Metro

P3010
Los Angeles LRV

COMMUNICATIONS

Section 1400
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Insert latest changed pages; dispose of superseded pages in accordance with applicable regulations.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 (1400) is **194** consisting of the following:

Original ..... 0 ..... October 2020
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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 Vehicle Management System (VMS).

The communication equipment, the monitoring and diagnostic equipment, the vehicle network equipment, the exterior signs, and CCTV system **all** utilize the Ethernet network 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 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. By design, most devices on the network are Commercial Off-the-Shelf (COTS) devices that are integrated into the network. This provides a means of dealing with equipment obsolescence issues in the future by providing an easy path to upgrade over the life of the LRV. In most modules there are no user serviceable parts.

This chapter covers four topics:

- Communications (PA, IC, Automatic Announcements, Passenger Interior Displays, Radio Interface),
- Exterior Destination Signs,
- Horn,
- Wayside Worker Alert System.

The 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
ACM	Acoustic Module
ACP	Audio Control Panel
ACP1A	Audio Control Panel 1A
ACP1B	Audio Control Panel 1B
CCH	Communication Control Head
CCTV	Closed Circuit Television
CCU	Communication Control Unit
cm	Centimeter
COTS	Commercial Off-the-Shelf
DA	Digital Acoustics
EEI	Enhanced Ethernet Interface
ER	Event Recorder
ESNA	Elastic Stop Nut Division
ETH	Ethernet
GPS	Global Positioning System
GS	Gong Switch
HS	Horn Switch
IAADS	Independent Automatic Announcement System
IC	Intercom
in.	Inch
kg.	Kilogram
LACMTA	Los Angeles County Metropolitan Transportation Authority
lbs.	Pounds
LED	Light Emitting Diode
LRV	Light Rail Vehicle
MDS	Monitor and Diagnostic System
mHz	Megahertz
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
PTT	Push-to-Talk
PTU	Portable Test Unit
RIO	Remote Input / Output
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
VoIP	Voice Over IP
WTB	Wired Train Bus
WWAS	Wayside Worker Alert System

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CHAPTER 2.0

FUNCTIONAL DESCRIPTION

The Communication System consists of functions controlled by the Communication Control Unit (CCU) and the A-End IAADs / PIDs controller along with additional functionality provided by stand-alone devices. The following sub-sections provide information on the functions of the Communication System based on the device(s) responsible.

The communication equipment, the monitoring and diagnostic equipment, the vehicle network equipment, the exterior signs, and CCTV system all utilize the Ethernet network on the vehicle for signaling control and 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 WTB / MVB network signals are bridged into the Ethernet network to provide additional signals to Ethernet connected devices. RIO Modules (Remote Input / Output) devices are used to collect signals and place them on the network.

The proper operation of the communications system is extremely dependent upon network connectivity and proper software installation. By design, most devices on the network are Commercial Off the Shelf (COTS) devices that are integrated into the network to provide a means of dealing with equipment obsolescence issues in the future by providing an easy path to upgrade. The unique aspect is the software and the integration of the devices. Figure 2-1 shows a top level of the Ethernet connected devices in the VMS (Vehicle Management System) General Block Diagram.

2.1 Communication System

2.1.1 Communication Control Unit (CCU)

The Communication System is controlled by the Communication Control Unit (CCU). The CCU is physically a “box computer”, located in the A-Cab electric locker, and the IAADS controller located in the cab ceiling of the A-End. The CCU and the IAADS controller provide all the communication system control functionality, including the Communication Control Head (CCH) functionality via the TOD and control switches on the console. Inside the console is a RIO module that collects push button and switch state and places it on Ethernet network. Audio Control Panels are located in both the A and B end electric lockers. The audio control panels contain modules that digitize audio and discrete switch signals for play (amplification) and control. Generally, the CCU controls trainline audio functions and the IAADS controls local audio automatic announcements.

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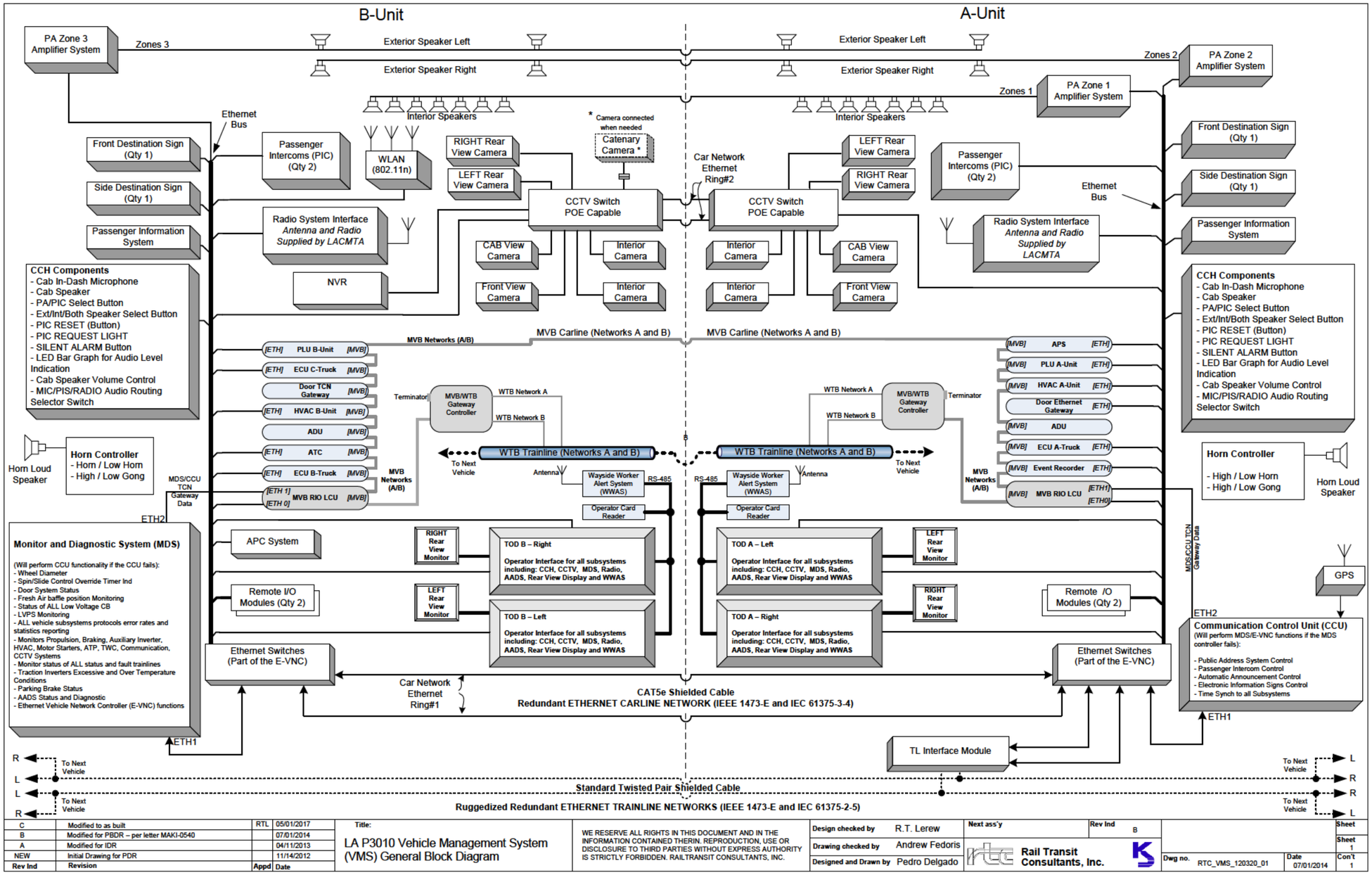


Figure 2-1: VMS General Block Diagram

The following are the functions controlled by the CCU:

- In-Dash microphone interface to the CCH 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 TOD 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 TOD (“canned messages”),
- Vehicle operator interface to the Communication System modes of operation via the TOD and console buttons,
- Vehicle two-way Radio audio system interface with the vehicle PA system,
- Synchronization of time and date for all subsystems,
- Provides location coordinates (from the GPS) to all subsystems as required.

The Independent Automatic Announcement (IAADS) and Passenger Information Display controller, located on the A-End in the cab ceiling, locally controls via the TOD HMI:

- 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,
- Synching of announcements via GPS and Door opening status,
- Skip Station functionality.

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

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

This priority scheme means that announcements or activities that have a higher priority will take precedence (override) a lower priority item.

The Communication Control Head group provides the operator interface to the vehicle communication system. This interface is accomplished via a panel on the console that groups the communications controls and selected TOD screens. The CCH provides the following resources and functionality to the operator:

- Train Operator Display screens – right side,
- Route Selection from TOD,
- In-Dash Microphone,
- PA/PIC/Radio Call Selection,
- PIC Operation control and indication,
- Silent Alarm Operation,
- Cab Speaker Volume Control (part of the TOD screen),
- Audio Routing (PIC/PA/RADIO - Audio Routing Selector Switch),
- Exterior/Interior/Both Speaker Selection,
- Push to Talk via the foot switch and a PTT button on the operator console,
- High/Low Gong and High/Low Horn operation.

The Push-to-Talk (PTT) button on the Operator console and the foot switch are provided for redundancy and convenience to the Operator. The PTT button and the foot switch have the same functionality. These buttons can be used to mute automatic announcements due to the priority control scheme.

The Train Operator Display touch screen provides soft button controls for Route Selection, Skip Station, PTT, PIC Control, and trainline prerecorded announcements and other functionality used by other subsystems. The right-side TOD is typically used for Communications Control.

The Silent Alarm is initiated by a push button on the console. This supplies an input to the radio to send a signal to ROC. Additionally, an input via the RIO in the console is used to log the silent alarm and a silent alarm light is illuminated on the vehicle.

The distance signal used by the announcements originates in the propulsion control electronic equipment where it is transmitted, via the Ethernet network on the car, to the CCU where it is interpreted and used to mark distance used for station spacing and waypoint determination.

2.1.3 Public Address (PA) Function

The PA equipment implements the following functions:

- One-way communications of automatically triggered pre-recorded audio and visual announcements to all passengers via the IAADS controller locally,
- One-way communications of manually TOD pushbutton triggered pre-recorded audio announcements to all passengers on a trainline basis,
- One-way voice communication (PA) from the Operator in the active cab 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.

The CCU system controller circuitry contains all the control circuitry to process the digital audio from the other communication system components and the speaker zone selection. The system provides each vehicle with multiple zones to direct audio to the interior speakers, the left side exterior and right side exterior speakers separately, thus offering, flexibility in PA operation modes. For this application, the exterior speaker zones are routed together. This means that both Right and Left exterior zones work together as “Exterior”.

The CCU audio is transmitted digitally on a trainline basis for a multiple vehicle consist via the Ethernet network. Once the route is selected, the IAADS Controller, on each LRV in the consist, is utilized to provide local automatic announcements, interior display control and exterior sign control. The IAADS system synchs each time the doors are open and/or by a GPS geo fence signal.

2.1.4 Passenger Intercom (PIC) Operation

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 lighted 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 TOD Communication screen will also flash the soft “PIC Answer” button.

To answer the call, the Operator typically touches the flashing IC soft button on the TOD or can move the console selector momentary switch to “IC”, then after acknowledging the call, presses and initiates the communication to the passenger by activating the foot switch, the PTT button on the console, or the TOD’s soft “PIC Answer” button (the TOD button light and the PIC station button light will be flashing until the Operator answers the call). 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 and the TOD’s soft “PIC Answer” button lights will be solid until the Operator ends the call.

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 TOD’s soft “PIC Answer” button again. If the Operator selects to answer an incoming Radio communication during a PIC call, the PIC station will be placed in a queue until the Operator returns to the PIC mode by selecting the “IC” mode. The Radio communication has priority over the PIC calls.

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. In this case, the station that first initiates a PIC call will be connected to the Operator when the “IC” mode is selected. All other stations will be placed in a queue. When connected to a PIC station, moving the console selector switch back to the “IC” position or pressing the TOD’s soft “PIC Answer” button again will disconnect this station. The operator must move the selector switch to “IC” to service the next station in the queue. If an automatic announcement is triggered while the PIC mode is selected by the Operator, it will broadcast to the passengers but it will not be heard over the Cab Speaker. The conversation between the Cab Microphone and the PIC, and PA Systems are controlled by the PTT or the foot switch.

2.1.5 Passenger Information System (PIS)

The Communications Control Unit (CCU) provides the control of the Passenger Information System controller. Data and canned message sound files are stored in the CCU control rack and in the IAADS controller. They can be updated by direct connection to the car network via the Portable Test Unit (PTU). Sound files and route files are compiled using the ***Route Configuration Programming Guide*** which provides instructions on how to prepare route files and audio files.

The Independent Automatic Announcement and Passenger Information Display controller (IAADS), located in the A-End cab ceiling electric locker, locally controls, via the TOD HMI, upon route selection the following:

- 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,
- Synching of announcements via GPS and Door opening status,
- Skip Station functionality.

The B-End Passenger Information Display (PID) controller, located in the B-End cab ceiling electric locker, controls the display of the station route list on the B-End PID Displays.

2.2 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. All four signs receive their commands from the TOD via the on-board Ethernet network. There is a maintenance screen on the TOD that can be used to drive test patterns to the exterior signs. The manufacture of the signs is Teknoware.

2.2.1 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 100 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 Control Cab TOD.

- Color Route Code Display PCB – A single PCB containing an LED matrix that displays the route code transmitted by the Control Cab TOD.

- 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 IAADS 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

2.2.2 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 thirteen 4 in. (10 cm) characters. Up to 100 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 TOD.
- Color Route Code Display PCB – A single PCB containing an LED matrix that displays the route code transmitted by the TOD.
- 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 TOD 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

2.3 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. See Figure 2-3. 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.

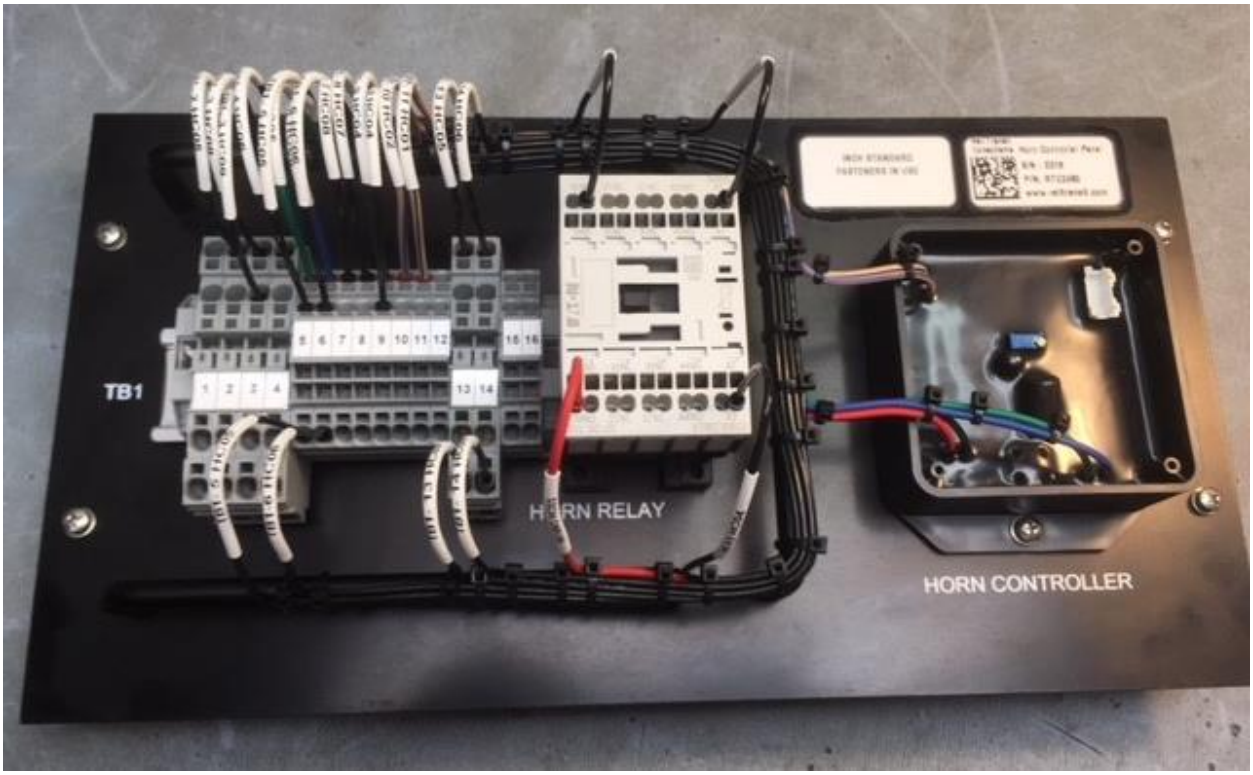


Figure 2-3: Horn Control Panel

2.4 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 following items make up the WWAS hardware.

Table 2-1. 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	

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 2-4 shows the system configuration.

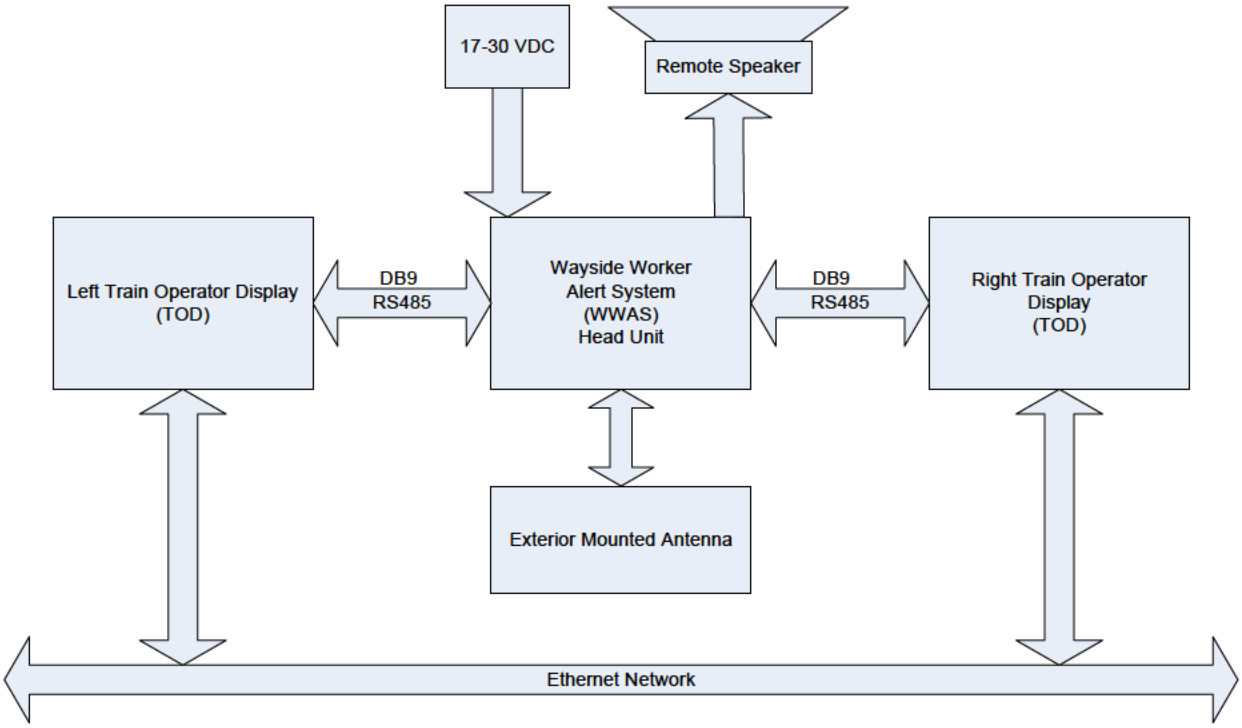


Figure 2-4: Wayside Worker Alert System Configuration Block Diagram

2.4.1 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. 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.

2.4.2 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.

The WWAS meets all of the following criteria derived from the technical specification.

Table 2-2. 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

Figure 2-5: ProTran WWAS Train Device

Figure 2-6: ProTran Antenna (Side View)

2.5 Radio

The Radio is supplied by Metro and is the responsibility of the Metro Communications department. The radio power supply, antenna, and interface to the vehicle is covered in this manual. Contact Rail Comms for radio and radio programming issues. 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 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. The radio output can be routed to the PA system via an ACM Module located on the ACP (Audio Control Panel). A Master Key Switch contact is used to provide the ignition sense required by the radio. The antenna is a whip style tuned to the Metro Frequencies.

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.

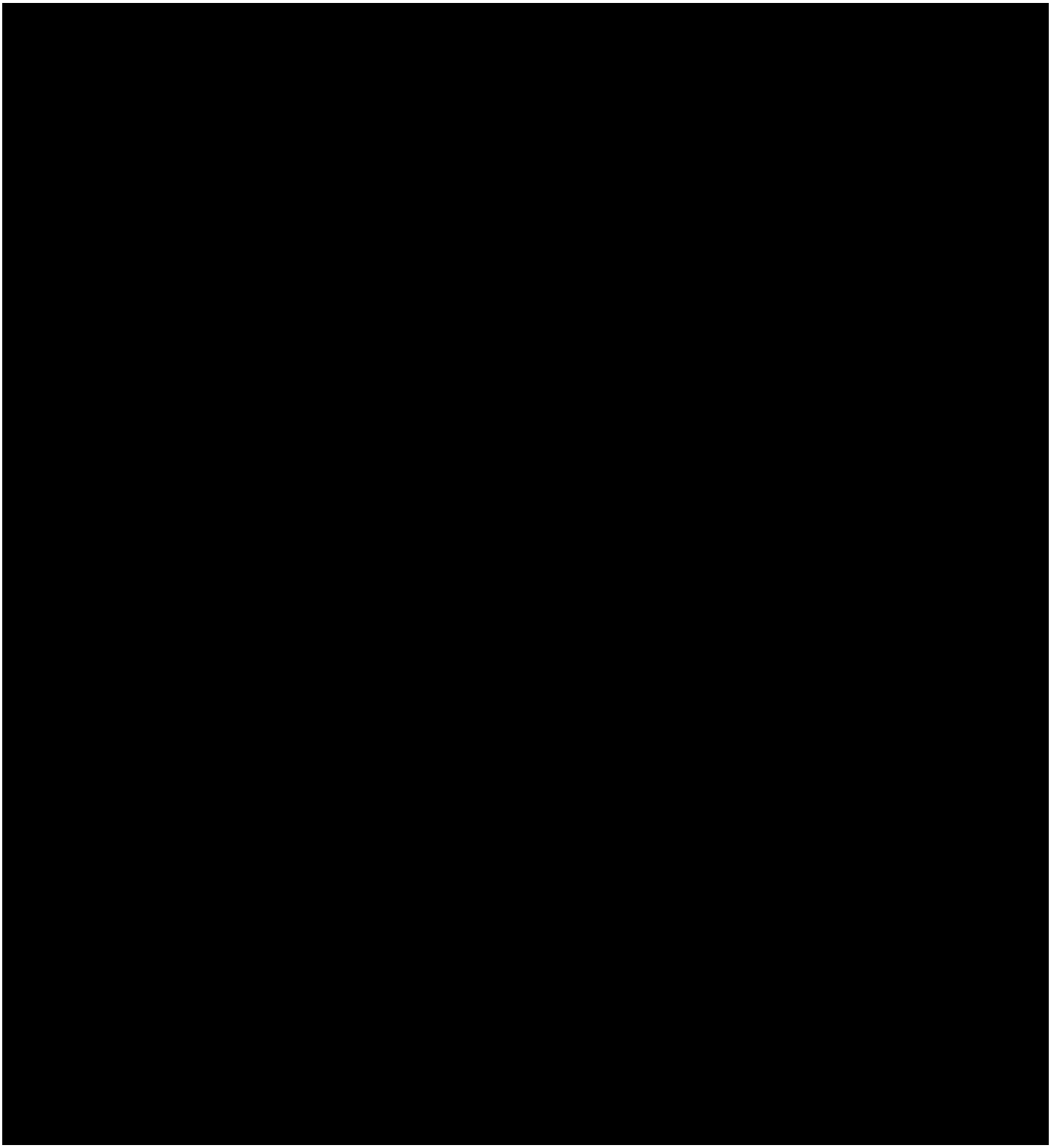
The cab and radio paging speakers are the same model number. The radio paging speaker and radio paging interconnect is described in the Cab Speaker Section of this document. The audio from the radio is connected into the Ethernet system via the IP7 module as shown below.

[redacted]

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.

Figure 2-7: Radio Power Supply

A wiring diagram of the radio control panel and associated equipment follows.



2.6 Key Equipment Used to Execute the Communications System Functionality

In order to execute the functionality described above there are certain pieces of equipment utilized that are connected via the Ethernet network. They include:

- CCU / MDS Computer
- IAADS / PIDS A-End Controller
- PIDS Controller B-End
- ACP Panels (A/B End Cab Lockers)
- PIC (4 places in passenger compartment)

Generally, the purpose of this equipment is to generate and route audio to various devices within the communication system and to control signs. The MDS computer also is used to collect, store, and present fault or activity data from the smart subsystems on the vehicle.

The CCU acts as an audio router for the cab microphone, stored general messages that are broadcast across the consist, PIC, and the radio. The CCU also performs routing of the audio to the selected speaker(s) based on switch input or selected activity (eg. Doors Close, PA/PTT, inside/outside/both).

The IAADS / PIDS controller plays prerecorded station announcements and public service announcements to the interior speakers while controlling the Passenger Information Displays in the vehicle. Audio from the IAADS controller is played locally on each car in a consist through an Audio Control Module Located in the ACPA (Audio Control Panel A-End). Audio from the IAADS has lowest priority and can be suppressed by audio routed from the CCU to the interior speakers.

The PIDS Controller routes visual messages from the IAADS to the PIDs displays in the interior passenger compartment of the LRV. There are 4 PIDs displays located on the cab and articulation walls.

The ACPs (Audio Control Panels) contain ACM or Audio Control Modules manufactured by Digital Acoustics (DA) that are used to digitize audio for VOIP communications over the Ethernet network. There are two types of ACMs utilized:

- IP7-ST-RT (low power)
- IP7-SS40-RT (40-Watt output)

The IP7-ST-RT is used for microphone input, single speaker output, PICs and Radio input. The IP7-SS40-RT are amplifier modules that drive the Interior Speakers, and Left and Right Exterior speakers. Two modules are used for the Interior speakers. One is used for trainline announcements from the CCU and the other is used for automatic announcements from the IAADs controller. The output to the Zone 1 interior speakers is arbitrated by an audio relay included on the A-End ACP. The automated announcements have lowest priority. Zone 1 is the interior speakers audio zone. The audio relay senses audio output from the CCU or the IAADS and gives priority to the CCU audio over the automatic announcements following the prioritization scheme specified.

The PIC (Passenger InterCom) mounted in the passenger compartment is used to communicate with the Operator on a trainline basis. The Speaker/Mic is connected to an ACM on the Audio Control Panel. Analog audio is transmitted or received by the speaker where it is input/output from the ACM2/3 Module(s). The ACM Module converts digital to analog or analog to digital for connection to Ethernet network where it is routed to the lead cab speaker and mic for control by the PTT.

A detailed interconnect diagram is shown in Section 2.7. This diagram is a network diagram that show the major control devices, switches, and the ACMs responsible for audio routing. This is an IP system. Interconnects are typically Ethernet multi-conductor cables.

2.7 Detail System Diagram

2.8 Communications System Components

2.8.1 CCU Diagram

The CCU Application is performed by two components: the CCU Controller and the Ethernet Remote I/O Module. The CCU Controller is based on the MenMikro Box Computer BC50M. This controller is compliant with the EN50155, and designed for mobile applications. The IAADS / PIDs controller (A-End) provides local station announcement, PIDs and sign control on each car.

Additionally, the Ethernet Remote I/O Module is Moxa's ioLogik E1512-T.

The CCU Application connections necessary to meet the LACMTA P3010 CCU functional requirements are shown in the following block diagram:

2.8.2 CCU Equipment

The CCU/MDS computer is a “box computer” with no user serviceable parts. The CCU provides the control of the audio components on a trainline basis. It routes audio from the cab mic to the passenger compartment. See Figures 2-11 and 2-12.

Figure 2-11: CCU / MDS Computer

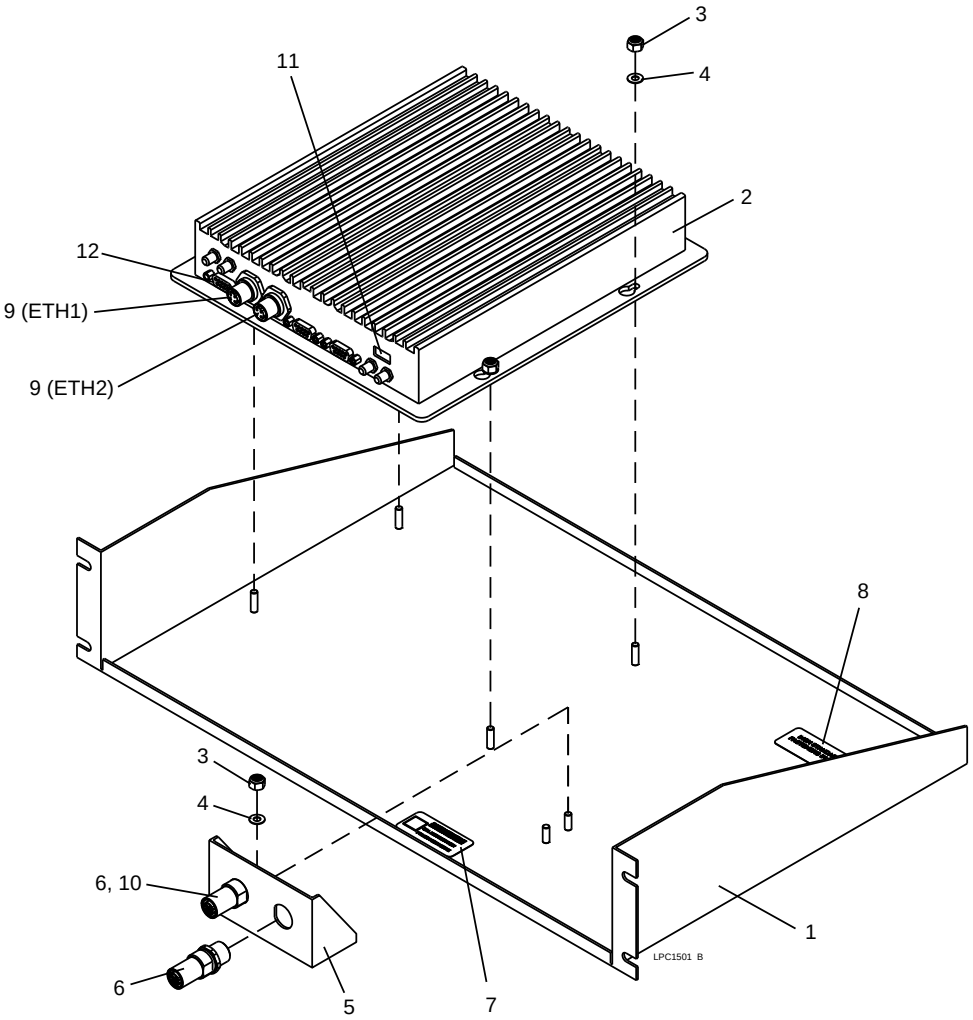
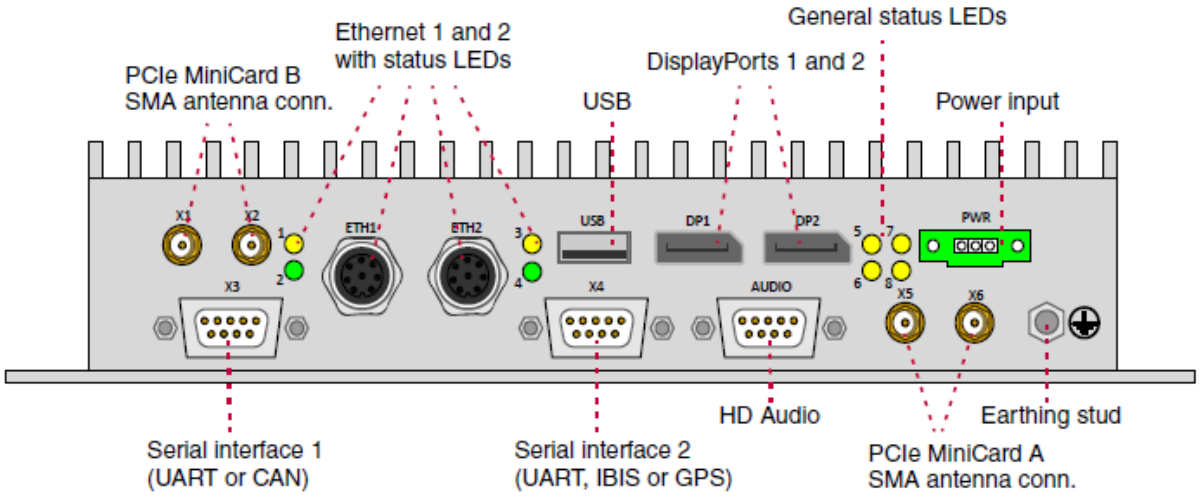


Figure 2-12: CCU / MDS Assembly

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.

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.



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.

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.

2.8.3 IAADS / PIDs Subsystem

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 controller runs an application program that is used to display station text, connecting information and public service messages based on triggers from the IAADS program running on the A-End PIDS. The route files are loaded on the A-End IAADS / PIDS Controller.

The IAADS / 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 A-End controller which provides the IAADS / PIDs control while the B-End controller provides the PIDs control for the B-End monitors. 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, including the updated trip times.

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.

Examples of a typical screen layout is shown below.

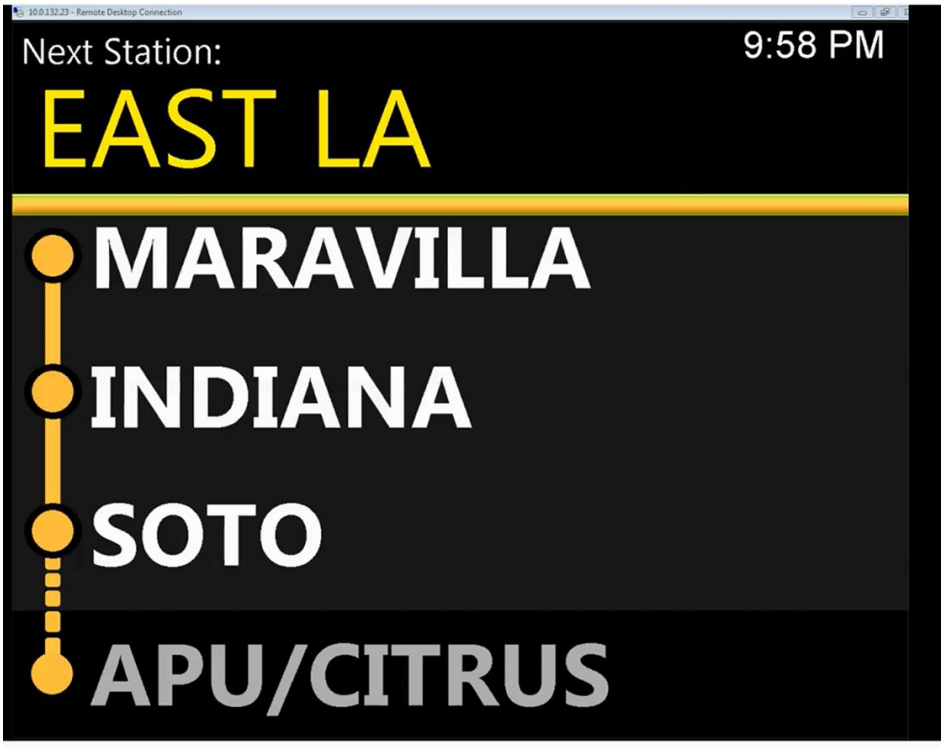


Figure 2-13: Typical Screen

2.8.3.1 IAADS / PIDS Controller

The Independent Automatic Announcement System and Passenger Information Display Controller (IAADS / PIDs controller (A-End)) provides local station announcement and controls both audio and the displays based on a route file, PIDs and sign control on each car. The IAADs / PIDs Controller is located in the cab ceiling. There are no user serviceable parts. Route files are located in the IAADs / PIDs controller.

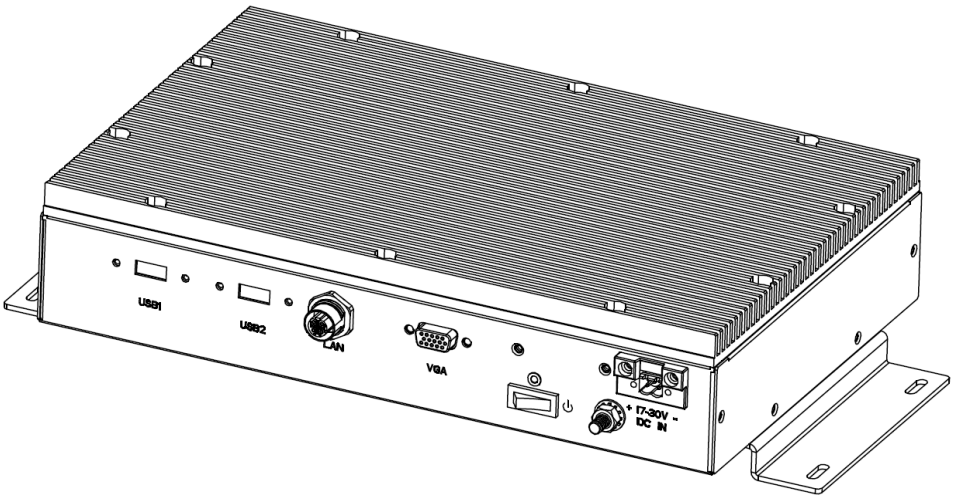


Figure 2-14: Controller

2.8.3.2 PIDs Controller

The PIDs Controller located in the B-End cab ceiling is physically the same as the IAADS / PIDs controller in the A-End cab ceiling. Only software differs on the units. Software is installed on the device via the PTU. Programming instructions are provided in the ***Communications Equipment Programming Guide*** provided separately.

2.8.3.3 PIDs Displays

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 2-15. 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)

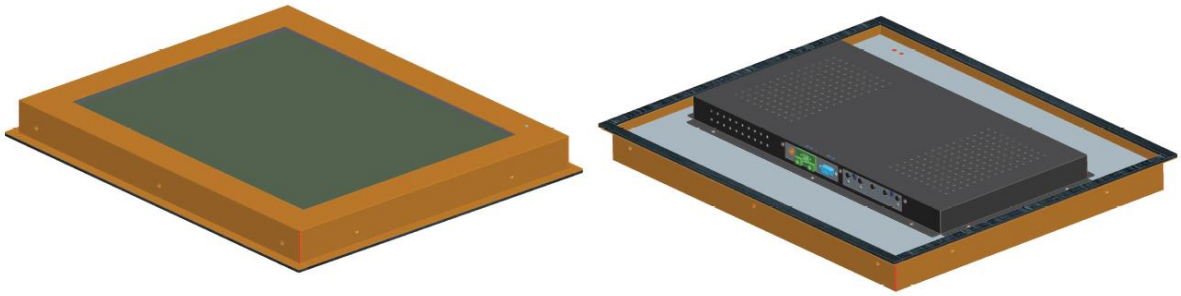


Figure 2-15: PIDs Displays

2.8.3.4 Route File Configuration Utility

Sound files and route files are compiled using the ***Route Configuration Programming Guide*** which provides instructions on how to prepare route files and audio files. These files are installed on the A-End IAADS / PIDS Controller device via the PTU. Programming instructions are provided in the ***Communications Equipment Programming Guide,*** provided separately.

2.8.3.5 VGA Extender

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.

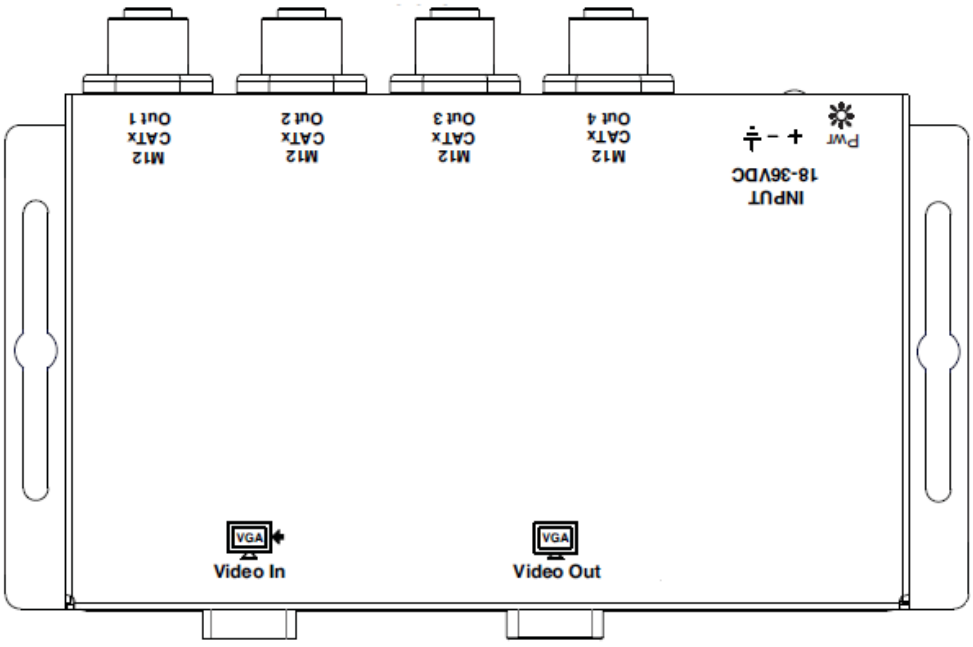


Figure 2-16: VGA Extender (Transmit)

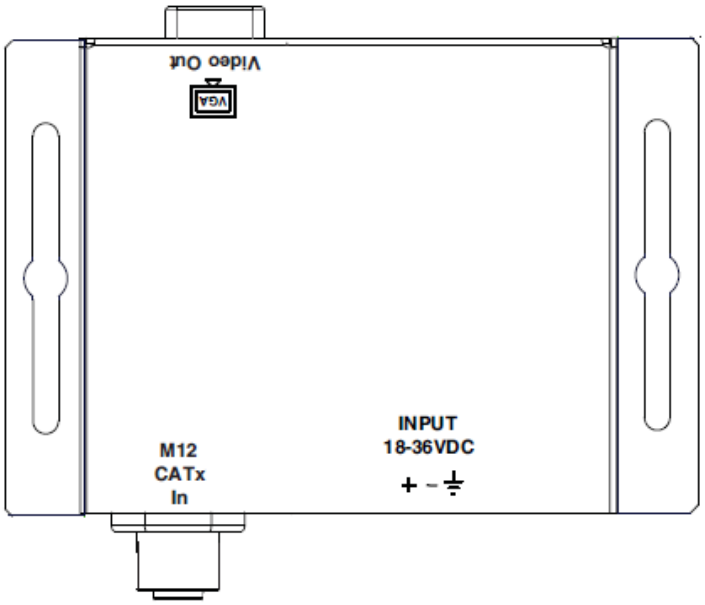


Figure 2-17: VGA Extender (Receive)

2.8.4 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 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).

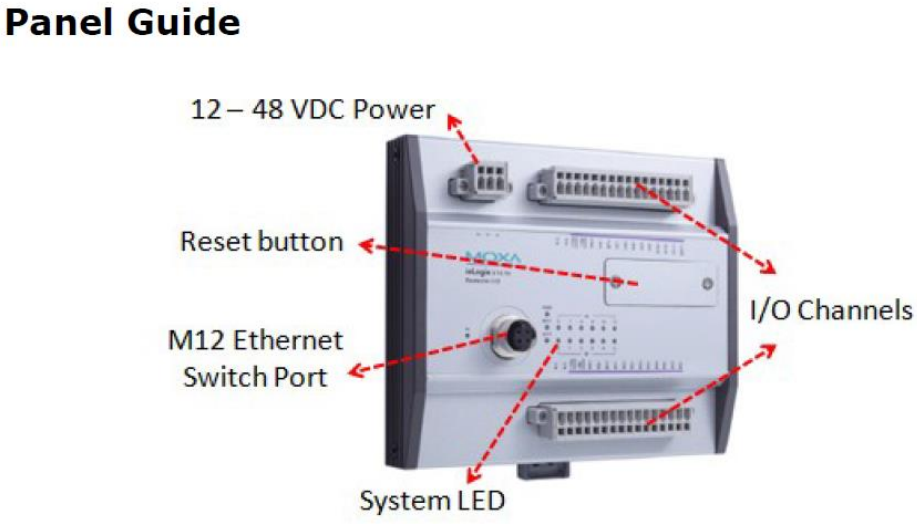


Figure 2-18: Ethernet Remote I/O Module Drawing

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.

2.8.5 Audio Control Panels

2.8.5.1 Audio Control Panels General Description

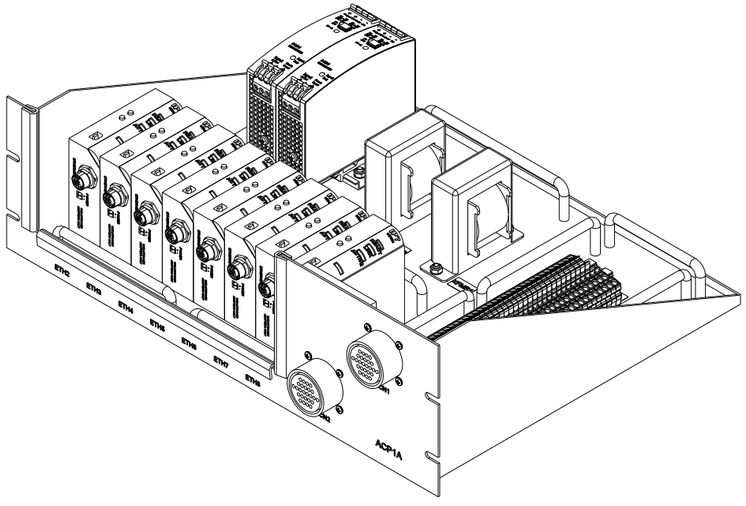
The P3010 audio communication is based on Voice over IP (VoIP) technology. The VoIP modules are located in two 19-inch rack enclosures. These enclosures are the Audio Control Panel 1A and 1B (ACP1A and ACP1B).

The ACPs are an assembly of ACM (Audio Control Modules) manufactured by Digital Acoustics. Transformers (70.7 V) for driving the interior and exterior speakers and redundant power supplies. Additionally, ACP1A has an audio control relay mounted in it that is used to arbitrate between the local automatic announcements via the IAADS controller and the trainline audio from the CCU computer. There are two types of ACM modules. The IP7-SS40-RT and the IP7-ST-RT. These modules are the primary conversion device that is used to change analog audio to digital signals for transmission on the Ethernet network or to change digital signals to analog signals for play by speakers. The control (i.e. audio routing) is via the CCU software functionality.

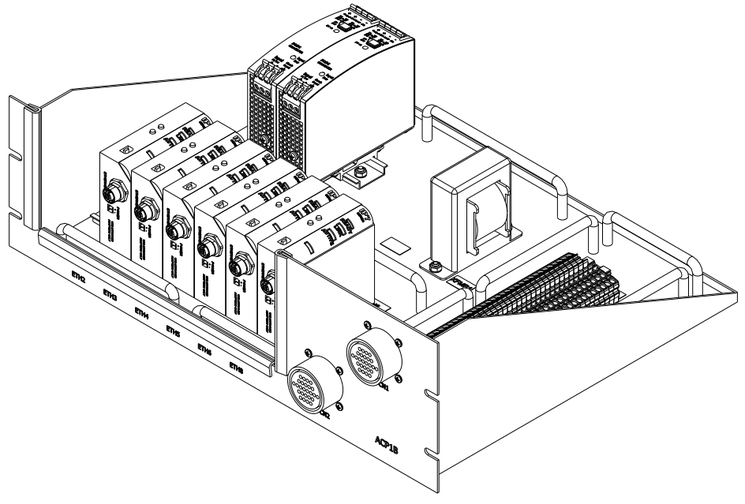
The following table shows the VoIP module allocation and function for each panel and DIP Switch setting for IP&-ST-RT modules:

Table 2-3. VoIP Module Allocation

Audio Control Panel 1A (ACP1A) A-Unit VoIP Modules			
Module Identifier	Description	Device Model	DIP SW
ACM1	Play Audio to PA Interior Speakers Zone via IAADS	IP7-SS40-RT	---
ACM2	Passenger Intercom 1A (PIC1A) - two-way Audio	IP7-ST-RT	ST
ACM3	Passenger Intercom 2A (PIC2A) - two-way Audio	IP7-ST-RT	ST
ACM4	Receive In-Dash Microphone Audio A-Cab	IP7-ST-RT	MIC
ACM5	Received Audio from the Radio A-Cab	IP7-ST-RT	MIC
ACM6	Play Audio to A-Cab Speaker	IP7-ST-RT	MIC
ACM7	Play Audio to PA Interior Speakers Zone via CCU	IP7-SS40-RT	---
ACM8	Play Audio to PA Right Exterior Speakers Zone	IP7-SS40-RT	---
Audio Control Panel 1B (ACP1B) B-Unit VoIP Modules			
Module Identifier	Description	Device Model	DIP SW
ACM2	Passenger Intercom 1B (PIC1B) - two-way Audio	IP7-ST-RT	ST
ACM3	Passenger Intercom 2B (PIC2B) - two-way Audio	IP7-ST-RT	ST
ACM4	Receive In-Dash Microphone Audio B-Cab	IP7-ST-RT	MIC
ACM5	Received Audio from the Radio B-Cab	IP7-ST-RT	MIC
ACM6	Play Audio to B-Cab Speaker	IP7-ST-RT	MIC
ACM8	Play Audio to PA Left Exterior Speakers Zone	IP7-SS40-RT	----



ACP1A (A-End)



ACP1B (B-End)

Audio Control Panel w/ Audio Relay Shown

ACP1A (A-End Audio Control Panel with Audio Control Relay)

Figure 2-19: Audio Control Panels

There are four LED indicators on the Modules that provide an indication of the state of the module. This is applicable to both types of modules.

- The blue LED indicates that the IP7 ACM has powered up. If the blue LED is the only illuminated indicator, this indicates that the firmware has been corrupted and the unit should be returned for repair.
- The three red LEDs indicate the status of the unit. See the following table.
- Two pushbuttons are provided to increase or decrease volume. These should not be used. Volume is set via a configuration file that is automatically downloaded to the ACMs. Pressing both buttons simultaneously for >5 seconds restores the ACM to the factory default settings. The unit will then need to be reconfigured to reset it back to the configuration for proper operation on the P3010 vehicles.

LED	Description
Ready	Indicates whether the unit has connected to a Server
Link	Indicates whether the unit has a valid network connection
Active	Indicates when audio is being received or transmitted

Table 2-4. LED Status Table

Description	Ready	Link	Activity
Normal operation mode. Unit can communicate with the server.	On	On	Off
Playing Audio (operation can be checked when audio is triggered)	On	On	Flashing
Playing Broadcast Audio	Fast Flash	On	Flashing
Attempting to connect to make a connection or the unit has not been configured (reconfigure module)	Flashing	On	
LAN connection is inactive or connection wiring issue (check LAN connection, wiring, or connector loose)	Flashing	Off	

2.8.5.2 IP7-ST-RT Module

The Digital Acoustics IP7-ST-RT is an IP (Internet Protocol) based Intercom that provides the functional audio equivalent of the basic "push to talk" intercom. The unit supports a single transducer speaker that also can be used as a MIC. It is applied using DHCP compliant IP assignment. A M12 Connector is used for Ethernet connection.

Figure 2-20: Digital Acoustics ST-RT and SS40-RT Series Module Photograph

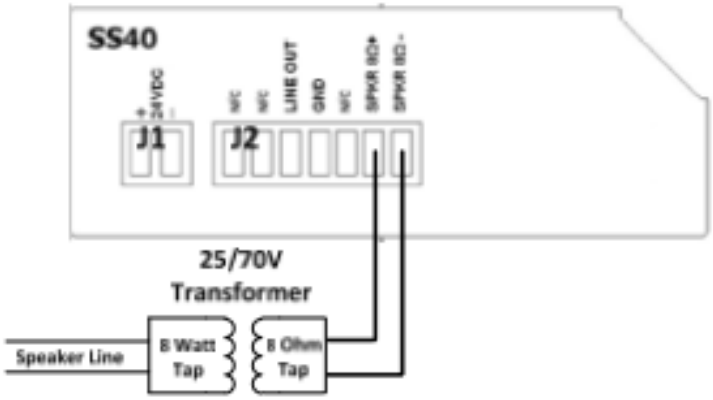
Refer to Table 2-4 above for specific application(s) of this module.

Please note that if a PIC module is being replaced or recommissioned as a MIC or Speaker type module, the unit MUST be set to the correct mode ST or MIC via the physical switch behind the DIN rail bracket on the Module (ST = PIC Configuration, MIC=all others). If this is not done correctly, the modules WILL NOT operate properly. Use a pencil tip to move the recessed switch to the **ST** position (towards the DIN Mounting Clip) when using as a PIC. Move the switch to the **MIC** positon (towards the edge of the case) for all other applications.

Figure 2-21: Speaker Connect Diagram

2.8.5.3 IP7-SS40-RT Module

The Digital Acoustics IP7-SS40-RT is an IP (Internet Protocol) amplifier that provides up to 40 watts of audio output. The SS40 is used to drive the interior and exterior speakers connected to a 70.7 V audio distribution line transformer. The unit output is 40 watt audio power with short circuit protection. DHCP IP assignment is from the network switch.



2.8.5.4 ACP Power Supply

Two redundantly isolated wired 24 to 24 Vdc power supplies are mounted to the ACP to provide an isolated source of power to the Audio system. There are no user serviceable parts. LEDs are provided to indicate DC OK (output voltage) and Input Low (monitor input voltage).

A Input terminals
Screw terminals
+ Positive input
- Negative (return) input
Chassis ground: can be used to bond the housing to PE
Ground this terminal to minimize high-frequency emissions.

B Output terminals
Screw terminals, dual terminals per pole, both pins are equal
+ Positive output
- Negative (return) output Screw terminals

C Output voltage potentiometer
Open the flap to set the output voltage. Factory set: 24.1V

D DC-OK LED (green)
Monitors the output voltage, which is produced by the DC/DC converter itself and is on when the voltage is higher than 90% of the adjusted output voltage.
DC-OK lamp and DC-OK contact functions are synchronized

E Signal terminals
Plug Connector for DC-OK and Input-low relay contact

F Input-low LED (yellow) see also chapter 13.
On when the input voltage is between 4Vdc and 20Vdc..
Input-low LED and Input-low contact functions are synchronized

Figure 2-22: DC/DC Power Supply

2.8.5.5 ACP Transformer

Impedance matching transformers (70.7 V) are provided to provide a constant voltage drive of the interior and exterior speakers. The transformer is provided an audio signal from the ACMs for each zone rated for an 8 ohm 40 Watt source and proves a constant voltage 70.7 output to the speakers. Speakers are tapped for proper loudness (sound level). The interior speakers are tapped at 1 Watt. This value was selected to give the proper sound level on the interior of the vehicle. The exterior speaker setting on the dial is set to position 4 to ensure the proper loudness. Refer to Section 2.8.7 of this manual section.

The wiring is connected as follows: Connect the Black 8Ω and the White COM leads from the transformer to the (SPKR 8Ω+ and SPKR 8Ω-) on the IP7 (polarity independent). Connect the Black 70V and Red COM to the speaker distribution line. See ACP panel wiring for the specific applications of the transformer to the interior and exterior speakers, Zones 1, 2 and 3. The wiring diagrams are included at the end of this manual.

2.8.5.6 Audio Relay

On ACP1A an audio control relay is utilized as part of the Audio Control Circuitry to establish priority of trainline line audio generated from the controlling CCU computer over the local IAADS / PIDs controller which generates automatic station and public service announcements locally. The relay is a ST-ACR1 which senses line input and transitions to direct the appropriate audio to the Zone 1 (interior speakers) transformer. The relay is adjusted to typical line level for switching. The delay is adjusted to minimize release.

Figure 2-23: Audio Controlled Relay

Two adjustment screws are located on the relay. The SENS adjustment should be set to mid-range to avoid relay chattering and the DELAY adjustment should be set for the minimum delay. These relays are factory set and should not need readjustment.

The output to the Zone 1 interior speakers is arbitrated by an audio relay included on the A-End ACP. The automated announcements have lowest priority. Zone 1 is the interior speakers audio zone. The audio relay senses audio output from the CCU or the IAADS and gives priority to the CCU audio over the automatic announcements following the prioritization scheme specified.

If the relay is out of adjustment, the SENS adjustment should be set to mid-range to avoid relay chattering. On car this can be done by observing the LED adjacent to the terminal entry below the SENS potentiometer. The red led is dimly lit when power is applied to the relay. Depress the foot switch PTT (engaging the console mic) and adjust the potentiometer until the LED is brightly lit. Release the foot pedal and verify that the LED is dimly lit.

The DELAY adjustment should be set for the minimum delay by gently turning DELAY potentiometer screw counter clock wise 25 turns or until it reaches the end of its travel.

2.8.5.7 Programming the ACP(s)

The ACM (Digital Acoustics Module) mounted to the ACPs require programming to set their configuration. A utility program is provided to commission the ACMs. Modules can be used for driving speakers, receiving audio from microphones and radio audio. Modules are also used to amplify and drive speakers. There are two types of modules used in an ACP. The utility program is used to commission both types. The commissioning utility sets the ACM I/P address for its function (i.e. mic listening mode, paging speaker, amplifier), default gain, enable automatic gain control, and assigns a friendly name. The program provides an input screen to input car number and a button to start the initialization process. It runs automatically to set up the ACMs.

The Configuration Program is supplied with the PTU. This program can perform the following functions:

- Commission a Digital Acoustics Audio Module
- Commission all the Digital Acoustics Audio Modules at once
- Play audio through a Digital Acoustics Audio Module
- Reset a Digital Acoustics Audio Control Module

Programming the ACP panels is covered in a separate ACP Configuration Utility Manual. It is provided to provide detailed instructions on ACP panel programming.

2.8.6 Passenger Intercom (PIC) Station

Passenger Intercoms are provided at four places in the passenger compartment. They are controlled by an ACM module that controls the speaker/mic and the indicator light pushbutton.

2.8.6.1 PIC Layout

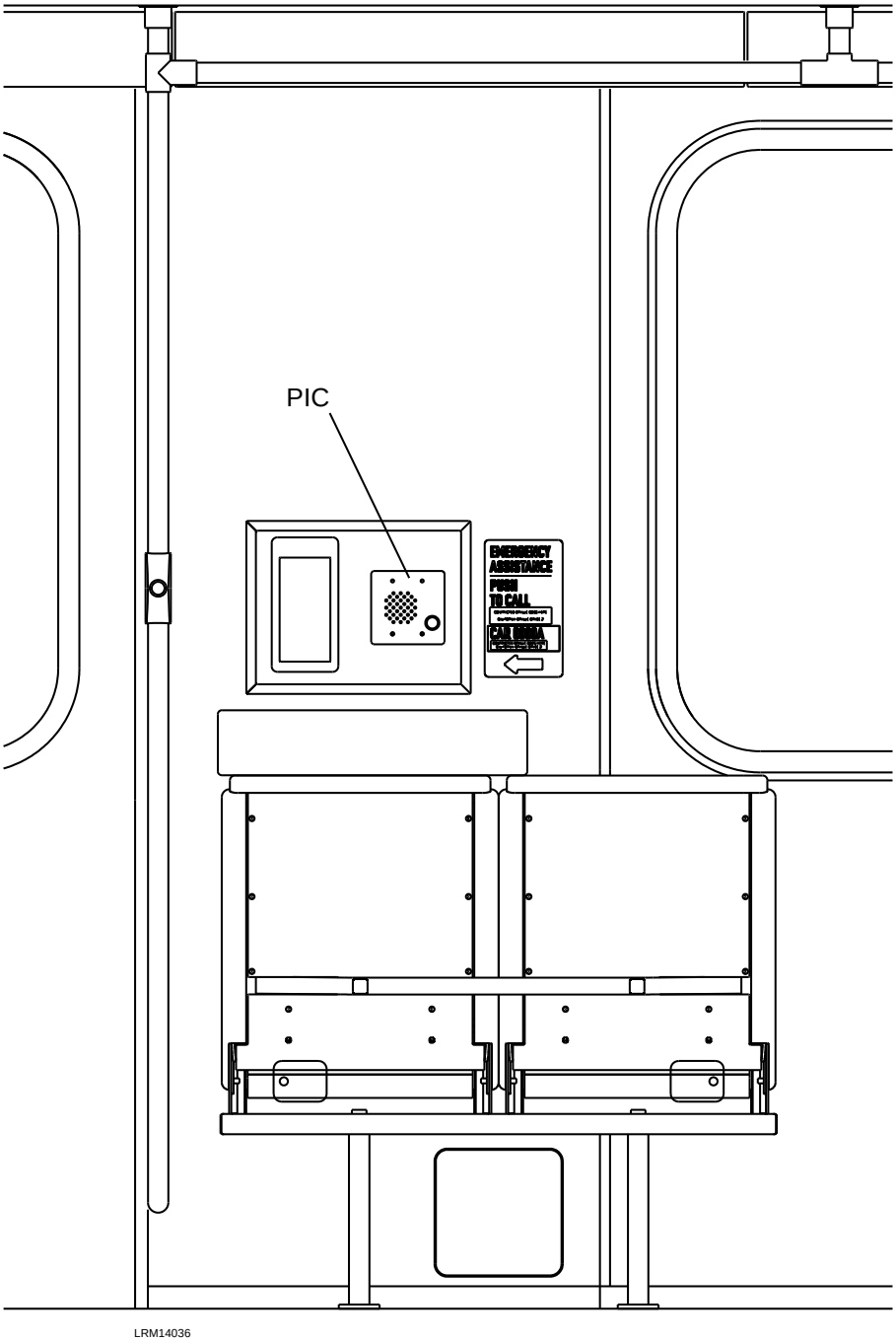


Figure 2-24: Passenger Intercom Station

2.8.6.2 PIC Interconnect Diagram

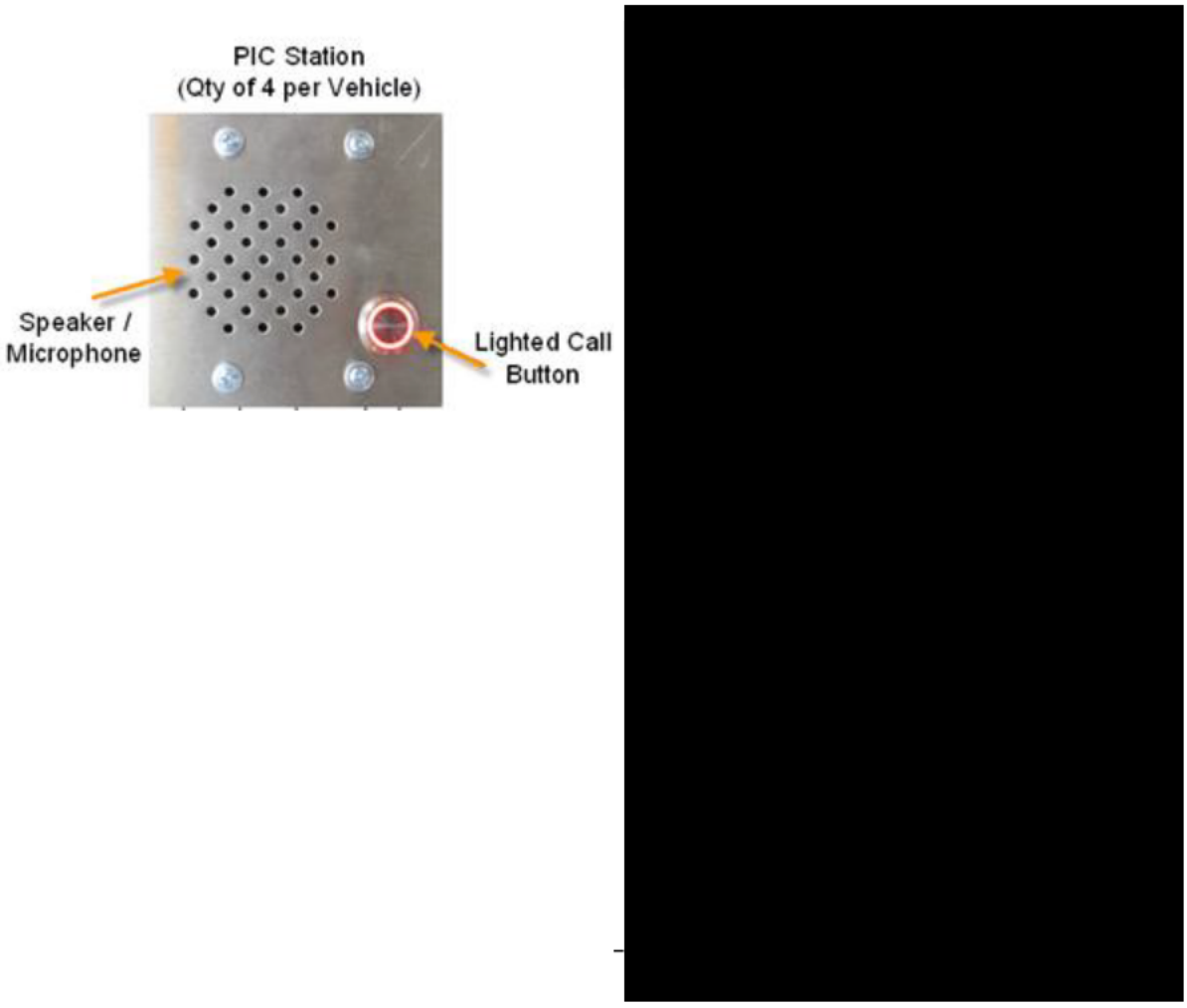
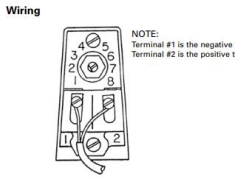


Figure 2-25: Passenger Intercom Station Interconnect Diagram
(Refer to Vehicle Schematic for Actual Wiring)

2.8.7 Exterior Speaker

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

2.8.8 Interior Speaker

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.

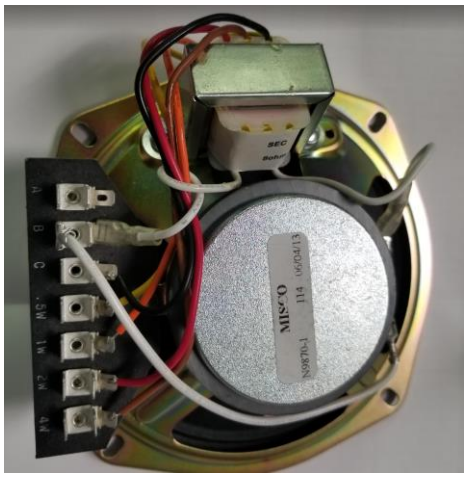
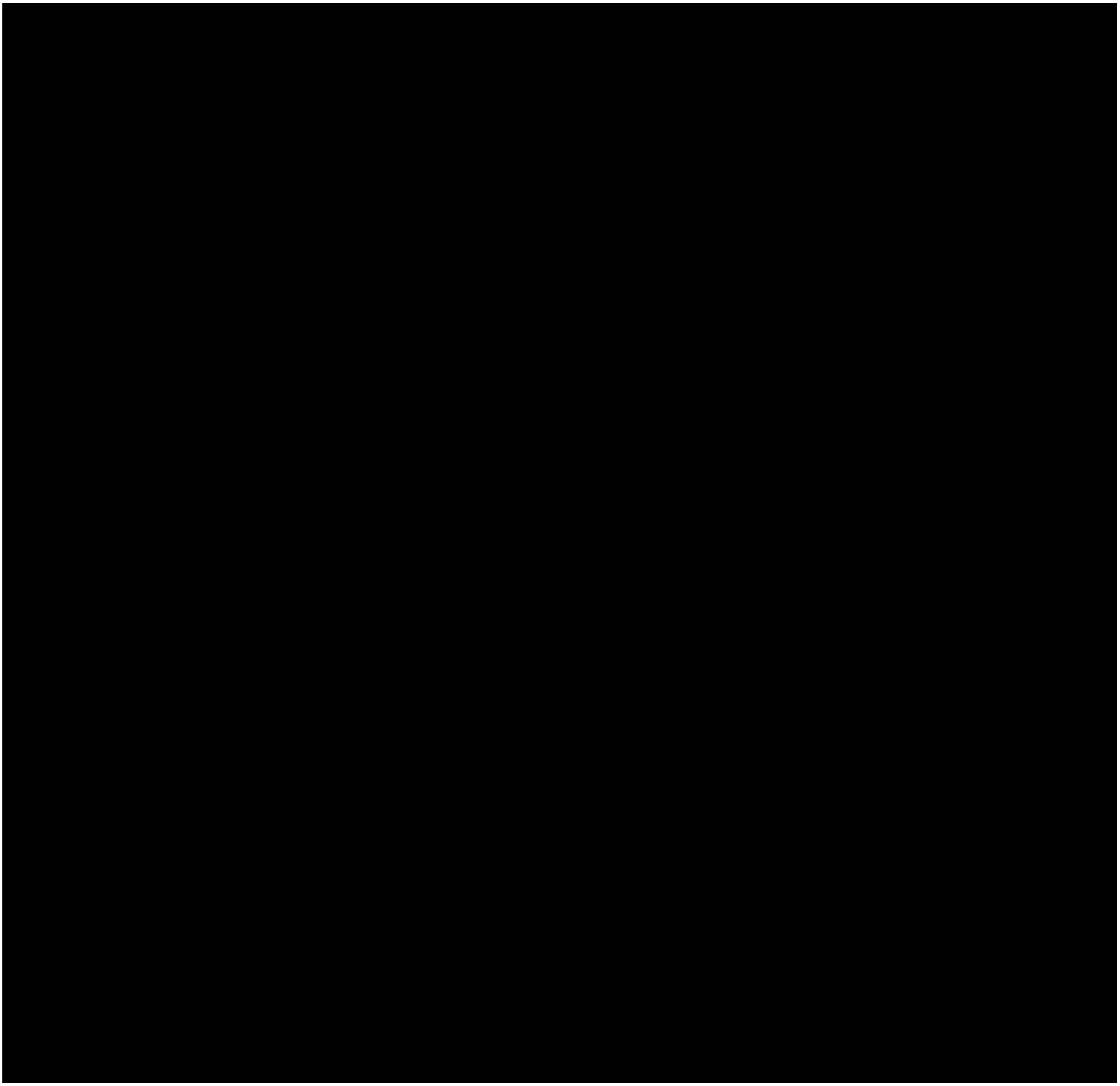


Figure 2-26: Interior Speaker

2.8.9 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 IP7-ST module.



2.8.11 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.

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

2.8.12 Global Position 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 9.5 of this manual section.

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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 Communications System

3.2.1.1 Communication Control Unit (CCU) Panel

There is one CCU located in the right side electric locker on the A-Unit. See Figures 3-1 and 8-1.

3.2.1.2 Audio Control Panel (ACP1A)

There is one Audio Control Panel 1A (ACP1A) located in the right-side electric locker on the A-Unit. See Figures 3-1 and 8-2.

3.2.1.3 Audio Control Panel (ACP1B)

There is one Audio Control Panel 1B (ACP1B) located in the right-side electric locker on the B-Unit. See Figures 3-1 and 8-3.

3.2.1.4 Radio

There is one Radio in each A and B-Unit cab. See Figures 3-1 and 8-4. It is located in the cab ceiling. The Radio Power Supply provides power to the radio equipment. The radio monitor speaker is located in the cab ceiling.

3.2.1.5 Passenger Information Display

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. The interior passenger information display displays the next three stations and the terminal station. The displays are driven by the IAADS / PIDs controller on the A-End and the PIDs Controller on the B-End. The controllers are mounted in the cab ceiling. The displays are VGA monitors that are sourced by the controller and a video extender / receiver module that supplies video to the articulation PIDs displays. See Figures 3-2 and 8-5.

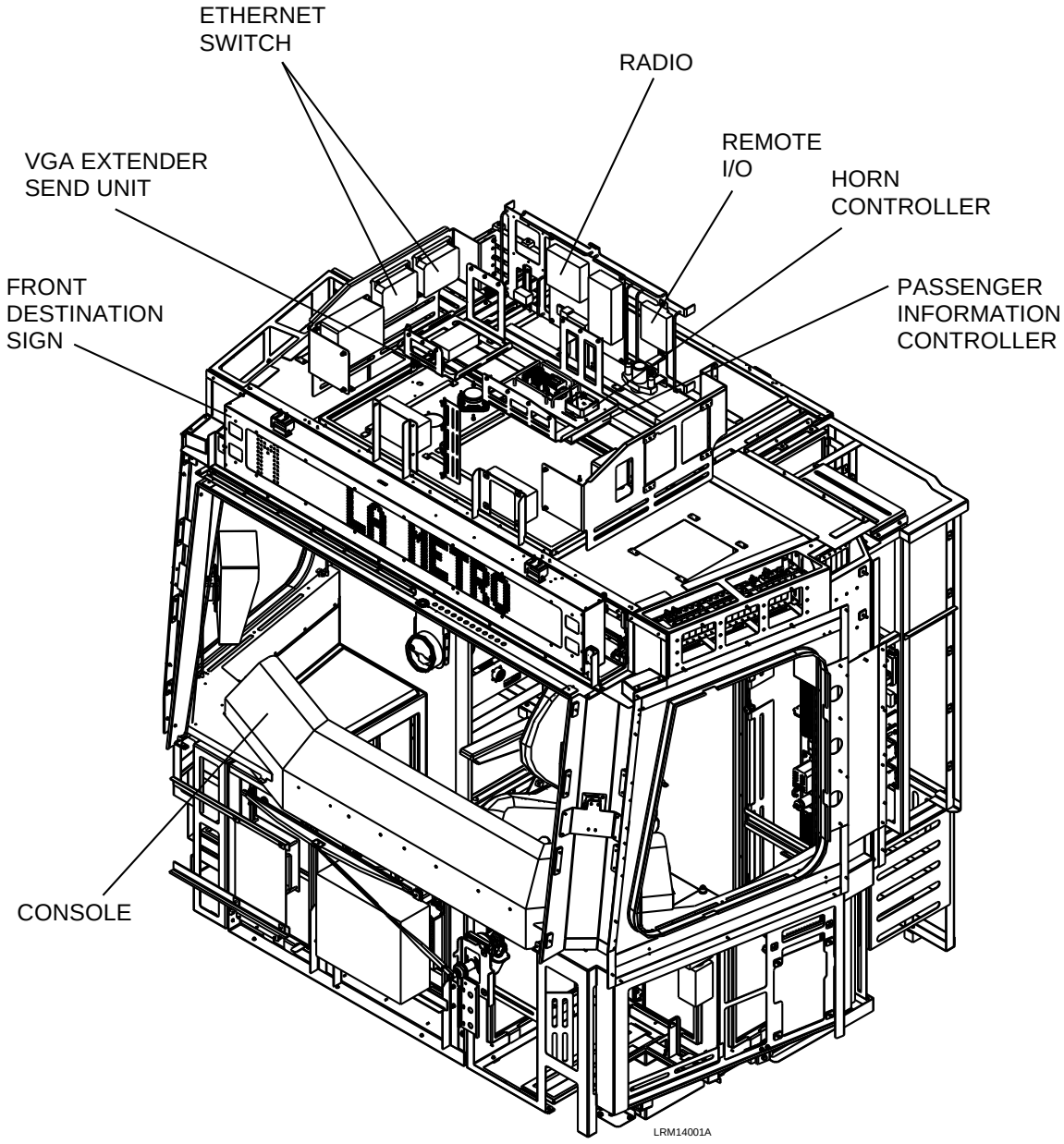


Figure 3-1: Communication Equipment Location
(Sheet 1 of 3)

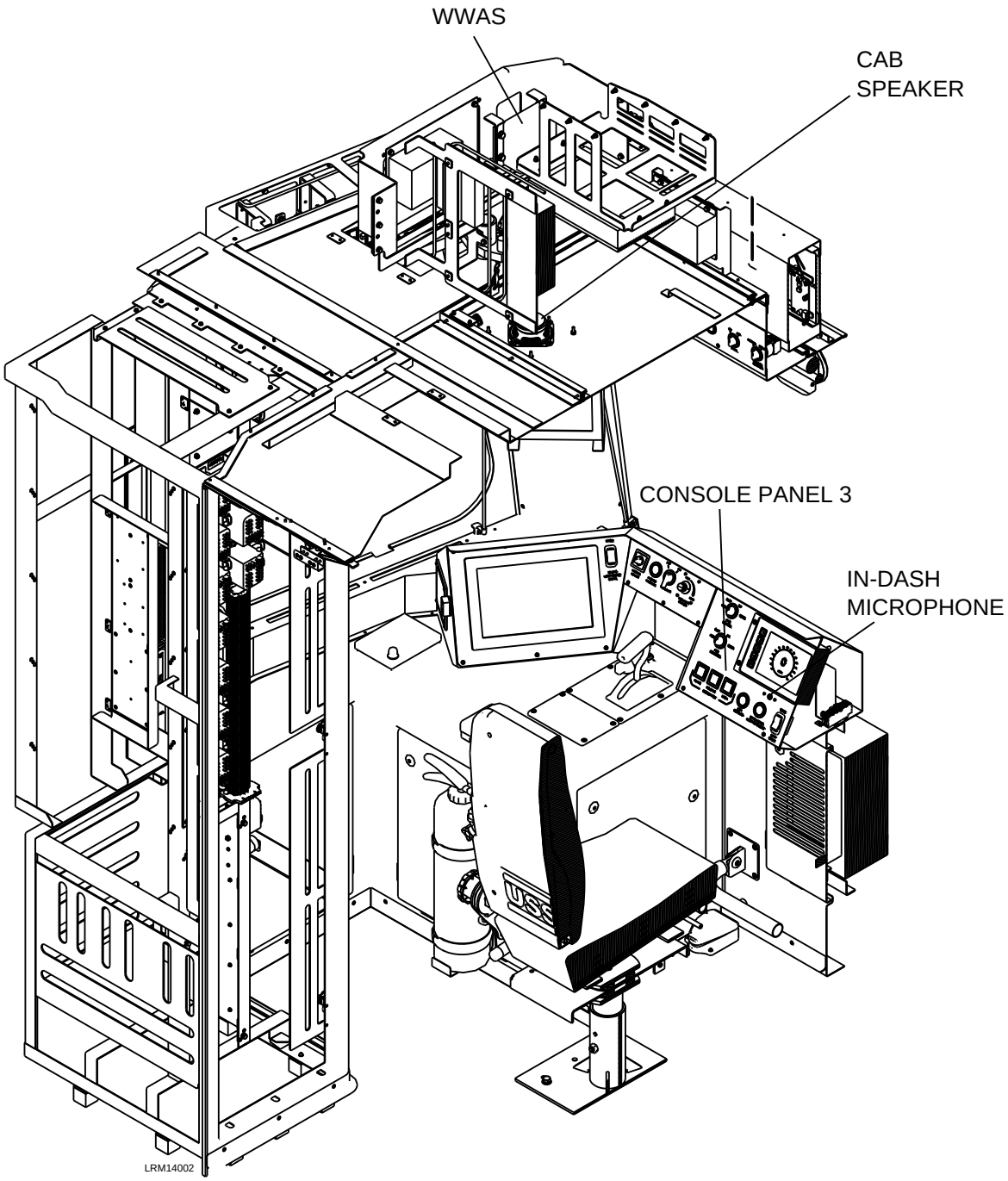


Figure 3-1: Communication Equipment Location
(Sheet 2 of 3)

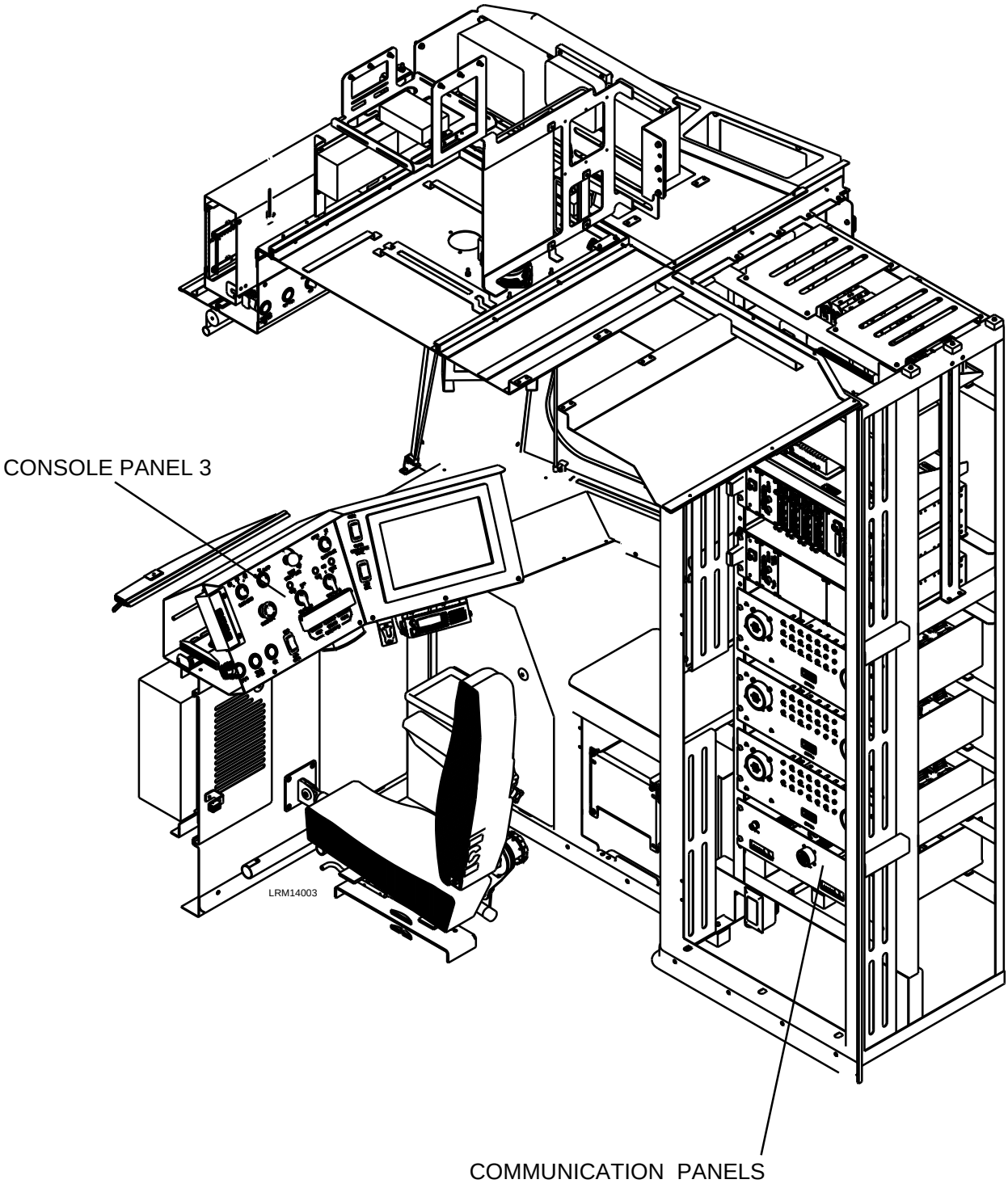


Figure 3-1: Communication Equipment Location
(Sheet 3 of 3)

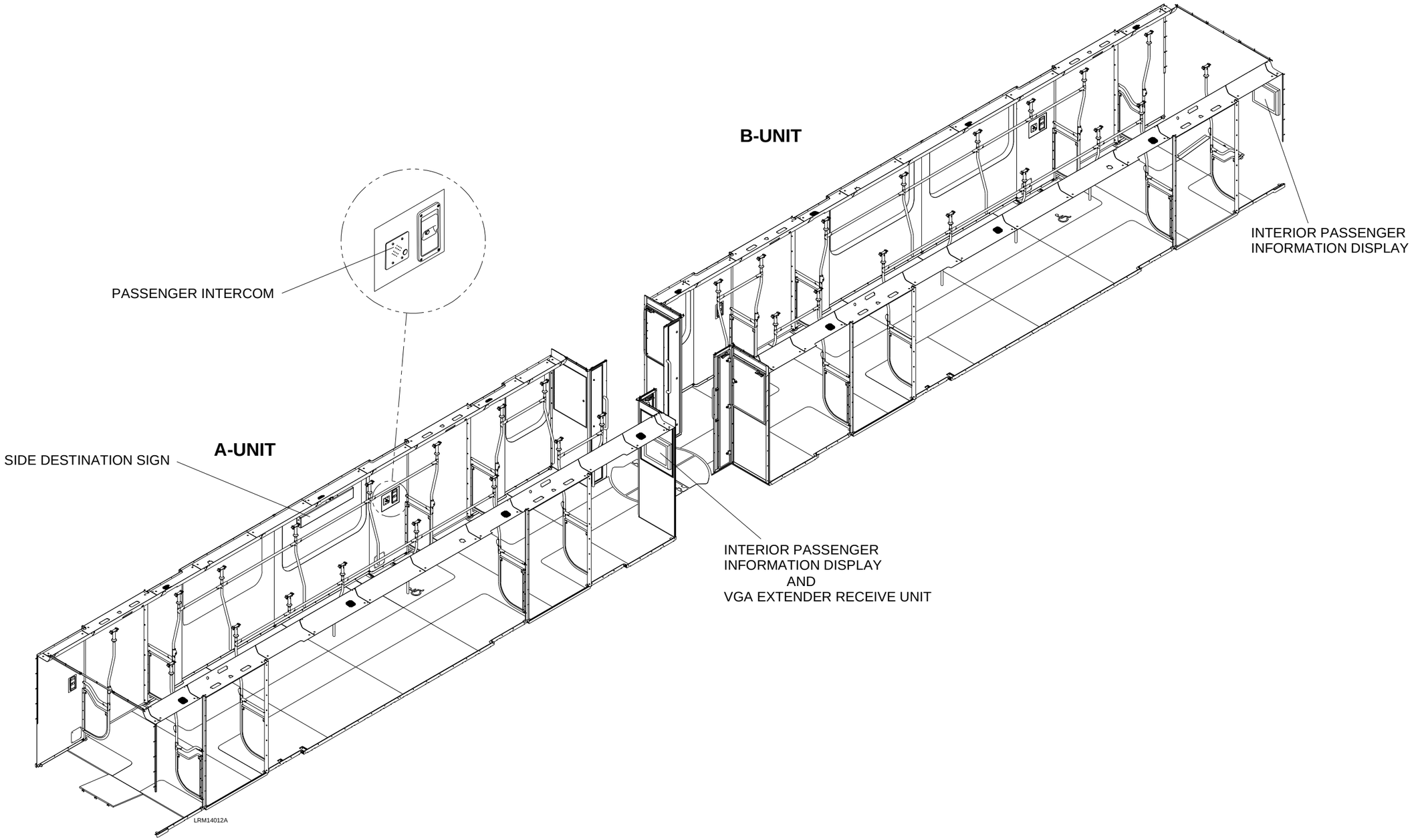


Figure 3-2: Interior Communication Equipment Locations

3.2.1.5.1 VGA Extender Receive Unit

There are two VGA Extender Receive Units per car. One located at each articulation Passenger Information Display. See Figures 3-1 and 8-6.

3.2.1.5.2 VGA Extender Send Unit

There are two VGA Extender Send Units per car. One each located in each Cab ceiling. See Figures 3-1 and 8-7.

3.2.1.5.3 Passenger Information Controller

There are two Passenger Information Controllers per car. One each located in each Cab ceiling. See Figures 3-1 and 8-8. The A-End controller is also the IAADS / PIDS controller. The B-End controller is the PIDS controller. Software installation is the differentiator.

3.2.1.6 Global Positioning System (GPS) Antenna

The GPS Antenna is located on the roof of the A-Unit adjacent to the roof antenna. See Figures 3-4 and 8-9. The GPS Antenna is a small rounded dome antenna that provides the LRV with location data. The GPS antenna continuously receives a satellite signal when available. The collected data provides the LRV with current location and time that is then distributed to onboard subsystems via the Vehicle Management System. The GPS signal is used by the IAADS to geofence station locations for announcement control and synchronization and by the Passenger Counter System for location. It is connected to the A-End CCU computer.

3.2.1.7 Ethernet Remote Input / Output (RIO)

There is one Ethernet Remote I/O located in the cab ceiling in each A and B-Unit and inside the console. See Figures 3-1 and 8-10.

3.2.1.8 In-Dash Microphone

There is one In-Dash Microphone mounted on Console Panel 3 in each A and B unit. See Figures 3-1 and 8-11.

3.2.1.9 Cab 4” Speaker

There are two Cab Speakers in each A and B-Unit cab. See Figures 3-1 and 8-12. They are located in the cab ceiling on either side of the cab.

3.2.1.10 Passenger Intercom (PIC)

There are four passenger intercoms per car. See Figures 3-2 and 8-13. One is located at each of the four wheelchair areas. The passenger intercoms allow the passengers to communicate with the Operator during an emergency situation.

3.2.1.11 Exterior Speaker

There are eight exterior speakers, four mounted in the roof shrouds on the A-Unit and four on the B-Unit. See Figures 3-5 and 8-14.

3.2.1.12 Interior 6” Speaker

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 3-6 and 8-15. The interior speakers provide the passengers a means by which to hear Operator announcements.

3.2.1.13 Radio Antenna

There is one Radio Antenna located on the roof of each A and B-Unit. See Figures 3-4 and 8-16. 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. The radio antenna is connected to the I-com radio used for the Train Operators communications.

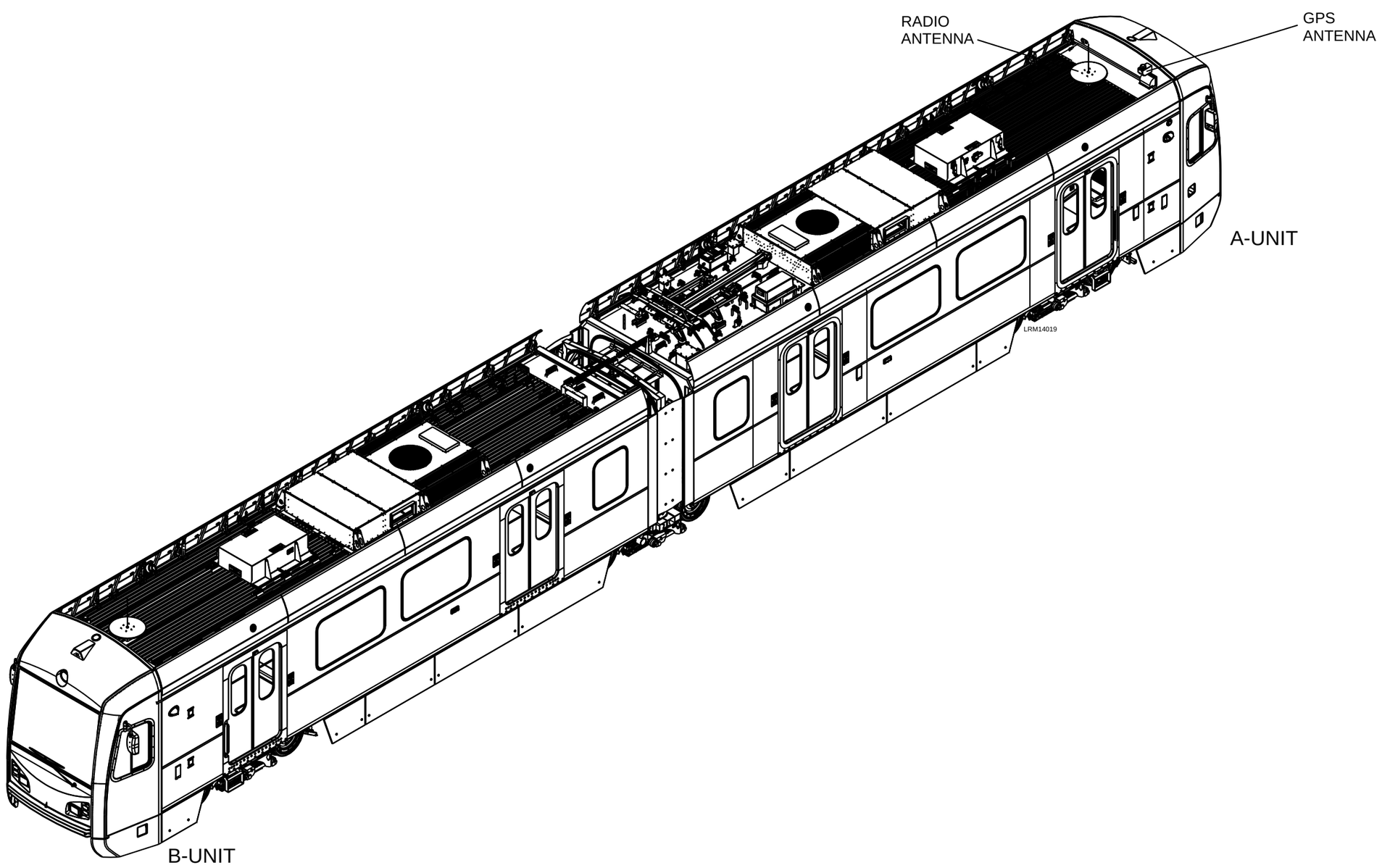


Figure 3-4: Roof Mounted Communication Equipment

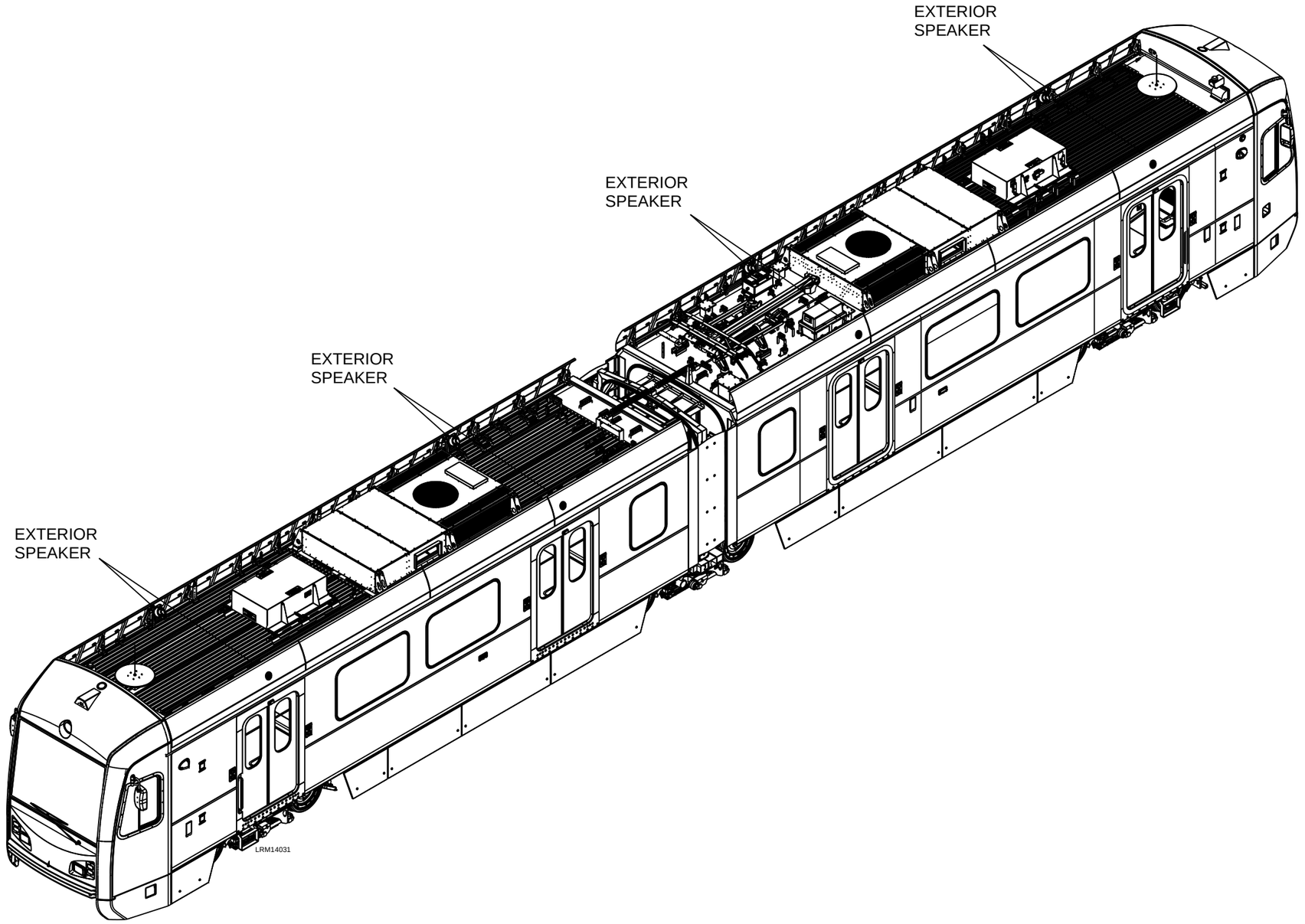


Figure 3-5: Exterior Speaker Locations

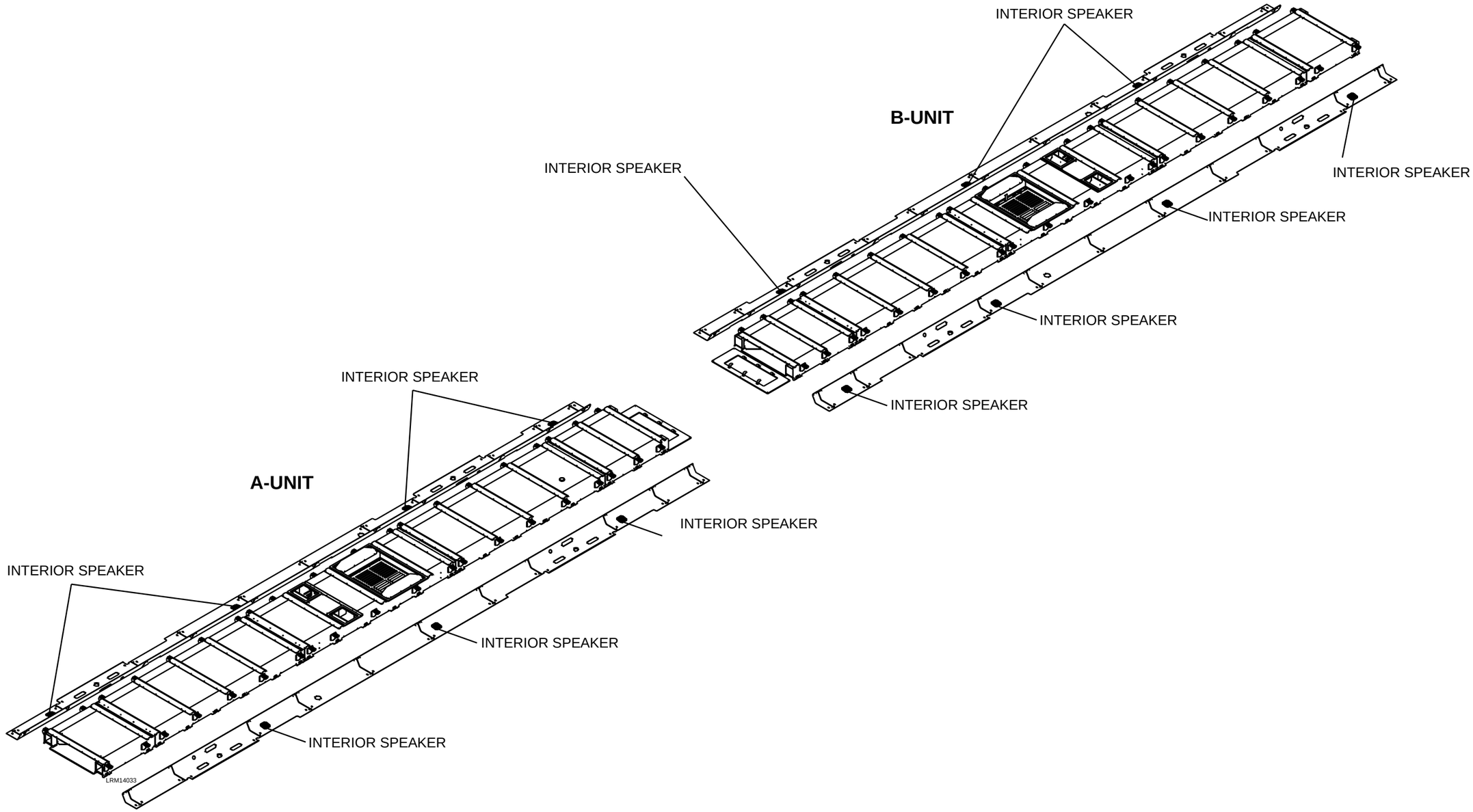


Figure 3-6: Interior Speaker Locations

3.2.2 Exterior Signs

3.2.2.1 Front Destination Sign

There is one Front Destination Sign located on the front of each A and B-Unit cab. See Figures 3-1 and 8-16. The destination display is an amber monochrome LED array capable of displaying 13 characters with a 6 in. (15 cm) character height. Up to 100 characters may be scrolled across the display. The route code display is a full color LED array displaying a single 6 in. (15 cm) high character. There are three display matrix PCB's for the destination, and one display matrix PCB for the route code display.

The sign assembly is 68 in. (172.7 cm) wide, 10.5 in. (26.6 cm) high, and 4.18 in. (10.6 cm) deep. It has a display window that is 59.75 in. (151.76 cm) wide and 6.45 in. (16.34 cm) high. The left side of the sign has a power connection, a Harting M12 connector for the network connection, and a plug for the left marker light. The right side has a plug for the right marker light.

3.2.2.2 Side Destination Sign

There are two side destination signs per car. See Figures 3-2 and 8-21. One each is located at the window near the center doors on each A and B-Unit. Side destination signs are visible from the outside of the car and display the final stop. The destination display is an amber-monochrome LED array that can display thirteen 4 in. (10 cm) characters. Up to 100 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. There are two display matrix PCB's for the destination, and a single display matrix PCB for the route code display.

The sign assembly is 41.5 in. (105.4 cm) wide, 7.1 in. (18 cm) high, and 3 in. (7.7 cm) deep. It has a display window that is 40 in. (101.6 cm) wide and 4.2 in. (10.7 cm) high.

3.2.3 Horn

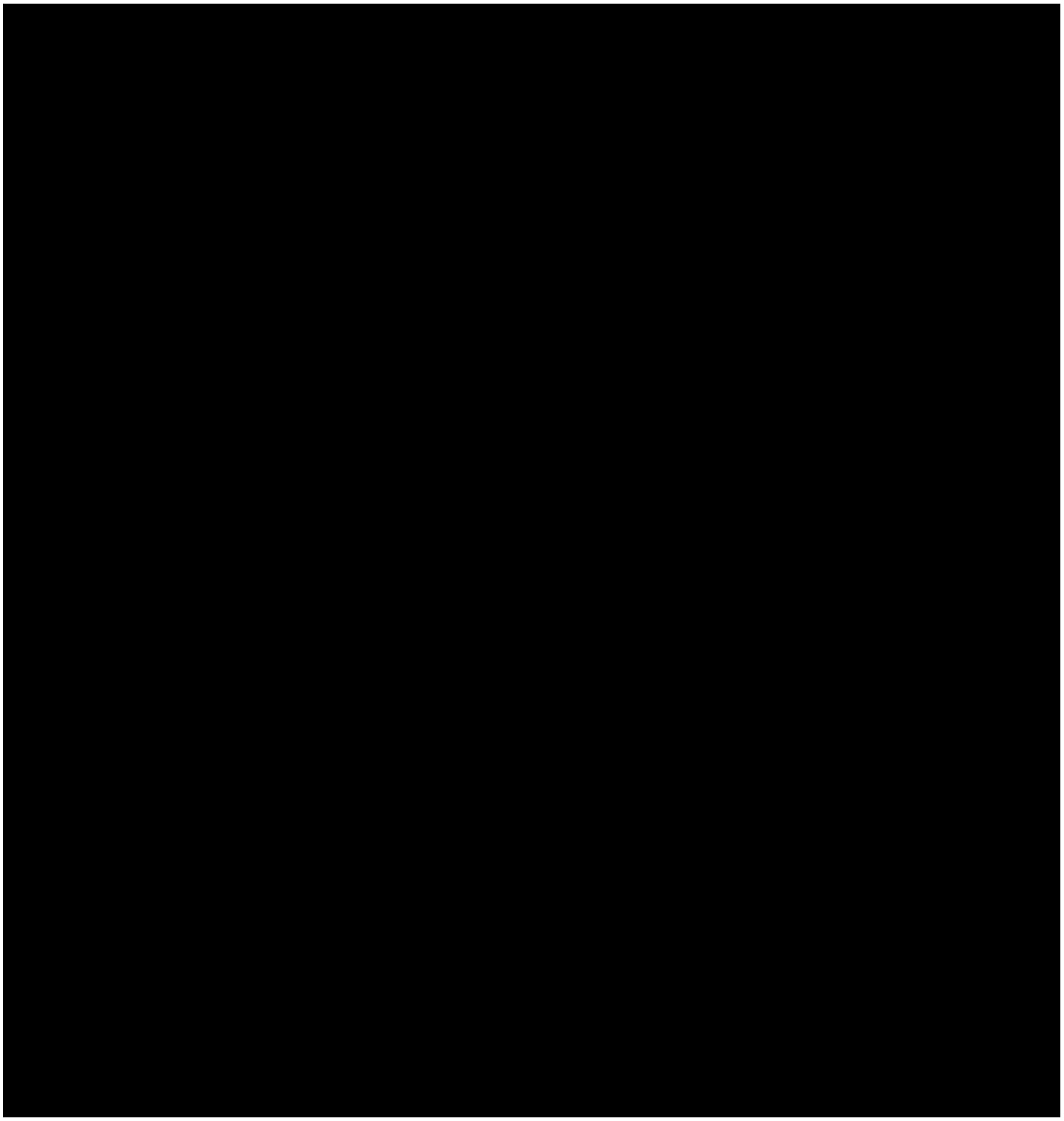
The horn is controlled by switches on the cab console. There is a High Horn and a Low Horn toggle style switch and a High Gong and Low Gong toggle style switch. The switches direct a battery signal to the appropriate input of the horn controller. The following circuit shows the control interface used for the Horn / Gong. The horn and gong/bell share a speaker directed to the front of the LRV. This speaker is driven by a horn controller. The Horn Switch (HS) and the Gong Switch (GS) are 3 position rocker switches (High, Off, Low). Actuation of the switch sends a battery level signal to both the horn controller and the TCN RIO to trigger the appropriate sound file from the horn controller and to log the actuation of the switch in the event recorder via the RIO.

3.2.3.1 Horn / Gong Speaker

There is one Horn / Gong Speaker mounted underneath the car on each A and B-Unit. The horn, when activated, is used to sound for alerts and emergency. See Figures 3-8 and 8-26.

3.2.3.2 Horn Controller Panel

There is one Horn Controller Panel located in the cab ceiling in each A and B-Unit cab. See Figures 3-1 and 8-27.



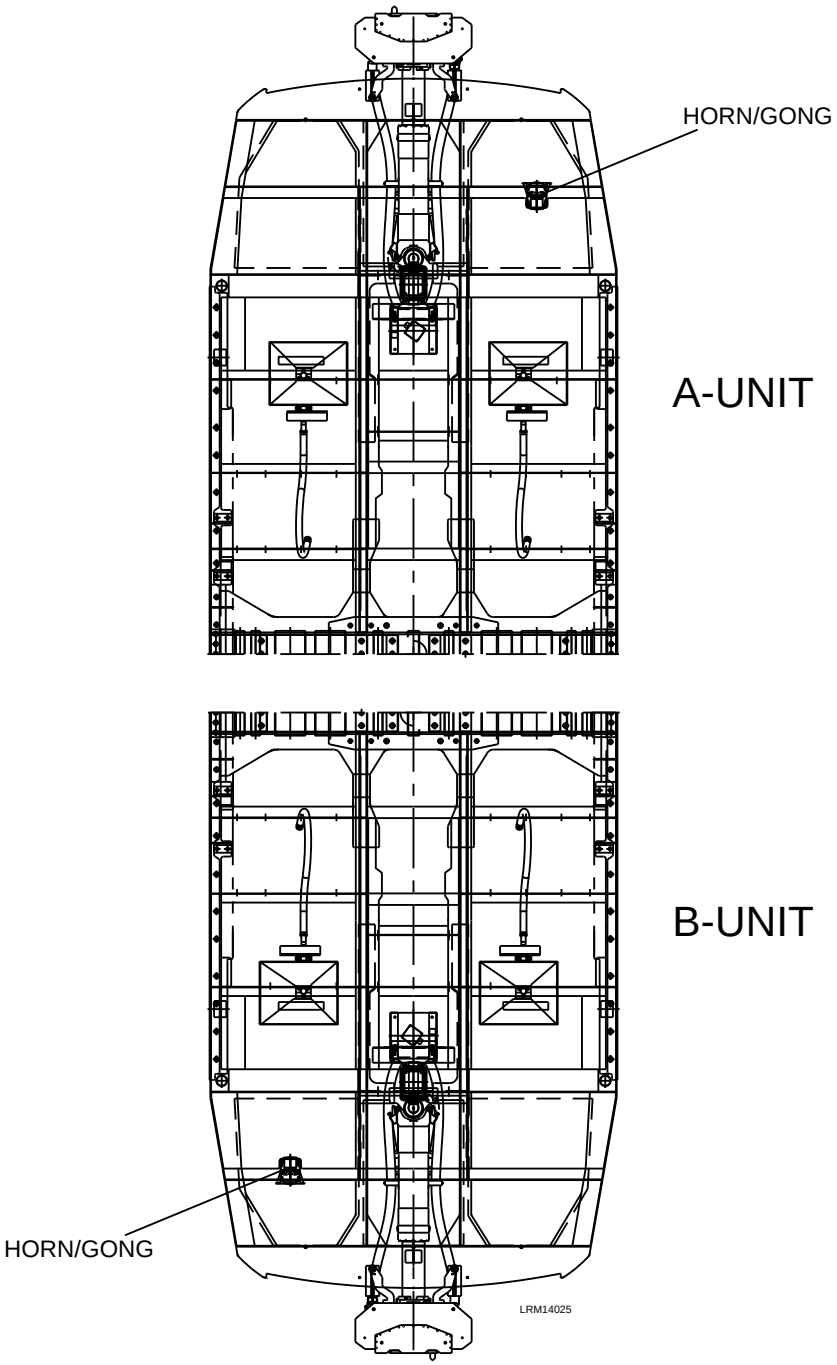


Figure 3-8: Undercar Mounted Communication Equipment

3.2.4 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 3-1 and 8-26.

The ProTracker Early Warning System is designed to enhance an authority's existing railroad worker protection program. It is a *secondary* warning system which works in conjunction with the authority's existing safety procedures, adding an additional layer of safety for track workers.

When used in conjunction with the appropriate Protran Technology devices, this system gives the train operator a warning of the presence of work crews, speed restrictions, track walkers, and has options, which, if instituted, can warn the train operator of many other circumstances such as trespassers, hazardous situations in tunnels, presence of first responders, high rail vehicles, pedestrian warnings, and platform intrusion warning.

As that the train operators get a warning of personnel out on the track workers will simultaneously get an advanced warning of the approaching train, giving them time to take the appropriate responses.

The Train Mounted Unit installed on the light rail vehicle is a transceiver. The Train Mounted Unit will receive an advanced warning and will send a signal to properly equipped personnel or equipment on the tracks ahead. The workers will be equipped with the Portable Warning Light and Horn (PWLH) and/or Personal Alert Devices (PAD) which give visual and audible warnings of approaching vehicles to those who are fouling the tracks or working in dangerous areas of the tracks. The workers are responsible to follow existing agency Standard Operating Procedures and be in position to clear the tracks.

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)

The Train Mounted Unit is installed inside the rail vehicle and will turn on when the vehicle is energized and a cab is activated. The unit itself is hidden from view and is tied into the train console. The unit is connected to the Train Operator Display (TOD) through a RS 485 connection. When the vehicle is in operation and an additional Protran Technology advanced warning device (see additional equipment section) is detected it will appear on the TOD. The audible alarm will also activate and be heard through the speaker inside the cab when approaching these areas. If the mute button is pressed the audible alarm will be silenced for 30 seconds*. The Train Mounted Unit transmits a signal that will activate any Personal Alert Device (PAD) that is at approximately 800-1200 ft. depending on the terrain.

Antenna

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

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.

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CHAPTER 4.0

SPECIAL TOOLS AND MATERIALS

4.1 Introduction

Maintenance of this equipment requires no special tools.

However, it is strongly recommended that a torque type M12 driver be used to tighten and remove the M12 style connectors used in the Ethernet circuitry.

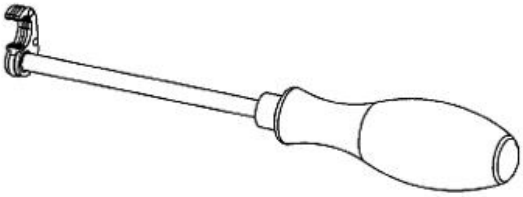

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Figure 4-1: Torque Type M12 Driver

Ethernet wiring can be checked with a specialized meter that will show network wire / connector faults.

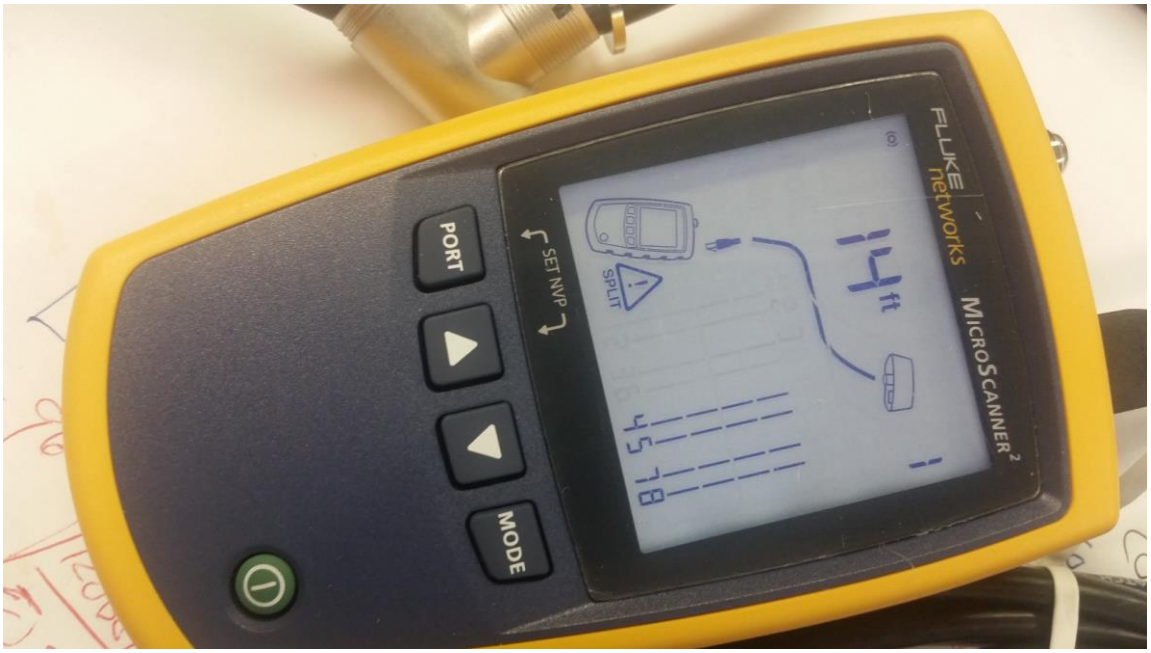

Figure 4-2: Ethernet Network Wiring Analyzer

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 1400 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.	
Daily	Front Destination Sign	Visually inspect all signs	6.3.2.1
Daily	Wayside Worker Alert System	Visually inspect for damage	6.3.4
Daily	Side Destination Signs	Visually inspect for defective LED’s	6.3.2.2
10,000 miles	Wayside Worker Alert System	Test function of unit	6.3.4
10,000 miles	Passenger Intercom	Verify operation	6.3.1.8
10,000 miles	Horn Controller Panel	Visually inspect for loose components and secure panel mounting hardware	6.3.3.2
30,000 miles	Remote I/O	Visually inspect for loose components and secure panel mounting hardware	6.3.1.6
30,000 miles	PIDs display	Visually inspect for vandalism, loose components and secure mounting hardware	6.3.1.11
60,000 miles	Communication Control Unit (CCU)	Visually inspect for loose components and secure panel mounting hardware	6.3.1.1
60,000 miles	ACP1A / ACP1B Panels	Visually inspect for loose components and secure panel mounting hardware	6.3.1.2
60,000 miles	Radio	Visually inspect for loose components and secure panel mounting hardware	6.3.1.3
60,000 miles	Cab Speakers	Visually inspect for loose components and secure mounting hardware	6.3.1.7

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

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1400 Communications Running Maintenance & Servicing Manual Section Reference
60,000 miles	Exterior Speaker	Visually inspect for loose hardware, electrical connections	6.3.1.9
60,000 miles	Interior Speakers	Visually inspect for loose components and proper operation	6.3.1.10
60,000 miles	Radio Antenna	Visually inspect for dirt and debris on the reflective plate and electrical connections/ground	6.3.1.12
120,000 miles	Ethernet Switches	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	6.3.2.1
120,000 miles	IAADs / PIDS	Replace Battery	6.3.1.11

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 Communications System

6.3.1.1 Communication Control Unit (CCU)

Visually inspect for loose components and secure panel mounting hardware every 60,000 miles. See Figures 3-1 and 8-1.

6.3.1.2 ACP1A / ACP1B Panels

Visually inspect for loose components and secure panel mounting hardware every 60,000 miles. See Figures 3-1, 8-2 and 8-3.

6.3.1.3 Radio

Visually inspect for loose components and proper operation every 60,000 miles. See Figures 3-1 and 8-4.

6.3.1.4 Global Positioning System (GPS) Antenna

There is no maintenance needed on the GPS Antenna. See Figures 3-4 and 8-9.

6.3.1.5 Ethernet Switches

Perform visual inspection of hardware 120,000 miles and verify that all M12 connectors are tightened to the proper torque. See Figures 3-1 and 3-3.

6.3.1.6 Remote I/O

Perform visual inspection of hardware and wires every 60,000 miles. See Figures 3-1 and 8-10.

6.3.1.7 Cab Speakers

Visually inspect for loose components and proper operation every 60,000 miles. See Figures 3-1 and 8-12.

6.3.1.8 Passenger Intercom

Visually inspect the passenger intercom every 10,000 miles for damage and proper operation. See Figures 3-2 and 8-13.

6.3.1.9 Exterior 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.

Visually inspect the exterior speakers for loose hardware and electrical connections every 60,000 miles. See Figures 3-5 and 8-14.

6.3.1.10 Interior Speakers

Visually inspect the interior speakers for loose components and proper operation every 60,000 miles. See Figures 3-6 and 8-15.

6.3.1.11 IAADS / PIDS

1. Visually inspect for vandalism, loose components and secure panel mounting hardware every 30,000 miles.
2. Replace the battery every 120,000 miles.

6.3.1.12 Radio Antenna

1. 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.

6.3.2 Exterior Signs

6.3.2.1 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 3-1 and 8-17.
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™

6.3.2.2 Side Destination Sign

Visually inspect the side destination sign on a daily basis for defective LED's. See Figures 3-2 and 8-22.

6.3.3 Horn

6.3.3.1 Horn / Gong Speaker

There is no maintenance needed on the Horn. See Figures 3-8 and 8-27.

6.3.3.2 Horn Controller Panel

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 8-28.

6.3.4 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 3-1 and 8-29.

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.

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CHAPTER 7.0

LUBRICATION

7.1 Introduction

There are no lubrication procedures for the Communication Equipment.

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CHAPTER 8.0

COMPONENT REMOVAL AND INSTALLATION

8.1 Introduction

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

8.2 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.

8.3 Removal and Installation Standard Shop Practices

Table 8-1: 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 8-2: 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 8-2: 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 8-2: 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

8.4 Removal

8.4.1 Communication System

8.4.1.1 Communication Control Unit (CCU) Panel

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 8-1.
3. Remove the four M6 x 16 screws (2), M6 lock washers (3), and M6 plain washers (4).
4. Carefully remove the CCU (1).

8.4.1.2 Audio Control Panel (ACP1A)

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 ACP1A Panel (1). See Figure 8-2.
3. Remove the four M6 x 16 screws (2), M6 lock washers (3), and M6 plain washers (4).
4. Carefully remove the ACP1A Panel (1).

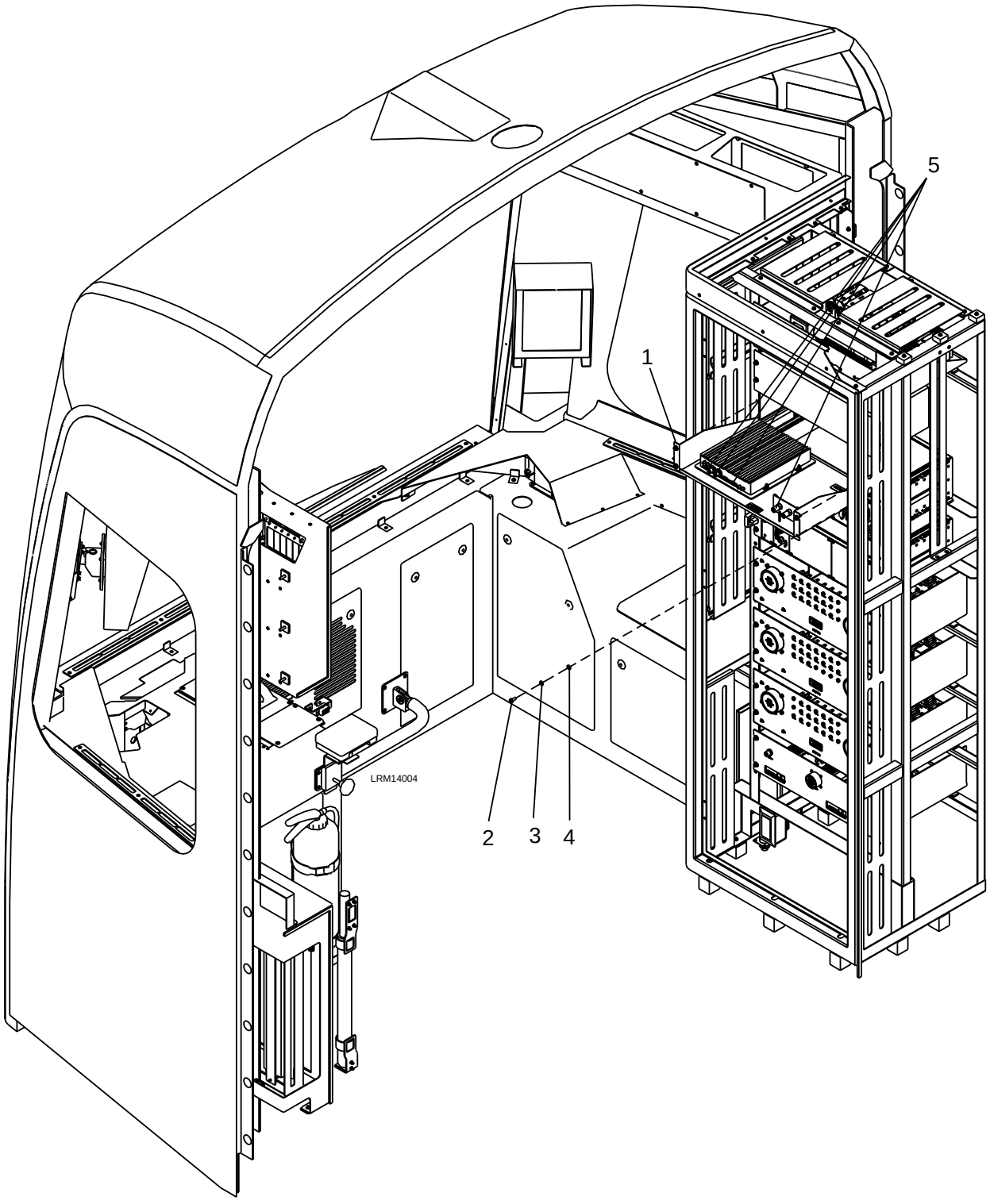

Figure 8-1: Communication Control Unit (CCU) Panel

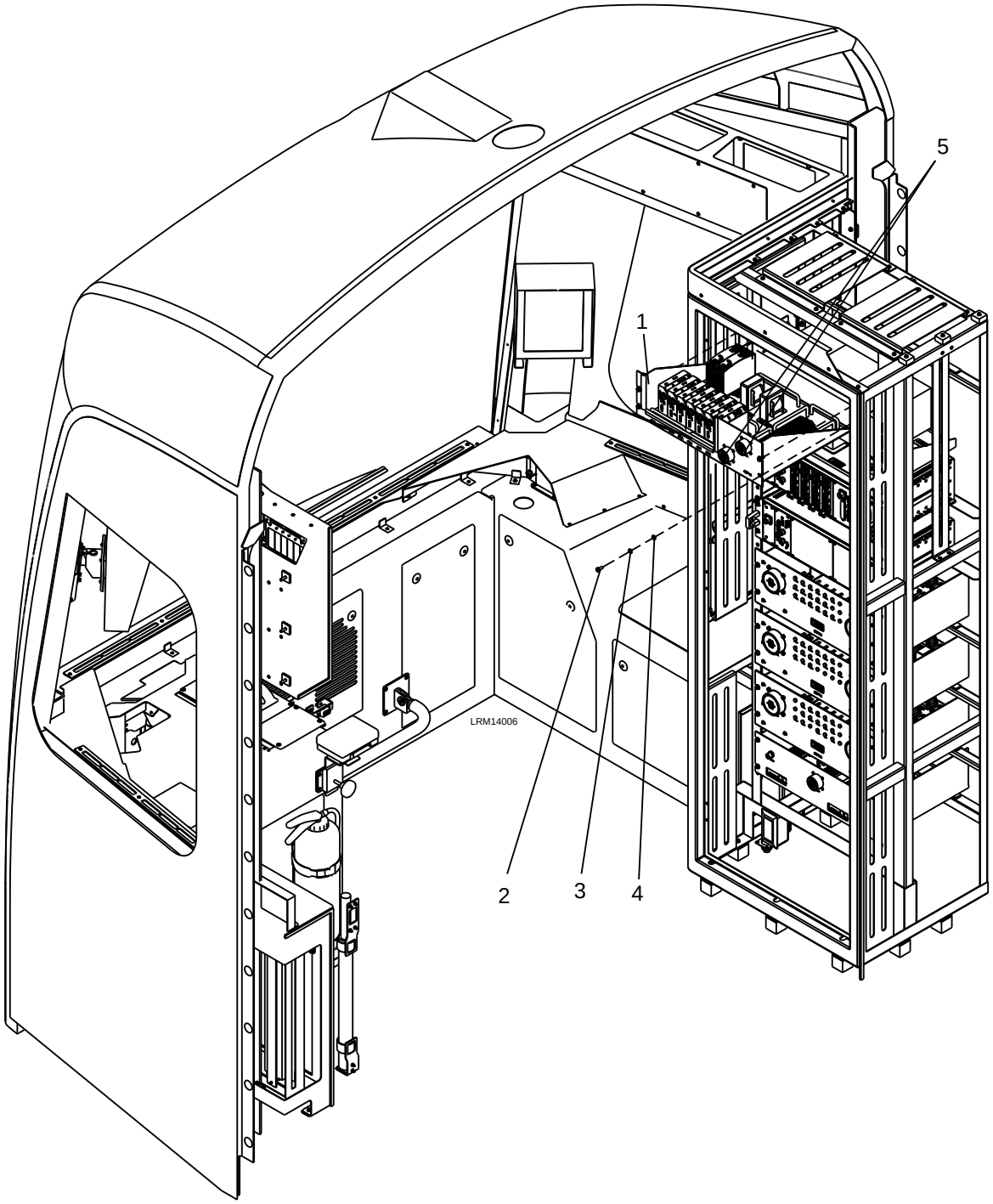

Figure 8-2: Audio Control Panel (ACP1A)

8.4.1.3 Audio Control Panel (ACP1B)

1. Open the right side electric locker door located in the B-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 ACP1B Panel (1). See Figure 8-3.
3. Remove the four M6 x 16 screws (2), M6 lock washers (3), and M6 plain washers (4).
4. Carefully remove the ACP1B Panel (1).

8.4.1.4 Radio

1. Unlock the two locks (5) and lower the cab ceiling panel (6) to access the Radio Power Supply (1). See Figure 8-4.

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.
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).

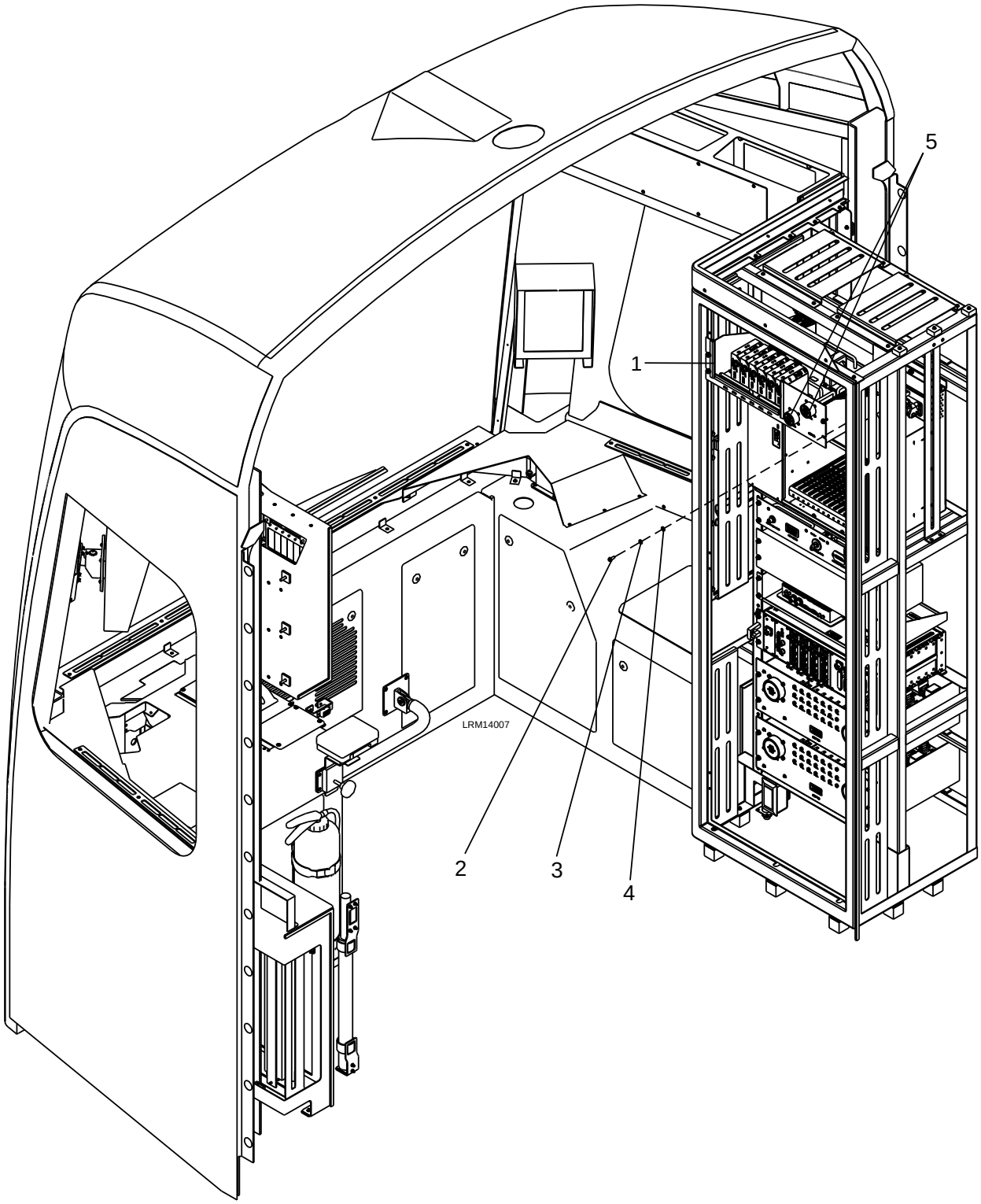

Figure 8-3: Audio Control Panel (ACP1B)

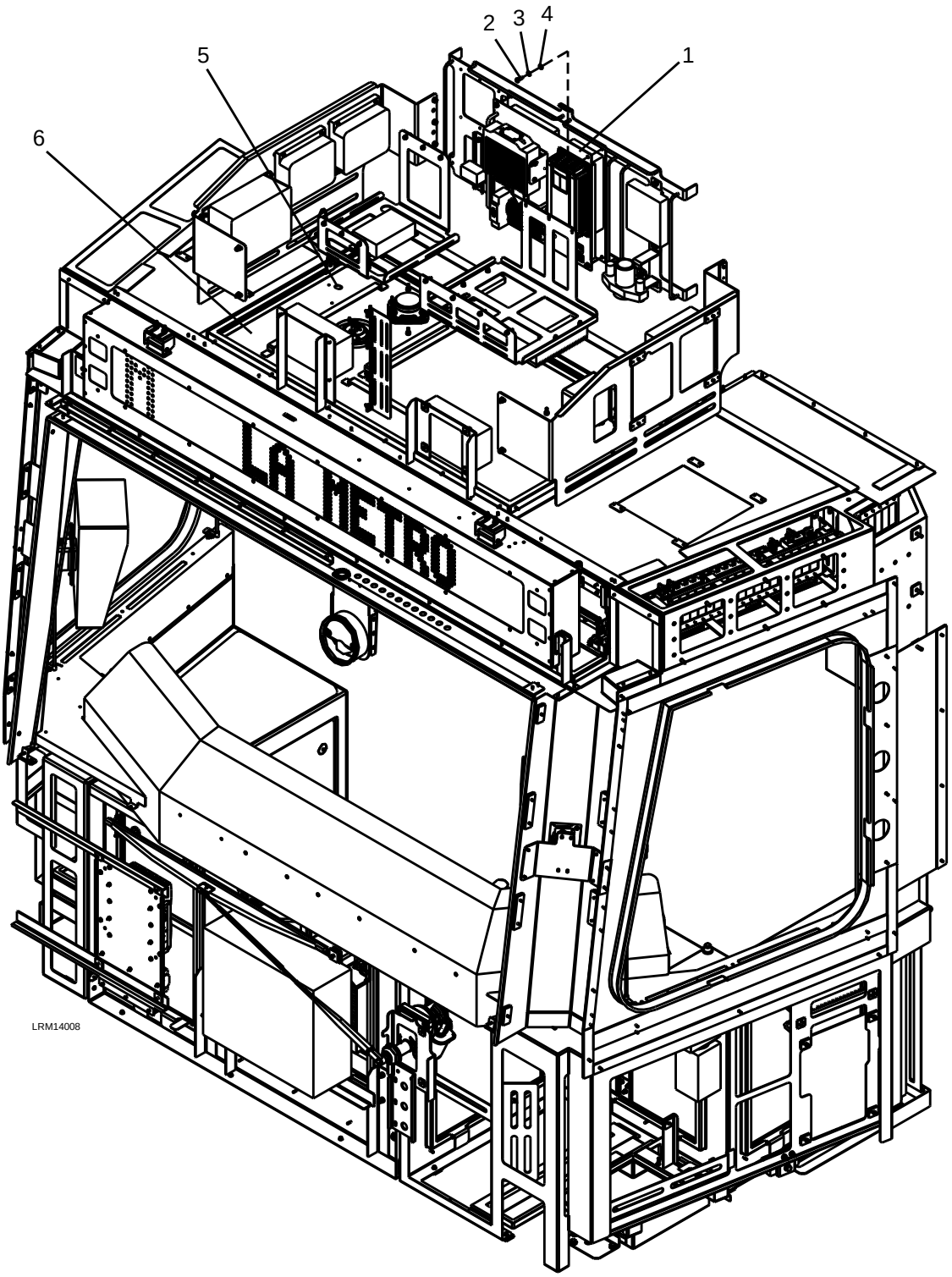

Figure 8-4: Radio
(Sheet 1 of 2)

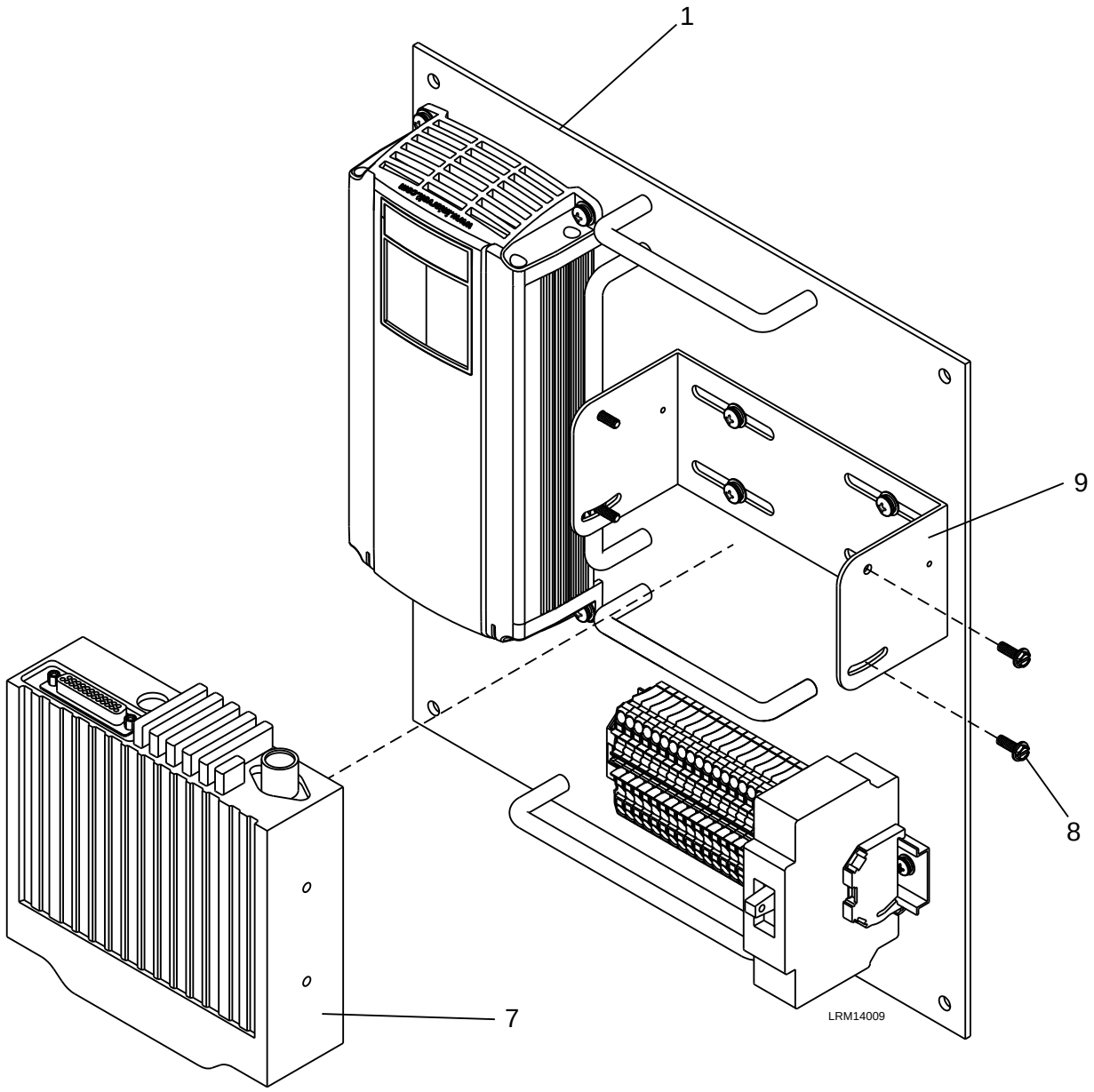

Figure 8-4: Radio
(Sheet 2 of 2)

8.4.1.5 Passenger Information Display

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 8-5.
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 8-5 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.

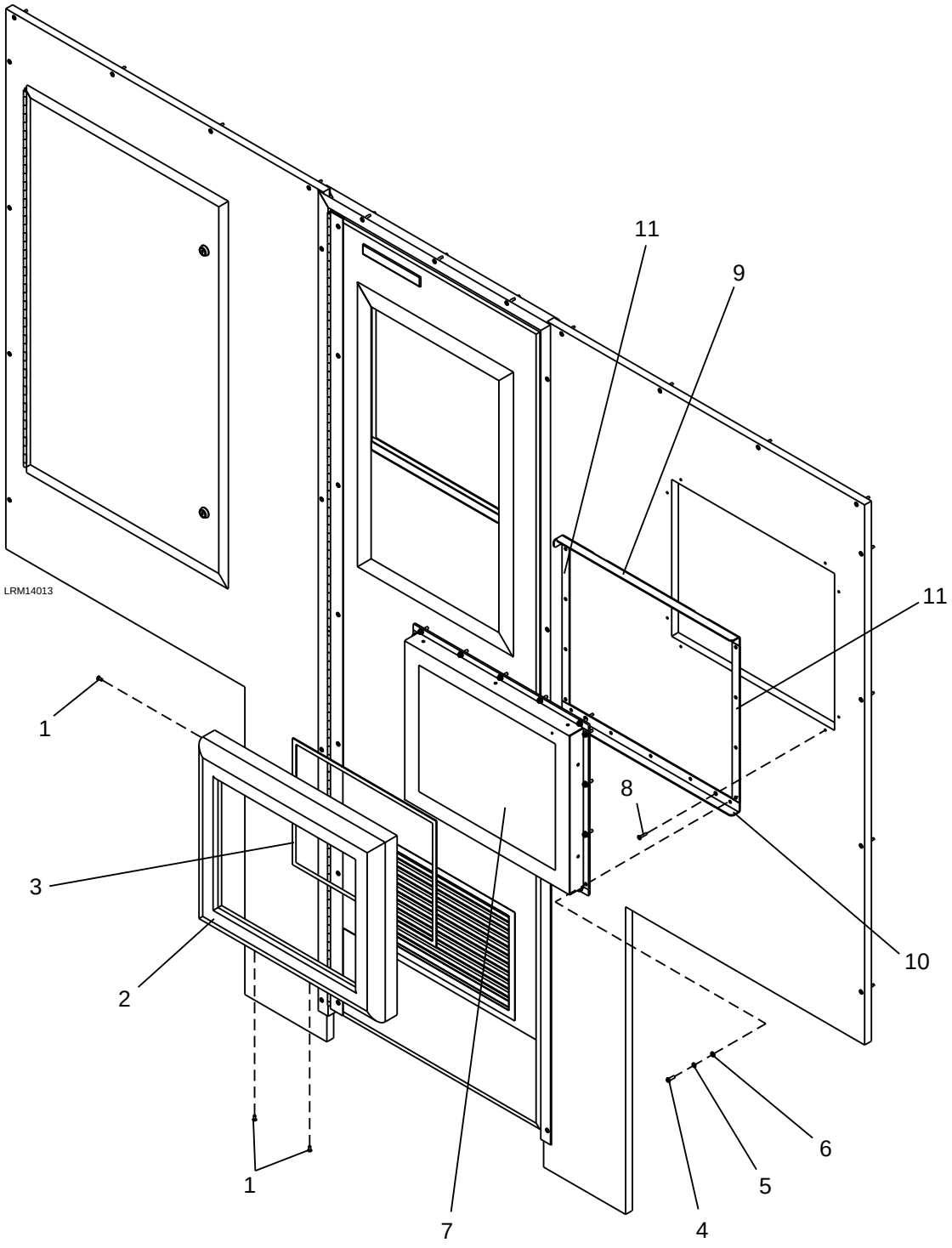

Figure 8-5: Passenger Information Display
(Sheet 1 of 2)

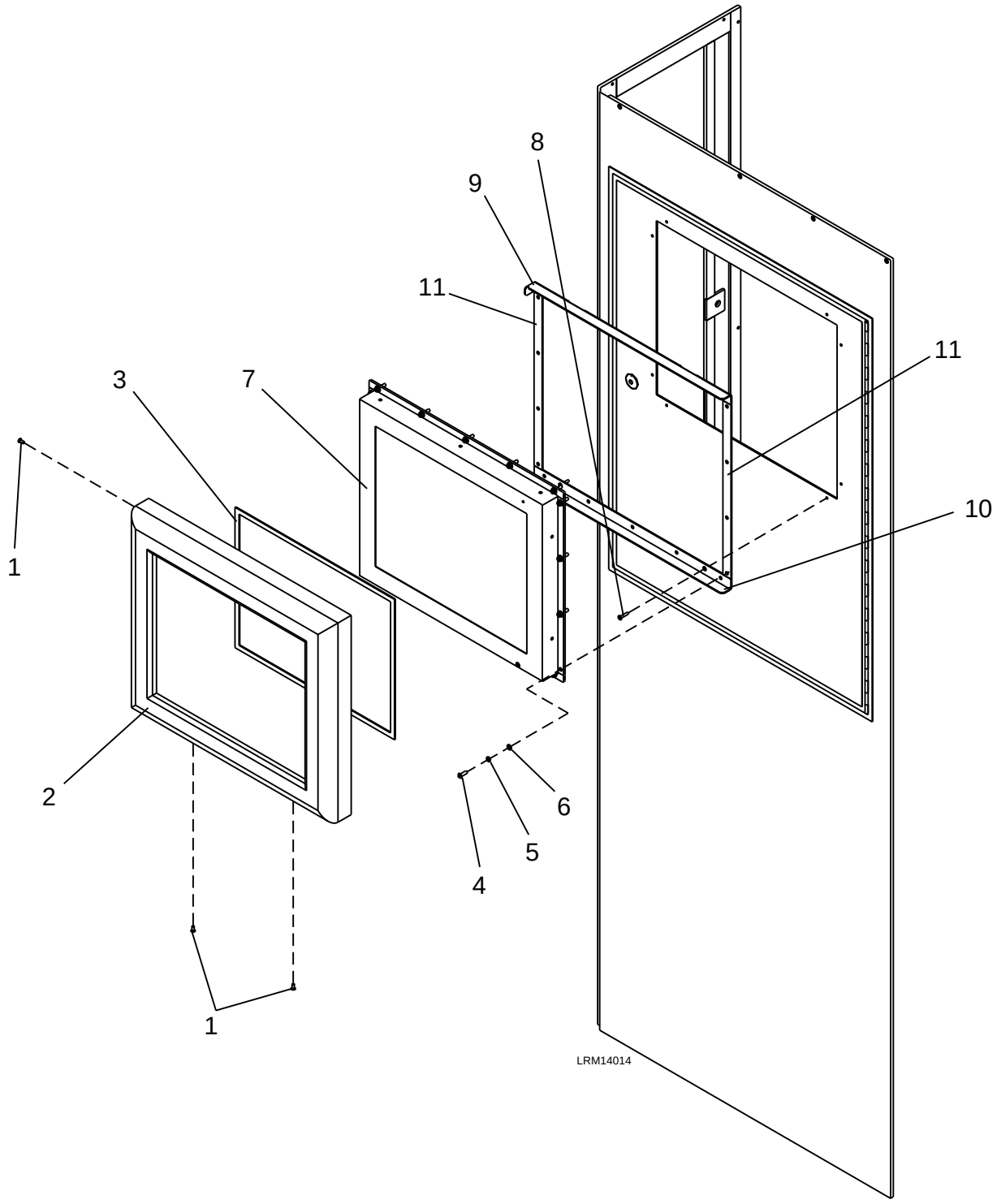

Figure 8-5: Passenger Information Display
(Sheet 2 of 2)

8.4.1.5.1 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 8-6.

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

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

8.4.1.5.2 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 8-7.

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

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

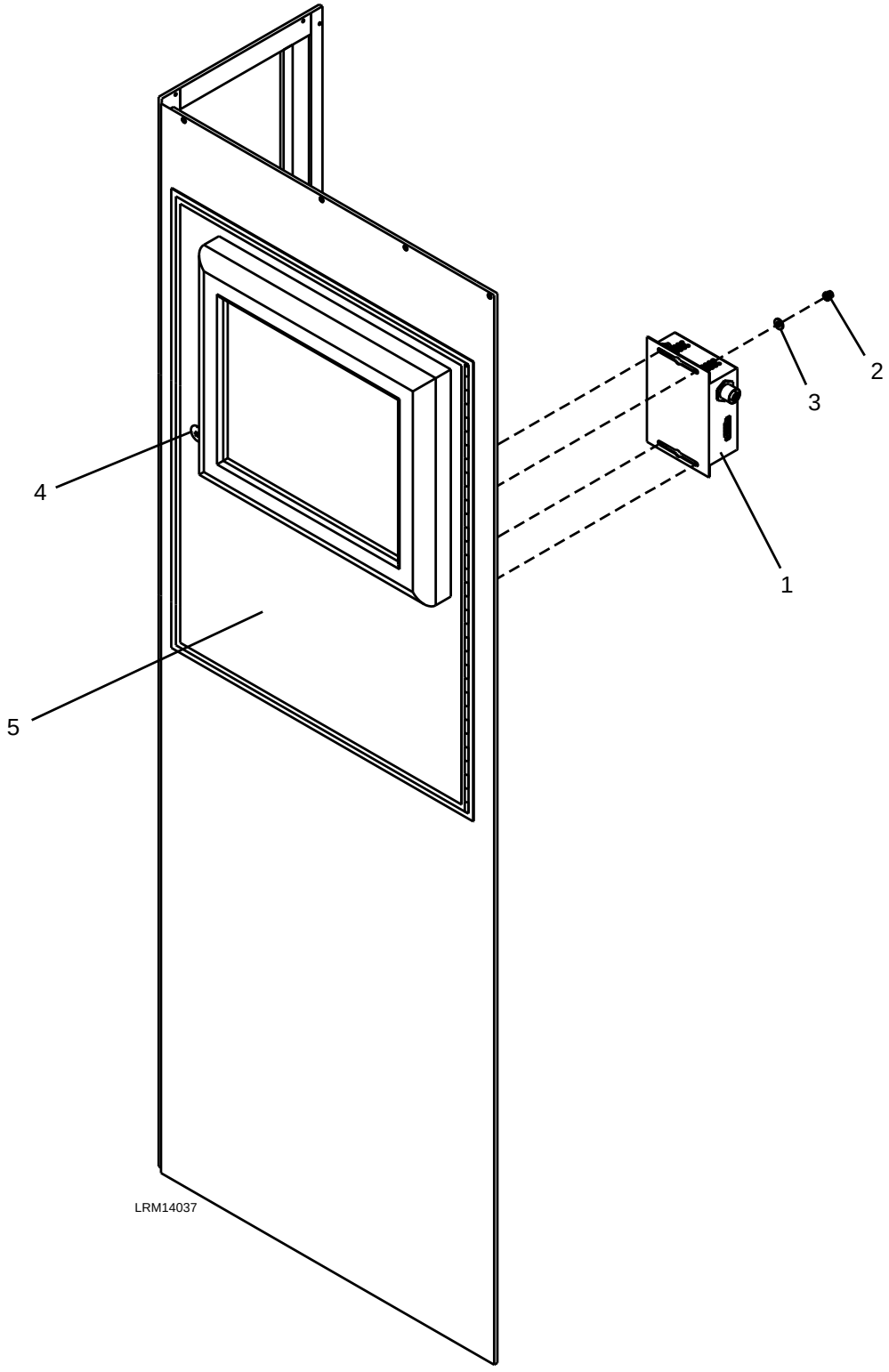

Figure 8-6: VGA Extender Receive Unit

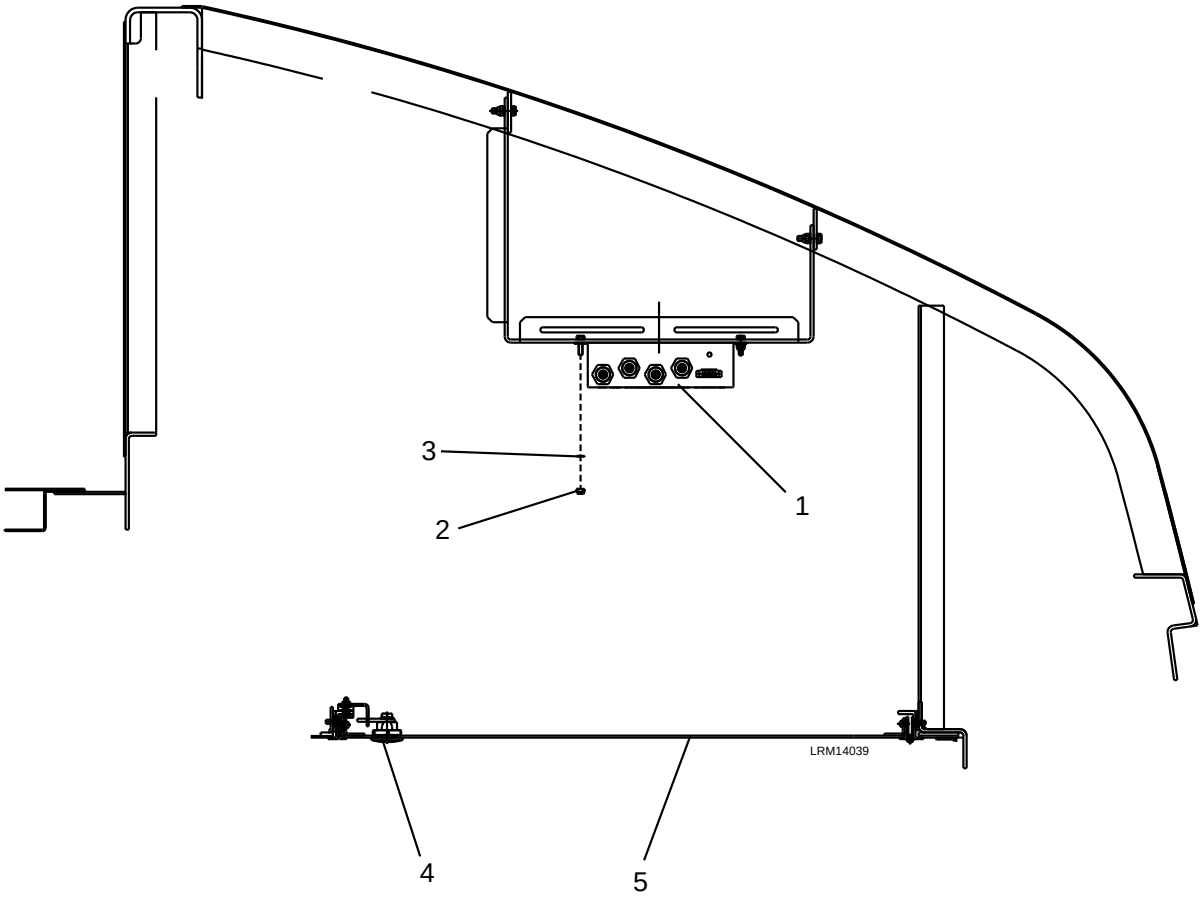

Figure 8-7: VGA Extender Send Unit

8.4.1.5.3 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 8-8.

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 8-8.

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).

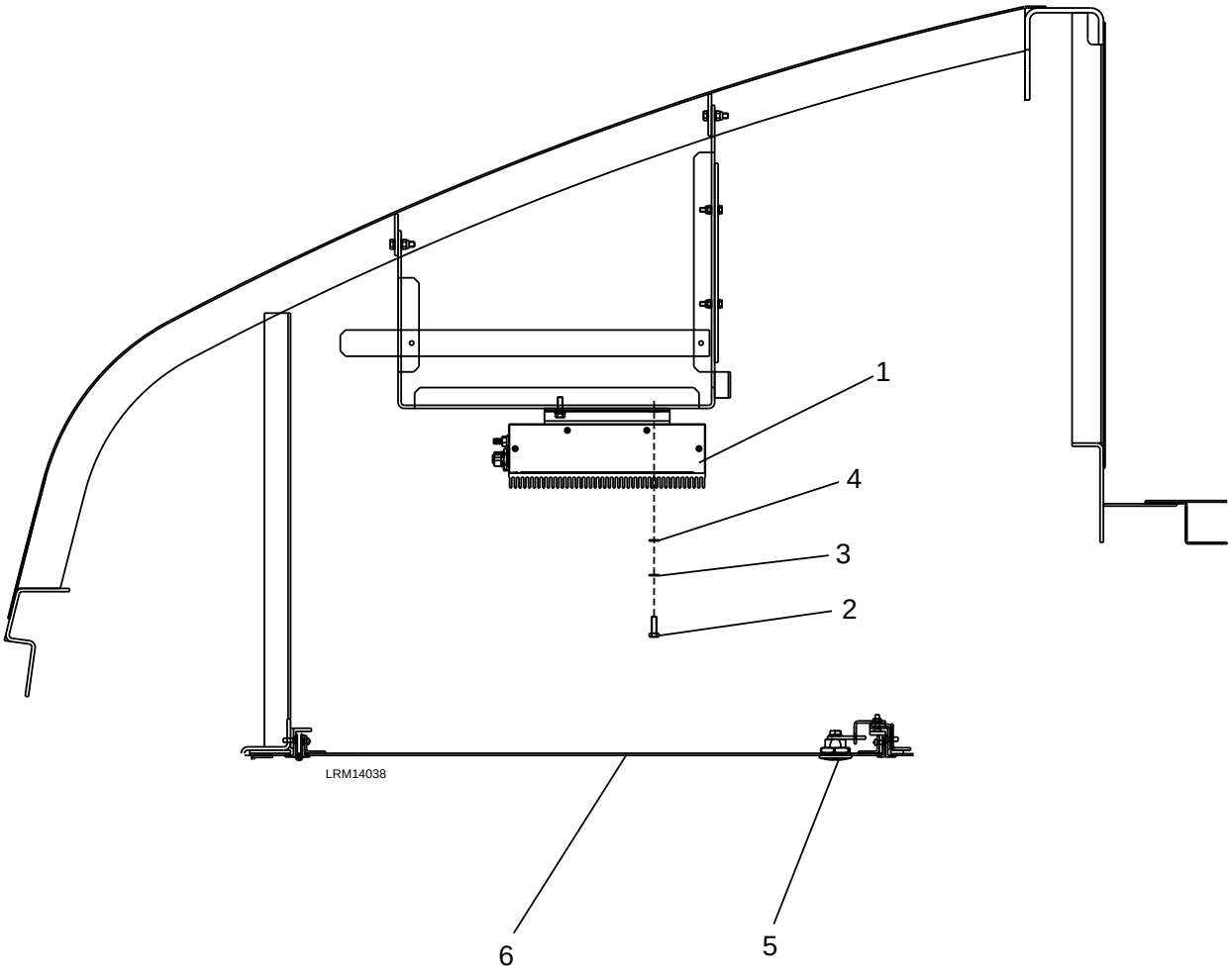

Figure 8-8: Passenger Information Controller
(Sheet 1 of 2) (Cars 1001 through 1025)

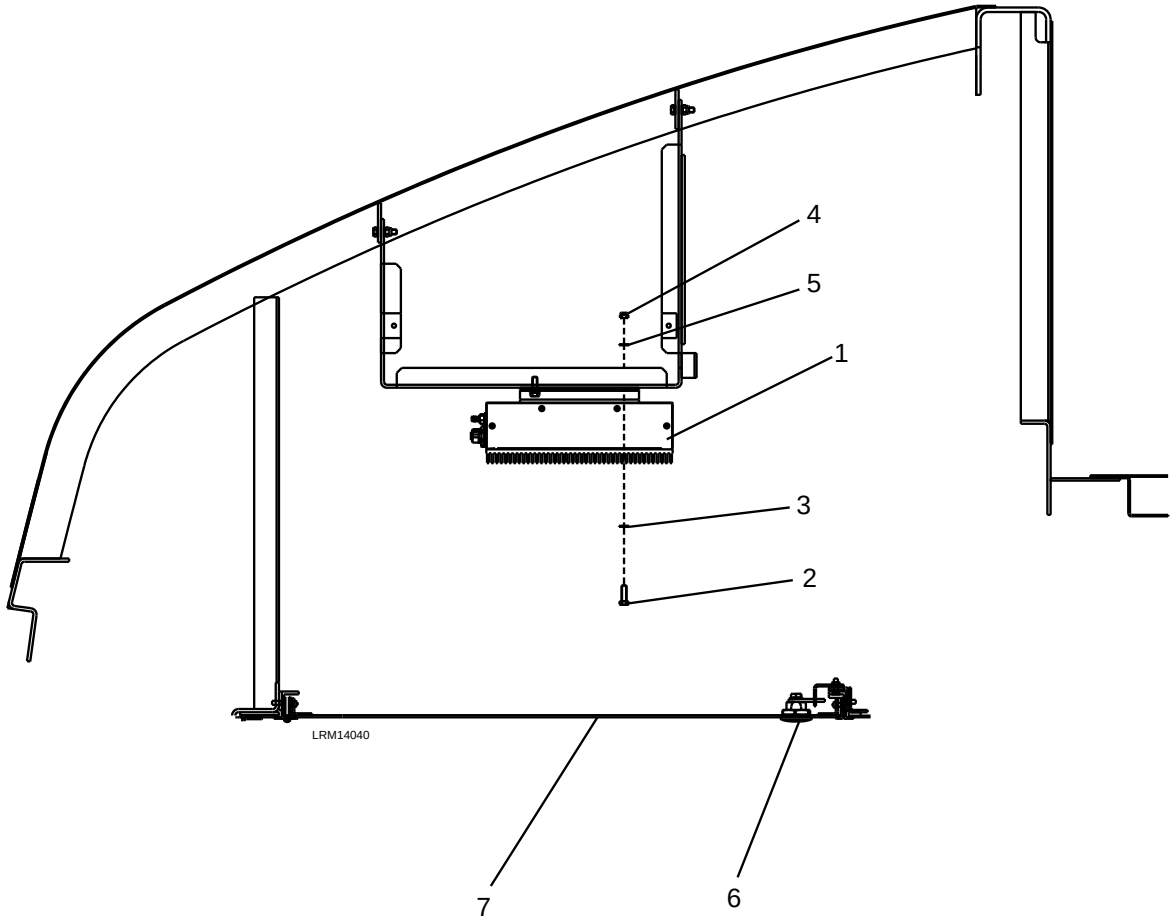

Figure 8-8: Passenger Information Controller
(Sheet 2 of 2) (Cars 1026 and Later)

8.4.1.6 Global Positioning System (GPS) Antenna

1. Remove the six M4 x 8 screws (5), M4 lock washers (6), and M4 plain washers (7). See Figure 8-9.
2. Remove the cover (3).

WARNING

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

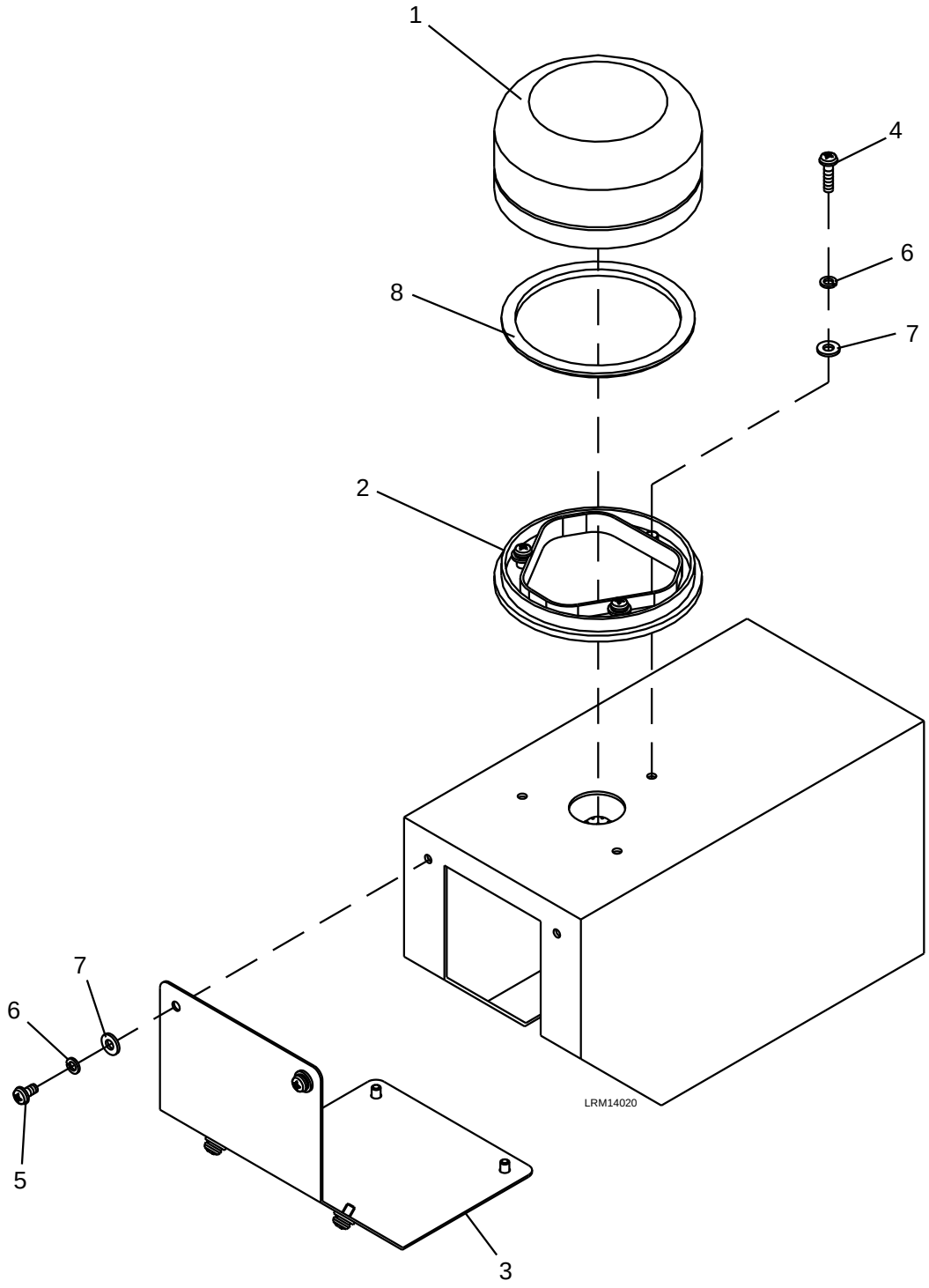

Figure 8-9: Global Positioning System (GPS) Antenna

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

8.4.1.7 Ethernet Remote Input / Output (RIO)

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 (2) and lower the cab ceiling panel (3) to access the Ethernet Remote I/O (1) and disconnect the electrical connection. See Figure 8-10.
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).

8.4.1.8 In-Dash Microphone

1. Remove the nine #8-32 flat head screws (2) from Console Panel 3 (1). See Figure 8-11.

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).

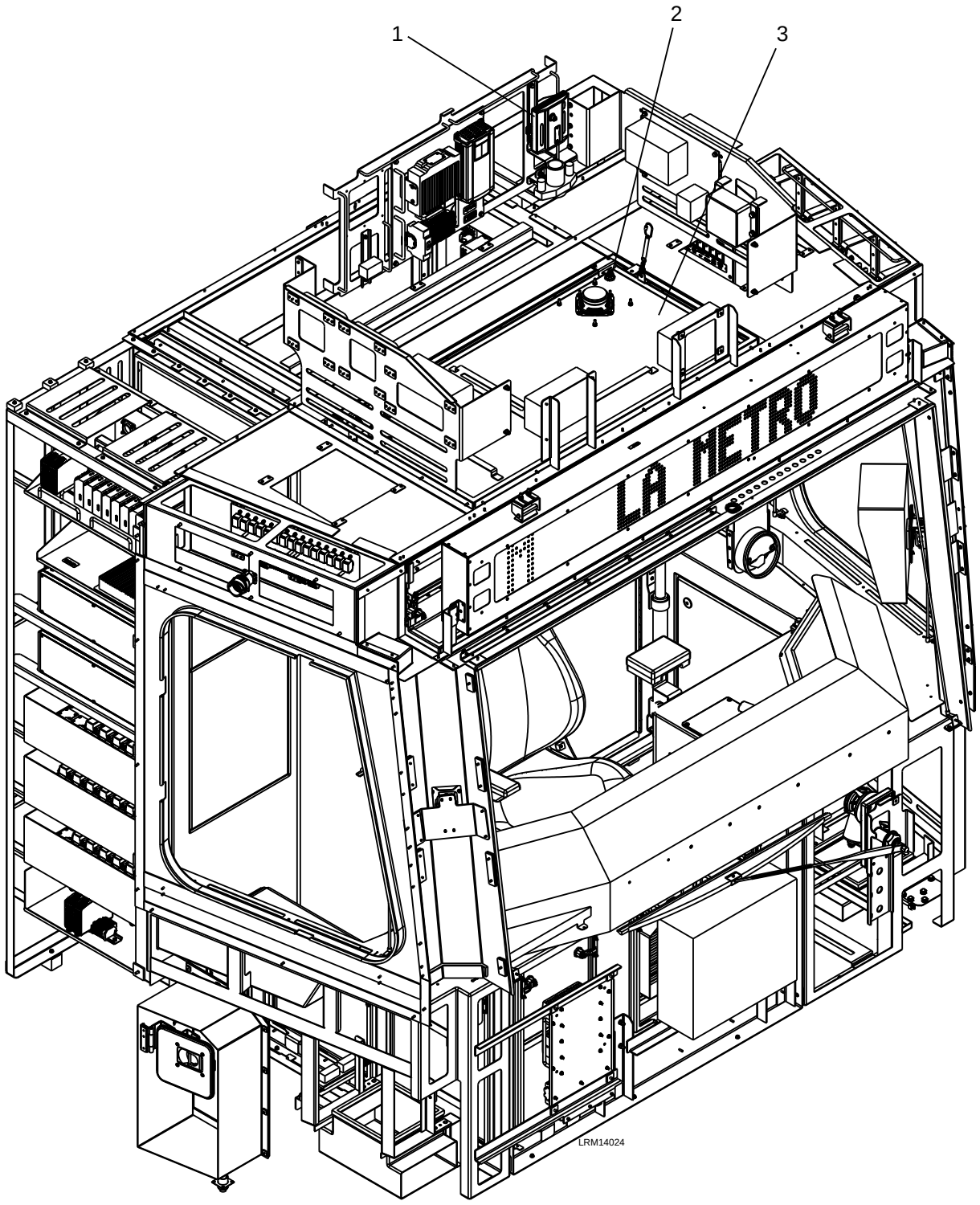

Figure 8-10: Ethernet Remote Input / Output (RIO)

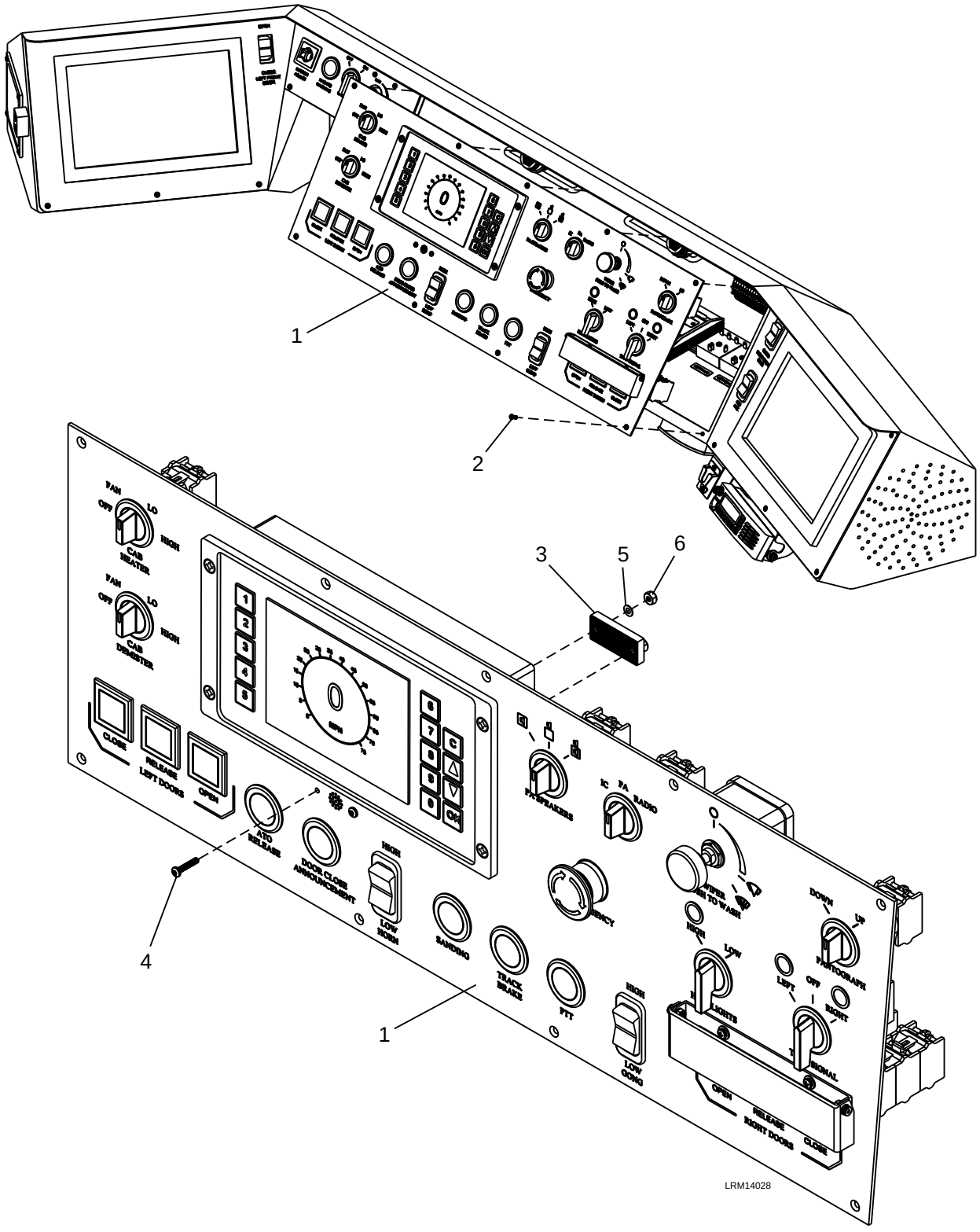

Figure 8-11: In-Dash Microphone

8.4.1.9 Cab 4” 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. 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 8-12.
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).

8.4.1.10 Passenger Intercom (PIC)

1. Remove the four M4 x 16 screws (1) from the Passenger Intercom (2). See Figure 8-13.

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).

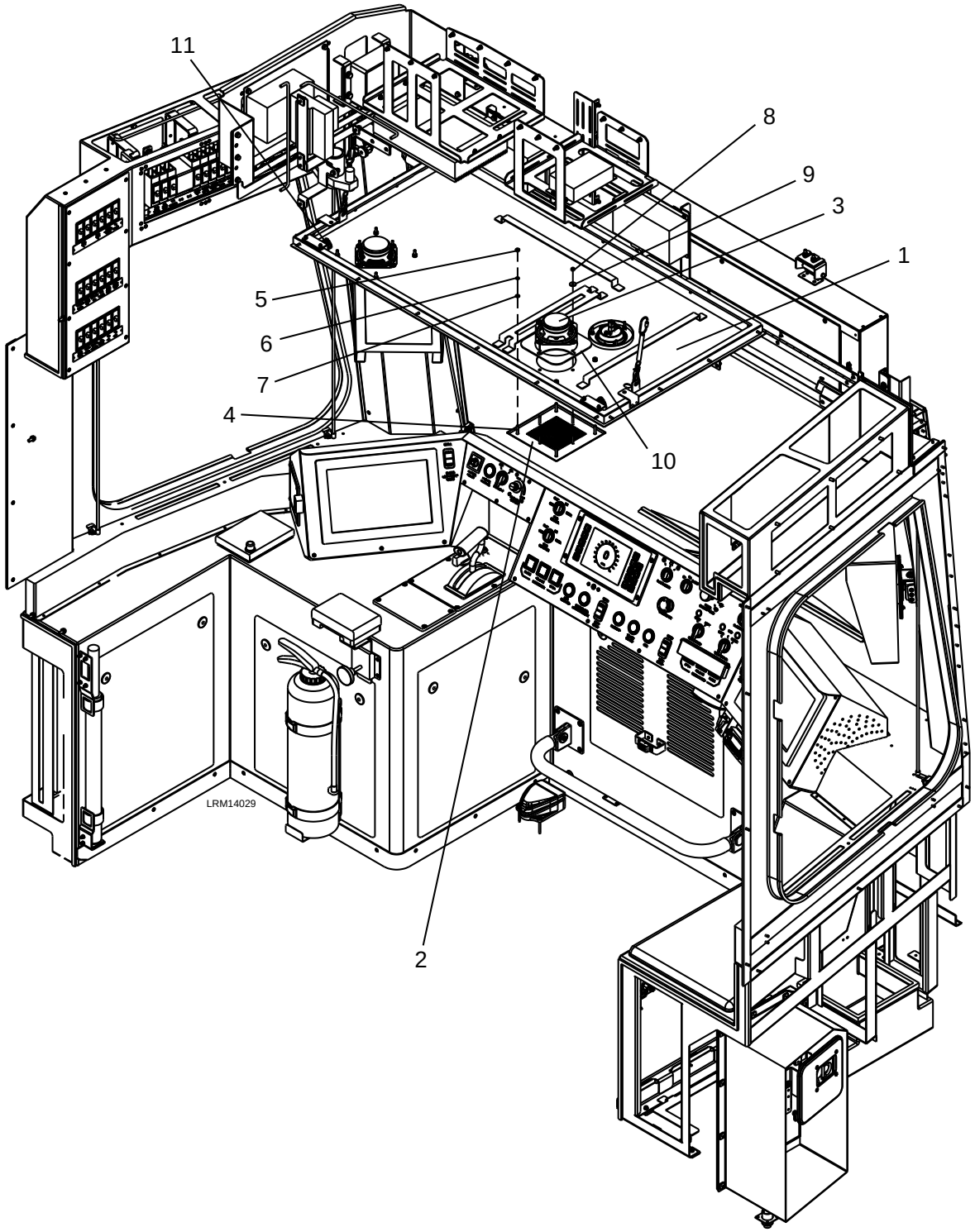

Figure 8-12: Cab 4” Speaker

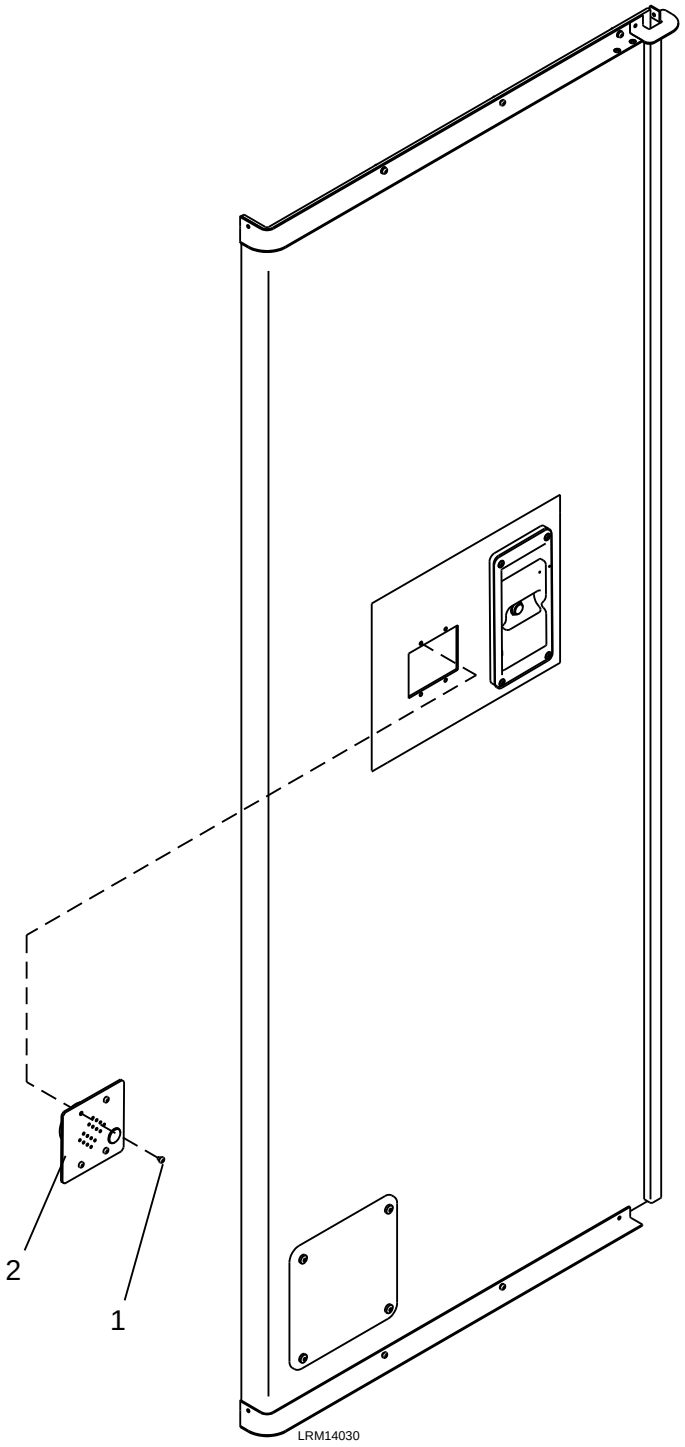

Figure 8-13: Passenger Intercom (PIC)

8.4.1.11 Exterior 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 #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 8-14.

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).

8.4.1.12 Interior 6” Speaker

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 8-15.

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

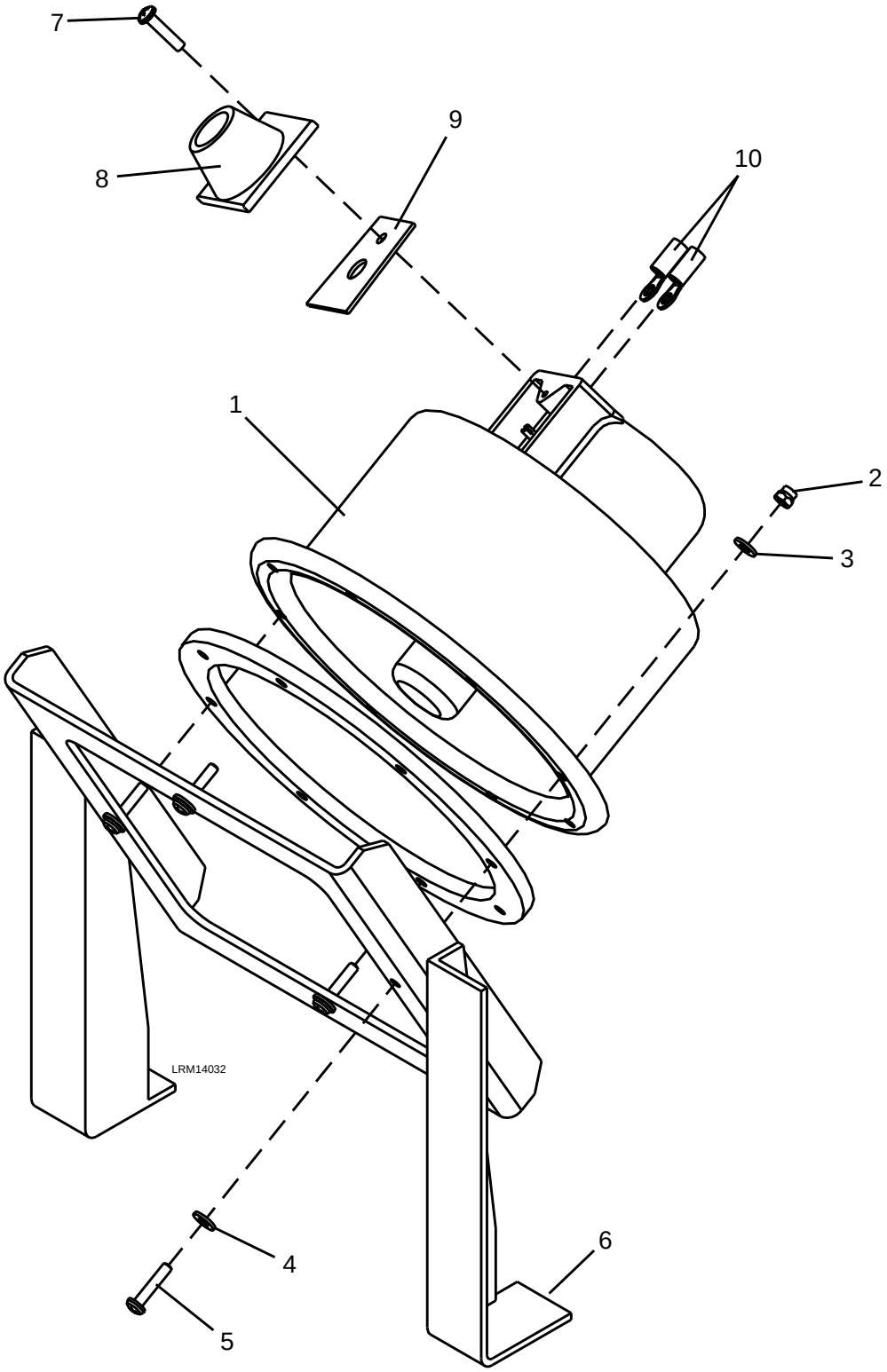

Figure 8-14: Exterior Speaker

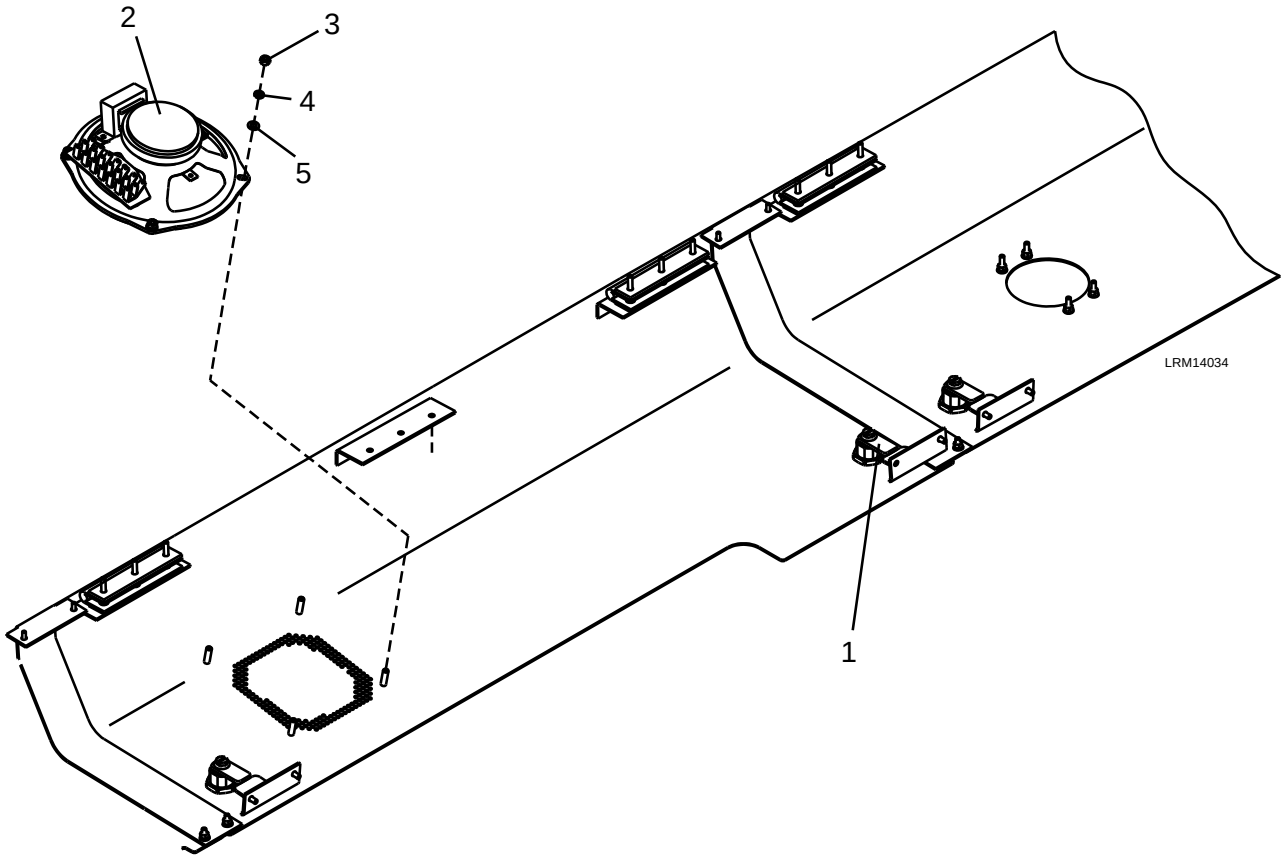

Figure 8-15: Interior 6” Speaker

8.4.1.13 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 8-16.

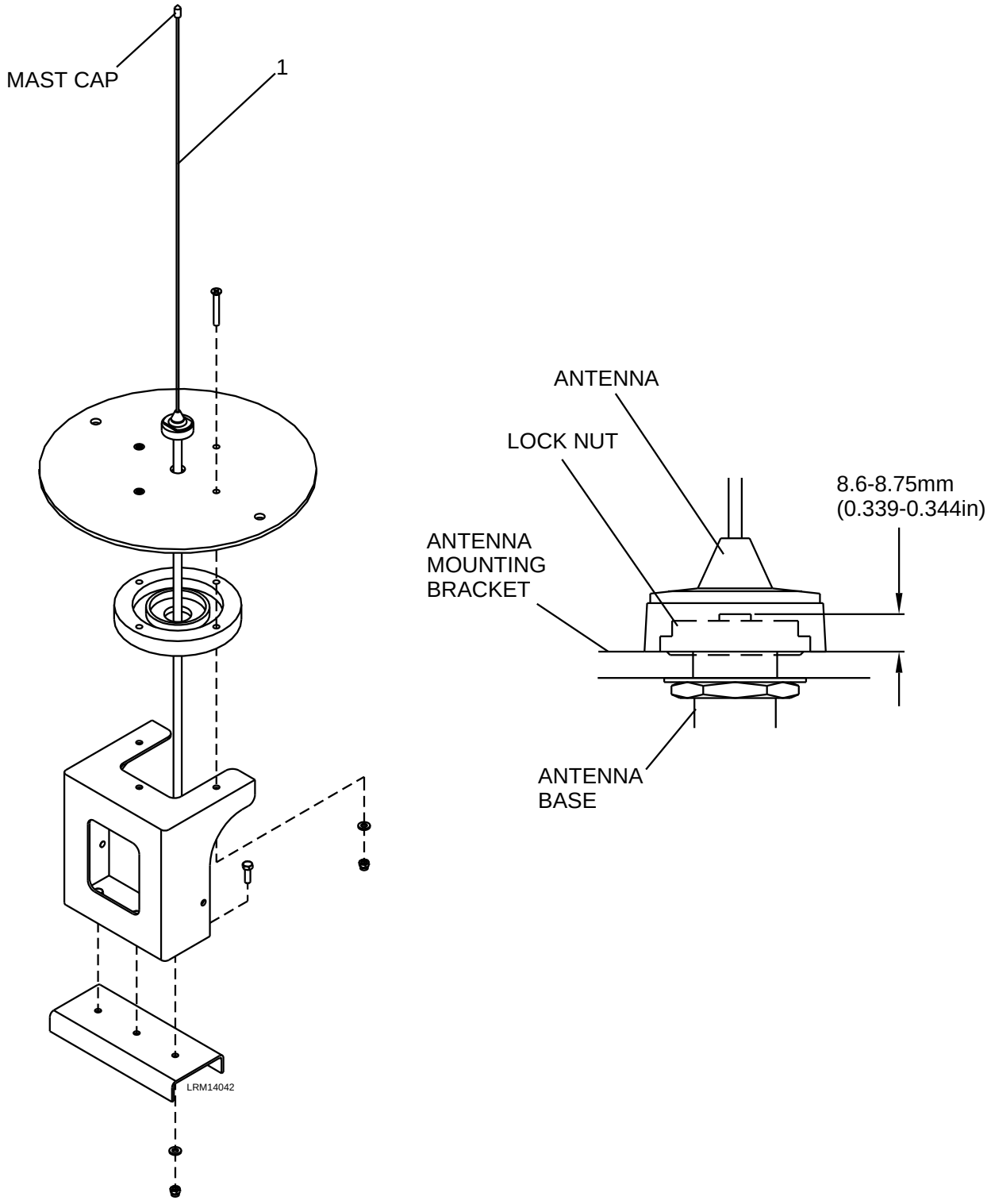

Figure 8-16: Radio Antenna

8.4.2 Exterior Signs

The cause of a malfunctioning destination sign is typically determined using the portable test equipment (PTE) or TOD utility. Refer to Section 9.4. Once the cause is identified, the applicable sign is normally removed, and a replacement sign installed, allowing the vehicle to re-enter service. The removed sign is repaired and returned to inventory for re-use.

8.4.2.1 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 8-17.
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).

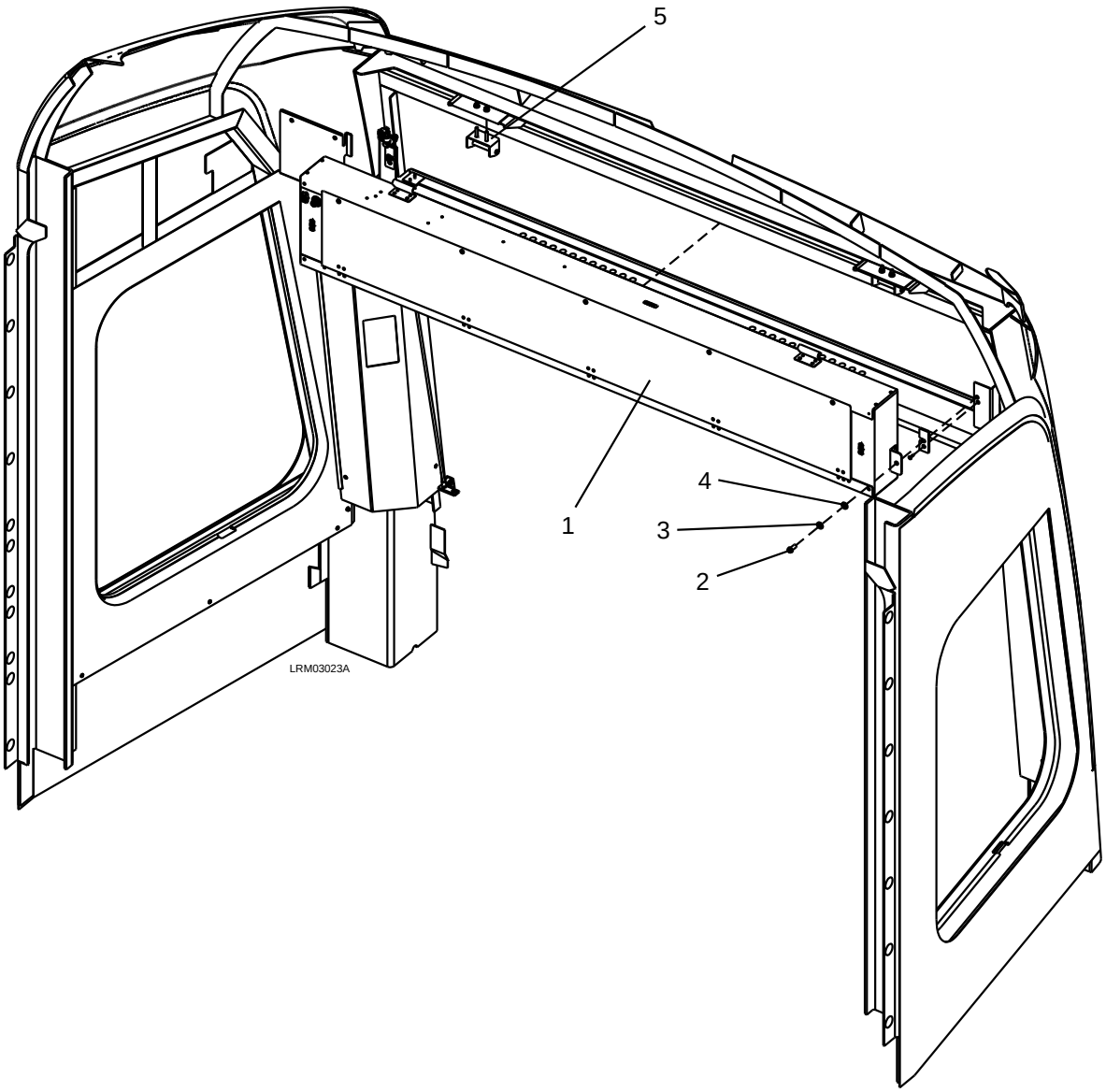

Figure 8-17: Front Destination Sign

8.4.2.1.1 Replace Front Destination Sign Power Supply PCB

1. Remove front destination sign assembly (1, Figure 8-18) 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).

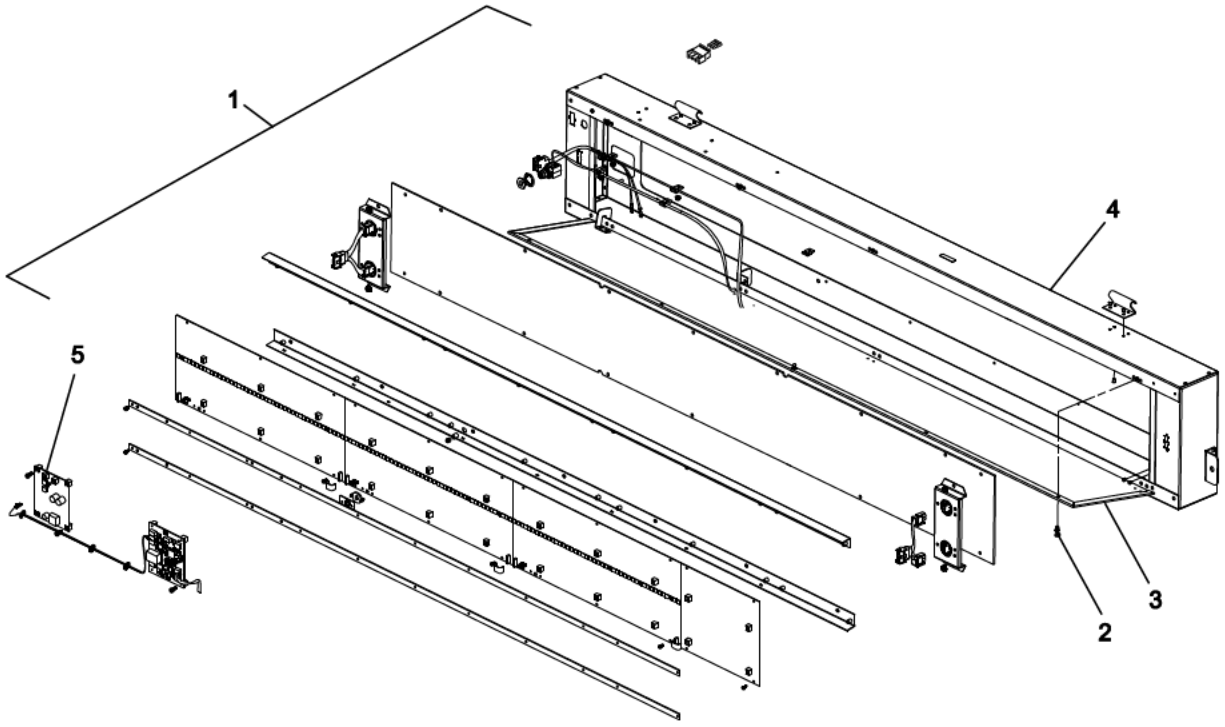

Figure 8-18: Replace Front Destination Sign Power Supply PCB

8.4.2.1.2 Replace Front Destination Sign Control PCB

1. Remove front destination sign assembly (1, Figure 8-19) 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).

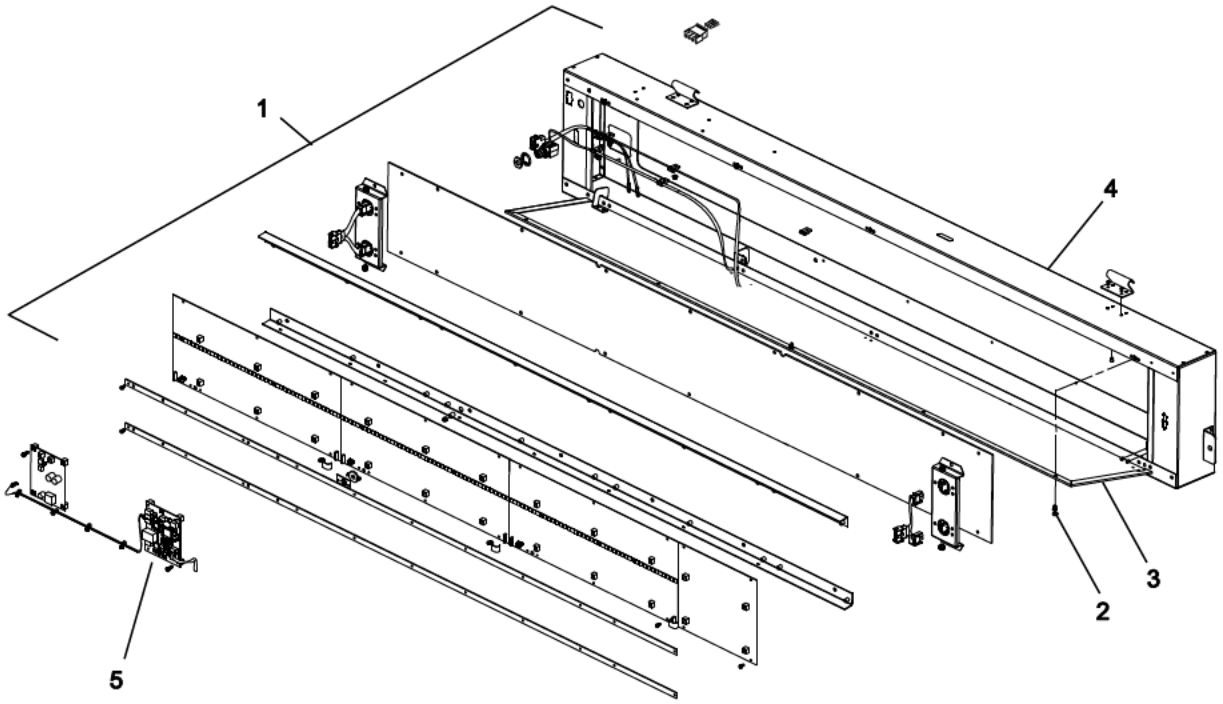

Figure 8-19: Replace Front Destination Sign Control PCB

8.4.2.1.3 Replace Front Destination Sign Light Sensor PCB

1. Remove front destination sign assembly (1, Figure 8-20) 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).

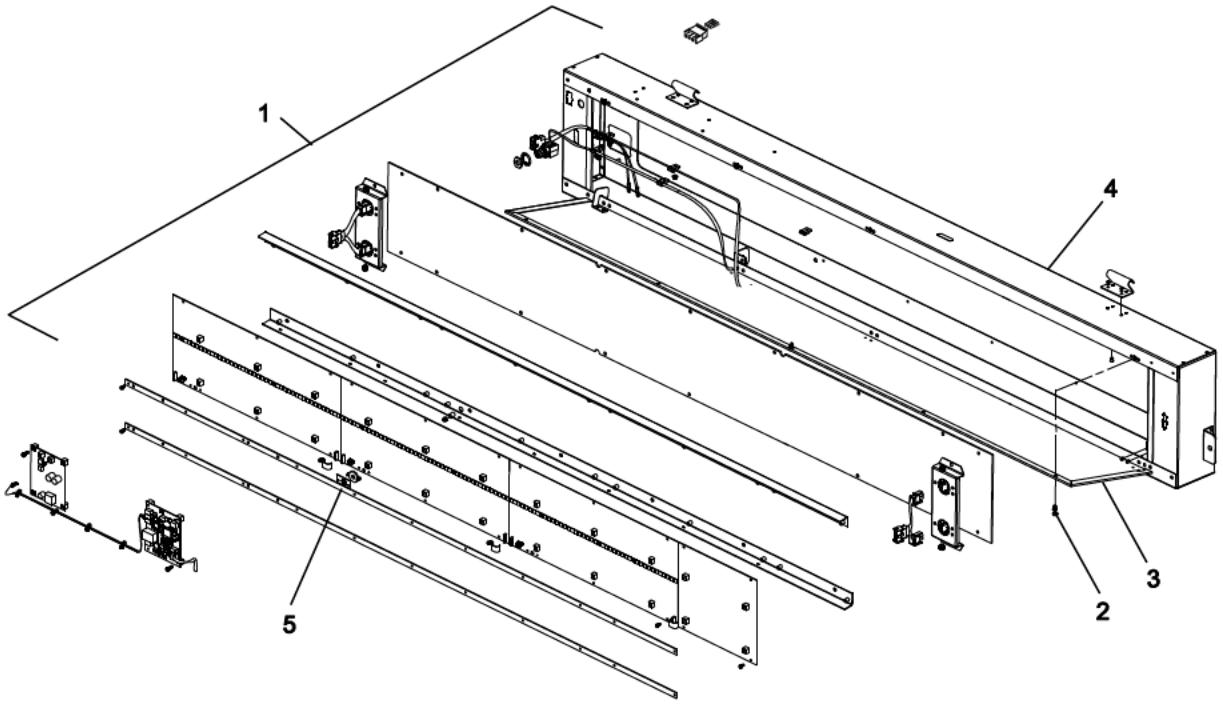

Figure 8-20: Replace Front Destination Sign Light Sensor PCB

8.4.2.1.4 Replace Front Destination Sign LED Display Matrix PCB

1. Remove front destination sign assembly (1, Figure 8-21) 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).

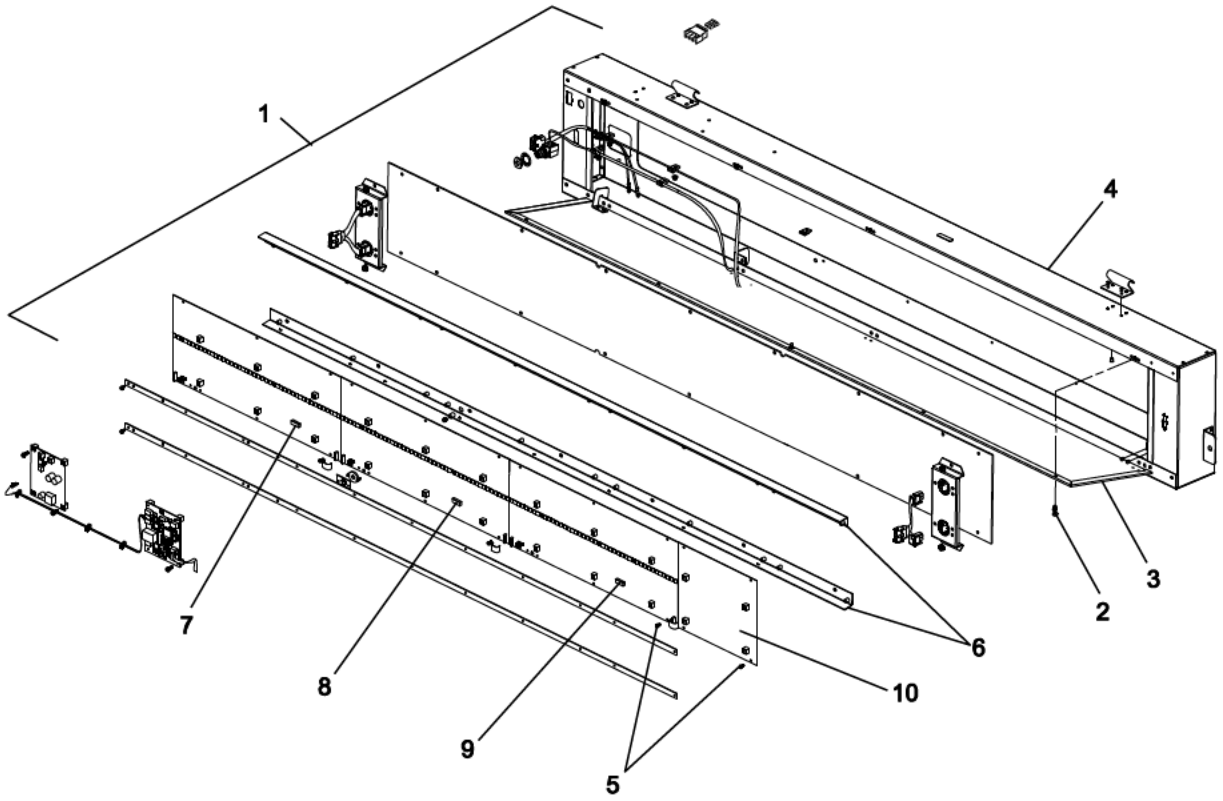

Figure 8-21: Replace Front Destination Sign LED Display Matrix PCB

8.4.2.2 Side Destination Sign

1. Remove the seven M4 x 12 screws (1) and M4 plain washers (2) from the cover (3). See Figure 8-22.
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).

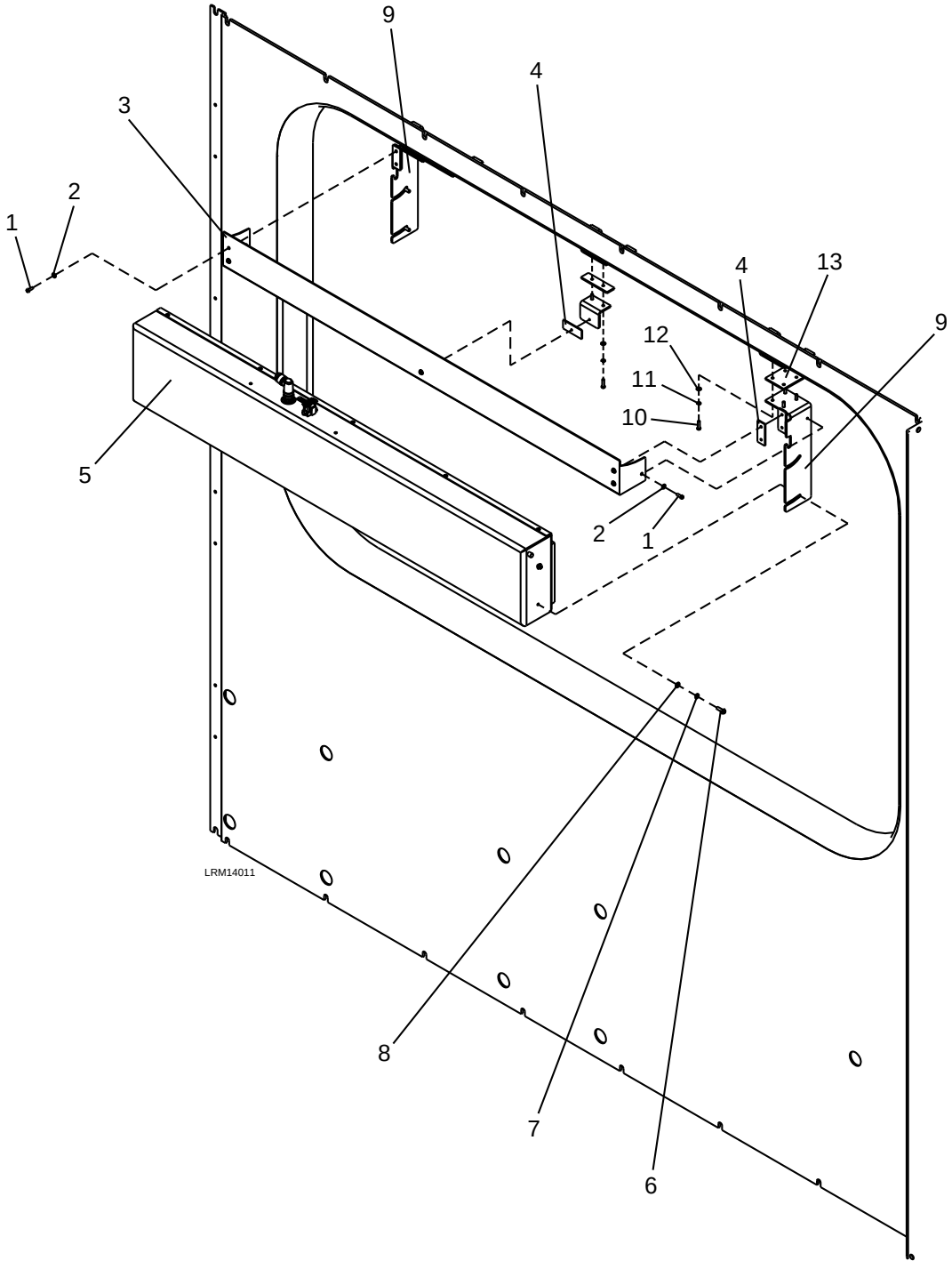

Figure 8-22: Side Destination Sign

8.4.2.2.1 Replace Side Destination Sign Power Supply PCB

1. Remove side destination sign assembly (1, Figure 8-23) 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).

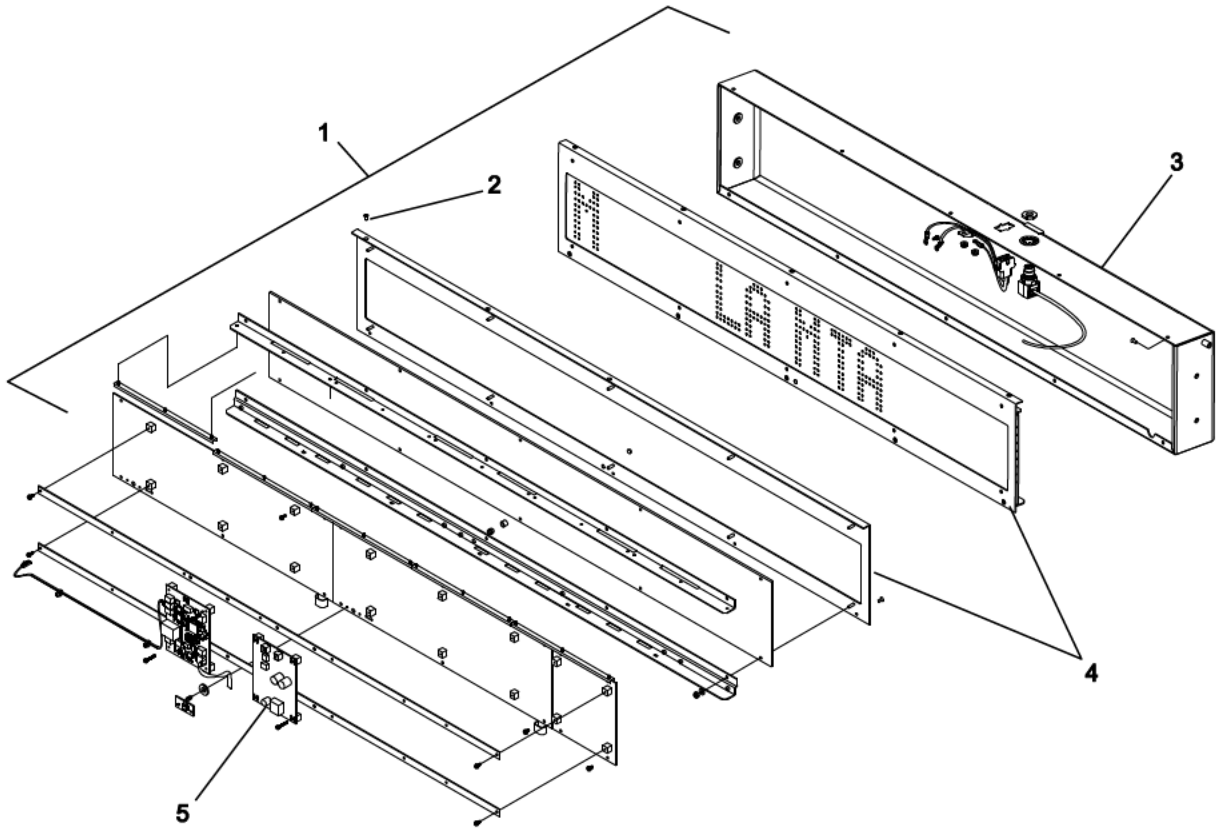

Figure 8-23: Replace Side Destination Sign Power Supply PCB

8.4.2.2.2 Replace Side Destination Sign Control PCB

1. Remove side destination sign assembly (1, Figure 8-24) 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).

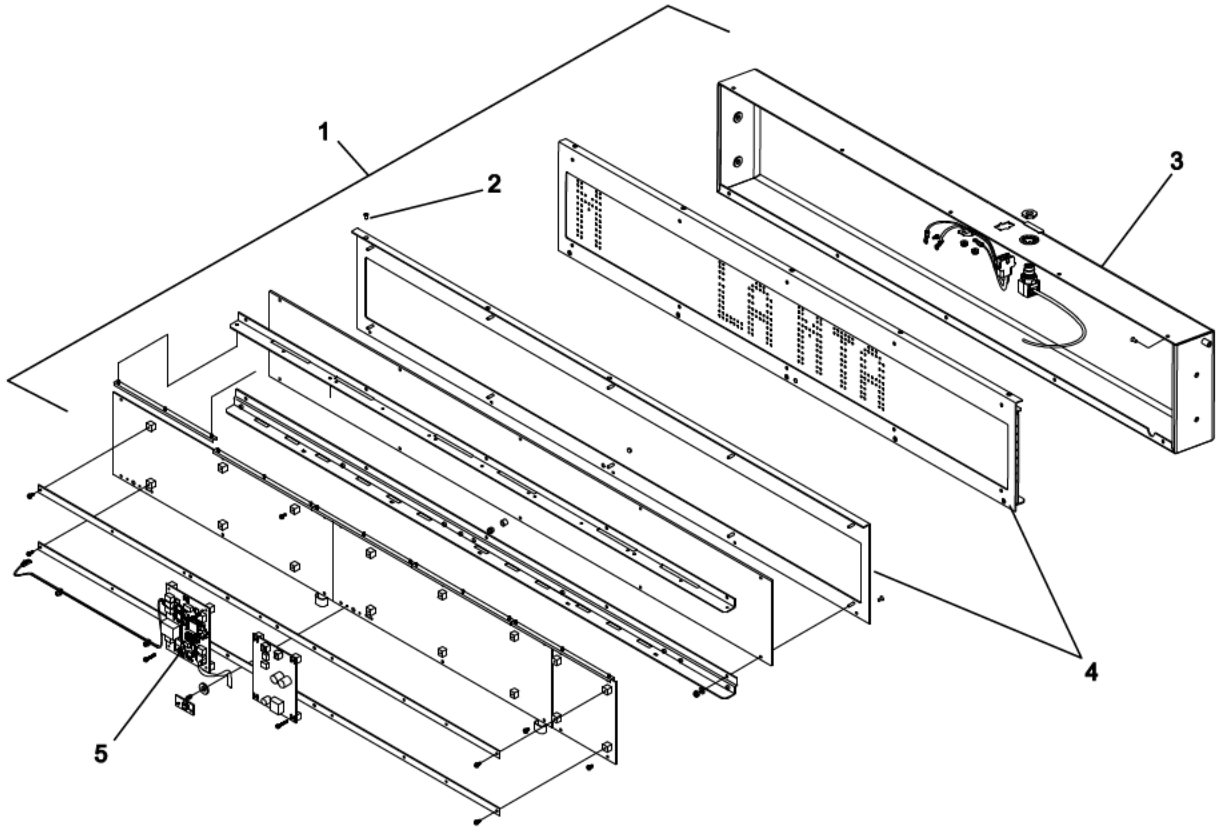

Figure 8-24: Replace Side Destination Sign Control PCB

8.4.2.2.3 Replace Side Destination Sign Light Sensor PCB

1. Remove side destination sign assembly (1, Figure 8-25) 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).

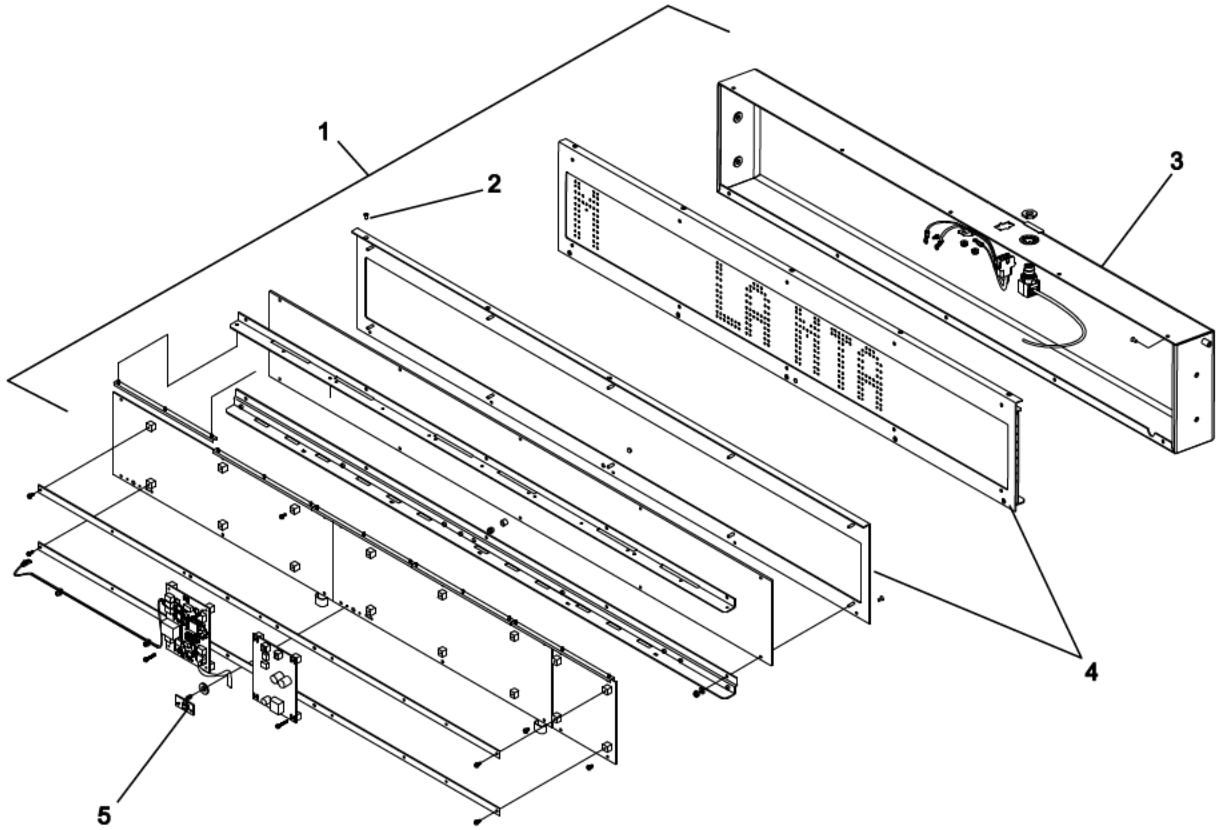

Figure 8-25: Replace Side Destination Light Sensor PCB

8.4.2.2.4 Replace Side Destination Sign LED Display Matrix PCB

1. Remove side destination sign assembly (1, Figure 8-26) 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.
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).

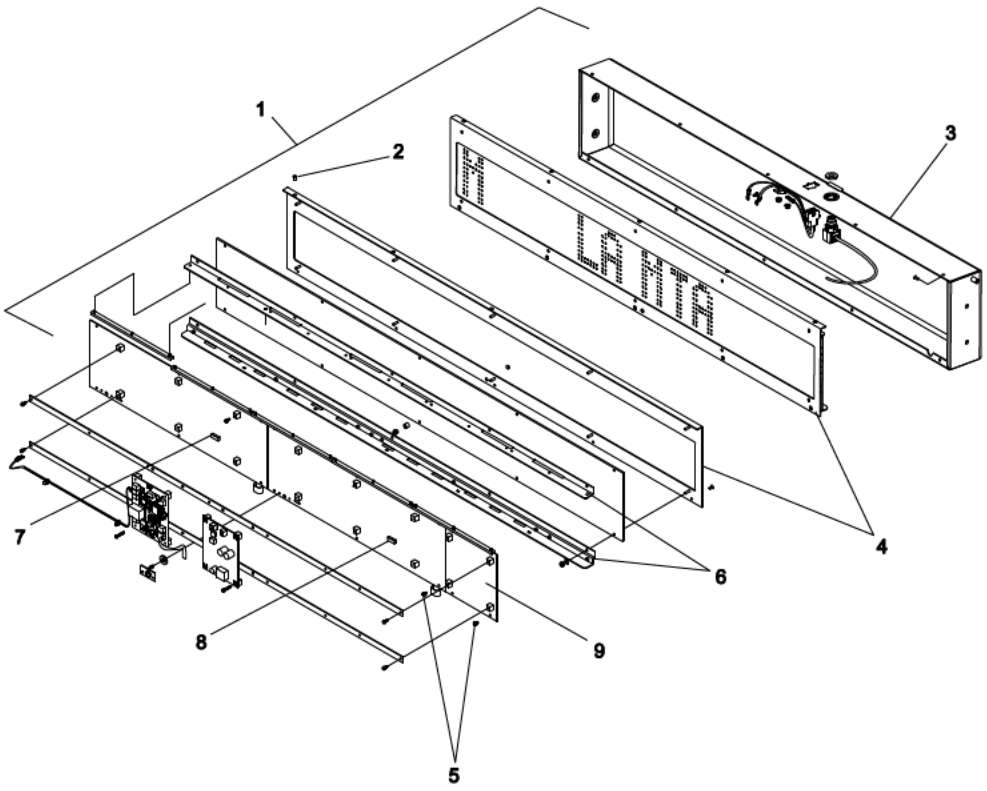

Figure 8-26: Replace Side Destination Sign LED Display Matrix PCB

8.4.3 Horn

8.4.3.1 Horn / Gong 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 8-27.

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

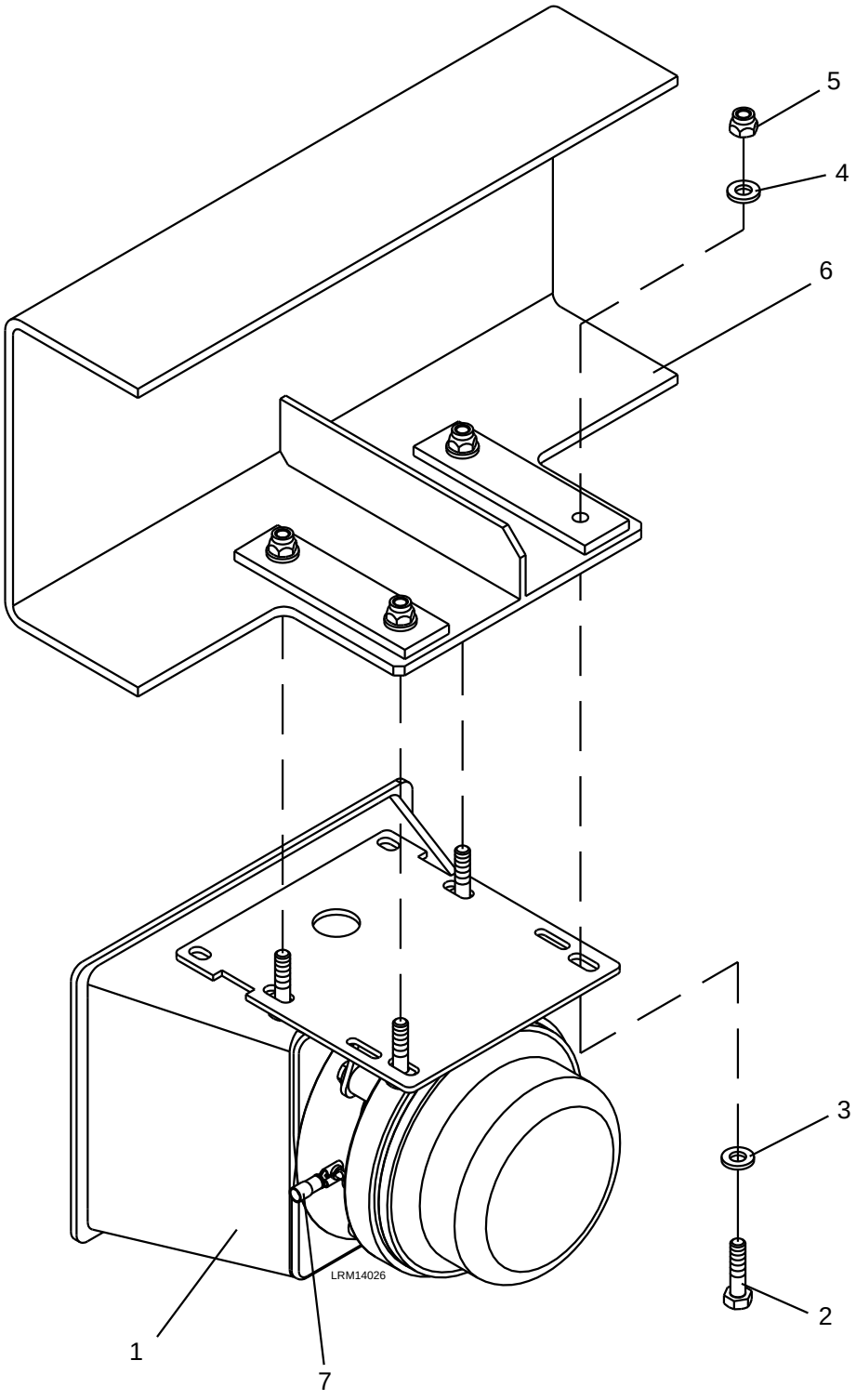

Figure 8-27: Horn / Gong Speaker

8.4.3.2 Horn Controller Panel

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 8-28.

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).

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 8-28.

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).

8.4.4 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 8-29.

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

3. Carefully remove the WWAS (1).

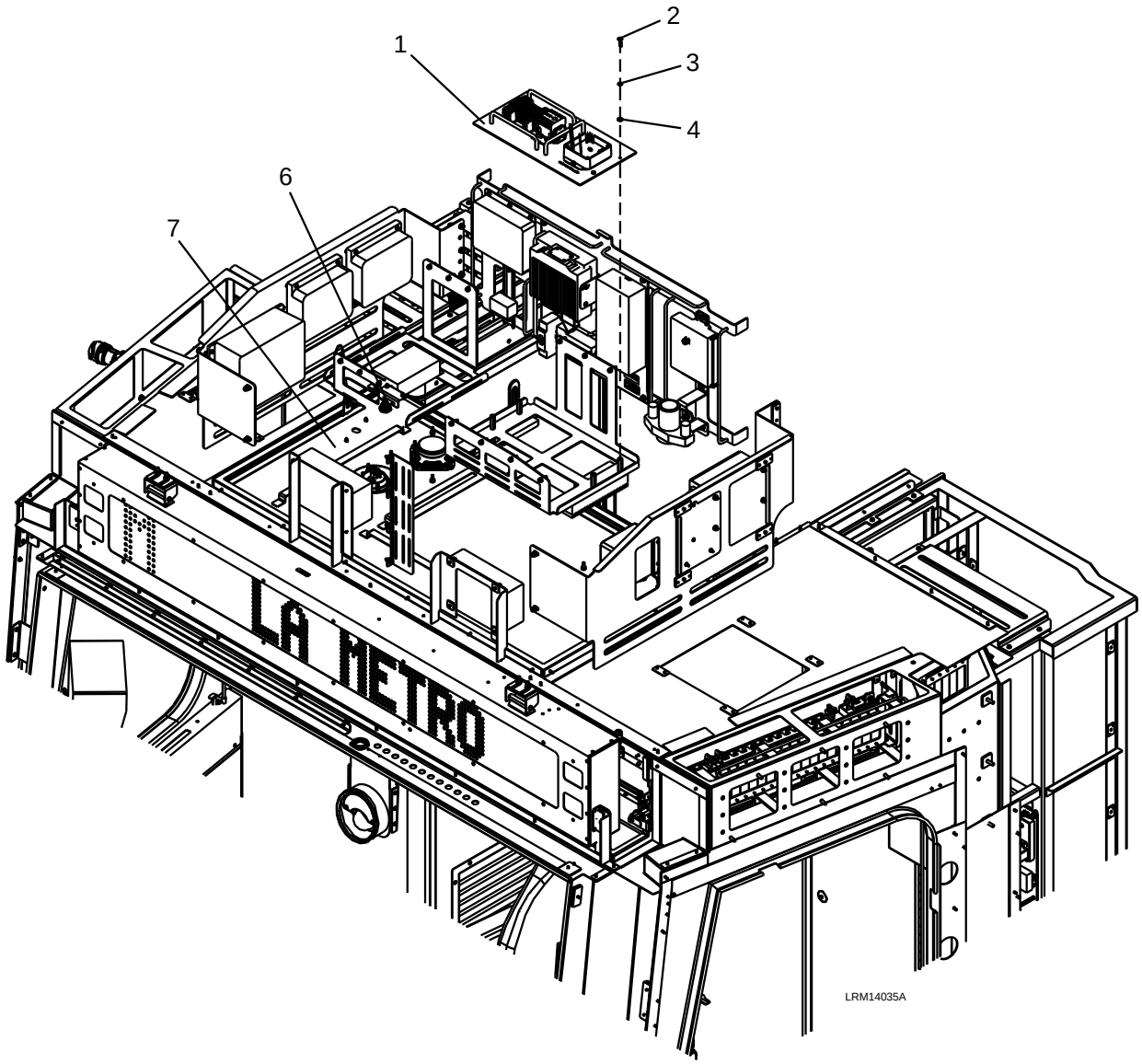

Figure 8-28: Horn Controller Panel
(Sheet 1 of 2) (Cars 1001 through 1025)

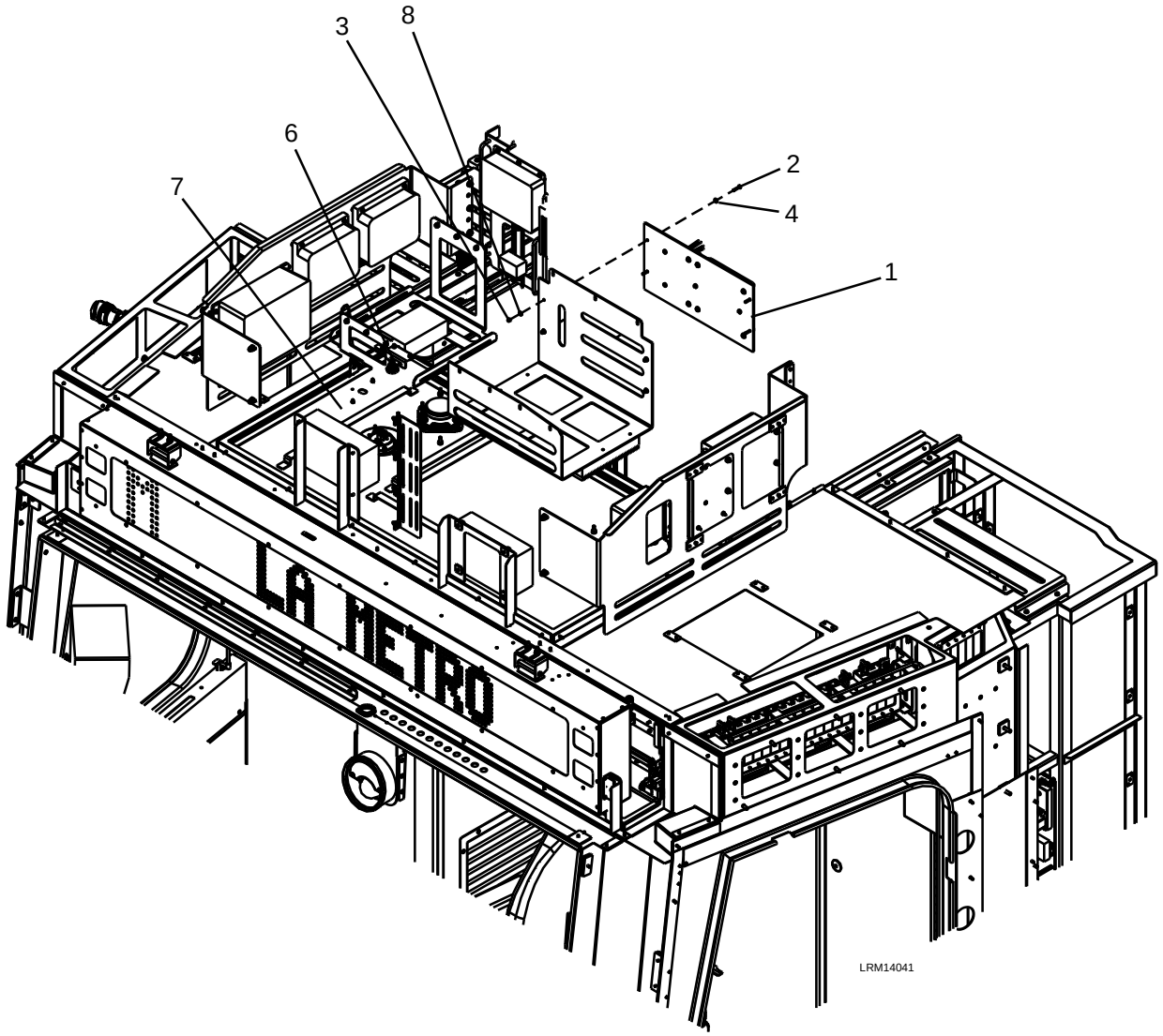

Figure 8-28: Horn Controller Panel
(Sheet 2 of 2) (Cars 1026 and Later)

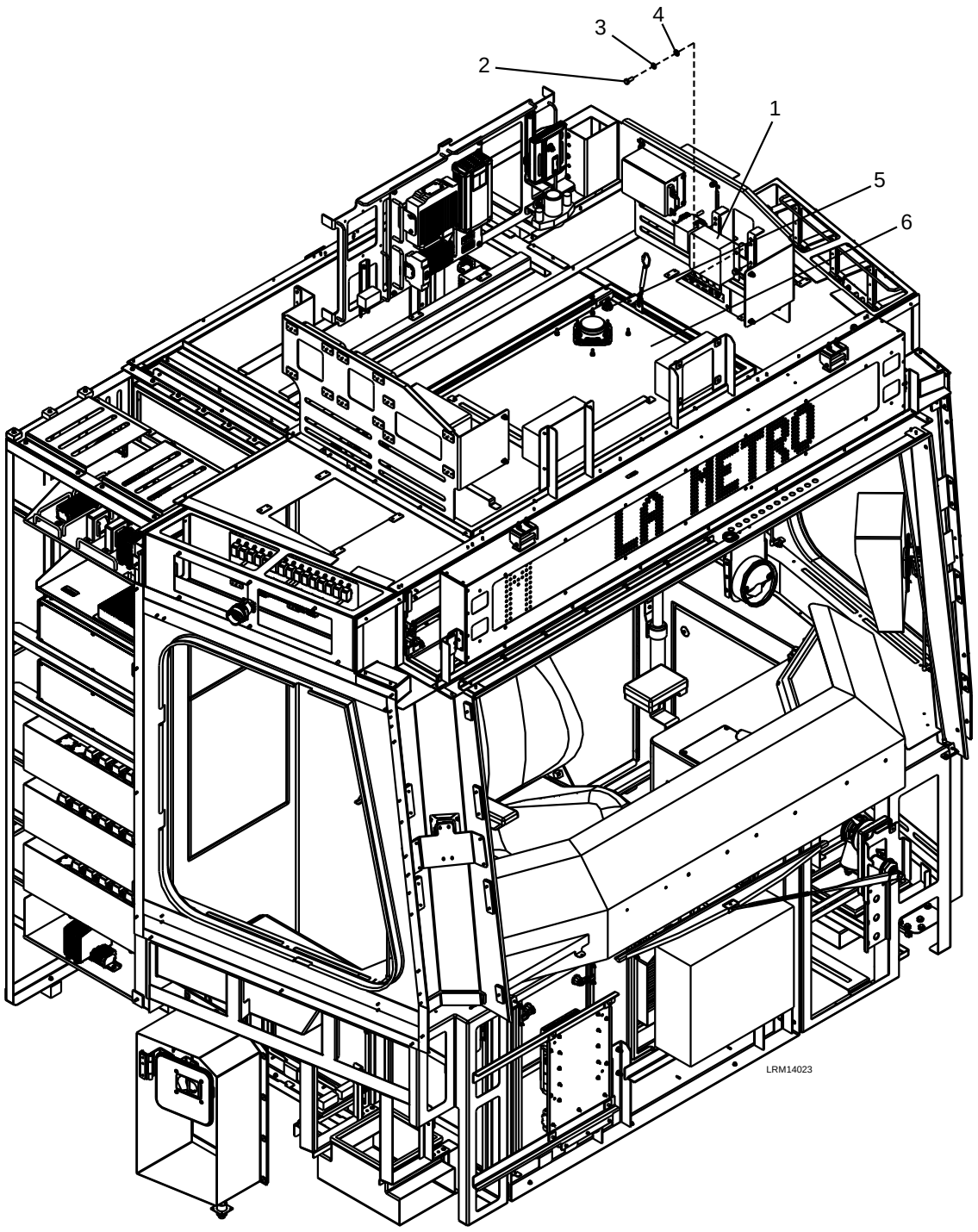

Figure 8-29 Wayside Worker Alert System (WWAS)

8.4.5 Foot Pedal

The foot pedal or foot switch removal and installation instructions are located in Sections 7.4.1.16 and 7.5.1.16 of Section 0200, Car Body of the Running Maintenance and Servicing Manual. The foot pedal switch is wired directly into a RIO digital input.

WARNING

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8.5 Installation

All active system components require functional testing after installation. Section 9.3 describes the functional test. 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. Additionally, the current software configuration (list separately maintained) should be confirmed using the Software Versions screen on the TOD after equipment replacement.

Programming of Communications Equipment is covered by three (3) separate manuals. They are:

- Communications Equipment Programming Guide
- ACP (Audio Control Panel) Programming Guide
- Exterior Destination Sign(s) PTU Manual (for firmware installation)

8.5.1 Communication System

8.5.1.1 Communication Control Unit (CCU) Panel

1. Open the right-side electric locker door located in the A-Unit. See Figure 8-1.
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 8.3 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.

8.5.1.2 Audio Control Panel (ACP1A)

1. Open the right-side electric locker door located in the A-Unit. See Figure 8-2.
2. Carefully install the ACP1A Panel (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 8.3 of this manual section.
5. Connect the electrical connectors (5) to the ACP1A Panel (1).
6. Close the right-side electric locker door located in the A-Unit.
7. This unit requires programming with the ACP utility program found on the PTU. The car number must be entered and the modules commissioned.

8.5.1.3 Audio Control Panel (ACP1B)

1. Open the right-side electric locker door located in the B-Unit. See Figure 8-3.
2. Carefully install the ACP1B Panel (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 8.3 of this manual section.
5. Connect the electrical connectors (5) to the ACP1B Panel (1).
6. Close the right-side electric locker door located in the B-Unit.
7. This unit requires programing with the ACP utility program found on the PTU. The car number must be entered and the modules commissioned.

8.5.1.4 Radio

1. Unlock the two locks (5) and lower the cab ceiling panel (6). See Figure 8-4.
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 8.3.

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 9.8 of this manual section.

8.5.1.5 Passenger Information Display

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 8-5.

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 8.3 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 8-5 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.

8.5.1.5.1 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 8-6.

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 8.3.

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.

8.5.1.5.2 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 8-7.

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.

8.5.1.5.3 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 8-8.

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 lock washers (3), and M4 plain washers (4).

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 (6) and secure.

7. Replacement of the Passenger Information 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.

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 8-8.

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 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 (7) and secure.

7. Replacement of the Passenger Information 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.

8.5.1.6 Global Positioning System (GPS) 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 8-9.

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.).

8.5.1.7 Ethernet Remote Input / Output (RIO)

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

1. Unlock the two locks (2) and lower the cab ceiling panel (3) to access the Ethernet Remote I/O (1) mounting. See Figure 8-10.
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.

8.5.1.8 In-Dash Microphone

1. Connect the In-Dash Microphone (3) connector to the panel wiring. See Figure 8-11.
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).

8.5.1.9 Cab 4” Speaker

1. Unlock the two locks (11) and lower the cab ceiling panel (1). See Figure 8-12.
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 8.3 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).

8.5.1.10 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 8-13.
2. Align the holes in the Passenger Intercom (2).
3. Insert the four M4 x 16 screws (1) and tighten.

8.5.1.11 Exterior Speaker

1. Carefully place the Exterior Speaker (1) onto the mounting bracket (6) aligning the mounting holes. See Figure 8-14.
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).

8.5.1.12 Interior 6” 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. 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 8-15.
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 8.3 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.

8.5.1.13 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 8-16.
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 9.8 of this manual section following replacement of the Radio Antenna.

8.5.2 Exterior Signs

8.5.2.1 Front Destination Sign

1. Carefully install the Front Destination Sign (1) by hanging on the bracket (5). See Figure 8-17.
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.

8.5.2.2 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 8-18.
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 8.3 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.).

8.5.3 Horn

8.5.3.1 Horn / Gong Speaker

1. Carefully install the Horn / Gong Speaker (1) on the mounting bracket (6) aligning the mounting holes. See Figure 8-27.
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 8.3 of this manual section.
4. Connect the 1/4” Faston electrical connections to the Horn / Gong Speaker (1).

8.5.3.2 Horn Controller Panel

Horn controller must be adjusted for proper sound level upon replacement. Refer to Section 6.3.3.2 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 8-28.
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 8-28.
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).

8.5.4 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 8-29.
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 8.3 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 6.3.4 following replacement of the WWAS.

CHAPTER 9.0

TROUBLESHOOTING

9.1 Introduction

This chapter provides troubleshooting procedures for the Communications equipment.

9.2 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 off line 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.

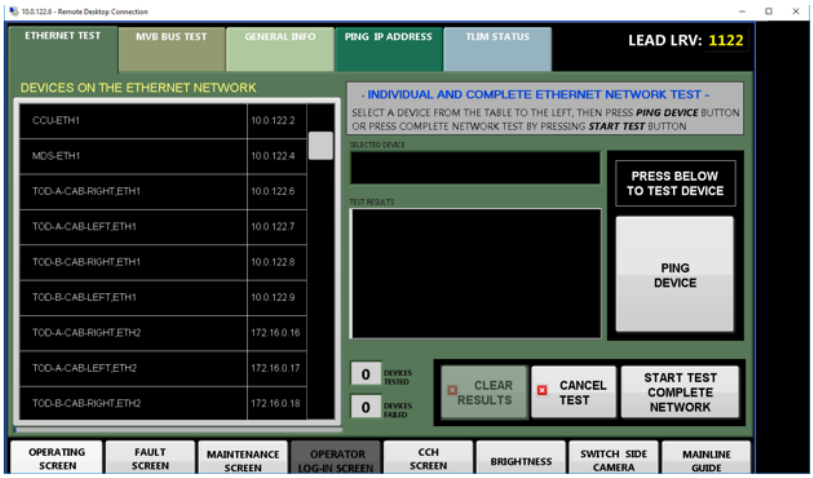


Figure 9-1: TOD Ping Test Screen

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. Additionally, from the Maintenance Tab, 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 9-2 of Section 9.6 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 Acoustic Module (ACM) maybe malfunctioning or wiring to that module 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 micro controllers, ACMs, 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 9.3 to determine the specific issues and to confirm reported symptoms of communications system errors.

If the TOD displays **PA READY WITH ERRORS**. Check the active fault list to determine the fault. If the fault has cleared from the active fault list the fault log will provide symptoms of the fault that caused the error. These symptoms should provide a focus for troubleshooting the anomaly.

9.3 Communications Functional 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.

PART 1

1. From the A cab, turn the transfer key to the on position to take an active cab.

2. Verify the software version on the TOD through the Software Version screen.

MDS		SYSTEM	P3010_20??_X_XX
CCU		SYSTEM	P3010_20??_X_XX

3. Confirm that the CCH displays “PA System Ready”

4. With the speaker selection switch in the exterior only position, make a test PA announcement using the foot pedal and confirm functionality. This must be heard on the EXTERIOR ONLY.

5. With the speaker selection switch in the interior only position, use the Push to Talk soft button on the TOD to make an announcement and confirm functionality. This must be heard on the INTERIOR ONLY

6. With the speaker selection switch in the interior and exterior position, use the Cab Console PTT button to make an announcement and confirm functionality. This must be heard on the EXTERIOR AND INTERIOR ONLY.

7. Depress the Door Close Warning pushbutton button to make a door close warning announcement and confirm functionality. This must be heard on the INTERIOR Speakers regardless of the switch position.

8. Depress the PIC closest to the cab in the A car and confirm that the PIC alarm sounds in the cab.

9. Connect the call using the PA/IC/Radio switch and confirm communication to and from the cab.

10. Disconnect the call using the PA/IC/Radio switch.

11. From the PIC closest to the articulation on the A side, depress the PIC button and confirm that the PIC alarm sounds in the cab.

12. Connect the call using the soft button on the CCH and confirm communication to and from the cab.

13. Disconnect the call using the soft button on the CCH.

14. Place the speaker select switch in the Exterior Only position. From the CCH, play the Train Out of Service announcement and confirm that it sounds.

15. Repeat steps 1 through 14 in the B cab.

PART 2

1. From the A cab, turn the transfer key to the on position to take an active cab.

2. On the right side TOD select the route 7th and Metro to Santa Monica.

3. Confirm the front signs oscillate from Santa Monica to Expo Line.

4. Confirm that all (4) PIDS Display the proper route.

5. Confirm the TOD Shows a START ROUTE.

6. Wait 30 Seconds, Depress the start Route and confirm the “Welcome Aboard Message” is heard.

7. Check all (4) PIDs Displays and confirm they show the route that was selected.

8. Key down the A Cab.

9. From the B cab, turn the transfer key to the on position to take an active cab.

10. On the right side TOD select a Gold line Route.

11. Confirm the front signs display the correct end destination.

12. Confirm that all (4) PIDS Display the proper route.

13. Confirm the TOD Shows a START ROUTE.

14. Wait 30 Seconds, Depress the start Route and confirm the “Welcome Aboard Message” is heard.

15. Check all (4) PIDs Displays and confirm they show the route that was selected.

16. Key down the A Cab.

9.4 Signs Troubleshooting

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

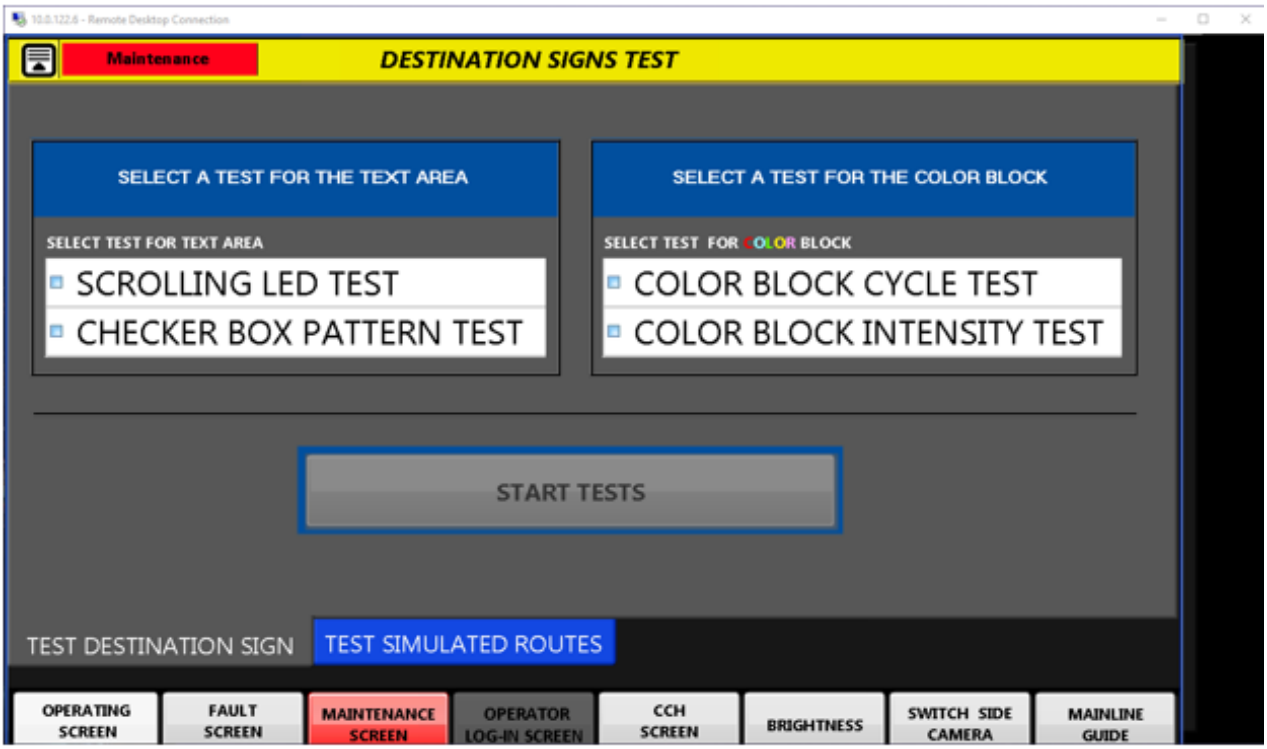


Figure 9-2: Destination Sign Test Screen

A destination sign test routine is built into the TOD. Patterns can be initiated from the test screen, as shown above to confirm proper sign operation. If the signs are not operating properly, following steps in Table 9-1 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 8.4.2 of this manual

Table 9-1. 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 CCU is loose or defective.	Replace CCU. Refer to appropriate RMM for procedure.
	CCU 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

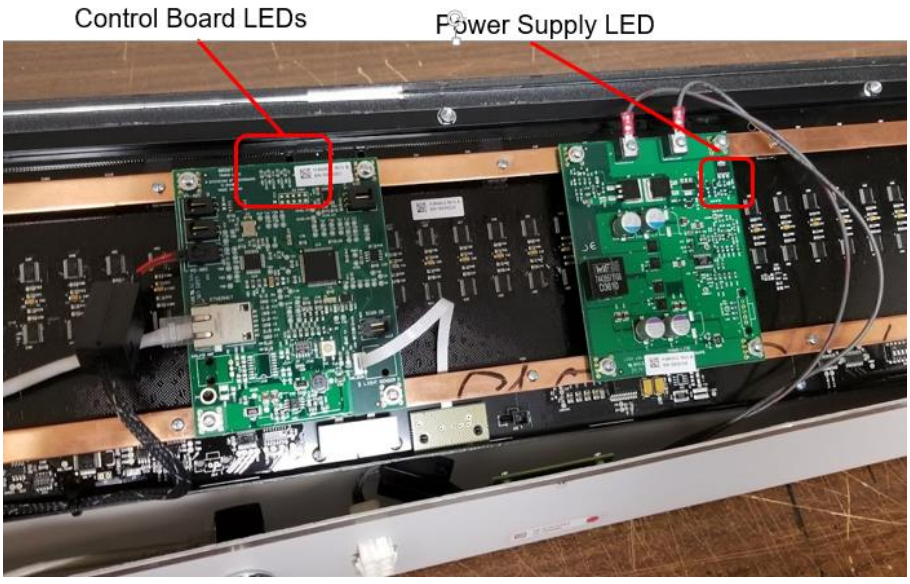
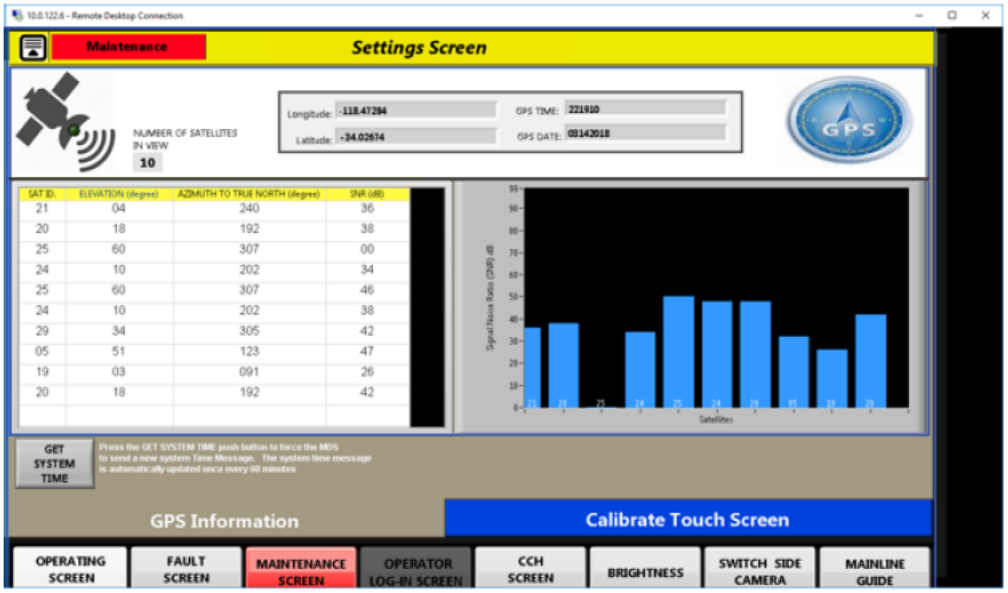


Figure 9-3: Sign Control Boards LEDs

9.5 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, Section 4.3.



9.6 Passenger Information Displays (PIDS) Troubleshooting

The IAADS / PIDS controller, located in the A-End cab ceiling, plays prerecorded station announcements and public service announcements to the interior speakers while controlling the Passenger Information Displays in the vehicle. There is a 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. Refer to Sections 2.8.3 and 3.2.1.5 for more detail on equipment functionality and locations.

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 drives 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 are the VGA displays, VGA cables, VGA transmitter(s), VGA receiver(s) and the controllers.

Video distortion or color abnormally 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.

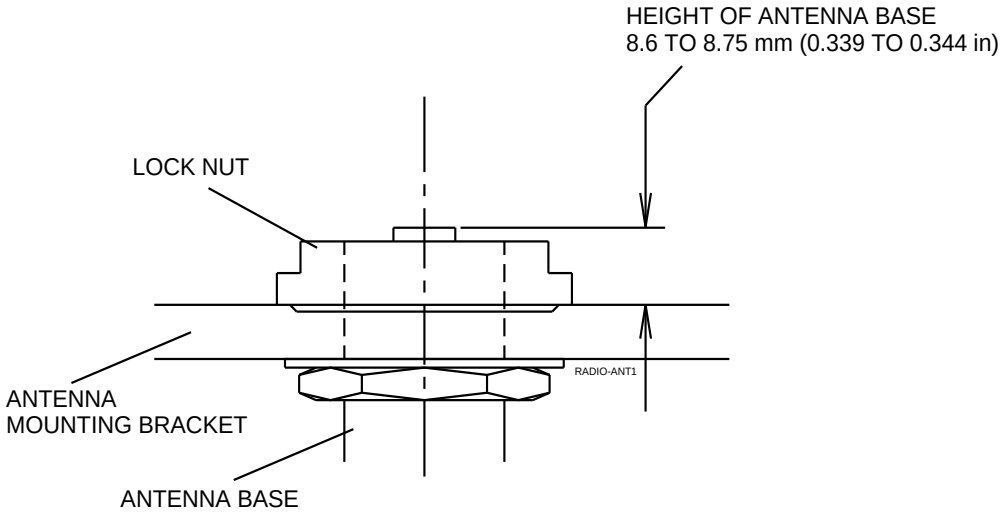
If the equipment / hardware checks out then the software on the controller may be corrupted. Confirm the software is correct by reloading and restarting the system. Refer to the Communications Equipment Programming Guide for instructions on reloading and confirming software.

9.7 Radio Antenna Troubleshooting

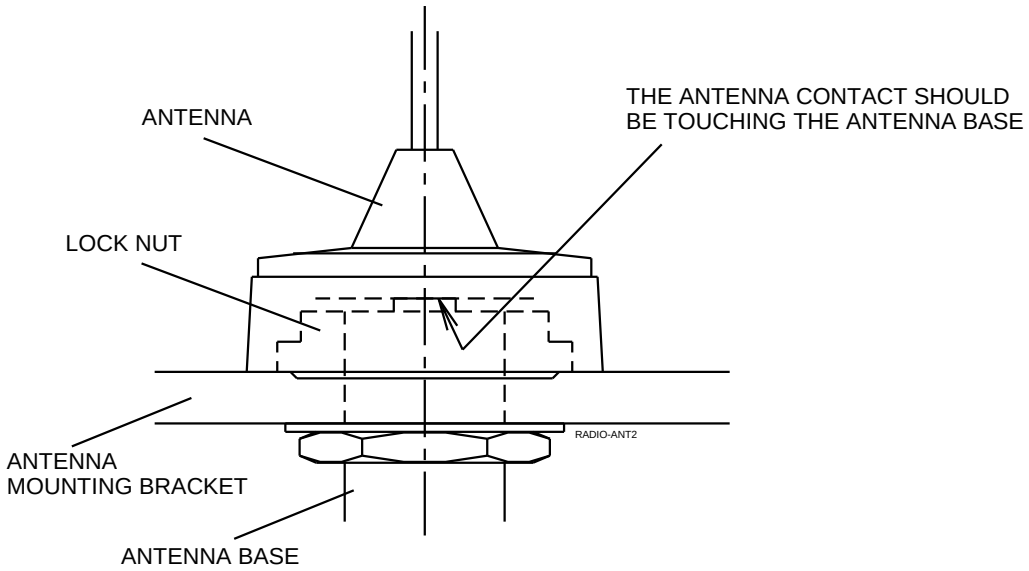
Typically, when the VSWR is higher it is an indication of a connection or grounding issue.

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.

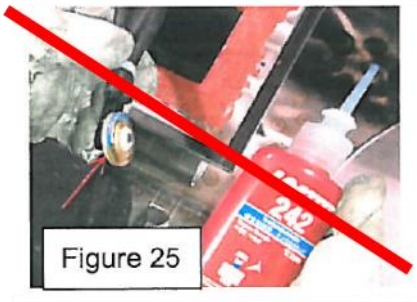


b. The antenna contact should be touching the antenna base.



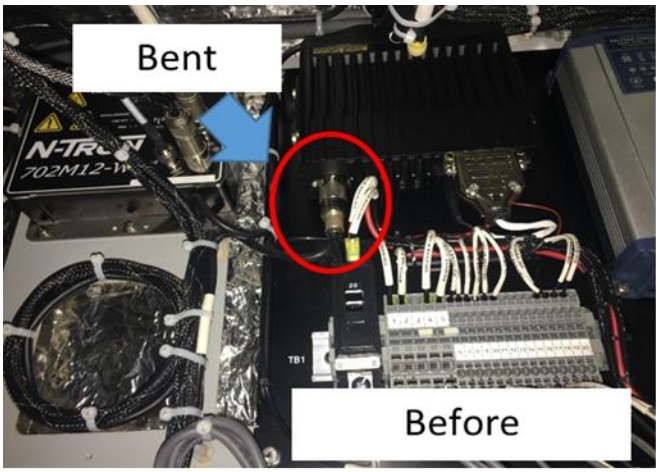
2. Grounding

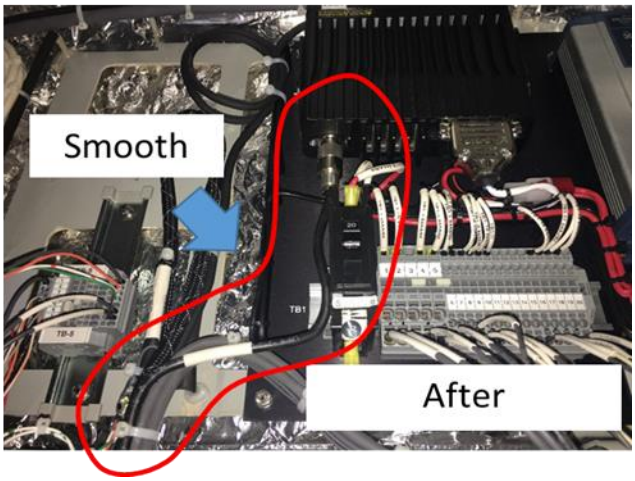
Do not apply Loctite around the threads of the radio antenna. Loctite is not electrically conductive. Clean the internal threads of the antenna base with a 3M Scotchbrite pad to remove the dielectric coating and assure proper electrical connection/grounding.



3. Coaxial cable

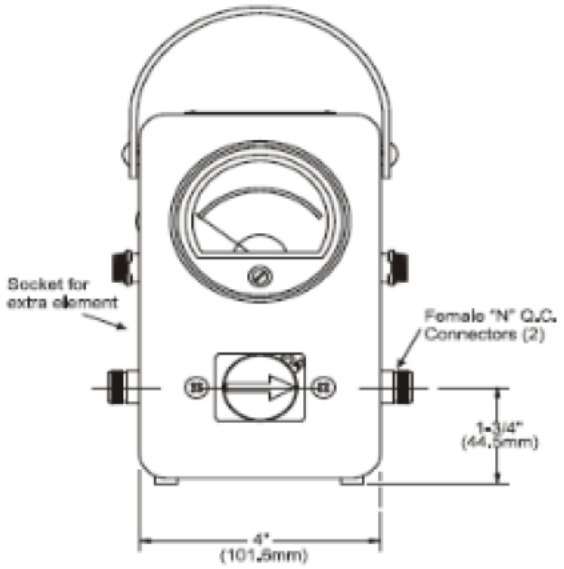
The coaxial cable wiring should be straight. DO NOT BEND THE CABLE.





9.8 Radio Antenna SWR Test

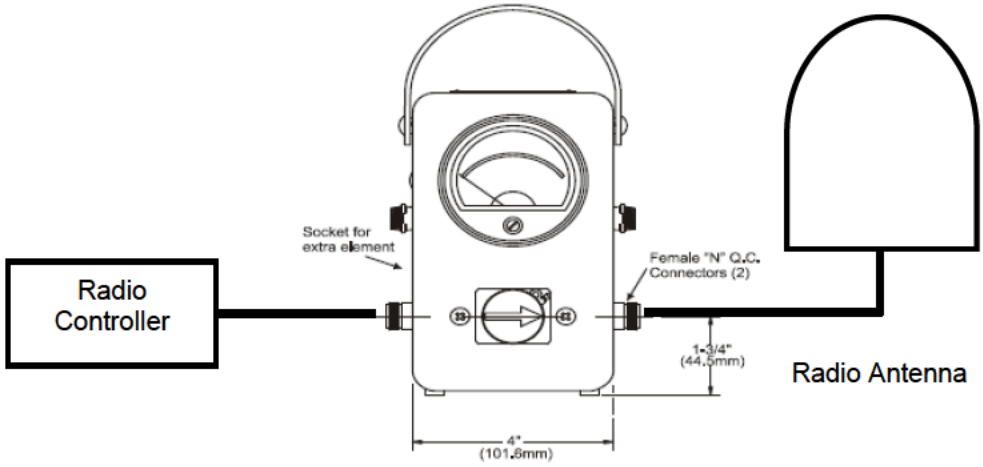
The SWR value shall be tested, using the watt meter as shown below.



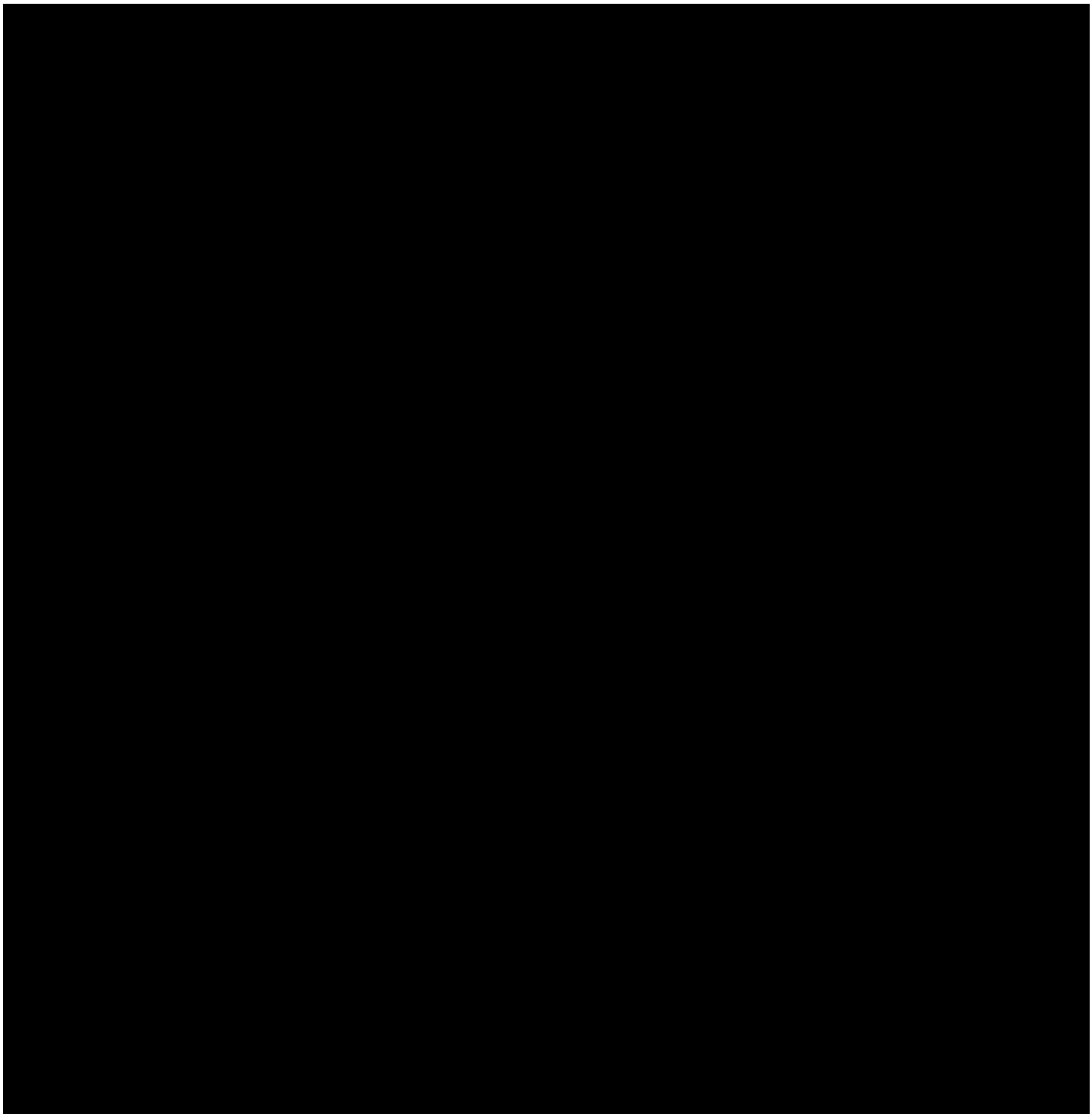
Watts meter

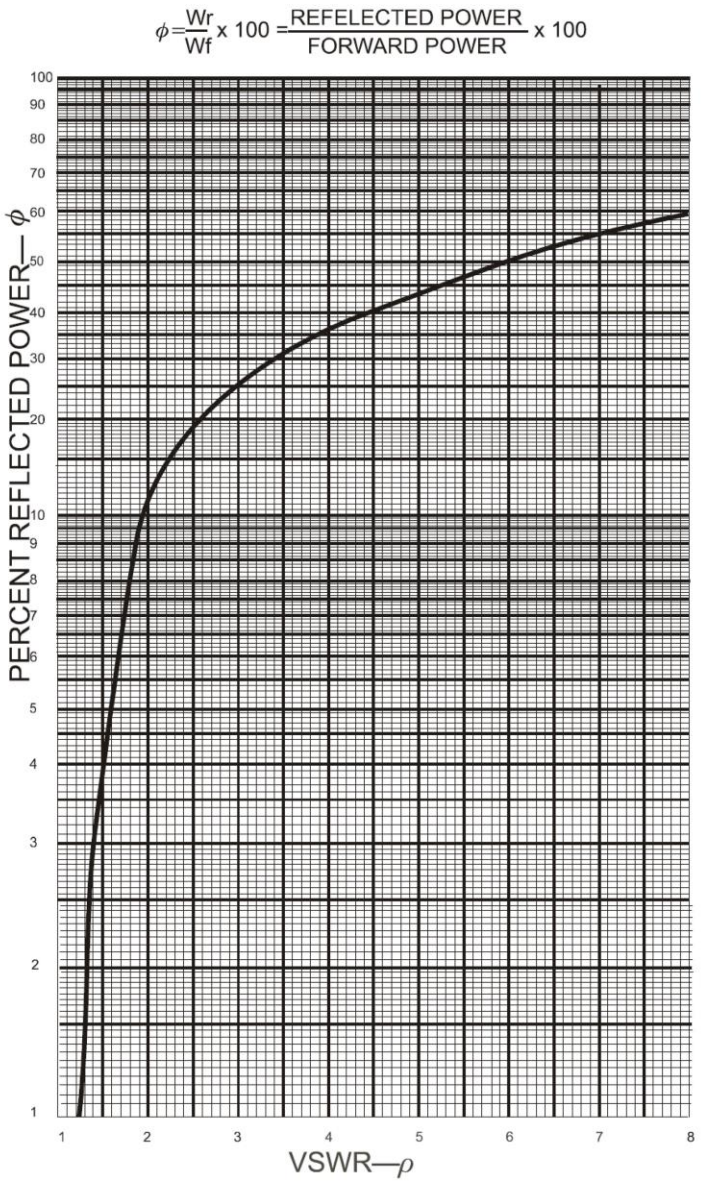
Setting

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





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

9.9 Troubleshooting Charts

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

Table 9-2 contains the troubleshooting procedures for the Communications 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 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 9-2. 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
TOD CCH screen does not change to PA Ready	There is communication error between the ACPs and CCU	Confirm the network connections on the ACP via TOD ping test or link LED on Module
		Confirm the network connection on the CCU by ping test and or inspection
		Confirm the network connection on the TOD by ping test
		Reprogram the ACP
		Replace the ACP
		Replace the CCU
TOD CCH screen does not change to PA Ready or PA Ready with Errors, ie PA Not Ready	Invalid Train or no Ethernet trainline. CCU application program corrupted	Check for proper train configuration / valid train
		Check for proper operation of EEI module / check EEI connectivity
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

Table 9-2. Communications Troubleshooting (cont.d)

Symptom	Probable Cause	Remedy
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
There is no sound on an end of the vehicle	The audio control panels are not connected or are not powered.	Ensure that the VMS circuit breaker is turned on
		Using the TOD confirm that the PA zones on the audio control are on the network
		Check the CN connectors on the ACP to ensure a tight connection
		Check the PULS power supply modules to ensure they are providing power. Replace if faulty
		Replace the audio control panel
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

Table 9-2. Communications Troubleshooting (cont'd.)

Symptom	Probable Cause	Remedy
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
No audio generated from In-Dash Mic when activated by PTT(s)	Damaged or disconnected Mic, Mic ACM module defective, PTT(s) inoperative	Confirm PTT functionality for all PTTs replace hardware if defective, Replace ACM if defective.
PID displays abnormal color or tint	Bad VGA cable to display monitor or VGA extender module	Check VGA cable, replace if necessary
		Check VGA Module
PID A-End or PID B-End inoperative	PIDs are independent troubleshoot each end separately	Refer to Section 9.6
Both PIDs on one LRV section do not display	PIDs have common point at transmitter and controller. Possible defective transmitter or PIDs controller	Confirm connectivity from controller to transmitter. Confirm PIDs controller operation. Confirm transmitter operation.
One PID on a LRV section does not display	If articulation display possible VGA Receiver or display. If Cab wall display possible display or transmitter.	Confirm receiver / transmitter. Confirm display operation. Replace as required.
PID or TOD Displays incorrect time.	GPS Error	Check GPS functionality using TOD. Replace GPS receiver as required. Refer to Section 9.5 of RMM.
Announcements occur early or prior to the station or repeat	Wheel diameter not adjusted after wheel truing	Adjust wheel diameter on TOD maintenance screen per actual diameters.

9.10 Fault List

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

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Table 9-3. Fault List

Fault/Status Name	Description of the Fault/Status	Possible Cause of the Fault	Corrective Action
PA_EXT_R_SPKR_ACM8_ERROR	PA Exterior Speaker RIGHT ACM to CCU General Error	ACP1A ACM8 Unit Error Detected	Check Eth ACP1A ETH8 port, Check Eth Switch LAN2A-Port 8, Replace ACP1A ACM8 Module
PA_INT_SPKR_ACM7_ERROR	PA Interior Speaker ACM to CCU General Error	ACP1A ACM7 Unit Error Detected	Check Eth ACP1A ETH7 port, Check Eth Switch LAN1A-Port 10, Replace ACP1A ACM7 Module
CAB_SPKR_A_ACM6_ERROR	CAB-A Speaker ACM to CCU General Error	ACP1A ACM6 Unit Error Detected	Check Eth ACP1A ETH6 port, Check Eth Switch LAN1A-Port 11, Replace ACP1A ACM6 Module
RADIO_A_ACM5_ERROR	RADIO-A Speaker ACM to CCU General Error	ACP1A ACM5 Unit Error Detected	Check Eth ACP1A ETH5 port, Check Eth Switch LAN1A-Port 12, Replace ACP1A ACM5 Module
MIC_A_ACM4_ERROR	MIC-A ACM to CCU General Error	ACP1A ACM4 Unit Error Detected	Check Eth ACP1A ETH4 port, Check Eth Switch LAN1A-Port 13, Replace ACP1A ACM4 Module
PIC2A_ACM3_ERROR	PIC2A ACM to CCU General Error	ACP1A ACM3 Unit Error Detected	Check Eth ACP1A ETH3 port, Check Eth Switch LAN1A-Port 14, Replace ACP1A ACM3 Module
PIC1A_ACM2_ERROR	PIC1A ACM to CCU General Error	ACP1A ACM2 Unit Error Detected	Check Eth ACP1A ETH2 port, Check Eth Switch LAN1A-Port 15, Replace ACP1A ACM2 Module
PA_EXT_L_SPKR_ACM8_ERROR	PA Exterior Speaker LEFT ACM to CCU General Error	ACP1B ACM8 Unit Error Detected	Check Eth ACP1B ETH8 port, Check Eth Switch LAN2B-Port 10, Replace ACP1B ACM8 Module
CAB_SPKR_B_ACM6_ERROR	CAB-B Speaker ACM to CCU General Error	ACP1B ACM6 Unit Error Detected	Check Eth ACP1B ETH6 port, Check Eth Switch LAN1B-Port 11, Replace ACP1B ACM6 Module
RADIO_B_ACM5_ERROR	RADIO-B Speaker ACM to CCU General Error	ACP1B ACM5 Unit Error Detected	Check Eth ACP1B ETH5 port, Check Eth Switch LAN1B-Port 12, Replace ACP1B ACM5 Module
MIC_B_ACM4_ERROR	MIC-B ACM to CCU General Error	ACP1B ACM4 Unit Error Detected	Check Eth ACP1B ETH4 port, Check Eth Switch LAN1B-Port 13, Replace ACP1B ACM4 Module

Table 9-3. Fault List (cont'd.)

Fault/Status Name	Description of the Fault/Status	Possible Cause of the Fault	Corrective Action
PIC2B_ACM3_ERROR	PIC2B ACM to CCU General Error	ACP1B ACM3 Unit Error Detected	Check Eth ACP1B ETH3 port, Check Eth Switch LAN1B-Port 14, Replace ACP1B ACM3 Module
PIC1B_ACM2_ERROR	PIC1B ACM to CCU General Error	ACP1B ACM2 Unit Error Detected	Check Eth ACP1B ETH2 port, Check Eth Switch LAN1B-Port 15, Replace ACP1B ACM2 Module
PA_EXT_R_SPKR_ACM8_COMM_FAULT	PA Exterior Speaker RIGHT ACM to CCU Communication Failure	Connection failure to the Ethernet system. Caused by the Ethernet subsystem failure, or ACP1A ACM8 unit failure	Check Eth ACP1A ETH8 port, Check Eth Switch LAN2A-Port 8, Replace ACP1A ACM8 Module
PA_INT_SPKR_ACM7_COMM_FAULT	PA Interior Speaker ACM to CCU Communication Failure	Connection failure to the Ethernet system. Caused by the Ethernet subsystem failure, or ACP1A ACM7 unit failure	Check Eth ACP1A ETH7 port, Check Eth Switch LAN1A-Port 10, Replace ACP1A ACM7 Module
CAB_SPKR_A_ACM6_COMM_FAULT	CAB-A Speaker ACM to CCU Communication Failure	Connection failure to the Ethernet system. Caused by the Ethernet subsystem failure, or ACP1A ACM6 unit failure	Check Eth ACP1A ETH6 port, Check Eth Switch LAN1A-Port 11, Replace ACP1A ACM6 Module
RADIO_A_ACM5_COMM_FAULT	RADIO-A Speaker ACM to CCU Communication Failure	Connection failure to the Ethernet system. Caused by the Ethernet subsystem failure, or ACP1A ACM5 unit failure	Check Eth ACP1A ETH5 port, Check Eth Switch LAN1A-Port 12, Replace ACP1A ACM5 Module
MIC_A_ACM4_COMM_FAULT	MIC-A ACM to CCU Communication Failure	Connection failure to the Ethernet system. Caused by the Ethernet subsystem failure, or ACP1A ACM4 unit failure	Check Eth ACP1A ETH4 port, Check Eth Switch LAN1A-Port 13, Replace ACP1A ACM4 Module
PIC2A_ACM3_COMM_FAULT	PIC2A ACM to CCU Communication Failure	Connection failure to the Ethernet system. Caused by the Ethernet subsystem failure, or ACP1A ACM3 unit failure	Check Eth ACP1A ETH3 port, Check Eth Switch LAN1A-Port 14, Replace ACP1A ACM3 Module
PIC1A_ACM2_COMM_FAULT	PIC1A ACM to CCU Communication Failure	Connection failure to the Ethernet system. Caused by the Ethernet subsystem failure, or ACP1A ACM2 unit failure	Check Eth ACP1A ETH2 port, Check Eth Switch LAN1A-Port 15, Replace ACP1A ACM2 Module

Table 9-3. Fault List (cont'd.)

Fault/Status Name	Description of the Fault/Status	Possible Cause of the Fault	Corrective Action
PA_EXT_L_SPKR_ACM8_COMM_FAULT	PA Exterior Speaker LEFT ACM to CCU Communication Failure	Connection failure to the Ethernet system. Caused by the Ethernet subsystem failure, or ACP1B ACM8 unit failure	Check Eth ACP1B ETH8 port, Check Eth Switch LAN2B-Port 10, Replace ACP1B ACM8 Module
CAB_SPKR_B_ACM6_COMM_FAULT	CAB-B Speaker ACM to CCU Communication Failure	Connection failure to the Ethernet system. Caused by the Ethernet subsystem failure, or ACP1B ACM6 unit failure	Check Eth ACP1B ETH6 port, Check Eth Switch LAN1B-Port 11, Replace ACP1B ACM6 Module
RADIO_B_ACM5_COMM_FAULT	RADIO-B Speaker ACM to CCU Communication Failure	Connection failure to the Ethernet system. Caused by the Ethernet subsystem failure, or ACP1B ACM5 unit failure	Check Eth ACP1B ETH5 port, Check Eth Switch LAN1B-Port 12, Replace ACP1B ACM5 Module
MIC_B_ACM4_COMM_FAULT	MIC-B ACM to CCU Communication Failure	Connection failure to the Ethernet system. Caused by the Ethernet subsystem failure, or ACP1B ACM4 unit failure	Check Eth ACP1B ETH4 port, Check Eth Switch LAN1B-Port 13, Replace ACP1B ACM4 Module
PIC2B_ACM3_COMM_FAULT	PIC2B ACM to CCU Communication Failure	Connection failure to the Ethernet system. Caused by the Ethernet subsystem failure, or ACP1B ACM3 unit failure	Check Eth ACP1B ETH3 port, Check Eth Switch LAN1B-Port 14, Replace ACP1B ACM3 Module
PIC1B_ACM2_COMM_FAULT	PIC1B ACM to CCU Communication Failure	Connection failure to the Ethernet system. Caused by the Ethernet subsystem failure, or ACP1B ACM2 unit failure	Check Eth ACP1B ETH2 port, Check Eth Switch LAN1B-Port 15, Replace ACP1B ACM2 Module
FDS_22_COMM_FAULT	Unable to communicate with B-End SIDE Destination Sign	Communication Timeout between Destination Sign with ID: 2-2 and CCU	Check Eth Switch LAN2A-Port 2, Check Sign Connectors Check Sign Connectivity via TOD Replace Sign
FTP_COMM_FLT	Could not FTP file from MDS	Issue with FTP server or client	Verify that server is running on MDS

Table 9-3. Fault List (cont'd.)

Fault/Status Name	Description of the Fault/Status	Possible Cause of the Fault	Corrective Action
FDS_21_COMM_FAULT	Unable to communicate with A-End SIDE Destination Sign	Communication Timeout between Destination Sign with ID: 2-1 and CCU	Check Eth Switch LAN2A-Port 3, Check Sign Connectors, Check Sign Connectivity via TOD Replace Sign
FDS_82_COMM_FAULT	Unable to communicate with B-End FRONT Destination Sign	Communication Timeout between Destination Sign with ID: 8-2 and CCU	Check Eth Switch LAN2B-Port 4, Check Sign Connectors Check Sign Connectivity via TOD Replace Sign
FDS_81_COMM_FAULT	Unable to communicate with A-End FRONT Destination Sign	Communication Timeout between Destination Sign with ID: 8-1 and CCU	Check Eth Switch LAN2B-Port 8, Check Sign Connectors Check Sign Connectivity via TOD Replace Sign
FDS_22_ERROR	B-End SIDE Destination Sign Error Received	Error Received from the Destination Sign with ID: 2-2	Check Eth Switch LAN2A-Port 2, Replace Sign
FDS_21_ERROR	A-End SIDE Destination Sign Error Received	Error Received from the Destination Sign with ID: 2-1	Check Eth Switch LAN2A-Port 3, Replace Sign
FDS_82_ERROR	B-End FRONT Destination Sign Error Received	Error Received from the Destination Sign with ID: 8-2	Check Eth Switch LAN2B-Port 4, Replace Sign
FDS_81_ERROR	A-End FRONT Destination Sign Error Received	Error Received from the Destination Sign with ID: 8-1	Check Eth Switch LAN2B-Port 8, Replace Sign
GPS_COMM_FAULT	No data is being received from the GPS receiver	Absence of serial data from the GPS – GPS Receiver failure	A-End Only – Check cable from the GPS antenna to/from the CCU Replace GPS Receiver/Antenna
GPS_DATA_ERROR	GPS receiver serial data corrupted	Consecutive data errors (invalid checksums) detected in the GPS data packets	A-End Only – Check cable from the GPS antenna to/from the CCU Replace GPS Receiver/Antenna

Table 9-3. Fault List (cont'd.)

Fault/Status Name	Description of the Fault/Status	Possible Cause of the Fault	Corrective Action
CCU_INITIALIZATION_ERROR	CCU detected at least one error during initialization	Error during an internal CCU Process or Communication Socket creation	Replace CCU Unit
MVB_RIOB_COMM_FAULT	MDS cannot communicate with the MVB RIOB Rack	Connection failure to the Ethernet system. Caused by the Ethernet subsystem failure, or TCN LCU Rack unit failure	Check B-END TCN LCU Rack Ethernet ETH1 port, Check Eth Switch LAN1B-Port 7, Check TCN Circuit Breaker Replace TCN Rack
MVB_RIOA_COMM_FAULT	MDS cannot communicate with the MVB RIOA Rack	Connection failure to the Ethernet system. Caused by the Ethernet subsystem failure, or TCN LCU Rack unit failure	Check A-END TCN LCU Rack Ethernet ETH1 port, Check Eth Switch LAN1A-Port 7, Check TCN Circuit Breaker Replace TCN Rack
ETH_RIO_2B_COMM_FAULT	MDS cannot communicate with the Ethernet RIO 2B Unit	Connection failure to the Ethernet system. Caused by the Ethernet subsystem failure, or the ETH_RIO_2B unit failure	Check ETH_RIO_2B port, Check Eth Switch LAN2B-Port 9, Replace the ETH_RIO_2B Unit
ETH_RIO_1B_COMM_FAULT	MDS cannot communicate with the Ethernet RIO 1B Unit	Connection failure to the Ethernet system. Caused by the Ethernet subsystem failure, or the ETH_RIO_1B unit failure	Check ETH_RIO_1B port, Check Eth Switch LAN1B-Port 8, Replace the ETH_RIO_1B Unit
ETH_RIO_2A_COMM_FAULT	MDS cannot communicate with the Ethernet RIO 2A Unit	Connection failure to the Ethernet system. Caused by the Ethernet subsystem failure, or the ETH_RIO_2A unit failure	Check ETH_RIO_2A port, Check Eth Switch LAN2A-Port 14, Replace the ETH_RIO_2A Unit
ETH_RIO_1A_COMM_FAULT	MDS cannot communicate with the Ethernet RIO 1A Unit	Connection failure to the Ethernet system. Caused by the Ethernet subsystem failure, or the ETH_RIO_1A unit failure	Check ETH_RIO_1A port, Check Eth Switch LAN1A-Port 8, Replace the ETH_RIO_1A Unit
MDS_INITIALIZATION_ERROR	MDS detected at least one error during initialization	Error during an internal MDS Process or Communication Socket creation	Replace MDS Unit

Table 9-3. Fault List (cont'd.)

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
IDDB_MDS_OLD_FLT	The MDS Identification database file is older than what is on the TOD	File on the MDS is an older file	Install newest 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.
AUDIO_SERVER_ERROR	The ACM Audio Server could not be started	The Application was not able to load the ACM Server	Re-install the AUDP Application
AUDIO_FILE_ERROR	The AUDP Application encountered audio file issues	Corrupted Audio Files Missing Audio Files	Check the Controller C: drive Audio File Location
ACM_COMM_ERROR	The ACM1 on Audio Panel A device could not be found or responded with errors	Ethernet wiring to the ACP1A panel, ACM1 device disconnected, ACM1 device not configured correctly.	Check wiring, Re-configure the ACM device, or replace ACM1 module. Check ACM1
INTERNAL_APP_FAULT	Internal Software Error	Memory Errors, Storage errors	Re-install the AUDP Application, if problem persist check the controller and replace if necessary
Media Missing	The Media file that the CCU requests does not exist on the PIDS	The PIDS does not have a media file that the CCU is requesting	Update the CCU or PIDS Media Directories
Route Missing	The Route file that the CCU requests does not exist on the PIDS	The PIDS does not have a route that the CCU is requesting	Update the CCU or PIDS Route Directories
Route Mismatch	Route file mismatch between CCU request and available routes on PIDS	The CCU and PIDS have the same route file with different date stamps	Update the CCU or PIDS Route Directories
ROUT FILE FAILED	ERROR WITH ROUTEFILE	MISSING OR CORRUPT ROUTE FILE	REPLACE ROUTE FILE

Table 9-3. Fault List (cont'd.)

Fault/Status Name	Description of the Fault/Status	Possible Cause of the Fault	Corrective Action
GPS FAILED	GPS IS NOT FUNCTIONAL	NO GPS MESSAGES	REPLACE GPS
MVB101 FAILED	MVB 101 IS NOT FUNCTIONAL	NO MVB101 DATA	CHECK TCN RIOA
MVB100 FAILED	MVB 100 IS NOT FUNCTIONAL	NO MVB100 DATA	CHECK TCN RIOA
COMM_ERRORS_CHECK_FAULT_SCREEN	Some PA ACMs are Missing	The CCU could not find the Interior Speaker, Active Cab MIC, Active Cab Speaker or Radio Interface ACM.	Check Ethernet Wiring on the CCU and all the Panels ACP1A and ACP1B, replace if necessary.
INVALID_TRAIN_DETECTED_TL_FAULT	ACM Configuration is not Possible	Ethernet Trainline Failure	Refer to the Ethernet Trainline subsystem troubleshooting
CCU_RE_STARTING_PLEASE_WAIT	No ACMs Found	The CCU could not found any ACMs	Check Ethernet Wiring on the CCU and all the Panels ACP1A and ACP1B, replace if necessary.
CCU_INITIALIZATION_ERROR	CCU detected at least one error during initialization	Error during an internal CCU Process or Communication Socket creation	Replace CCU Unit
PA_SYSTEM_READY	PA Components Ready	Status	N/A
PA_SYSTEM_NOT_READY	PA System is Initializing	Status	N/A

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APPENDIX

DRAWINGS

ACP1A Wiring Diagram
ACP1B Wiring Diagram
Radio Control Panel Wiring Diagram
Horn Control Wiring

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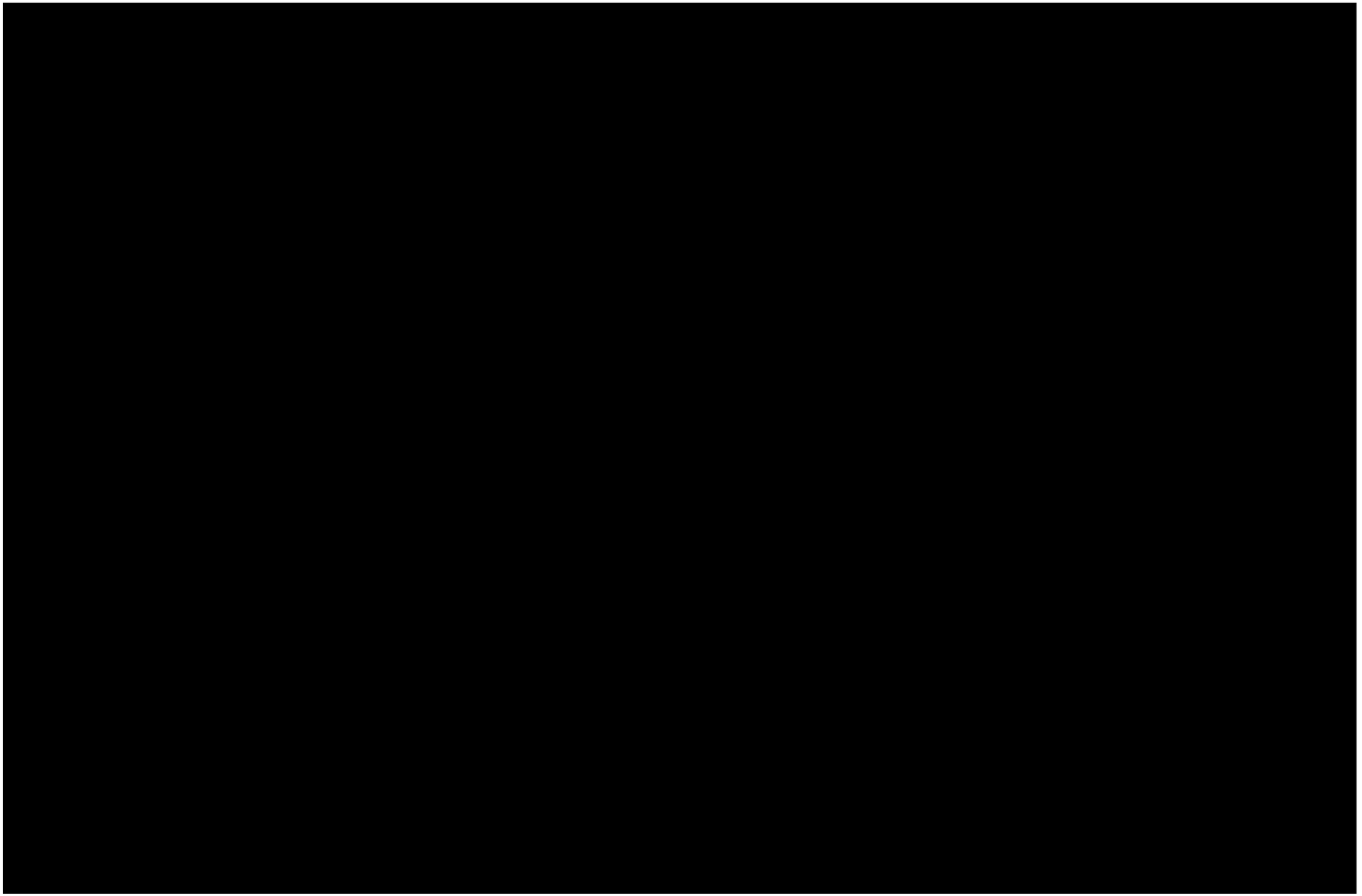

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