



MOTOTRBO™ MOBILE

PROFESSIONAL DIGITAL TWO-WAY RADIO

MOTOTRBO™ Mobile XPR 4000/5000/5000e Series INSTALLATION GUIDE

DECEMBER 2020

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Foreword

This manual is intended for use by experienced technicians familiar with similar types of equipment. Specifically, it contains installation information required for the Mobile Radios.

For details on radio operation or component-level troubleshooting, refer to the applicable manuals available separately. A list of related publications is provided in the Related Publications section.

Product Safety and RF Exposure Compliance



CAUTION: Before using this product, read the Product Safety and RF Exposure booklet enclosed with your radio which contains important operating instructions for safe usage and RF energy awareness and control for compliance with applicable standards and regulations.

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Notice

Installation Requirements for Compliance with Radio Frequency (RF) Energy Exposure Safety Standards

CAUTION: This radio is intended for use in occupational/controlled conditions, where users have full knowledge of their exposure and can exercise control over their exposure to meet FCC limits. This radio device is NOT authorized for general population, consumer, or any other use.

To ensure compliance to RF Energy Safety Standards:

- Install only Motorola Solutions approved antennas and accessories.
- Be sure that antenna installation is per "Antenna Installation" of this manual.
- Be sure that the Product Safety and RF Safety Booklet enclosed with this radio is available to the end user upon completion of the installation of this radio.

Before using this product, read the guide enclosed with your radio which contains important operating instructions for safe usage and RF energy awareness and control for compliance with applicable standards and regulations.



WARNING: For radios installed in vehicles fueled by liquefied petroleum gas, refer to the (U.S.) National Fire Protection Association standard, NFPA58, for storage, handling, and/or container information.

This radio has a transmitter Time-out Timer that disables the transmitter during a transmission after a pre-defined time period, which by default is set to 60 seconds.



CAUTION: It is recommended NOT to change the default 60 seconds time period for the Time-out Timer as the radio is intended for intermittent duty cycle operation.

For a list of Motorola Solutions-approved antennas and other accessories, visit <http://www.motorolasolutions.com>.



WARNING: This equipment is compliant with Class A of EN55032. In a residential environment, this equipment may cause radio interference.

Document History

The following major changes have been implemented in this manual since the previous edition:

Edition	Description	Date
6880309T23-FB	Compliance with the new Motorola Solutions design standard.	December 2020
	Added Eliminating False Emergency Alert Triggering Topic.	

Related Publications

The following list contains part numbers and titles of related publications.

- 6880309T21_, *MOTOTRBO XPR 4350/4550 Mobile Basic Service Manual*
- 68009272001_, *MOTOTRBO XPR 4380/4580 Mobile Basic Service Manual*
- 68009515001_, *MOTOTRBO XPR 5350/5550 Mobile Basic Service Manual*
- MN000305A01_, *MOTOTRBO XPR 5580/5380*
- MN002201A01_, *MOTOTRBO XPR 5000e Series Mobile Service Manual*

Notations Used in This Manual

Throughout the text in this publication, you will notice the use of warning, caution, and notice notations. These notations are used to emphasize that safety hazards exist, and due care must be taken and observed.



WARNING: WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or injury.



CAUTION: CAUTION indicates a potentially hazardous situation which, if not avoided, might result in equipment damage.



NOTICE: NOTICE indicates an operational procedure, practice, or condition that is essential to emphasize.

Mobile Radio Model Numbering Scheme

Table 1: Numbering Scheme for XPR 4000/5000

Position	1	2	3	4	5	6	7	8	9	10	11	12	13
Typical Model Number	AA	M	2	7	Q	P	H	9	L	A	1	A	N

Table 2: Numbering Scheme for XPR 5000e

Position	1	2	3	4	5	6	7	8	9	10	11	12	13
Typical Model Number	A A	M	2	8	J	Q	C	9	R	A	1	A	N

Table 3: Sales Models – Description of Symbols

Position	Description	Value
1	Region	AA = North America
		AZ = Asia
		LA = Latin America (except Mexico)
		MD = Europe/Middle East/Africa
2	Type of Unit	M = Mobile
3	Model Series	28 = MOTOTRBO XPR 5000/5000e Mobile
4		27 = MOTOTRBO XPR 4000 Mobile
5	Band	J = 136–174 MHz
		M = 217–222 MHz
		K = 300–360 MHz
		P = 350–400 MHz
		Q = 403–470 MHz
		T = 450–527 MHz
		X = 450–520 MHz
		U = 806–941 MHz
V = 806–870 MHz		
6	Power Level	N = 1–25W
		P = 25–40W
		Q = 25–45W
		R = 1–40W
		M = 10–35W

Position	Description	Value
7	Physical Packages	C = Numeric Display
		H = Monochrome Display
		N = Color Display
		X = No Control Head
8	Channel Information	9 = Variable/Programmable Channel Spacing
9	Primary Operation	J = Basic (No GNSS, No Bluetooth)
		K = GNSS (GPS or GLONASS) and Bluetooth
		L = GPS only
		M = Bluetooth only
		R = GNSS, WiFi, and Bluetooth
		S = WiFi and Bluetooth only
		V = Basic (No WiFi, No GNSS, No Bluetooth, No embedded GOB)
		W = GNSS only
10	Primary System Type	A = Conventional
		B = Trunking
		C = Analog Only
		D = Limited System
		E = Modified Conventional
11	Feature Level	1 = Mini-U (Mobile)
		2 = BNC (Mobile)
12	Version Letter	N/A
13	Unique Variation	N = Standard Package

Commercial Warranty

Limited Warranty

For information on warranty terms, see the Support page at <https://www.motorolasolutions.com>.

I. What This Warranty Covers And For How Long

Motorola Solutions Inc. ("Motorola Solutions") warrants the Motorola Solutions manufactured Communication Products listed below ("Product") against defects in material and workmanship under normal use and service for a period of time from the date of purchase as scheduled below:

Mobile Radios	Two Years
Product Accessories	One Year

The radios additionally ship with a standard 1-year Repair Service Advantage (RSA) (for U.S. customers) or 1-year Extended Warranty (for Canada customers). However, at the time of order, you may choose to omit these warranties. For more RSA or Extended Warranty information, please refer to the price pages or Motorola Online (<https://businessonline.motorolasolutions.com>) > Resource Center > Services > Service Product Offerings > Repair Service Advantage or Extended Warranty.

Motorola Solutions, at its option, will at no charge either repair the Product (with new or reconditioned parts), replace it (with a new or reconditioned Product), or refund the purchase price of the Product during the warranty period provided it is returned in accordance with the terms of this warranty. Replaced parts or boards are warranted for the balance of the original applicable warranty period. All replaced parts of Product shall become the property of Motorola Solutions.

This express limited warranty is extended by Motorola Solutions to the original end user purchaser only and is not assignable or transferable to any other party. This is the complete warranty for the Product manufactured by Motorola Solutions. Motorola Solutions assumes no obligations or liability for additions or modifications to this warranty unless made in writing and signed by an officer of Motorola Solutions. Unless made in a separate agreement between Motorola Solutions and the original end user purchaser, Motorola Solutions does not warrant the installation, maintenance or service of the Product.

Motorola Solutions cannot be responsible in any way for any ancillary equipment not furnished by Motorola Solutions which is attached to or used in connection with the Product, or for operation of the Product with any ancillary equipment, and all such equipment is expressly excluded from this warranty. Because each system which may use the Product is unique, Motorola Solutions disclaims liability for range, coverage, or operation of the system as a whole under this warranty.

II. General Provisions

This warranty sets forth the full extent of Motorola Solutions responsibilities regarding the Product. Repair, replacement or refund of the purchase price, at Motorola Solutions option, is the exclusive remedy.

This warranty is given in lieu of all other express warranties, implied warranties, including without limitation, implied warranties of merchantability and fitness for a particular purpose, are limited to the duration of this limited warranty. In no event shall Motorola Solutions be liable for damages in excess of the purchase price of the product, for any loss of use, loss of time, inconvenience, commercial loss, lost profits or savings or other incidental, special or consequential damages arising out of the use or inability to use such product, to the full extent such may be disclaimed by law.

III. State Law Rights (Applicable Only in U.S.A.)

Some states do not allow the exclusion or limitation of incidental or consequential damages or limitation on how long an implied warranty lasts, so the above limitation or exclusions may not apply.

This warranty gives specific legal rights, and there may be other rights which may vary from state to state.

IV. How To Get Warranty Service

You must provide proof of purchase (bearing the date of purchase and Product item serial number) in order to receive warranty service and, also, deliver or send the Product item, transportation, and insurance prepaid, to an authorized warranty service location.

Warranty service will be provided by Motorola Solutions through one of its authorized warranty service locations. If you first contact the company which sold you the Product, it can facilitate your obtaining warranty service.

You can also call Motorola Solutions at 1-800-927-2744 US/Canada.

V. What This Warranty Does Not Cover

This warranty does not cover the following conditions:

- Defects or damage resulting from use of the Product in other than its normal and customary manner.
- Defects or damage from misuse, accident, water, or neglect.
- Defects or damage from improper testing, operation, maintenance, installation, alteration, modification, or adjustment.
- Breakage or damage to antennas unless caused directly by defects in material workmanship.
- A Product subjected to unauthorized Product modifications, disassemblies or repairs (including, without limitation, the addition to the Product of non-Motorola Solutions supplied equipment) which adversely affect performance of the Product or interfere with Motorola Solutions normal warranty inspection and testing of the Product to verify any warranty claim.
- Product which has had the serial number removed or made illegible.
- Rechargeable batteries if:
 - Any of the seals on the battery enclosure or cells are broken or show evidence of tampering.
 - The damage or defect is caused by charging or using the battery in equipment or service other than the Product for which it is specified.
- Freight costs to the repair depot.
- A Product which, due to illegal or unauthorized alteration of the software/firmware in the Product, does not function in accordance with Motorola Solutions published specifications or the FCC type acceptance labeling in effect for the Product at the time the Product was initially distributed from Motorola Solutions.
- Scratches or other cosmetic damage to Product surfaces that does not affect the operation of the Product.
- Normal and customary wear and tear.

VI. Patent And Software Provisions

Motorola Solutions will defend, at its own expense, any suit brought against the end user purchaser to the extent that it is based on a claim that the Product or parts infringe a United States patent, and

Motorola Solutions will pay those costs and damages finally awarded against the end user purchaser in any such suit which are attributable to any such claim.

But such defense and payments are conditioned on the following:

- Motorola Solutions will be notified promptly in writing by such purchaser of any notice of such claim.
- Motorola Solutions will have sole control of the defense of such suit and all negotiations for its settlement or compromise.
- Product or parts become, or in Motorola Solutions opinion be likely to become, the subject of a claim of infringement of a United States patent, that such purchaser will permit Motorola Solutions, at its option and expense, either to procure for such purchaser the right to continue using the Product or parts or to replace or modify the same so that it becomes noninfringing or to grant such purchaser a credit for the Product or parts as depreciated and accept its return. The depreciation will be an equal amount per year over the lifetime of the Product or parts as established by Motorola Solutions.

Motorola Solutions will have no liability with respect to any claim of patent infringement which is based upon the combination of the Product or parts furnished hereunder with software, apparatus or devices not furnished by Motorola Solutions, nor will Motorola Solutions have any liability for the use of ancillary equipment or software not furnished by Motorola Solutions which is attached to or used in connection with the Product. The foregoing states the entire liability of Motorola Solutions with respect to infringement of patents by the Product or any parts thereof.

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VII. Governing Law

This Warranty is governed by the laws of the State of Illinois, USA.

Chapter 1

Introduction

This manual covers the installation procedures for WAVE Mobile Radios and accessories required to complete the radio system. The radio system consists of a control head, radio, antenna, microphone, speaker, cabling, and accessories.

1.1

Mobile Radio Description

This chapter covers the basic dimensions of the dash mount trunnion of the mobile radio.

1.1.1

Dimensions

When installing the radio, plan the installation carefully and leave room for cabling and accessory connections in the installed location and to the sides and top of the radio for the installation of the radio into the trunnion with the appropriate hardware.



NOTICE: The measurement unit used is millimeter unless otherwise stated.

Figure 1: Front View of Dash Mount Trunnion for MOTOTRBO XPR 4000/4000e

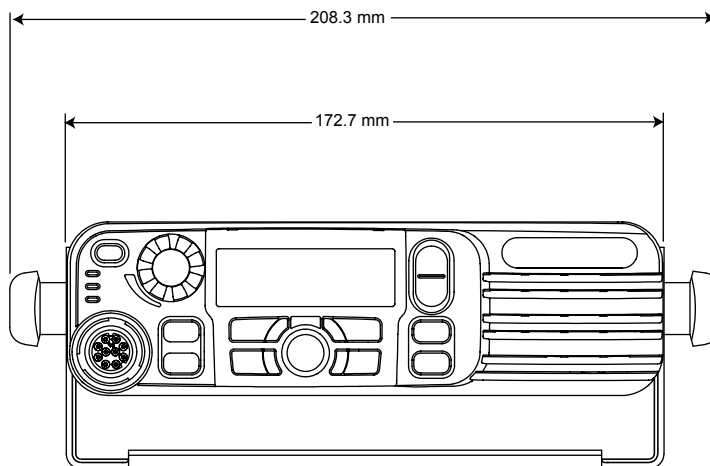


Figure 2: Front View of Dash Mount Trunnion for MOTOTRBO XPR 5000/5000e

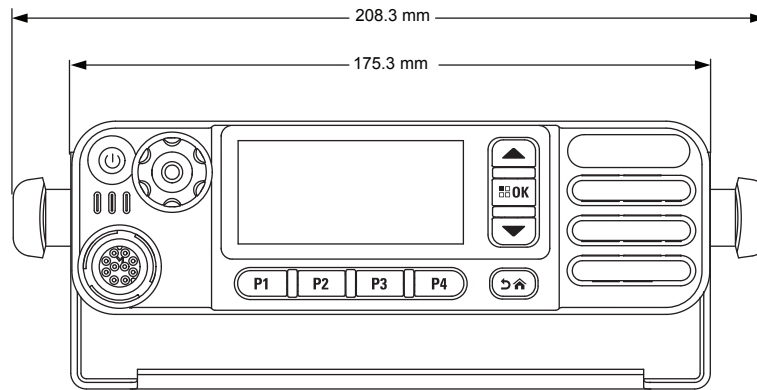
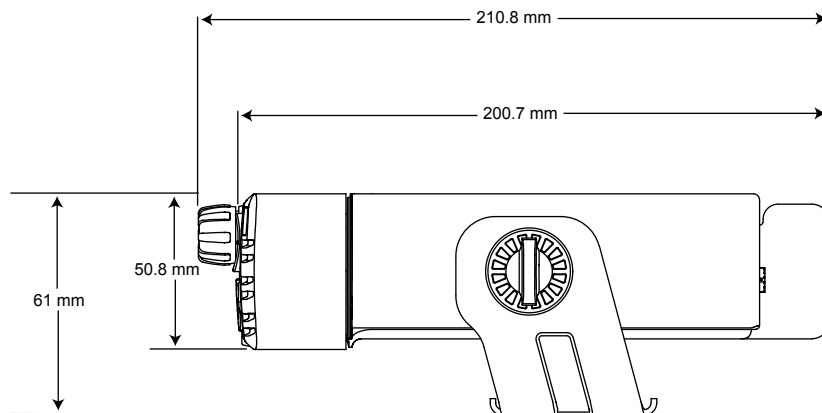
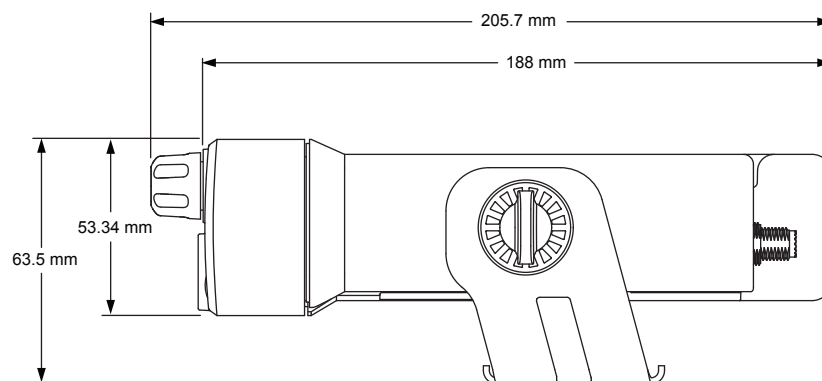


Figure 3: Side View of Dash Mount with Low Profile Trunnion for MOTOTRBO XPR 4000/4000e



NOTICE: The MOTOTRBO XPR 4000/4000e Series mobile models use wing screws with thread length of 14.9 mm while the XPR 5000/5000e Series mobile models require wing screws with thread length of 9.9 mm to secure the radio to the mounting trunnion.

Figure 4: Side View of Dash Mount with Low Profile Trunnion for MOTOTRBO XPR 5000/5000e



NOTICE: The rear accessory connector adds 0.75 in (19.1 mm) to the overall length.

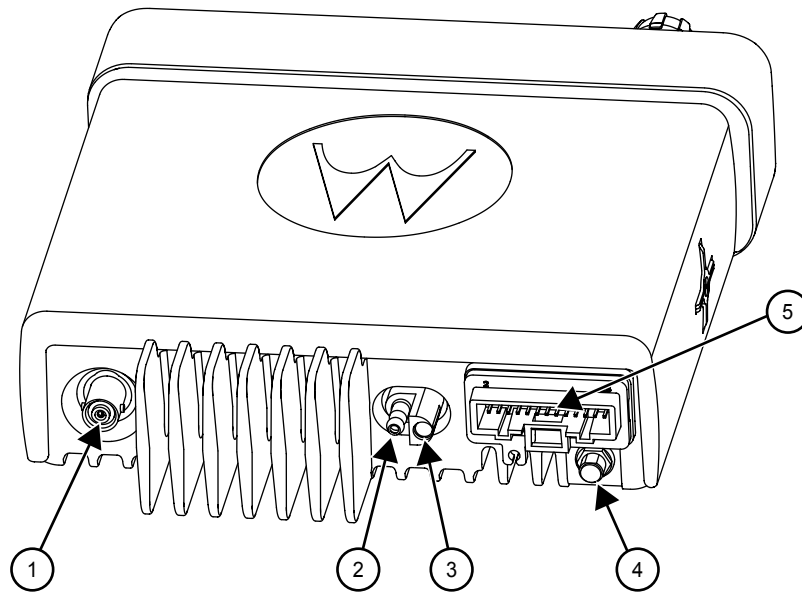
1.1.2

Connections on the Back of the Radio

The following figure shows the connections that are found on the back of the radio.

For complete pin configuration of the rear accessory connector, refer to "Pin Configuration of Rear Accessory Connector".

Figure 5: Back View of the Mobile Radio



Item	Description
1	Antenna Connector
2	Battery+
3	Battery-
4	GPS-Antenna Connector
5	Rear Accessory Connector

1.2

Standard Configurations

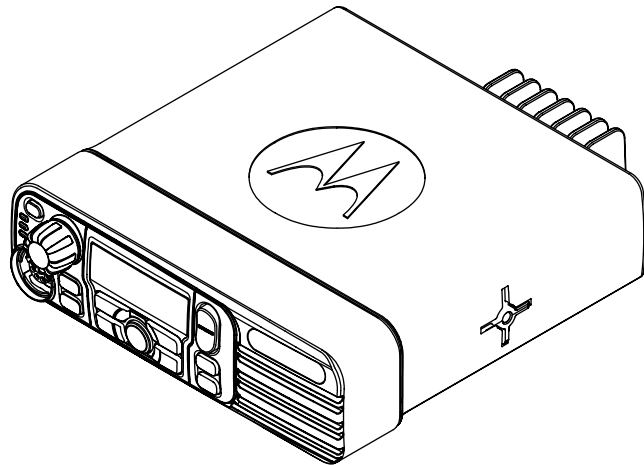
The XPR 4000/4000e Series mobile can be either dash mounted or remote mounted. The XPR 5000/5000e Series mobile can only be dash mounted at this time.

1.2.1

Dash Mount Configuration

In the dash mount configuration of the mobile radio, the control head is mounted on the front of the transceiver housing. Electrical connection between the two takes place within the radio via a flexible cable between the connectors on the front of the transceiver and at the back of the control head.

Figure 6: Dash Mount Configuration



For details on this configuration, see section Dash Mount with Trunnion.

1.2.2

Remote Mount Configuration

In the remote control version, the control head and the transceiver are mounted separately in the vehicle.

The control head is mounted in a remote trunnion (PMLN4912_) near the operator using an extension cable. The transceiver is mounted using one of the trunnion mounting options shown in Mounting Kits table. If the transceiver is located in a car trunk, be sure that secure mounting and sufficient cooling are provided. Do not cover the transceiver with baggage or blankets.

See publication 6878397A01 for the mobile radio remote mount control head installation instructions.

1.3

Base/Control Stations

If the mobile radio equipment is installed at a fixed location and operated as a control station or as a fixed unit, the radio and antenna installation must comply with the following requirements in order to ensure optimal performance and compliance with the RF energy exposure limits in the standards and guidelines listed in the Safety Booklet provided with the radio:

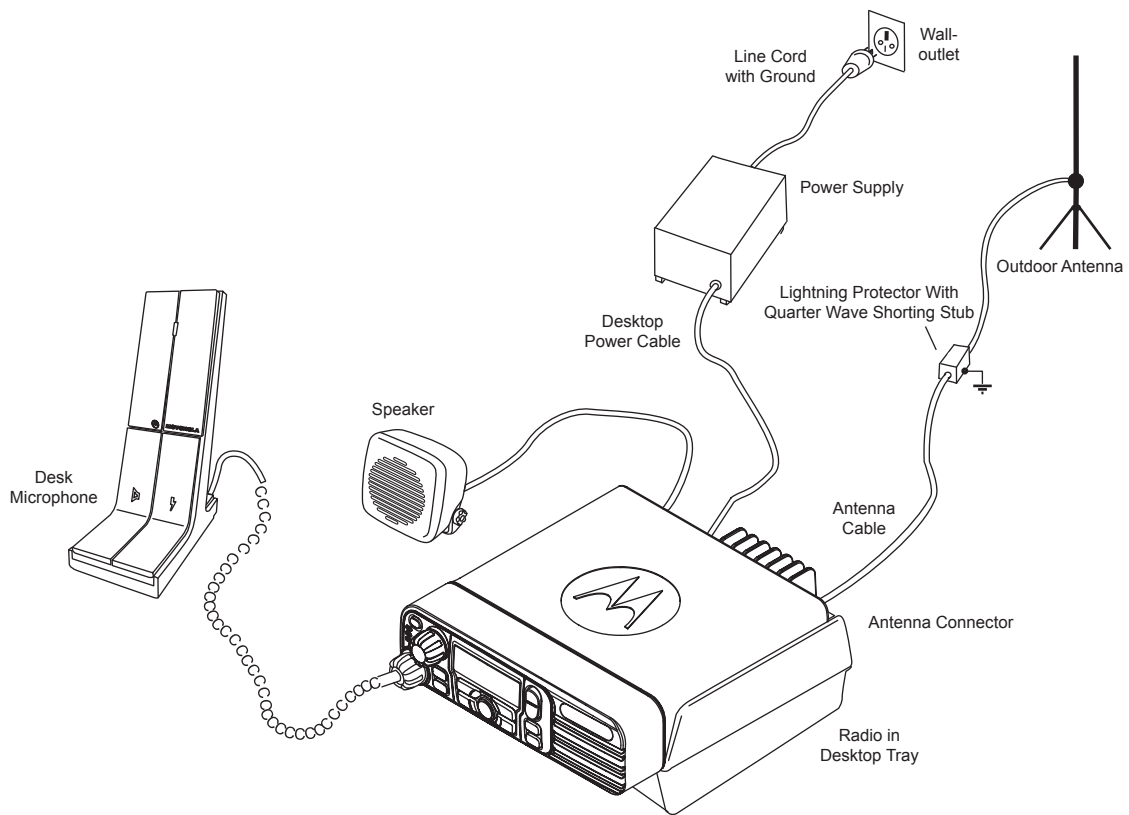


WARNING: For outdoor antenna installations, proper site grounding and lightning protection are vitally important. Failure to provide proper lightning protection may result in permanent damage to the radio equipment. Refer to Motorola Solutions Quality Standards Fixed Network Equipment Installation Manual R56 (which can be obtained by ordering CDROM 9880384V83) for complete information regarding lightning protection.

- The antenna should be mounted outside the building on the roof or a tower if at all possible and the antenna cable should be earth grounded.
- The radio chassis must be earth grounded and a lightning surge protector should be used in line with the radio connector and the outdoor antenna. The lightning surge protector should be earth grounded and located at the point where the antenna cable enters the building.
- The line voltage power supply must have a proper ground connection.
- As with all fixed site antenna installations, it is the responsibility of the licensee to manage the site in accordance with applicable regulatory requirements. Also, additional compliance actions such as site survey measurements, signage, and site access restrictions may be required in order to ensure that exposure limits are not exceeded.

The following figure shows a typical setup of a Base/Control Station configuration .

Figure 7: Example of a Base/Control Station Configuration



Chapter 2

Installation Details for Standard Configurations

The mobile radio operates only in negative ground electrical systems.

Before starting the radio installation, make sure that the ground polarity of the vehicle is correct. Accidentally reversing the polarity will not damage the radio, but will cause the cable fuses to blow.

2.1

Planning the Installation

Planning is the key to fast, easy radio installation. Before starting the installation, inspect the vehicle and determine how and where you intend to mount the antenna, radio, and accessories.

Plan wire and cable runs to provide maximum protection from pinching, crushing, and overheating.



CAUTION:

Before installing any electrical equipment, check the vehicle manufacturer user manual for warnings or recommendations.

The installation of this device should be completed by an authorized servicer or installer. Failure to properly install the device may result in damage to the device, or improper operation.

2.1.1

Tools Required for Installation

The following table shows the tools required for installation.

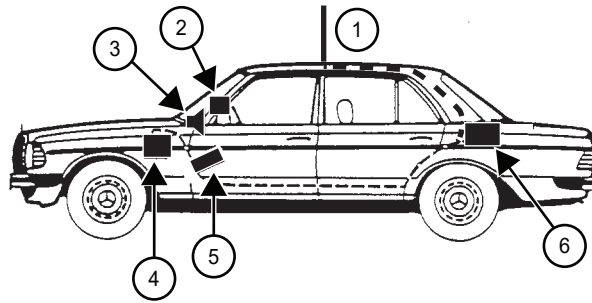
Tool	Motorola Solutions Part Number
Rubber-coated pliers	-
Regular slot screwdriver or Phillips #2	-
Pin removal tool	6680163F01
¼ hex driver	-
11/32 hex driver	-

2.1.2

Installation Example

The mobile two-way radio offers various methods of installation, with accessories placed to the vehicle as desired.

The radio can only be installed in a dash or remote mount configuration.

Figure 8: Typical Remote Mount Configuration

Label	Description
1	Antenna $\frac{1}{4}$ Wavelength
2 and 5	Control Head
3	Speaker
4	Battery
6	Radio

2.1.3

Wiring Diagrams

Identify the configuration that you are installing and use the wiring diagram when planning the installation.

Figure 9: Radio Installation (Dash Mount)

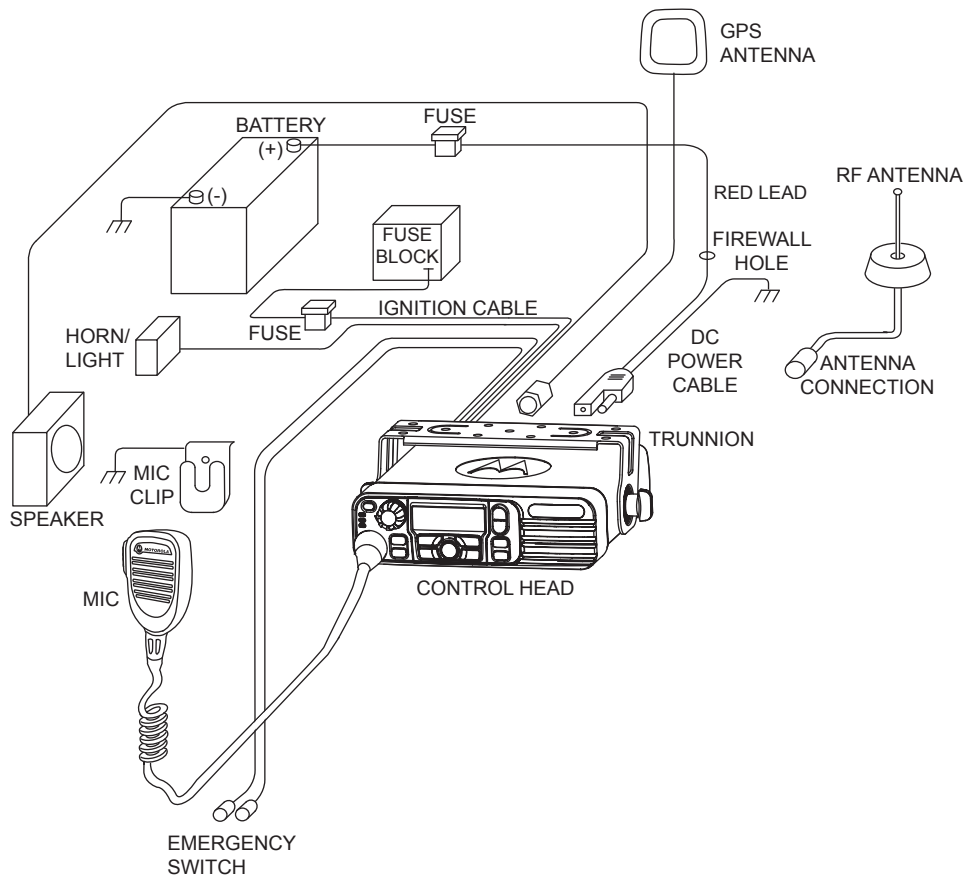
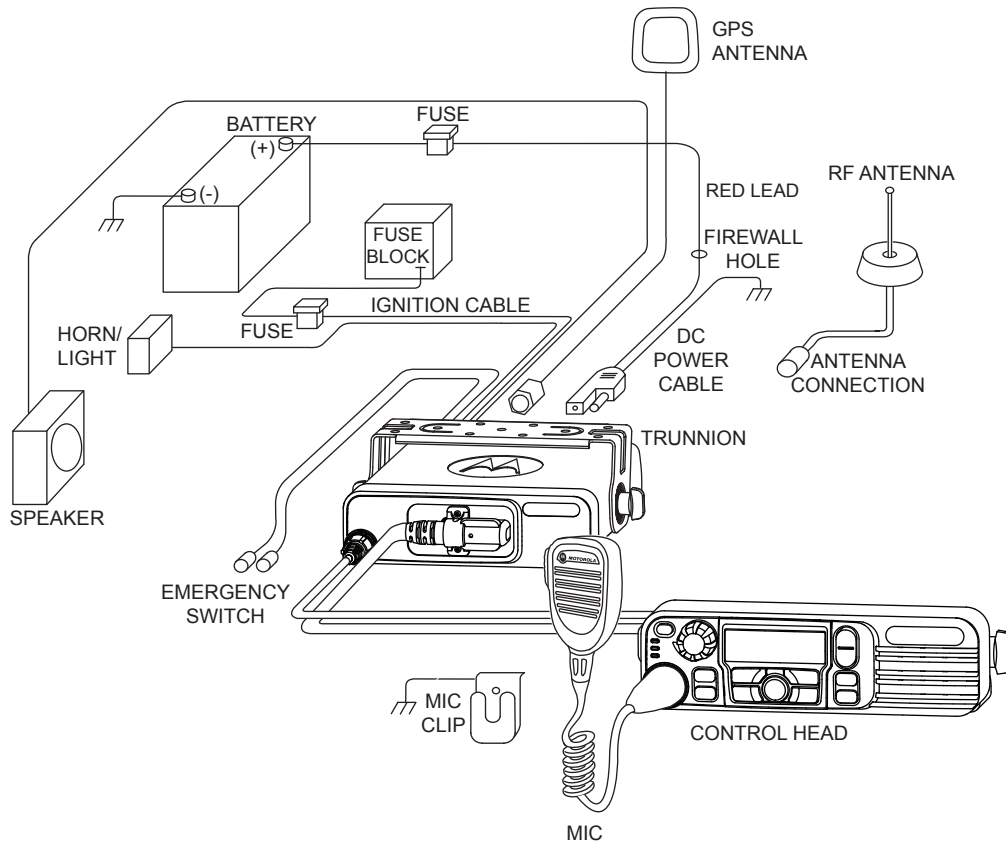


Figure 10: Radio Installation (Remote Mount)

NOTICE: For complete rear accessory connector pin configuration, see [Accessories Installation](#)

2.2

Radio Mounting



CAUTION:

Do not mount the radio on a plastic dashboard without first reinforcing the dashboard; the weight of the radio may crack or break the dashboard.

Do not mount the radio on a flat or concave surface where the radio could be partially submerged in water. This is especially important if the cab area of the vehicle is cleaned by spraying with water. If the radio sits in water for a length of time, moisture may seep inside the radio and damage the electronic components.

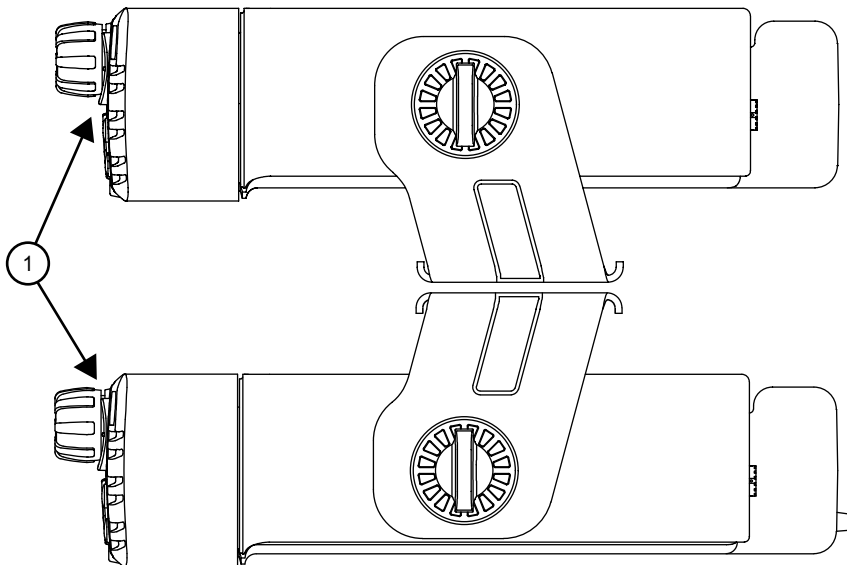
Do not allow water to stand in recessed areas of vertically mounted radios. Remove any moisture immediately to prevent it from seeping down into the radio.

The mounting location must be accessible and visible. Select a location that permits routing the RF antenna cable as directly as possible.

For new or existing installations, use one of the mounting kits as specified in table below. Orient the mounting trunnion.

Mounting Kit	Motorola Solutions Part Number	Motorola Solutions Part Number
Low Profile Trunnion Kit (ships as part of mobile radio package)	RLN6076_	RLN6469_
Low Profile Trunnion Kit (ships in a box – intended for resale)	RLN6077_	RLN6466_
Standard Profile Trunnion Kit	RLN6078_	RLN6467_
Key Lock Trunnion Kit	RLN6079_	RLN6468_
DIN Mount	RLN5933_	RLN6465_

Figure 11: Trunnion Orientation for Above or Below Mobile



Label	Description
1	Radio Front

2.2.1

Dash Mount with Trunnion

Procedure:

- 1 Select the location to mount your radio on the transmission hump or under the dash.

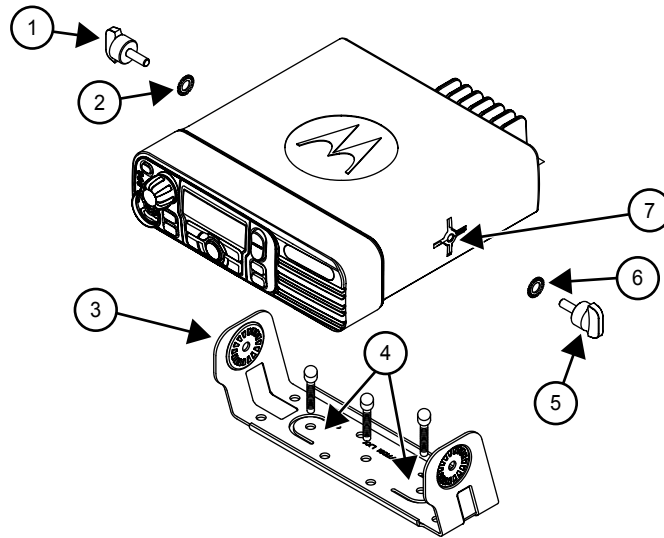


NOTICE: When mounting the trunnion on the transmission hump take care that the transmission housing is not affected.

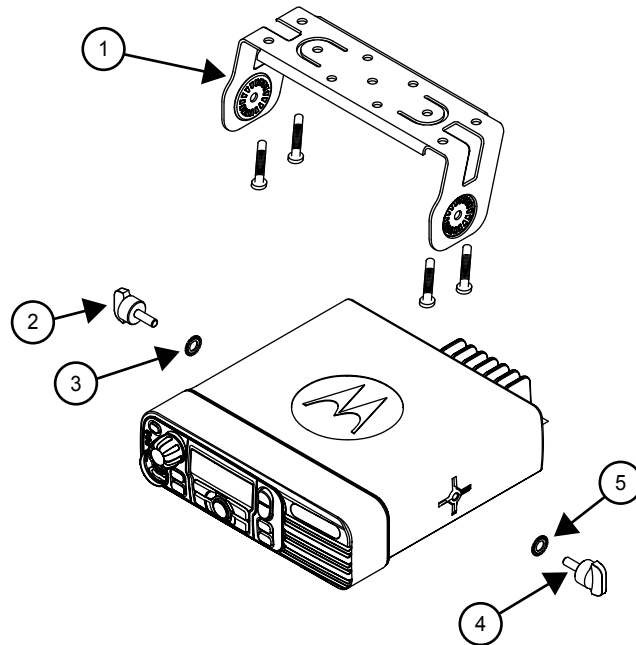
- 2 Using the trunnion mounting bracket as a template, mark the positions of the holes on the mounting surface. Use the innermost four holes for a curved mounting surface such as the transmission hump, and the four outmost holes for a flat surface such as under the dash.
- 3 Center punch the spots you have marked and realign the trunnion in position.

- 4 Secure the trunnion mounting bracket with the four self-drilling screws provided. The number of screws used will depend on how the radio is mounted.
- 5 Position the radio to align the trunnion with the trunnion mounting features on the radio. Secure the radio with the two wing screws and lock washers (position the flat side of the washer to the thumbscrew and the washer sharp side to the trunnion) provided.

Figure 12: Transmission Hump Trunnion Mounting



Label	Description
1	Wing Screw
2	Lock Washer
3	Trunnion
4	Tabs
5	Wing Screw
6	Lock Washer
7	Threaded Hole for Wing Screw

Figure 13: Below Dash Trunnion Mounting

Label	Description
1	Trunnion
2 and 4	Wing Screw
3 and 5	Lock Washer

2.2.2

Locking Kit (Optional)

If an optional locking kit is used, refer to the following steps to install locking kit for all radio types.

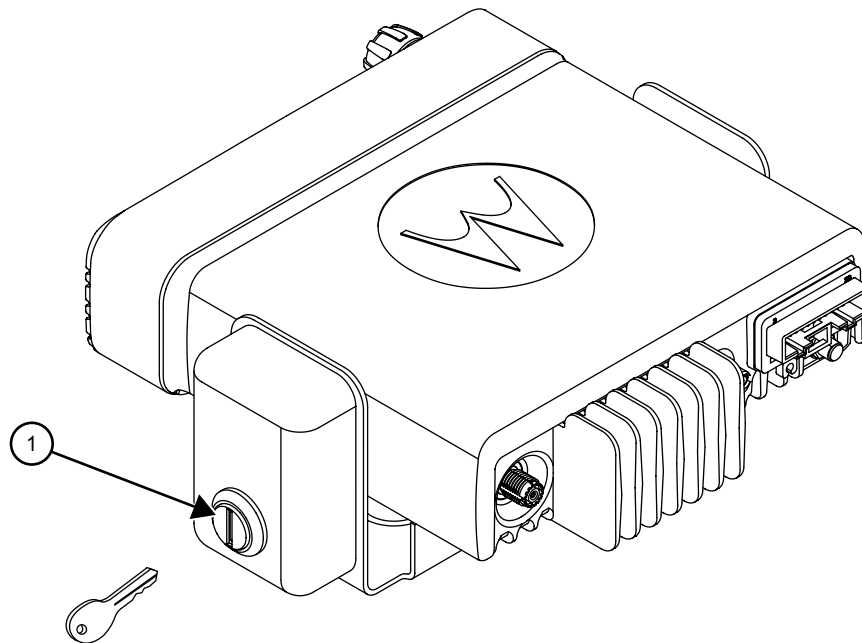
2.2.2.1

Installing Locking Kit for All Radios

Procedure:

- 1 Position the lock bottom housing on the trunnion before installing the radio mounting screws.
- 2 Slip the top lock housing on and remove the key.
- 3 Install the lock on either side of the radio.

Figure 14: Locking Kit (Optional)



Label	Description
1	Lock

2.3

DIN Mount

This chapter explains the steps to install, mount, and remove the Mounting Frame.

2.3.1

Installing the Frame into the Dashboard

Procedure:

- 1 Open up the radio cut-out in the dashboard to ISO7736 specification (182 mm x 53 mm).
- 2 Insert the mounting frame into the cut-out and retain it by bending back the relevant fixing tabs (using all six where possible). Check the orientation of the frame is correct by ensuring that the word "TOP" is uppermost.



NOTICE:

The tabs are easily bent back by twisting a large flat-head screwdriver in the slot behind the tabs.

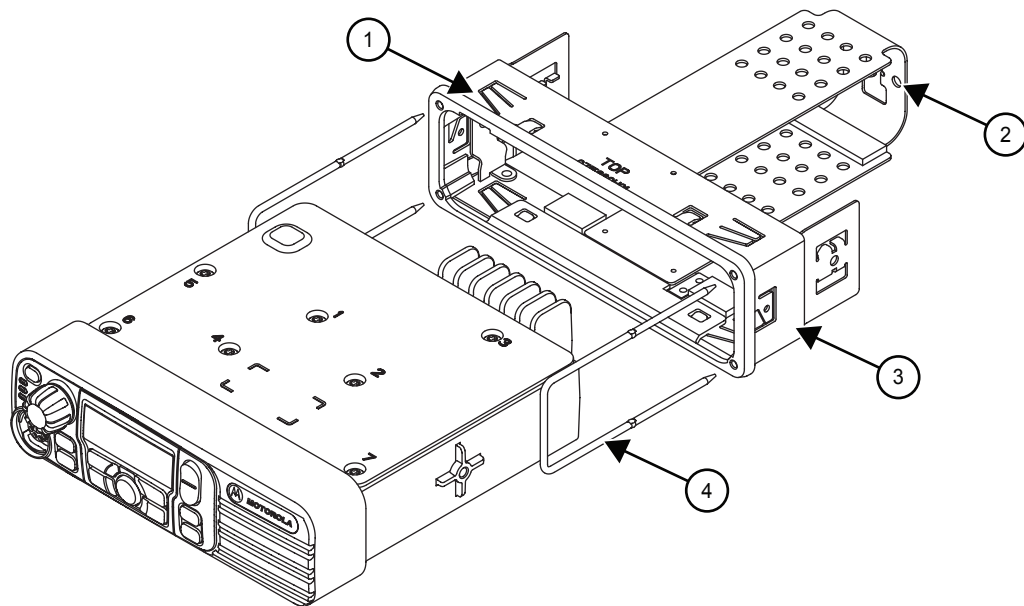
For a more secure installation, the frame should also be secured with the appropriate number of screws to the mounting conditions (min. 1).

The demounting tool can be used as an aid to mounting as well as demounting.

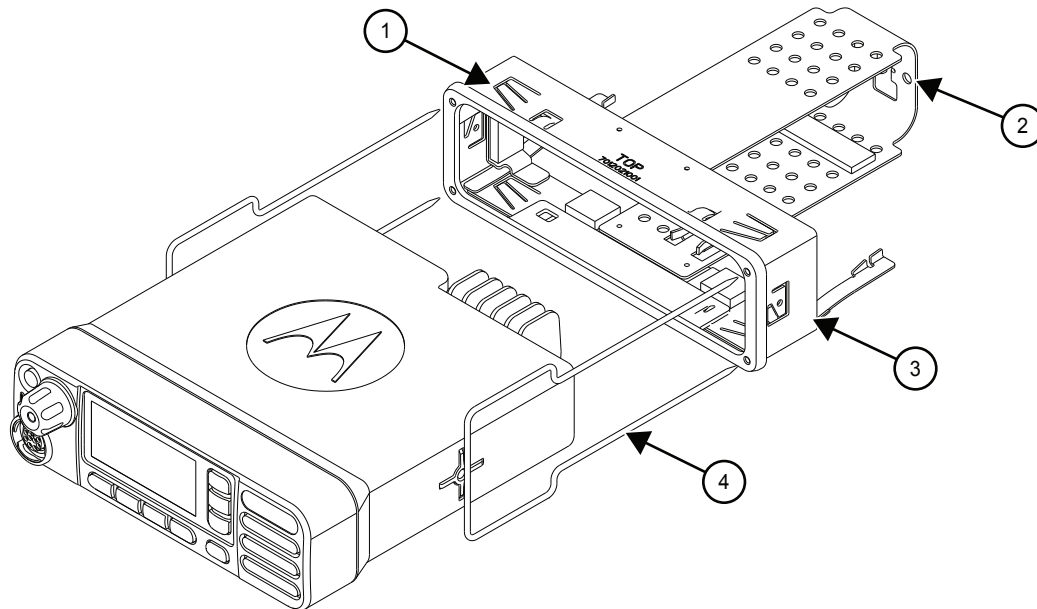
2.3.2

Mounting the Radio in the Frame**Procedure:**

- 1 Provide the electrical connections for the radio (power, antenna, accessories).
- 2 Plug in all the connectors and push the radio firmly into the mounting frame until the two springs snap into place.

Figure 15: Dashboard Mounting

Label	Description
1	Fixing Tabs
2	Demounting Tool
3	DIN Mount RLN5933_
4	Fix screws here to secure frame

Figure 16: Dashboard Mounting for MOTOTRBO XPR 5000/XPR 5000e Series

Label	Description
1	Fixing Tabs
2	Fixing screws here to secure frame
3	DIN Mount RLN6465_
4	Demounting Tool

2.3.3

Removing the Radio from the Frame

Procedure:

- 1 Push the two demounting tools through the openings in the frame until the two springs release the radio.
- 2 Slide out the radio.



NOTICE:

The fixing tabs should be checked for tightness each time the radio is removed. The tabs are easily tightened by twisting a large flat-head screwdriver in the slot behind the tabs.

The frame is not designed for regular mounting and demounting.

2.4

Remote Mount with Trunnion

For remote mount installation, the radio may be mounted anywhere in the vehicle, as long as the installation location is safe, follows the cautions mentioned at the beginning of this section, and is accessible for servicing/maintenance and cabling. A typical mounting location recommended by Motorola Solutions is in the trunk of the vehicle. The trunnion provided may still be used to mount the radio, and the mounting process is the same for dash mount installation.

See publication 6878397A01 for the MOTOTRBO mobile radio remote mount control head installation instructions.

2.5

Power Cables

Route the red radio power cable from the radio to the battery compartment of the vehicle, using accepted industry methods and standards. Be sure to grommet the firewall hole to protect the cable.

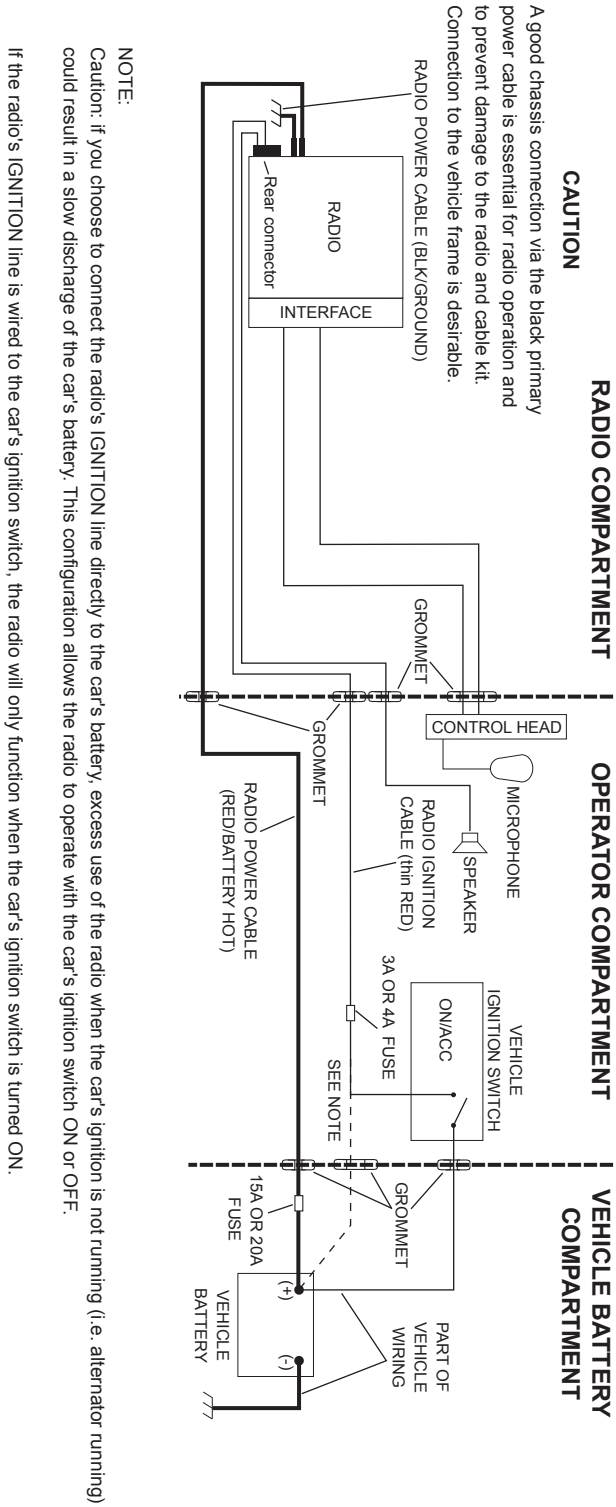
Remove the 15-Amp (part number 6580283E06) or 20-Amp (part number 6580283E07) fuse from the fuseholder and connect the red lead of the radio power cable to the positive battery terminal using the hardware provided.

Connect the black lead to a convenient solid chassis ground point. Do not connect the black lead directly to the battery negative terminal.

**NOTICE:**

The radio nominal operating voltage for 12 V vehicle installation is 13.2 VDC with an operating voltage range of 10.8–15.6 V.

Figure 17: Cabling Interconnect Diagram for Remote Mount



2.6

Ignition Sense Cable

Motorola Solutions supplies an ignition sense cable and recommends that it be used with every mobile installation. The ignition sense cable allows the radio to be turned on and off with the vehicle ignition

switch, and allows the radio to “remember” the state of the radio on/off switch, even if it is changed while the vehicle is off.

- For radio ON/OFF control independent of the ignition switch, connect the red ignition cable (pin 25 of accessory connector) to “battery hot” at the vehicle fuse block.

The ignition sense cable uses either a 3-Amp (P/N 6500139764) or 4-Amp (P/N 6580283E02) fuse.

For other considerations when connecting the ignition cable, see the MOTOTRBO Basic Service Manual.

2.7

Antenna Installation



IMPORTANT: To assure optimum performance and compliance with RF Energy Safety standards, these antenna installation guidelines, and instructions are limited to metal-body vehicles with appropriate ground planes and take into account the potential exposure of back seat passengers and bystanders outside the vehicle.



NOTICE: For mobile radios with rated power of 7 W or less, the only installation restrictions are to use only Motorola Solutions approved antennas and install the antenna externally on metal body vehicles. For mobile radios with rated power greater than 7 W, always adhere to all the guidelines and restrictions in "Selecting an Antenna Site/Location on a metal Body Vehicle".

2.7.1

Selecting an Antenna Site/Location on a Metal Body Vehicle

Prerequisites:

- Be sure that the distance from the antenna location on the trunk lid is at least 85 cm (33 in.) from the front surface of the rear seat-back to assure compliance with RF Energy Safety standards.
- Ensure that the trunk lid is grounded by connecting grounding straps between the trunk lid and the vehicle chassis.



CAUTION: If these conditions cannot be satisfied, then mount the antenna on the roof top.

Procedure:

- 1 Do one of the following:

External installation

Check the requirements of the antenna supplier and install the vehicle antenna external to a metal body vehicle in accordance with those requirements.

Roof top

For optimum performance and compliance with RF Energy Exposure regulations, mount the antenna in the center area of the roof.

Trunk lid

On some vehicles with clearly defined, flat trunk lids, the antennas of some radio models (see restrictions below) can also be mounted on the center area of the trunk lid. For vehicles without clearly defined, flat trunk lids (such as hatchback autos, sports utility vehicles, and pick-up trucks), mount the antenna in the center area of the roof.



NOTICE: For all VHF and UHF models with the output power set to 30 W or higher, the $\frac{1}{4}$ wave antenna shall be mounted only in the center area of the roof, not on the trunk lid, to ensure compliance with RF Energy Safety standards.

- 2 Ensure that the antenna cable can be easily routed to the radio. Route the antenna cable as far away as possible from the vehicle electronic control units and associated wiring.

- 3 Check the antenna location for any electrical interference.
- 4 Make sure that the mobile radio antenna is installed at least 30 cm (1 foot) away from any other antenna on the vehicle.



NOTICE: Any two metal pieces rubbing against each other (such as seat springs, shift levers, trunk and hood lids, exhaust pipes, and others) in close proximity to the antenna can cause severe receiver interference.

2.7.2

Installing the Antenna

Procedure:

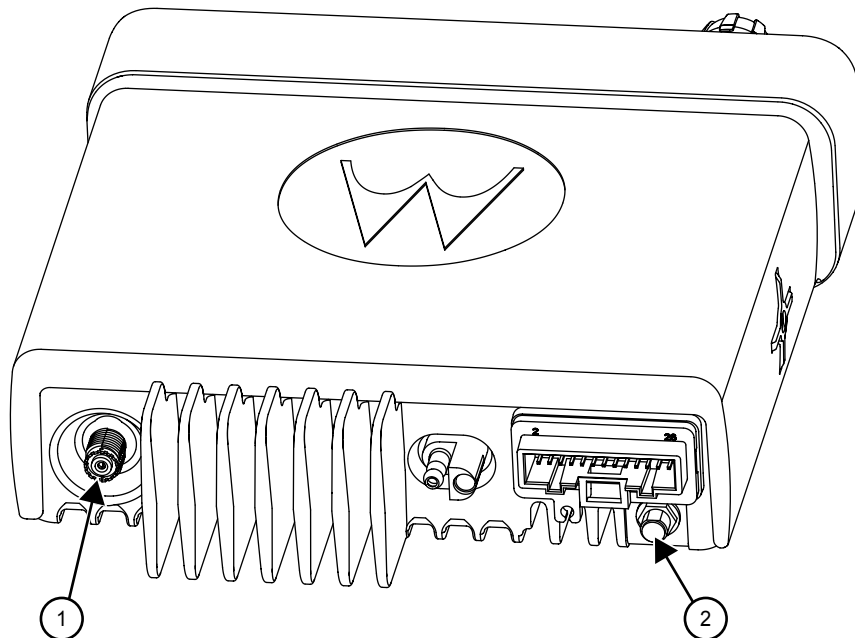
- 1 Mount the antenna according to the instructions provided with the antenna kit. Run the coaxial cable to the radio mounting location. If necessary, cut off the excess cable and install the cable connector.



NOTICE: Do not mount the antenna on metal surface.

- 2 Connect the antenna cable connector to the radio antenna connector on the rear of the radio.

Figure 18: Antenna Connections on the Back of the Radio



Label	Description
1	Antenna Connector
2	GPS-Antenna Connector

- 3 In case of a GPS model, connect the GPS antenna to the GPS antenna connector on the rear of the radio.

2.7.3

Antenna Connection

To ensure a secure connection of an antenna cable plug to a radio jack, their interlocking features must be properly engaged. If they are not properly engaged, the system will loosen.

Prerequisites:

NOTICE: Applying excessive force with a tool can cause damage to the antenna or the connector (stripping threads, deforming the collar or connector, or causing the connector to twist in the housing opening and break).

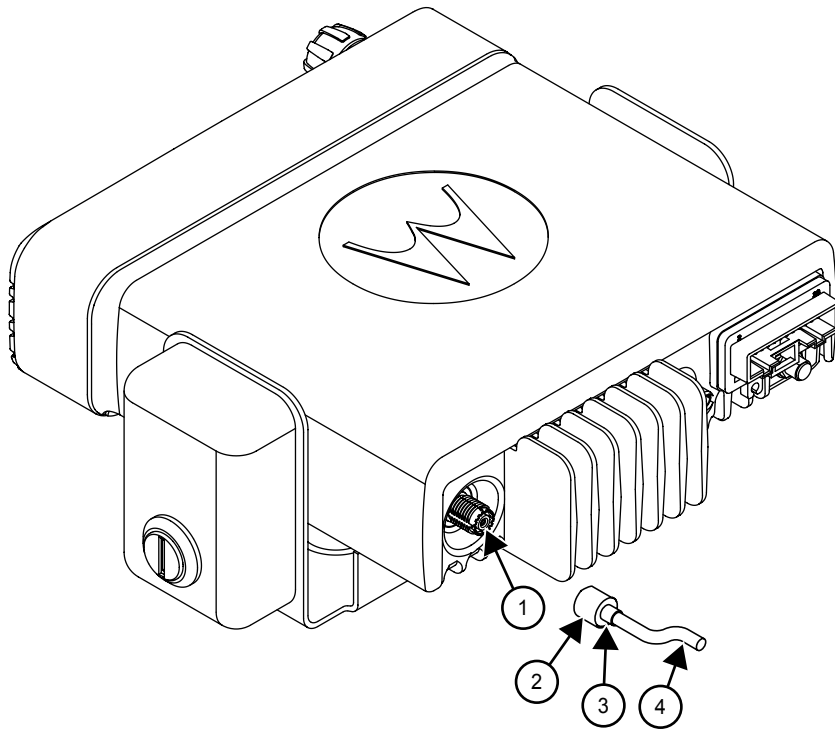
Procedure:

- 1 Make sure that there is sufficient slack in the antenna cable.
- 2 Make sure that the collar of the antenna cable plug is loose and does not bind.
- 3 Slide the collar back against the flange. Insert the antenna cable plug pin fully into the radio jack, but do not engage the threads.
- 4 Ensure that the plug and jack interlocking features are fully seated. Check this by grasping the crimp on the cable jack, rotating the cable, and noting any movement. If the features are seated correctly, there should be NO movement.
- 5 Finger-tighten the antenna cable plug collar onto the radio jack.
- 6 Give a final tug, by hand, to the collar, and retighten by hand as firmly as possible.
- 7 Use the rubber-coated pliers to grip the plug knurled collar, then turn clockwise to tighten the collar. It should take $\frac{1}{4}$ turn or less. Turning counterclockwise loosens the collar.



NOTICE: Overtightening the collar can damage the connector and the radio.

Figure 19: Connection



Label	Description
1	Mini-UHF Jack
2	Collar Pulled Back to Flange
3	Flange
4	Cable

2.8 Microphone Hang-Up Clip

This chapter explains the usage of Standard Hang-Up Clip.

2.8.1 Standard Hang-Up Clip

The hang-up clip must be within reach of the operator(s). Measure this distance before actually mounting the bracket. Since the bracket has a positive-detent action, the microphone can be mounted in any position. The microphone hang-up clip must be grounded.

Use the hang-up clip as a template to locate the mounting holes. To avoid interference when removing the microphone, install the flathead screw in the top clip hole.

2.9 Completing the Installation

Complete the installation by connecting the power wires and plugging in the microphone cable to the mobile.

Chapter 3

Options and Accessories Installation

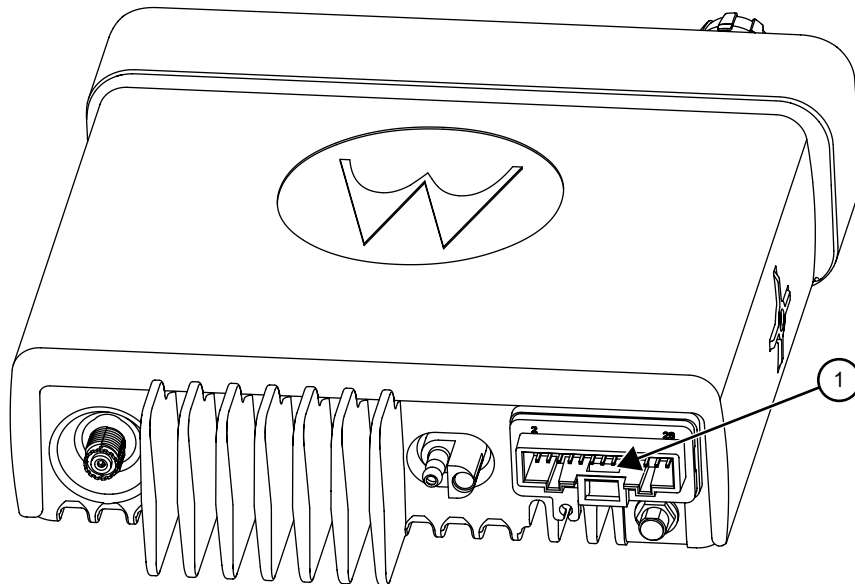
3.1

Accessory Installation

The accessories must be installed through the rear accessory connector that is located on the rear of the radio, adjacent to the power connector. Most of the Motorola Solutions-approved accessories are supplied with female terminals crimped to a 20-gauge wire specifically designed to fit the plug of the rear accessory connector.

Insert the female terminal into the accessory connector assembly in the appropriate location and connect the accessory connector assembly in the rear accessory port. Do not use other generic terminals in the plug. Generic terminals can cause electrical intermittencies and may cause damage to the plug.

Figure 20: Location of the Rear Accessory Connector



Label	Description
1	Rear Accessory Connector

Figure 21: Pin Configuration of Rear Accessory Connector (as viewed from the rear of the radio)

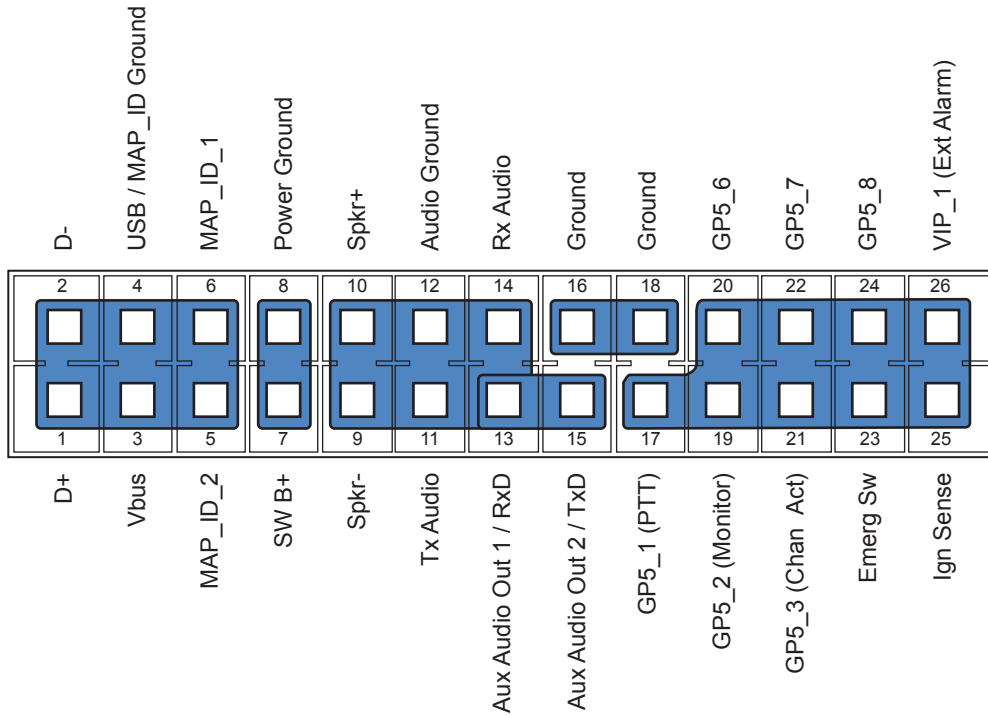


Table 4: Rear Accessory Connector Pin Functions

Pin No.	Pin Name	Pin Function
1	USB+	USB + (Data)
2	USB-	USB - (Data)
3	VBUS	USB Power (5 V from USB accessory/cable)
4	USB/MAP_ID GDN	USB/MAP_ID Ground
5	MAP_ID_2	Accessory Identifier
6	MAP_ID_1	Accessory Identifier
7	SW B+	Switched Battery Voltage
8	PWRGND	Ground
9	SPKR-	Speaker - (3.2 Ω minimum impedance)
10	SPKR+	Speaker + (3.2 Ω minimum impedance)
11	Tx Audio	Rear External Microphone Input ¹
12	Audio GND	Audio Ground

¹ This microphone signal is independent of the microphone signal on the front microphone connector. The nominal input level is 80mVrms for 60% deviation. The DC impedance is 660 Ω and the AC impedance is 560 Ω .

Pin No.	Pin Name	Pin Function
13	AUX Audio 1	PUBLIC Address 1
14	Rx Audio	Receive Live Audio ²
15	AUX Audio 2	PUBLIC Address 2
16	GND	Ground
17	GP5-1 (PTT)	5 V Level GPIO, PTT Input ³
18	GND	Ground
19	GP5-2 (Monitor)	5 V Level GPIO, Monitor Input ⁴
20	GP5-6	5 V Level GPIO
21	GP5-3	5 V Level GPO, Channel Activity Function
22	GP5-7	5 V Level GPIO
23	EMERGENCY	Emergency Switch Input
24	GP5-8	5 V Level GPIO
25	IGN SENSE	Ignition Sense ⁵
26	VIP-1	12 V Tolerant, 5V GPIO, External Alarm

3.1.1

Emergency Pushbutton or Footswitch Installation

Mount the emergency pushbutton (Motorola Solutions part number RLN5926_) or the footswitch (Motorola Solutions part number RLN5929_) using the hardware that comes with the kit. Press the terminal into the accessory connector housing. Connect the emergency switch wires to pins 23 and 18. Route the finished cable from the switch location to the control head location.

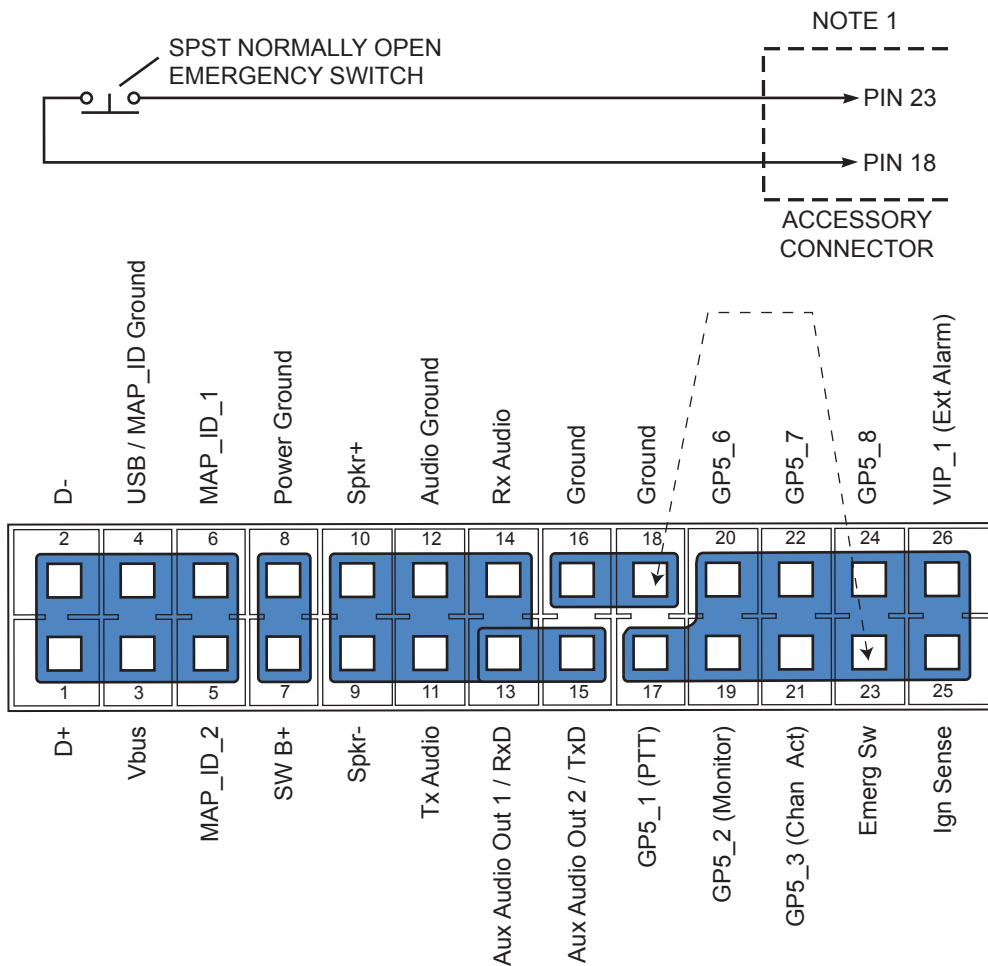
² Fixed level (independent of volume level) received audio signal, including alert tones. Flat or de-emphasis are programmed by CPS. Output voltage is approximately 330 mVrms per 1 kHz of deviation.

³ Pulling this line to ground will activate PTT function, activating the AUX_MIC input.

⁴ This input is used to detect when a rear microphone accessory is taken off-hook, to override PL to alert the user to busy traffic prior to transmitting.

⁵ See [Figure 9: Radio Installation \(Dash Mount\) on page 23](#) and [Figure 17: Cabling Interconnect Diagram for Remote Mount on page 32](#) for wiring information.

Figure 22: Emergency Switch Wiring Diagram



3.1.2 Horn and Lights (External Alarms) Relays

When and where to use: This feature allows the user to be alerted to an incoming call when away from the vehicle. The vehicle's horn or lights or both are used depending on which option is connected to the accessory port. When the radio receives a call alert or emergency alarm/call, there is a delay before activating the horn and/or lights. The delay is programmable using the Horn & Lights Delay Time feature in the CPS. Once activated, the Horn and/or Lights remain active depending on the option selected. The Horn & Lights feature can be toggled between ON or OFF, via a short or long programmable button press (Horn & Lights On/Off) or Horn/Lights (Utilities Menu) feature. For installations that use the horn/lights option, select a suitable location for mounting which normally is under the dash.

Procedure:

Do one of the following:

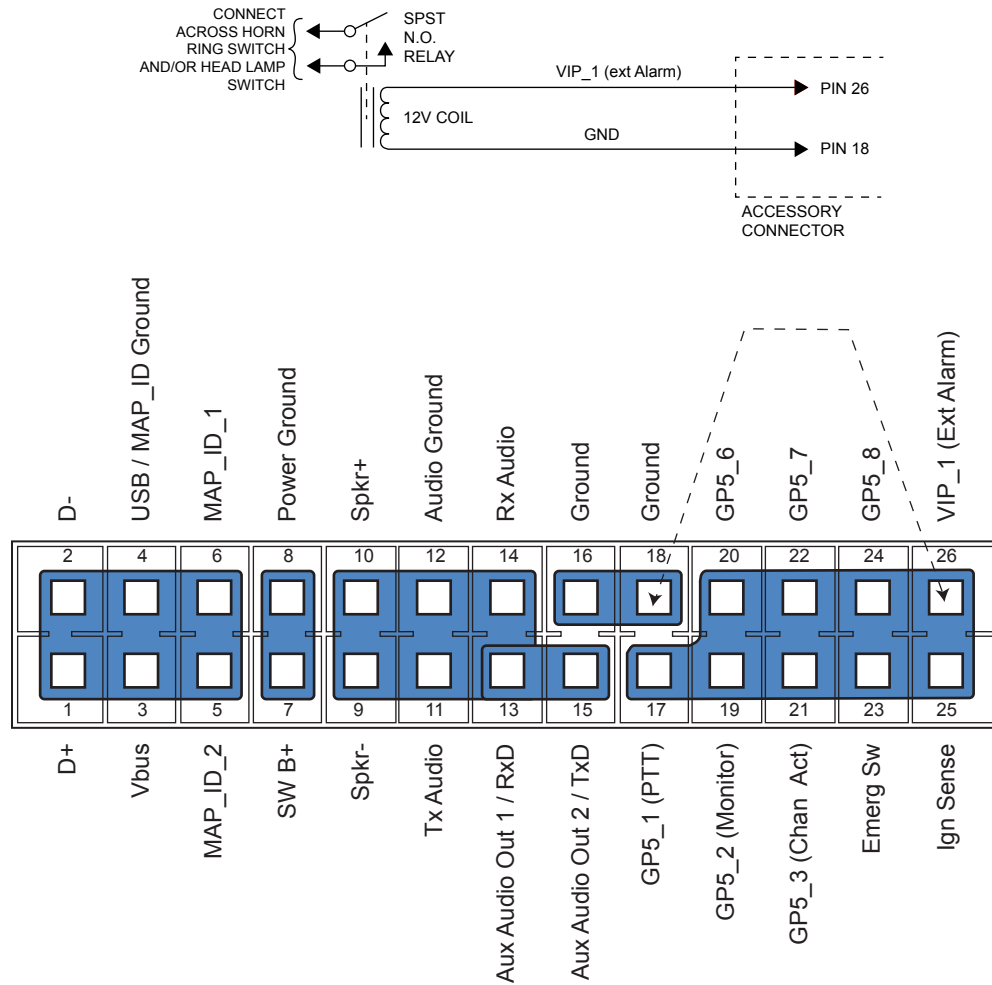
Horn Relay

Connect the relay contacts across the horn ring switch, typically found in the steering column. Open the accessory cable connector and connect the two control wires (male pins) into locations 26 and 18 of the connector.

Lights Relay

Connect the relay across the head lamp ON/OFF switch, typically found in the steering column. Open the accessory cable connector and connect the two control wires (male pins) into locations 26 and 18 of the accessory connector.

Figure 23: Horn/Light Wiring Diagram



3.1.3

External Speaker

The external speaker kit includes a trunnion bracket that allows the speaker to be mounted in various ways.

Prerequisites:



CAUTION: Do not ground the radio speaker leads. This system has a floating speaker output (dc voltage on both leads); grounding or shorting both leads damage the audio circuit.

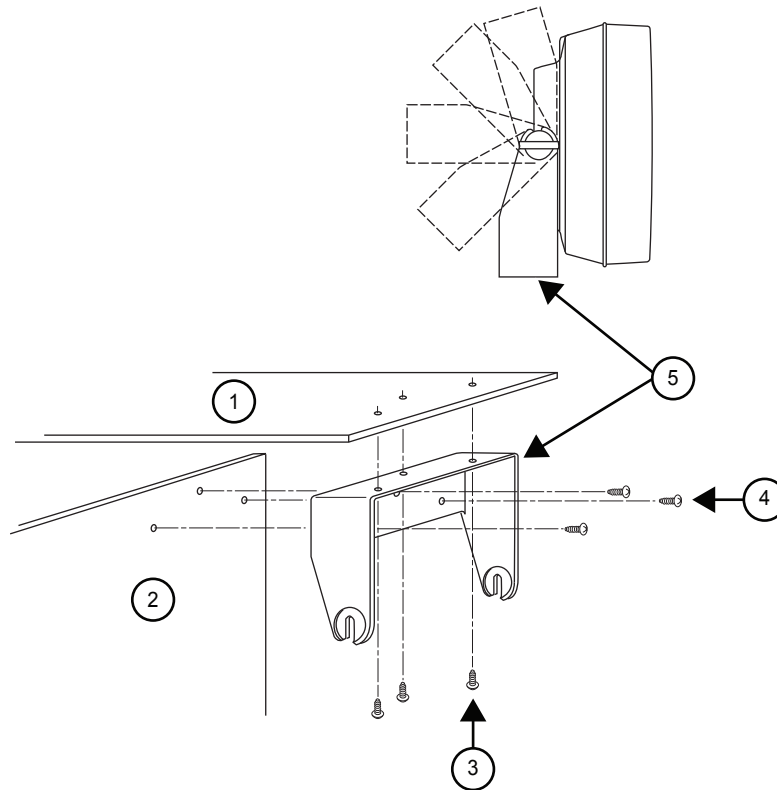
When and where to use: With the trunnion bracket, the external speaker can be mounted permanently on the dashboard or in accessible firewall areas. The trunnion allows the external speaker to tilt for best operation. Mount the external speaker out of the way so that it will not be kicked or knocked around by the vehicle occupants.

Procedure:

- 1 Use the external speaker mounting bracket as a template to mark the mounting hole locations.

- 2 Use the self-drilling screws provided to fasten the trunnion.
- 3 Attach the external speaker and fasten to the trunnion with two wing screws.
- 4 Route the speaker wires under the carpet or floor covering, or behind the kick panels. Be sure that the wires are out of the way and will not be snagged and broken by the occupants of the vehicle.

Figure 24: External Speaker Mounting



Label	Description
1	Dashboard
2	Firewall
3	Can be mounted permanently on dashboard.
4	Can be mounted permanently in firewall areas.
5	Trunnion Bracket

Chapter 4

Best Practices: Installation & Troubleshooting

In this section are Motorola Solutions recommended vehicle installation practices that can address or prevent many issues, including:

- Radio circuit damage due to over voltage condition
- Radio/Accessories "lock up"
- Radio/Accessories change state/lock-up when radio PTT is depressed
- Radio intermittently resets
- Alternator whine present when transmitting with engine running
- Radio/Accessories turn themselves on/off
- Radio sending false emergency alerts at vehicle cranking or during battery maintenance

4.1

Check Wiring of Ignition and Radio Ignition Sensing

- If it is required to turn the radio on and off through the ignition sense switch, in addition to the control head on/off switch, connect the ignition sense lead to the accessory terminal from the ignition switch (usually in the vehicle fuse panel under accessory or radio).



NOTICE: Motorola Solutions recommends protecting or isolating the radio ignition sense input from voltage spikes in excess of +/- 40 VDC. Such spikes can be hundreds of volts in amplitude and are common in larger vehicles (utility trucks, buses and others), especially when the source is common to a solenoid coil. A triggerable oscilloscope is required to determine the existence of such spikes as most voltmeters cannot measure in short duration (< 1 msec). If the condition of the intended ignition sense source is unknown, Motorola Solutions recommends isolating the source from the radio with a relay or the use of a suppression diode wired between the source and ground. Any high current suppression diode that is MR2535 with a breakdown voltage of between 18 and 40 V suffices. A suitable diode kit is available from Motorola Solutions parts, kit number HLN6325_.

- If it is required to have the radio power up only through the control head on/off switch, then connect the ignition sense lead directly to the positive terminal of the battery. This means the ignition sense is always ignored and a re-wiring is necessary in the future if the operator chooses any ignition sense CPS setting.

4.2

Check Physical Installation of Radio Ground and Radio Accessory Wiring

- Take care to scrape away paint on the chassis at the place where the ground connection is to be made, and try to keep the ground lead as short as possible.
- Verify that the red A+ lead is connected directly to the positive terminal of the battery and the black ground lead is connected to the vehicle chassis using a wire with practical length.
- For vehicles that have other types of electronic equipment installed such as lights, flashers, computers siren, PA, and others, use a separate ground for the mobile radio equipment.

- Make sure that the mobile radio antenna is the minimum required distance (three feet) from the mobile radio equipment to prevent radio frequency interference (RFI) from interfering with the radio and/or accessories.
- Do not coil up any excess length of the red A+ lead. This action may cause a large transient voltage to be produced when there is a high current drain for example, during transmit. Thus, could cause the radio to reset when the push-to-talk (PTT) is depressed.
- Do not coil up any excessive length of antenna cable, if possible. It may affect the radio receive performance.

4.3

Improving the Electrical Quality of the Power and Ignition Lines

Procedure:

- 1 Use a relay to isolate the vehicle ignition switch point (ACC) from the radio ignition sense point. Control this relay from the vehicle ignition switch point (ACC). Supply a cleaner voltage from the positive terminal of the battery into the relay, which is attached to the radio ignition sense point. Now the ACC line toggles the relay, instead of directly toggling the radio ignition sense line.
- 2 Install a Power Line Filter between the A+ lead and the positive terminal of the battery. This is intended to filter the battery power applied to the transmitter power amplifiers. Pay extra caution to this because the series filter introduces a negative spike when the radio transmits that may cause problems with radio operation.
- 3 For vehicles that use electromechanical relays to control external devices (lights, motors, switch boxes and others), these relay circuits should be isolated as best as possible from the mobile radio equipment. Diode suppression should be used across the relay contacts to minimize the noise produced by the collapsing magnetic field.
- 4 If the ignition sense switch is to be used, make sure that there is not a large voltage drop between the A+ point (usually the positive terminal of the battery) and the ignition sense point. In general, the voltage difference between these two points, should not be greater than 1.5 volts when all accessories/air-conditioner, others are turned on. Refer to the Basic Service Manual for specifications for minimum and maximum voltage levels. Typical battery voltage levels are 13.6 V +/- 20%.

4.4

Jump-Start the Vehicle

Prerequisites:



CAUTION: Do not jump-start vehicle with radio power or ignition sense cables connected. Damage to the radio and/or accessories may result.

The state of your radio prior to needing a jump-start may be unknown, and the radio may attempt to return to its last state (radio ON), when doing a jump-start. Therefore, Motorola Solutions recommends the following steps be taken before jump-starting any vehicle containing a radio.

Procedure:

- 1 Locate the ignition sense line and the main power leads (thick red wire) near the battery positive terminal.

NOTICE: These lines are fused. In the event these lines are not fused (add the appropriate fuse in line) use whatever tools necessary to physically disconnect the ignition sense and power lines from the battery terminal.
- 2 Open up the fuse holders and remove the fuses out of the kits.

- 3 Re-tighten the fuse holders but without the fuses to insure that ignition sense and power lines do not interfere with moving parts.
- 4 Proceed with the jump-start routine as described by your vehicle owner manual.
- 5 Once the jump-start process is complete, re-install the fuses into their holders.

4.5

Eliminate Noise/Howling from PA Speaker

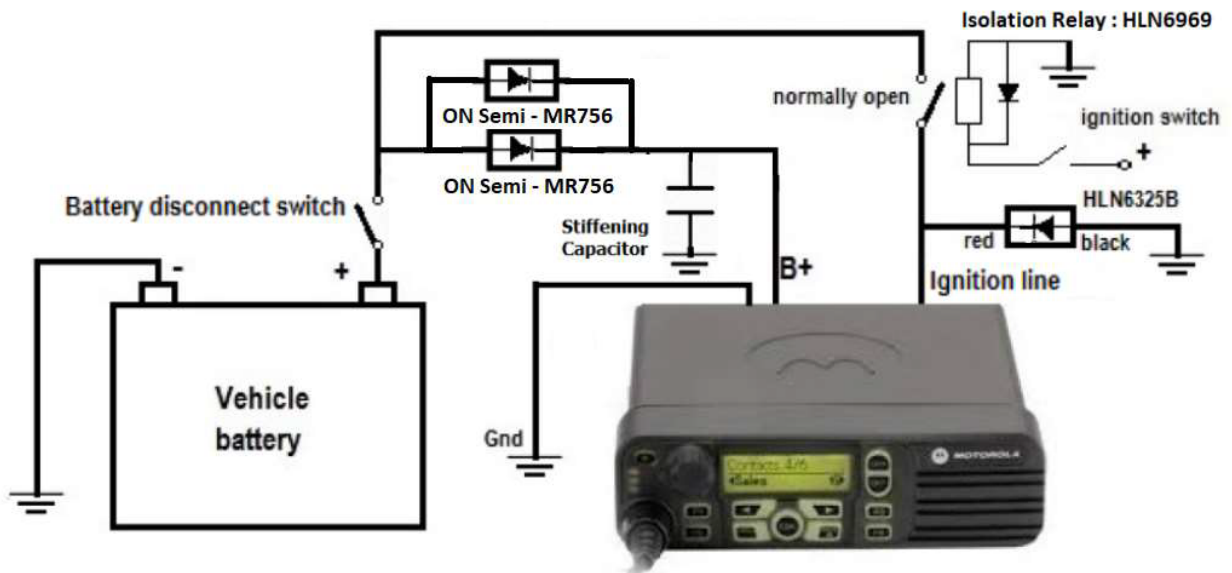
- 1 Refer to [Installation Example on page 21](#) for recommended methods of installation available for the mobile two-way radio, with accessories placed to the vehicle as desired.
- 2 Refer to [Figure 9: Radio Installation \(Dash Mount\) on page 23](#) and [Figure 10: Radio Installation \(Remote Mount\) on page 24](#) for the wiring diagrams for the recommended configurations.

4.6

Eliminating False Emergency Alert Triggering

Procedure:

- 1 If the Emergency Alert Triggering feature is not required before turning on the radio, uncheck **Rear Emergency Pin Prior to Power Up** in CPS Programming.
- 2 Inspect emergency Footswitch for faulty switch and/or corroded connections.
- 3 Clean or replace any corroded connections.
- 4 Solder wire connections and use Anti-oxidant Compound to protect connections from corrosion as needed.
- 5 If Emergency Alert Triggering feature is required before turning on the radio, use a stiffening capacitor with a diode to minimize acute power fluctuations. Recommended value for a stiffening capacitor may be **1000 uF to 10,000 uF, 50 V surge or higher**. The following figure shows the wiring illustration.



- 6 Before performing battery maintenance procedure, turn off the radio and remove the Fuse from radio power supply. Reinsert the Fuse after battery maintenance is completed. The following figure shows the location of the Fuse.



Item	Description
1	Fuse location

Appendix A

Replacement Parts Ordering

Some replacement parts, spare parts, and/or product information can be ordered directly from the Motorola Solutions local distribution organization or through Motorola Online.

Basic Ordering Information

While parts may be assigned with a Motorola Solutions part number, they may not be available from the Motorola Solutions Radio Products and Solutions Organization⁶ (RPSO). Some parts may have become obsolete and are no longer available in the market due to cancellations by the supplier. If no Motorola Solutions part number is assigned, the part is normally not available from Motorola Solutions, or is not a user-serviceable part. Part numbers appended with an asterisk are serviceable by Motorola Solutions Depot only.

Place orders for replacement parts, kits, and assemblies directly on Motorola Solutions local distribution organization or through Motorola Online. When ordering replacement parts or equipment information, include the complete identification number. This applies to all components, kits, and chassis. If the component part number is not known, the order should include the number of the chassis or kit of which it is a part of, and sufficient description of the desired component to identify it.

To identify non-referenced spare parts, request for help from the Customer Care organization of a Motorola Solutions local area representative.

Motorola Online

The product catalog is available on the Motorola Online website. To register for login access:

- For U.S. and Canada Service Centers only, call 1-800-422-4210.

Types of Orders	Contact Information
Mail Orders Mail orders are only accepted by the U.S. Federal Government Markets Division (USFGMD).	Motorola Solutions 7031 Columbia Gateway Drive 3rd Floor – Order Processing Columbia, MD 21046 U.S.A.
Telephone Orders and Parts Identification	Radio Products and Solutions Organization (RPSO) (United States and Canada) 7:00 AM to 7:00 PM (Central Standard Time) Monday through Friday (Chicago, U.S.A.) 1-800-422-4210 1-847-538-8023 (United States and Canada) U.S. Federal Government Markets Division (USFGMD)

⁶ Radio Products and Solutions Organization (RPSO) was formerly known as the Radio Products Services Division (RPSD) and/or the Accessories and Aftermarket Division (AAD).

Types of Orders	Contact Information
Fax Orders	1-800-826-1913 Federal Government Parts (Credit Cards Only) 8:30 AM to 5:00 PM (Eastern Standard Time) Radio Products and Solutions Organization (RPSO) (United States and Canada) 1-800-622-6210 1-847-576-3023 (United States and Canada) U.S. Federal Government Markets Division (USFGMD) 1-800-526-8641

Product Customer Service

Radio Products and Solutions Organization (RPSO) (United States and Canada)
1-800-927-2744

Appendix B

Motorola Solutions Offices

For more information regarding to your radio, please contact the following Motorola Solutions Offices to submit your queries.

Table 5: Motorola Solutions Offices

Office	Address	Telephone Number
Motorola Solutions Service Center	1220 Don Haskins Drive, Suite A El Paso, TX 79936	915-872-8200
Motorola Solutions Federal Technical Center	10105 Senate Drive Lanham, MD 20706	1800-969-6680 Fax: 1800-784-4113
Motorola Solutions Canadian Technical Logistics Center	181 Whitehall Drive Markham, Ontario L3R 9T1	1-800-543-3222

Glossary

This glossary contains an alphabetical listing of terms and their definitions that are applicable to portable and mobile subscriber radio products. All terms do not necessarily apply to all radios, and some terms are merely generic in nature.

Analog Refers to a continuously variable signal or a circuit or device designed to handle such signals.

Band Frequencies allowed for a specific purpose.

Customer Programming Software (CPS) Software with a graphical user interface containing the feature set of a radio.

Default A pre-defined set of parameters.

Digital Refers to data that is stored or transmitted as a sequence of discrete symbols from a finite set; most commonly this means binary data represented using electronic or electromagnetic signals.

Digital Private-Line (DPL) A type of digital communications that utilizes privacy call, as well as memory channel and busy channel lock out to enhance communication efficiency.

Dispatcher An individual who has radio-system management duties and responsibilities.

Federal Communications Commission (FCC) Regulates interstate and international communications by radio, television, wire, satellite and cable in all 50 states, the District of Columbia, and U.S. territories. It was established by the Communications Act of 1934 and operates as an independent U.S. government agency overseen by Congress. The commission is committed to being a responsive, efficient and effective agency capable of facing the technological and economic opportunities of the new millennium.

Frequency Number of times a complete electromagnetic-wave cycle occurs in a fixed unit of time (usually one second).

General-Purpose Input/Output (GPIO) Pins whose function is programmable.

Global Navigation Satellite System GNSS uses satellites from the GPS, GLONASS and BeiDou systems.

- Global Positioning System (GPS)
 - It includes Satellite Based Augmentation System (SBAS).
 - Method of location based on reception of multiple satellite signals by a device on the ground or in an airplane.
- Global Navigation Satellite System (GLONASS)
- BeiDou Navigation Satellite System (BDS)
 - Chinese Satellite Navigation System.

Integrated Circuit (IC) An assembly of interconnected components on a small semiconductor chip, usually made of silicon. One chip can contain millions of microscopic components and perform many functions.

kilohertz (kHz) One thousand cycles per second. Used especially as a radio-frequency unit.

Liquid-Crystal Display (LCD) An LCD uses two sheets of polarizing material with a liquid-crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them.

Light Emitting Diode (LED) An electronic device that lights up when electricity is passed through it.

Motorola Digital Communications (MDC) A Motorola Solutions proprietary signaling scheme permitting the transfer of data communications at the rate of 1200 bits per second. Designed specifically for high reliability in the land-mobile radio environment. Digital encoding allows a much greater amount of information to pass over the channel with each message than with alternative tone encoding methods. Some features include: PTT ID, Emergency, Call Alert, Emergency Alarm, Voice Selection Call (SelCall), Radio Check, and Monitor.

Megahertz (MHz) One million cycles per second. Used especially as a radio-frequency unit.

Paging One-way communication that alerts the receiver to retrieve a message.

Printed Circuit Board (PC Board) A circuit manufactured so that many or all of the components are attached to a non-conductive circuit board with copper strips on one or both sides to replace wires.

Private-Line Tone Squelch (PL) A continuous sub-audible tone that is transmitted along with the carrier.

Programming Cable A cable that allows the computer to communicate directly with certain radios using USB.

Receiver Electronic device that amplifies RF signals. A receiver separates the audio signal from the RF carrier, amplifies it, and converts it back to the original sound waves.

Repeater Remote transmit/receive facility that re-transmits received signals in order to improve communications range and coverage (conventional operation).

Radio Frequency (RF) The portion of the electromagnetic spectrum between audio sound and infrared light (approximately 10 kHz to 10 GHz).

Signal An electrically transmitted electromagnetic wave.

Spectrum Frequency range within which radiation has specific characteristics.

Squelch Muting of audio circuits when received signal levels fall below a pre-determined value. With carrier squelch, all channel activity that exceeds the radio's preset squelch level can be heard.

Time-out Timer (TOT) A timer that limits the length of a transmission.

Tone Private Line (TPL) A continuous tone-coded squelch, which contains 29 codes. It is not compatible with DPL, and is common among all radio manufacturers.

Transceiver Transmitter-receiver: A device that both transmits and receives analog or digital signals.

| **Abbreviation:**XCVR

Transmitter Electronic equipment that generates and amplifies an RF carrier signal, modulates the signal, and then radiates it into space.

Trunking Priority Monitor Scan List A scan list that includes talkgroups that are all from the same trunking system.

Ultra-High Frequency (UHF) The term for the International Telecommunication Union (ITU) Radio Band with a frequency range of 300 to 3000 MHz.

Universal Serial Bus (USB) An external bus standard that supports data transfer rates of 12 Mbps.