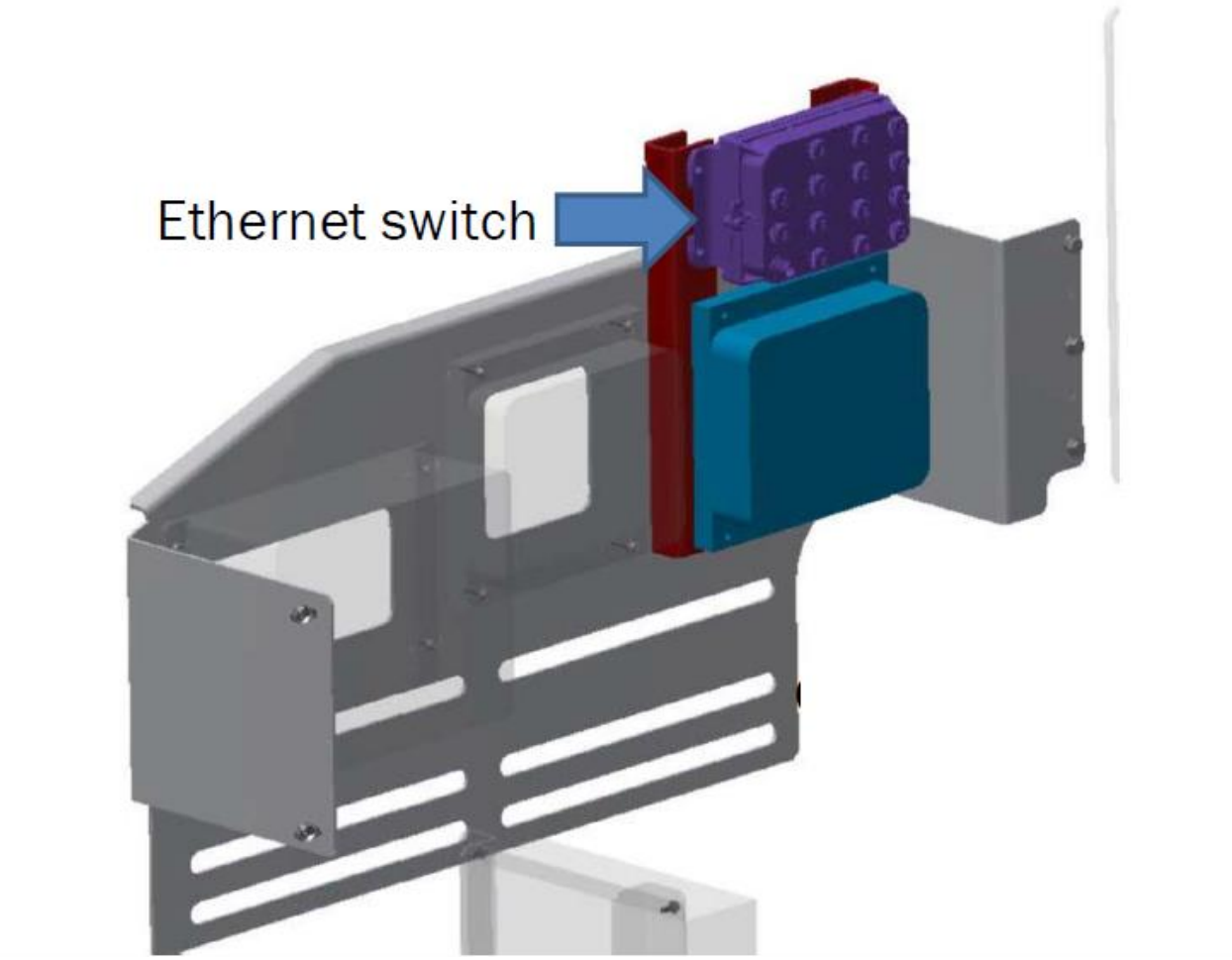


Figure 3-6: Detail Location of Ethernet Switch Installed

3.2.1.5 Ethernet Interface Module, DDW-002-B1

Ethernet Interface Module is installed in the right side locker in the cab as shown in Figure 3-7 and Figure 3-8. Two are in the A car, and another two in the B car.

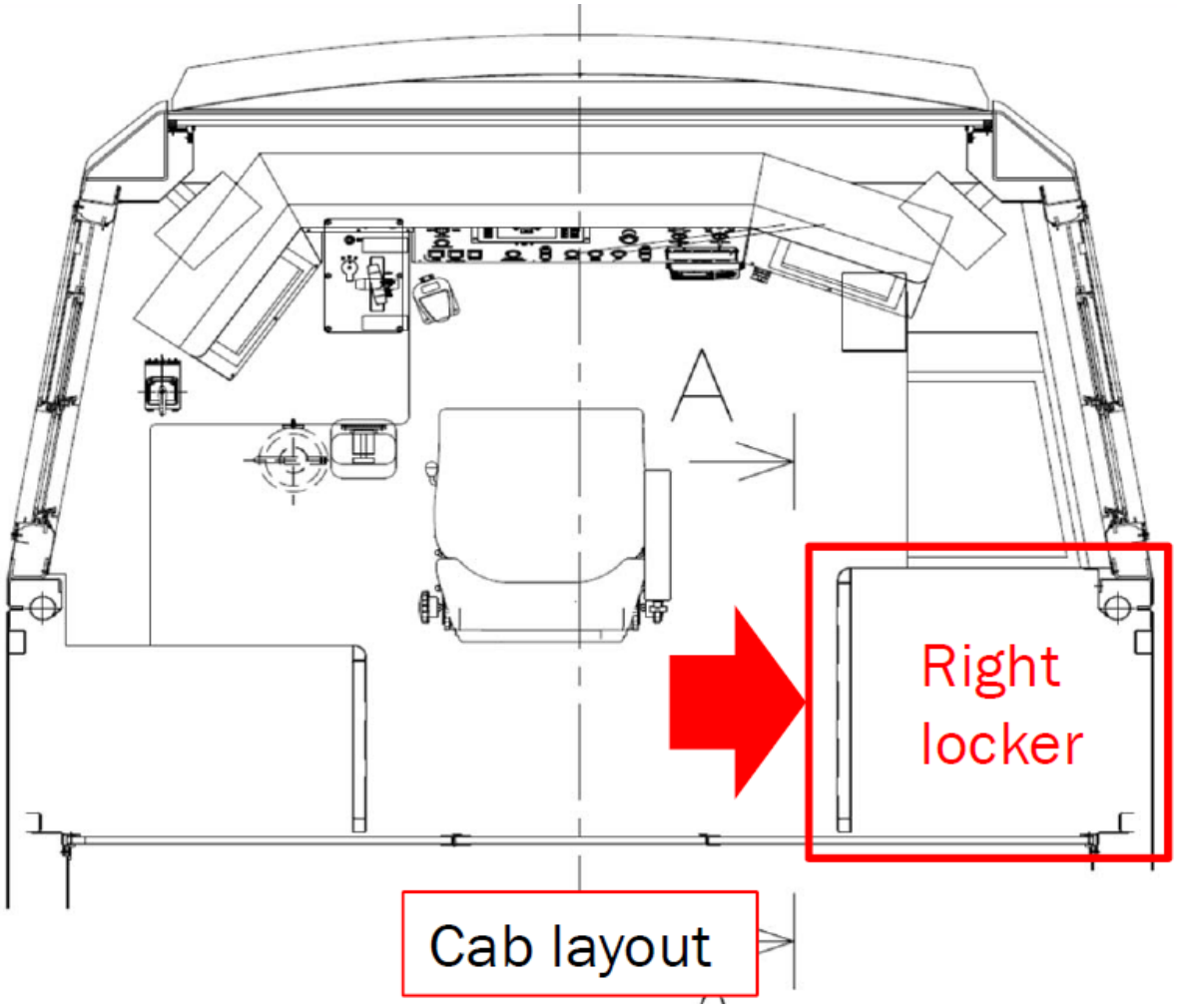


Figure 3-7: Location of Ethernet Interface Module Installed

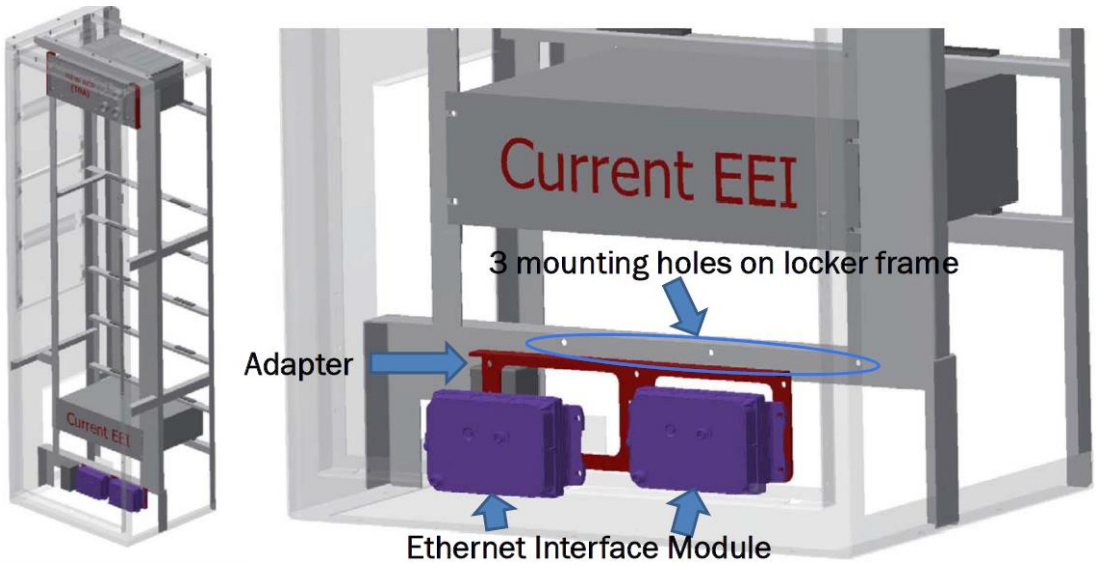


Figure 3-8: Detail Location of Ethernet Interface Module Installed

3.2.2 Passenger Information System

3.2.2.1 Passenger Information Display (PID)

There are four interior Passenger Information Displays per car. Two are located near the articulation area and two are mounted on the cab partition wall. See Figures 3-10 and 7-4.

3.2.2.2 VGA Extender Receive Unit

There are two VGA Extender Receive Units per car. One located at each articulation Passenger Information Display. See Figures 3-10 and 7-5.

3.2.2.3 VGA Extender Send Unit

There are two VGA Extender Send Units per car. One each located in each Cab ceiling. See Figures 3-9 and 7-6.

3.2.2.4 Passenger Information Controller

There are two Passenger Information Controllers per car. One each located in each Cab ceiling. See Figures 3-9 and 7-7.

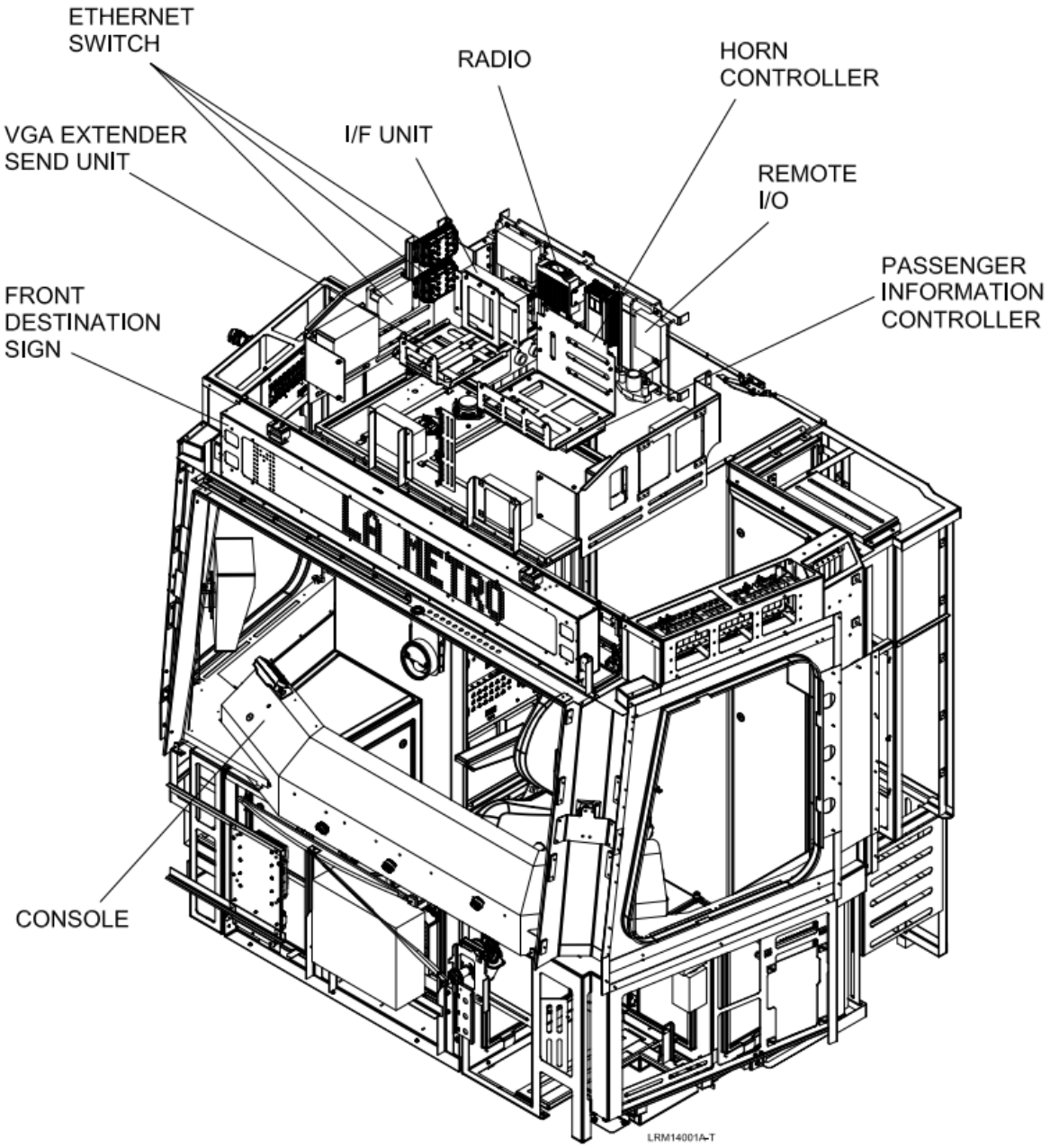


Figure 3-9: Communication Equipment Location
(Sheet 1 of 4)

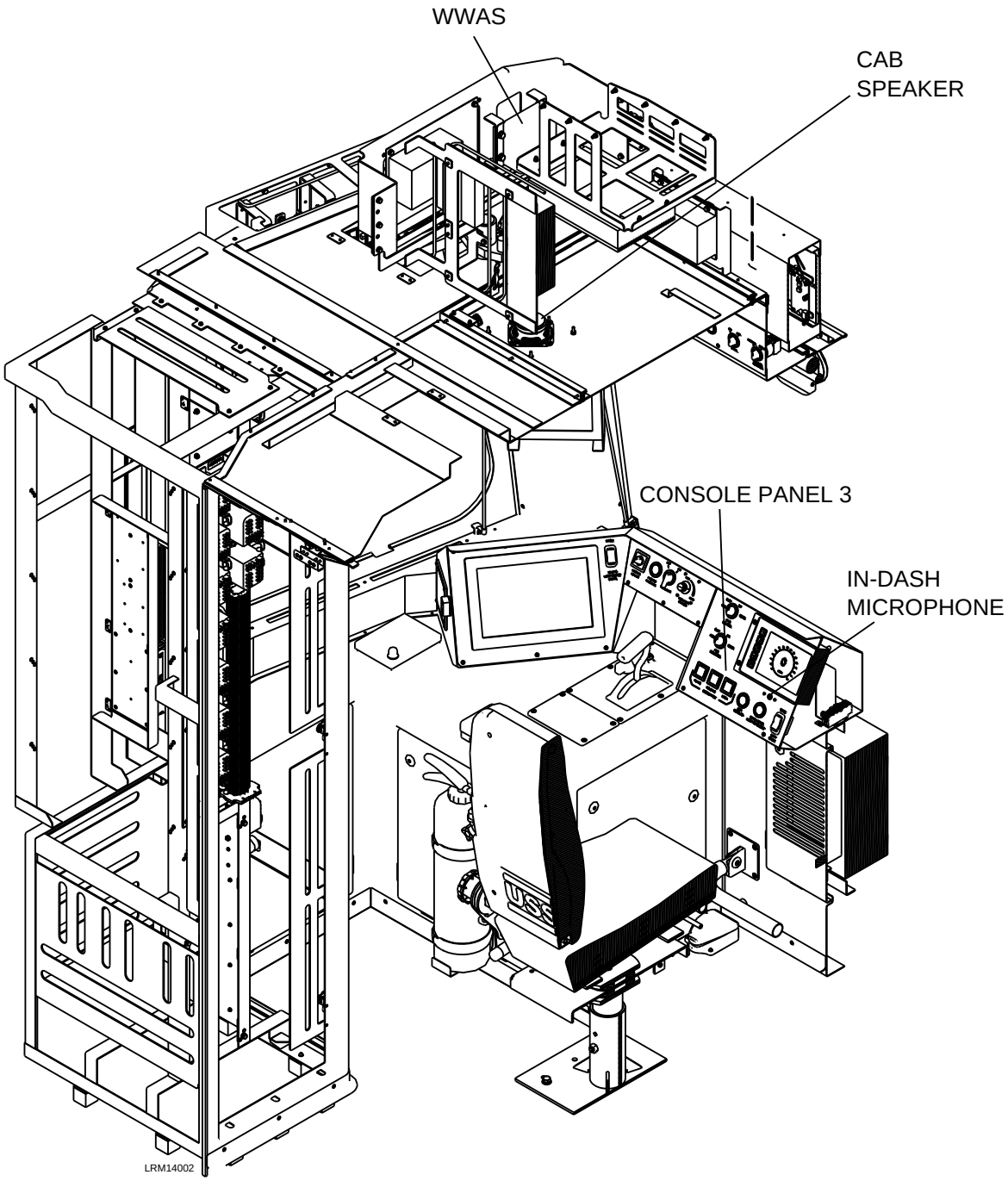


Figure 3-9: Communication Equipment Location
(Sheet 2 of 4)

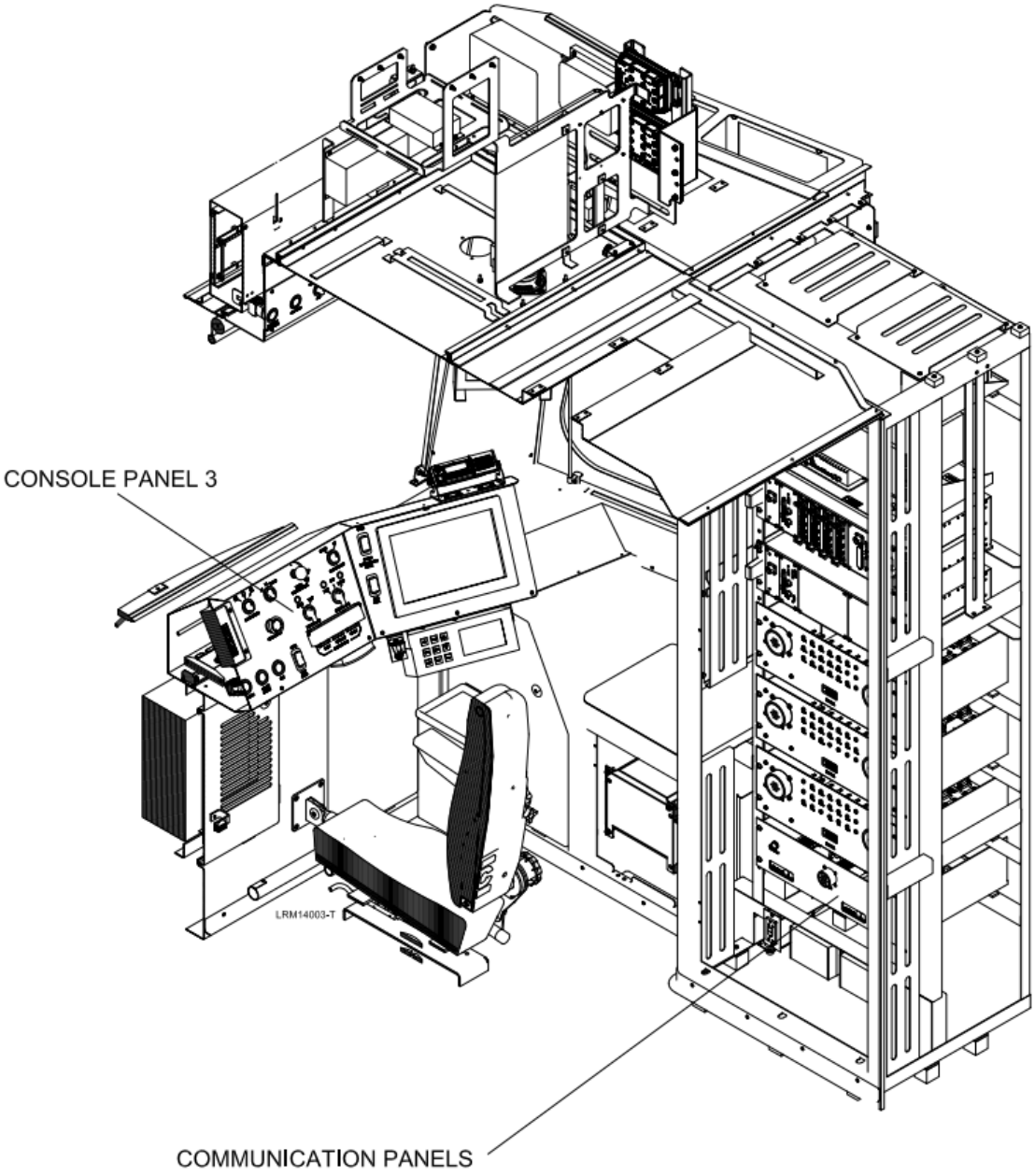


Figure 3-9: Communication Equipment Location
(Sheet 3 of 4)

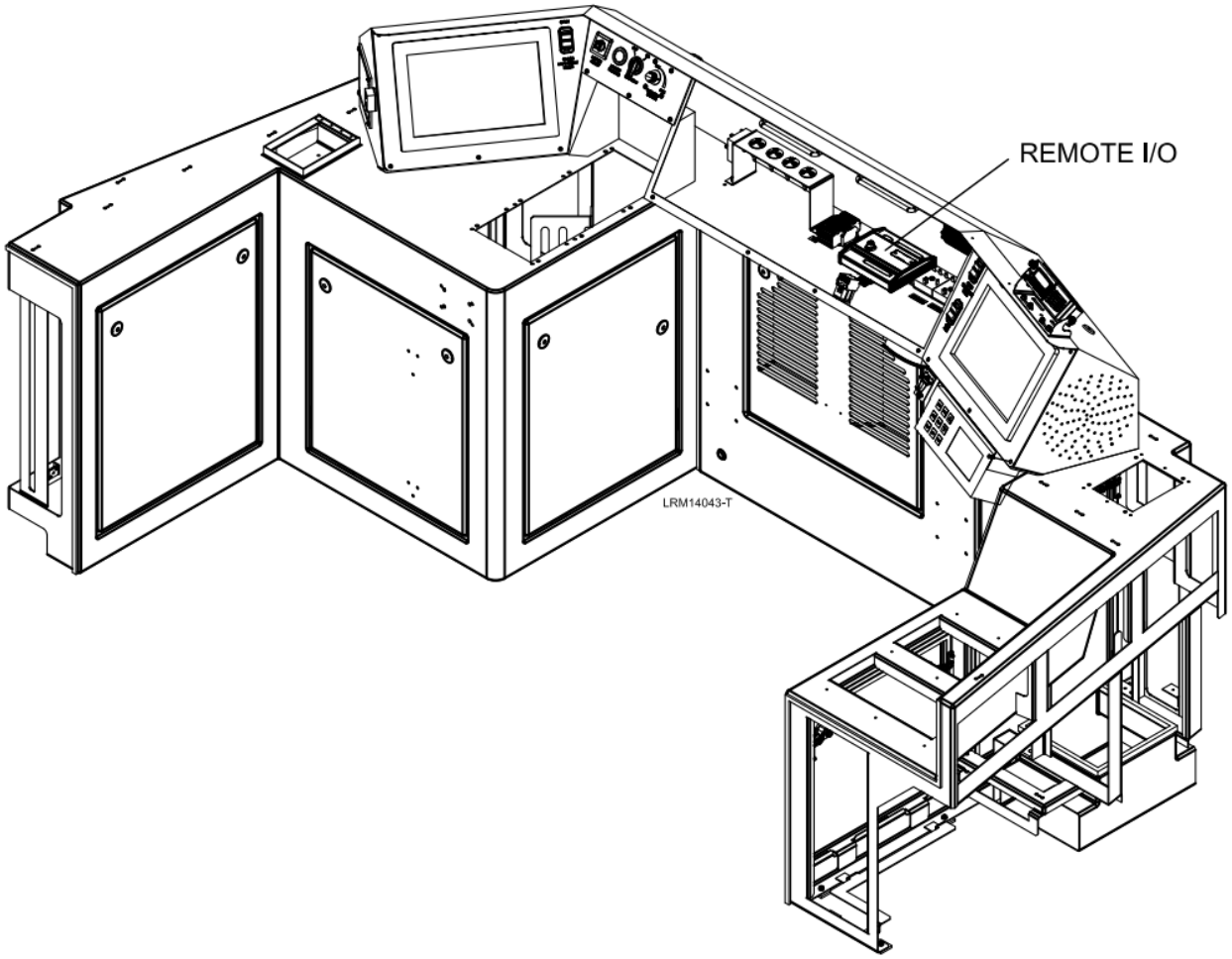


Figure 3-9: Communication Equipment Location
(Sheet 4 of 4)

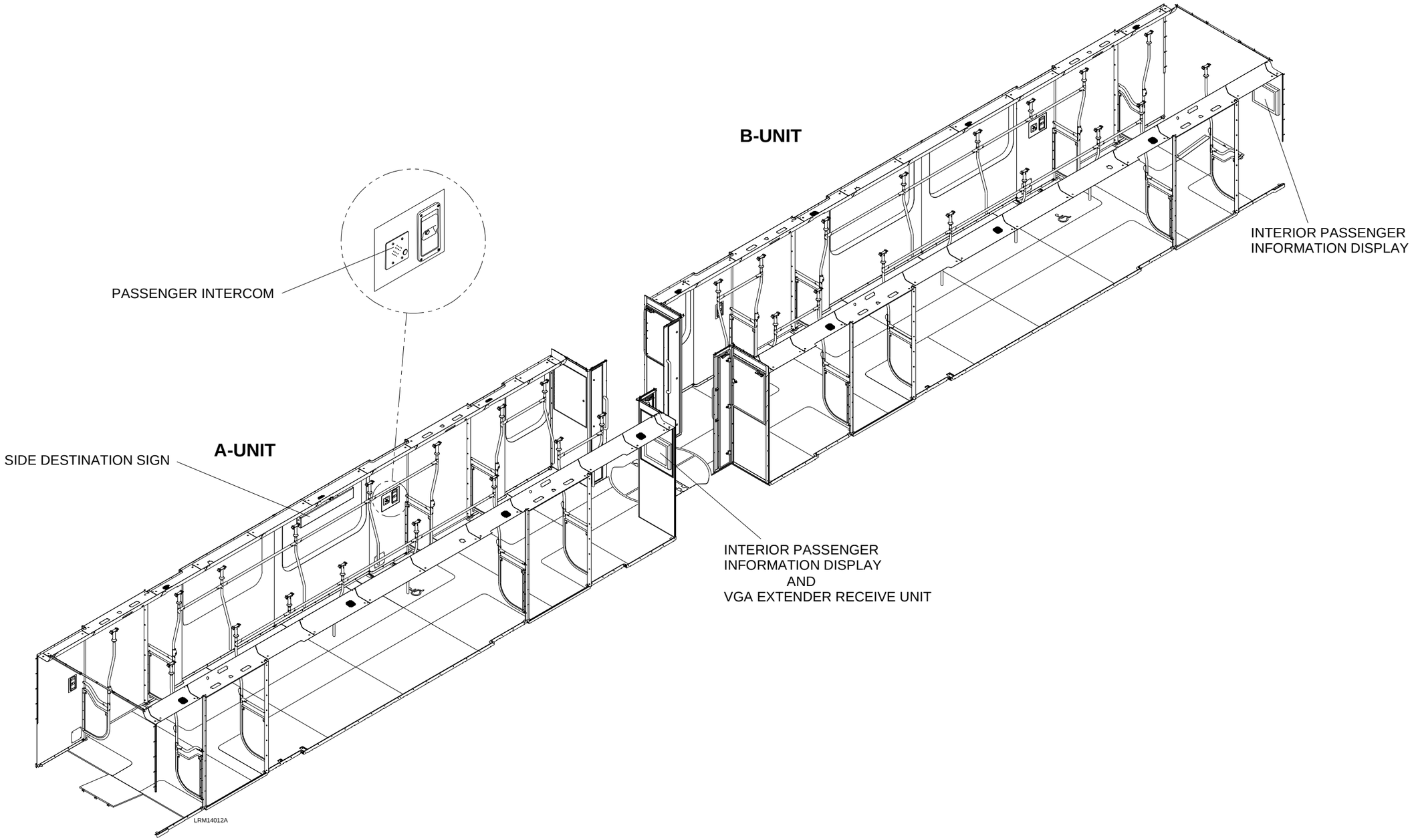


Figure 3-10: Interior Communication Equipment Locations

3.2.3 Passenger Intercom (PIC)

There are four passenger intercoms per car. One is located at each of the four wheelchair areas. See Figures 3-10 and 7-9.

3.2.4 Exterior Destination Signs

3.2.4.1 Front Destination Sign

There is one Front Destination Sign located on the front of each A and B-Unit cab. See Figures 3-9 and 7-10.

3.2.4.2 Side Destination Sign

There are two side destination signs per car. One each is located at the window near the center doors on each A and B-Unit. See Figures 3-10 and 7-15.

3.2.5 Speakers

3.2.5.1 Exterior Speakers

There are eight exterior speakers, four mounted in the roof shrouds on the A-Unit and four on the B-Unit. See Figures 3-13 and 7-20.

3.2.5.2 Interior Speakers

There are fourteen interior speakers per car. Seven are located each in the A and B-Unit mounted on the side access covers. See Figures 3-14 and 7-21.

3.2.5.3 Cab Speakers

There are two Cab Speakers in each A and B-Unit cab. They are located in the cab ceiling on either side of the cab. See Figures 3-9 and 7-22.

3.2.6 In-Dash Microphone

There is one In-Dash Microphone mounted on Console Panel 3 in each A and B unit. See Figures 3-9 and 7-23.

3.2.7 Remote I/O Module

There is one Ethernet Remote I/O located in the cab ceiling in each A and B-Unit (Ethernet RIO 2A / 2B). There is one Ethernet Remote I/O located inside the cab console behind console 3 in each A and B-Unit (Ethernet RIO 1A / 1B). See Figures 3-9 (sheet 1, sheet 4) and 7-24.

3.2.8 Communication Control Unit (CCU)

There is one CCU located in the right-side electric locker on the A-Unit. See Figures 3-9 and 7-25.

3.2.9 Global Positioning System (GPS) Receiver/Antenna

The GPS Antenna is located on the roof of the A-Unit adjacent to the roof antenna. See Figures 3-12 and 7-26.

3.2.10 Wayside Worker Alert System (WWAS)

There is one Wayside Worker Alert System (WWAS) located in the cab ceiling in each A and B-Unit cab. See Figures 3-9 and 7-27.

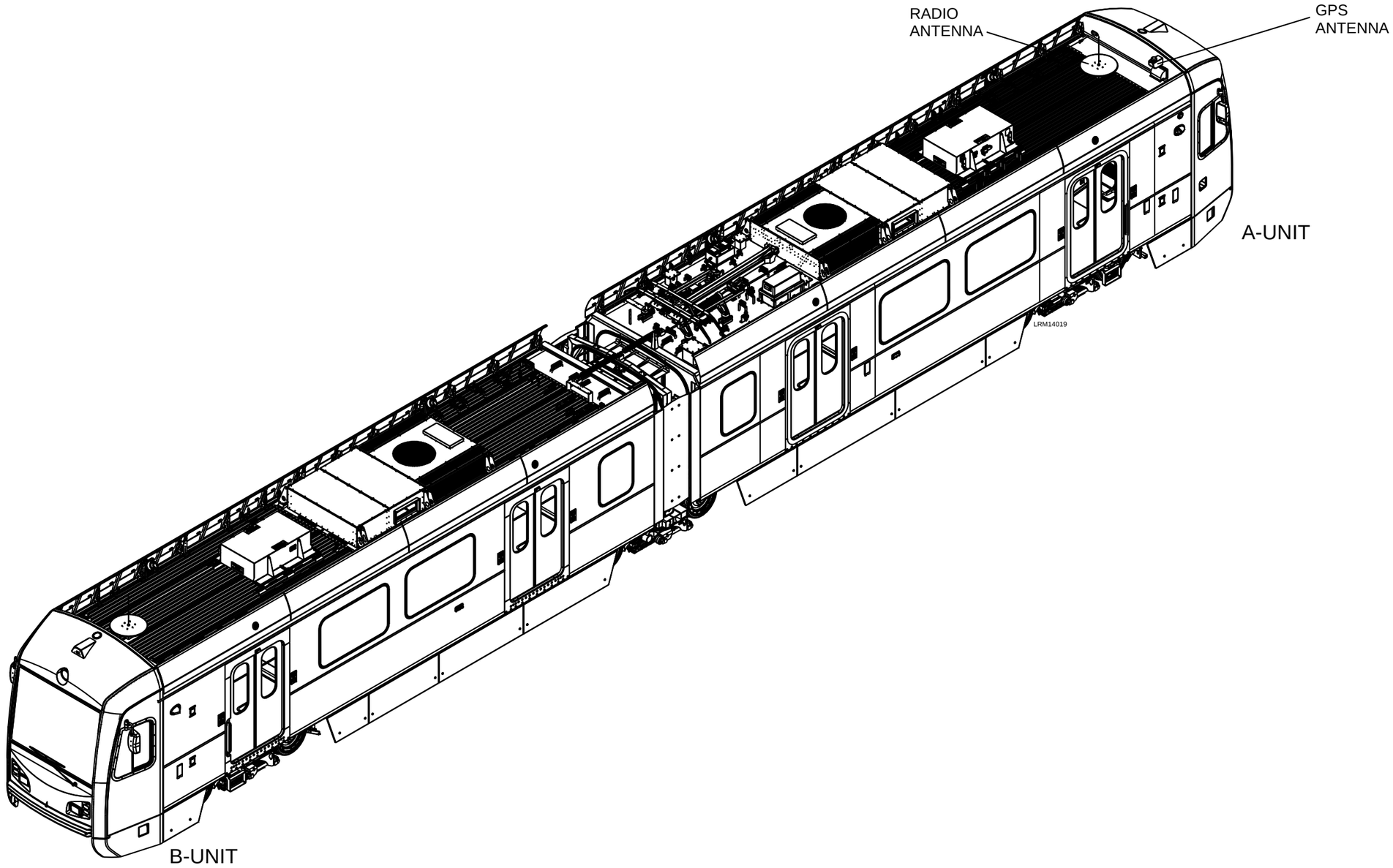


Figure 3-12: Roof Mounted Communication Equipment

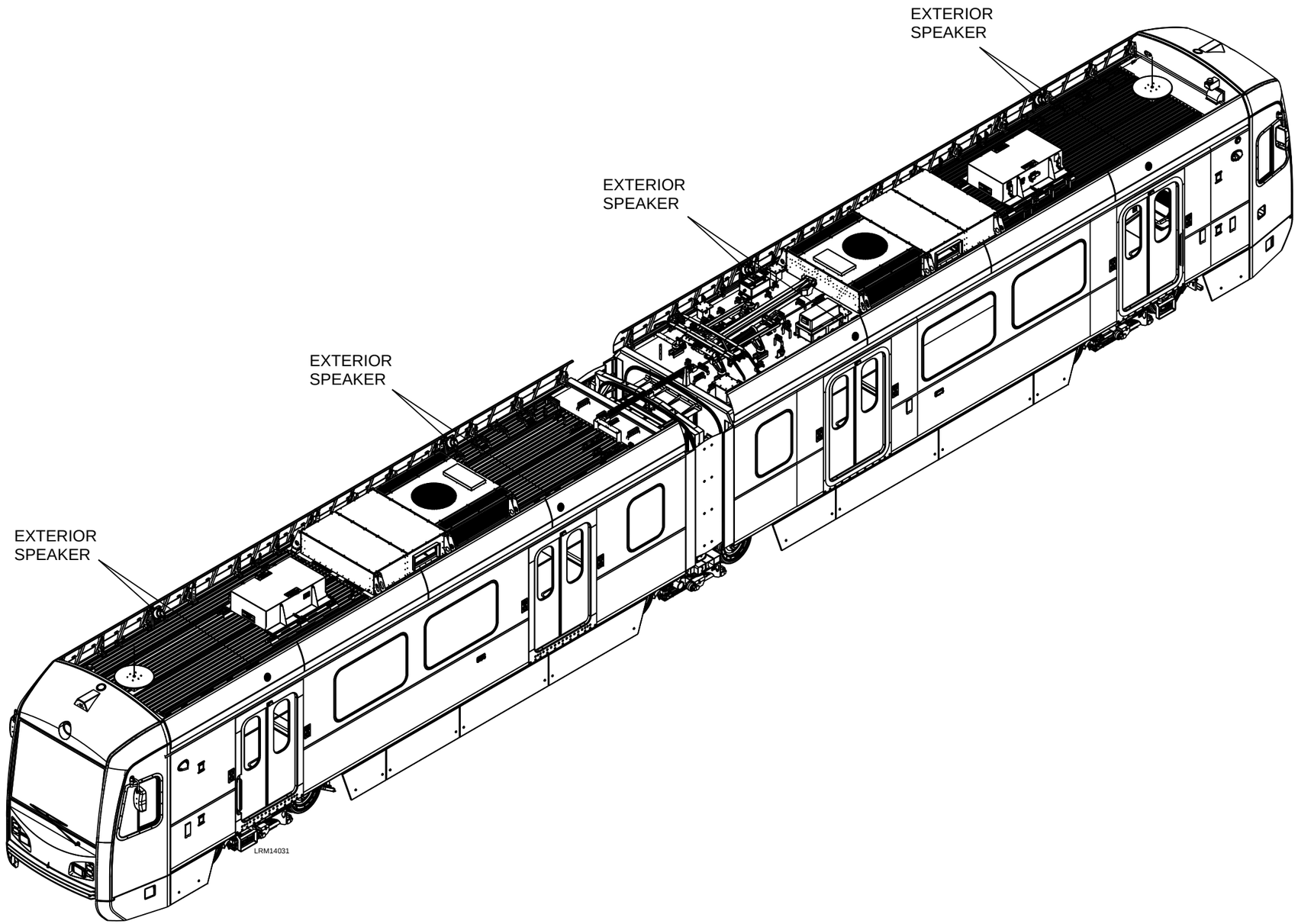


Figure 3-13: Exterior Speaker Locations

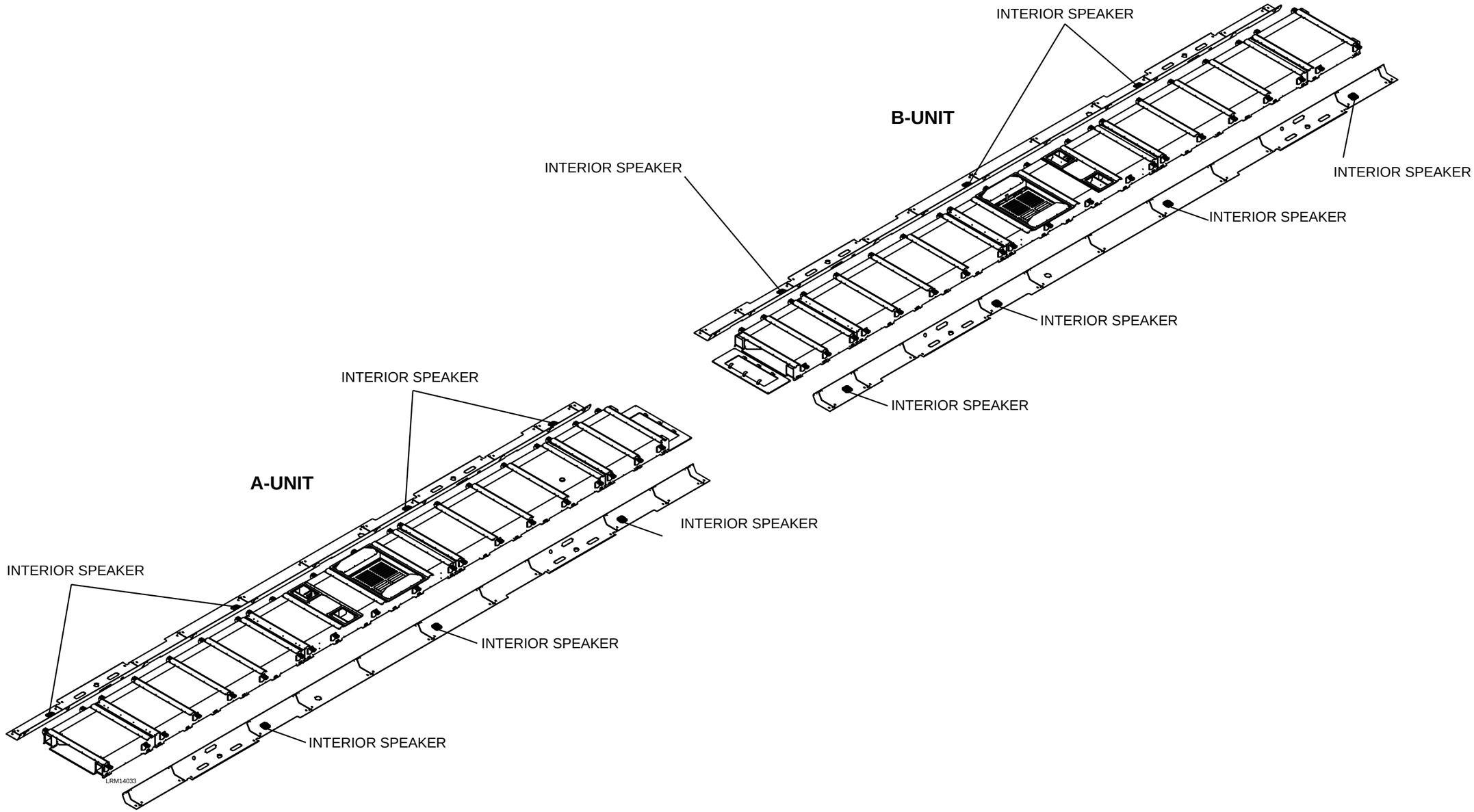


Figure 3-14: Interior Speaker Locations

3.2.11 Horn

3.2.11.1 Horn Controller

There is one Horn Controller Panel located in the cab ceiling in each A and B-Unit cab. See Figures 3-9 and 7-28.

3.2.11.2 Horn Speaker

There is one Horn / Gong Speaker mounted underneath the car on each A and B-Unit. See Figures 3-15 and 7-29.

3.2.12 Radio

3.2.12.1 Radio Equipment Panel

There is one Radio in each A and B-Unit cab. It is located in the cab ceiling. See Figures 3-9 and 7-30.

3.2.12.2 Radio Antenna

There is one Radio Antenna located on the roof of each A and B-Unit. The Radio Antenna is located adjacent to the Global Positioning System (GPS) antenna on the A-Unit and adjacent to the WLAN antenna on the B-Unit. It is a small whip antenna fixed to a perpendicular ground plane. See Figures 3-12 and 7-31.

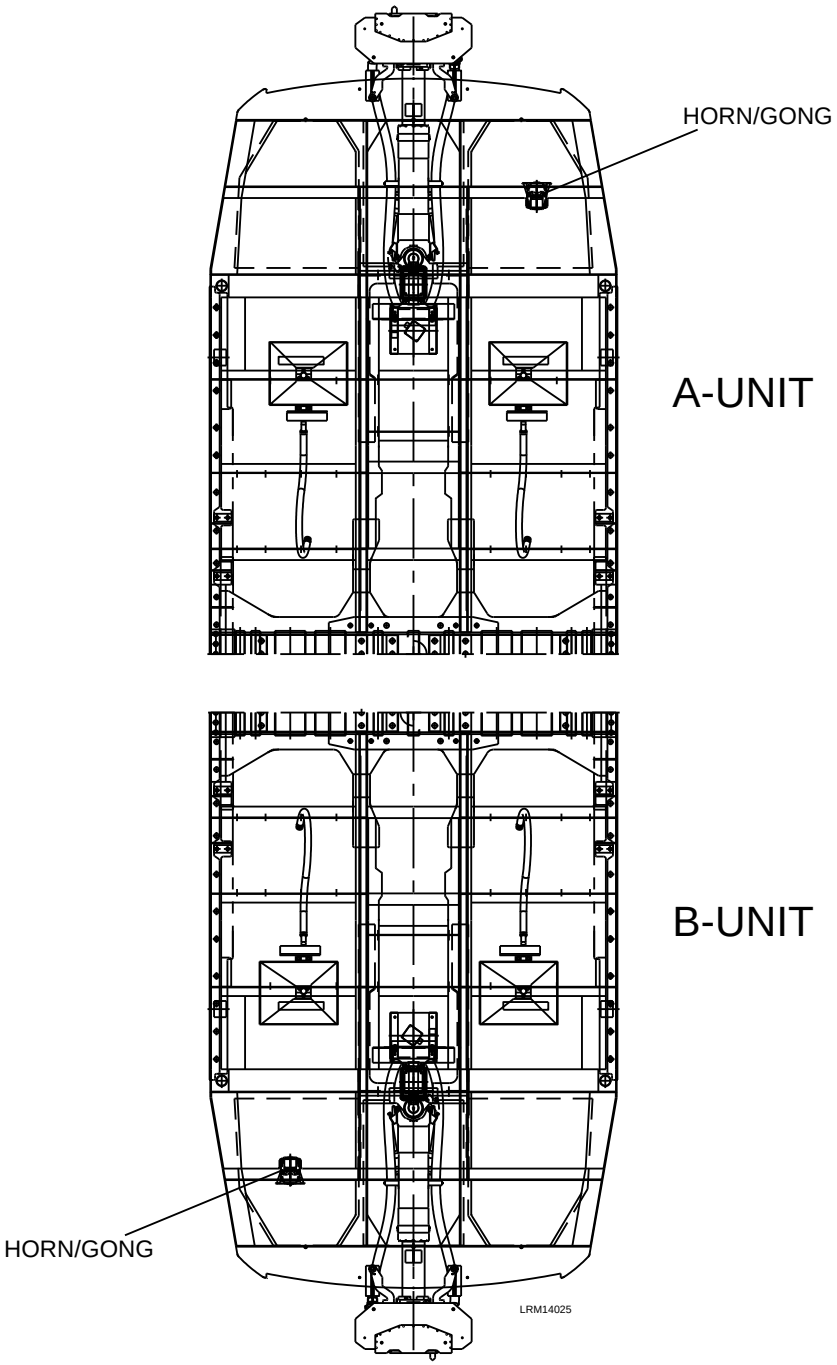


Figure 3-15: Undercar Mounted Communication Equipment

CHAPTER 4.0

SPECIAL TOOLS AND MATERIALS

4.1 Introduction

The following recommended commercially available tools for troubleshooting and maintaining the Communications System are listed in Table 4-1 below.

Table 4-1: Recommended Communications Tools

Tool	Use	Manufacture/Model	Required
USB Type CF Card Reader	- Store updated route information from the Route Management Editor Software onto CF Card for ACPs	(Multiple)	Yes
M12 Torque Screwdriver	- Tightening M12 Connectors to 0.4Nm - Removing M12 Connectors	Phoenix Contact TSD 04 SAC – 1208429	No
M12 Torque Nut	- Used with M12 Torque Screwdriver	Phoenix Contact SACC BIT M12-D20 - 1208445	No
Network Cable Tester	(Model Dependent) - Test Cable Continuity - Test Wiremap (cross connections)	Fluke Networks CableIQ or MicroScanner	No

4.2 CF Card Reader

The route information is generated by the Route Management Editor (RME) and stored in a CF card which is set in each Audio Control Panel (ACP). For this purpose, the following special tool is required and supplied by KI.

- USB type CF card reader to connect with PC

Figure 4-1: USB Type CF Card Reader

4.3 M12 Torque Driver

An M12 Torque Driver is recommended for tightening the M12 connectors to the proper value of 0.4Nm (see Figure 4-2). Improperly seated connectors can cause device connectivity issues and improperly torqued connectors can come loose due to the vibrations experienced in a moving LRV. The M12 driver is also handy for removing M12 connectors in hard to reach locations – such as in one of the inner ports on the Ethernet switches.

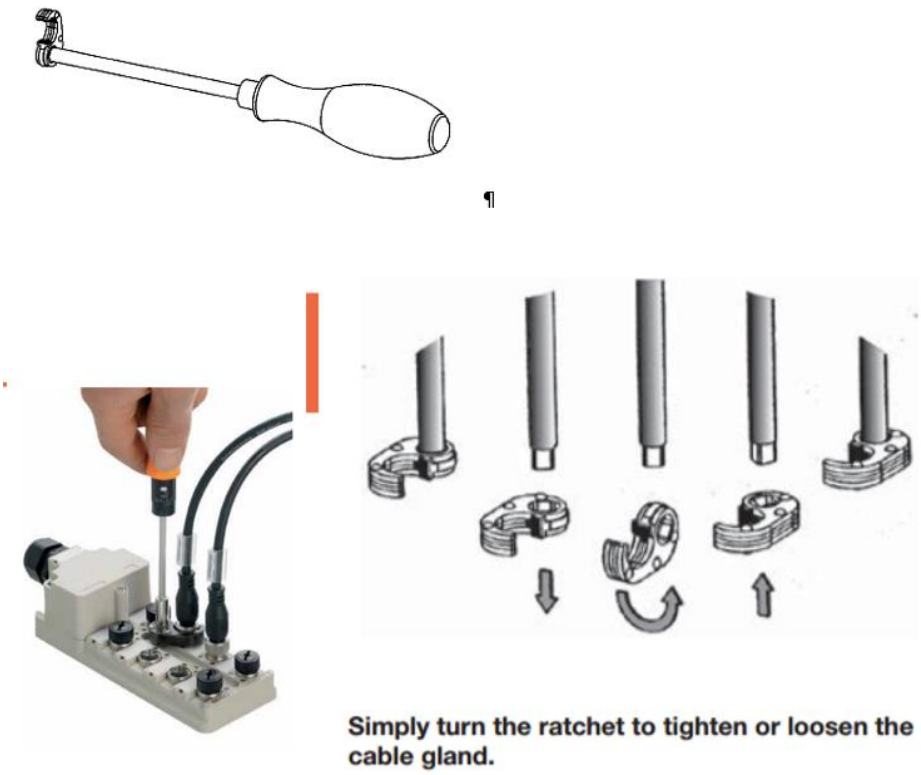


Figure 4-2: Torque Type M12 Driver

4.4 Network Cable Tester

A network cable tester is recommended for troubleshooting Ethernet connectivity issues. Although there are many manufactures and models which provide additional features, such as the Fluke CableIQ tester shown in Figure 4-3, the key functions of the cable tester that are used to troubleshoot P3010 Ethernet connectivity issues are the following:

- Cable Continuity Test – this test checks the continuity of the Ethernet wires and, model depending, can estimate the location of the wire break
- Wiremap Tests (Cross Connections) – this test checks the connectors for correct pin wiring

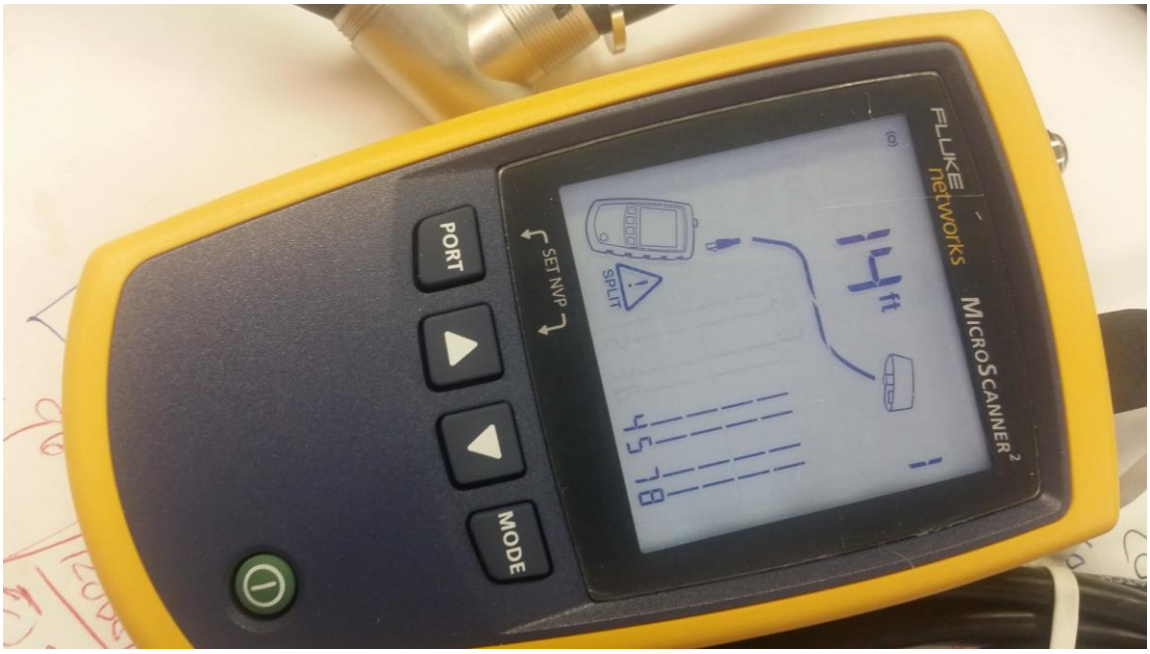


Figure 4-3: Ethernet Network Wiring Analyzer (Fluke MicroScanner shown)

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CHAPTER 5.0

SCHEDULED MAINTENANCE TASKS

5.1 Introduction

This chapter provides scheduled maintenance tasks in the form of a quick reference table. A thorough visual inspection should be performed before proceeding. Obvious malfunctions from damage observed during the visual inspection are to be corrected.

5.2 Scheduled Maintenance Index

Table 5-1 is a scheduled maintenance index, which lists maintenance intervals and each maintenance task for the Communications equipment. The reference column indicates the section of this manual that details these maintenance procedures.

Table 5-1: Scheduled Maintenance

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1402 Communications Running Maintenance & Servicing Manual Section Reference
Daily	Train interconnected network systems	Key vehicle completely off to allow computer controls systems to reset and reinitialize.	n/a
Daily	Onboard Test	Initiate Onboard Test via TOA CCH to inspect test tones from Interior/Exterior Speakers and test patterns on PID Displays and Destination Signs, and verify no fault on the TOA CCH	8.3
Daily	Front Destination Signs	Visually inspect for defective LED's	6.3.4.1
Daily	Side Destination Signs	Visually inspect for defective LED's	6.3.4.2
Daily	Wayside Worker Alert System	Visually inspect for damage	6.3.10
10,000 miles	Wayside Worker Alert System	Test function of unit	6.3.10
10,000 miles	Passenger Intercom	Verify operation	6.3.3
10,000 miles	Horn Controller Panel	Visually inspect for loose components and secure panel mounting hardware	6.3.11.1
30,000 miles	TOA Ethernet Switch	Visually inspect LED indicator to confirm the status of network connection	6.3.1.4
30,000 miles	TOA Ethernet Interface Module	Visually inspect LED indicator to confirm the status of network connection	6.3.1.5
30,000 miles	PIDS display	Visually inspect for vandalism, loose components and secure mounting hardware	6.3.2.1

Table 5-1. Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1402 Communications Running Maintenance & Servicing Manual Section Reference
60,000 miles	TOA ACP(A), TOA ACP(B)	Visually inspect for loose components and secure panel mounting hardware	6.3.1.2
60,000 miles	TOA IFU	Visually inspect for loose components and secure panel mounting hardware	6.3.1.3
60,000 miles	TOA CCH(A), TOA CCH (B)	Visually inspect for loose components and secure panel mounting hardware	6.3.1.2
60,000 miles	Communication Control Unit (CCU)	Visually inspect for loose components and secure panel mounting hardware	6.3.8
60,000 miles	Remote I/O	Visually inspect for loose components and secure panel mounting hardware	6.3.7
60,000 miles	Radio Panel	Visually inspect for loose components and secure panel mounting hardware	6.3.12.1
60,000 miles	Cab Speakers	Visually inspect for loose components and secure mounting hardware	6.3.5.3
60,000 miles	Exterior Speaker	Visually inspect for loose hardware, electrical connections	6.3.5.1
60,000 miles	Interior Speakers	Visually inspect for loose components and proper operation	6.3.5.2
60,000 miles	Radio Antenna	Visually inspect for dirt and debris on the reflective plate and electrical connections/ground	6.3.12.2
120,000 miles	TOA Ethernet Switch	Verify all M12 connectors are tightened to the proper torque	6.3.1.4
120,000 miles	TOA Ethernet Interface Module	Verify all M12 connectors are tightened to the proper torque	6.3.1.5
120,000 miles	Front Destination Sign	Clean exterior sign display window	6.3.4.1
120,000 miles	Side Destination Sign	Clean exterior sign display window	6.3.4.2
840,000 miles	PIDS Controller	Replace Battery	6.3.2.4

CHAPTER 6.0

CORRECTIVE MAINTENANCE

6.1 Introduction

This chapter provides maintenance information for the Communications equipment.

6.2 Safety Information

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

WARNING

THE USE OF AN AIR JET, WHICH MUST BE LESS THAN 30 PSIG (2.1 BAR), TO BLOW PARTS CLEAN OR TO BLOW THEM DRY AFTER BEING CLEANED WITH A SOLVENT WILL CAUSE PARTICLES OF DIRT AND/OR DROPLETS OF THE CLEANING SOLVENT TO BE AIRBORNE. THESE PARTICLES AND DROPLETS MAY CAUSE SKIN AND/OR EYE IRRITATION. PERSONAL EYE PROTECTION MUST BE WORN TO PROTECT THE EYES FROM POSSIBLE INJURY. WHEN USING AN AIR JET DO NOT DIRECT IT TOWARD ANOTHER PERSON. IMPROPER USE OF AN AIR JET COULD RESULT IN BODILY INJURY.

CAUTION

DO NOT SCRUB WITH ABRASIVES OR USE BRUSHES FOR CLEANING. DO NOT USE GASOLINE. AGGRESSIVE CLEANING PROCEDURES OR AUTOMATED WASHING EQUIPMENT WILL EVENTUALLY RESULT IN VISUAL HAZING, LOSS OF LIGHT TRANSMISSION AND COATING DELAMINATION.

CAUTION

WEAR SAFETY SHOES AND HARD HATS WHEN WORKING WHERE OBJECTS MIGHT FALL.

WARNING

CLEANING MATERIALS CAN BE TOXIC AND DANGEROUS TO HANDLE. READ THE HANDLING INSTRUCTIONS BEFORE USING AND FOLLOW THE MANUFACTURER'S RECOMMENDATIONS.

WARNING

USE PROPER LIFTING EQUIPMENT TO REMOVE AND INSTALL COMPONENTS THAT WEIGH 50 LBS. (23 KG) OR MORE. ENSURE THAT THE COMPONENT IS SECURELY FASTENED TO THE LIFTING DEVICE. FAILURE TO HEED THESE WARNINGS COULD RESULT IN SEVERE INJURY OR DEATH TO PERSONNEL AND DAMAGE TO EQUIPMENT.

WARNING

ALL AIR SUPPLY AND/OR ELECTRIC CURRENT TO THESE DEVICES AND/OR ANY COMPONENT PARTS MUST BE CUT-OFF BEFORE THESE DEVICES AND/OR COMPONENT PART ARE REMOVED FROM THE EQUIPMENT ARRANGEMENT.

WARNING

TO PREVENT RECEIVING ELECTRICAL SHOCK WHEN PERFORMING ELECTRICAL TEST, HANDS MUST BE CLEAR OF ELECTRICAL COMPONENTS, CONTACTS AND HOUSING AND THERE MUST BE NO BODILY CONTACT WITH THE WORK BENCH. FAILURE TO HEED THIS WARNING COULD RESULT IN SEVERE INJURY OR DEATH.

WARNING

SHUT OFF POWER TO THE CAR BEFORE ATTEMPTING TO SERVICE ANY ROOF MOUNTED EQUIPMENT.

WARNING

MUCH OF THE EQUIPMENT ON THESE CARS OPERATES AT VOLTAGE AND CURRENT LEVELS THAT ARE HAZARDOUS AND LIFE THREATENING. PROPER PRECAUTIONS SHOULD BE TAKEN AND METRO SAFETY RULES, PRACTICES AND PROCEDURES CLOSELY OBSERVED.

WARNING

INSULATED GLOVES MUST BE WORN AND EXTREME CARE TAKEN TO PREVENT BURNS WHEN HANDLING HEATED PARTS.

CAUTION

THE EQUIPMENT OPERATING PROCEDURES DESCRIBED BELOW SHOULD BE FOLLOWED AS GIVEN TO AVOID THE POSSIBILITY OF DAMAGE TO EQUIPMENT AND/OR BODILY INJURY.

CAUTION

WEAR PROPER PPE EQUIPMENT WHEN WORKING UNDER THE CAR.

The importance of safe operation and maintenance cannot be over stressed. The following are some important points for maintenance personnel to observe:

1. Wear an insulated hard hat when working on the vehicle roof or any of the roof-mounted components.

2. Wear safety shoes and hard hats when working where objects might fall.

3. Never work on equipment while electrical power is applied unless it is absolutely necessary as part of the maintenance program. Verify that power is removed by checking with reliable equipment.

4. Attach a tag with the name of the person who removed the power from the equipment. That person knows why the power was removed and when it will be safe to restore it. Only the individual whose name appears on the tag or a person who has his approval should remove the tag and restore power.

5. Use proper lifting equipment to remove and replace heavy components. Make sure the components are securely fastened to the lifting device.

6. Never attempt to perform a two-person operation alone. Know and follow emergency procedures.

7. Never take any short cuts that are not clearly defined and approved.

6.3 Corrective Maintenance Procedures

6.3.1 TOA Communications Equipment

6.3.1.1 Audio Control Panels (ACP)

Visually inspect for loose components and secure panel mounting hardware every 60,000 miles. See Figure 2-17, Figure 3-1, Figure 3-2, Figure 7-1 and Figure 7-32.

6.3.1.2 Communication Control Head (CCH)

Visually inspect for loose components and secure panel mounting hardware every 60,000 miles. See Figure 2-21, Figure 3-3, Figure 7-2.

6.3.1.3 Interface Unit (IFU)

Visually inspect for loose components and secure panel mounting hardware every 60,000 miles. See Figure 2-23, Figure 3-4, Figure 7-3 and Figure 7-33.

6.3.1.4 Ethernet Switch, Viper-112A

Perform visual inspection of the LED indicator status of the following items every 30,000 miles and verify that the network condition stays in the normal condition.

1. “FRNT” indicated as green (B-end) / blinking (A-end).
2. “X1” or “X2” indicated as green. (Another will indicate as yellow. It means the green color port is working as the “master” connection between the TOA Ethernet Switches and the yellow color port is working as the “slave” connection between them.).

Figure 6-1 shows the explanation of the LED indications for the Ethernet Switch.

LED	Status	Description
ON	OFF	Unit has no power.
	GREEN	All OK, no alarm condition.
	RED	Alarm condition, or until unit has started up. (Alarm conditions are configurable, see "WeOS Management Guide").
	BLINK	Location indicator ("Here I am!"). Activated when connected to IPConfig Tool, or when configuring the unit via Web or CLI.
DC	OFF	Unit has no power.
	GREEN	Power OK on DC1 and DC1.
	RED	Power failure on DC1 or DC2.
FRNT	OFF	FRNT disabled.
	GREEN	FRNT OK.
	RED	FRNT Error.
	BLINK	Unit configured as FRNT Focal Point.
RSTP	OFF	RSTP disabled.
	GREEN	RSTP enabled.
	BLINK	Unit elected as RSTP/STP root switch.
X1 to X12	OFF	No Link.
	GREEN	Link established.
	GREEN FLASH	Data traffic indication.
	YELLOW	Port alarm and no link. Or if FRNT or RSTP mode, port is blocked.

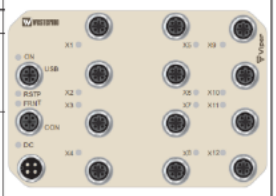

Figure 6-1: LED Indicators for Ethernet Switch, Viper-112A

Perform a visual inspection of the hardware every 120,000 miles and verify that all M12 connectors are tightened to the proper torque. See Table 2-6, Figure 2-24, Figure 3-5 and Figure 3-6.

6.3.1.5 Ethernet Interface Module, DDW-002-B1

Perform visual inspection of the LED indicator status of the following items every 30,000 miles and verify that the network condition stays in the normal condition.

1. “LINK STATUS” and “LINK MASTER” indicator is ON for one of the Ethernet Interface Modules in each cab locker. (ON means the applicable Ethernet Interface Modules are working as “master” connection. OFF means “slave” connection”).
2. “X1” indicator is green or green flash for one of the Ethernet Interface Modules in each cab locker. (Green or green flash means the applicable Ethernet Interface Modules are working as “master” connection. OFF means “slave” connection”)

Figure 6-2 shows the explanation of LED indication for Ethernet Interface Module.

LED	Status	Description
ON	OFF	Unit has no power
	GREEN	All OK, no alarm condition
DC1	OFF	Unit has no power
	GREEN	Power OK on DC1
	RED	Power failure on DC1
DC2	OFF	Unit has no power
	GREEN	Power OK on DC2
	RED	Power failure on DC2
X1	OFF	No Link
	GREEN	Link established
	GREEN FLASH	Data traffic indication
LINK STATUS	OFF	No PLC link established
	ON	PLC link established
ACTIVITY	OFF	No traffic on PLC link
	GREEN	PLC traffic on PLC link
LINK MASTER	OFF	Device is not link master (if PLC link established)
	ON	Device is link master in the established PLC network

Figure 6-2: LED Indicators for Ethernet Interface Module, DDW-002-B1

Perform visual inspection of hardware every 120,000 miles and verify that all M12 connectors are tightened to the proper torque. See Figure 2-25, Figure 3-7, and Figure 3-8.

6.3.2 Passenger Information System

6.3.2.1 Passenger Information Display

Visually inspect for vandalism, loose components and secure panel mounting hardware every 30,000 miles. See Figures 3-10 and 7-4.

6.3.2.2 VGA Extender Receive Unit

There is no maintenance needed on the VGA Extender Receive Unit. See Figures 3-10 and 7-5.

6.3.2.3 VGA Extender Send Unit

There is no maintenance needed on the VGA Extender Send Unit. See Figures 3-9 and 7-6.

6.3.2.4 Passenger Information Controller

1. Visually inspect for loose components and secure panel mounting hardware every 30,000 miles.

2. Replace the Real Time Clock battery every 840,000 miles. (PN: BR2032)

a. Remove the controller from the cab ceiling mount. Refer to Section 7.4.2.4 of this manual.

b. Remove the ten (10) screws that secure the heat sink to the controller. See Figure 6-3.

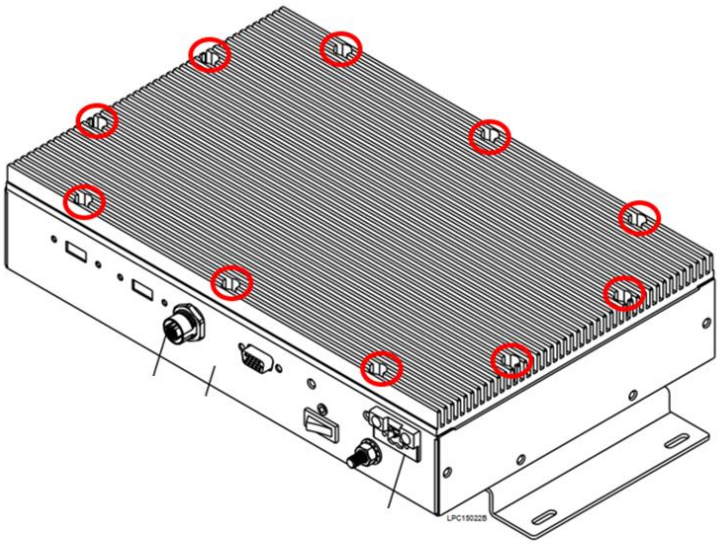

Figure 6-3: PIDS Controller Heat Sink Screws

c. Lift away the heat sink and remove the thermal paste.

d. Remove the battery. See Figure 6-4.

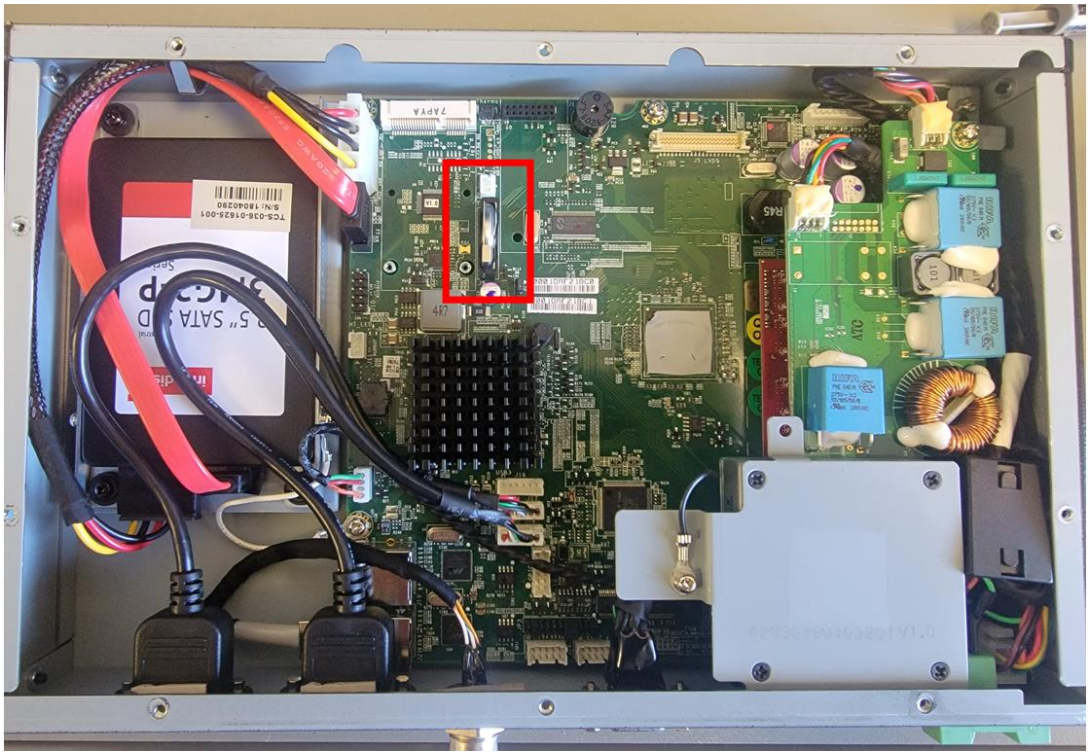

Figure 6-4: PIDS Controller RTC Battery Location

e. Install a new BR2032 battery.

f. Replace the thermal paste (ArticSilver AS5 or equivalent) and reposition the heat sink.

g. Reinstall the ten (10) screws that secure the heat sink to the controller.

h. Install the controller in the cab ceiling. Refer to Section 7.5.2.4 of this manual.

6.3.3 Passenger Intercom (PIC)

Visually inspect the passenger intercom every 10,000 miles for damage and proper operation. See Figures 3-10 and 7-9.

6.3.4 Exterior Destination Signs

6.3.4.1 Front Destination Sign

1. Visually inspect all sign displays on a daily basis for LED's that do not illuminate when a message is displayed. See Figures 3-9 and 7-10.

2. Clean exterior sign displays every 120,000 miles as follows:

Display windows are made of Lexan plastic. Certain solvents can destroy the surface and create a permanent haze or fogging effect. Use only those cleaning agents listed in Table 6-1.

CAUTION

DO NOT SCRUB WITH ABRASIVES OR USE BRUSHES FOR CLEANING. DO NOT USE GASOLINE. AGGRESSIVE CLEANING PROCEDURES OR AUTOMATED WASHING EQUIPMENT WILL EVENTUALLY RESULT IN VISUAL HAZING, LOSS OF LIGHT TRANSMISSION AND COATING DELAMINATION.

a. Select the appropriate cleaning agent from Table 6-1.

b. Apply the cleaning agent with a soft cloth or cellulose sponge. Do not scrub the surface aggressively.

c. Allow the cleaning agent to clean the surface. If necessary, apply cleaning agent several times.

d. When finished, wipe the surface dry. Then perform a final wash with soap, and rinse with plain water.

e. Dry the surface to prevent spotting.

Table 6-1: Compatible Cleaning Agents

Surface Substance	Cleaning Agent
Normal dust, dirt, grime	Aqueous solutions of soaps and detergents such as: Fantastik; Joy; Neleco-Placer; Formula 409; Lysol; Pine-Sol; Hexcel, F.O. 554; Mr. Clean; Top Job; Windex
Oils, paint, etc	Organic solvents such as: Aliphatic Hydrocarbons; Naphtha (VM&P Grade); Kerosene, Petroleum Spirits
Bugs	Alcohols such as: Isopropyl Alcohol; Methanol
Graffiti, lipstick, marking pen ink	Butyl Cellosolve™

6.3.4.2 Side Destination Sign

1. Visually inspect all sign displays on a daily basis for LED's that do not illuminate when a message is displayed. See Figures 3-10 and 7-15.

2. Clean exterior sign displays every 120,000 miles as follows:

Display windows are made of Lexan plastic. Certain solvents can destroy the surface and create a permanent haze or fogging effect. Use only those cleaning agents listed in Table 6-2.

CAUTION

DO NOT SCRUB WITH ABRASIVES OR USE BRUSHES FOR CLEANING. DO NOT USE GASOLINE. AGGRESSIVE CLEANING PROCEDURES OR AUTOMATED WASHING EQUIPMENT WILL EVENTUALLY RESULT IN VISUAL HAZING, LOSS OF LIGHT TRANSMISSION AND COATING DELAMINATION.

a. Select the appropriate cleaning agent from Table 6-2.

b. Apply the cleaning agent with a soft cloth or cellulose sponge. Do not scrub the surface aggressively.

c. Allow the cleaning agent to clean the surface. If necessary, apply cleaning agent several times.

d. When finished, wipe the surface dry. Then perform a final wash with soap, and rinse with plain water.

e. Dry the surface to prevent spotting.

Table 6-2: Compatible Cleaning Agents

Surface Substance	Cleaning Agent
Normal dust, dirt, grime	Aqueous solutions of soaps and detergents such as: Fantastik; Joy; Neleco-Placer; Formula 409; Lysol; Pine-Sol; Hexcel, F.O. 554; Mr. Clean; Top Job; Windex
Oils, paint, etc	Organic solvents such as: Aliphatic Hydrocarbons; Naphtha (VM&P Grade); Kerosene, Petroleum Spirits
Bugs	Alcohols such as: Isopropyl Alcohol; Methanol
Graffiti, lipstick, marking pen ink	Butyl Cellosolve™

6.3.5 Speakers

6.3.5.1 Exterior Speakers

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

Visually inspect the exterior speakers for loose hardware and electrical connections every 60,000 miles. See Figures 3-13 and 7-20.

6.3.5.2 Interior Speakers

Visually inspect the interior speakers for loose components and proper operation every 60,000 miles. See Figures 3-14 and 7-21.

6.3.5.3 Cab Speakers

Visually inspect for loose components and proper operation every 60,000 miles. See Figures 3-9 and 7-22.

6.3.6 In-Dash Microphone

There is no maintenance needed on the In-Dash Microphone. See Figures 3-9 and 7-23.

6.3.7 Remote I/O Module

Perform visual inspection of hardware and wires every 60,000 miles. See Figures 3-9 and 7-24.

6.3.8 Communication Control Unit (CCU)

Visually inspect for loose components and secure panel mounting hardware every 60,000 miles. See Figures 3-9 and 7-25.

6.3.9 Global Positioning System (GPS) Receiver/Antenna

There is no maintenance needed on the GPS Antenna. See Figures 3-12 and 7-26.

6.3.10 Wayside Worker Alert System (WWAS)

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

1. Perform visual inspection of hardware and wires daily. See Figures 3-9 and 7-27.
2. Perform a functional test every 10,000 miles using the following steps:
    - Choose observation site and be sure proper personnel are notified to advise train operators.
    - Key up the first cab for testing.
    - Turn on the PAD and confirm the WWAS Sounds the alarm and the visual indication is present on the TOD.
    - Acknowledge the alarm on a TOD and confirm the alarm is silenced.
    - Change ends and direction and confirm proper operation in the other cab.

6.3.11 Horn

6.3.11.1 Horn Controller

1. Perform visual inspection of hardware and wires every 10,000 miles.
2. Adjust the output of the Horn Controller by turning the screw to the desired volume. The **HIGH HORN** is the controlling value. This value is greater than 85 dBA at 100 feet (30 m) open field environment (track centerline) at approximately 5 ft. height. See Figure 3-9 and 7-28.

6.3.11.2 Horn Speaker

There is no maintenance needed on the Horn. See Figures 3-15 and 7-29.

6.3.12 Radio

6.3.12.1 Radio Control Panel

Perform visual inspection of hardware and wires every 60,000 miles. See Figures 3-9 and 7-30.

6.3.12.2 Radio Antenna

Visually inspect the radio antenna for dirt and debris on the reflective plate and on the electrical connections/ground every 60,000 miles. If there is any dirt on the reflective plate or the electrical connections/ground, it should be cleaned with a MS-739 contact cleaner. See Figures 3-12 and 7-31.

CHAPTER 7.0

COMPONENT REMOVAL AND INSTALLATION

7.1 Introduction

This chapter provides general guidelines on component removal and installation of the Communication Equipment.

7.2 Safety Information

NOTE: Never take any short cuts that are not clearly defined and approved.

CAUTION

WEAR SAFETY SHOES AND HARD HATS WHEN WORKING WHERE OBJECTS MIGHT FALL.

WARNING

USE THE PROPER LIFTING EQUIPMENT TO REMOVE AND REPLACE HEAVY COMPONENTS. ALSO MAKE SURE THE COMPONENT IS SECURELY FASTENED TO THE LIFTING DEVICE. NEVER ATTEMPT TO PERFORM A TWO PERSON OPERATION ALONE. KNOW AND FOLLOW EMERGENCY PROCEDURES.

7.3 Removal and Installation Standard Shop Practices

Table 7-1: Standard Fastener Torques for LACMTA P3010 LRV

Diameter / Pitch	Force / Torque	Stainless Steel Group 1, 2, 3 Condition CW		Steel Fastener			
				Grade 5		Grade 8	
		A	B	A	B	A	B
1/4 - 20	ft-lbs. Nm kg cm	6 8 80	5 6 60	8 11 110	6 8 80	12 16 165	9 12 120
5/16 - 18	ft-lbs. Nm kg cm	13 18 180	10 14 140	17 23 230	13 18 180	25 34 350	18 24 250
3/8 - 16	ft-lbs. Nm kg cm	24 33 330	18 24 250	31 42 430	23 31 320	44 60 610	33 45 460
7/16 - 14	ft-lbs. Nm kg cm	38 52 530	28 38 390	49 67 680	37 50 510	70 95 970	53 72 730
1/2 - 13	ft-lbs. Nm kg cm	58 78 800	43 58 590	76 103 1050	57 77 790	105 142 1450	80 108 1100
5/8 - 11	ft-lbs. Nm kg cm	115 155 1590	85 115 1190	150 205 2070	125 170 1730	210 285 2900	160 215 2200
3/4 - 10	ft-lbs. Nm kg cm	140 190 1940	105 145 1500	265 360 3660	200 270 2770	370 500 5120	280 380 3870
7/8 - 9	ft-lbs. Nm kg cm	225 305 3110	170 230 2350	430 585 5940	320 435 4430	600 815 8300	450 610 6220
1 - 8	ft-lbs. Nm kg cm	340 460 4700	255 345 3530	640 870 8850	480 650 6640	910 1230 12500	580 925 9400
NOTE A: DO NOT USE LUBRICANT FOR FASTENERS – DRY NOTE B: TO BE OILED OR WAXED ON THREADS OF FASTENERS - LUBRICATED							

Table 7-2: Standard Metric Torques for LACMTA P3010 LRV

		Grade 4.6 (4T)		Grade 4.8		Grade 5.6 (5T)	
Nominal diameter	Torque Conversion	Dry	Oil	Dry	Oil	Dry	Oil
M5	ft-lbs.	1.8	1.6	2.4	2.1	2.2	1.8
	N*m	2.5	2.1	3.3	2.8	3	2.5
	kgf cm	25	21	34	29	31	26
M6	ft-lbs.	2.9	2.6	4.1	3.6	3.8	3.2
	N*m	3.9	3.5	5.6	4.8	5.1	4.3
	kgf cm	40	35	57	49	52	44
M8	ft-lbs.	7.2	6.3	10.3	8.9	8.9	7.4
	N*m	9.8	8.5	14	12	12	10
	kgf cm	100	85	140	120	130	110
M10	ft-lbs.	16	13	20	17	18	15
	N*m	22	17	27	23	25	21
	kgf cm	220	170	270	230	250	210
M12	ft-lbs.	27	22	35	30	32	27
	N*m	37	30	47	40	43	36
	kgf cm	380	300	480	410	440	370
M14	ft-lbs.	44	34	55	48	50	43
	N*m	60	46	75	65	68	58
	kgf cm	620	470	760	650	690	590
M16	ft-lbs.	70	53	89	74	81	66
	N*m	95	72	120	100	110	90
	kgf cm	1000	730	1200	1000	1100	920
M18	ft-lbs.	89	74	118	100	111	96
	N*m	120	100	160	135	150	130
	kgf cm	1300	1000	1650	1400	1500	1300
M20	ft-lbs.	125	103	170	144	155	133
	N*m	170	140	230	195	210	180
	kgf cm	1800	1400	2300	2000	2100	1800
M22	ft-lbs.	177	140	229	195	207	177
	N*m	240	190	310	265	280	240
	kgf cm	2500	1950	3160	2700	2900	2400
M24	ft-lbs.	221	181	295	247	266	221
	N*m	300	245	400	335	360	300
	kgf cm	3100	2500	4000	3400	3600	3100
M27	ft-lbs.	340	262	428	361	384	325
	N*m	460	355	580	490	520	440
	kgf cm	4700	3600	5900	5000	5300	4500
M30	ft-lbs.	465	358	575	487	524	443
	N*m	630	485	780	660	710	600
	kgf cm	6500	4900	8000	6800	7200	6100

Table 7-2: Standard Metric Torques for LACMTA P3010 LRV (continued)

		Grade 5.8		Grade 6.8 (6T)		Grade 8.8 (7T)	
Nominal diameter	Torque Conversion	Dry	Oil	Dry	Oil	Dry	Oil
M5	ft-lbs.	3	2.5	3.5	3	4.6	3.8
	N*m	4.1	3.4	4.7	4	6.2	5.2
	kgf cm	41	35	48	41	63	53
M6	ft-lbs.	5.1	4.3	6	5	7.4	6.6
	N*m	6.9	5.8	8	6.8	10	8.9
	kgf cm	70	59	81	69	110	91
M8	ft-lbs.	12	10	14	12	18	16
	N*m	17	14	19	16	25	22
	kgf cm	170	140	200	170	260	220
M10	ft-lbs.	24	21	28	24	37	32
	N*m	33	28	38	32	50	43
	kgf cm	340	290	390	330	510	440
M12	ft-lbs.	43	36	49	42	67	57
	N*m	58	49	67	57	91	77
	kgf cm	590	500	680	580	930	790
M14	ft-lbs.	68	58	81	66	111	89
	N*m	92	78	110	90	150	120
	kgf cm	940	790	1100	920	1500	1300
M16	ft-lbs.	103	89	125	103	170	140
	N*m	140	120	170	140	230	190
	kgf cm	1500	1200	1700	1400	2300	2000
M18	ft-lbs.	148	125	170	140	229	192
	N*m	200	170	230	190	310	260
	kgf cm	2000	1700	2300	2000	3200	2700
M20	ft-lbs.	207	177	236	207	325	273
	N*m	280	240	320	280	440	370
	kgf cm	2800	2400	3300	2800	4500	3800
M22	ft-lbs.	280	236	325	273	443	376
	N*m	380	320	440	370	600	510
	kgf cm	3900	3300	4500	3800	6100	5200
M24	ft-lbs.	354	302	413	347	560	480
	N*m	480	410	560	470	760	650
	kgf cm	4900	4200	5700	4900	7800	6600
M27	ft-lbs.	524	443	605	509	811	701
	N*m	710	600	820	690	1100	950
	kgf cm	7200	6100	8400	7100	11000	9700
M30	ft-lbs.	708	605	811	693	1106	959
	N*m	960	820	1100	940	1500	1300
	kgf cm	9800	8300	11000	9600	15000	13000

Table 7-2: Standard Metric Torques for LACMTA P3010 LRV (continued)

		Grade 9.8		Grade 10.9		Grade 12.9	
Nominal diameter	Torque Conversion	Dry	Oil	Dry	Oil	Dry	Oil
M5	ft-lbs.	5.1	4.4	6.5	5.5	7.4	6.5
	N*m	6.9	5.9	8.8	7.5	10	8.8
	kgf cm	71	60	90	77	110	89
M6	ft-lbs.	8.9	7.4	11	9.6	13	11
	N*m	12	10	15	13	18	15
	kgf cm	120	100	150	130	180	150
M8	ft-lbs.	21	18	27	23	32	27
	N*m	28	24	36	31	43	36
	kgf cm	290	250	370	320	430	370
M10	ft-lbs.	42	35	53	45	62	53
	N*m	57	48	72	61	84	72
	kgf cm	580	490	740	630	860	730
M12	ft-lbs.	74	62	96	81	111	96
	N*m	100	84	130	110	150	130
	kgf cm	1000	850	1300	1100	1500	1300
M14	ft-lbs.	118	96	148	125	170	148
	N*m	160	130	200	170	230	200
	kgf cm	16000	1400	2000	1700	2400	2000
M16	ft-lbs.	177	155	229	199	266	229
	N*m	240	210	310	270	360	310
	kgf cm	2500	2100	3200	2700	3700	3200
M18	ft-lbs.			317	273	369	317
	N*m			430	370	500	430
	kgf cm			4400	3700	5100	4300
M20	ft-lbs.			450	384	524	450
	N*m			610	520	710	610
	kgf cm			6200	5300	7300	6200
M22	ft-lbs.			612	524	715	605
	N*m			830	710	970	820
	kgf cm			8400	7200	9900	8400
M24	ft-lbs.			811	664	885	738
	N*m			1100	900	1200	1000
	kgf cm			11000	9100	13000	11000
M27	ft-lbs.			1106	960	1328	1106
	N*m			1500	1300	1800	1500
	kgf cm			16000	13000	18000	16000
M30	ft-lbs.			1550	1328	1770	1550
	N*m			2100	1800	2400	2100
	kgf cm			21000	18000	25000	21000

7.4 Removal

7.4.1 TOA Communications Equipment

7.4.1.1 Audio Control Panels (ACP)

1. Open the right-side cab locker shown in Figure 3-1 by unlocking the three locks using a maintenance key. The ACP is located at the top of the rack shown in Figure 3-2.
2. Disconnect the ID plug from the ACP. Figure 7-1 shows the installation detail of the ID plug for the ACP. First, disconnect the ID plug from the ACP, Second, release the lanyard from the ACP handle. Third, the ID plug is secured to the rack frame. The disconnected ID plug will be reused for an ACP replacement. Therefore, the ID plug should be secured to the rack frame.

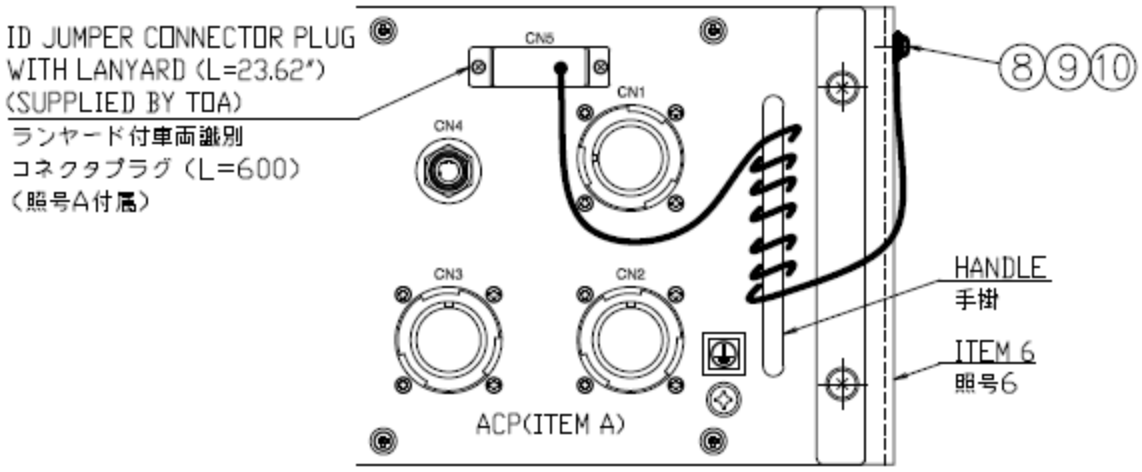

Figure 7-1: Detail View of ID Plug installation in the ACP

3. Disconnect the electrical connections from the ACP, including the M12 connector in CN4.
4. Release each four of the M6x20 bolts, M6 lock washers, and M6 plain washers and remove the ACP from the adapter brackets.

7.4.1.2 Communication Control Head (CCH)

1. Disconnect the CCH wiring, running the cable through the hole in the bottom of the console from the radio wiring.
2. Release screws with plain washers (two per each side of the CCH), and remove the CCH from the bracket.

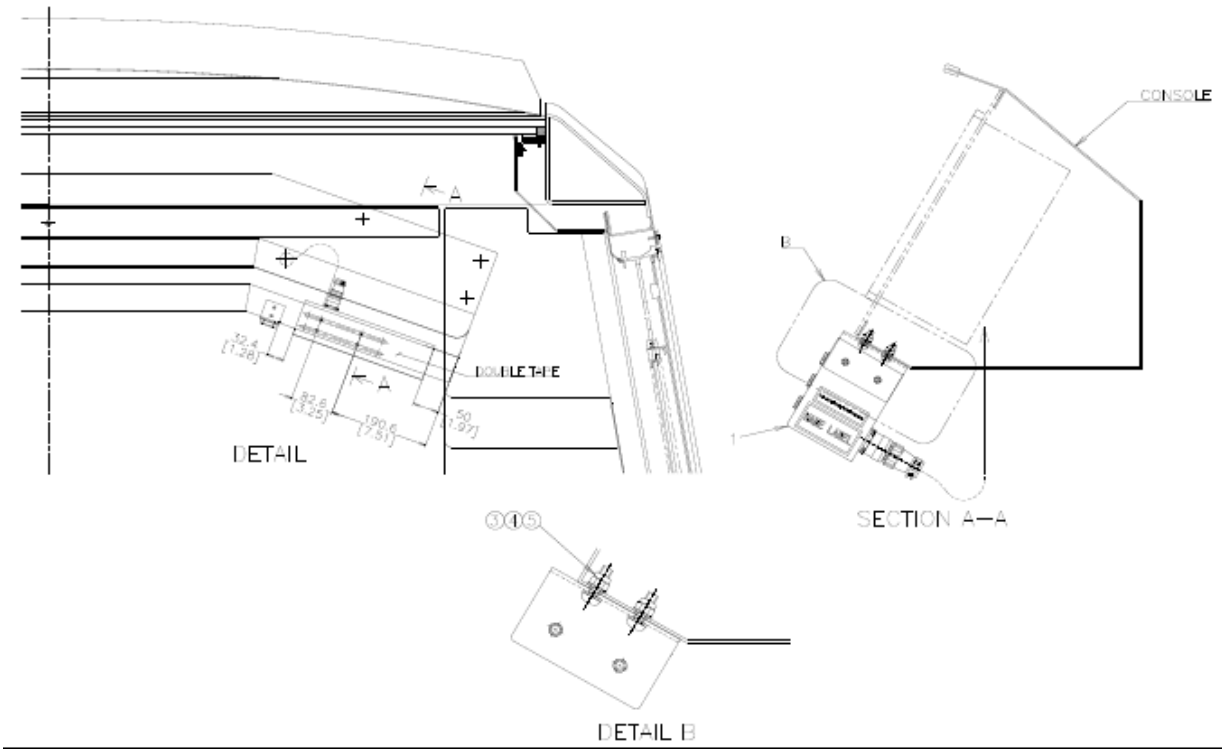

Figure 7-2: Detail View of Installed Communication Control Head

7.4.1.3 Interface Unit (IFU)

1. In the B-Unit cab, unlock the two locks on the cab ceiling panel using a maintenance key, lower the cab ceiling panel, and release the two safety chains to fully open the panel.
2. Disconnect the ID plug from the IFU. Figure 7-3 shows the installation detail of the ID plug for the IFU. First, release the fixed bolt with washers. Second, disconnect the ID plug from the IFU. The disconnected ID plug will be reused for the replaced IFU, therefore, the ID plug should be secured to the rack frame (using M4 hex bolt, nut and washer shown in Figure 3-4) if the IFU is not immediately replaced with a new device.

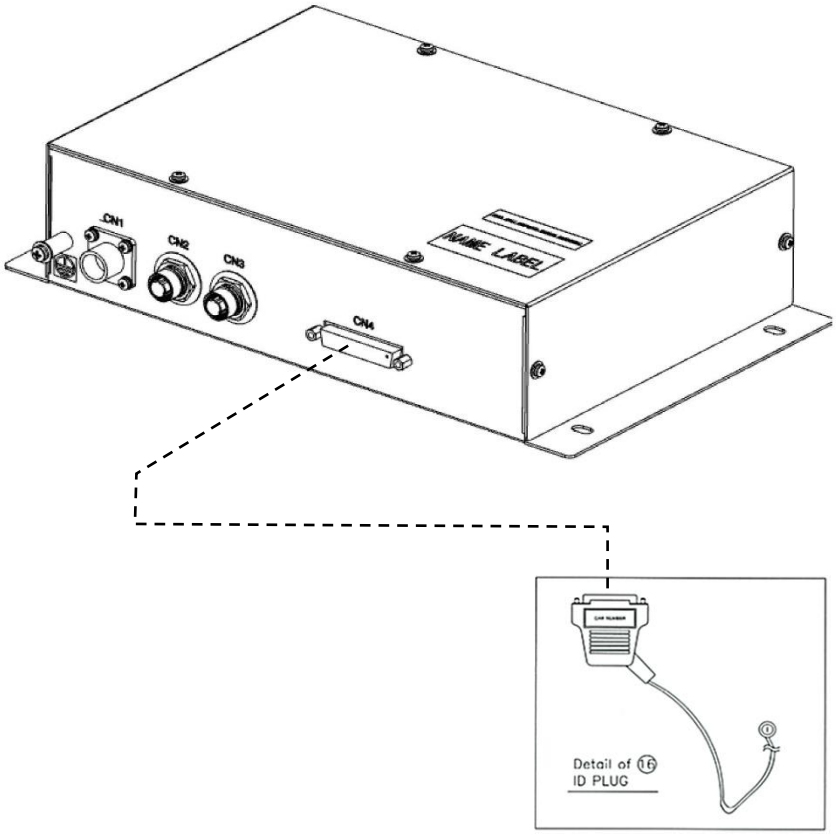

Figure 7-3: Detail View of ID Plug Installation Status in IFU

3. Disconnect all electrical connections from the IFU including M12 connectors in CN2 and CN3.
4. Release four each of M5x16 bolts, M5 nuts, and M5 plain washers and remove the IFU from the brackets.

7.4.1.4 Ethernet Switch, Viper-112A

1. To access the Ethernet Switch, unlock the two locks on the cab ceiling panel using a maintenance key, lower the cab ceiling panel, and release the two safety chains to fully open the panel.
2. Disconnect all Ethernet cable connections from the Ethernet Switch.
3. Release four screws with lock/plain washers and remove the Ethernet Switch from the bracket.

7.4.1.5 Ethernet Interface Module, DDW-002-B1

1. Open the right side cab locker shown in Figure 3-7 by unlocking the three locks using a maintenance key and locate the two Ethernet Interface Modules at the bottom of the rack shown in Figure 3-8.

2. Disconnect all cable connection from the Ethernet Interface Module.

3. Release four each of the M6x20 screws, M6 lock washers, and M6 plain washers per module and remove the Ethernet Interface Modules from the adapter plate.

7.4.2 Passenger Information System

7.4.2.1 Passenger Information Display (PID)

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

1. Remove the three M4 x 10 screws (1) from the cover (2). See Figure 7-4.

2. Remove the cover (2) and packing (3).

3. Remove the eighteen M5 x 20 screws (4), M5 lock washers (5) and M5 plain washers (6).

4. Remove the Passenger Information Display (7) enough to access the wiring.

5. Disconnect the wiring from the Passenger Information Display (7).

6. Remove the Passenger Information Display (7).

7. Remove the four M4 x 12 screws (8).

8. Remove the two brackets (9 & 10) and the packing (11) for reuse on reinstallation.

NOTE: Sheet 1 of Figure 7-4 is the Cab Passenger Information Display and Sheet 2 is the Electric Locker Interior Passenger Information Display. Removal is the same for both sign locations.

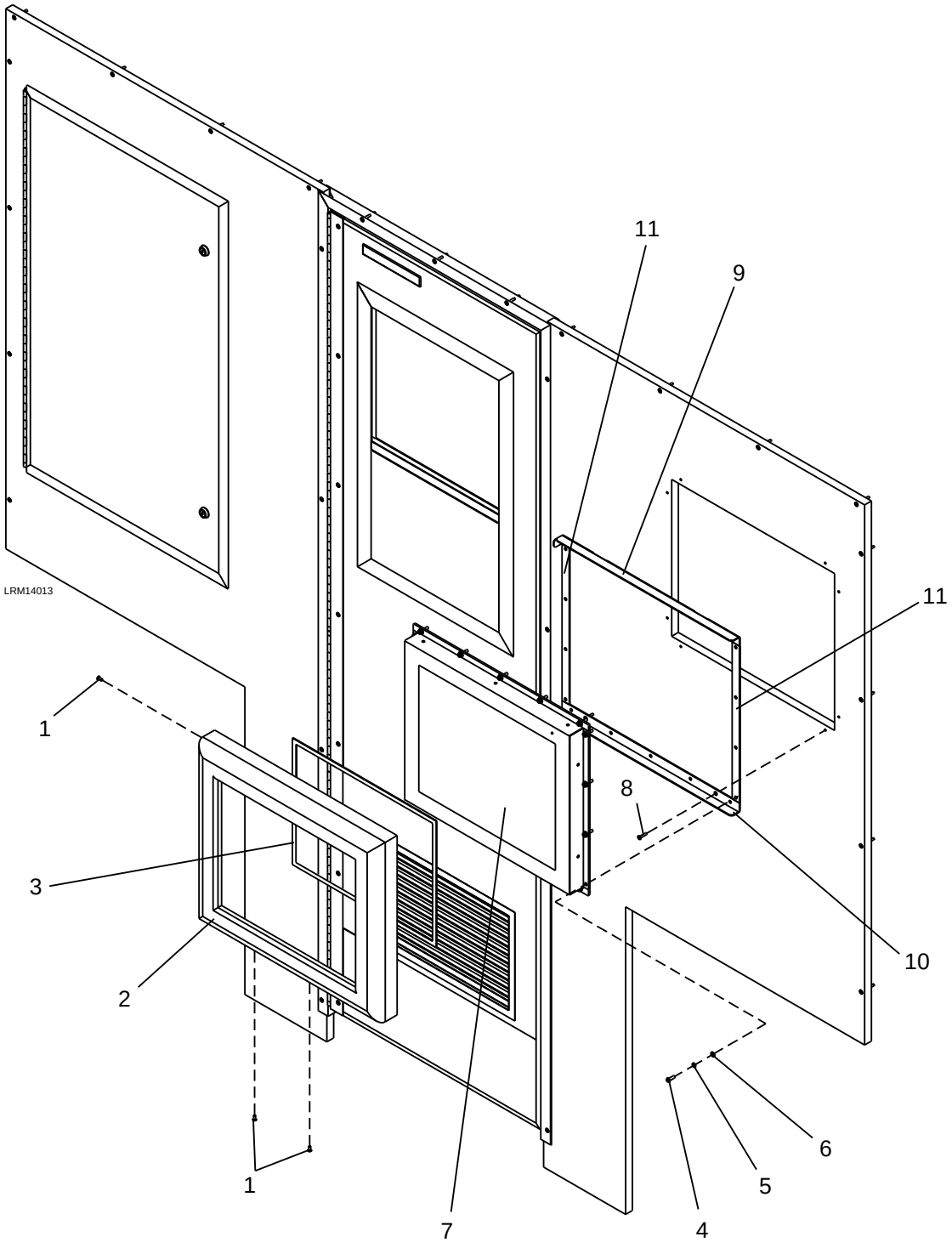

Figure 7-4: Passenger Information Display
(Sheet 1 of 2)

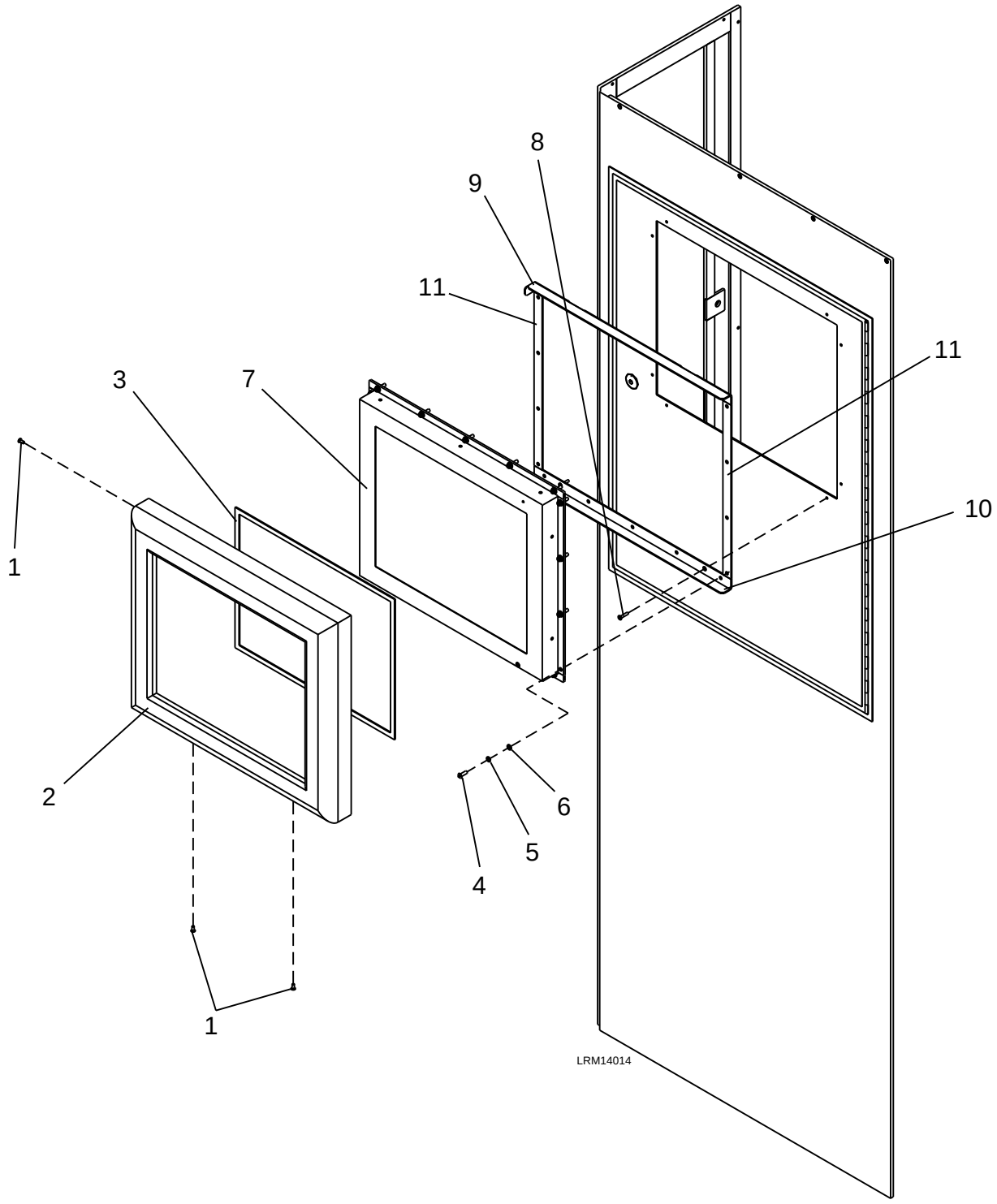

Figure 7-4: Passenger Information Display
(Sheet 2 of 2)

7.4.2.2 VGA Extender Receive Unit

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

1. Unlock the single lock (4) and open the locker door panel (5) to access the VGA Extender Receive Unit (1) hardware and disconnect the electrical connections using a Torque Screwdriver for the M12 connections. See Figure 7-5.

2. Remove the four M4 hexagon nuts (2) and M4 plain washers (3).

3. Carefully remove the VGA Extender Receive Unit (1).

7.4.2.3 VGA Extender Send Unit

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

1. Unlock the two locks (4) and lower the cab ceiling panel (5) to access the VGA Extender Send Unit (1) and disconnect the electrical connections using a Torque Screwdriver for the M12 connections. See Figure 7-6.

2. Remove the four M4 hexagon nuts (2) and M4 plain washers (3).

3. Carefully remove the VGA Extender Send Unit (1).

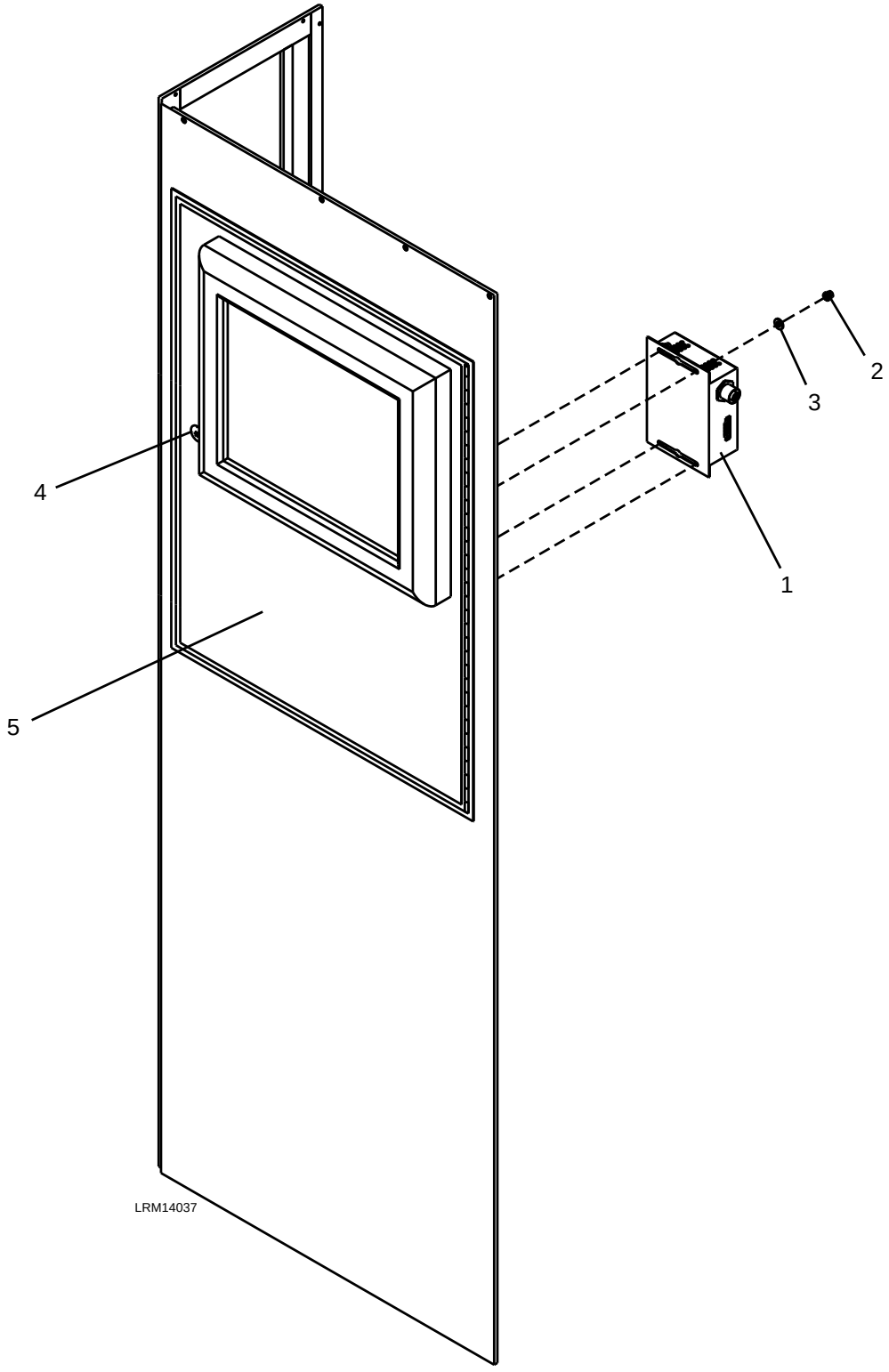

Figure 7-5: VGA Extender Receive Unit

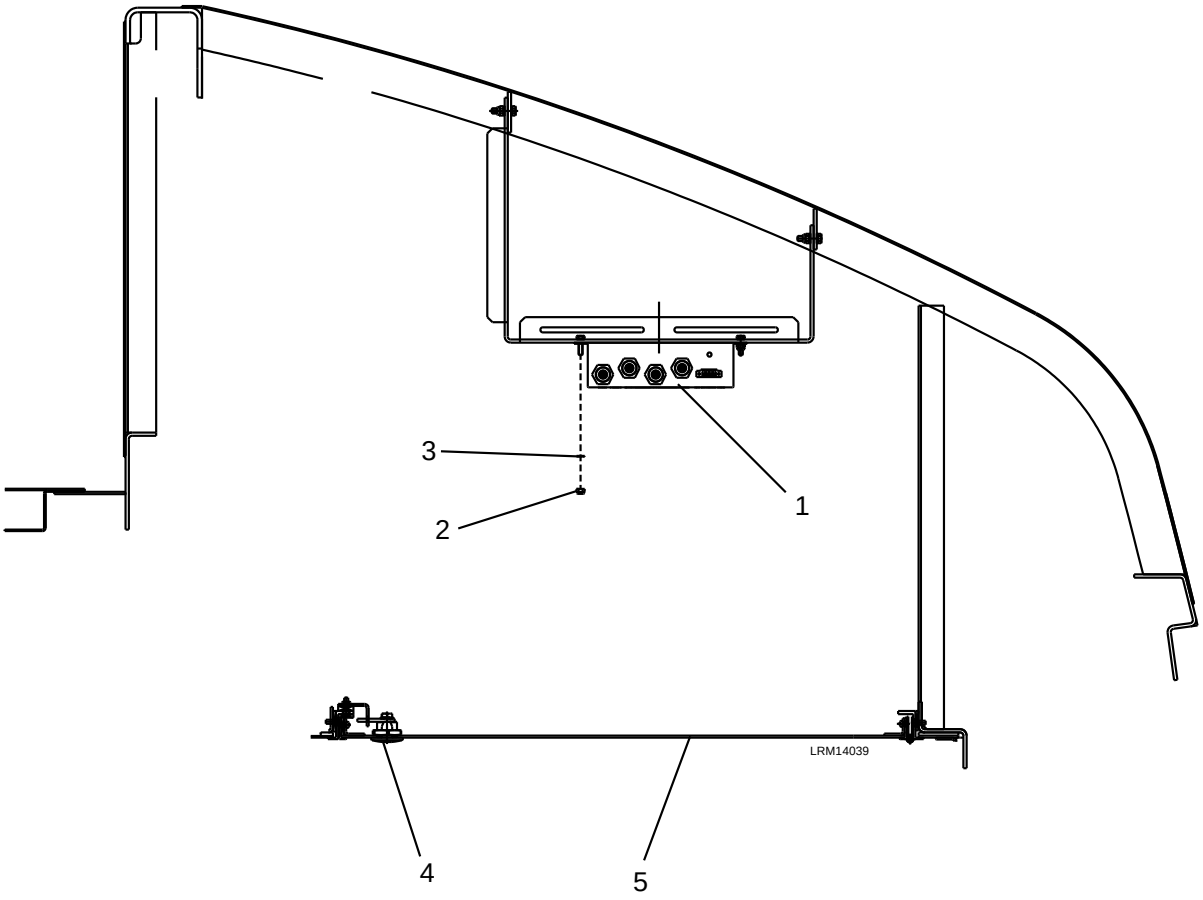

Figure 7-6: VGA Extender Send Unit

7.4.2.4 Passenger Information Controller

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

Cars 1001 through 1025

1. Unlock the two locks (5) and lower the cab ceiling panel (6) to access the Passenger Information Controller (1) and disconnect the electrical connections using a Torque Screwdriver for the M12 connections. See Figure 7-7.

2. Remove the four M4 x 16 bolts (2), M4 lock washers (3), and M4 plain washers (4).

3. Carefully remove the Passenger Information Controller (1).

Cars 1026 and Later

1. Unlock the two locks (6) and lower the cab ceiling panel (7) to access the Passenger Information Controller (1) and disconnect the electrical connections using a Torque Screwdriver for the M12 connections. See Figure 7-8.

2. Remove the four M4 x 16 bolts (2), M4 plain washers (3), M4 hexagon nuts (4) and M4 plain washers (5).

3. Carefully remove the Passenger Information Controller (1).

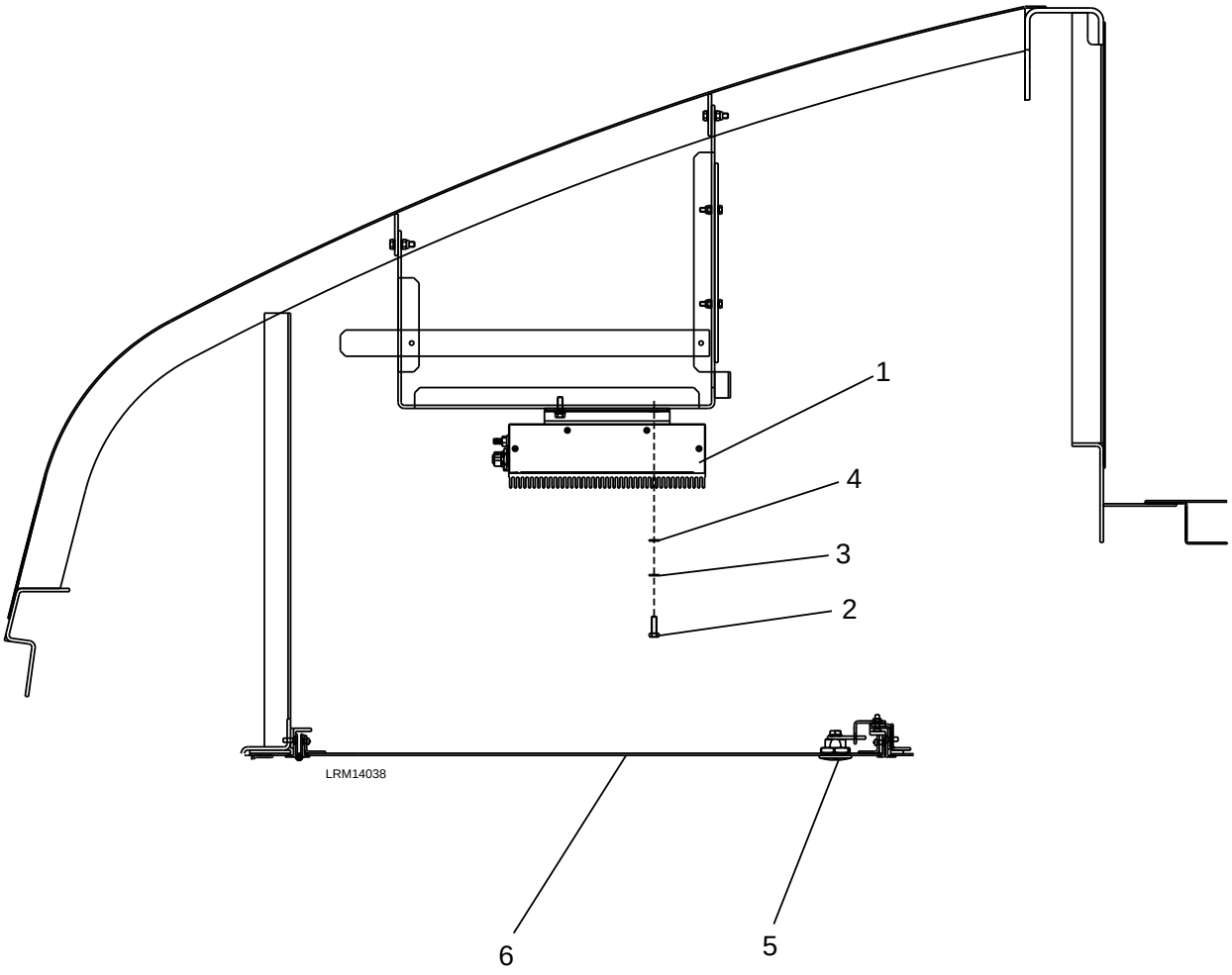

Figure 7-7: Passenger Information Controller
(Cars 1001 through 1025)

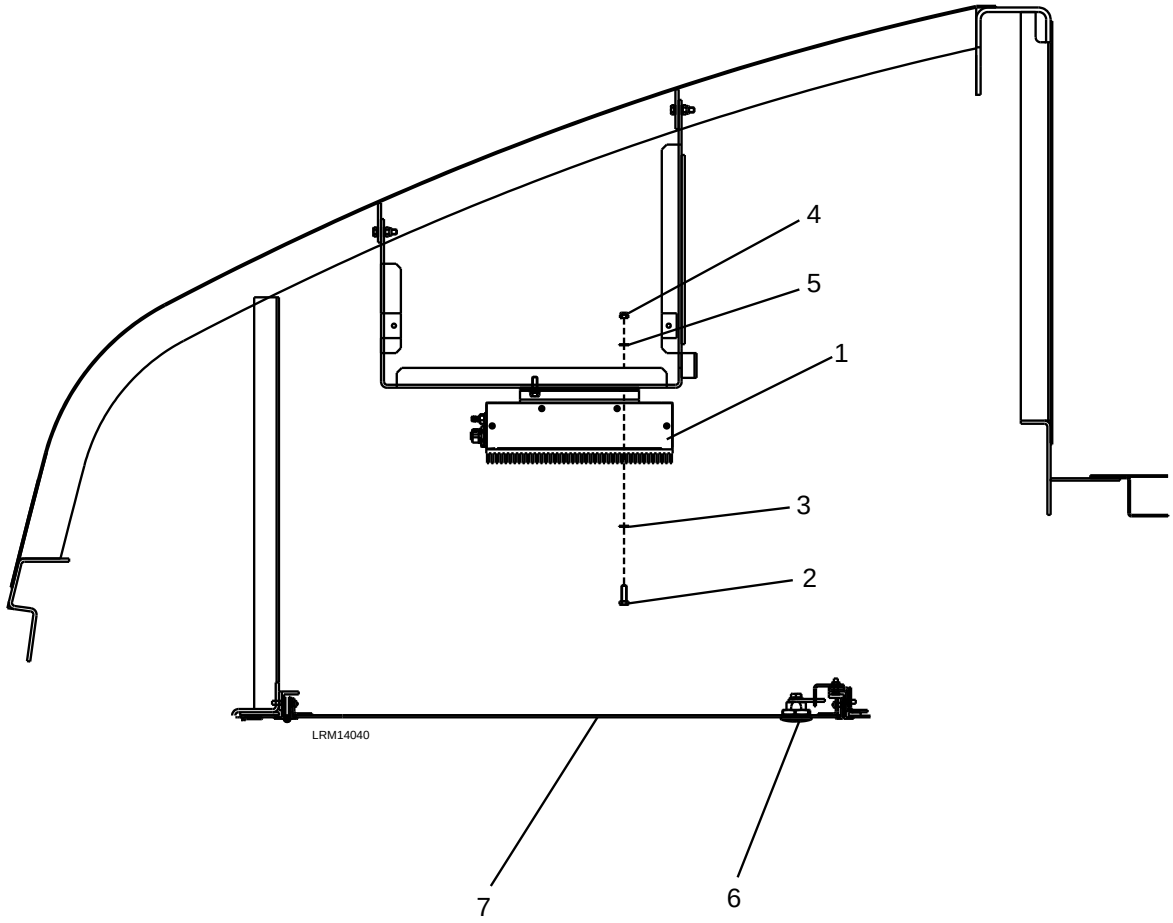

Figure 7-8: Passenger Information Controller
(Cars 1026 and Later)

7.4.3 Passenger Intercom (PIC)

1. Remove the four M4 x 16 screws (1) from the Passenger Intercom (2). See Figure 7-9.

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

2. Remove the Passenger Intercom (2) enough to access the wiring.
3. Disconnect the wiring from the Passenger Intercom (2).
4. Remove the Passenger Intercom (2).

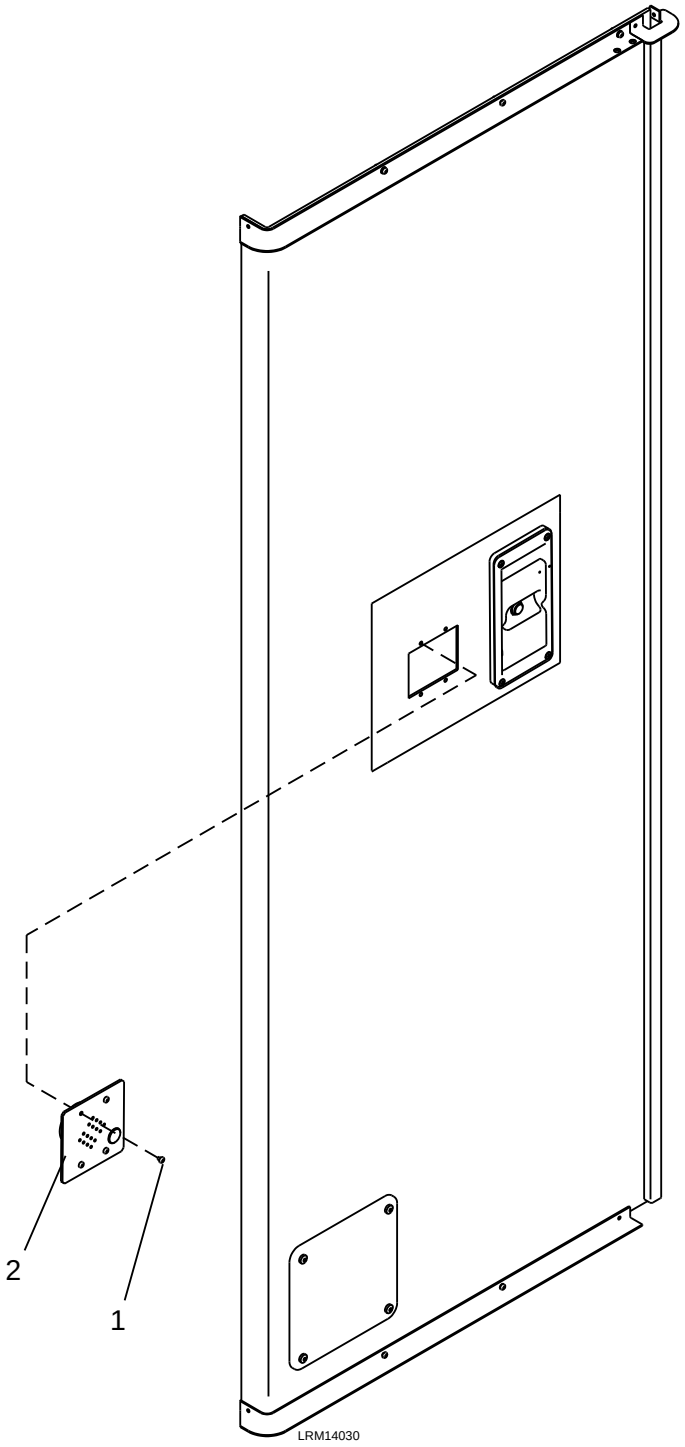

Figure 7-9: Passenger Intercom (PIC)

7.4.4 Exterior Destination Signs

7.4.4.1 Front Destination Sign

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

1. Disconnect the electrical connections from the Front Destination Sign (1). See Figure 7-10.
2. Remove the two M8 x 20 screws (2), M8 lock washers (3) and M8 plain washers (4).
3. Carefully remove the Front Destination Sign (1) by lifting up off the brackets (5).

7.4.4.1.1 Replace Power Supply PCB

1. Remove front destination sign assembly (1, Figure 7-11) from its mounted location.
2. Remove ten 6-32 x 5/16 SEM screws (2) that secure backplate assembly (3) to front panel assembly (4).
3. Carefully separate backplate assembly (3) from front panel assembly (4) to access electrical wiring and harnesses.
4. Tag and disconnect electrical wiring connectors from the power supply PCB (5).
5. Remove power supply PCB (5).
6. Install replacement power supply PCB (5) with connectors J1 and J2 upwards.
7. Connect electrical wiring connectors to the power supply PCB (5).
8. Install the backplate assembly (3) to the front panel assembly (4) using ten 6-32 x 5/16 SEM screws (2).

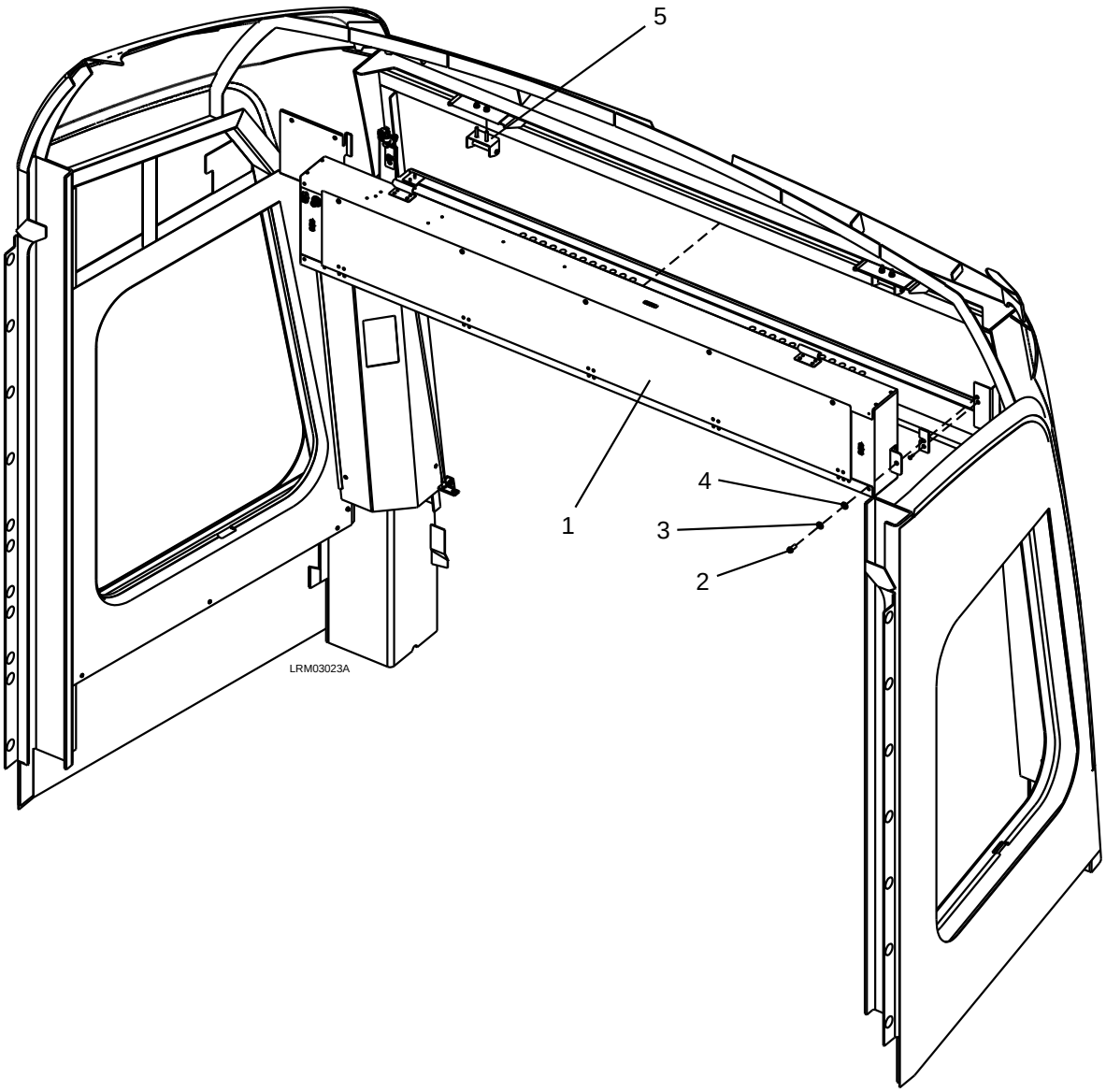

Figure 7-10: Front Destination Sign

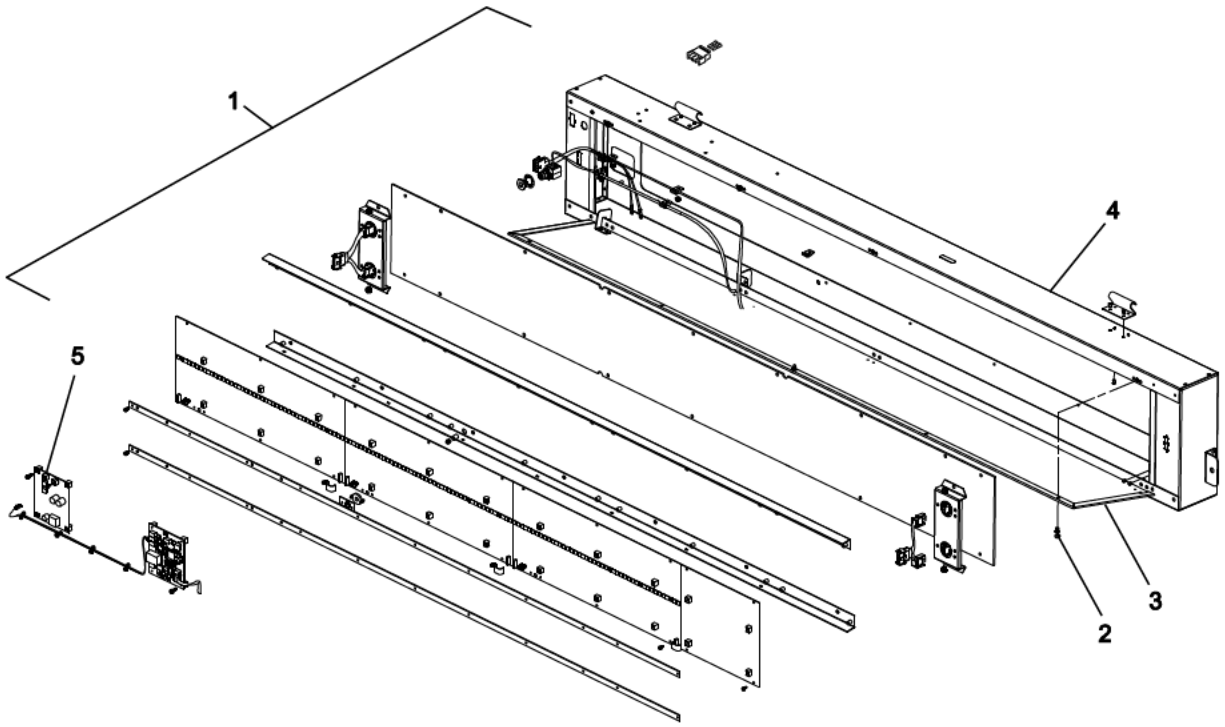

Figure 7-11: Replace Front Destination Sign Power Supply PCB

7.4.4.1.2 Replace Sign Control PCB

1. Remove front destination sign assembly (1, Figure 7-12) from its mounted location.
2. Remove ten 6-32 x 5/16 SEM screws (2) that secure backplate assembly (3) to front panel assembly (4).
3. Carefully separate backplate assembly (3) from front panel assembly (4) to access electrical wiring and harnesses.
4. Tag and disconnect electrical wiring connectors from the control PCB (5).
5. Remove control PCB (5).
6. Install replacement control PCB (5) with RS-485 ports to the left.
7. Connect electrical wiring connectors to the control PCB (5).
8. Install the backplate assembly (3) to the front panel assembly (4) using ten 6-32 x 5/16 SEM screws (2).

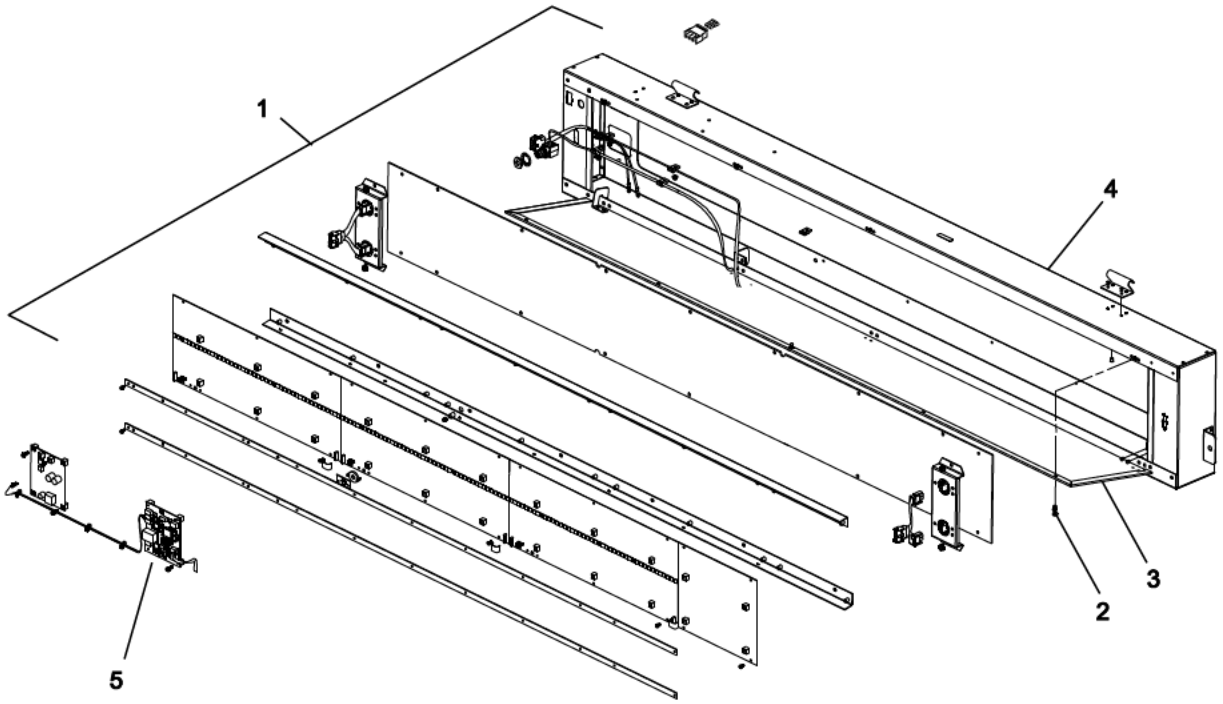

Figure 7-12: Replace Front Destination Sign Control PCB

7.4.4.1.3 Replace Light Sensor PCB

1. Remove front destination sign assembly (1, Figure 7-13) from its mounted location.
2. Remove ten 6-32 x 5/16 SEM screws (2) that secure backplate assembly (3) to front panel assembly (4).
3. Carefully separate backplate assembly (3) from front panel assembly (4) to access electrical wiring and harnesses.
4. Tag and disconnect electrical wiring connectors from the light sensor PCB (5).
5. Remove light sensor PCB (5).
6. Install replacement light sensor PCB (5).
7. Connect electrical wiring connectors to the light sensor PCB (5).
8. Install the backplate assembly (3) to the front panel assembly (4) using ten 6-32 x 5/16 SEM screws (2).

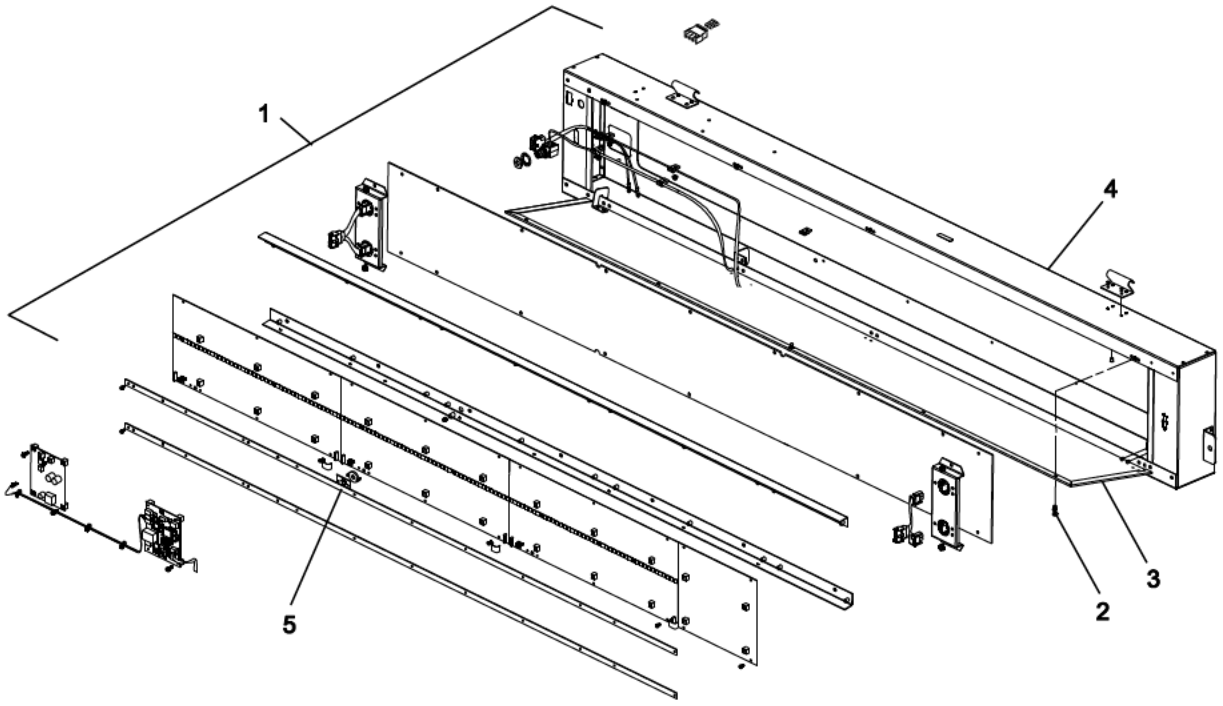

Figure 7-13: Replace Front Destination Sign Light Sensor PCB

7.4.4.1.4 Replace LED Display Matrix PCB

1. Remove front destination sign assembly (1, Figure 7-14) from its mounted location.

2. Remove ten 6-32 x 5/16 SEM screws (2) that secure backplate assembly (3) to front panel assembly (4).

3. Carefully separate backplate assembly (3) from front panel assembly (4) to access electrical wiring and harnesses.

4. Tag and disconnect electrical wiring connectors from the defective LED Display Matrix PCB (7, 8, 9, or 10).

5. Remove 6-32 x 5/16 SEM screws (5) that secure the defective LED Display Matrix PCB (7, 8, 9, or 10) to the bracket assembly (6). There are six screws on each destination matrix and four on the route code matrix.

6. Remove the defective LED Display Matrix PCB.

7. Install the replacement LED Display Matrix PCB using the 6-32 x 5/16 SEM screws (5) that were removed previously.

8. Verify that the DIP switch setting on the first LED Display Matrix (7) is:

1	2	3	4	5	6	7	8
Off	Off	Off	Off	Off	Off	Off	Off

9. Connect electrical wiring connectors to the LED Display Matrix PCB (7).

10. Verify that the DIP switch setting on the second LED Display Matrix (8) is:

1	2	3	4	5	6	7	8
Off	Off	Off	Off	ON	Off	Off	Off

11. Connect electrical wiring connectors to the LED Display Matrix PCB (8).

12. Verify that the DIP switch setting on the third LED Display Matrix (9) is:

1	2	3	4	5	6	7	8
Off	Off	Off	Off	ON	Off	Off	Off

13. Connect electrical wiring connectors to the LED Display Matrix PCB (9).

14. Install the backplate assembly (3) to the front panel assembly (4) using ten 6-32 x 5/16 SEM screws (2).

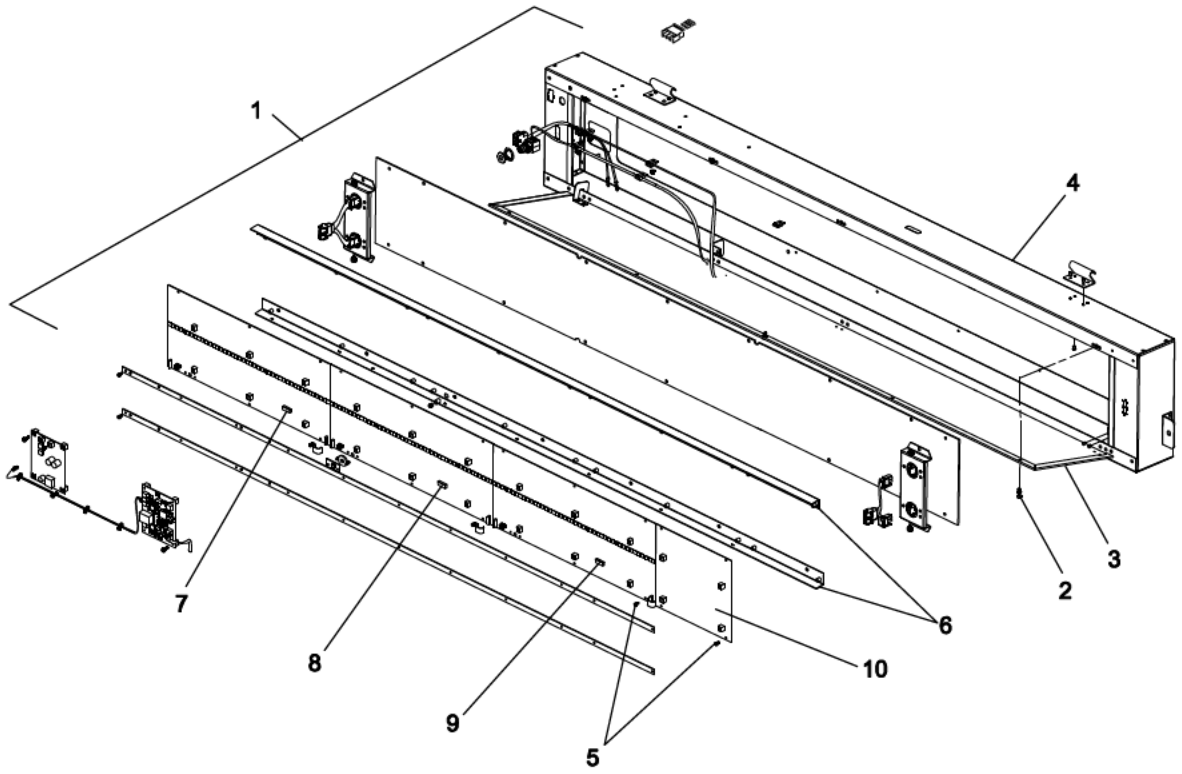

Figure 7-14: Replace Front Destination Sign LED Display Matrix PCB

7.4.4.2 Side Destination Sign

1. Remove the seven M4 x 12 screws (1) and M4 plain washers (2) from the cover (3). See Figure 7-15.

2. Remove the cover (3) and the three packing (4).

WARNING

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3. Disconnect the electrical connections to the Side Destination Sign (5).

4. Remove the four M5 x 16 screws (6), M5 lock washers (7) and M5 plain washers (8).

5. Rotate the Side Destination Sign (5) and remove from the brackets (9).

NOTE: Only proceed with steps 6 and 7 below if brackets (9) are damaged.

6. Remove the eight M4 x 16 screws (10), M4 lock washers (11) and M4 plain washers (12) from the brackets (9).

7. Remove the brackets (9) and packing (13).

7.4.4.2.1 Replace Power Supply PCB

1. Remove side destination sign assembly (1, Figure 7-16) from its mounted location.

2. Remove ten 6-32 x 5/16 FH Phillips screws (2) that secure the housing assembly (3) to front panel assembly (4).

3. Carefully separate the housing assembly (3) from front panel assembly (4) to access electrical wiring and harnesses.

4. Tag and disconnect electrical wiring connectors from the power supply PCB (5).

5. Remove power supply PCB (5).

6. Install replacement power supply PCB (5) with J1 and J2 connectors upwards.

7. Connect electrical wiring connectors to the power supply PCB (5).

8. Install the housing assembly (3) to the front panel assembly (4) using ten 6-32 x 5/16 FH Phillips screws (2).

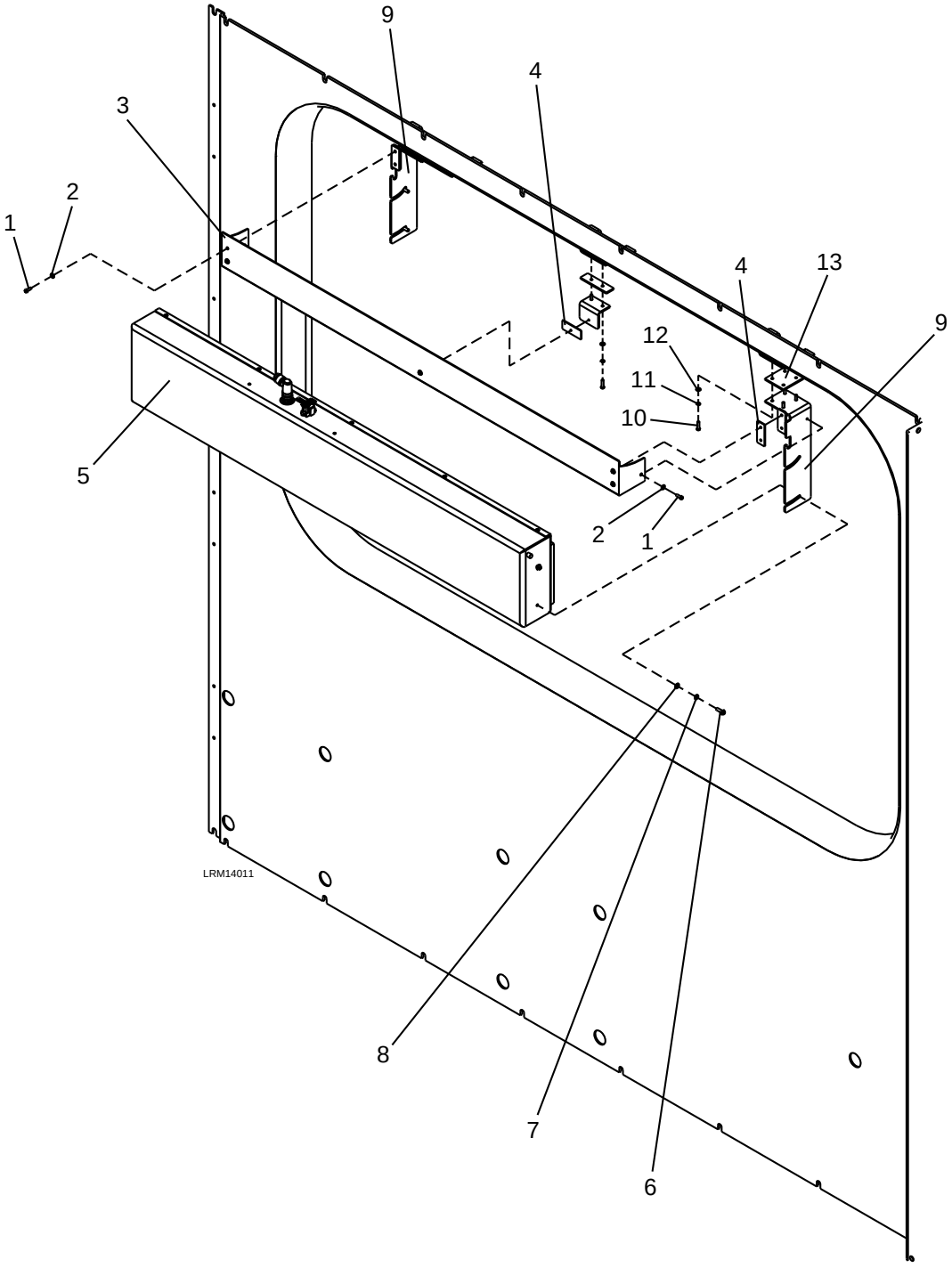

Figure 7-15: Side Destination Sign

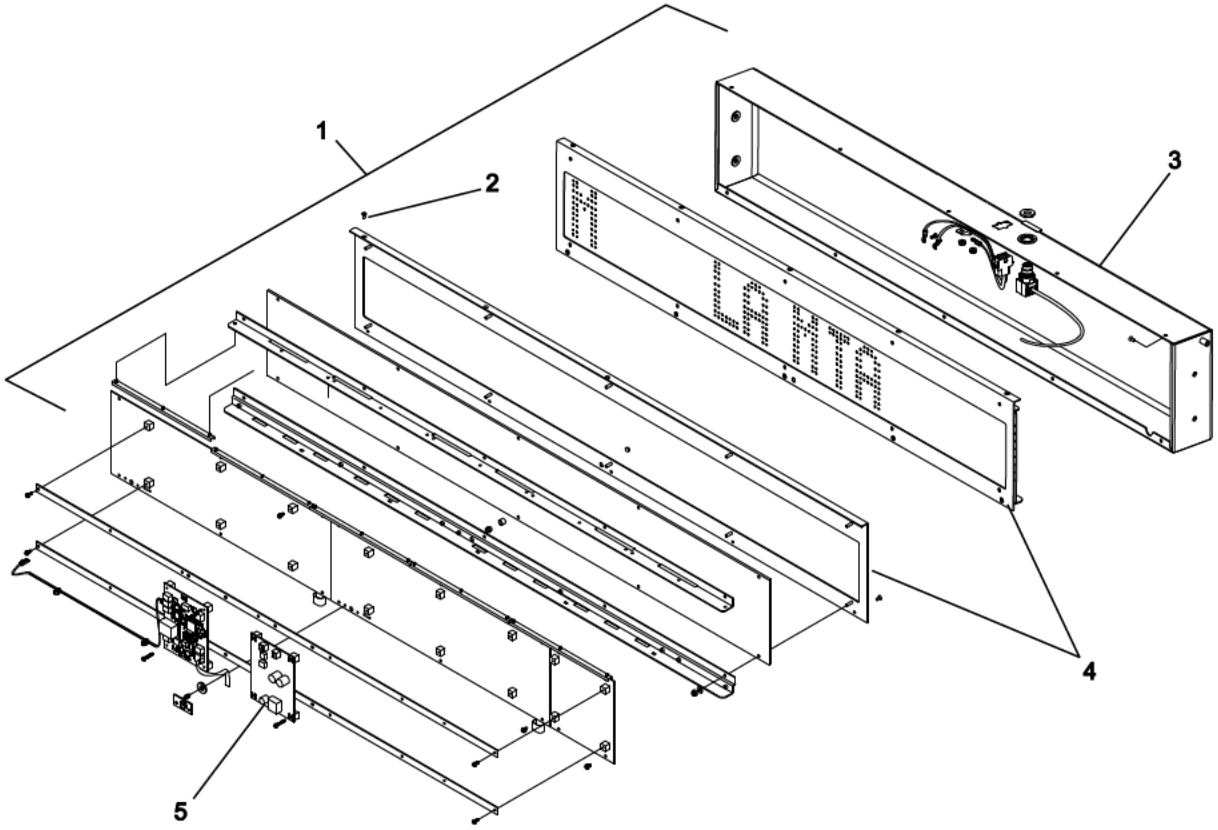

Figure 7-16: Replace Side Destination Sign Power Supply PCB

7.4.4.2.2 Replace Sign Control PCB

1. Remove side destination sign assembly (1, Figure 7-17) from its mounted location.
2. Remove ten 6-32 x 5/16 FH Phillips screws (2) that secure the housing assembly (3) to front panel assembly (4).
3. Carefully separate the housing assembly (3) from front panel assembly (4) to access electrical wiring and harnesses.
4. Tag and disconnect electrical wiring connectors from the control PCB (5).
5. Remove control PCB (5) with RS-485 ports to the left.
6. Install replacement control PCB (5).
7. Connect electrical wiring connectors to the control PCB (5).
8. Install the housing assembly (3) to the front panel assembly (4) using ten 6-32 x 5/16 FH Phillips screws (2).

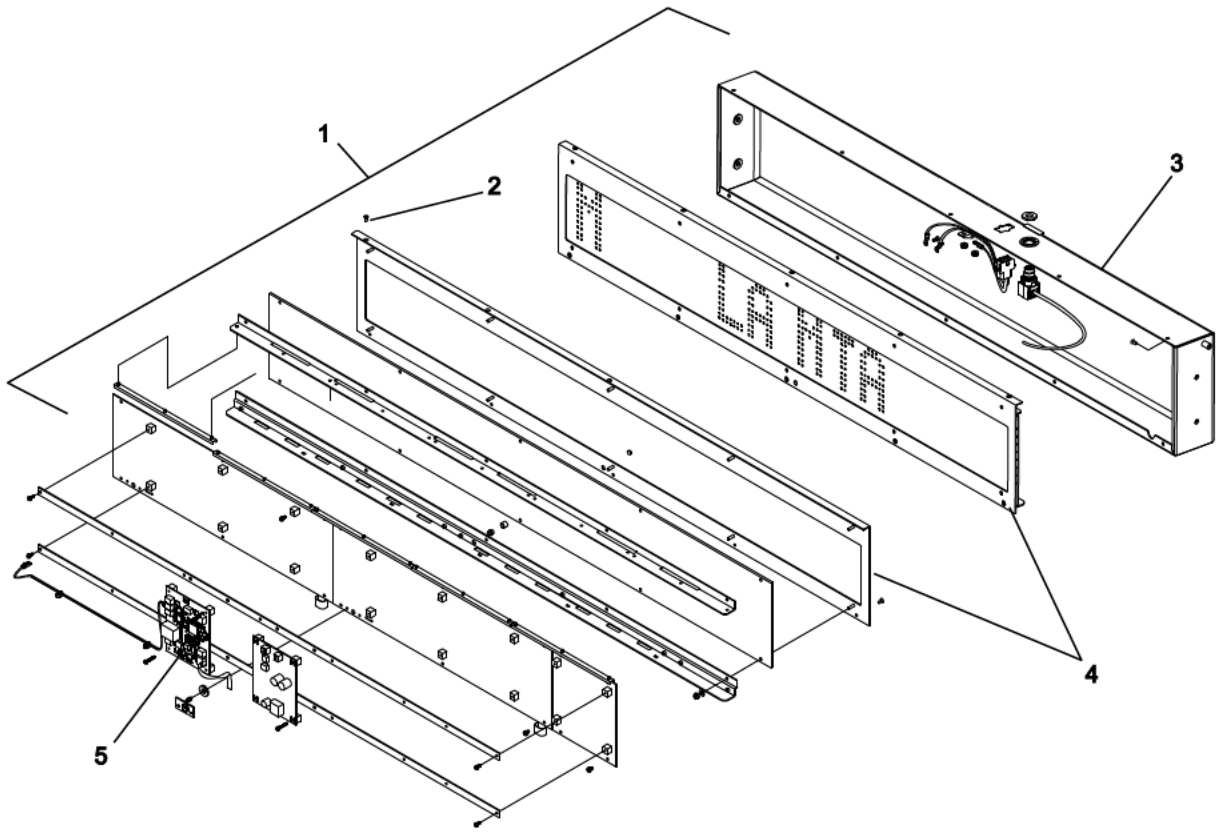

Figure 7-17: Replace Side Destination Sign Control PCB

7.4.4.2.3 Replace Light Sensor PCB

1. Remove side destination sign assembly (1, Figure 7-18) from its mounted location.
2. Remove ten 6-32 x 5/16 FH Phillips screws (2) that secure the housing assembly (3) to front panel assembly (4).
3. Carefully separate the housing assembly (3) from front panel assembly (4) to access electrical wiring and harnesses.
4. Tag and disconnect electrical wiring connectors from the light sensor PCB (5).
5. Remove light sensor PCB (5).
6. Install replacement light sensor PCB (5).
7. Connect electrical wiring connectors to the light sensor PCB (5).
8. Install the housing assembly (3) to the front panel assembly (4) using ten 6-32 x 5/16 FH Phillips screws (2).

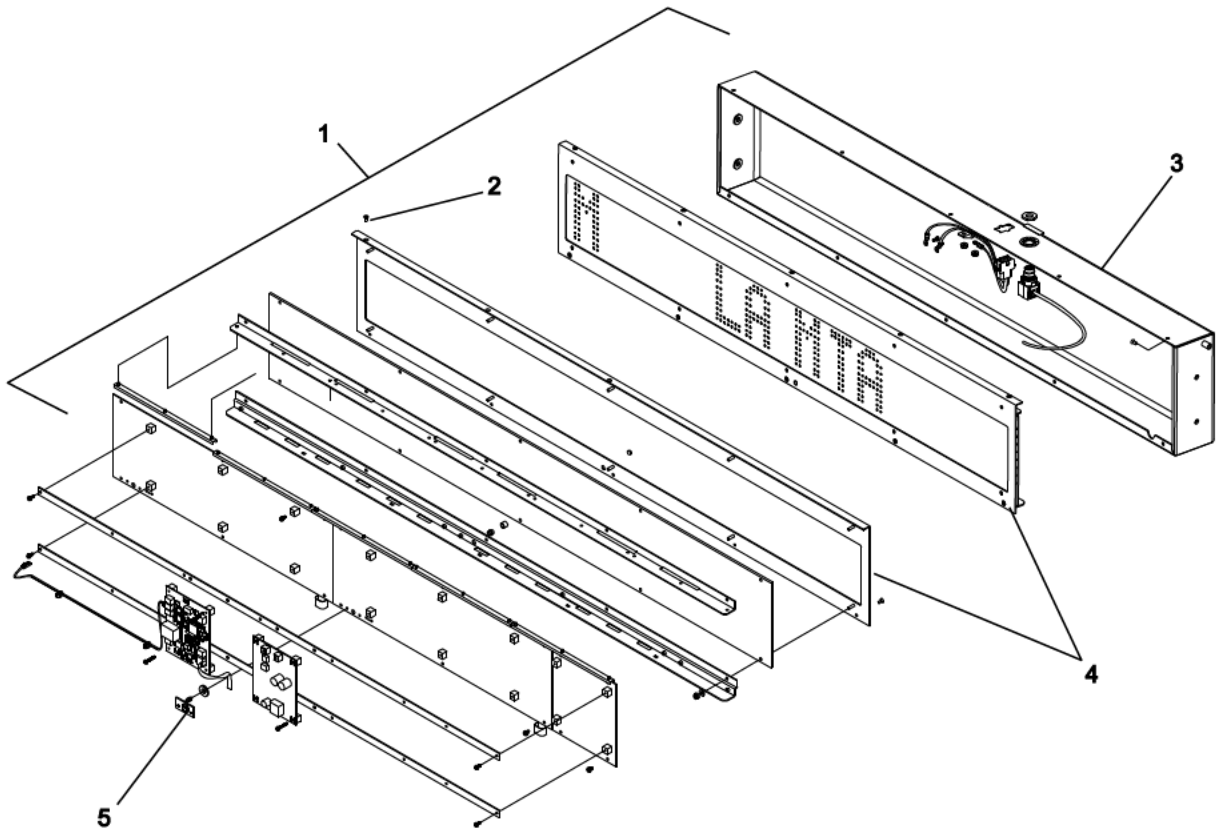

Figure 7-18: Replace Side Destination Light Sensor PCB

7.4.4.2.4 Replace LED Display Matrix PCB

1. Remove side destination sign assembly (1, Figure 7-19) from its mounted location.
2. Remove ten 6-32 x 5/16 SEM screws (2) that secure the housing assembly (3) to front panel assembly (4).
3. Carefully separate the housing assembly (3) from front panel assembly (4) to access electrical wiring and harnesses.
4. Tag and disconnect electrical wiring connectors from the defective LED Display Matrix PCB (7, 8, or 9).
5. Remove 6-32 x 5/16 SEM screws (5) that secure the defective LED Display Matrix PCB to the bracket assembly (6). There are six screws on each destination matrix (7, 8) and four on the route code matrix (9).
6. Remove the defective LED Display Matrix PCB.
7. Install the replacement LED Display Matrix PCB using the 6-32 x 5/16 SEM screws (5) that were removed previously.

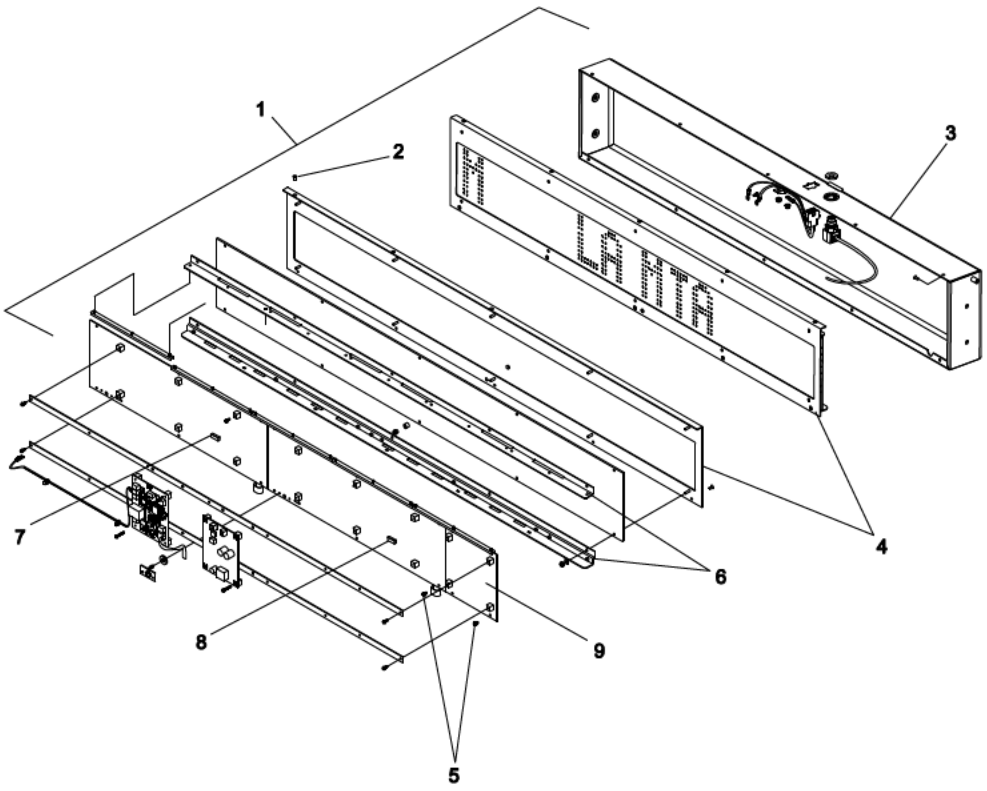

Figure 7-19: Replace Side Destination Sign LED Display Matrix PCB

8. Verify that the DIP switch setting on the first LED Display Matrix (7) is:

1	2	3	4	5	6	7	8
Off	Off	Off	Off	Off	Off	Off	Off

9. Connect electrical wiring connectors to the LED Display Matrix PCB (7).

10. Verify that the DIP switch setting on the second LED Display Matrix (8) is:

1	2	3	4	5	6	7	8
Off	Off	Off	Off	ON	Off	Off	Off

11. Connect electrical wiring connectors to the LED Display Matrix PCB (8).

12. Install the housing assembly (3) to the front panel assembly (4) using ten 6-32 x 5/16 SEM screws (2).

7.4.5 Speakers

7.4.5.1 Exterior Speakers

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

1. Disconnect the #6 electrical connections (10) from the Exterior Speaker (1) by removing the screw (7) from the cover (8) and the cover gasket (9). See Figure 7-20.

2. Remove the four M4 ESNA nuts (2) and M4 plain washers (3), M4 x 20 screws (5), and M4 plain washers (4).

3. Carefully remove the Exterior Speaker (1) from the mounting bracket (6).

7.4.5.2 Interior Speakers

1. Using a crew key, unlock and open the side access cover (1).

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

2. Disconnect the Faston connectors from the Interior Speaker (2). See Figure 7-21.

3. Remove the four M5 nuts (3), M5 lock washers (4) and M5 plain washers (5).

4. Remove the Interior Speaker (2).

5. Close and lock the side access cover using a crew key

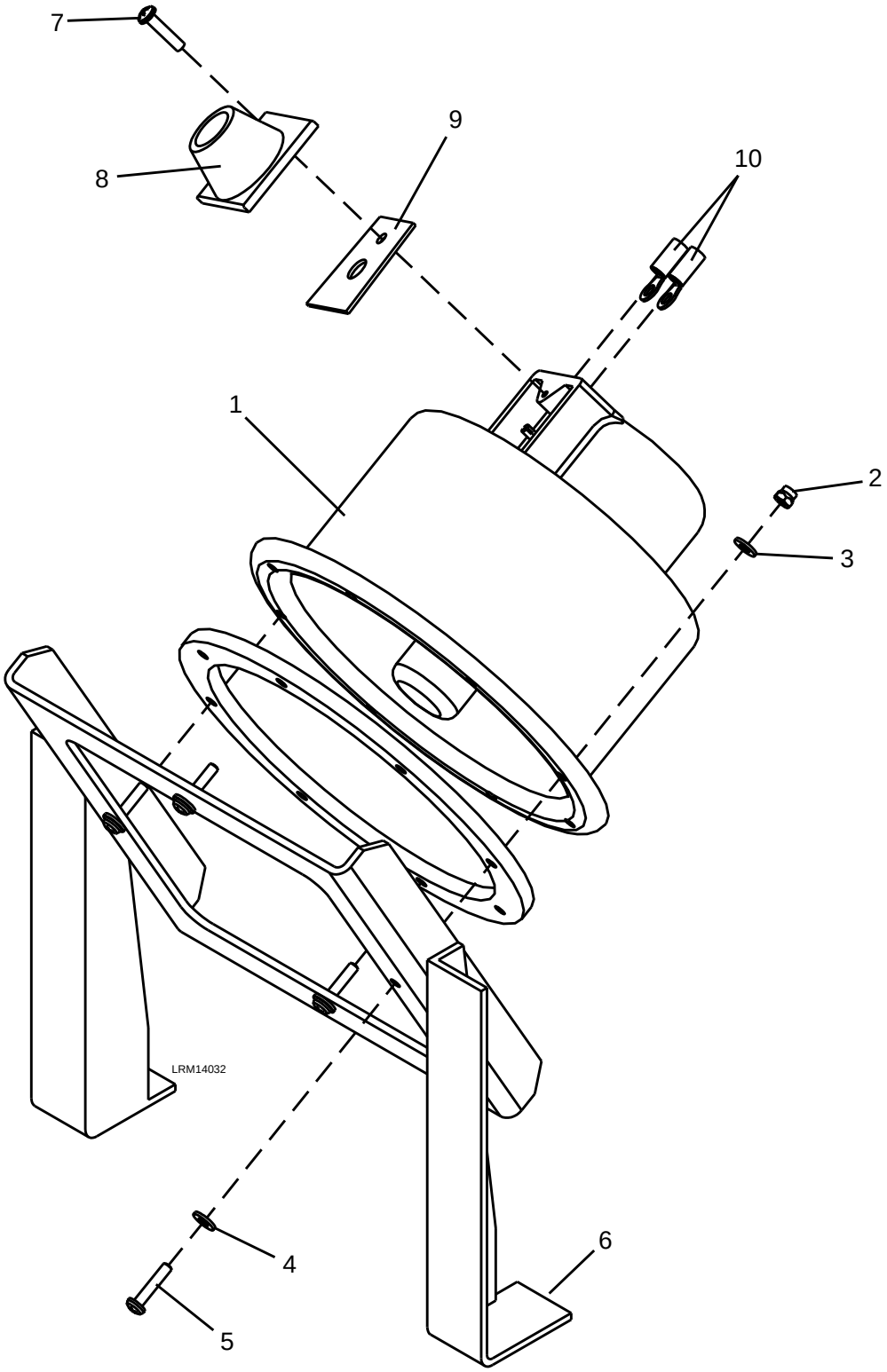

Figure 7-20: Exterior Speaker

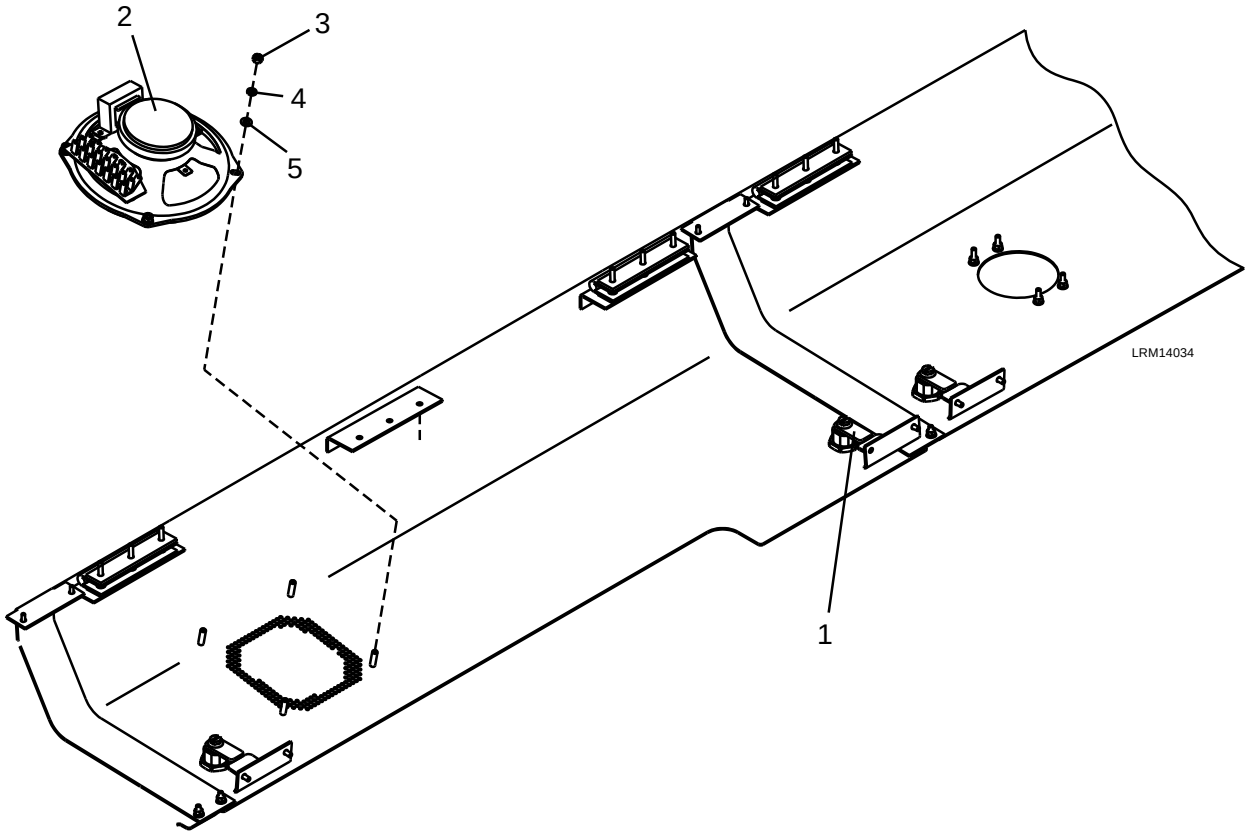

Figure 7-21: Interior 6” Speaker

7.4.5.3 Cab Speakers

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

1. Unlock the two locks (11) and lower the cab ceiling panel (1) to access the cab speaker hardware and disconnect the electrical connection. See Figure 7-22.

2. Remove the four M6 hexagon nuts (5), M6 lock washers (6), M6 plain washers (7), and M6 x 20 screws (4).

3. Remove the speaker grill (2).

4. Remove the four lock nuts (8), and plain washers (9).

5. Remove the speaker (3).

6. Remove the speaker gasket (10).

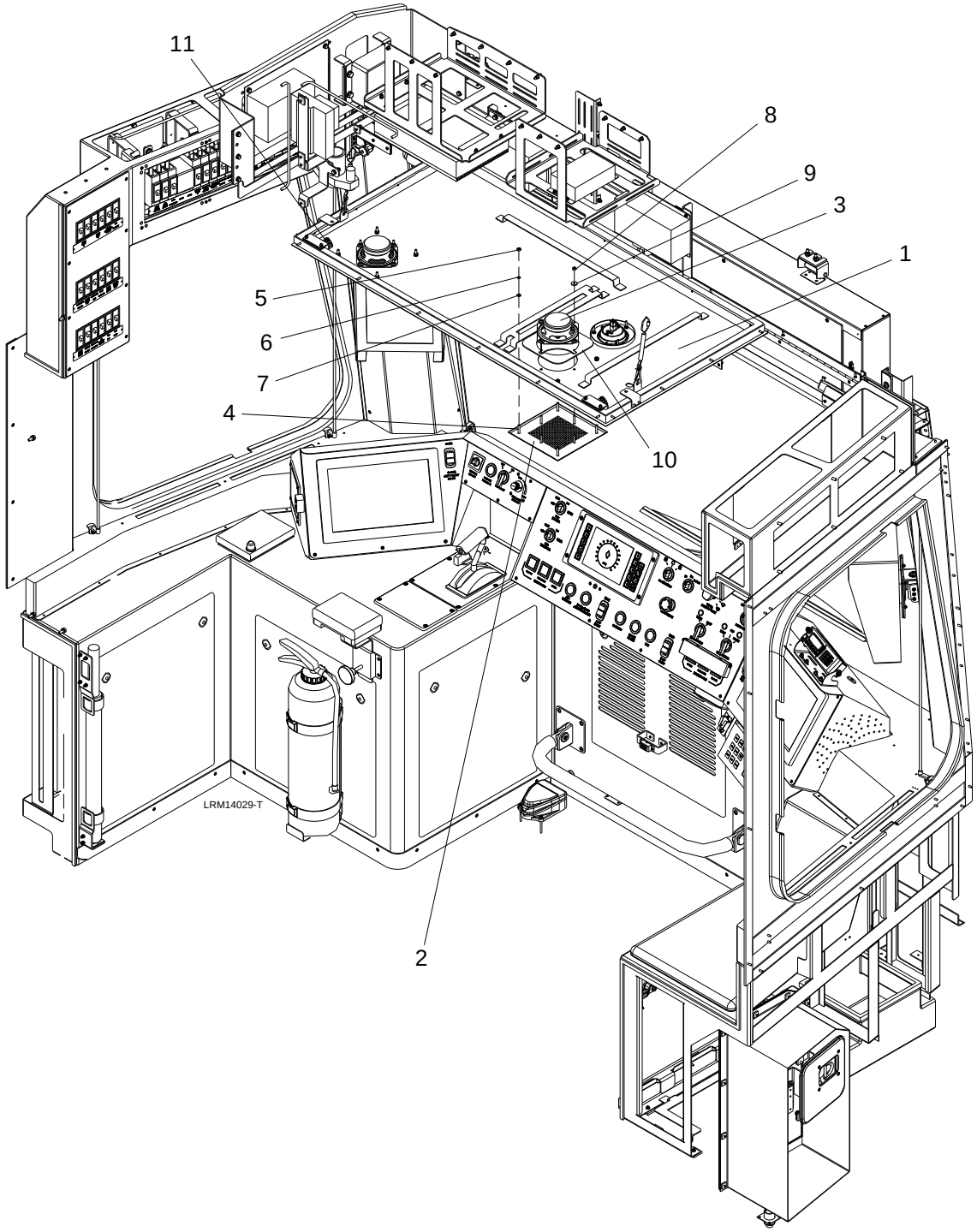

Figure 7-22: Cab 4” Speaker

7.4.6 In-Dash Microphone

1. Remove the nine #8-32 flat head screws (2) from Console Panel 3 (1). See Figure 7-23.

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

2. Carefully remove Console Panel 3 (1) and disconnect the two connectors.
3. Disconnect the electrical connector.
4. Remove the two #6-32 ESNA nuts (6), #6 plain washers (5), and #6-32 x 3/4" screws (4).
5. Remove the In-Dash Microphone (3).

7.4.7 Remote I/O Module

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

<u>ETHERNET RIO 1A / 1B</u>

1. Remove the nine #8-32 flat head screws (2) from Console Panel 3 (1). See Figure 7-23.
2. Carefully remove Console Panel 3 (1) and disconnect the electrical connection.
3. Remove the Ethernet Remote I/O by unlatching the lever located on the side.
4. Carefully remove the Ethernet Remote I/O. See Figure 3-9 (Sheet 4).

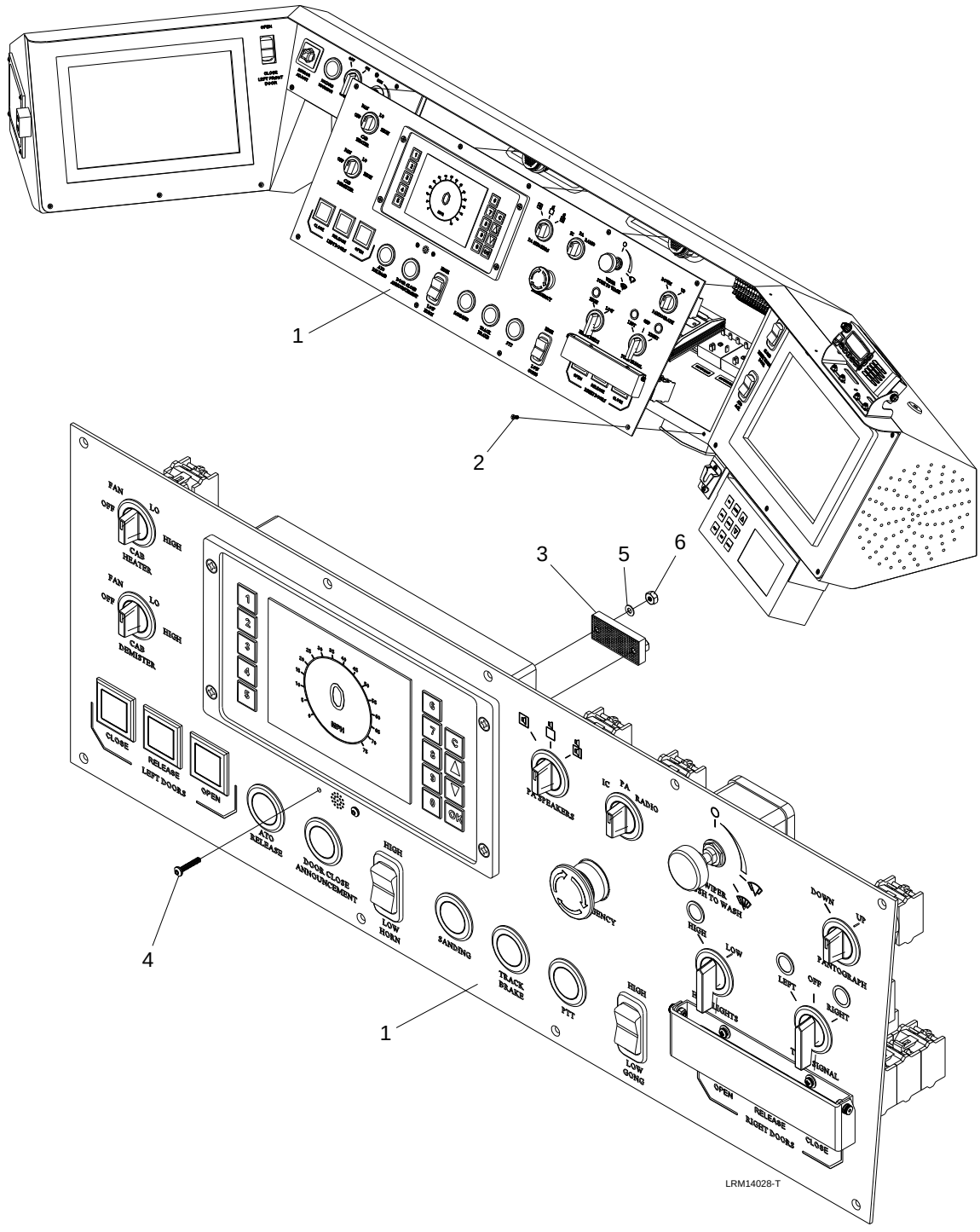

Figure 7-23: In-Dash Microphone

ETHERNET RIO 2A / 2B

1. Unlock the two locks (2) and lower the cab ceiling panel (3) to access the Ethernet Remote I/O (1) and disconnect the electrical connection. See Figure 7-24.

2. Remove the Ethernet Remote I/O (1) by unlatching the lever located on the side.

3. Carefully remove the Ethernet Remote I/O (1).

7.4.8 Communication Control Unit (CCU)

1. Open the right-side electric locker door located in the A-Unit.

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

2. Disconnect the electrical connectors (5) to the CCU (1). See Figure 7-25.

3. Remove the four M6 x 16 screws (2), M6 lock washers (3), and M6 plain washers (4).

4. Carefully remove the CCU (1).

7.4.9 Global Positioning System (GPS) Receiver/Antenna

1. Remove the six M4 x 8 screws (5), M4 lock washers (6), and M4 plain washers (7). See Figure 7-26.

2. Remove the cover (3).

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

3. Remove the electrical connections to the GPS Antenna (1).

4. Remove the GPS Antenna (1) by turning the unit counterclockwise.

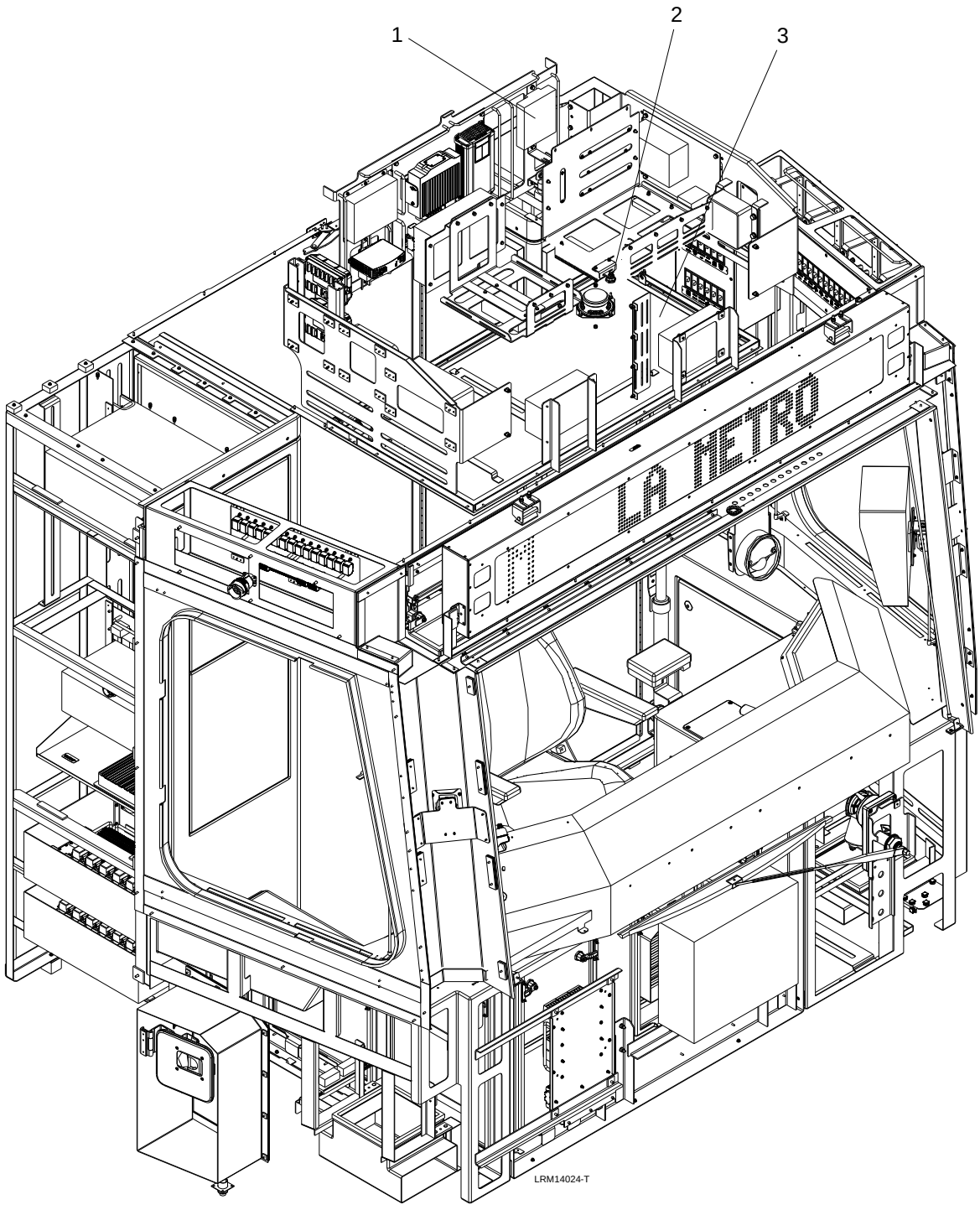

Figure 7-24: Ethernet Remote Input / Output (RIO) Ceiling

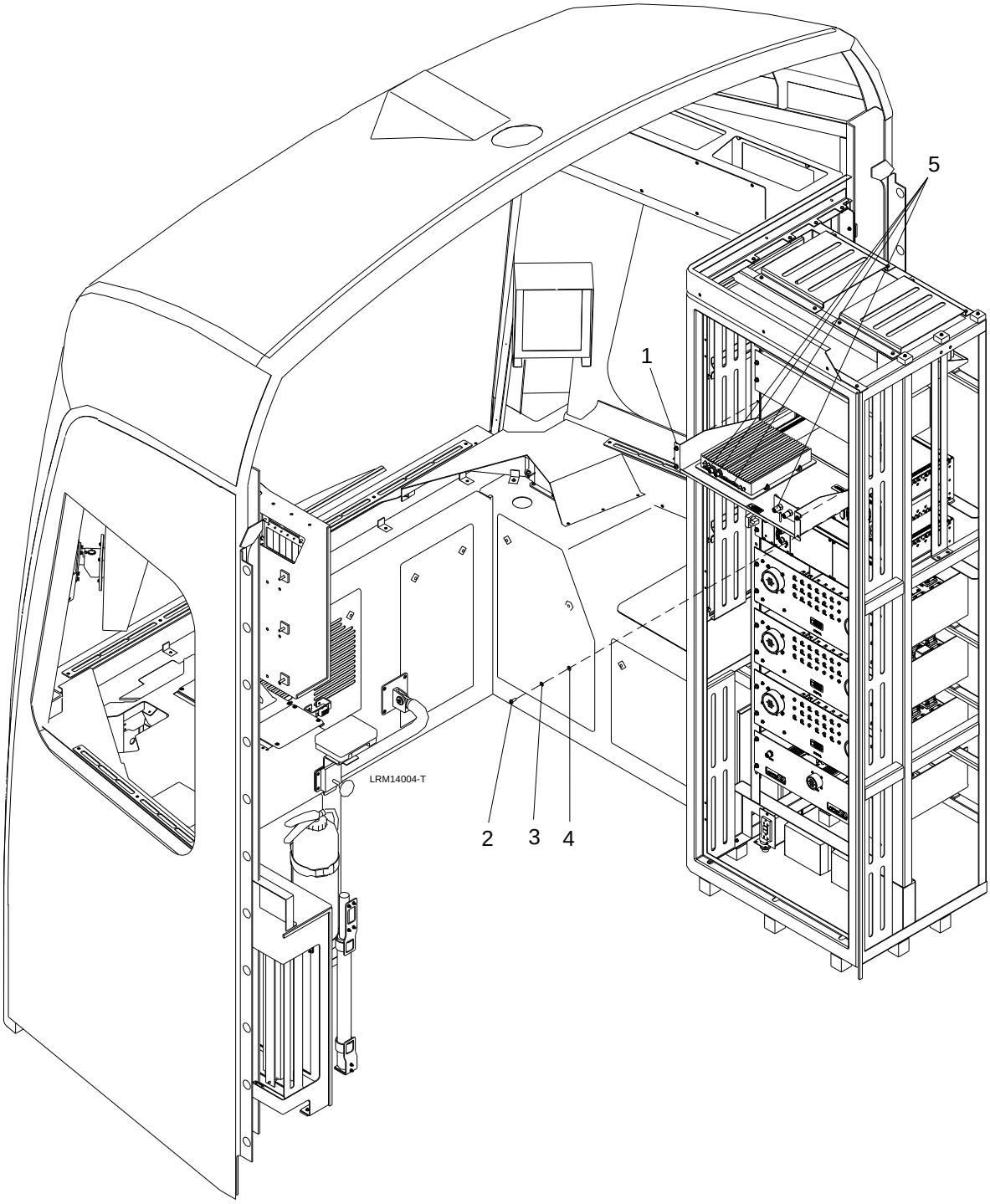

Figure 7-25: Communication Control Unit (CCU) Panel

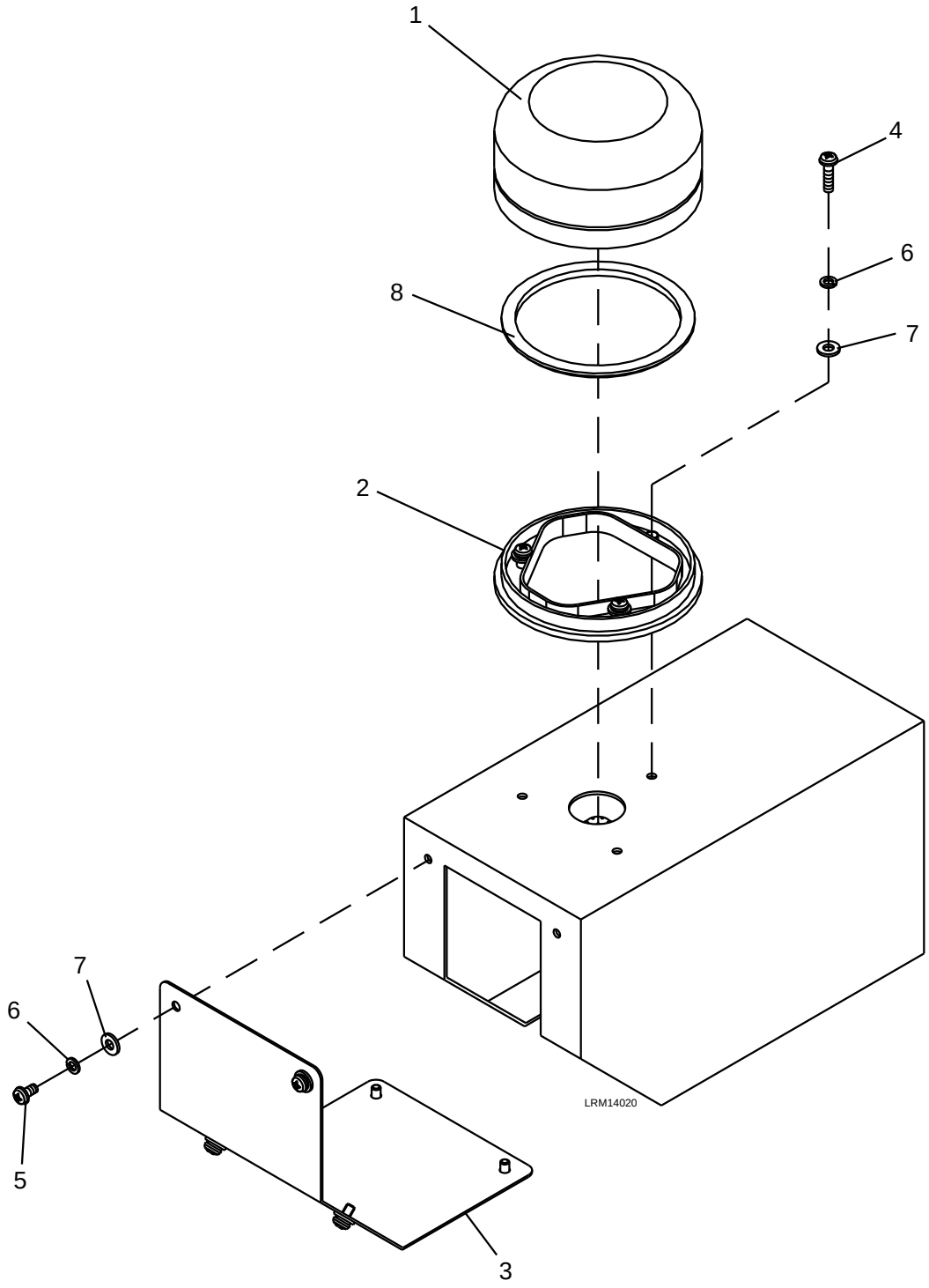

Figure 7-26: Global Positioning System (GPS) Antenna

5. Remove the gasket (8).

6. Remove the three M4 x 16 screws (4), M4 lock washers (6), and M4 plain washers (7).

7. Remove the mounting bracket (2).

7.4.10 Wayside Worker Alert System (WWAS)

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

1. Unlock the two locks (5) and lower the cab ceiling panel (6) to access the WWAS (1) and disconnect the electrical connectors. See Figure 7-27.

2. Remove the four M8 x 20 bolts (2), M8 lock washers (3), and M8 plain washers (4).

3. Carefully remove the WWAS (1).

7.4.11 Horn

7.4.11.1 Horn Controller

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

Cars 1001 through 1025

1. Unlock the two locks (6) and lower the cab ceiling panel (7) to access the Horn Controller Panel (1) and disconnect the WAGO terminal electrical connections. See Figure 7-28 (sheet 1).

2. Remove the four M4 screws (2), M4 lock washers (3), and M4 plain washers (4) from the Horn Controller Panel (1).

3. Carefully remove the Horn Controller Panel (1).

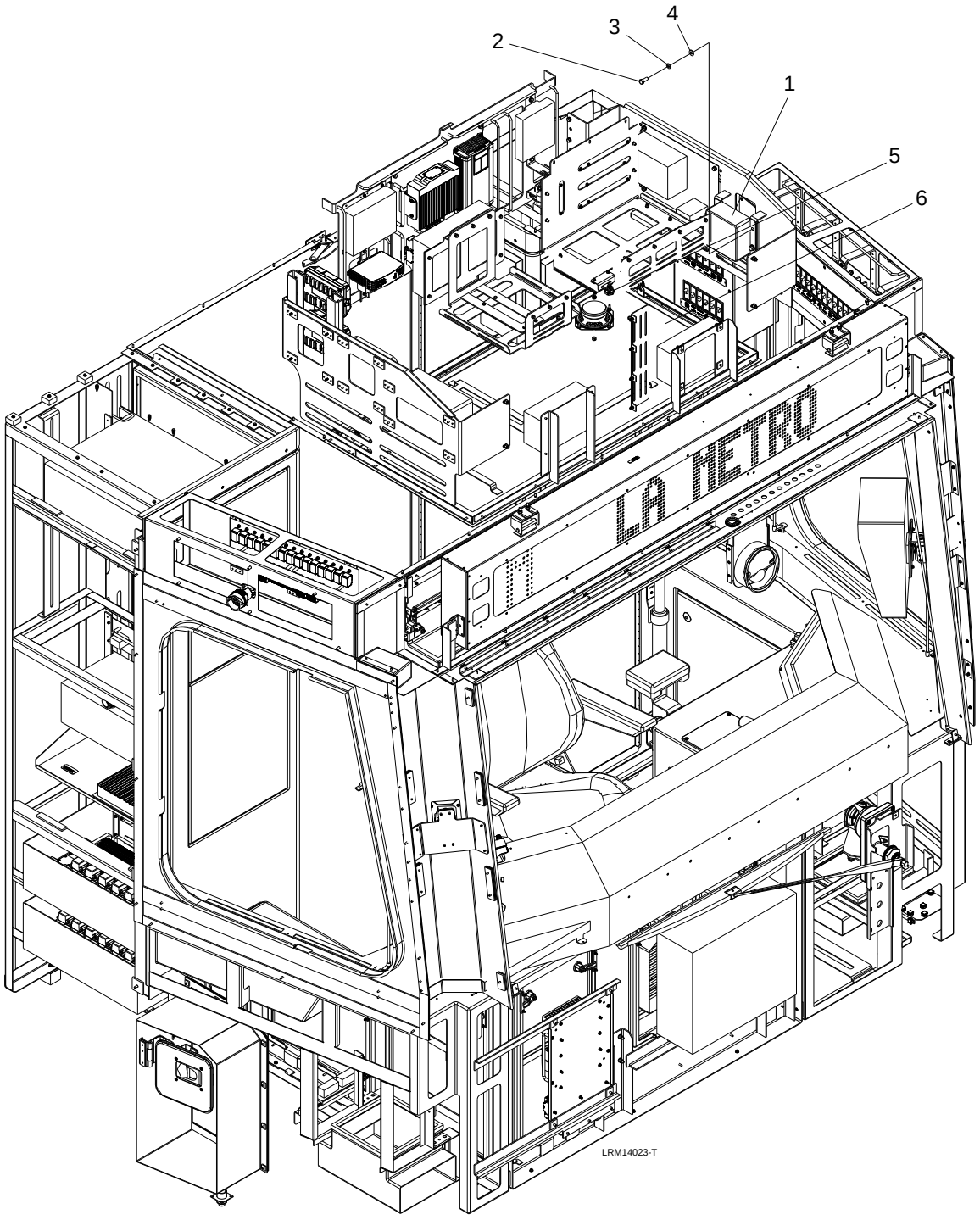

Figure 7-27: Wayside Worker Alert System (WWAS)

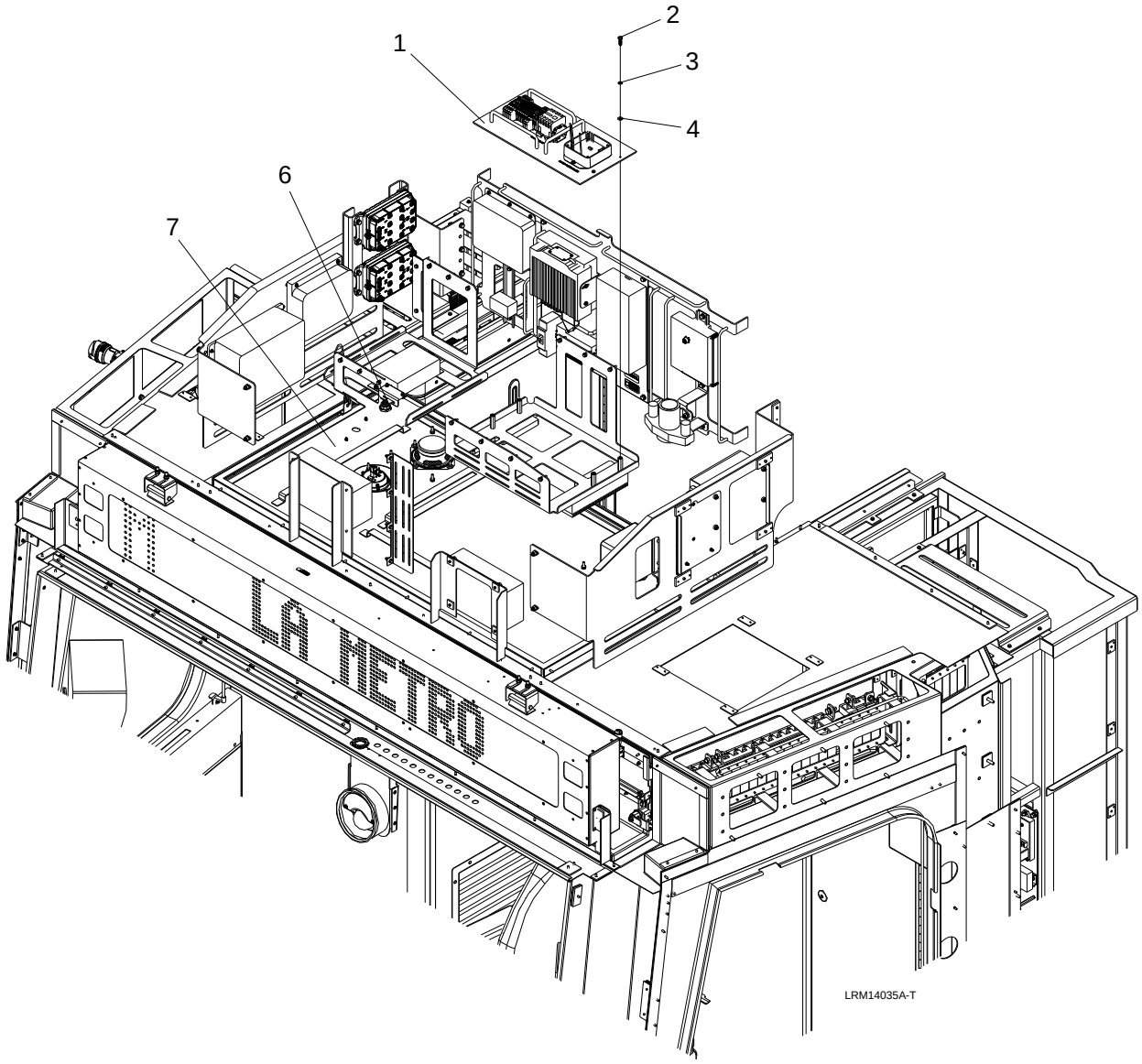

Figure 7-28: Horn Controller Panel
(Sheet 1 of 2) (Cars 1001 through 1025)

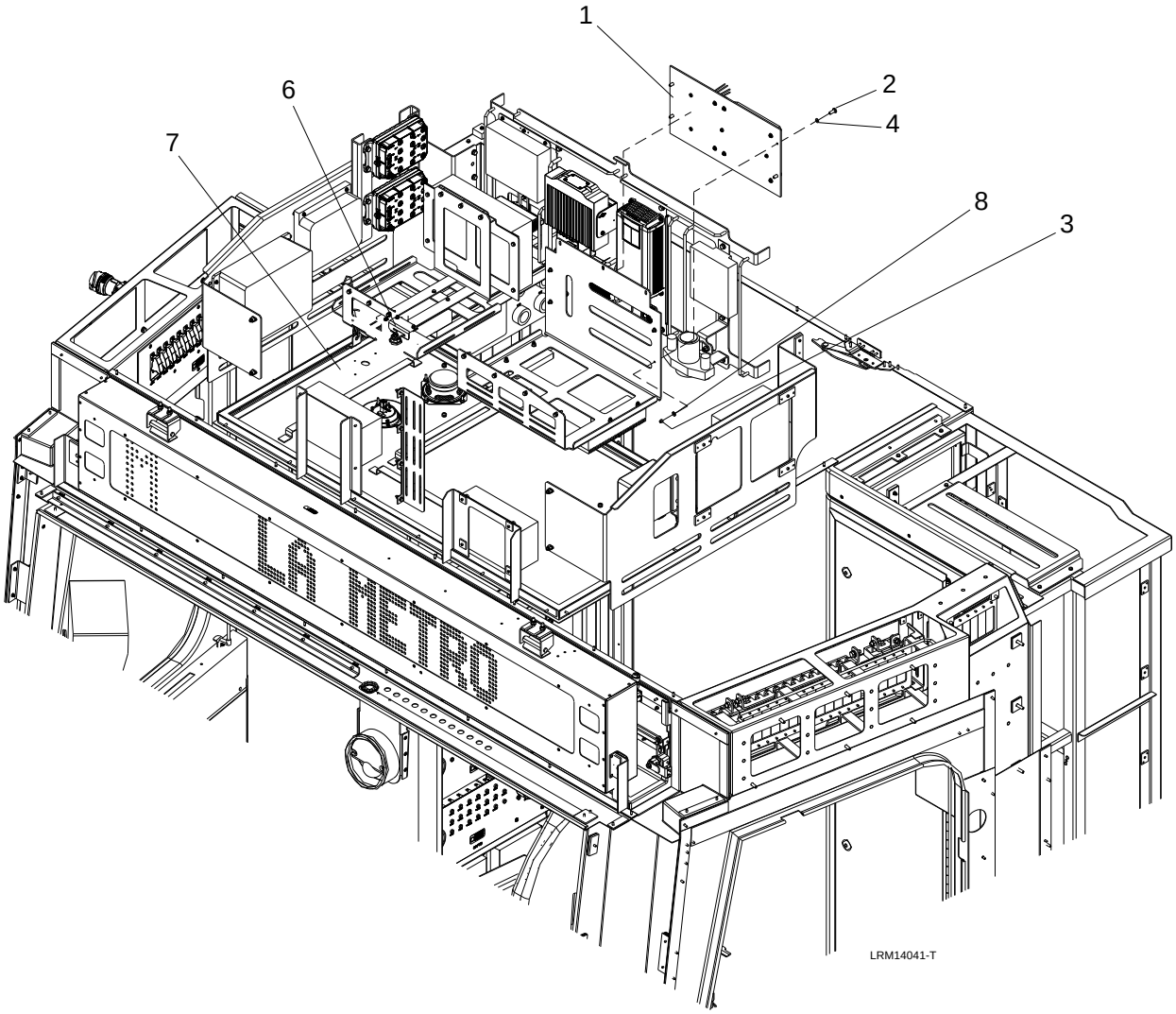

Figure 7-28: Horn Controller Panel
(Sheet 2 of 2) (Cars 1026 and Later)

Cars 1026 and Later

1. Unlock the two locks (6) and lower the cab ceiling panel (7) to access the Horn Controller Panel (1) and disconnect the WAGO terminal electrical connections. See Figure 7-28 (sheet 2).

2. Remove the four M4 screws (2), M4 plain washers (4), M4 hexagon nut (3), and M4 plain washers (8) from the Horn Controller Panel (1).

3. Carefully remove the Horn Controller Panel (1).

7.4.11.2 Horn Speaker

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

1. Disconnect the 1/4” Faston electrical connections (7) to the Horn / Gong Speaker (1).

2. Remove the four M6 ESNA nuts (5) and M6 plain washers (4), M6 x 25 bolts (2), and M6 plain washers (3). See Figure 7-29.

3 Carefully remove the Horn / Gong Speaker (1) from the mounting bracket (6).

7.4.12 Radio

7.4.12.1 Radio Equipment Panel

1. Unlock the two locks (5) and lower the cab ceiling panel (6) to access the Radio Power Supply (1). See Figure 7-30.

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

2. Remove all electrical connections to the WAGO terminal blocks.

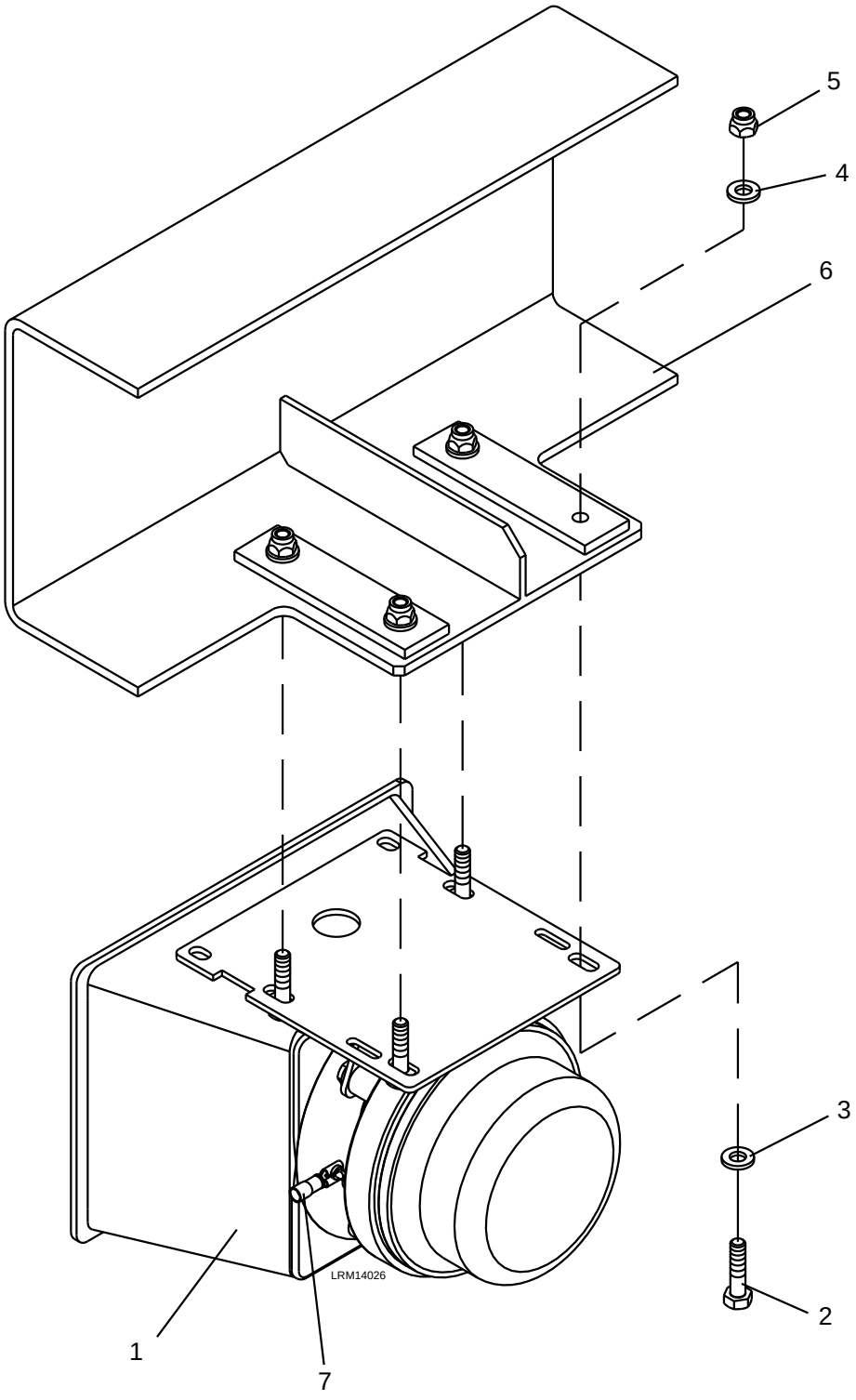

Figure 7-29: Horn / Gong Speaker

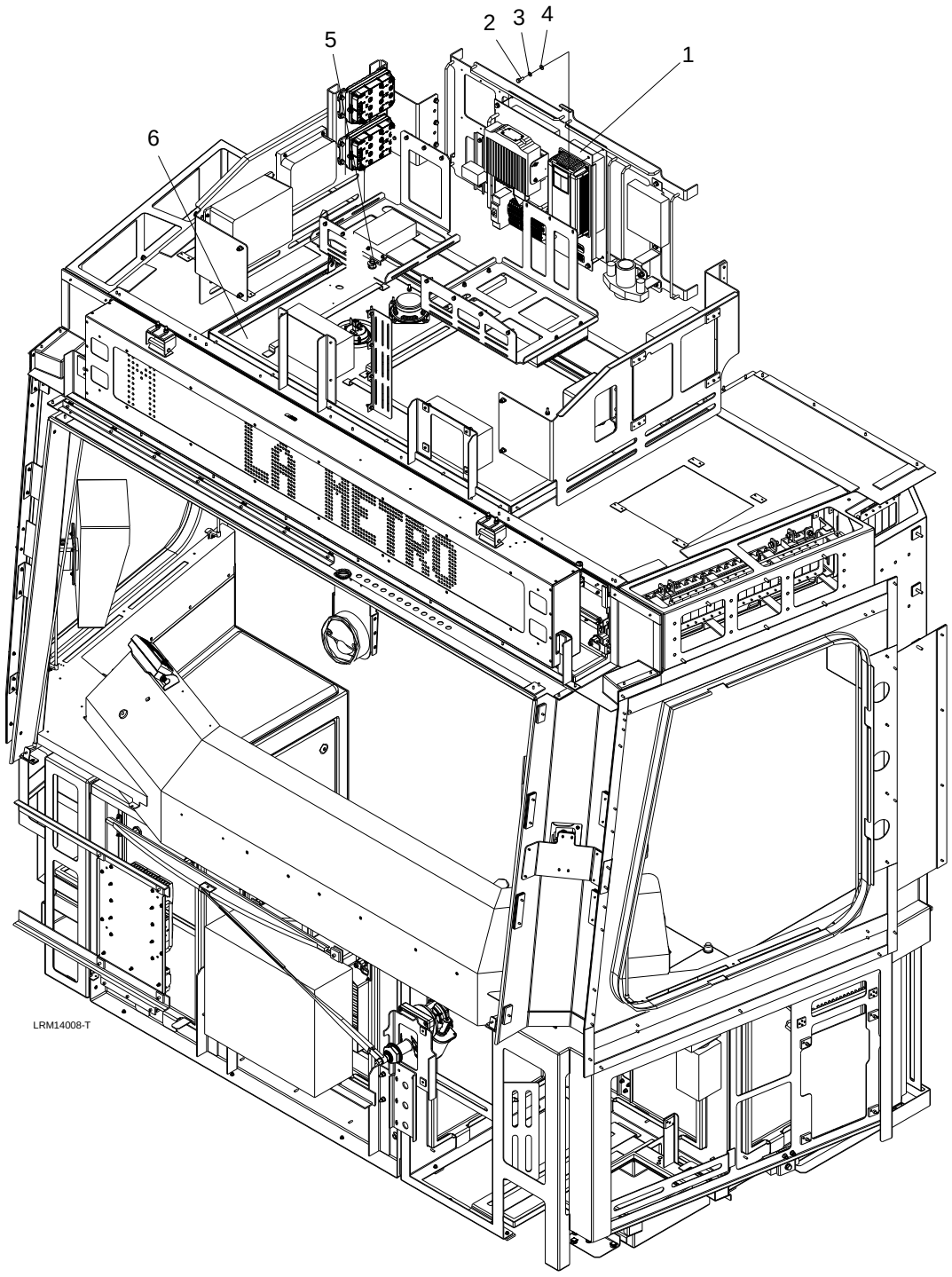

Figure 7-30: Radio
(Sheet 1 of 2)

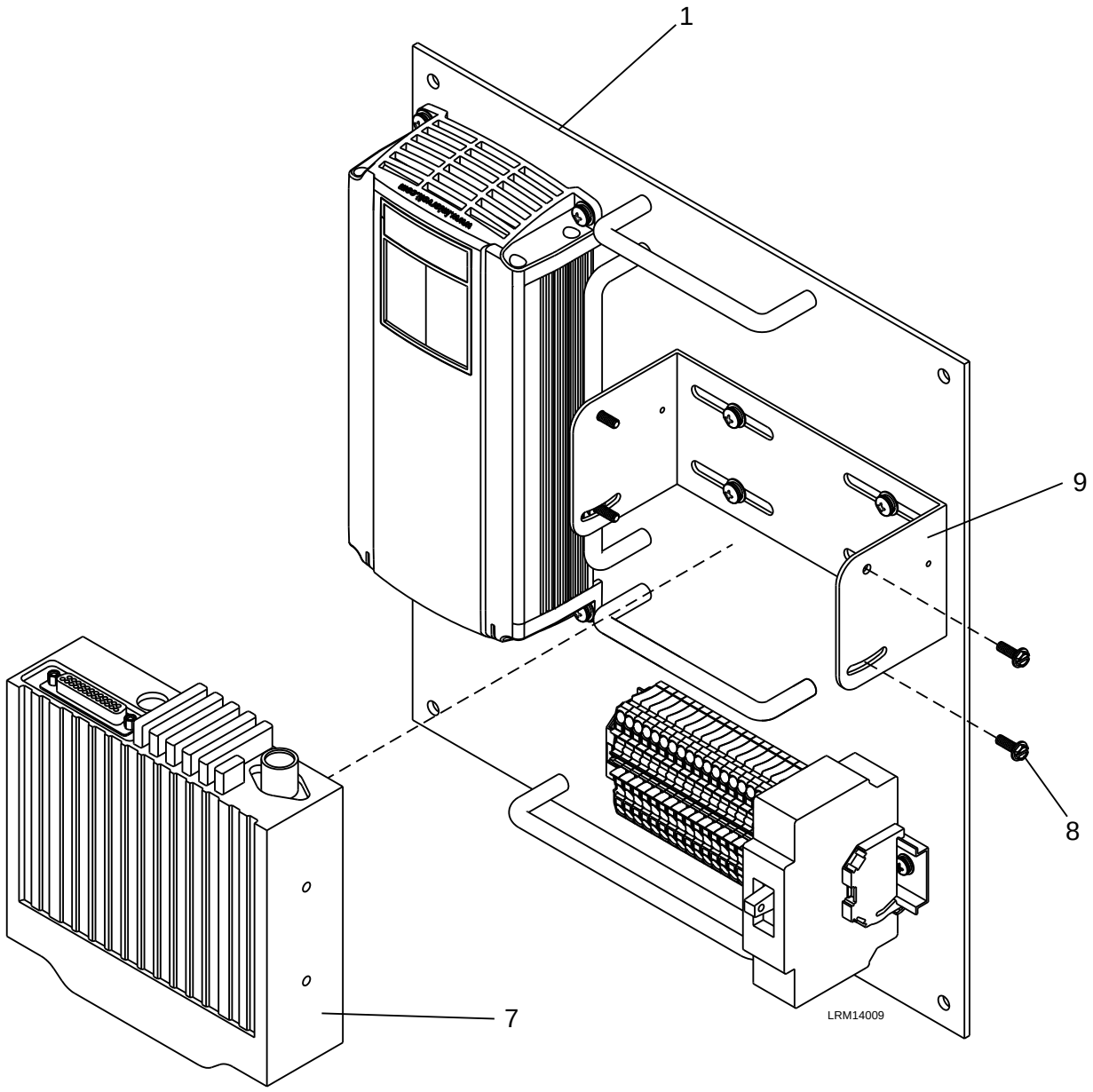

Figure 7-30: Radio
(Sheet 2 of 2)

3. Remove the four M6 x 16 bolts (2), M6 lock washers (3), and M6 plain washers (4).
4. Carefully remove the Radio Power Supply (1).
5. Disconnect the electrical connections to the Radio (7).
6. Remove the four screws (8) that secure the Radio (7) to the bracket (9).
7. Carefully remove the Radio (7).

7.4.12.2 Radio Antenna

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

1. Remove the radio antenna (1) by turning it counterclockwise. See Figure 7-31.

7.5 Installation

All components require testing and may require re-programming after installation. Please refer to the table below for reference to the programming instructions.

Component	Programming Instructions Reference
Audio Control Panels (ACPs)	TTEM 1401: TOA Communication System Portable Test Unit Manual
Interface Unit (IFU)	TTEM 1401: TOA Communication System Portable Test Unit Manual
Ethernet Switch, Viper-112A	RMSM 1402: Communications w/TOA, Chapter 8.9.1
Ethernet Interface Module, DDW-002-B1	RMSM 1402: Communications w/TOA, Chapter 8.9.2
Passenger Information Controller	TTEM 1401: TOA Communication System Route Management Editor Manual
Front / Side Destination Signs	TTEM 1400: Communications (Destination Sign) PTU User Manual.
Communication Control Unit (CCU)	TTEM 1400: Comms Programming Guide

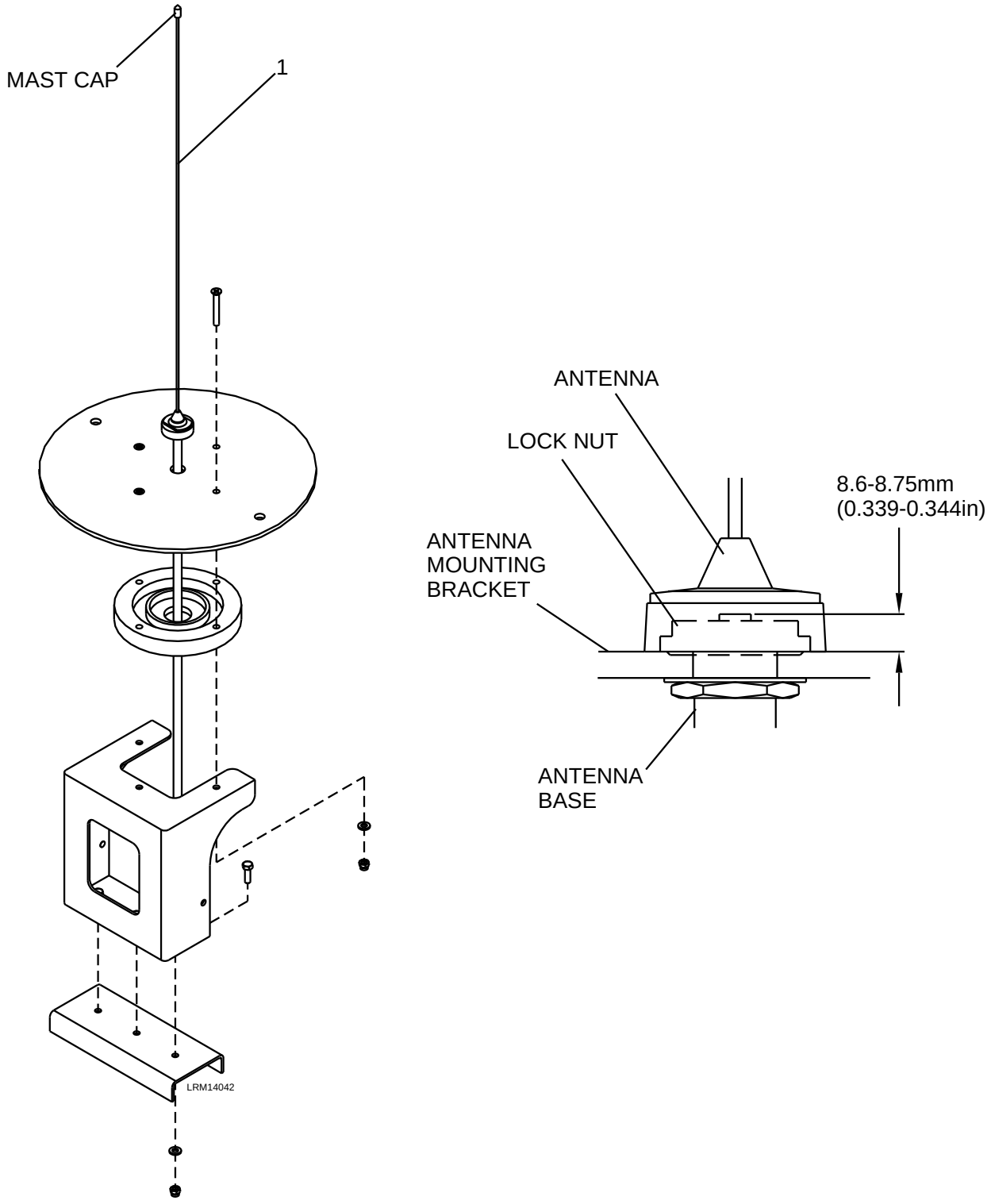

Figure 7-31: Radio Antenna

7.5.1 TOA Communications Equipment

7.5.1.1 Audio Control Panels (ACP)

1. Install the ACP onto the adapter brackets using each four of the M6x20 bolts, M6 lock washers, and M6 plain washers.
2. Reconnect electrical connections to the ACP including M12 connector in CN4.
3. Reconnect the ID plug to the ACP. Figure 7-1 shows the installation detail of the ID plug for the ACP. First, check the car number label on the ID plug secured to the rack frame whether its car number is the same as the actual LRV car number (e.g. Label Example “Car0125”). The ID Plug acts as an identifier of the car number to the ACP. Please refer to Figure 7-32. Second, wrap the lanyard around the ACP handle. Third, reconnect the ID plug to ACP.

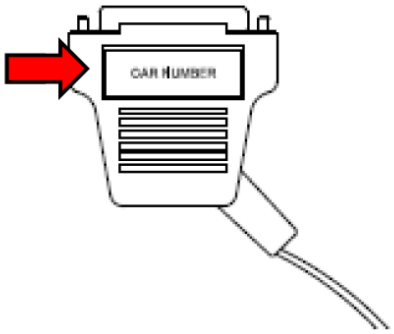

Figure 7-32: Detail View of ID Plug for the ACP

4. Close the right-side cab locker by locking the three locks using a maintenance key.

7.5.1.2 Communication Control Head (CCH)

1. Install the CCH on the bracket with screws with plain washers (two per each side of the CCH).
2. Reconnect the CCH wiring, running the cable through the hole in the bottom of the console from the radio wiring.

7.5.1.3 Interface Unit (IFU)

1. In the B-Unit cab, unlock the two locks on the cab ceiling panel using a maintenance key, lower the cab ceiling panel, and release the two safety chains to fully open the panel.
2. Install the IFU onto the brackets using each four of the M5x16 bolts, M5 nuts, and M5 plain washers.
3. Connect all electrical connections, including the ID plug on the IFU, and M12 connectors in CN2 and CN3.

4. Reconnect the ID plug to the IFU. Figure 7-3 shows the installation detail of the ID plug for the IFU. First, reconnect the ID plug on the IFU. Second, wrap the lanyard around the bracket. Third, fix the end of the lanyard by using a bolt with washers. The ID Plug acts as a car number identifier to the IFU. The car number label should be checked on the ID plug whether its car number is the same as the actual LRV car number (e.g. Label Example “Car0125”). Please refer to Figure 7-33.

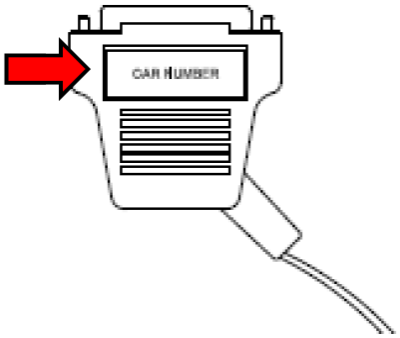

Figure 7-33: Detail View of ID Plug for the IFU

5. Close and lock the cab ceiling panel.

7.5.1.4 Ethernet Switch, Viper-112A

1. Mount the Ethernet Switch to the brackets using four screws with lock/plain washers.
2. Reconnect all Ethernet cable connections to the Ethernet Switch.
3. Hook the two safety chains, close the cab ceiling panel and unlock the two locks on the cab ceiling panel using a maintenance key.

Refer to Section 8.9.1 for Ethernet Switch setup procedure.

7.5.1.5 Ethernet Interface Module, DDW-002-B1

1. Mount the Ethernet Interface Modules to the adapter plate using four M6x20 screws together with lock washers and plain washers per module.
2. Reconnect the cable connection to the Ethernet Interface Module.
3. Close the right-side cab locker by locking the three locks using a maintenance key.

Refer to Section 8.9.2 for Ethernet Interface Module setup procedure.

7.5.2 Passenger Information System

7.5.2.1 Passenger Information Display (PID)

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

NOTE: Replacement of the Passenger Information Display requires no reprogramming. This unit is a monitor that receives information from the PIDs controller to display.

1. Align the two packing (11) and brackets (9 & 10). See Figure 7-4.
2. Insert the four M4 x 12 screws (8) and tighten.
3. Align the Passenger Information Display (7) with the wall panel.
4. Insert the eighteen M5 plain washers (6), M5 lock washers (5) and M5 x 20 screws (4) and tighten and torque per the chart listed in Section 7.3 of this manual section.
5. Connect the wiring to the Passenger Information Display (7).
6. Align the packing (3) and the cover (2) with the Passenger Information Sign (7).
7. Insert the three M4 x 10 screws (1), tighten and torque to 1.5 Nm (13 in-lbs.).

NOTE: Sheet 1 of Figure 7-4 is the Cab Interior Passenger Information Sign and Sheet 2 is the Electric Locker Interior Passenger Information Sign. Installation is the same for both sign locations.

7.5.2.2 VGA Extender Receive Unit

1. Unlock the single lock (4) and open the locker door panel (5) to access the VGA Extender Receive Unit (1) mounting. See Figure 7-5.
2. Carefully install the VGA Extender Receive Unit (1) on the mounting bracket aligning the mounting holes.
3. Install the four M4 hexagon nuts (2), and M4 plain washers (3).
4. Tighten and torque the hardware using the information in the torque chart in Section 7.3.

5. Connect the electrical connections using a Torque Screwdriver. Torque the M12 connectors to 0.4 Nm.

6. Close the locker door panel (5) and secure.

7.5.2.3 VGA Extender Send Unit

1. Unlock the two locks (4) and lower the cab ceiling panel (5) to access the VGA Extender Send Unit (1) mounting. See Figure 7-6.

2. Carefully install the VGA Extender Send Unit (1) on the mounting bracket aligning the mounting holes.

3. Install the four M4 hexagon nuts (2), and M4 plain washers (3).

4. Tighten and torque the hardware using the information in the torque chart in Section 8.3.

5. Connect the electrical connections using a Torque Screwdriver. Torque the M12 connectors to 0.4 Nm.

6. Raise the cab ceiling panel (5) and secure.

7.5.2.4 Passenger Information Controller

Cars 1001 through 1025

1. Unlock the two locks (5) and lower the cab ceiling panel (6) to access the Passenger Information Controller (1) mounting. See Figure 7-7.

2. Carefully install the Passenger Information Controller (1) on the mounting bracket aligning the mounting holes.

3. Install the four M4 x 16 bolts (2), M4 lock washers (3), and M4 plain washers (4).

4. Tighten and torque the hardware using the information in the torque chart in Section 7.3.

5. Connect the electrical connections using a Torque Screwdriver. Torque the M12 connectors to 0.4 Nm.

6. Raise the cab ceiling panel (6) and secure.

Cars 1026 and Later

1. Unlock the two locks (6) and lower the cab ceiling panel (7) to access the Passenger Information Controller (1) mounting. See Figure 7-8.

2. Carefully install the Passenger Information Controller (1) on the mounting bracket aligning the mounting holes.

3. Install the four M4 x 16 bolts (2), M4 plain washers (3), M4 plain washers (5), and M4 hexagon nuts (4).

4. Tighten and torque the hardware using the information in the torque chart in Section 7.3.

5. Connect the electrical connections using a Torque Screwdriver. Torque the M12 connectors to 0.4 Nm.

6. Raise the cab ceiling panel (7) and secure.

7.5.3 Passenger Intercom (PIC)

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

1. Connect the wiring to the Passenger Intercom (2). See Figure 7-9.

2. Align the holes in the Passenger Intercom (2).

3. Insert the four M4 x 16 screws (1) and tighten.

7.5.4 Exterior Destination Signs

7.5.4.1 Front Destination Sign

1. Carefully install the Front Destination Sign (1) by hanging on the bracket (5). See Figure 7-10.

2. Apply Locktite to the M8 x 20 screws (2).

3. Install the two M8 x 20 screws (2), M8 lock washers (3) and M8 plain washers (4).

4. Tighten the hardware.

5. Connect the electrical connectors.

7.5.4.2 Side Destination Sign

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

NOTE: Skip steps 1 through 3 if only installing a new sign and the brackets are not damaged.

1. Align the packing (13) and bracket (9) with the holes in the window mask. See Figure 7-15.
2. Insert the four M4 plain washers (12), M4 lock washers (11) and M4 x 16 screws (10) and tighten.
3. Repeat steps 1 and 2 for the remaining bracket (9).
4. Place the Side Destination Sign (5) in the slots of the brackets (9).
5. Insert the four M5 plain washers (8), M5 lock washers (7) and M5 x 16 screws (6), tighten and torque per the chart listed in Section 7.3 of this manual section.
6. Connect the electrical connectors to the Side Destination Sign (5).
7. Align the three packing (4) and the cover (3) with the holes in the brackets (9).
8. Insert the seven M4 plain washers (2) and M4 x 12 screws (1), tighten and torque to 1.5 Nm (13 in-lbs.).

7.5.5 Speakers

7.5.5.1 Exterior Speakers

1. Carefully place the Exterior Speaker (1) onto the mounting bracket (6) aligning the mounting holes. See Figure 7-20.
2. Install the four M4 x 20 screws (5), M4 plain washers (4), M4 plain washers (3), and M4 ESNA nuts (2).
3. Torque the hardware to 1.5 Nm (13 in-lbs.).

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

4. Connect the #6 electrical connections (10) to the Exterior Speaker (1) and torque to 1 Nm (10 in-lbs.).

5. Place the cover gasket (9) and cover (8) onto the speaker and install the screw (7). Tighten the screw (7).

7.5.5.2 Interior Speakers

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

1. Using a crew key, unlock and open the side access cover (1).

2. Align the Interior Speaker (2) with the holes in the side access cover (1). See Figure 7-21.

3. Insert the four M5 plain washers (5), M5 lock washers (4) and M5 nuts (3), tighten and torque per the chart listed in Section 7.3 of this manual section.

4. Connect the Faston connectors to the Interior Speaker (2) at the 1 W position.

5. Close and lock the side access cover using a crew key.

7.5.5.3 Cab Speakers

1. Unlock the two locks (11) and lower the cab ceiling panel (1). See Figure 7-22.

2. Install the speaker grill (2) aligning the mounting holes.

3. Install the four M6 hexagon nuts (5), M6 lock washers (6), M6 plain washers (7), and M6 x 20 screws (4).

4. Tighten the hardware and torque per the chart listed in Section 7.3 of this manual section.

5. Install the speaker gasket (10).
6. Install the Cab Speaker (3).
7. Install the four lock nuts (8), and plain washers (9).
8. Tighten the hardware.
9. Connect the 1/4” Faston electrical connections.
10. Close the cab ceiling panel (1).

7.5.6 In-Dash Microphone

1. Connect the In-Dash Microphone (3) connector to the panel wiring. See Figure 7-23.
2. Align the mounting holes and insert the two #6-32 screws (4), #6 plains washers (5), and #6-32 ESNA nuts (6).
3. Tighten the nuts (6).
4. Connect the two connectors to the panel wiring.
5. Align the mounting holes and insert the nine #8-32 flat head screws (1).
6. Tighten the screws (1).

7.5.7 Remote I/O Module

NOTE: No programming is required for replacement of Ethernet Remote I/O (RIO).

ETHERNET RIO 1A / 1B

1. Remove the nine #8-32 flat head screws (2) from Console Panel 3 (1). See Figure 7-23.
2. Carefully remove Console Panel 3 (1) and disconnect the two connectors.
3. Carefully install the Remote I/O (1) into the din rail ensuring the latch clicks in place.
4. Connect the electrical connections.
5. Align the mounting holes and insert the nine #8-32 flat head screws (1).
6. Tighten the screws (1).

ETHERNET RIO 2A / 2B

1. Unlock the two locks (2) and lower the cab ceiling panel (3) to access the Ethernet Remote I/O (1) mounting. See Figure 7-24.
2. Carefully install the Remote I/O (1) into the din rail ensuring the latch clicks in place.
3. Connect the electrical connections.
4. Raise the cab ceiling panel (3) and secure.

7.5.8 Communication Control Unit (CCU)

1. Open the right-side electric locker door located in the A-Unit. See Figure 7-25.
2. Carefully install the CCU (1) aligning the mounting holes.
3. Install the four M6 x 16 screws (2), M6 lock washers (3), and M6 plain washers (4).
4. Tighten the hardware and torque per the chart listed in Section 7.3 of this manual section.
5. Connect the electrical connectors (5) to the CCU (1).
6. Close the right-side electric locker door located in the A-Unit.
7. Replacement of the CCU/MDS Controller requires updated programming. Refer the Communications Equipment Programing Guide for instructions on reprogramming. Note that the controller is the same for A or B but the software is different depending on location.

7.5.9 Global Positioning System (GPS) Receiver/Antenna

1. Install the mounting bracket (2) aligning the mounting holes.
2. Install the three M4 plain washers (7), M4 lock washers (6), and M4 x 16 screws (4). See Figure 7-26.
3. Install the gasket (8).
4. Install the GPS Antenna (1) by turning the unit clockwise.
5. Install the electrical connector to the GPS Antenna (1).
6. Install the cover (3) aligning the mounting holes.
7. Install the six M4 plain washers (7), M4 lock washers (6), and M4 x 8 screws (5).
8. Tighten and torque the hardware to 1.5 Nm (13 in-lbs.).

7.5.10 Wayside Worker Alert System (WWAS)

1. Unlock the two locks (5) and lower the cab ceiling panel (6) to access the WWAS (1) mounting. See Figure 7-27.
2. Carefully install the WWAS (1) to the mounting bracket aligning the mounting holes.
3. Install the four M8 x 20 bolts (2), M8 lock washers (3), and M8 plain washers (4).
4. Tighten the hardware and torque per the chart listed in Section 7.3 of this manual section.
5. Connect the electrical connectors.
6. Raise the cab ceiling panel (6) and secure.
7. Testing is required to verify correct operation after replacement. Perform the test in Section 6.3.10 following replacement of the WWAS.

7.5.11 Horn

7.5.11.1 Horn Controller

Horn controller must be adjusted for proper sound level upon replacement. Refer to Section 6.3.11.1 of this manual section for procedure.

Cars 1001 through 1025

1. Unlock the two locks (6) and lower the cab ceiling panel (7). See Figure 7-28 (sheet 1).
2. Carefully install the Horn Controller Panel (1) aligning the mounting holes.
3. Install the four M4 screws (2), M4 lock washers (3), and M4 plain washers (4).
4. Tighten the hardware and torque to 1.5 Nm (13 in-lbs.).
5. Install all electrical connections to the WAGO terminal blocks.
6. Close the cab ceiling panel (7).

Cars 1026 and Later

1. Unlock the two locks (6) and lower the cab ceiling panel (7). See Figure 7-28 (sheet 2).
2. Carefully install the Horn Controller Panel (1) aligning the mounting holes.
3. Install the four M4 screws (2), M4 plain washers (4), M4 plain washers (8), and M4 hexagon nut (3).
4. Tighten the hardware and torque to 1.5 Nm (13 in-lbs.).
5. Install all electrical connections to the WAGO terminal blocks.
6. Close the cab ceiling panel (7).

7.5.11.2 Horn Speaker

1. Carefully install the Horn / Gong Speaker (1) on the mounting bracket (6) aligning the mounting holes. See Figure 7-29.
2. Install the four M6 x 25 bolts (2), M6 plain washers (3), M6 plain washers (4), and M6 ESNA nuts (5).
3. Torque the hardware using the torque chart in Section 7.3 of this manual section.
4. Connect the 1/4” Faston electrical connections to the Horn / Gong Speaker (1).

7.5.12 Radio

7.5.12.1 Radio Equipment Panel

1. Unlock the two locks (5) and lower the cab ceiling panel (6). See Figure 7-30.
2. Place the Radio (7) into the bracket (8) aligning the mounting holes.
3. Insert the four mounting screws (8) and tighten. Ensure that the Radio (7) is level to the Radio Power Supply (1).
4. Connect the electrical connections to the Radio (7).
5. Carefully install the Radio Power Supply (1) aligning the mounting holes.
6. Install the four M6 x 16 bolts (2), M6 lock washers (3), and M6 plain washers (4).
7. Tighten the hardware and torque per the chart listed in Section 7.3.
8. Install all electrical connections to the WAGO terminal blocks.
9. Close the cab ceiling panel (6).

10. Confirm radio function. Contact Rail Com to verify function or if reprogramming is required.

11. Verify Radio operation with an SWR check. Refer to Section 8.8 of this manual section.

7.5.12.2 Radio Antenna

WARNING

BEFORE INSPECTING ANY ELECTRICAL EQUIPMENT IN AN ELECTRICAL SYSTEM, MAKE SURE THAT THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.

1. Use a 3M Scotch Brite pad to remove the dielectric coating from the threads of the Radio Antenna (1) and clean with contact cleaner MS-739. See Figure 7-31.

2. Remove the mast cap and cut the Radio Antenna (1) to a length of 490mm. Replace the mast cap.

3. Using a dial caliper, ensure the measurement from the mounting bracket to the radio antenna base is between 8.6mm - 8.75mm (0.339 in. to 0.344 in.).

4. Install the Radio Antenna (1) by turning clockwise until tight.

5. Perform the test in Section 8.8 of this manual section following replacement of the Radio Antenna.

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CHAPTER 8.0

TROUBLESHOOTING

8.1 Introduction

This chapter provides troubleshooting procedures for the Communications equipment.

8.2 Troubleshooting

Before fault isolation, perform a thorough visual equipment inspection to determine if a malfunction is being caused by some obvious defect such as a damaged component, defective wiring, etc. Otherwise, fault isolation should follow a logical sequence designed to isolate a malfunction to a single component or assembly. Symptoms of a fault are typically identified by a loss of function. The function lost, inoperative or malfunctioning will provide a means to identify a course of troubleshooting. The vehicle schematics will provide information to troubleshoot wiring and connectivity issues. Intermittent connectivity issues are the most difficult to troubleshoot. Ensure that all connectors are properly installed and properly tightened.

Before deciding that a system/subsystem is malfunctioning, check that all related circuit breakers, switches, control devices are set properly for normal operation. The Communications system is interconnected to other intelligent subsystems on the vehicle and draws signal states from them through the Ethernet network. Consideration must be given to these interrelationships while troubleshooting.

From the TOD, check indicator status. A flashing yellow indicator indicates that there is an Ethernet communications issue with the subsystem that is flashing. The fault could be that the equipment is offline or a connectivity issue. The Vehicle Management button will provide an indication of Ethernet Connectivity. Additionally, a PING test is available from the Network Status button for all Ethernet connected devices. You can “Ping” all devices or individually select the device connected to the network. This will show if the device is connected and can respond to a query.

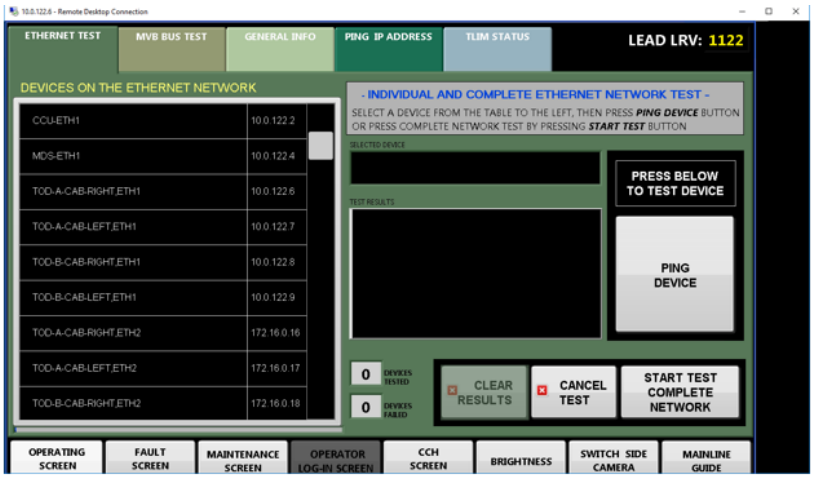


Figure 8-1: TOD Ping Test Screen

If the TOD Subsystem indicator is red, this indicates that a fault is being communicated to the Monitoring and Diagnostic System. Check the list of active faults to determine if there is an active fault that impacts the communications equipment or network equipment. If a fault is detected by the TOA Communications, check the CCH for further fault details.

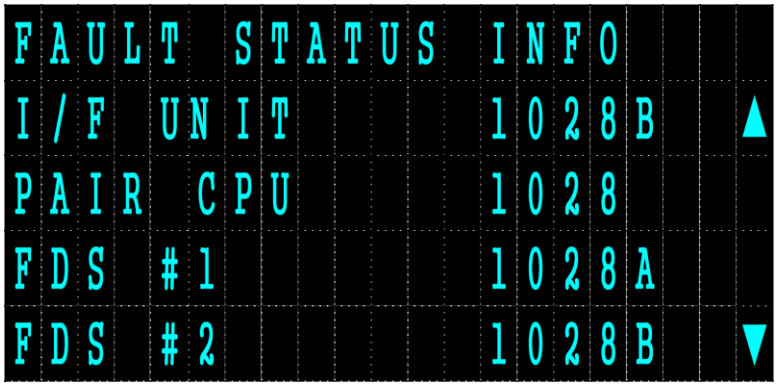


Figure 8-2: TOA CCH Fault Info Status Screen

Additionally, from the Maintenance Tab on the TOD, the Fault Log Screen will also provide information on faults that have occurred over time. A list of Faults that impact communications is provided in Table 8-3 of Section 8.12 of this chapter. Faults that impact the Ethernet network also may impact communications. Loss of trainline control / functionality may indicate network issues or wiring issues. This screen can provide an indication of intermittent faults that have cleared. TOD screens for operations and maintenance are defined in Section 1800 of this suite of manuals. There are two levels of access in the TOD screen hierarchy. At the operator level, a top-level overview of system function is available along with an active fault log. At the maintainer level, (password accessible), you can drill down into additional screens that will aid in troubleshooting the defective system.

Look for groupings of lost functionality. If an Ethernet Switch is lost, all items connected to that switch would provide an indication to troubleshoot that switch or the signal source to/from (wiring, connectors, or connected device) that switch.

Loss of audio functionality indicates that an Audio Control Panel (ACP) may be malfunctioning or wiring to that panel may be the cause. Loss of control functionality i.e. PTT switches, routing switches indicates either a switch function problem or a RIO problem. You can Ping the RIOs to determine if they are communicating. The RIOs also have indicator LEDs that show activity and input port status. Note that the RIOs in this application are all configured for input.

LED indicators are provided on microcontrollers, computers, and RIOs can be used to determine the state of the device. See the specific sections of this manual for each device for LED information associated with that device.

Perform the Communications Functional Test listed in Section 8.3 to determine the specific issues and to confirm reported symptoms of communications system errors.

8.3 Communications Functional (Onboard) Test

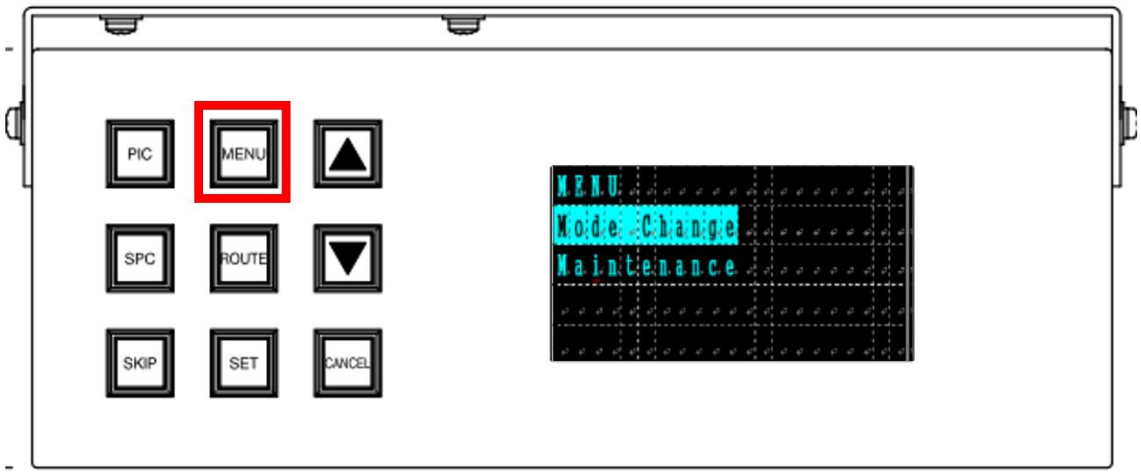
The following test should be run to determine the proper functionality of the Communications system. This testing should be run as part of the diagnostic function to determine which areas to concentrate fault isolation efforts and after the system has been repaired to confirm proper operation prior to releasing a LRV for service.

The Onboard test function performs as a local diagnostic test.

The CCH provides the activation button for the Onboard test and the Operator/Maintenance personnel can activate the test function from the CCH.

The Onboard Test procedure should be performed as follows:

1. A or B Cab, place the Transfer Switch to the “ON” position.
2. Using the TOA Communication Control Head (CCH) start the Onboard test.
   - Select ‘Menu’ on CCH



   - Use the ‘Up’, ‘Down’, and ‘Set’ buttons to select ‘Maintenance’

- Select ‘Onboard Test’, ‘Set’

- Select ‘Start’, ‘Set’

3. After the Onboard Test is started, the following test patterns will be announced or displayed on the Audio (Interior/Exterior speakers), Signs (FDS/SDS) and PID LCDs;

   - Audio (Interior/Exterior Speakers)

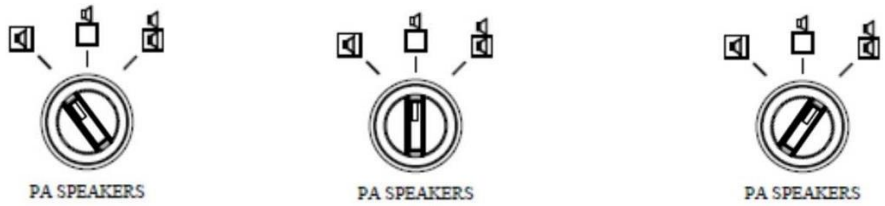
     Speaker output check is available by the Onboard test function. While speaker outputs the test announcements, maintenance personnel can verify the output audio from speakers.

     Test audio announcement and test tone;

     “This is a test message: One, two, three, four, five, six, seven, eight, nine, ten” and test tone.

     During the Onboard Test, the PA speaker selection switch located on the cab console can be changed to “Interior only”, “Exterior only” and “both Interior and Exterior” by the maintenance personnel and test audio announcement can be changed as per the selection.

Interior Only Exterior Only Both Interior and Exterior



- Sign (FDS, SDS)

  Factory test of LED display is available by the Onboard test function.

  - Test for the text area (Repeats continuously until Onboard Test is stopped):

    blank (all Lights off) >> checker box pattern >> checker box pattern (reverse) >> checker box pattern >> checker box pattern (reverse) >> blank (all Lights off) >> scroll up from bottom to top >> >> filled (all Lights on) >> blank (all Lights off)

  - Test for the color block (Repeats continuously until Onboard Test is stop):

    blank (all Lights off) >> repeating filled white/red/green/blue >> increase lighting intensity from low, medium to high by one of color (white/red/green/blue) >> blank (all Lights off)

Figure 8-3 shows the sample displays during the Onboard Test.

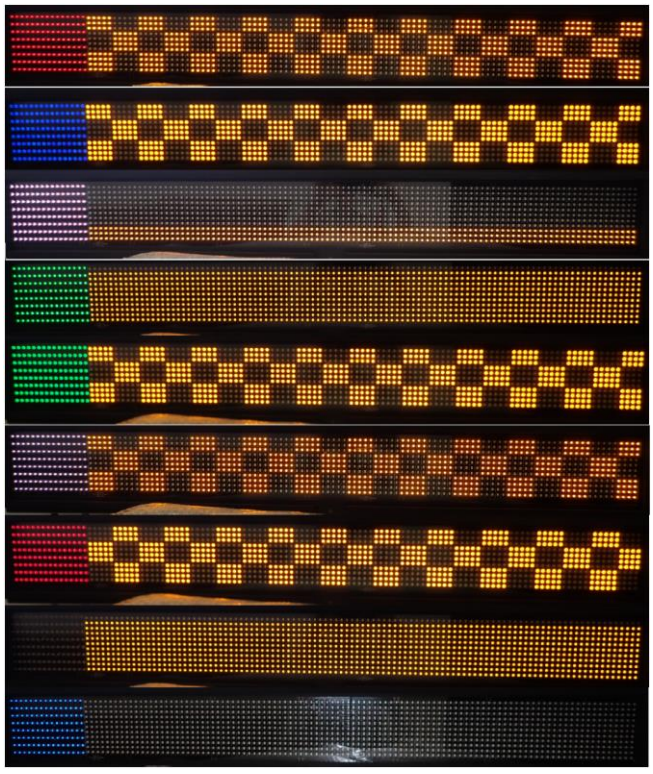


Figure 8-3: Sample LED Signs Display During Onboard Test

- PID (LCD)

  PID signs will display the automatic test patterns shown in Figure 8-4 cyclically;

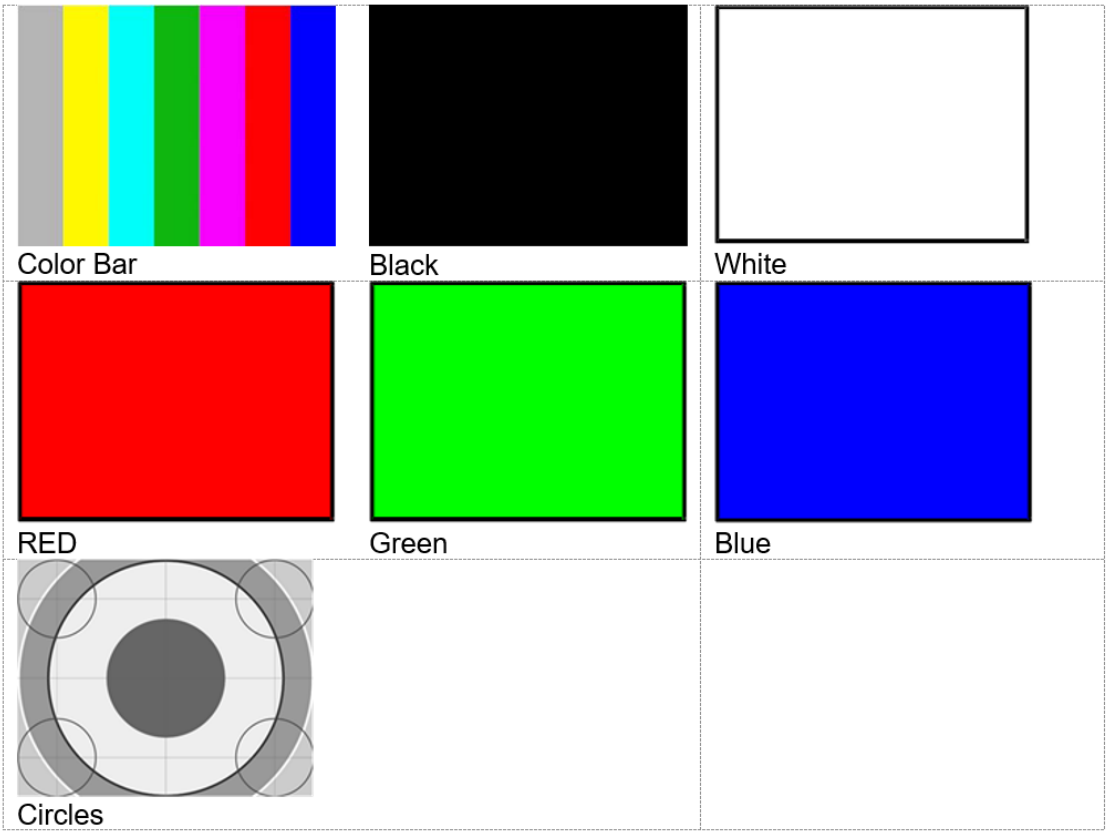


Figure 8-4: Cyclic PID LCD Automatic Test Patterns During Onboard Test

4. Verify all signs are free from any anomalies or defects.
5. Select ‘Stop’ then ‘Set’ on CCH.

8.4 Signs Troubleshooting

The Exterior Signs consists of the Front Destination Signs and the Side Destination Signs. They are controlled by the master ACP.

A destination sign test routine is built into the CCH. Patterns can be initiated from the Onboard Test, as shown in Section 8.3 of this chapter. If the signs are not operating properly, following steps in Table 8-1 to identify faulty component. Signs components can be removed and replaced with basic hand tools. Additionally, a PTU manual is provided that can be referenced to function test the signs and to update firmware if required.

Sign removal, replacement and board level replacement are described in Section 7.4.4 of this manual.

Table 8-1. Destination Sign Troubleshooting

Symptom	Probable Cause	Remedy
All signs fail to power-up.	Tripped circuit breaker. (DSLCB)	Reset circuit breaker by placing in the OFF position then the ON position.
All signs power-up, but do not display messages.	Network connection at Master ACP is loose or defective.	Replace Master ACP. Refer to appropriate RMM for procedure.
	Master ACP failure.	
One or more signs do not power-up.	No power to the sign.	Check for voltage at the sign power connection.
	Sign power supply PCB is defective.	If LED1 is not illuminated, replace power supply PCB.
One or more signs do not display data.	Failed network connection.	Repair connection.
		If LED3 is not illuminated, repair broken network link.
	Failed control PCB.	If LED4 is not blinking, replace control PCB
		Replace control PCB
One or more signs have display LEDs that do not illuminate.	Defective display LED(s).	Replace LED display matrix PCB
One or more sign displays do not adjust brightness when ambient light changes.	Optical sensor is blocked.	Remove blockage.
	Defective optical sensor.	Replace optical sensor PCB

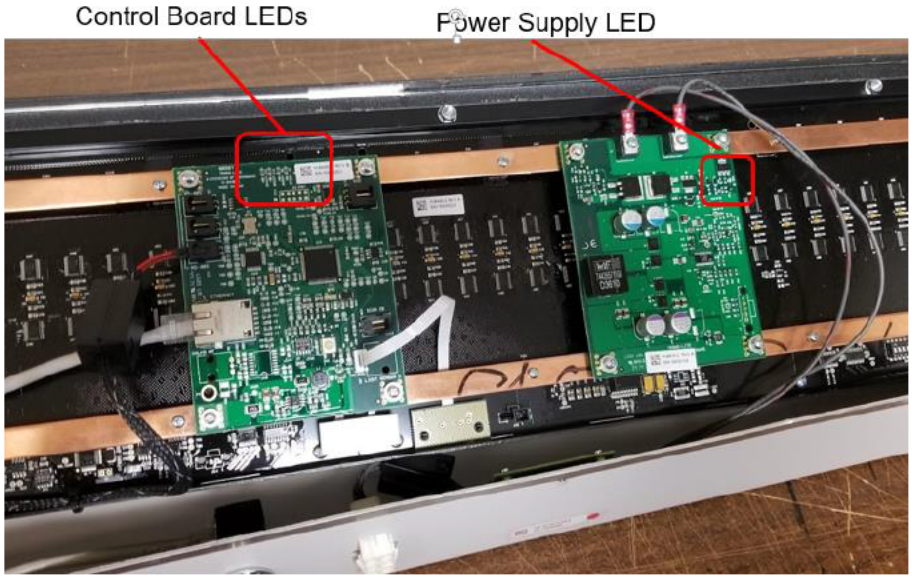


Figure 8-5: Sign Control Boards LEDs

[redacted]

8.5 GPS Troubleshooting

The GPS functionality can be checked using the following utility screen from the maintenance screens. If the antenna on the A-End roof has a clear view of the sky and satellites can not be acquired as shown below in the utility screen, remove and replace the GPS antenna or reload the GPS program on the CCU. The version can be checked on the software version screen found on the TOD. Software loading instructions can be found in the Communications System Programming Guide.

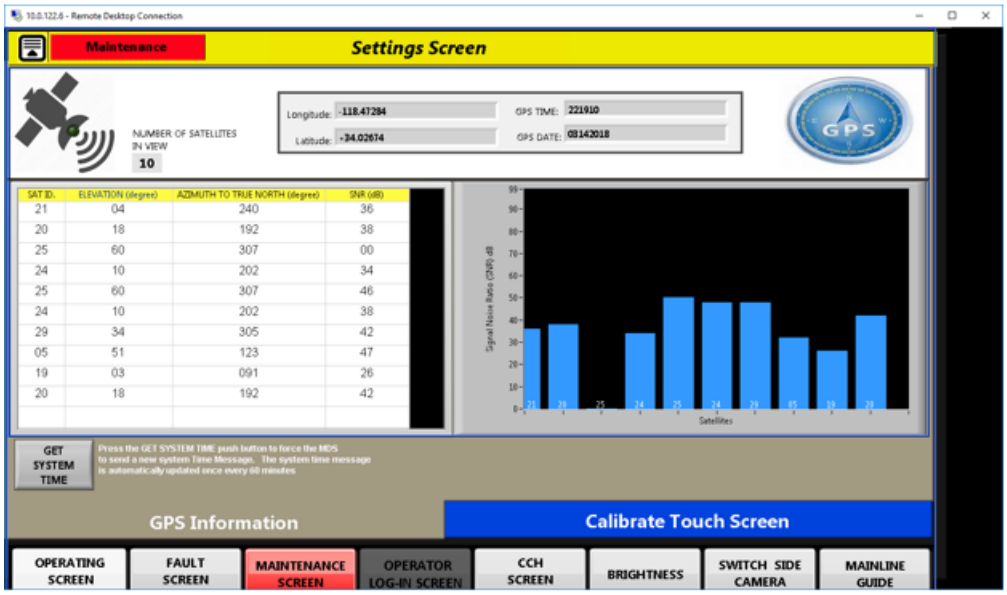


Figure 8-7: GPS Information Page on the TOD

8.6 Passenger Information Displays (PIDS) Troubleshooting

There is one PIDS controller in the A-cab ceiling that controls the PIDs on the A-end. There is another PIDS controller in the B-cab ceiling that controls the PIDs on the B-end. The controllers provide the video output to the VGA extenders that are used to drive the two displays in each end of the LRV.

The PIDs controllers are independent. The displays on one end of the LRV can be functional and the displays on the other end can be non-functional.

The PIDs system is comprised of the controller that transmits video through a VGA extender (transmitter / receiver set) to provide video to two displays. The controller operates on a Windows embedded operating system.

The equipment is non-repairable, so troubleshooting takes the form of isolating the faulty component and replacing it with a known good component. The components include the VGA displays, VGA cables, VGA transmitter(s), VGA receiver(s) and the controllers.

Video distortion or abnormal video color is usually due to a faulty VGA cable. If the cable is connected properly and not faulty, then the VGA transmitter or receiver may be faulty.

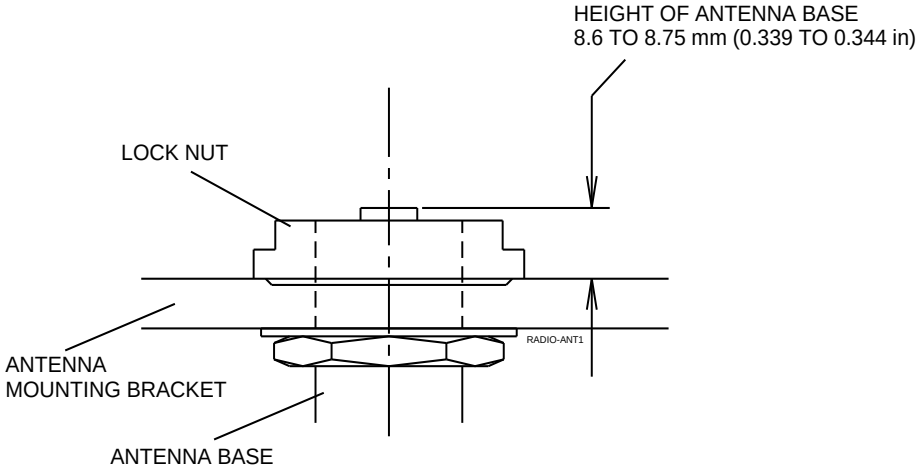
If the equipment / hardware has been checked and verified, then the software on the controller may be corrupt. Confirm the software is correct by reloading and restarting the system.

8.7 Radio Antenna Troubleshooting

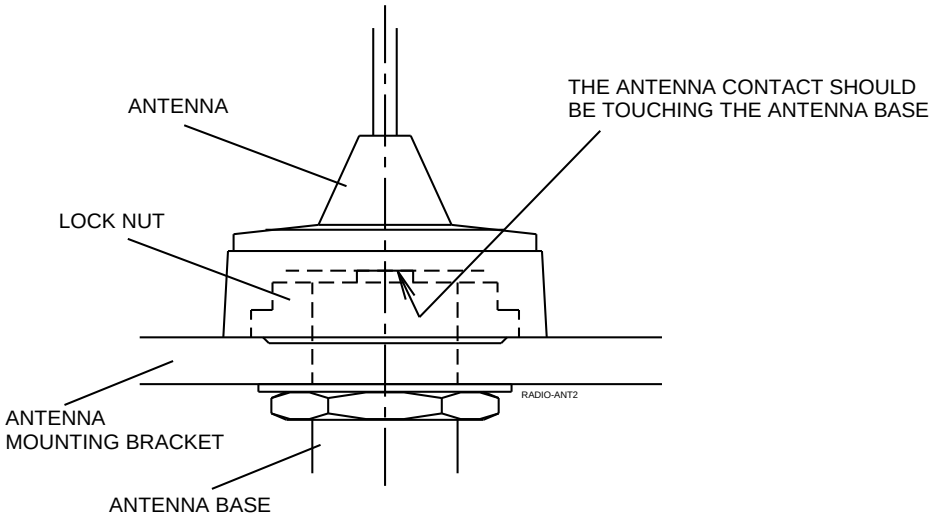
Typically, when the VSWR is higher it is an indication of a connection or grounding issue.

1. Connection

a. The figure below shows the proper radio antenna connector installation. The height of the antenna base should be between 8.6mm to 8.75mm from the antenna mounting bracket.

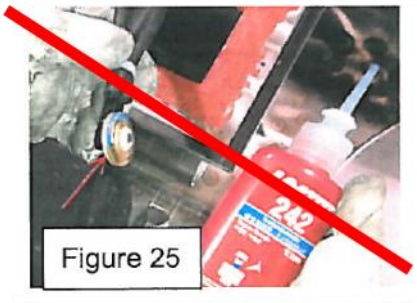


b. The antenna contact should be touching the antenna base.



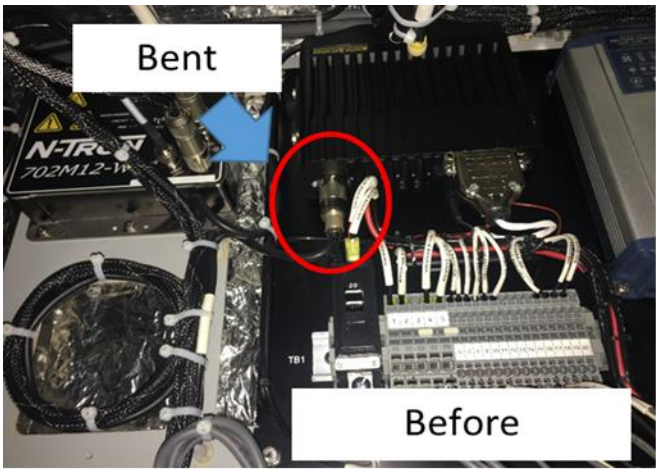
2. Grounding

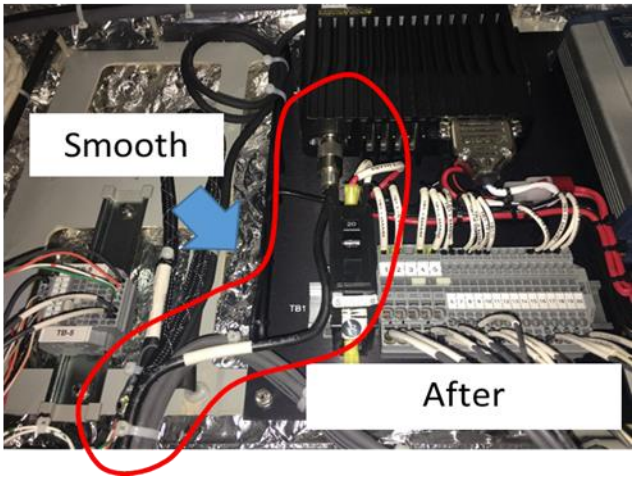
Do not apply Loctite around the threads of the radio antenna. Loctite is not electrically conductive. Clean the internal threads of the antenna base with a 3M Scotchbrite pad to remove the dielectric coating and assure proper electrical connection/grounding.



3. Coaxial cable

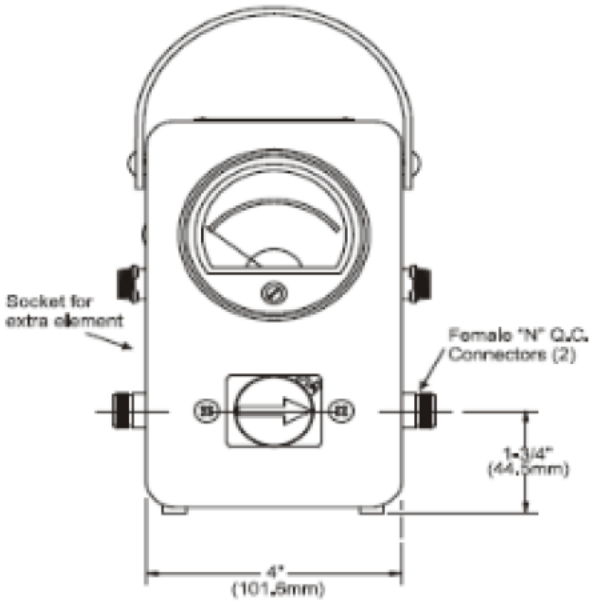
The coaxial cable wiring should be straight. DO NOT BEND THE CABLE.





8.8 Radio Antenna SWR Test

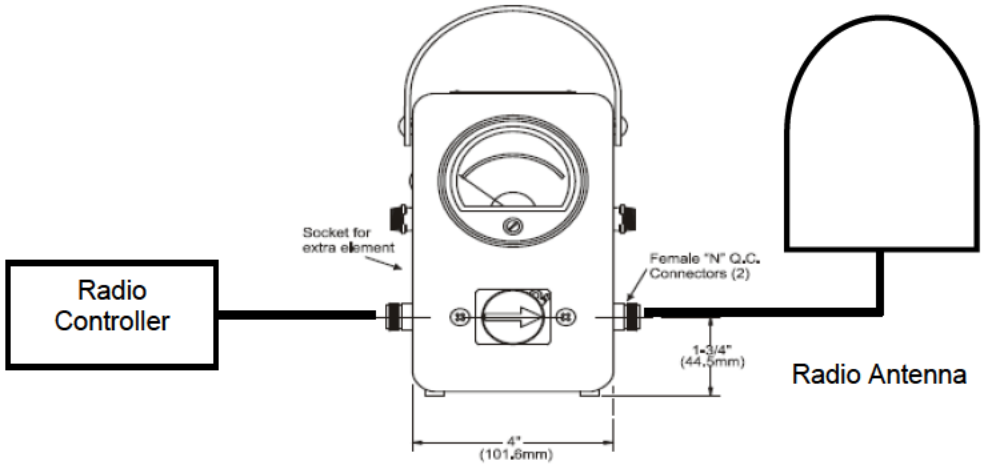
The SWR value shall be tested, using the watt meter as shown below.



Watts meter

Setting

1. Remove the antenna cable from the radio power supply in the cab ceiling.
2. Connect the antenna cable to the watt meter.
3. Connect the watt meter to the radio controller.



Watt meter

After setting up the watt meter, measure the forward power and the reflected power per the information below.

After the Forward SWR and Reverse (Reflected) SWR measurements are taken, use those values to calculate the Percent Reflected Power using the following formula. The Percent Reflected Power is under 11%. Also, Metro recommends VSWR of antenna system is ideally lower than 1.5 and 3.0 or less.

ϕ = Percent Reflected Power (%)

$$\phi = \frac{Wr}{Wf} \times 100 = \frac{REFLECTED\ POWER}{FORWARD\ POWER} \times 100 < \mathbf{11}\%$$

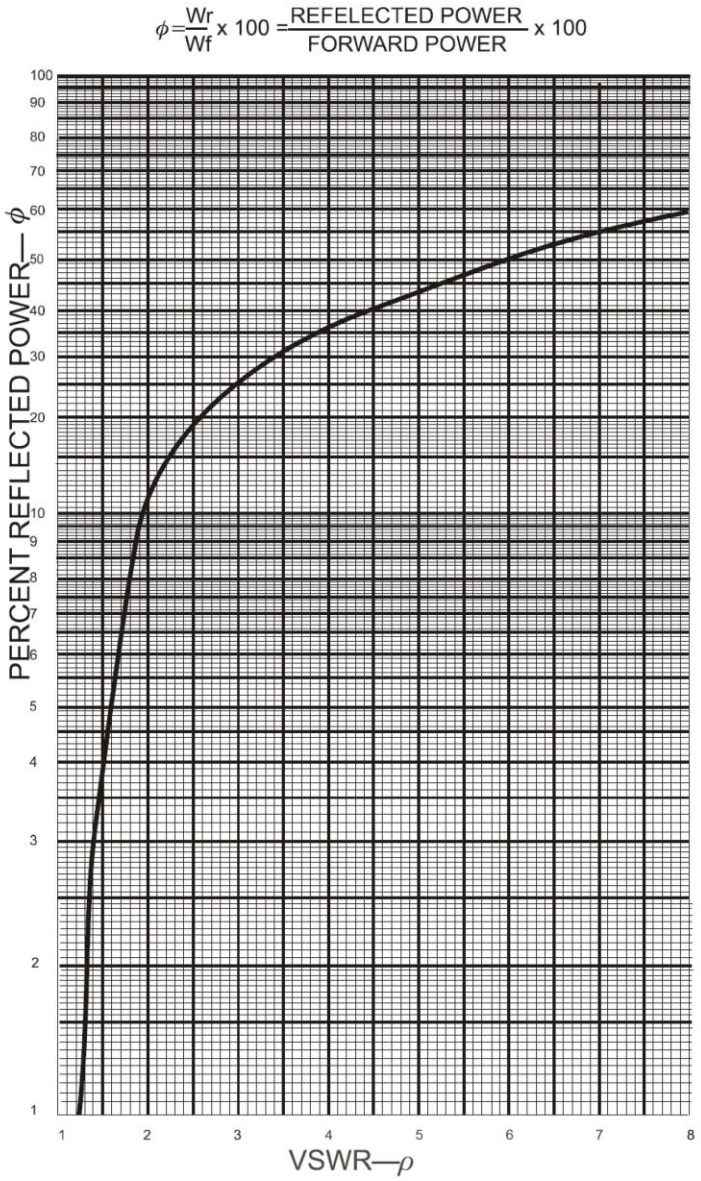
Example: Forward Power SWR = 25Watts
Reflected Power SWR = 2.5 Watts

$$\phi = \frac{2.5}{25} \times 100 = 10\%$$

Percent Reflected Power = 10% PASS

Check the VSWR value on the graph of Percent Reflected Power vs. VSWR (1.0-8.0)

VSWR (ρ) value is 1.9. PASS



Low Reflection Measurements

f = 10% (r = 2) is the typical limit of antenna match. Further effort is frequently not worthwhile because below this level reflected power is hard to measure, and W_l can not be significantly increased. TV and VHF transmitters are examples of systems requiring lower reflected power but for reasons other than maximizing power transmission.

CAUTION
For low reflection measurements, do not rotate the reflected power element to read forward power. Damage to the element or wattmeter could result

8.9 TOA Ethernet Switch and Interface Module Setup

The following section describes the procedures required to setup the TOA Ethernet Switches and Interface Modules.

8.9.1 TOA Ethernet Switch

When the TOA Ethernet Switch is installed to the new one, the network setting for the Ethernet Switch shall be properly implemented. The following procedure describes how to set up the Ethernet Switch.

8.9.1.1 Preparation

System configuration to setup the Ethernet Switch is shown in the figure below.

"

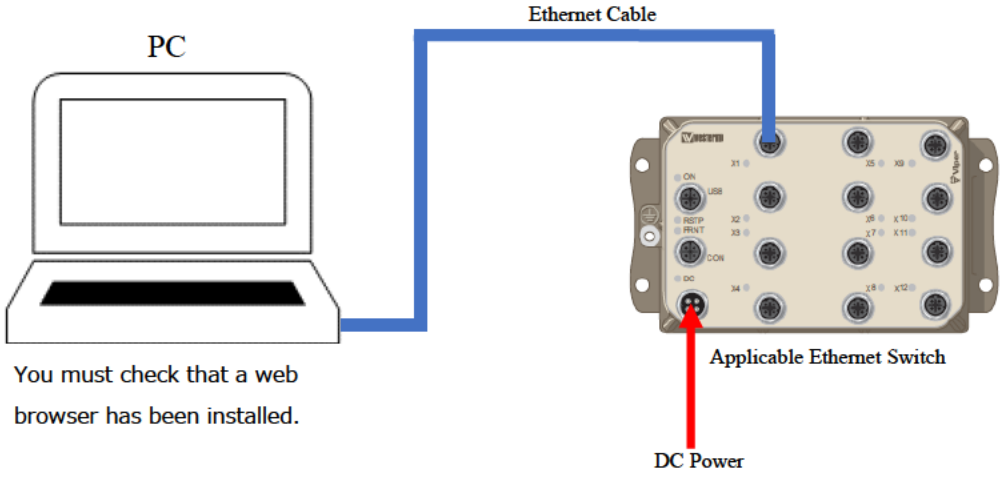


Figure 8-8: System Configuration

8.9.1.2 Setup Procedure

1. Turn off the “Communication Control” circuit breaker. If you work on the A car, the circuit breaker location is shown Figure 8-9. If you work on the B car, the breaker location is shown in Figure 8-10.

Figure 8-9: “Communication Control” Circuit Breaker Location on A Car

Figure 8-10: “Communication Control” Circuit Breaker Location on B Car

2. Remove all Ethernet cables from the Ethernet switch except the one which connects with the Laptop PC. The DC power cable shall not be removed as well. (Please refer to Figure 8-8 for Ethernet switch layout)
3. Turn on the “Communication Control” circuit breaker. If you work on the A car, the circuit breaker location is shown in Figure 8-9. If you work on the B car, the breaker location is shown in Figure 8-10.
4. Change the network setting as follows:

   IP Address: 192.168.2.1

   Sub netmask: 255.255.255.0

   Gateway: Disabled

If the Ethernet switch has already been installed to the train, change the network setting as follows.

IP Address: 10.0.0.99

Sub netmask: 255.0.0.0

Gateway: Disabled

[How to open the network setting?]

a. In the Start menu, search for and select the "ncpa.cpl".

b. Right click on your Ethernet connection adapter and select "Properties" from the drop-down menu.

c. This will open a new window. In the "Networking" tab, select "Internet Protocol Version 4 (TCP/IPv4)" and click the "Properties" button.

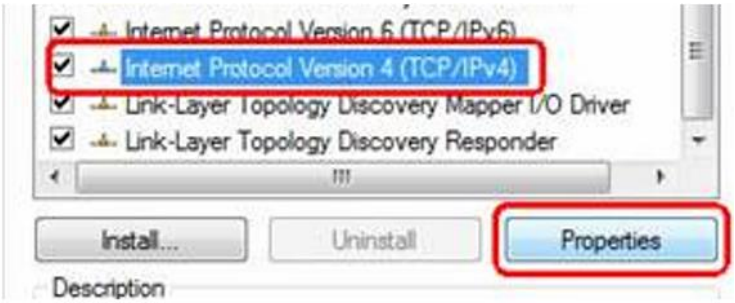


Figure 8-11: Window Screen for Network Setting

d. Click the radio button by "Use the following IP address" and put the above IP address and Sub netmask. Click the radio button by "Obtain DNS server address automatically". Click "OK" to finish and close.

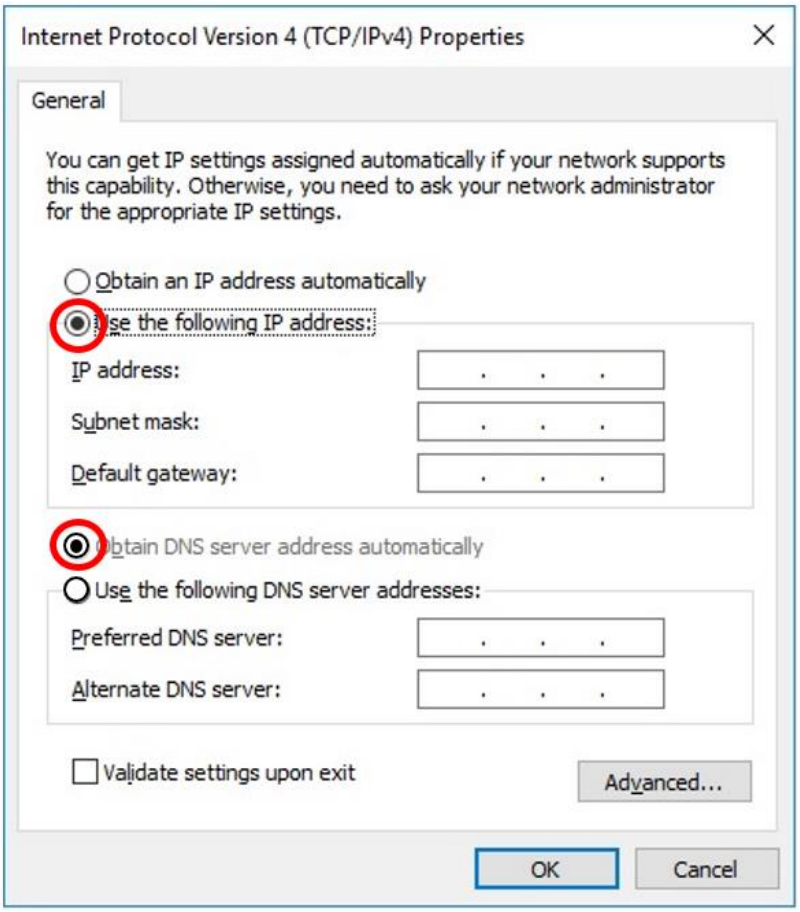


Figure 8-12: Window Screen for Internet Protocol Version 4 (TCP/IPv4) Setting

5. Log in to the Ethernet Switch by using the following username and password.

   Login username: admin

   Password: westermo

   Note) In case of the factory setting

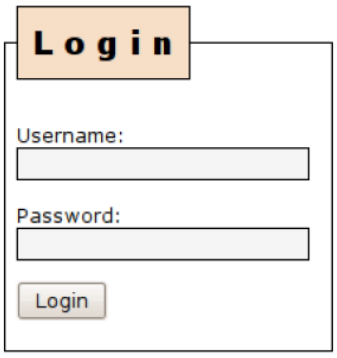


Figure 8-13: WeOS Log In

6. Ethernet Switch setting should be set on WeOS.

Load the basic setting file, and update information as necessary, in accordance with the car number and A/B-Unit of the location of the Ethernet Switch.

（Menu path: Maintenance⇒Backup&Restore）

To update the information, Click the “Apply” Button for each page.

Figure 8-14: WeOS Maintenance > Backup&Restore Page

For the IP Address for Car No. 1xxx A-Unit:

a. Load the basic setting file, “TOA Ethernet A end.cfg”

b. Set the IP address Setting

“Menu path: Configuration 〉 Network 〉 Interface”

IP Address = 10.0.xxx.28

NOTE: If you find that the default primary address is 10.0.xxx.29 in the A car, the configuration file which you applied is incorrect. Please select the correct file.

c. Set the DHCP Server Setting as shown in Figure 8-15. Click each pencil icon, then the IP address for each port can be modified as shown in Figure 8-16, Figure 8-17 and Figure 8-18.

“Menu path: Configuration 〉 Network 〉 DHCP Server”

Host 1: Port X9 (FDS), IP Address 10.0.xxx.81 (See Static Lease 1 screen in Figure 8-16)

Host 2: Port X10 (SDS), IP Address 10.0.xxx.21 (See Static Lease 2 screen in Figure 8-17)

Host 3: Port X11 (PIDS), IP Address 10.0.xxx.23 (See Static Lease 3 screen in Figure 8-18)

d. Set the Identity as shown in Figure 8-19. Put the name of Viper as “TrainXXXX-A” in Hostname

For the IP Address for Car No. 1xxx B-Unit:

a. Load the basic setting file, “TOA Ethernet B end.cfg”

b. Set the IP address Setting
“Menu path: Configuration > Network > Interface”

Primary IP Address = 10.0.xxx.29

NOTE: If you find that the default primary address is 10.0.xxx.28 in the B car, the configuration file which you applied is incorrect. Please select the correct file.

c. Set the DHCP Server Setting as shown in Figure 8-15. Click each pencil icon, then the IP address for each port can be modified as shown in Figure 8-18.

“Menu path: Configuration > Network > DHCP Server”

Host 1: Port X9 (FDS), IP Address 10.0.xxx.82 (See Static Lease 1 screen in Figure 8-18)

Host 2: Port X10 (SDS), IP Address 10.0.xxx.22 (See Static Lease 2 screen in Figure 8-18)

Host 3: Port X11 (PIDS), IP Address 10.0.xxx.24 (See Static Lease 3 screen in Figure 8-18)

d. Set the Identity as shown in Figure 8-19. Put the name of Viper as “TrainXXXX-B” in Hostname

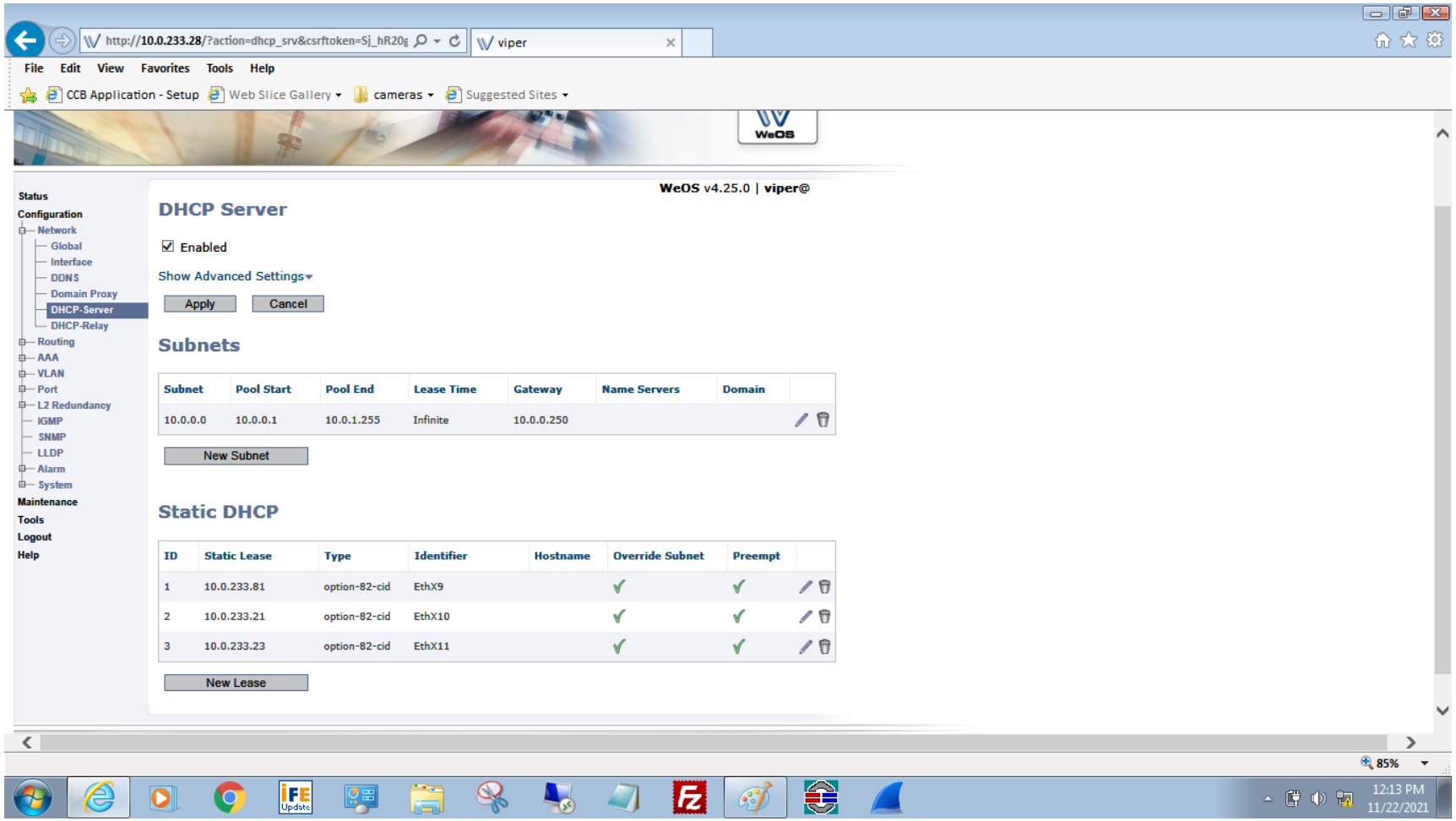


Figure 8-15: DHCP Server Screen

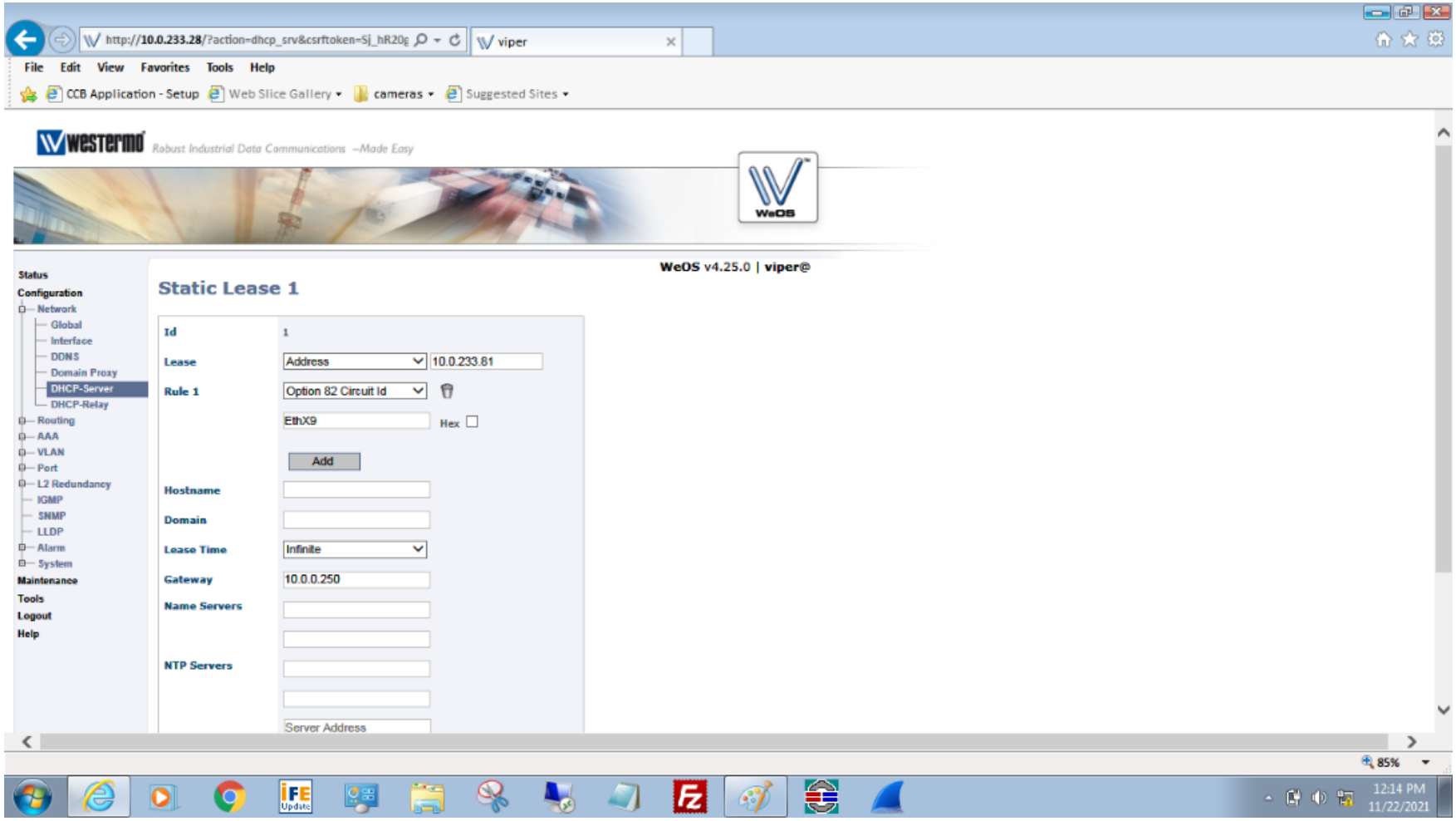


Figure 8-16: Static Lease 1 Screen for each Static ID

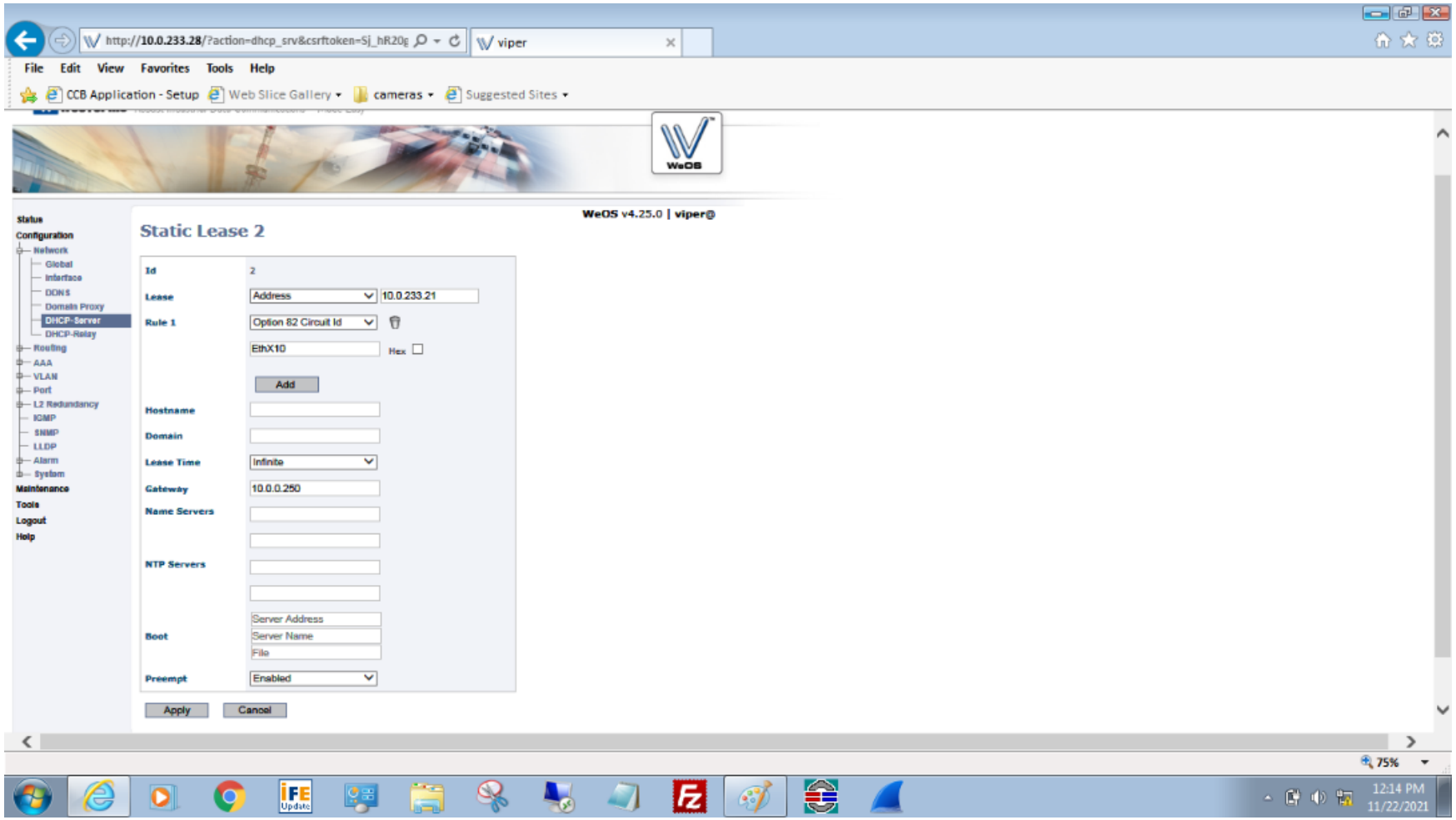


Figure 8-17: Static Lease 2 Screen for each Static ID

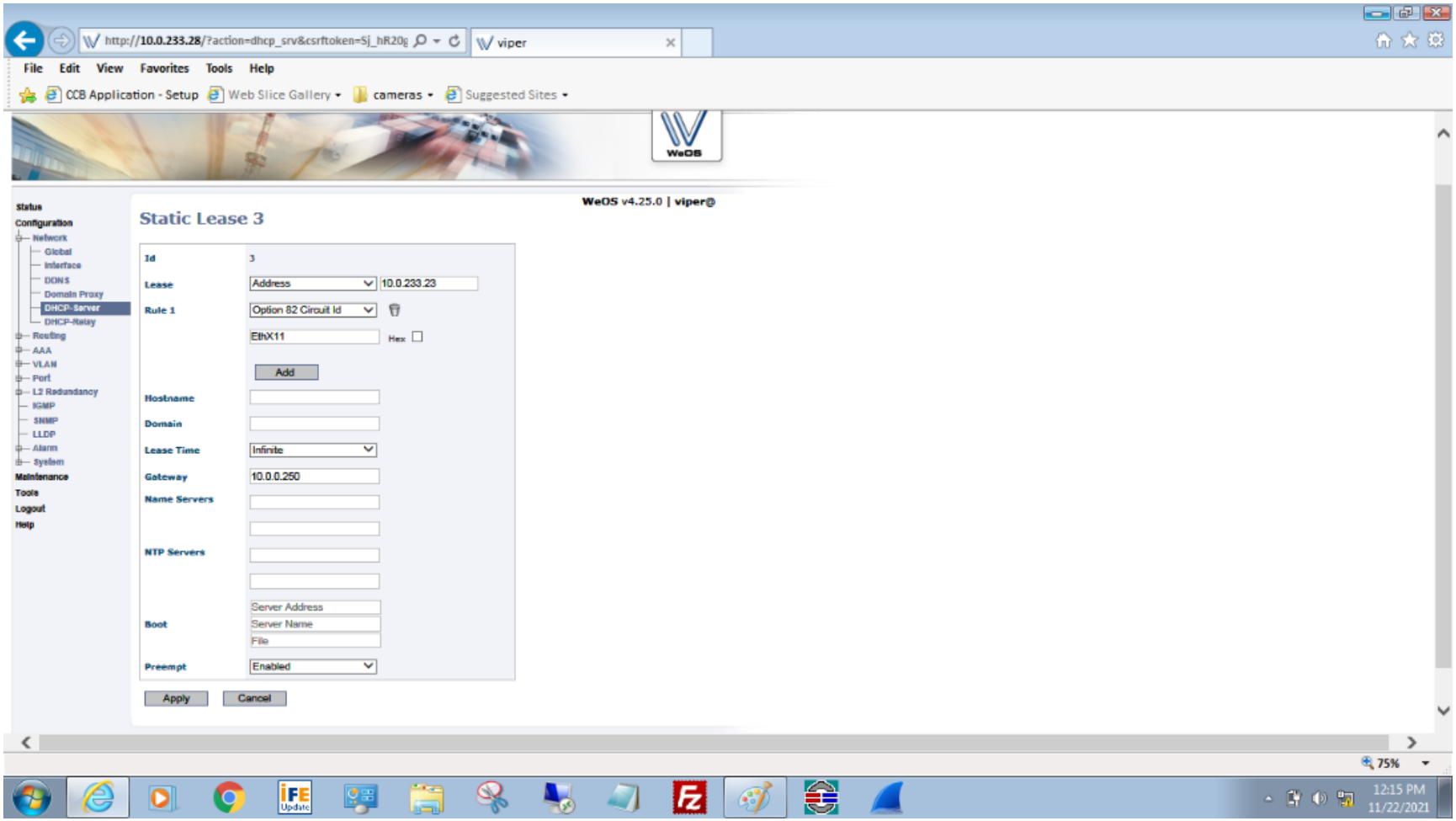


Figure 8-18: Static Lease 3 Screen for each Static ID

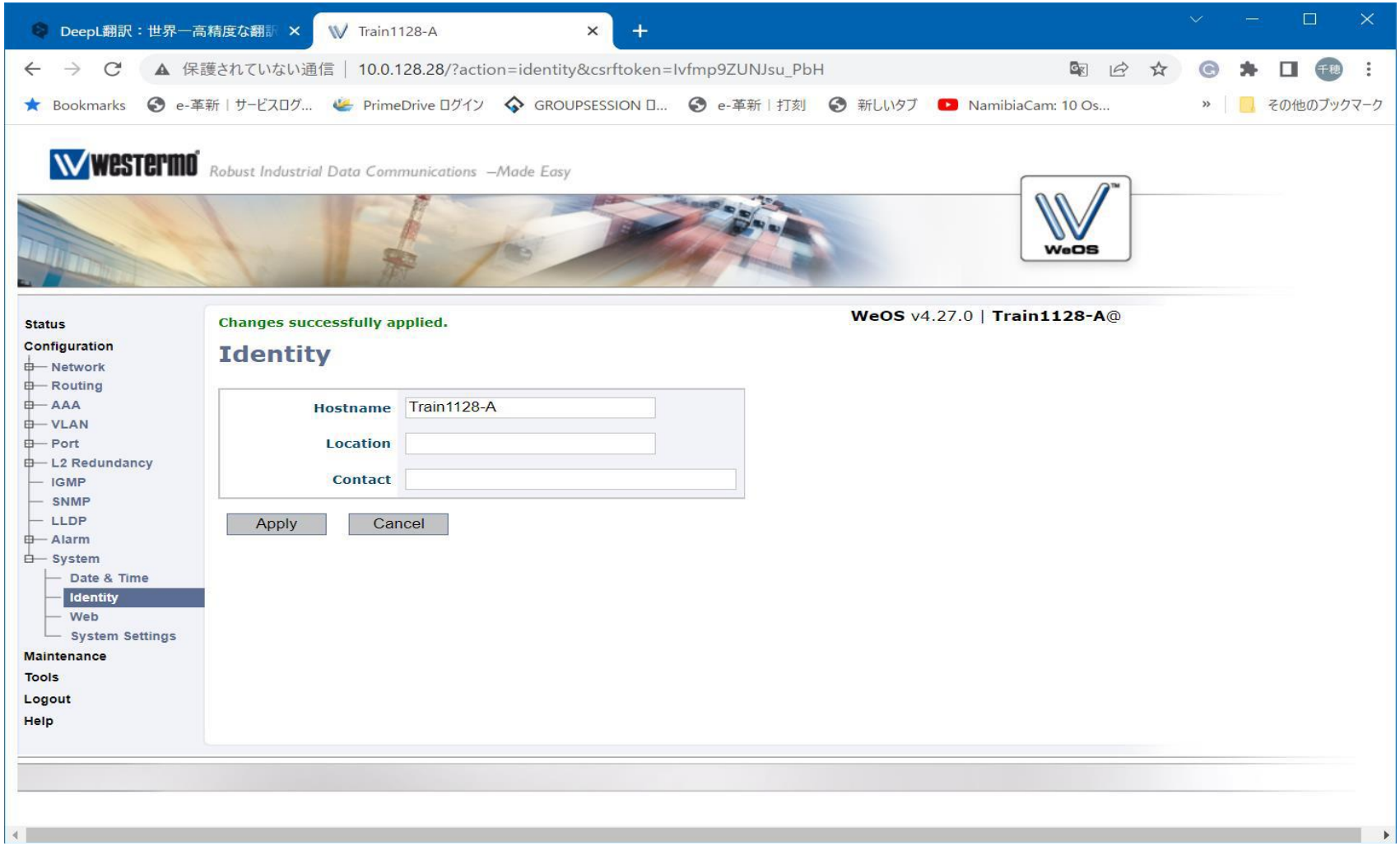


Figure 8-19: Identity Screen

7. Create the backup setting file.

   “Menu path: Maintenance 〉 Backup&Restore”

8. Turn off the “Communication Control” circuit breaker. If you work on the A car, the circuit breaker location is shown in Figure 8-9. If you work on the B car, the breaker location is shown in Figure 8-10.
9. Re-connect all Ethernet cables from the Ethernet switch except the one which connects with the Laptop PC. (Please refer to Figure 8-8 for Ethernet switch layout.)
10. Turn on the “Communication Control” circuit breaker. If you work on the A car, the circuit breaker location is shown in Figure 8-9. If you work on the B car, the breaker location is shown in Figure 8-10.
11. Key on the LRV and implement Onboard Test as per Section 8.3 to verify PID and SDS/FDS is working correctly

8.9.2 TOA Ethernet Interface Module

When the TOA Ethernet Interface Module is replaced by the new one, the network setting for the Ethernet Interface Module shall be properly implemented. The following procedure describes how to set up the Ethernet Interface Module.

8.9.2.1 Preparation

The latest WeConfig should be installed in the Laptop PC before setting from the following web browser:

https://www.westermo.com/solutions/weconfig/get-weconfig

NOTE: WeConfig 1.16.X cannot detect powerline devices (DDW-002). WeConfig 1.15.X should be installed.

When the Ethernet Interface Modules have already been installed to the train, change the network setting of the laptop PC as follows.

IP Address: 10.0.0.99

Sub netmask: 255.0.0.0

Gateway: Disabled

After Ethernet switches (Viper-112A) are adopted FRNT network setting, WeConfig cannot access via the Ethernet switch.

Connect the laptop PC to the Ethernet Interface Module directly.

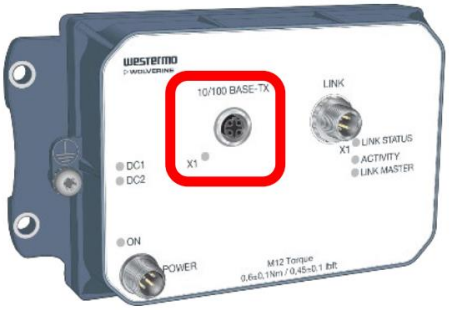


Figure 8-20: DDW-002-B1

8.9.2.2 Setup Procedure

1. Start WeConfig software.

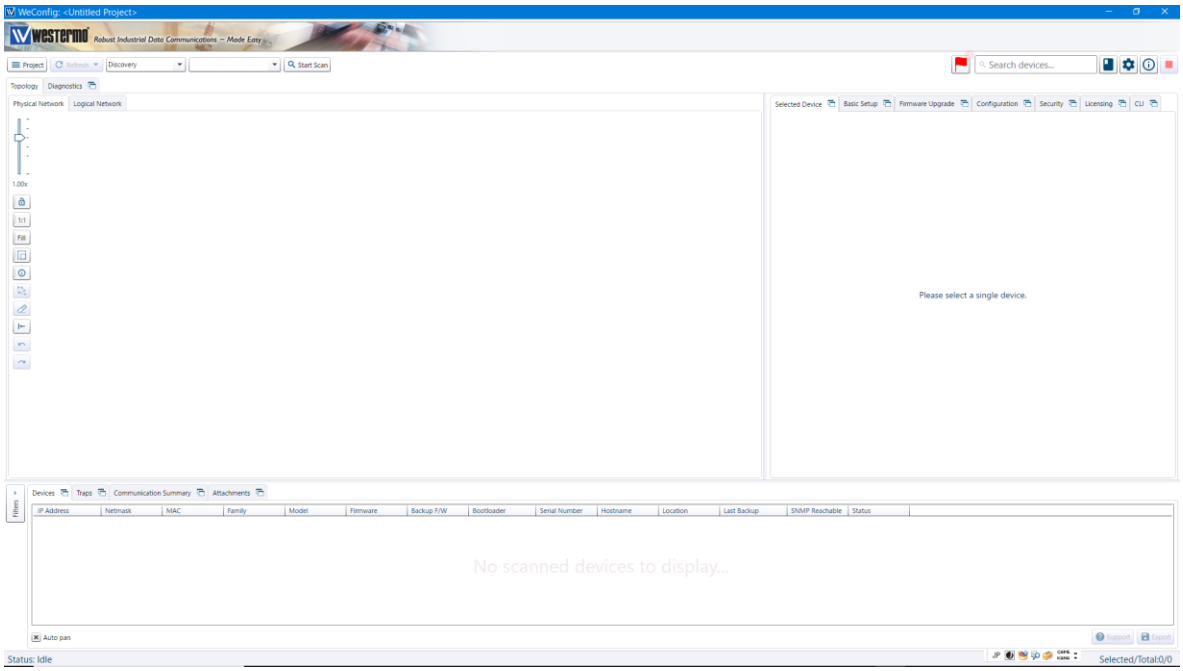


Figure 8-21: WeConfig Main Screen

2. Go to Setting and make sure that Powerline is selected.
3. Start Scan for all the Westermo Devices on the network.

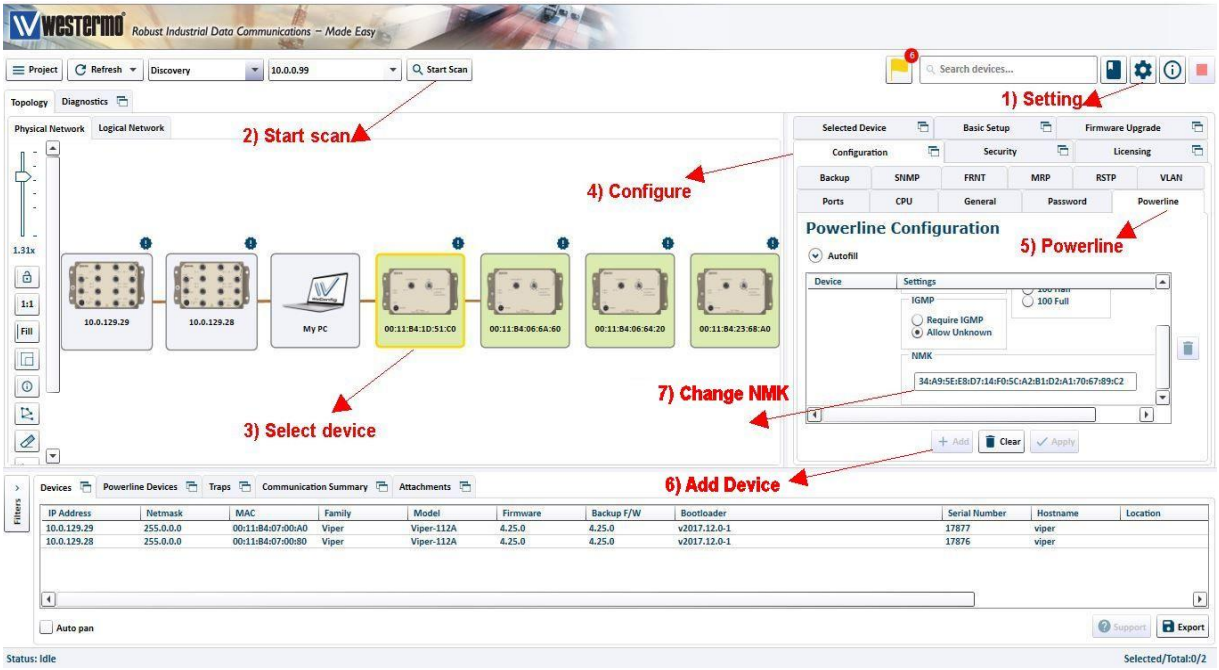


Figure 8-22: WeConfig Screen After Scan

4. Select the Ethernet Interface Module for which you need to change the NMK.

NOTE: Make sure only the desired EIM's are connected to the network to avoid any mistakes.

5. Select the Configurations to make changes.
6. Then Select the Powerline Configuration.
7. Add the Device.
8. Change the NMK Value.
   - EIM1= 34:A9:5E:E8:D7:14:F0:5C:A2:B1:D2:A1:70:67:89:CE (Factory default)
   - EIM2 = 34:A9:5E:E8:D7:14:F0:5C:A2:B1:D2:A1:70:67:89:C2

NOTE: EIM1 should be linked to port 8 of the Ethernet Switch (Viper-112A) and EIM2 should be linked to port 12 of the Ethernet Switch (Viper-112A).

NOTE: Default of IGMP is "Allow Unknown".

It is able to change IGMP settings from "Require IGMP" to "Allow Unknown" by WeConfig. But the table will not fresh automatically, you need to "clear" and "add" the devices again after you apply the changes, then it will show the updated configurations.

9. Close WeConfig application and disconnect laptop PC from the Ethernet switch. Click “Project/new” and “Start Scan”.

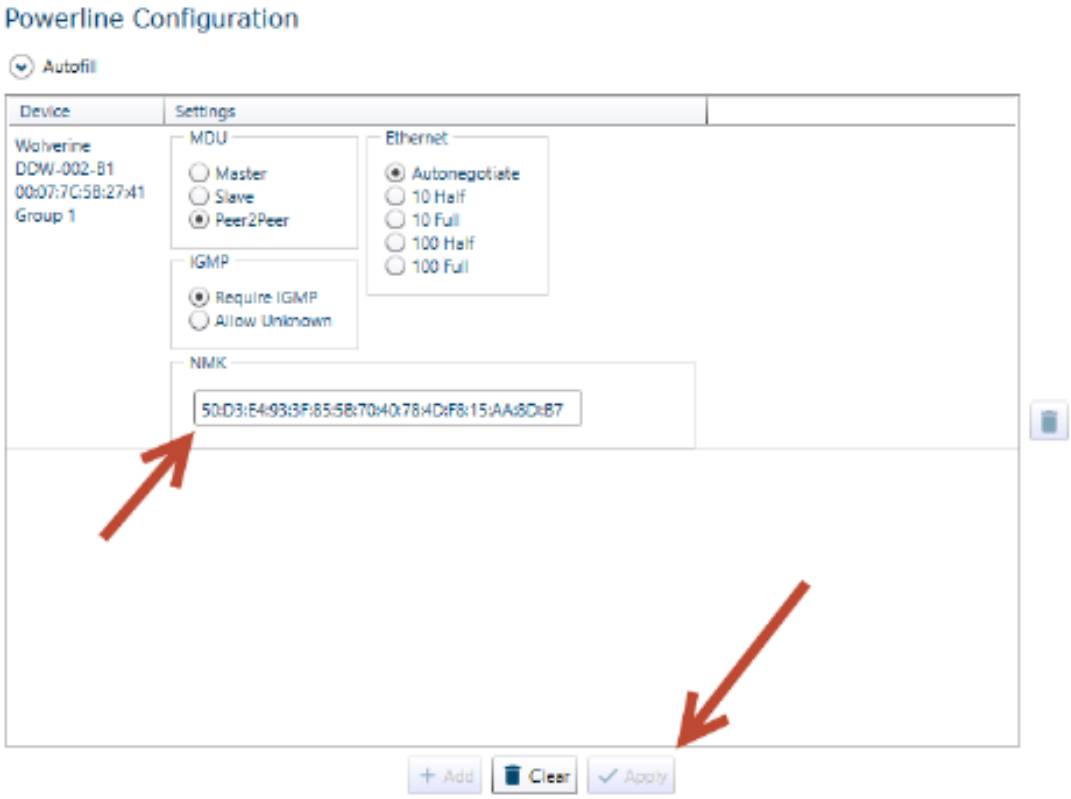


Figure 8-23: WeConfig Powerline Configuration Screen

8.10 CCU / MDS SD Card and SSD Replacement

The following are instructions to replace the SD Card and the SSD of either the Communications Control Unit (CCU) or the Monitoring and Diagnostics System (MDS) computers. For computer removal, refer to Section 7.4.8. For computer installation, refer to Section 7.5.8.

8.10.1 SD Card Replacement Instructions

1. Remove the (4) T8 screws from the back plate and remove the back plate of the computer. See Figure 8-24.

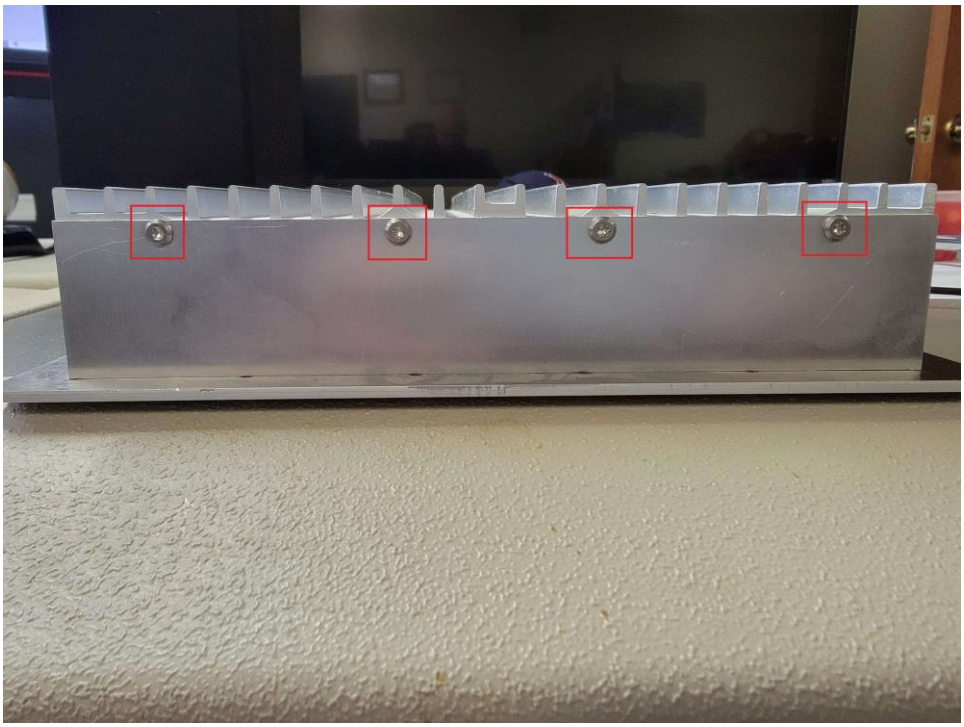


Figure 8-24: CCU / MDS Computer Backplate with T8 Screws

2. Depress the SD card and allow it to move back. See Figure 8-25.

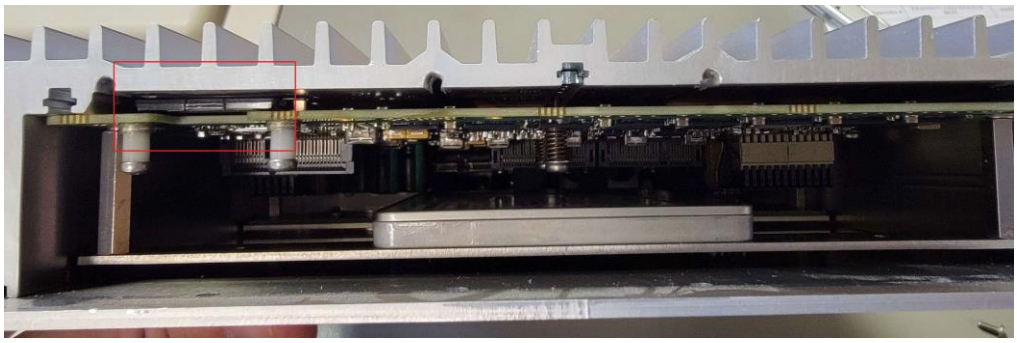


Figure 8-25: CCU / MDS Computer SD Card Slot

3. Remove the SD card
4. Insert the new SD card until the audible “click:’ is heard
5. Confirm the new SD card is in the inserted position
6. Replace the back plate of the computer and replace the (4) T8 screws

8.10.2 SSD Replacement Instructions

1. Remove the (6) recessed T8 screws from the top of the heat sink and remove the computer assembly from the base plate. See Figure 8-26.

Figure 8-26: CCU / MDS Heat Sink with T8 Screws

2. Remove the (4) T8 screws at the corners of the solid state drive assembly. See Figure 8-27.

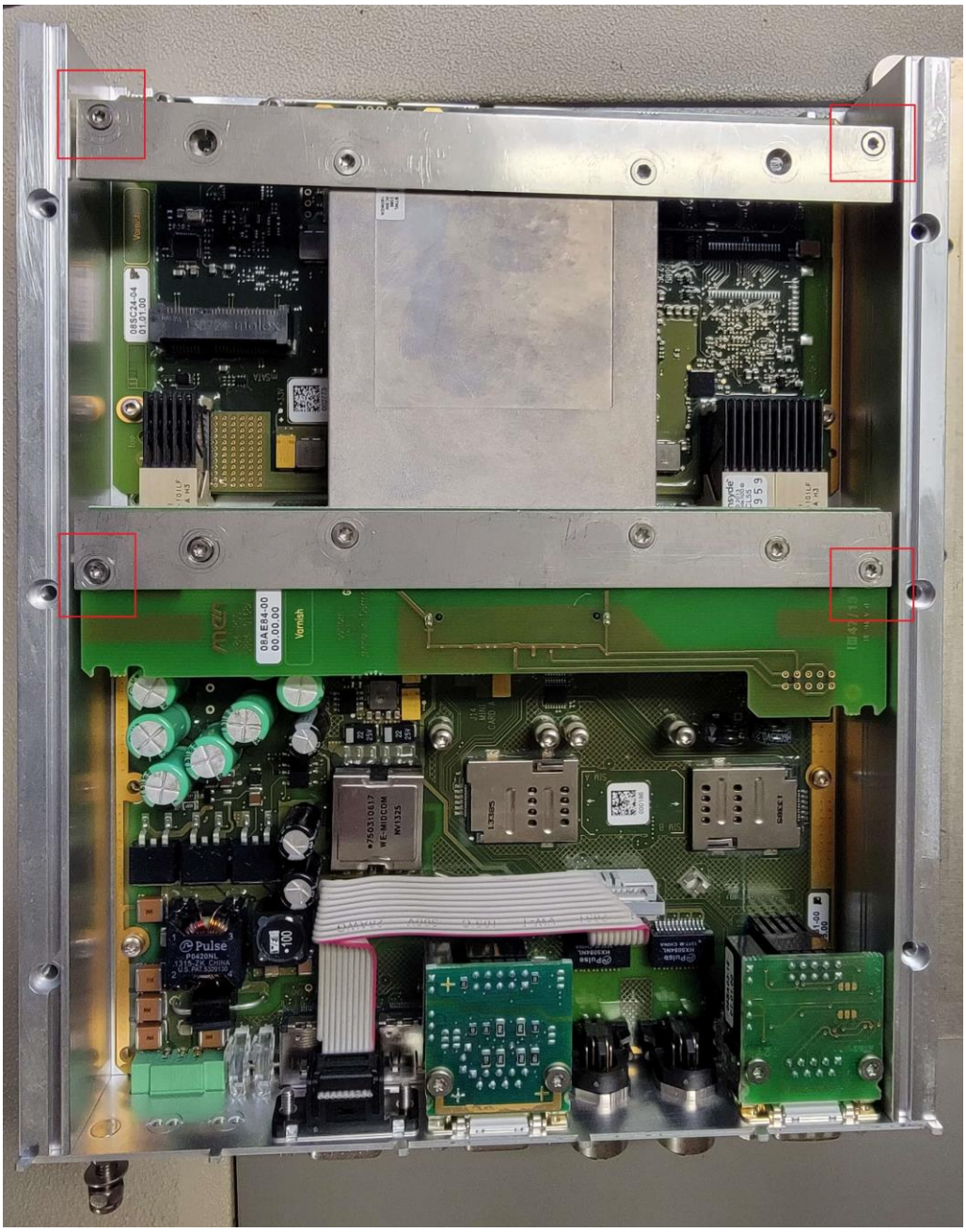


Figure 8-27: CCU / MDS SSD Assembly with T8 Screws

3. Once the screws are removed, gently lift the solid state drive assembly from the SATA pin header and remove the hard drive assembly from the computer. See Figure 8-28.

Figure 8-28: CCU / MDS SATA Pin Header

4. Remove the (2) T8 screws that connect the hard drive to the SATA bridge and remove the (2) T8 screws that connect the solid state drive to the mounting bracket. See Figure 8-29.

Figure 8-29: CCU / MDS SATA Bridge with T8 Screws

5. Attach the SATA bridge and mounting bracket to the new solid state drive.

6. Replace the solid state drive assembly in the computer ensuring that the SATA pin header is fully seated.

7. Replace the (4) T8 screws at the corners of the solid state drive assembly.

8. Replace the computer assembly on the base plate and replace the (6) recessed T8 screws in the computer case.

8.11 Troubleshooting Charts

The fault isolation chart lists the symptoms most likely to occur and suggests probable causes and corrective actions.

Table 8-2 contains the troubleshooting procedures for the VMS Communications Equipment. The symptoms listed are the most common malfunctions. The probable cause and remedy are also listed.

The troubleshooting Table 8-2 is divided into three columns:

- Column 1, lists the symptoms (indications) of the trouble
- Column 2, indicates the probable fault(s) which may cause the trouble
- Column 3, indicates the possible corrective action to repair the cause of the trouble

Table 8-2: Communications Troubleshooting

Symptom	Probable Cause	Remedy
The CCU does not power on	The power connector is bad or the unit is bad	Confirm that the VMS circuit breaker is on
		Confirm voltages at the CCU power connector
		Replace CCU
CCU does not connect to network	The connection between the CCU and the switch is bad or the CCU has failed	Confirm the Ethernet connection at the CCU
		Confirm the Ethernet connection at the LAN 1A Port - link LED2 green
		Reload CCU/MDS software
		Replace the CCU
Cab console buttons do not work	The connection between the button and the RIO is bad or the RIO is not communicating	Confirm the button connection at the Ethernet RIO
		Confirm the connection at the console
		Confirm the RIO is connected on the Ethernet network using the TOD
		Replace the console button
The Ethernet RIO is not present on the Ethernet network	The wiring between the RIO and the Ethernet network is bad or the RIO has failed	Confirm the wiring connection at the Ethernet RIO
		Confirm wiring at appropriate switch / port
		Replace the Ethernet RIO
		Replace the speaker
The foot pedal does not work	The foot pedal has a poor connection to the RIO or RIO DI has failed	Check the connection of the foot pedal at the RIO
		Check the connection at the RIO
		Replace the foot pedal
		Replace the RIO

Table 8-2: Communications Troubleshooting (cont.d)

Symptom	Probable Cause	Remedy
The WWAS does not respond to a worker equipped with a Protran device	There is no power to the WWAS or the antenna connection has come loose	Confirm the WWAS breaker is ON
		Check the power connection on the WWAS receiver
		Check the antenna connection on the WWAS
		Replace the WWAS unit
The WWAS responds with an alarm but doesn't indicate on the TOD	The serial connection has come loose between the TOD and the WWAS	Check the serial cable at the WWAS unit
		Check the serial cable at the TOD
		Replace the serial cable
		Replace the WWAS unit
		Replace the TOD
The WWAS responds on the TOD but doesn't sound an alarm	The connection between the WWAS unit and the speaker has become loose	Ensure that the audible alarm cutout is not enabled
		Check the wiring between the speaker and the WWAS unit
		Replace the cab console speaker
		Replace the WWAS unit
The Horn/Gong doesn't sound	There is trouble with wiring between the controller and the speaker or the power supply to the horn controller	Confirm the cab control circuit breaker is in the ON position
		Confirm the wiring at the horn controller
		Confirm the wiring to the Horn/Gong speaker
		Confirm the wiring at the rocker buttons on the cab console
		Replace the Horn/Gong Speaker
		Replace the rocker button on the cab console
		Replace the Horn/Gong controller
The Horn/Gong is too soft or too loud	The potentiometer is too low and must be adjusted	Carefully turn the potentiometer to attain the desired volume
No input from GPS	The communication between the GPS and CCU has failed	Confirm the connection at the TOD
		Confirm the connection at the GPS unit
		Replace GPS unit
		Replace the CCU
System time is incorrect	There has been time slippage or there is a communication issue	Confirm communication of the GPS to the CCU
		Confirm CCU network connectivity
PID or TOD Displays incorrect time.	GPS Error	Check GPS functionality using TOD. Replace GPS receiver as required. Refer to Section 8.5 of RMM.

Table 8- contains the troubleshooting procedures for the TOA Communication System equipment. The symptoms listed are the most common malfunctions. The probable cause and remedy are also listed. The troubleshooting table is divided into three columns:

- Column 1, lists the symptoms (indications) of the issue
- Column 2, indicates Location
- Column 3, Indicates the Probable Cause
- Column 4, indicates Probable Fault
- Column 5, indicates the Corrective action

Table 8-3: TOA Communication System Troubleshooting

Symptom	Location	Probable Cause	Probable Fault		Corrective Action
			Shown on TOD	Shown on TOA CCH	
TOA CCH screen does not work	Master Cab	CCH is disconnected from ACP.	ACP(A) CCH Error or ACP(B) CCH Error	N/A	Confirm CCH connector is connected properly.
					Confirm the wiring between CCH and ACP.
		CCH is malfunctioning.			Replace CCH.
		ACP is disconnected from power supply.	ACP(A) Fault or ACP(B) Fault		Confirm ACP CN1 connector is connected properly.
					Check for voltage at the ACP power connection.
		ACP is malfunctioning.			Replace ACP.
	Sub Cabs	No problem. It's the right spec.	N/A	N/A	N/A
TOA CCH buttons do not work	Master Cab	ACP is in the process of booting up.	None	None	Wait about a minute.
		Master key is removed.		N/A	Insert master key
		ACP cannot control CCH.	ACP(A) Fault or ACP(B) Fault		Restart the Train by local off/on switch.
		CCH is malfunctioning.	ACP(A) CCH Error or ACP(B) CCH Error		Replace CCH.
	Sub Cabs	No problem. It's the right spec.	N/A	N/A	N/A
The footswitch, PTT switch, Mode selector switch, Door Close Announcement button, and Speaker selector do not work	Master Cab	RIO cannot respond.	Error with RIO(A) connection or Error with RIO(B) connection	RIOA or RIOB	Wait about a few minutes.
					Restart the Train by local off/on switch.
		RIO is disconnected from Ethernet.			Confirm the connection between RIO and Ethernet switch.
		RIO is malfunctioning.			Replace RIO.

Table 8-3: TOA Communication System Troubleshooting (cont'd.)

Symptom	Location	Probable Cause	Probable Fault		Corrective Action
			Shown on TOD	Shown on TOA CCH	
The footswitch, PTT switch, Mode selector switch, Door Close Announcement button, and Speaker selector do not work (Cont'd)	B-cab of Leading car	IFU is disconnected from power supply.	TOAE Network Error	I/F UNIT	Confirm IFU CN1 connector is connected properly.
					Check for voltage at the ACP power connection.
		IFU cannot respond.			Restart the Train by local off/on switch.
		IFU is malfunctioning.			Replace IFU.
The Mode selector switch does not work	Master Cab	The Mode selector switch has a poor connection to the RIO or RIO DI has failed.	None	None	Check the connection of the Mode selector switch and the RIO.
		The Mode selector switch is malfunctioning.	None	None	Replace the Mode selector switch.
The Door Close Announcement button does not work	Master Cab	The Door Close Announcement button has a poor connection to the RIO or RIO DI has failed.	None	None	Check the connection of the Door Close Announcement button and RIO.
		The Door Close Announcement button is malfunctioning.	None	None	Replace the Door Close Announcement button.
The Speaker selector does not work	Master Cab	The Speaker selector has a poor connection to the RIO or RIO DI has failed.	None	None	Check the connection of the Speaker selector and RIO.
		The Speaker selector is malfunctioning.	None	None	Replace the Speaker selector.

Table 8-3: TOA Communication System Troubleshooting (cont'd.)

Symptom	Location	Probable Cause	Probable Fault		Corrective Action
			Shown on TOD	Shown on TOA CCH	
There is no sound	One car	The ACP cannot control Audio function.	None	None	Restart the Train by local off/on.
		The ACP is disconnected from Ethernet.	ACP(A) or ACP(B) Fault	PAIR CPU	Confirm the connection between ACP and Ethernet switch.
		The ACP is malfunctioning.	Ditto	PAIR CPU	Replace ACP.
	Trail cars	ACPs are disconnected from Ethernet.	None	None	Confirm the Ethernet connection between cars.
	All cars	Master ACP cannot control Audio function.	None	None	Restart the Train by local off/on.
		Master ACP is malfunctioning.	ACP(A) or ACP(B) Fault	PAIR CPU	Replace ACP.

Table 8-3: TOA Communication System Troubleshooting (cont'd.)

Symptom	Location	Probable Cause	Probable Fault		Corrective Action
			Shown on TOD	Shown on TOA CCH	
No audio generated from In-Dash Mic when activated by the footswitch or the PTT switch	Master Cab	The position of the Mode selector switch is not set to "PA".	None	None	Change Mode selector switch position to "PA".
		The footswitch has a poor connection to the RIO or RIO DI has failed.			Check the connection of the footswitch at footswitch and the RIO.
		The PTT switch has a poor connection to the RIO or RIO DI has failed.			Check the connection of the PTT switch at the PTT switch and the RIO.
		The footswitch is malfunctioning.			Replace the footswitch.
		The PTT switch is malfunctioning.			Replace the PTT switch.
		ACP cannot input audio from the In-Dash Microphone.			Confirm the Mic and wiring between the Mic and ACP. Replace In-Dash Microphone.
		ACP cannot communicate with the RIO.	Error with RIO(A) connection or Error with RIO(B) connection	RIOA or RIOB	Confirm the RIO and wiring between the RIO and ACP.
		ACP cannot control manual PA.	ACP(A) or ACP(B) Fault or None	PAIR CPU or None	Restart the Train by local off/on.
		ACP is malfunctioning.	ACP(A) or ACP(B) Fault	PAIR CPU	Replace ACP.

Table 8-3: TOA Communication System Troubleshooting (cont'd.)

Symptom	Location	Probable Cause	Probable Fault		Corrective Action
			Shown on TOD	Shown on TOA CCH	
No audio generated from RADIO PA when activated	Master Cab	ACP cannot control Radio PA	ACP(A) Fault or ACP(B) Fault	PAIR CPU or None	Restart the Train by local off/on.
		The position of the Mode selector switch is not set to "Radio"	None	None	Change Mode selector switch position to "RADIO".
		ACP cannot input audio from the Radio	None	None	Confirm the Radio and wiring between the Radio and ACP.
No audio generated from RADIO PA when activated (Cont'd)	Master Cab (Cont'd)	ACP cannot input audio from the Radio (Cont'd)	Error with RIO(A) connection or Error with RIO(B) connection	RIOA or RIOB	Confirm the RIO and wiring between the RIO and ACP.
		ACP is malfunctioning	ACP(A) Fault or ACP(B) Fault	PAIR CPU	Replace ACP.
PIC fault indicated on Master CCH after Onboard Test	One or multiple PIC	1. The PIC is malfunctioning 2. The ACP cannot recognize that PIC is activated.	PIC(A#1) Error or PIC(A#2) Error or PIC(B#1) Error or PIC(B#2) Error	PIC #1 or PIC #2 on CCH in Master Cab	Remove and Insert the CN2 connector on ACP.
					Check cable connection between ACP (CN2) and PIC.
					Swap the faulty PIC and the healthy PIC to see whether fault report is transferred to the log or not.
					If the fault has been transferred, replace the PIC.
"EMERGENCY CALL" screen does not appear on TOA CCH screen when activated by any of PIC	One PIC	1. The ACP cannot recognize that PIC is activated. 2. The PIC is malfunctioning	PIC(A#1) Error or PIC(A#2) Error or PIC(B#1) Error or PIC(B#2) Error (after Onboard Test)	PIC #1 or PIC #2 on CCH in Master Cab (after Onboard Test)	After revenue service, carry out Onboard Test from CCH in Master Cab
					Do the same step as "PIC fault indicated on Master CCH after Onboard Test"

Table 8-3: TOA Communication System Troubleshooting (cont'd.)

Symptom	Location	Probable Cause	Probable Fault		Corrective Action
			Shown on TOD	Shown on TOA CCH	
Automatic announcements occur earlier or later than specified timing	All cars	Wheel diameter not adjusted after wheel truing	None	None	Adjust wheel diameter by PTU per actual diameters.
		The distance between stations in the route file is incorrect, if a new route file is loaded in CF card	None	None	Verify the distance in the route file and revise it and create a new route file by RME
Arriving message of automatic announcement does not occur	All cars	Wheel diameter not adjusted after wheel truing	None	None	Adjust wheel diameter by PTU per actual diameters.
		The distance between stations in the route file is incorrect, if a new route file is loaded in CF card	None	None	Verify the distance in the route file and revise it and create a new route file by RME
One or more FDS/SDS do not power-up.	One car	No power to the FDS/SDS	FDS(#1) Error or FDS(#2) Error or SDS(#1) Error or SDS(#2) Error	FDS #1 or FDS #2 or SDS #1 or SDS #2	Check for voltage at the FDS/SDS power connection.
		Tripped circuit breaker (DSLCB)	FDS(#1) Error SDS(#1) Error and/or FDS(#2) Error SDS(#2) Error	FDS #1 SDS #1 and/or FDS #2 SDS #2	Reset circuit breaker by placing in the OFF position then the ON position.
		FDS/SDS power supply PCB is defective.	FDS(#1) Error or FDS(#2) Error or SDS(#1) Error or SDS(#2) Error	FDS #1 or FDS #2 or SDS #1 or SDS #2	If LED1 on FDS/SDS is not illuminated, replace power supply PCB of FDS/SDS.
		Failed control PCB			If LED4 is not blinking, replace control PCB of FDS/SDS.
					Replace control PCB of FDS/SDS.

Table 8-3: TOA Communication System Troubleshooting (cont'd.)

Symptom	Location	Probable Cause	Probable Fault		Corrective Action
			Shown on TOD	Shown on TOA CCH	
One or more FDS/SDS do not display data.	One car	The FDS or SDS cannot communicate with ACP	FDS(#1) Error or FDS(#2) Error or SDS(#1) Error or SDS(#2) Error	FDS #1 or FDS #2 or SDS #1 or SDS #2	Check wiring between the FDS or SDS and ACP, Ethernet switch and its ports are set DHCP correctly.
					Repair connection.
					If LED3 on FDS/SDS is not illuminated, repair broken network link.
					Restart the system.
		Defective display LED(s)	None	None	Replace LED display matrix PCB in FDS/SDS.
One or more FDS/SDS displays do not adjust brightness when ambient light changes.	One car	Optical sensor is blocked	None	None	Remove blockage.
		Defective optical sensor	None	None	Replace optical sensor PCB.
FDS/SDS on one LRV section in a coupled trainset do not display	Trail cars	The LRV is disconnected	None	None	Confirm coupling the LRV. Confirm Ethernet Interface Modules are activated and set correctly.
PID displays abnormal color or tint	One car	Bad VGA cable to display monitor or VGA extender module	None	None	Check VGA cable or VGA module, replace if necessary.

Table 8-3: TOA Communication System Troubleshooting (cont'd.)

Symptom	Location	Probable Cause	Probable Fault		Corrective Action
			Shown on TOD	Shown on TOA CCH	
One PID on a LRV section does not display	One car	The PIDS monitor is malfunctioning	None	None	Replace the PIDS monitor.
		The PIDS monitor is not input video signal	None	None	Check VGA cable and its connection.
					Check Gigabit Ethernet cable and its connection.
					Replace VGA extender.
PID A-End or PID B-End inoperative	One car	PIDs are independent; troubleshoot each end separately	PIDS Controller (#1) Error or PIDS Controller (#2) Error	PIDS #1 or PIDS #2	Refer to Section 8.6.
Both PIDs on one LRV section do not display	All cars	PIDs have common point at transmitter and controller. Possible defective transmitter or PIDs controller.	PIDS Controller (#1) Error PIDS Controller (#2) Error	PIDS #1 PIDS #2	Confirm connectivity from controller to transmitter.
					Confirm PIDs controller operation.
					Confirm transmitter operation
PID Displays incorrect time.	All cars	GPS Error	None	None	Wait for 10 minutes whether time is updated on PID Displays or not.
					Check GPS functionality using TOD. Replace GPS receiver as required.
	One car	PIDS is set as wrong date and daylight saving time function.	None	None	Confirm date and daylight saving time function is off on PIDS controller.

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8.12 Fault List

A Fault List follows that identifies possible faults, causes, and corrective actions for communications related equipment.

Table 8-4: Fault List

Fault/Status Name	Description of the Fault/Status	Possible Cause of the Fault	Corrective Action
IDDB_MISSING_FLT	The MDS is missing the Identification database file	File missing on the MDS	Install missing file on MDS
TOD2TOD_COMM_FLT	The TOD is not communicating with other TOD in cab	TODs are not communicating.	Verify connectors, switches, and wiring. Replace bad TOD
TOD2WWAS_COMM_FLT	TOD not communicating with the WWAS	The TOD is not receiving WWAS RS485 messages	Check connectors and wiring. Check WWAS and TOD.
GPS FAILED	GPS IS NOT FUNCTIONAL	NO GPS MESSAGES	REPLACE GPS

Table 8-5: TOA Fault List

Fault/Status Name			Description of the Fault/Status	Cause of the Fault (if a Fault)	Corrective Action	Notes
Shown on TOD	**Shown on TOA CCH**	**Shown on TOA ACP internal log[*1]**				
ACP(B) Fault	PAIR CPU	FAULT UP (Pair CPU comm)	ACP(B) does not respond to the request from ACP(A)	ACP(A) cannot communicate with ACP(B). ACP(B) doesn't respond to the request from ACP(A).	1. Switch MCB ON/OFF to reset the system to see whether system can be recovered. 2. Remove and insert the CN1 and CN4 connector on ACP(B). (To check the network condition between two ACP(A) and (B).) If the fault remains, replace ACP(B).	Error to be detected and logged by ACP(A) for each car and to be indicated on TOD and CCH in Master Cab.
ACP(A) CF Card Content Error	CF DATA	FAULT UP (CF card data)	Missing file of ACP(A) CF setting	Data in the CF card is not correct.	1. Remove and insert the CF card. (Refer to Appendix B in RME manual) 2. Reload the data inside CF card. If the fault remains, replace the ACP(A).	Error to be detected and logged by ACP(A) for each car and to be indicated on TOD and CCH in Master Cab.
ACP(A) IO Error	IO	FAULT UP (PIO unit comm)	Communication Error between CPU board and PIO board inside ACP(A)	The 485 communication between PCBs inside ACP(A) fails.	Replace ACP(A).	Error to be detected and logged by ACP(A) for each car and to be indicated on TOD and CCH in Master Cab.

Table 8-5: TOA Fault List (cont'd.)

Fault/Status Name			Description of the Fault/Status	Cause of the Fault (if a Fault)	Corrective Action	Notes
Shown on TOD	**Shown on TOA CCH**	**Shown on TOA ACP internal log[*1]**				
ACP(A) CCH Error	ACP-CCH	FAULT UP (CCH unit comm)	CCH(A) does not respond to the request from ACP(A)	ACP(A) cannot communicate with CCH(A).	1. Switch MCB ON/OFF to reset the system to see whether system can be recovered. 2. Remove and insert the CN3 connector on ACP(A). (To check the network condition between ACP(A) and CCH(A). If the fault remains, replace CCH(A).	Error to be detected and logged by ACP(A) for each car and to be indicated on TOD and CCH in Master Cab.
PIC(A#1) Error	PIC #1	FAULT UP (PIC #1)	PIC(A#1) Error (ONBOARD TEST is needed)	ACP(A) cannot receive the normal sounds where it's input from inside Mic of PIC(A#1), correctly.	1. Remove and Insert the CN2 connector on ACP(A). 2. Check cable connection between ACP (CN2) and PIC. 3. Swap the faulty PIC and the healthy PIC to see whether fault report is transferred to the log or not. 4. If the fault has been transferred, replace the PIC. 5. If the failure is not resolved even if you replace the PIC with a good one, ACP failure is suspected. Replace ACP(A)	Error to be detected and logged by ACP(A) for each car and to be indicated on TOD and CCH in Master Cab.
PIC(A#2) Error	PIC #2	FAULT UP (PIC #2)	PIC(A#2) Error (ONBOARD TEST is needed)	ACP(A) cannot receive the normal sounds where it's input from inside Mic of PIC(A#2), correctly.		Error to be detected and logged by ACP(A) for each car and to be indicated on TOD and CCH in Master Cab.

Table 8-5: TOA Fault List (cont'd.)

Fault/Status Name			Description of the Fault/Status	Cause of the Fault (if a Fault)	Corrective Action	Notes
Shown on TOD	**Shown on TOA CCH**	**Shown on TOA ACP internal log[*1]**				
ACP(A) Fault	PAIR CPU	FAULT UP (Pair CPU comm)	ACP(A) does not respond to the request from ACP(B)	ACP(B) cannot communicate with ACP(A). ACP(A) doesn't respond to the request from ACP(B).	1. Switch MCB ON/OFF to reset the system to see whether system can be recovered. 2. Remove and insert the CN1 and CN4 connector on ACP(A). (To check the network condition between two ACP(A) and (B).) If the fault remains, replace ACP(A).	Error to be detected and logged by ACP(B) for each car and to be indicated on TOD and CCH in Master Cab.
ACP(B) CF Card Content Error	CF DATA	FAULT UP (CF card data)	Missing file of ACP(B) CF setting	Data in the CF card is not correct.	1. Remove and insert the CF card. (Refer to Appendix B in RME manual) 2. Reload the data inside CF card. If the fault remains, replace ACP(B).	Error to be detected and logged by ACP(B) for each car and to be indicated on TOD and CCH in Master Cab.
ACP(B) IO Error	IO	FAULT UP (PIO unit comm)	Communication Error between CPU board and PIO board inside ACP(B)	The 485 communication between PCBs inside ACP(A) fails.	Replace ACP(B).	Error to be detected and logged by ACP(B) for each car and to be indicated on TOD and CCH in Master Cab.

Table 8-5: TOA Fault List (cont'd.)

Fault/Status Name			Description of the Fault/Status	Cause of the Fault (if a Fault)	Corrective Action	Notes
Shown on TOD	**Shown on TOA CCH**	**Shown on TOA ACP internal log[*1]**				
ACP(B) CCH Error	ACP-CCH	FAULT UP (CCH unit comm)	CCH(B) does not respond to the request from ACP(B)	ACP(A) cannot communicate with CCH(A).	1. Switch MCB ON/OFF to reset the system to see whether system can be recovered. 2. Remove and insert the CN3 connector on ACP(B). (To check the network condition between ACP(B) and CCH(B). If the fault remains, replace CCH(B).	Error to be detected and logged by ACP(B) for each car and to be indicated on TOD and CCH in Master Cab.
PIC(B#1) Error	PIC #1	FAULT UP (PIC #1)	PIC(B#1) Error (ONBOARD TEST is needed)	ACP(B) cannot receive the normal sounds where it's input from inside Mic of PIC(B#1), correctly.	1. Remove and Insert the CN2 connector on ACP(B). 2. Check cable connection between ACP(B) (CN2) and PIC. 3. Swap the faulty PIC and the healthy PIC to see whether fault report is transferred to the log or not. 4. If the fault has been transferred, replace the PIC. 5. If the failure is not resolved even if you replace the PIC with a good one, ACP failure is suspected. Replace ACP(B)	Error to be detected and logged by ACP(B) for each car and to be indicated on TOD and CCH in Master Cab.
PIC(B#2) Error	PIC #2	FAULT UP (PIC #2)	PIC(B#2) Error (ONBOARD TEST is needed)	ACP(B) cannot receive the normal sounds where it's input from inside Mic of PIC(B#2), correctly.		Error to be detected and logged by ACP(B) for each car and to be indicated on TOD and CCH in Master Cab.

Table 8-5: TOA Fault List (cont'd.)

Fault/Status Name			Description of the Fault/Status	Cause of the Fault (if a Fault)	Corrective Action	Notes
Shown on TOD	**Shown on TOA CCH**	**Shown on TOA ACP internal log[*1]**				
FDS(#1) Error	FDS #1	FAULT UP (FDS #1 comm)	FDS(#1) Error (Disconnection or Inside Error)	ACP(A) cannot communicate with FDS(#1).	1. Switch the system ON/OFF. 2. Remove and insert the connector. (To check the network condition.) FDS(#1): Port X9 of TOA Ethernet Switch#1 in A car. SDS(#1): Port X10 of TOA Ethernet Switch#1 in A car. 3. If the fault still remains, swap the faulty FDS/SDS with a healthy one to see whether fault report moves on the log or not. 4. If the fault moves, replace the FDS/SDS. 5. If the failure is not, other failures are suspected. The possibilities are as follows. (1) Power cable and communication line are broken; (2) Ethernet Switch or port failure; or (3) ACP failure. In either case, it is necessary to replace the applicable equipment and cable.	Error to be detected and logged by ACP(B) for each car and to be indicated on TOD and CCH in Master Cab.
SDS(#1) Error	SDS #1	FAULT UP (SDS #1 comm)	SDS(#1) Error (Disconnection or Inside Error)	ACP(A) cannot communicate with SDS(#1).		Error to be detected and logged by ACP(B) for each car and to be indicated on TOD and CCH in Master Cab.

Table 8-5: TOA Fault List (cont'd.)

Fault/Status Name			Description of the Fault/Status	Cause of the Fault (if a Fault)	Corrective Action	Notes
PIDS Controller (#1) Error	PIDS #1	FAULT UP (PID #1 comm)	PIDS Controller (#1) Error (Disconnection or Inside Error)	ACP(A) cannot communicate with PIDS(#1).	1. Switch the system ON/OFF. 2. Remove and insert the connector. (To check the network condition.) PIDS Controller(#1): Port X11 of TOA Ethernet Switch#1 in A car. 3. If the fault still remains, swap the faulty PIDS display with a healthy one to see whether fault report is moves on the log or not. 4. If the failure is not, other failures are suspected. The possibilities are as follows. (1) Breakage of VGA cable, power cable, and communication line; (2) VGA EXTENDER, VGA REMOTE UNIT failure; (3) PIDS controller failure; (4) Ethernet Switch failure / port failure; or (5) ACP failure. In either case, it is necessary to replace the applicable equipment and cable.	Error to be detected and logged by ACP(B) for each car and to be indicated on TOD and CCH in Master Cab.

Table 8-5: TOA Fault List (cont'd.)

Fault/Status Name			Description of the Fault/Status	Cause of the Fault (if a Fault)	Corrective Action	Notes
FDS(#2) Error	FDS #2	FAULT UP (FDS #2 comm)	FDS(#2) Error (Disconnection or Inside Error)	ACP(B) cannot communicate with FDS(#2).	1. Switch the system ON/OFF. 2. Remove and insert the connector. (To check the network condition.) FDS(#2): Port X9 of TOA Ethernet Switch#2 in B car. SDS(#2): Port X10 of TOA Ethernet Switch#2 in B car. 3. If the fault still remains, swap the faulty FDS/SDS with a healthy one to see whether fault report moves on the log or not. 4. If the fault moves, replace the FDS/SDS. 5. If the failure is not, other failures are suspected. The possibilities are as follows. (1) Power cable and communication line are broken; (2) Ethernet Switch or port failure; or (3) ACP failure. In either case, it is necessary to replace the applicable equipment and cable.	Error to be detected and logged by ACP(B) for each car and to be indicated on TOD and CCH in Master Cab.
SDS(#2) Error	SDS #2	FAULT UP (SDS #2 comm)	SDS(#2) Error (Disconnection or Inside Error)	ACP(B) cannot communicate with SDS(#2).		Error to be detected and logged by ACP(B) for each car and to be indicated on TOD and CCH in Master Cab.

Table 8-5: TOA Fault List (cont'd.)

Fault/Status Name			Description of the Fault/Status	Cause of the Fault (if a Fault)	Corrective Action	Notes
PIDS Controller (#2) Error	PIDS #2	FAULT UP (PID #2 comm)	PIDS Controller(#2) Error (Disconnection or Inside Error)	ACP(B) cannot communicate with PIDS(#2).	1. Switch the system ON/OFF. 2. Remove and insert the connector. (To check the network condition.) PIDS Controller(#1): Port X11 of TOA Ethernet Switch#1 in A car. 3. If the fault still remains, swap the faulty PIDS display with a healthy one to see whether fault report is moves on the log or not. 4. If the failure is not, other failures are suspected. The possibilities are as follows. (1) Breakage of VGA cable, power cable, and communication line; (2) VGA EXTENDER, VGA REMOTE UNIT failure; (3) PIDS controller failure; (4) Ethernet Switch failure / port failure; or (5) ACP failure. In either case, it is necessary to replace the applicable equipment and cable.	Error to be detected and logged by ACP(B) for each car and to be indicated on TOD and CCH in Master Cab.

Table 8-5: TOA Fault List (cont'd.)

Fault/Status Name			Description of the Fault/Status	Cause of the Fault (if a Fault)	Corrective Action	Notes
TOAE Network Error (TOD will possibly display various equipment errors)	NW SW#1 or NW SW#2 (TOA CCH will possibly display various equipment errors)	FAULT UP (ETHER SW #A) or FAULT UP (ETHER SW #B) (TOA ACP internal log will possibly display various equipment errors)	IFU(B) cannot communicate with ACP(A) or ACP(B)	There is malfunction inside network pass between IFU and ACP(A) or ACP(B). Cause of the fault will be Ethernet switch or cables. IFU change the status of this bit as error to notify the faulty condition inside TOAE network.	1. Check actual fault status on screen of CCH(A) and (B) 2. Follow the instruction of listed fault. 3. Switch ON/OFF the system to see whether system can be recovered. 4. Remove and insert the connectors at the equipment shown in CCH screen If fault remains, replace relevant equipment for TOAE network.	Serious Failure, e.g. Communication Error with current equipment
IFU Error	IFU	FAULT UP (Interface BOX)	Disconnect communication between two CPUs inside IFU	The CPU for RTC network cannot communicate with another one for TOAE network. (Note: This fault will be detected at only RTC network side. And it's sent to MDS)	Replace IFU.	Serious Failure, e.g. Communication Error with current equipment
Error with TCNA connection	TCNA	FAULT UP (TCN comm)	TOAE Network does not receive the MVB0103 and 0151 port status.	IFU(B) cannot communicate with the TCNA. And ACP(A) or (B) cannot receive the status from TCNA for operation.	1. Switch ON/OFF the system to see whether system can be recovered. If the fault remains, follow the troubleshooting for TCN.	Communication Error with the equipment located in Car side Network
Error with TCNB connection	TCNB	FAULT UP (TCN comm)	TOAE Network does not receive the MVB 2441 port status.	IFU(B) cannot communicate with the TCNB. And ACP(A) or (B) cannot receive the status from TCNB for operation.	2. Switch ON/OFF the system to see whether system can be recovered. If the fault remains, follow the troubleshooting for TCN.	Communication Error with the equipment located in Car side Network

Table 8-5: TOA Fault List (cont'd.)

Fault/Status Name			Description of the Fault/Status	Cause of the Fault (if a Fault)	Corrective Action	Notes
Not shown	MDS	FAULT UP (MDS comm)	IFU (B) cannot communicate with MDS.	IFU(B) cannot communicate with the MDS.	1. Switch ON/OFF the system to see whether system can be recovered. If the fault remains, follow the troubleshooting for MDS. 1.	Communication Error with the equipment located in Car side Network
Error with RIO(A) connection	RIOA	FAULT UP (RIO #A comm)	RIO A SIDE Communication Error	IFU(B) cannot communicate with the RIO(A). And ACP(A) or (B) cannot receive the status from RIO(A) for operation.	2. Switch ON/OFF the system to see whether system can be recovered. If the fault remains, replace the unit.	Communication Error with the equipment located in Car side Network Note *2
Error with RIO(B) connection	RIOB	FAULT UP (RIO #B comm)	RIO B SIDE Communication Error	IFU(B) cannot communicate with the RIO(B). And ACP(A) or (B) cannot receive the status from RIO(B) for operation.	1. Switch ON/OFF the system to see whether system can be recovered. If the fault remains, replace the unit.	Communication Error with the equipment located in Car side Network Note *2
No Route Set	"ROUTE" button blinks	FAULT UP (No Route Set)	The Operator does not set the Route by TOA CCH and the train starts running	The Operator does not set the Route by TOA CCH Display before the train starts running.	1. The Operator sets the Route via TOA CCH at the next station with doors open.	Operation Error
The master ACP cannot determine the order of train IDs	N/A	FAULT UP (Train ID)	Incorrect combination pattern of TAIL Relay Information	When the train consists of 3 cars and Master Key is ON, there is no car that Tail End Relay is active or there are multiple cars that Tail End Relay are actives.	1. Confirm each TCN and Head or Tail Relay condition.	Incorrect Information of TAIL Relay Note *3

Note *1: If a fault is reset, the ACP internal log records “FAULT RECOVER (xxxx)”.

Note *2: The RIOB and RIOA Faults may occur occasionally in operation, single RIO Fault that clears itself within 2 seconds does not require any further investigation or corrective action and is not treated as a real fault. If there is continues Set and reset more than 3 times then it needs to be treated as a real fault and further investigation is required.

Note *3: For the TrainID fault, when 2 car consist is coupled with a single car to Make a 3 car, TrainID fault will be seen. When the Active cab (due to coupling is not lead cab) becomes the Lead car the fault will clear.

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APPENDIX

DRAWINGS

Radio Control Panel Wiring Diagram
Horn Control Wiring

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