

PROFESSIONAL DIGITAL TWO-WAY RADIOS

**MOTOTRBO™**

**XPR™ 2500**

**ALPHANUMERIC  
DISPLAY MOBILE**

**BASIC SERVICE  
MANUAL**





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## Foreword

This manual covers all XPR™ 2500 Mobiles, unless otherwise specified. It includes all the information necessary to maintain peak product performance and maximum working time, using levels 1 and 2 maintenance procedures. This level of service goes down to the board replacement level and is typical of some local service centers, Motorola Authorized Dealers, self-maintained customers, and distributors.



**These servicing instructions are for use by qualified personnel only. To reduce the risk of electric shock, do not perform any servicing other than that contained in the Operating Instructions unless you are qualified to do so. Refer all servicing to qualified service personnel.**

### Product Safety and RF Exposure Compliance

#### ATTENTION!

**Before using the mobile two-way product, XPR™ 2500, read the RF Energy Exposure and Safety guide that ships with the 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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## Notes

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## Document History

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

Edition	Description	Date
68009620001-A	Initial Release.	June 2013

## Notes

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# Commercial Warranty

## Limited Warranty

### MOTOROLA COMMUNICATION PRODUCTS

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XPR 2500 Digital Mobile Radios	Two (2) Years
Product Accessories	One (1) Year

The mobiles additionally ship with a standard 1-year Repair Service Advantage (RSA)(for U.S. customers) or Extended Warranty (for Canada customers) options can be selected for an additional fee. At the time of order you must choose the warranty option.

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.

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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 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 at 1-888-567-7347 US/Canada.

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- A. Defects or damage resulting from use of the Product in other than its normal and customary manner.
- B. Defects or damage from misuse, accident, water, or neglect.
- C. Defects or damage from improper testing, operation, maintenance, installation, alteration, modification, or adjustment.
- D. Breakage or damage to antennas unless caused directly by defects in material workmanship.
- E. A Product subjected to unauthorized Product modifications, disassemblies or repairs (including, without limitation, the addition to the Product of non-Motorola supplied equipment) which adversely affect performance of the Product or interfere with Motorola's normal warranty inspection and testing of the Product to verify any warranty claim.
- F. Product which has had the serial number removed or made illegible.
- G. Freight costs to the repair depot.
- H. A Product which, due to illegal or unauthorized alteration of the software/firmware in the Product, does not function in accordance with MOTOROLA's published specifications or the FCC type acceptance labeling in effect for the Product at the time the Product was initially distributed from MOTOROLA.
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- B. that MOTOROLA will have sole control of the defense of such suit and all negotiations for its settlement or compromise; and
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## VII. Governing Law

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

## Notes



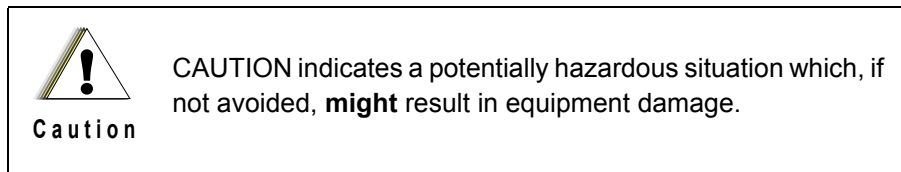
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# Chapter 1 Introduction

## 1.1 Notations Used in This Manual

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

**NOTE:** An operational procedure, practice, or condition that is essential to emphasize.



## 1.2 Radio Description

The XPR 2500 mobile radios are available in the following frequency ranges and power levels.

*Table 1-1 Radio Frequency Ranges and Power Levels*

Freq. Band	Bandwidth	Power Level
VHF	136–174 MHz	1–25 Watts 25–45 Watts
UHF B1	403–470 MHz	1–25 Watts 25–40 Watts

These radios are among the most sophisticated two-way radios available. They have a robust design for radio users who need high performance, quality, and reliability in their daily communications. This architecture provides the capability of supporting a multitude of legacy and advanced features resulting in a more cost-effective two-way radio communications solution.

## 1.3 Control Head Description

The control head used with the radio has logic circuitry that operates the standard and optional features built into the system.

The following illustration shows the typical radio control head.

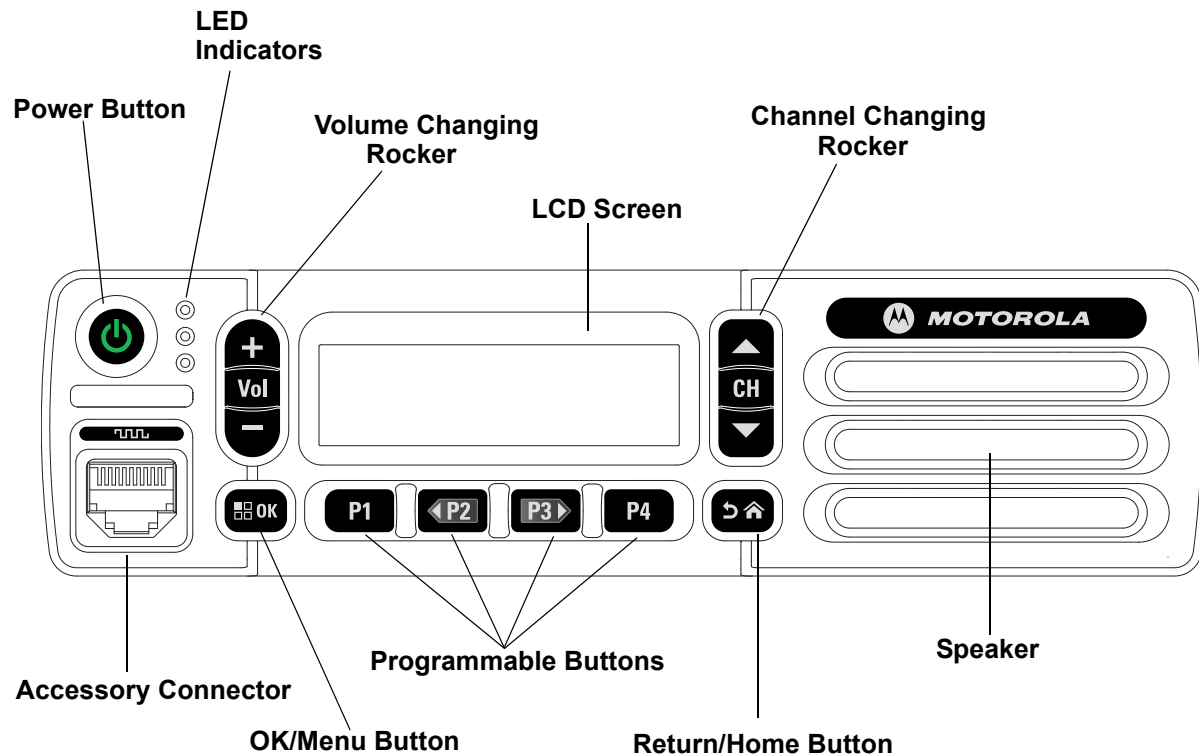


Figure 1-1 Radio Control Head

### 1.3.1 Control Head Controls

- **POWER BUTTON** – Turns the radio on and off.
- **VOLUME CHANGING ROCKER** – Press top side to increment or bottom side to decrement the volume.
- **CHANNEL CHANGING ROCKER** – Press top side to increment or bottom side to decrement the channel.
- **LED INDICATORS** – Red, yellow and green light-emitting diodes indicate operating status.
- **LCD (Liquid Crystal Display)** – 132x36 display provides visual information about many radio features.
- **OK/MENU BUTTON** – One button to provide menu navigation and selection interface.
- **PROGRAMMABLE BUTTONS** – Four buttons are field programmable using the CPS.
- **RETURN/HOME BUTTON** – One button which quickly brings you to the home page.

# 1.4 MOTOTRBO Mobile Radio Model Numbering Scheme

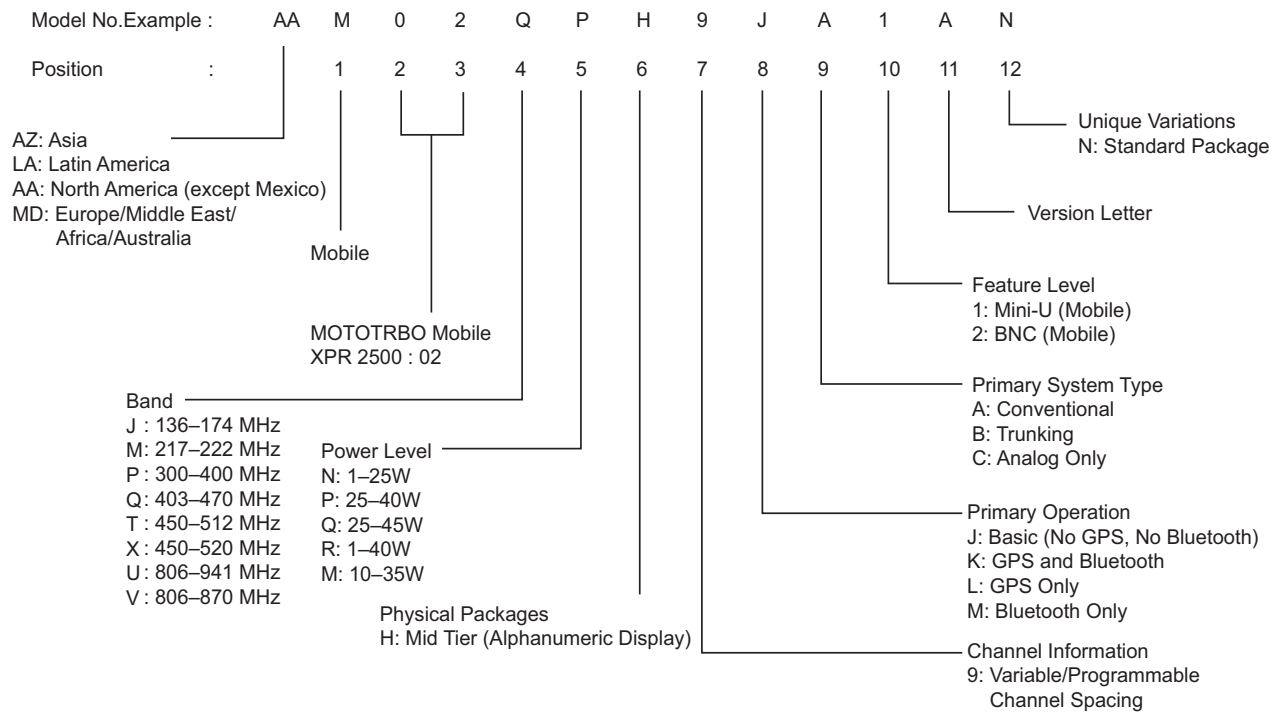


Figure 1-2 Mobile Radio Model Numbering Scheme

## 1.5 VHF High Power (136–174 MHz) Model Chart

<b>VHF 136–174 MHz 25–45W, Mini-U</b>	
<b>Model</b>	<b>Description</b>
AAM02JQH9JA1_N	136–174 MHz, 25–45W, MOTOTRBO XPR 2500 Alphanumeric Display Mobile
<b>Item</b>	<b>Description</b>
X PMUD3240_S	*Service Kit, VHF, 25–45W
X PMLN6441_	Alphanumeric Display Model Control Head
X 68009614001	Mobile Quick Reference Guide and Safety Booklet

X = Item Included

\* = Service Kit is the main board only

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

## 1.6 VHF Low Power (136–174 MHz) Model Chart

<b>VHF 136–174 MHz 1–25W, Mini-U</b>	
<b>Model</b>	<b>Description</b>
AAM02JNH9JA1_N	136–174 MHz, 1–25W, MOTOTRBO XPR 2500 Alphanumeric Display Mobile
<b>Item</b>	<b>Description</b>
X PMUD3241_S	*Service Kit , VHF, 1–25W
X PMLN6441_	Alphanumeric Display Model Control Head
X 68009614001	Mobile Quick Reference Guide and Safety Booklet

X = Item Included

\* = Service Kit is the main board only

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

## 1.7 UHF1 High Power (403–470 MHz) Model Chart

UHF1 403–470 MHz 25–40W, Mini-U		
Model	Description	
AAM02QPH9JA1_N	403–470 MHz, 25–40W, MOTOTRBO XPR 2500 Alphanumeric Display Mobile	
	Item	Description
X	PMUE4164_S	*Service Kit, UHF1, 25–40W
X	PMLN6441_	Alphanumeric Display Model Control Head
X	68009614001	Mobile Quick Reference Guide and Safety Booklet

X = Item Included

\* = Service Kit is the main board only

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

## 1.8 UHF1 Low Power (403–470 MHz) Model Chart

UHF1 403–470 MHz 1–25W, Mini-U		
Model	Description	
AAM02QNH9JA1_N	403–470 MHz, 1–25W, MOTOTRBO XPR 2500 Alphanumeric Display Mobile	
	Item	Description
X	PMUE4168_S	*Service Kit, UHF1, 1–25W
X	PMLN6441_	Alphanumeric Display Model Control Head
X	68009614001	Mobile Quick Reference Guide and Safety Booklet

X = Item Included

\* = Service Kit is the main board only

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

## 1.9 Specifications

General		
Specification	VHF	UHF1
Model:	Alphanumeric Display	
Channel Capacity:	128	
Typical RF Output: Low Power High Power	1–25 W 25–45 W	1–25 W 25–40 W
Frequency Range:	136–174 MHz	403–470 MHz
Dimensions: (HxWxL)	1.7 x 6.7 x 5.3 in (44 x 169 x 134 mm)	
Weight:	2.9 lbs. (1.3 kg)	
Current Drain: Standby Rx @ rated audio Transmit	0.81 A max 2 A max 1–25 W: 11.0 A max 25–40 W: 14.5 A max 25–45 W: 14.5 A max	
FCC Description:	1–25 W: ABZ99FT3090 25–45 W: ABZ99FT3091	1–25 W: ABZ99FT4092 25–40 W: ABZ99FT4093
IC Description:	1–25 W: 109AB-99FT3090 25–45 W: 109AB-99FT3091	1–25 W: 109AB-99FT4092 25–40 W: 109AB-99FT4093

Receiver		
Specification	VHF	UHF1
Model:	Alphanumeric Display	
Frequency:	136–174 MHz	403–470 MHz
Channel Spacing:	12.5 kHz/25 kHz*	
Frequency Stability: (-30°C to +60°C, +25°C Ref)	±0.5 ppm	
Analog Sensitivity (12 dB SINAD):	0.3 µV 0.22 µV (typical)	
Digital Sensitivity: (5% BER)	0.25 µV 0.19 µV (typical)	
Intermodulation TIA603D:	75 dB	70 dB
Adjacent Channel Selectivity TIA603D:	50 dB @ 12.5 kHz, 75 dB @ 25 kHz	50 dB @ 12.5 kHz, 70 dB @ 25 kHz
Spurious Rejection TIA603D:	75 dB	70 dB
Rated Audio:	4 W (Internal) 7.5 W (External – 8 ohms) 13 W (External – 4 ohms)	
Audio Distortion @ Rated Audio:	3% (Typical)	
Hum and Noise:	-40 dB @ 12.5 kHz -45 dB @ 25 kHz	
Audio Response:	TIA603D	
Conducted Spurious Emission (TIA603D):	-57 dBm	

\*25 kHz may not be available in the U.S. for Part 90 operation due to the FCC's Narrowbanding requirements.

Transmitter		
Specification	VHF	UHF1
Model:	Alphanumeric Display	
Frequency:	136–174 MHz	403–470 MHz
Channel Spacing:	12.5 kHz/25 kHz*	
Frequency Stability: (-30°C to +60°C, +25°C Ref)	±0.5 ppm	
Power Output: Low Power High Power	1–25 W 25–45 W	1–25 W 25–40 W
Modulation Limiting:	±2.5 kHz @ 12.5 kHz ±5.0 kHz @ 25 kHz	
FM Hum and Noise:	-40 dB @ 12.5 kHz -45 dB @ 25 kHz	
Conducted/ Radiated Emission:	-36 dBm <1 GHz -30 dBm >1 GHz	
Adjacent Channel Power (TIA603D):	60 dB @ 12.5 kHz 70 dB @ 25 kHz	
Audio Response:	TIA603D	
Audio Distortion:	3%	
FM Modulation:	12.5 kHz: 11K0F3E 25 kHz: 16K0F3E	
4FSK Digital Modulation:	12.5 kHz Data: 7K60F1D & 7K60FXD 12.5 kHz Voice: 7K60F1E & 7K60FXE Combination of 12.5 kHz Voice & Data: 7K60F1W	
Digital Vocoder Type:	AMBE+2™	
Digital Protocol:	ETSI TS 102 361-1 ETSI TS 102 361-2 ETSI TS 102 361-3	

\*25 kHz may not be available in the U.S. for Part 90 operation due to the FCC's Narrowbanding requirements.



Self-Quieter	
VHF	UHF1
153.6 MHz +/- 10 kHz	422.4 MHz
172.8 MHz +/- 10 kHz	–

Military Standards 810C, D, E, F & G										
	MIL-STD 810C		MIL-STD 810D		MIL-STD 810E		MIL-STD 810F		MIL-STD 810G	
	Method	Proc./Cat	Method	Proc./Cat	Method	Proc./Cat	Method	Proc./Cat	Method	Proc./Cat
Low Pressure	500.1	I	500.2	II	500.3	II	500.4	II	500.5	II
High Temperature	501.1	I, II	501.2	I/A1, II/A1	501.3	I/A, II/AI	501.4	I/HOT, II/HOT	501.5	I/AI, II
Low Temperature	502.1	I	502.2	I/C3, II/C1	502.3	I/C3, II/C1	502.4	I/C3, II/C1	502.5	I/C3, II
Temperature Shock	503.1	–	503.2	I/A1/C3	503.3	I/AI/C3	503.4	I	503.5	I/C
Solar Radiation	505.1	II	505.2	I	505.3	I	505.4	I	505.5	I/A1
Rain	506.1	I, II	506.2	I, II	506.3	I, II	506.4	I, III	506.5	I, III
Humidity	507.1	II	507.2	II	507.3	II	507.4	–	507.5	II - Aggravated
Salt Fog	509.1	–	509.2	–	509.3	–	509.4	–	509.5	–
Dust	510.1	I	510.2	I	510.3	I	510.4	I	510.5	I
Vibration	514.2	VIII/F, Curve-W	514.3	I/10, II/3	514.4	I/10, II/3	514.5	I/24	514.6	I/24
Shock	516.2	I, II	516.3	I, IV	516.4	I, IV	516.5	I, IV	516.6	I, IV, V, VI

<b>Environmental Specifications</b>	
Operating Temperature	-30°C / +60°C
Storage Temperature	-40°C / +85°C
Thermal Shock	Per MIL-STD
Humidity	Per MIL-STD
ESD	IEC 61000-4-2 Level 3
Dust and Water Intrusion	IP54, MIL-STD**
Packaging Test	Per MIL-STD

\*\*Radio meets IP54 and MIL-STD rating with microphone sealing boot and rear accessory connector cover properly installed.

Specifications subject to change without notice. All specifications shown are typical.

Radio meets applicable regulatory requirements. Version 1 05/13

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## Chapter 2 Test Equipment and Service Aids

### 2.1 Recommended Test Equipment

The list of equipment contained in Table 2-1 includes most of the standard test equipment required for servicing Motorola mobile radios.

*Table 2-1 Recommended Test Equipment*

Equipment	Characteristic	Example	Application
Service Monitor	Can be used as a substitute for items marked with an asterisk (*)	Aeroflex 3920 or equivalent	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
Digital RMS Multimeter*	100 $\mu$ V to 300 V 5 Hz to 1 MHz 10 Mega Ohm Impedance	Fluke 179 or equivalent (www.fluke.com)	AC/DC voltage and current measurements. Audio voltage measurements.
RF Signal Generator*	100 MHz to 1 GHz -130 dBm to +10 dBm FM Modulation 0 kHz to 10 kHz	Agilent N5181 (www.agilent.com) or equivalent	Receiver measurements
Oscilloscope*	2 Channels 50 MHz Bandwidth 5 mV/div to 20 V/div	Tektronix TDS1001b (www.tektronix.com) or equivalent	Waveform measurements
Power Meter and Sensor*	5% Accuracy 100 MHz to 500 MHz 50 Watts	Bird 43 Thruline Watt Meter (www.bird-electronic.com) or equivalent	Transmitter power output measurements
RF Millivolt Meter	100 mV to 3 V RF 10 kHz to 1 GHz	Boonton 92EA (www.boonton.com) or equivalent	RF level measurements
Power Supply	0 V to 32 V 0 A to 20 A	B&K Precision 1790 (www.bkprecision.com) or equivalent	Voltage supply

## 2.2 Service Aids

Table 2-2 lists the service aids recommended for working on the radio. While all of these items are available from Motorola, most are standard workshop equipment items, and any equivalent item capable of the same performance may be substituted for the item listed.

Table 2-2 Service Aids

<b>Motorola Part Number</b>	<b>Description</b>	<b>Application</b>
RLN4460_	Test Box	Enables connection to audio/accessory jack. Allows switching for radio testing.
RVN5115_	Customer Programming Software on CD-ROM	Allows servicer to program radio parameters, tune and troubleshoot radios.
PMKN4147_	Front Telco MMP USB Programming Cable	Connects the radio's front connector to a USB port for radio programming and data applications.
PMKN4148_	Back 20 Pin MAP USB Programming Cable	Connects the radio's rear connector to a USB port for radio programming and data applications.
PMKN4149_	Back 20 Pin MAP Test and USB Programming Cable	Connects the radio's rear connector to a USB port for radio programming, data applications, testing and alignment.
PMKN4150_	Back 20 Pin MAP Test Cable	Connects the radio's rear connector for testing. Must use in conjunction with PMKN4147_ (Front Telco MMP USB Programming Cable) for radio programming and alignment.
PMKN4151_	Back 16 Pin MAP Universal Cable	Connects the radio's rear connector to the center 16 pins with unterminated connectors at the user end.
HPN4007_	Power Supply	Provides the radio with power when bench testing.
PMEN4041_	Chassis Eliminator Kit	Test Fixture used to bench test the radio PCB.
6686119B01	Control Head Dismantling Tool	Assists in the removal of radio control head.

### 2.3 Programming Cables

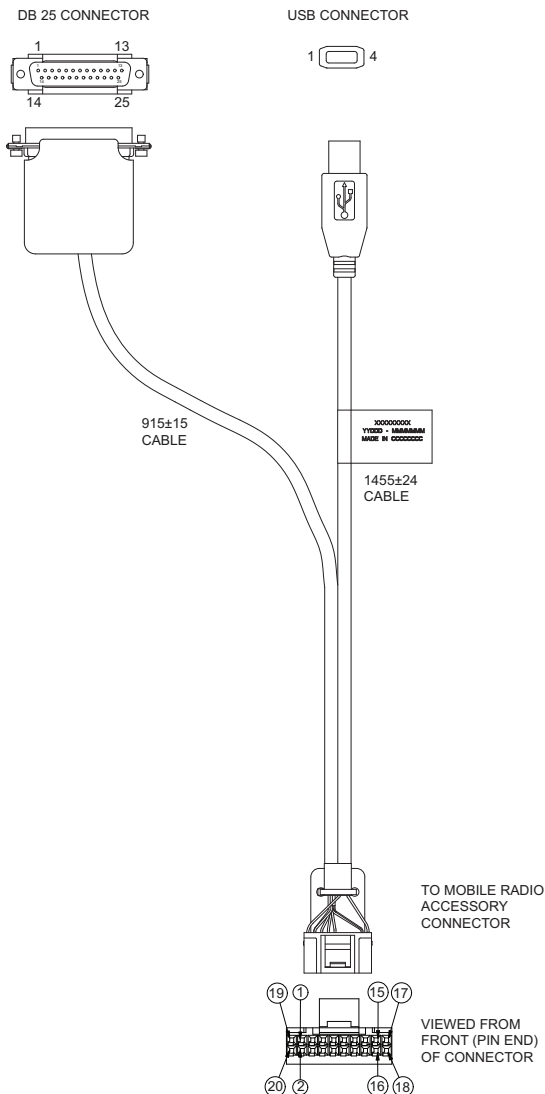


Figure 2-1 Front Telco MMP USB Programming Cable PMKN4147\_



Figure 2-2 Back 20 Pin MAP USB Programming Cable PMKN4148\_

### 2.4 Programming and Test Cable



WIRE DIAGRAM				
20 PIN ACCESSORY PORT CONNECTOR		WIRE COLOR	USB	DB25P
PIN 19	VCC (5v) (USB VBUS)	RED	PIN 1	
PIN 18	DATA -	WHITE	PIN 2	
PIN 17	DATA +	GREEN	PIN 3	
PIN 20	GROUND (USB)	BLACK	PIN 4	
	DRAIN WIRE AND BRAID	DRAIN WIRE/BRAID	SHELL	
PIN 1	SPEAKER -	ORANGE		PIN 2 & 7
PIN 2	EXT MIC AUDIO	GREY		PIN 10 & 15
PIN 3	PROGM INPUT (EXT. PTT)	PINK		PIN 20
PIN 5	FLAT TX AUDIO	YELLOW		PIN 18
PIN 7	GROUND (DB25)	BLACK		PIN 16
PIN 15	RSSI	BROWN		PIN 19
PIN 16	SPEAKER +	PURPLE		PIN 1 & 5

Figure 2-3 Back 20 Pin MAP Test and USB Programming Cable PMKN4149\_

### 2.5 Test Cable

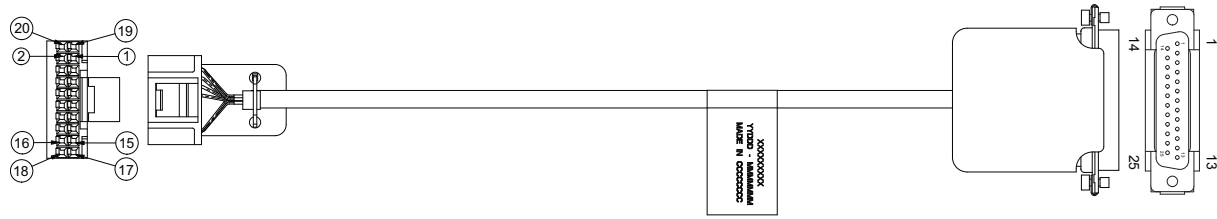


Figure 2-4 Back 20 Pin MAP Test Cable PMKN4150\_

Table 2-3 Wire Diagram for PMKN4150\_

WIRE DIAGRAM			
20 PIN ACCESSORY PORT CONNECTOR		WIRE COLOR	DB25P
PIN No.	DESCRIPTION	--	--
1	SPEAKER -	ORANGE	2 & 7
2	EXT MIC	GREY	10 & 15
3	GPI_1 (EXT PTT)	PINK	20
5	FLAT TX	YELLOW	18
7	GROUND	BLACK	16
15	RSSI	BROWN	19
16	SPEAKER +	PURPLE	1 & 5

## 2.6 Accessory Cable

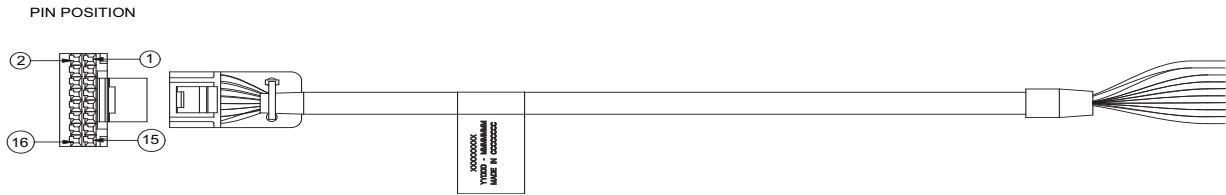


Figure 2-5 Back 16 Pin MAP Universal Cable PMKN4151\_

Table 2-4 Wire Diagram for PMKN4151\_

WIRE DIAGRAM						
16 PIN CONNECTOR	WIRE COLOR	WIRE LEAD SIDE		16 PIN CONNECTOR	WIRE COLOR	WIRE LEAD SIDE
1	BLACK	NC		9	PURPLE	NC
2	WHITE	NC		10	GREY	NC
3	GREEN	NC		11	PINK	NC
4 *	YELLOW / DRAIN WIRE	NC *		12	WHT / BLK	NC
5	ORANGE	NC		13	WHT / BRN	NC
6	BLUE	NC		14	WHT / RED	NC
7	BROWN	NC		15	WHT / ORG	NC
8	RED	NC		16	WHT / GRN	NC

(\*) NOTE: CRIMP YELLOW WIRE AND DRAIN WIRE TO TERMINAL ON 26 PIN CONNECTOR.  
 TIN YELLOW WIRE AND DRAIN WIRE TOGETHER ON WIRE LEAD SIDE

## Notes



# Chapter 3 Transceiver Performance Testing

## 3.1 General

These radios meet published specifications through their manufacturing process by utilizing high-accuracy laboratory-quality test equipment. The recommended field service equipment approaches the accuracy of the manufacturing equipment with few exceptions. This accuracy must be maintained in compliance with the manufacturer’s recommended calibration schedule.

## 3.2 Setup

Supply voltage is provided using a 13.8 VDC power supply. (Note: applying 13.8 VDC at the DC power cable will ensure a minimum of 13.2 VDC at the DC connector of the radio). The equipment required for alignment procedures is shown in the Radio Tuning Equipment Setup Diagram, Figure 4-4.

Initial equipment control settings should be as indicated in Table 3-1. The remaining tables in this chapter contain the following related technical data:

Table Number	Title
3-2	Front Panel Access Test Mode Displays
3-3	Test Environments
3-4	Test Channel Spacing
3-5	Test Frequencies
3-6	Transmitter Performance Checks
3-7	Receiver Performance Checks

Table 3-1 Initial Equipment Control Settings

Service Monitor	Power Supply	Test Set
Monitor Mode: Power Monitor	Voltage: 13.8 VDC	Speaker set: A
RF Attenuation: -70	DC On/Standby: Standby	Speaker/load: Speaker
AM, CW, FM: FM	Volt Range: 20 V	PTT: OFF
Oscilloscope Source: Mod Oscilloscope Horizontal: 10 mSec/Div Oscilloscope Vertical: 2.5 kHz/Div Oscilloscope Trigger: Auto Monitor Image: Hi Monitor Bandwidth: Narrow Monitor Squelch: middle setting Monitor Vol: 1/4 setting	Current: 20 A	

### 3.3 Alphanumeric Display Model Test Mode

#### 3.3.1 Entering Display Radio Test Mode

1. Turn the radio on.
2. Within ten seconds after self test is complete, press **button P2**, five times in succession.
3. The radio beeps and will show a series of displays that will give information regarding various version numbers and subscriber specific information. The displays are described in Table 3-2.

Table 3-2 Front Panel Access Test Mode Displays

Name of Display	Description	Appears
Service Mode	The literal string indicates the radio has entered test mode.	Always
Host Version	The version of host firmware.	Always
DSP Version	The version of DSP firmware.	Always
Model Number	The radio's model number as programmed in the codeplug.	Always
MSN	The radio's serial number as programmed in the codeplug.	Always
FLASHCODE	The FLASH codes as programmed in the codeplug.	Always
RF Band	The radio's band.	Always

**NOTE:** The radio stops at each display for 2 seconds before moving to the next information display. If the information cannot fit into 1 line, the radio display scrolls automatically character by character after 1 second to view the whole information. If the Top Navigation Button (▲) is pressed before the last information display, the radio shall suspend the information display until the user presses Bottom Navigation Button (▼) to resume the information display. The radio beeps for each button press. After the last display, RF Test Mode will be displayed.

#### 3.3.2 RF Test Mode

When the radio is operating in its normal environment, the radio's microcontroller controls the RF channel selection, transmitter key-up, and receiver muting, according to the customer codeplug configuration. However, when the unit is on the bench for testing, alignment, or repair, it must be removed from its normal environment via a special routine, called **TEST MODE** or air test.

In RF Test Mode, the display upon the first line is "RF Test", together with the power level icon at the right end of the first line. The display upon the second line is the test environment, the channel number and channel spacing ("CSQ CHXX SP25"). The default test environment is CSQ.

1. Each short press of **button P2** changes the test environment (CSQ->TPL->DIG->USQ->CSQ). The radio beeps once when radio toggles to CSQ, beeps twice for TPL, beeps three times for DIG and beeps four times for USQ.

**NOTE:** DIG is digital mode and other test environments are analog mode as described in Table 3-3.

2. Each short press of **button P1** toggles the channel spacing between 20 kHz, 25 kHz and 12.5 kHz. The radio beeps once when radio toggles to 20 kHz, beeps twice for 25 kHz and beeps three times for 12.5 kHz.

3. Pressing of the Channel Changing Rocker changes the test channel from 1 to 14. Press the top side to increase or bottom side to decrease the channel number. The radio beeps in each position. The channel test frequencies are described in Table 3-5.

### 3.3.3 Alphanumeric Display Test Mode

1. Press and hold **button P1** in RF Test Mode. The radio beeps once and momentarily displays 'Display Test Mode'.
2. Upon entering Display Test Mode, the radio displays a horizontal line on row 8 (center row).
3. With each button press, the radio fills up the screen with 2 horizontal lines from the center row (1 line each above and below the center row) until the top and bottom of the screen (row 7–0 and 9–16) is completely filled.
4. When the screen is filled up with the horizontal lines, any button press clears the screen and displays vertical lines at column 0, 6, 12, 18, 24, 30, 36, 42, 48, 54, 60. Any button press fills the screen with vertical lines, (1 line to the right of all existing lines) until the display is filled.

### 3.3.4 LED Test Mode

1. Press and hold **button P1** after Display Test Mode. The radio beeps once and displays "LED Test Mode".
2. Upon any button press, the radio lights on the red LED and displays "Red LED On".
3. Consequently, upon any button press, the red LED is turned off and the radio lights on the green LED and displays "Green LED On".
4. Consequently, upon any button press, the green LED is turned off and the radio shall light on the yellow LED and displays "Yellow LED On".

### 3.3.5 Backlight Test Mode

1. Press and hold **button P1** after LED Test Mode. The radio beeps once and displays "Backlight Test Mode".
2. The radio lights on both LCD and keypad backlight together.

### 3.3.6 Speaker Tone Test Mode

1. Press and hold **button P1** after Backlight Test Mode. The radio beeps once and displays "Speaker Tone Test Mode".
2. The radio generates a 1 kHz tone with the internal speaker.

### 3.3.7 Earpiece Tone Test Mode

1. Press and hold **button P1** after Speaker Tone Test Mode. The radio beeps once and displays "Earpiece Tone Test Mode".
2. The radio generates a 1 kHz tone with the earpiece.

### 3.3.8 Audio Loopback Test Mode

1. Press and hold **button P1** after Earpiece Tone Test Mode. The radio beeps once and displays "Audio Loopback Test Mode".
2. The radio shall route any audio on the mic to the internal speaker.

### 3.3.9 Audio Loopback Earpiece Test Mode

1. Press and hold **button P1** after Audio Loopback Test Mode. The radio beeps once and displays "Audio Loopback Earpiece Test".
2. The radio shall route any audio on the mic to the accessory earpiece.

### 3.3.10 Button Test Mode

1. Press and hold **button P1** after Audio Loopback Earpiece Test Mode. The radio beeps once and displays "Button Test".
2. The radio also displays the Button Command Opcode (BCO) and state (BCO/state) on the screen upon any button state changes.
3. The radio must be powered off to end Test Mode.

Table 3-3 Test Environments

No. of Beeps	Description	Function
1	Carrier Squelch (CSQ)	RX: unsquelch if carrier detected TX: mic audio
2	Tone Private-Line (TPL)	RX: unsquelch if carrier and tone (192.8 Hz) detected TX: mic audio + tone (192.8 Hz)
3	Digital (DIG)	RX: unsquelch if carrier and digital code detected TX: mic audio
4	Unsquelch (USQ)	RX: constant unsquelch TX: mic audio

Table 3-4 Test Channel Spacing

Number of Beeps	Channel Spacing
1	20 kHz
2	25 kHz
3	12.5 kHz

Table 3-5 Test Frequencies

Test Mode	Test Channel Low Power	Test Channel High Power	VHF (MHz)	UHF1 (MHz)
TX	1	8	136.075	403.000
RX	1	8	136.075	403.000
TX	2	9	142.575	414.150
RX	2	9	142.575	414.150
TX	3	10	146.575	425.350
RX	3	10	146.575	425.350
TX	4	11	155.575	436.500
RX	4	11	155.575	436.500
TX	5	12	161.575	447.675
RX	5	12	161.575	447.675
TX	6	13	167.575	458.850
RX	6	13	167.575	458.850
TX	7	14	174.975	470.000
RX	7	14	174.975	470.000

Table 3-6 Transmitter Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comment
Reference Frequency (see Note below Table 3-6)	Mode: PWR MON 4th channel test frequency* Monitor: Frequency error Input at RF In/Out	TEST MODE, Test Channel 4, carrier squelch	PTT to continuously transmit (during the performance check)	Frequency error: ±90 Hz (VHF) ±150 Hz (UHF)
Power RF	As above	TEST MODE Test Channel 4, carrier squelch  TEST MODE Test Channel 11, carrier squelch	As above	Low Power Set: 1.0–1.3 W: (VHF 1–25 W, UHF1 1–25 W) 25–29 W: (VHF 25–45 W, UHF1 25–40 W)  High Power Set: 25–29 W: (VHF 1–25 W, UHF1 1–25 W) 40–47 W: (UHF1 25–40 W) 45–53 W: (VHF 25–45 W)
Voice Modulation	Mode: PWR MON 4th channel test frequency* atten to -70, input to RF In/Out Monitor: DVM, AC Volts Set 1 kHz Mod Out level for 800mVrms at test set, 800mVrms at AC/DC test set jack	TEST MODE Test Channel 4, carrier squelch	As above, meter selector to mic	Deviation: 2.5 kHz Max. (12.5 kHz Ch. Sp.) 4 kHz Max. (20 kHz Ch. Sp.) 5 kHz Max. (25 kHz Ch. Sp.)
Voice Modulation (internal)	Mode: PWR MON 4th channel test frequency* atten to -70, input to RF In/Out	TEST MODE, Test Channel 4 carrier squelch output at antenna	Remove modulation input	Deviation: 2.5 kHz Max. (12.5 kHz Ch. Sp.) 4 kHz Max. (20 kHz Ch. Sp.) 5 kHz Max. (25 kHz Ch. Sp.)
TPL Modulation	As above 4th channel test frequency* BW to narrow	TEST MODE, Test Channel 4 TPL	As above	Deviation: 0.25–0.5 kHz (12.5 kHz Ch. Sp.) 0.4–0.8 kHz (20 kHz Ch. Sp.) 0.5–1.0 kHz (25 kHz Ch. Sp.)

Table 3-6 Transmitter Performance Checks (Continued)

Test Name	Communications Analyzer	Radio	Test Set	Comment
FSK Error	DMR mode. FSK error	TEST MODE, Digital mode, transmit with O.153 test pattern	Key up radio with O.153 test pattern modulation using Tuner	Not Exceed 5%
Magnitude Error	DMR mode. Magnitude error	As above	As above	Not Exceed 1%
Symbol Deviation	DMR mode. Symbol deviation	As above	As above	Symbol Deviation should be within 648 +/-10% and 1944 +/-10%
Transmitter BER	DMR mode	As above	As above	Transmitter BER should be 0%

\* See Table 3-5

**NOTE:** It is recommended that the reference oscillator be recalibrated after two years to maintain optimized Dual Capacity Direct Mode performance.

Table 3-7 Receiver Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comment
Rated Audio	Mode: GEN Output level: 1.0 mV RF 4th channel test frequency* Mod: 1 kHz tone at 3 kHz deviation Monitor: DVM: AC Volts	TEST MODE Test Channel 4, 25 kHz channel spacing, carrier squelch	PTT to OFF (center), meter selector to Audio PA	Set volume control to 7.5 Vrms
Distortion	As above, except to distortion	As above	As above	Distortion <5.0%
Sensitivity (SINAD)	As above, except SINAD, lower the RF level for 12 dB SINAD.	As above	PTT to OFF (center)	RF input to be <0.3 $\mu$ V
Noise Squelch Threshold (only radios with conventional system need to be tested)	RF level set to 1 mV RF	As above	PTT to OFF (center), meter selection to Audio PA, spkr/load to speaker	Set volume control to 7.5 Vrms
	As above, except change frequency to a conventional system. Raise RF level from zero until radio unsquelches.	out of TEST MODE; select a conventional system	As above	Unsquelch to occur at <0.25 $\mu$ V. Preferred SINAD = 9–10 dB
Receiver BER	IFR DMR mode. Signal generator with O.153 test pattern	Test mode, Digital mode, receive O.153 test pattern	Read BER using Tuner. Adjust RF level to get 5% BER	RF level to be <0.3 $\mu$ V for 5% BER

\* See Table 3-5

## Notes



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# Chapter 4 Radio Programming and Tuning

## 4.1 Introduction

This chapter provides an overview of the MOTOTRBO Customer Programming Software (CPS), as well as the Tuner and AirTracer applications, which are all designed for use on a Windows 8/7/Vista/XP operating system. These programs are available in one kit as listed in Table 4-1. An Installation Guide is also included with the kit.

**NOTE:** Refer to the appropriate program on-line help files for the programming procedures.

*Table 4-1 Radio Software Program Kit*

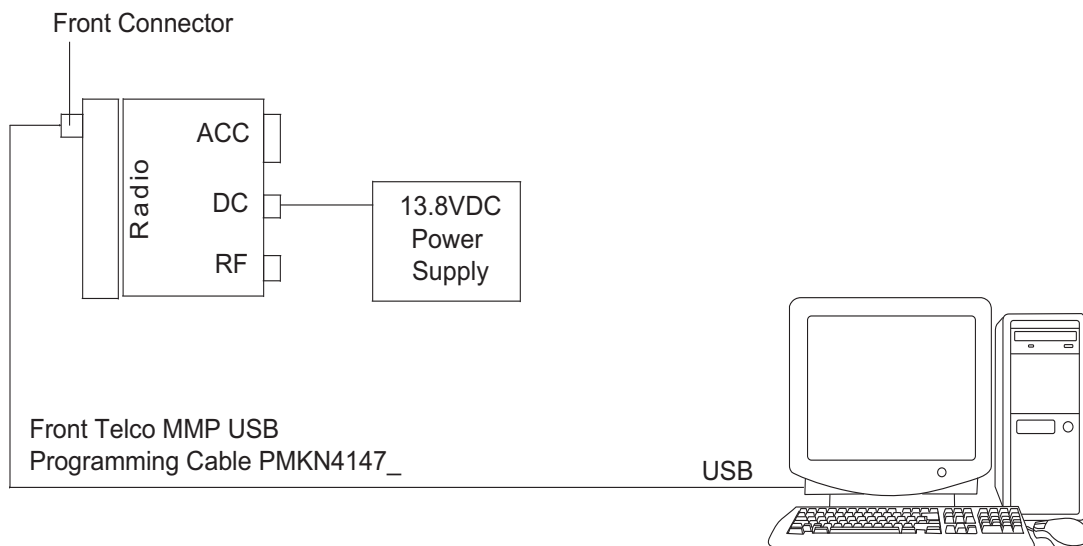
Description	Kit Number
MOTOTRBO CPS, Tuner and AirTracer Applications CD	RVN5115_

## 4.2 Customer Programming Software Setup

The Customer Programming Software setups, shown in Figure 4-1 and Figure 4-2, are used to program the radio.

**NOTE:** Refer to the appropriate program on-line help files for the programming procedures.

**CAUTION:** Computer USB ports can be sensitive to Electronic Discharge.  
Do not touch exposed contacts on cable when connected to a computer.



*Figure 4-1 Customer Programming Software Setup from Front Connector*

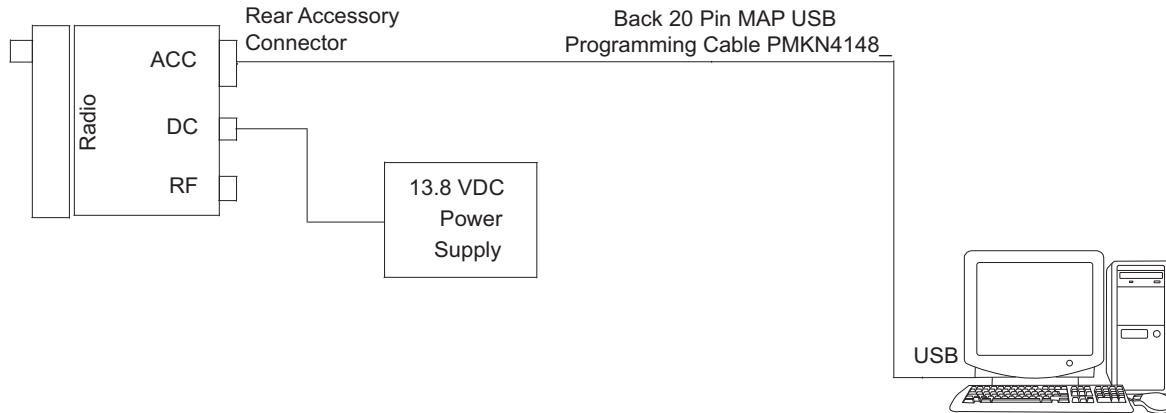


Figure 4-2 Customer Programming Software Setup from Rear Accessory Connector

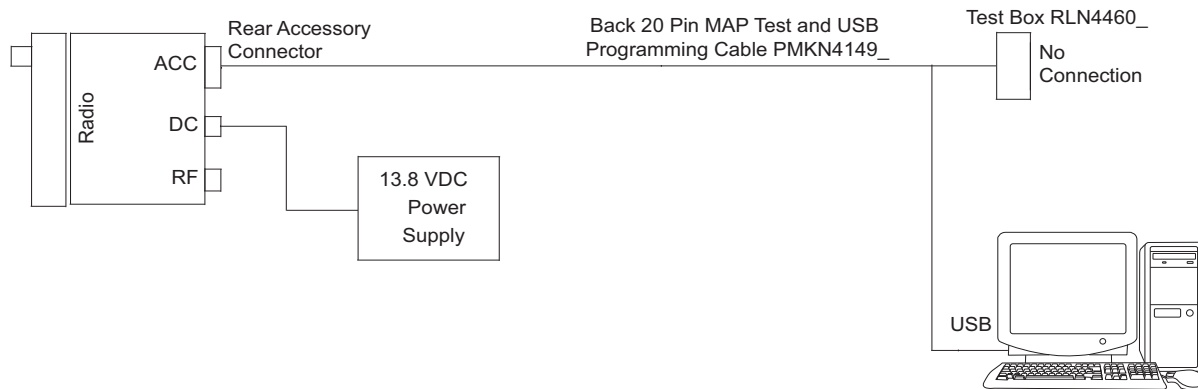


Figure 4-3 Customer Programming Software Setup with Test Box Connection

### 4.3 AirTracer Application Tool

The MOTOTRBO AirTracer application tool has the ability to capture over-the-air digital radio traffic and save the captured data into a file. The AirTracer application tool can also retrieve and save internal error logs from MOTOTRBO radios. The saved files can be analyzed by trained Motorola personnel to suggest improvements in system configurations or to help isolate problems.

## 4.4 Radio Tuning Setup

A personal computer (PC), Windows 8/7/Vista/XP and a tuner program (which is available as part of the MOTOTRBO CPS kit) are required to tune the radio. To perform the tuning procedures, the radio must be connected to the PC and test equipment setup as shown in Figure 4-4 or Figure 4-5.

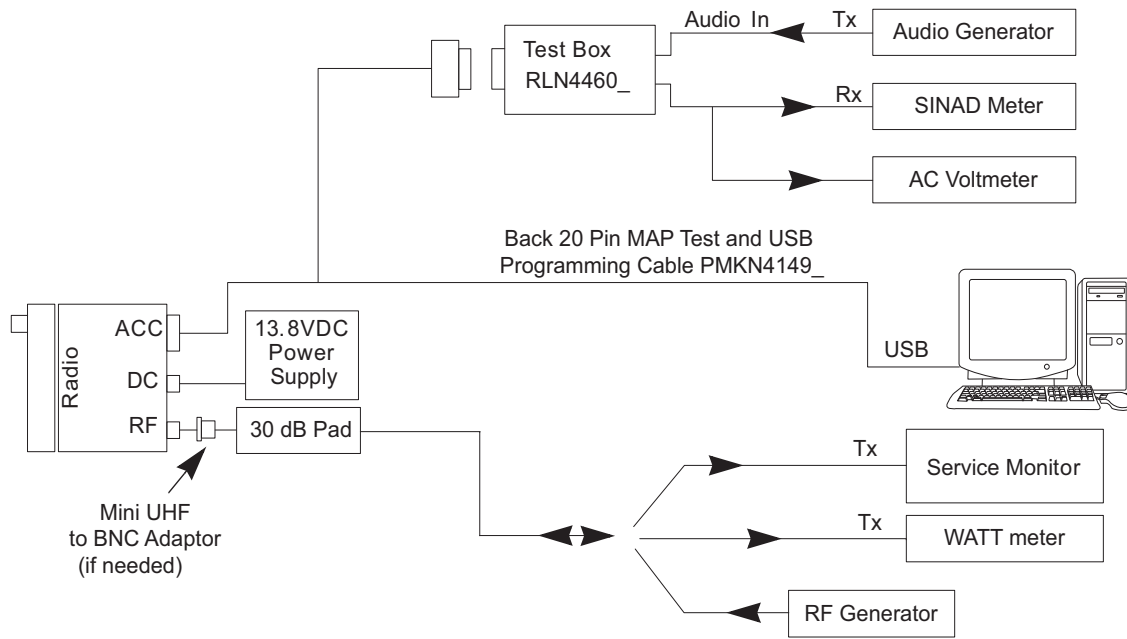


Figure 4-4 Radio Tuning Equipment Setup

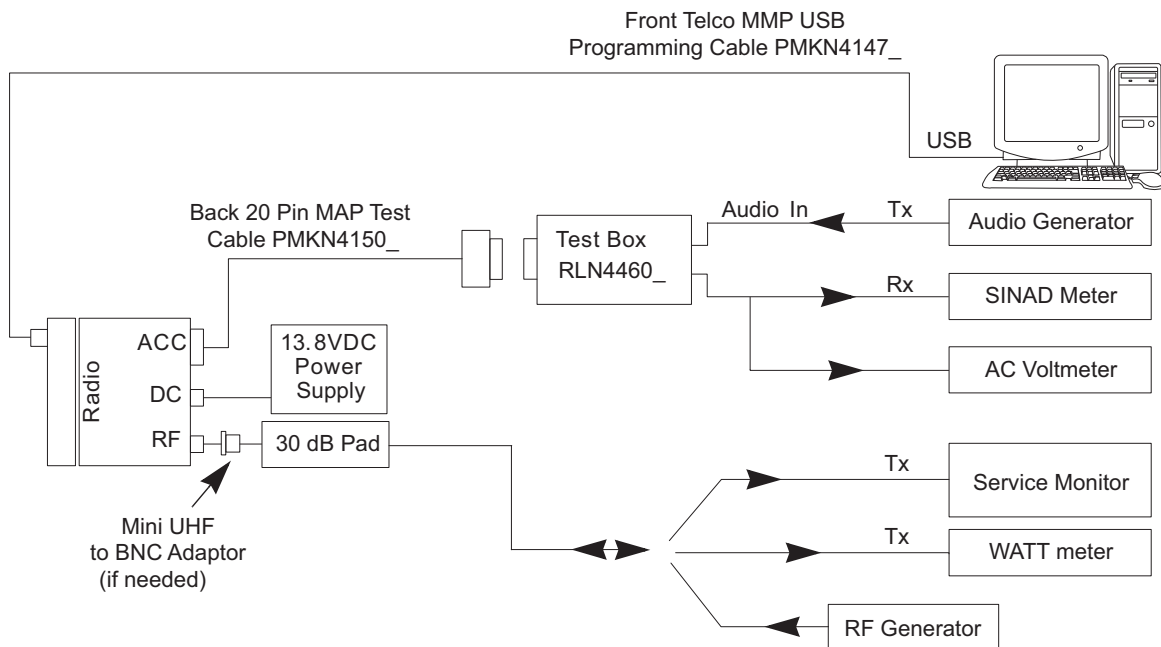


Figure 4-5 Radio Tuning Equipment Setup (Alternative Method)

## Notes

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# Chapter 5 Disassembly/Reassembly Procedures

## 5.1 Introduction

This chapter provides details about the following:

- Preventive maintenance (inspection and cleaning).
- Safe handling of CMOS and LDMOS devices.
- Repair procedures and techniques.
- Disassembly and reassembly of the radio.

## 5.2 Preventive Maintenance

Periodic visual inspection and cleaning is recommended.

### 5.2.1 Inspection

Check that the external surfaces of the radio are clean, and that all external controls and switches are functional. It is not recommended to inspect the interior electronic circuitry.

### 5.2.2 Cleaning Procedures

The following procedures describe the recommended cleaning agents and the methods to be used when cleaning the external and internal surfaces of the radio. External surfaces include the control head and housing assembly. These surfaces should be cleaned whenever a periodic visual inspection reveals the presence of smudges, grease, and/or grime.

**NOTE:** Internal surfaces should be cleaned only when the radio is disassembled for service or repair.

The only recommended agent for cleaning the external radio surfaces is a 0.5% solution of a mild dishwashing detergent in water. The only factory recommended liquid for cleaning the printed circuit boards and their components is isopropyl alcohol (100% by volume).



**Caution**

Use all chemicals as prescribed by the manufacturer. Be sure to follow all safety precautions as defined on the label or material safety data sheet.

The effects of certain chemicals and their vapors can have harmful results on certain plastics. Avoid using aerosol sprays, tuner cleaners and other chemicals.

### **Cleaning External Plastic Surfaces**

Apply the 0.5% detergent-water solution sparingly with a stiff, non-metallic, short-bristled brush to work all loose dirt away from the radio. Use a soft, absorbent, lintless cloth or tissue to remove the solution and dry the radio. Make sure that no water remains entrapped near the connectors, cracks, or crevices.

### **Cleaning Internal Circuit Boards and Components**

Isopropyl alcohol (100%) may be applied with a stiff, non-metallic, short-bristled brush to dislodge embedded or caked materials located in hard-to-reach areas. The brush stroke should direct the dislodged material out and away from the inside of the radio. Make sure that controls or tunable components are not soaked with alcohol. Do not use high-pressure air to hasten the drying process since this could cause the liquid to collect in unwanted places. Once the cleaning process is complete, use a soft, absorbent, lintless cloth to dry the area. Do not brush or apply any isopropyl alcohol to the frame, control head and housing assembly.

**NOTE:** Always use a fresh supply of alcohol and a clean container to prevent contamination by dissolved material (from previous usage).

## **5.3 Safe Handling of CMOS and LDMOS Devices**

Complementary Metal Oxide Semiconductor (CMOS) and Laterally Diffused Metal Oxide Semiconductor (LDMOS) devices are used in this family of radios, and are susceptible to damage by electrostatic or high voltage charges. Damage can be latent, resulting in failures occurring weeks or months later. Therefore, special precautions must be taken to prevent device damage during disassembly, troubleshooting, and repair.

Handling precautions are mandatory for CMOS/LDMOS circuits and are especially important in low humidity conditions.

DO NOT attempt to disassemble the radio without first referring to the following CAUTION statement.



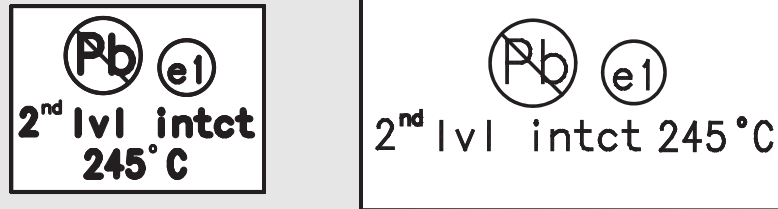
Caution

**This radio contains static-sensitive devices. Do not open the radio unless you are properly grounded. Take the following precautions when working on this unit:**

- Store and transport all CMOS/LDMOS devices in conductive material so that all exposed leads are shorted together. Do not insert CMOS/LDMOS devices into conventional plastic “snow” trays used for storage and transportation of other semiconductor devices.
- Ground the working surface of the service bench to protect the CMOS/LDMOS device. We recommend using a wrist strap, two ground cords, a table mat, a floor mat, ESD shoes, and an ESD chair.
- Wear a conductive wrist strap in series with a 100k resistor to ground. (Replacement wrist straps that connect to the bench top covering are Motorola part number 4280385A59).
- Do not wear nylon clothing while handling CMOS/LDMOS devices.
- Do not insert or remove CMOS/LDMOS devices with power applied. Check all power supplies used for testing CMOS/LDMOS devices to be certain that there are no voltage transients present.
- When straightening CMOS/LDMOS pins, provide ground straps for the apparatus used.
- When soldering, use a grounded soldering iron.
- If at all possible, handle CMOS/LDMOS devices by the package and not by the leads. Prior to touching the unit, touch an electrical ground to remove any static charge that you may have accumulated. The package and substrate may be electrically common. If so, the reaction of a discharge to the case would cause the same damage as touching the leads.

## 5.4 Repair Procedures and Techniques – General

**NOTE** Environmentally Preferred Products (EPP) (refer to the marking on the printed circuit boards – examples shown below) were developed and assembled using environmentally preferred components and solder assembly techniques to comply with the European Union's **Restriction of Hazardous Substances (ROHS 2) Directive 2011/65/EU** and **Waste Electrical and Electronic Equipment (WEEE) Directive 2012/19/EU**. To maintain product compliance and reliability, use only the Motorola specified parts in this manual.



Any rework or repair on Environmentally Preferred Products must be done using the appropriate lead-free solder wire and lead-free solder paste as stated in the following table:

*Table 5-1 Lead Free Solder Wire Part Number List*

Motorola Part Number	Alloy	Flux Type	Flux Content by Weight	Melting Point	Supplier Part number	Diameter	Weight
1088929Y01	95.5Sn/3.8Ag/0.7Cu	RMA Version	2.7–3.2%	217°C	52171	0.015"	1lb spool

*Table 5-2 Lead Free Solder Paste Part Number List*

Motorola Part Number	Manufacturer Part Number	Viscosity	Type	Composition & Percent Metal	Liquid Temperature
1085674C03	NC-SMQ230	900–1000KCPs Brookfield (5rpm)	Type 3 (-325/+500)	(95.5%Sn-3.8%Ag-0.7%Cu) 89.3%	217°C

### Parts Replacement and Substitution

Check the parts list for the proper Motorola part number and order the part from the nearest Motorola Radio Products and Solutions Organization listed in Appendix A of this manual.

### Rigid Circuit Boards

This family of radios uses bonded, multi-layer, printed circuit boards. Since the inner layers are not accessible, some special considerations are required when soldering and unsoldering components. The printed-through holes may interconnect multiple layers of the printed circuit. Therefore, exercise care to avoid pulling the plated circuit out of the hole.

When soldering near a connector:

- Avoid accidentally getting solder in the connector.
- Be careful not to form solder bridges between the connector pins.
- Examine your work closely for shorts due to solder bridges.



## 5.5 Disassembling and Reassembling the Radio – General

Since these radios may be disassembled and reassembled with the use of only eleven screws (board to casting), it is important to pay particular attention to the snaps and tabs, and how parts align with each other.

The following tools are required for disassembling and assembling the radio:

- Small Flat Blade Screwdriver
- Control Head Dismantling Tool (Motorola Part No. 6686119B01)
- Torque Driver (2–36 lbs-in or 0.2–4.0 N-m), (Motorola Part No. RSX4043A)
- TORX™ T10 Driver Bit (Motorola Part No. 6680387A74)
- TORX™ T8 Driver Bit (Motorola Part No. 6680387A72)
- TORX™ T6 Driver Bit (Motorola Part No. 6680387A70 - for use with Option Board only)
- 9/16" Deep Socket Driver (RF Connector Nut)

If a unit requires more complete testing or service than is customarily performed at the basic level, please send radio to a Motorola Service Center listed in Appendix B.

The following disassembly procedures should be performed only if necessary.

## 5.6 Radio Disassembly – Detailed

The procedure to remove and replace the control head, top cover or transceiver board is similar for all models. A typical procedure is therefore provided in this section followed by detailed disassembly procedures for each specific control head model.

### 5.6.1 Control Head Removal

1. Insert the dismantling tool in the groove between the control head and the radio assembly as shown in Figure 5-1.
2. Press the dismantling tool under the control head to release the snap features.

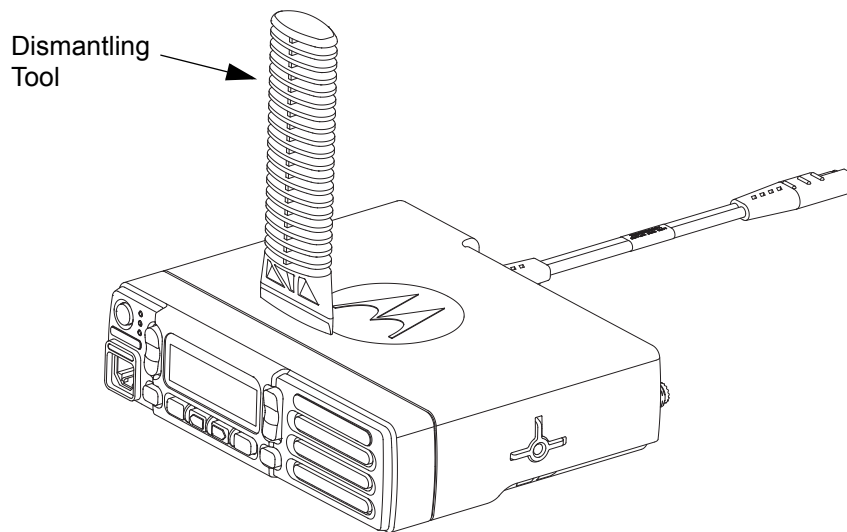


Figure 5-1 Typical Control Head Removal

3. Pull the control head away from the radio assembly as shown in Figure 5-2.

**NOTE:** During the control head disassembly, the control head PCB may snap out of position. The control head PCB will need to be snapped back in place prior to reassembly.

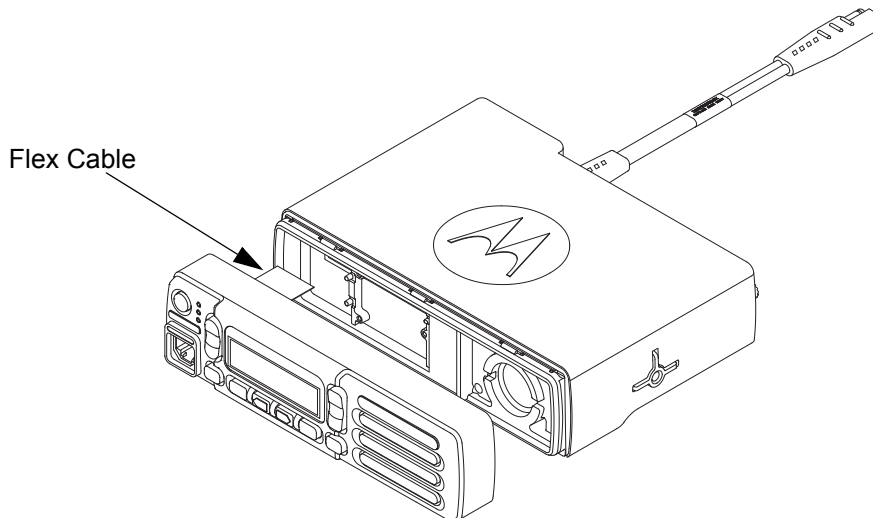


Figure 5-2 Flexible Connection Removal

4. Remove the flex cable from the socket on the radio assembly as shown in Figure 5-2.

## 5.6.2 Top Cover Removal

1. Insert the dismantling tool between the top cover and the chassis as shown in Figure 5-3.
2. Press on the dismantling tool until one side wall of the top cover starts to clear the chassis trunnion mounting features.
3. Repeat step 2 for the other side of the top cover.
4. A small flat screwdriver may be required to release the rear catch.
5. Lift the top cover from the chassis.

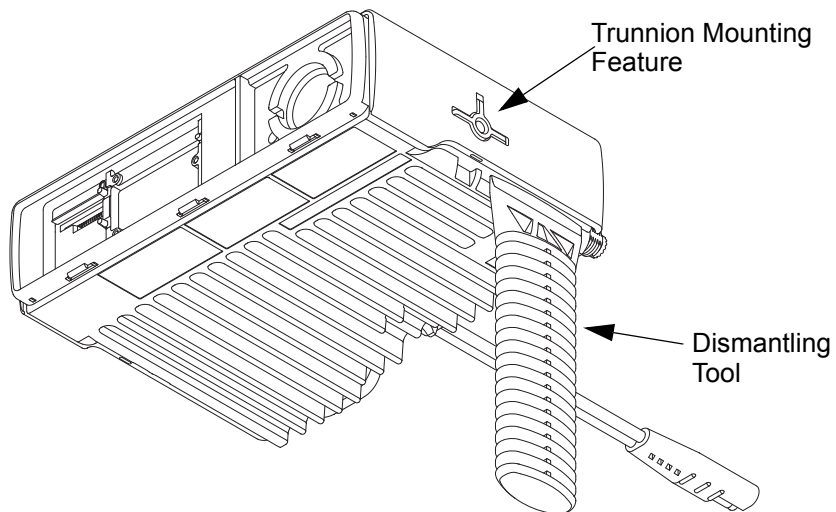


Figure 5-3 Top Cover Removal (Image May Not Match Exact Product)

### 5.6.3 Transceiver Board Removal

1. Using a T6 TORX™ driver, remove the screws securing the option board to the chassis (Option Board Only).
2. Unplug the flex from the transceiver board (Option Board Only).

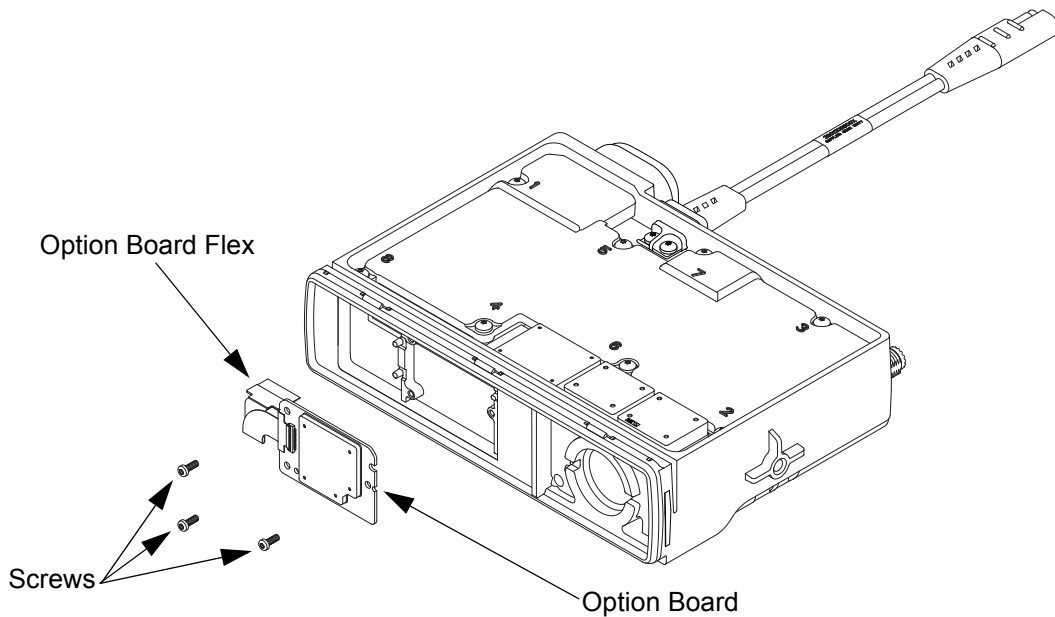


Figure 5-4 Option Board Removal (Image May Not Match Exact Product)

3. Remove the eight screws from the die cast main shield, the one screw directly on the PCB and the two screws from the DC Cable using the T10 TORX™ driver as shown in Figure 5-5.
4. Lift the die cast main shield from the chassis.

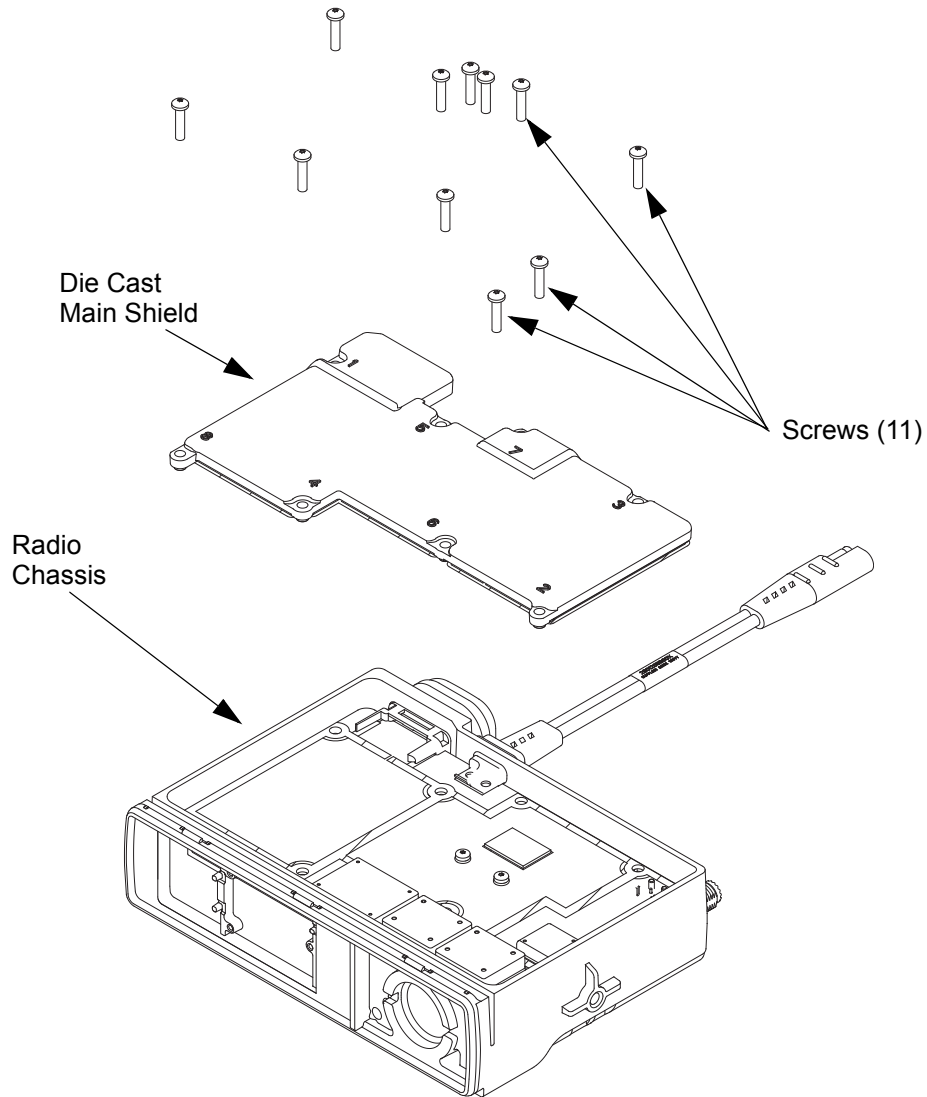
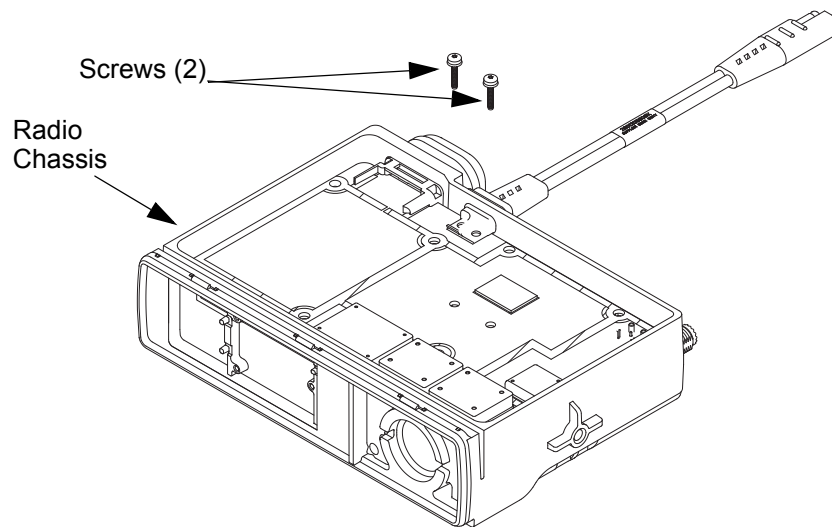


Figure 5-5 Die Cast Main Shield Removal

5. Remove the two screws from the PCB using the T8 TORX™ driver as shown in Figure 5-6.

**NOTE:** Do not remove the washers from the screws.



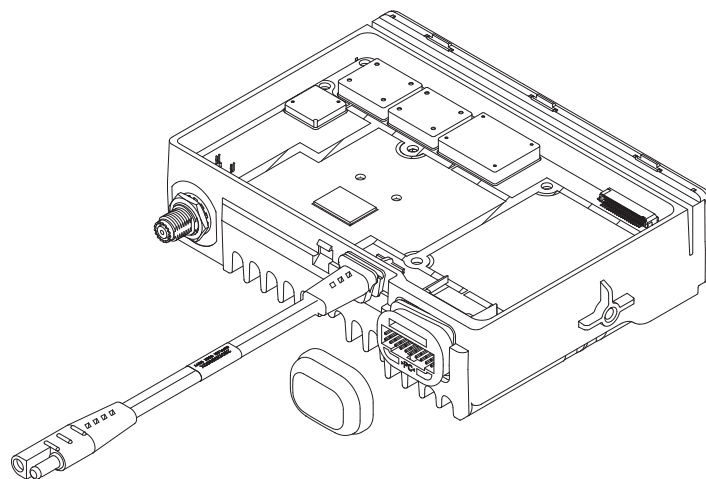
*Figure 5-6 PA Screw Removal*

6. Remove the accessory connector cap.
7. Remove the accessory connector from the radio assembly by pulling the connector straight out of the radio chassis as shown in Figure 5-7.



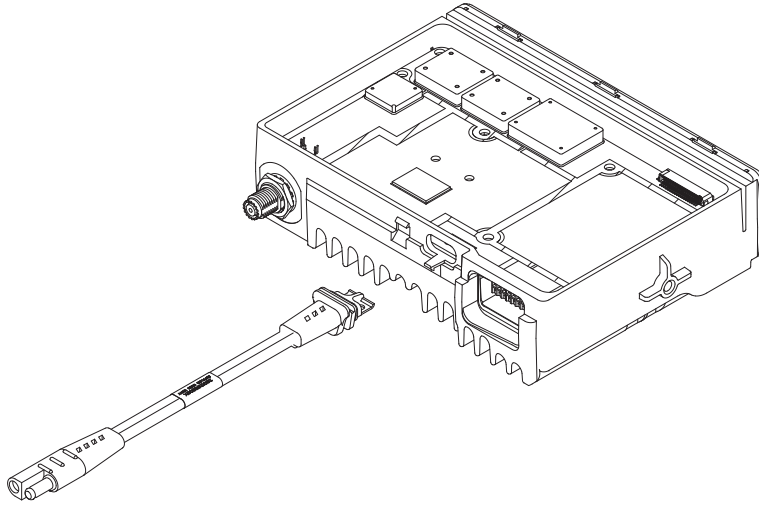
**Caution**

The accessory connector should never be removed when the die cast main shield is still assembled to the radio.



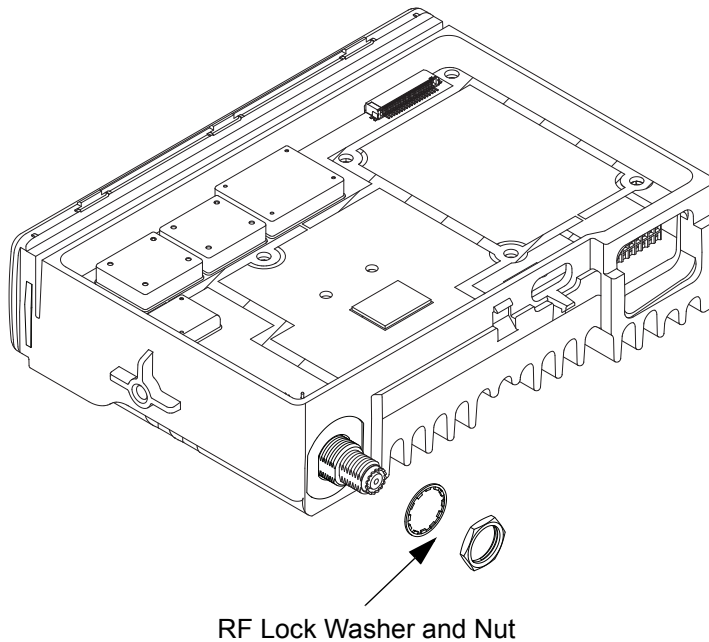
*Figure 5-7 Accessory Connector Removal*

8. Remove the DC Cable by gently pulling it away from the radio chassis as shown in Figure 5-8.



*Figure 5-8 DC Cable Removal*

9. Remove the RF connector nut and lock washer using a 9/16" deep socket driver (Figure 5-9).



*Figure 5-9 RF Connector Nut Removal*

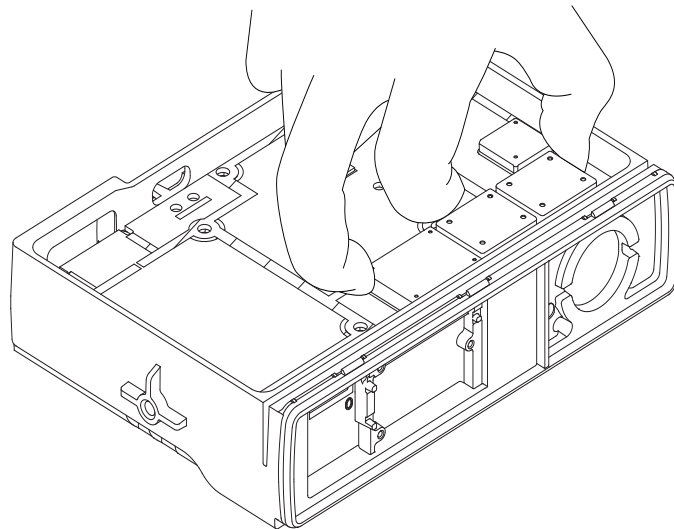
10. Remove the transceiver board by grabbing and lifting the SMT shields and lift the transceiver board, as shown in Figure 5-10. Then, slide the transceiver board towards the front of the radio to allow the RF connector to clear the chassis. Handle the transceiver board by the edges only and store it in an antistatic bag.

**NOTE:** If the RF connector gasket remain in the chassis, remove it and place it back on the connector. Every time the Transceiver Board is removed, the Final Driver Thermal Pad must be replaced.



**Caution**

The thermal pads can act as an adhesive and cause stress to critical components on the transceiver board if the transceiver board is lifted too quickly.



*Figure 5-10 Transceiver Board Removal*

### 5.6.4 Disassembly of Alphanumeric Display Control Head

1. Unplug the control head flex from the control head board by gently pulling the flex out of the connector as shown in Figure 5-11.

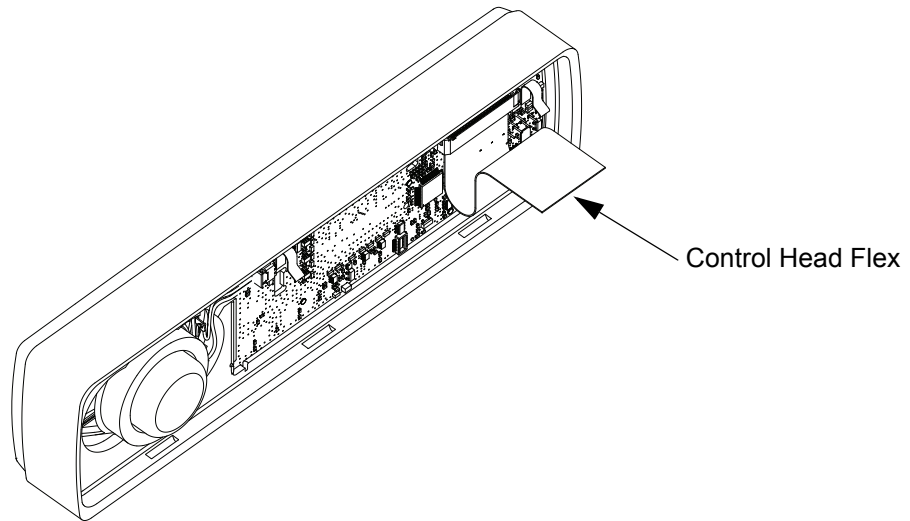


Figure 5-11 Control Head Flex Removal

2. Remove the speaker tape from the PCB by using a tweezer as shown in Figure 5-12.
3. Disconnect the speaker connector from the control head board.

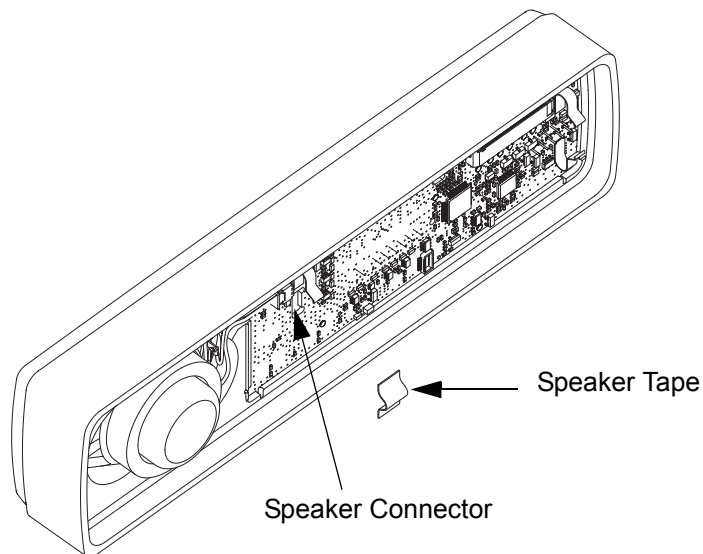


Figure 5-12 Speaker Tape Removal



4. Remove the keypad assembly from the control head housing by pushing on the keypad buttons while disengaging the control head PCB by deflecting the control head housing side walls. Once the keypad begins to separate from the control head housing, pull both components apart. Refer to Figure 5-13.

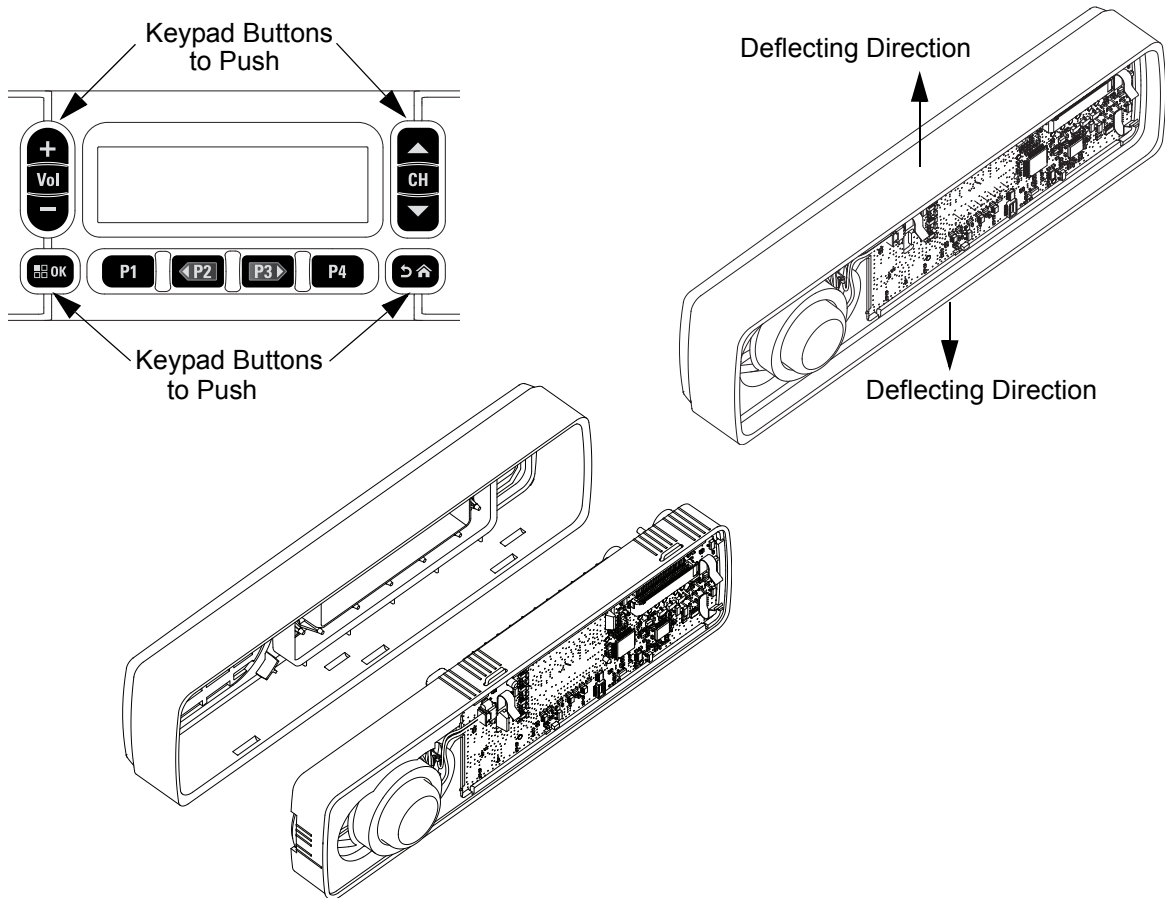


Figure 5-13 Keypad Assembly Removal

5. Remove the speaker from the keypad assembly as shown in Figure 5-14.

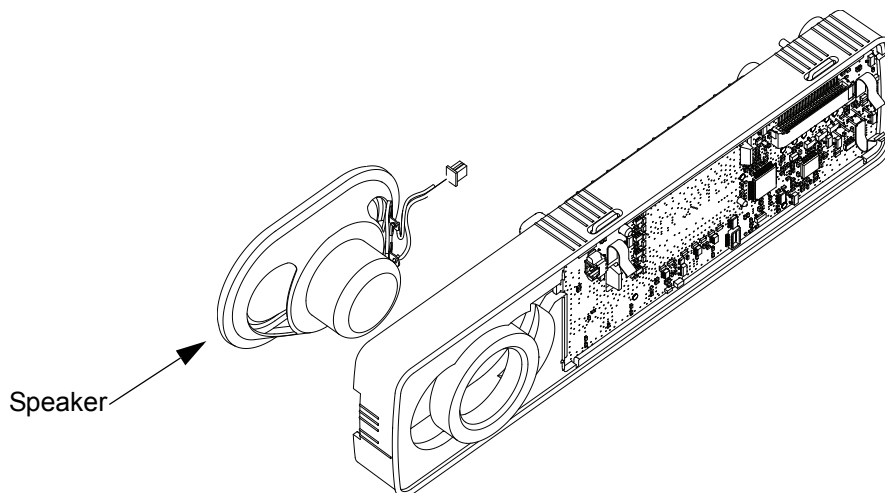


Figure 5-14 Speaker Removal

6. Gently lift the keypad upwards to disengage the PCB tabs from the keypad openings. Simultaneously, remove the keypad flaps around the PCB. Then remove the PCB from the keypad. Refer to Figure 5-15.

**NOTE:** Do not touch or contaminate the conductive contacts (especially the grounding contacts) on the PCB.

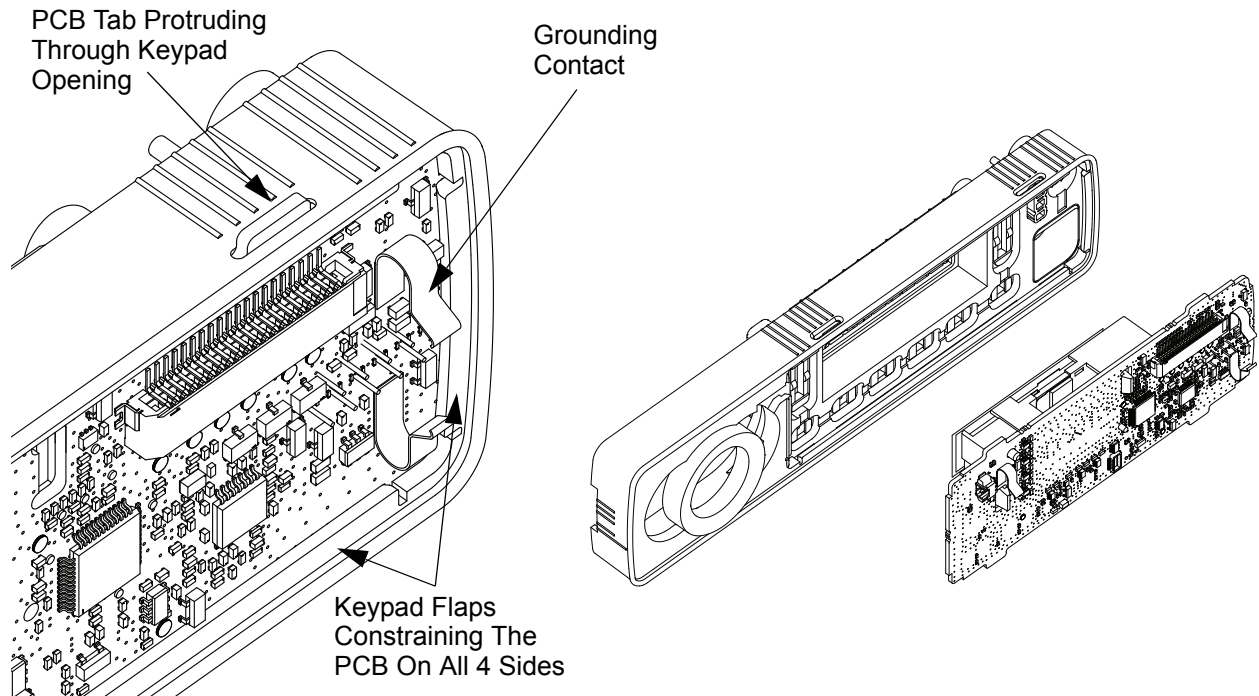


Figure 5-15 PCB Removal

7. Gently remove the indicator barrier from the keypad as shown in Figure 5-16.

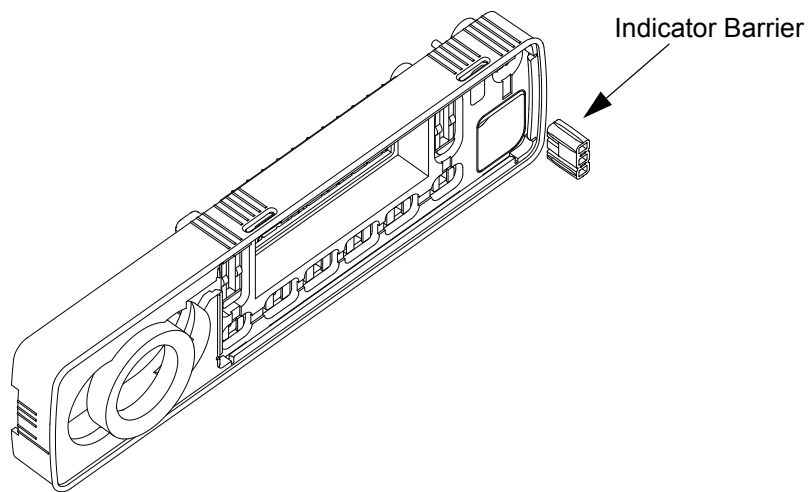
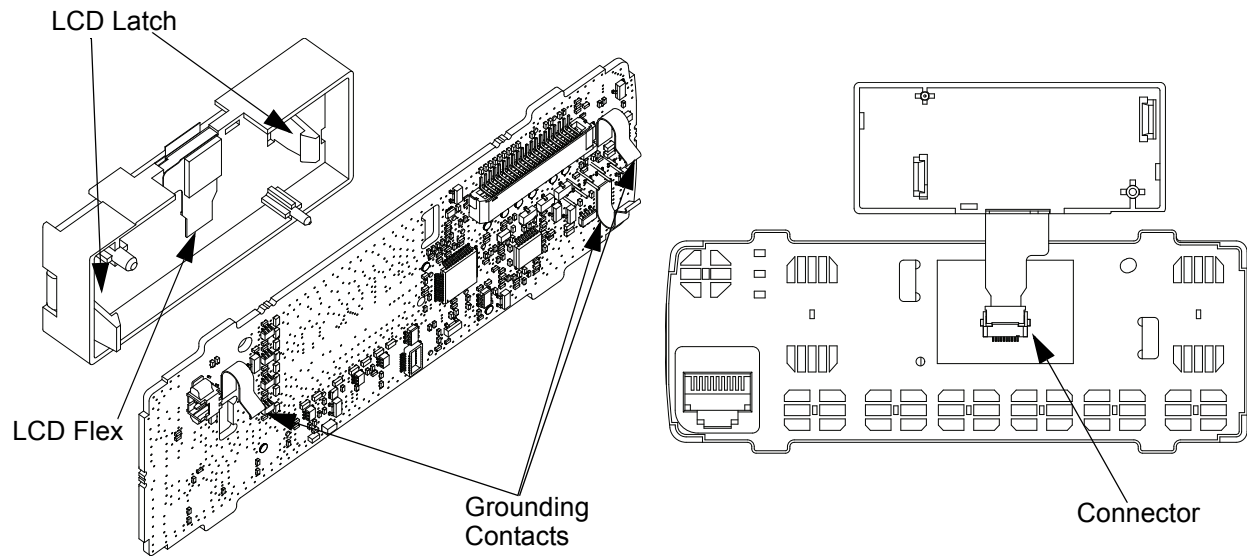


Figure 5-16 Indicator Barrier Removal

8. Gently push the LCD display latch and remove the LCD from the PCB. Refer to Figure 5-17.
9. Remove the LCD flex from the connector.

**NOTE:** Do not touch or contaminate the conductive contacts (especially the grounding contacts) on the PCB.



*Figure 5-17 LCD and LCD Flex Removal*

## 5.7 Radio Reassembly – Detailed

### 5.7.1 Reassembly of Alphanumeric Display Control Head

1. Connect the display flex to the connector on the PCB.
2. Align the LCD alignment pins to the PCB holes.
3. Firmly press along the outer perimeter of the display until the LCD display latch is attached to the PCB. Refer to Figure 5-18.

**NOTE:** Do not touch or contaminate the conductive contacts (especially the grounding contacts) on the PCB.

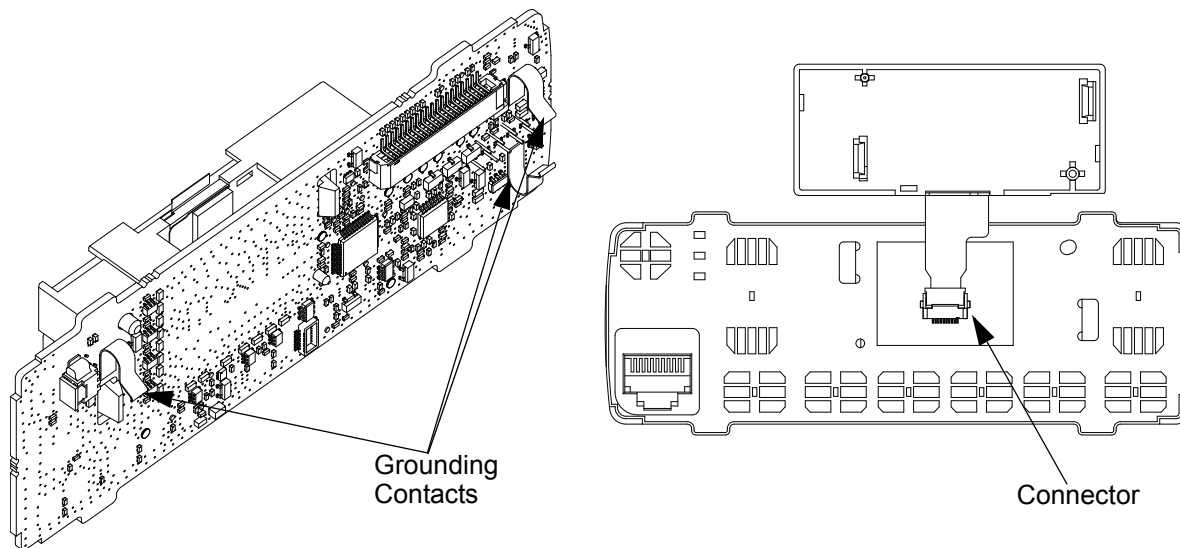


Figure 5-18 LCD Display Assembly

4. Gently assemble the indicator barrier to the keypad as shown in Figure 5-19.

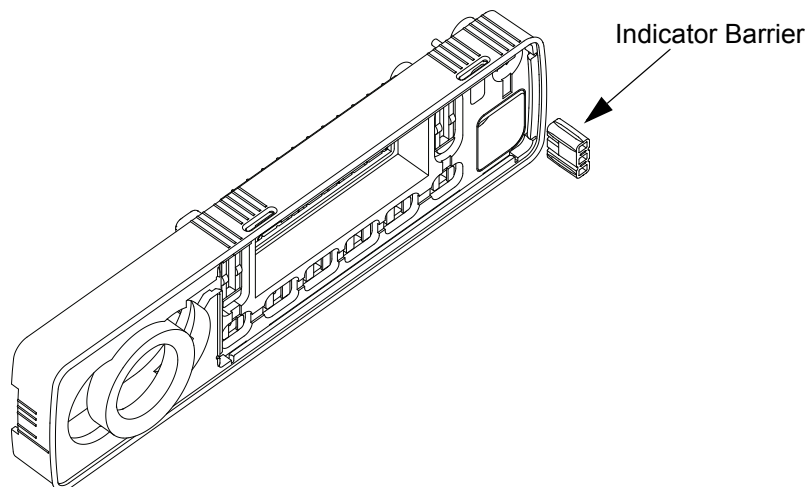


Figure 5-19 Indicator Barrier Assembly

5. Assemble the speaker to the keypad. Refer to Figure 5-20.

**NOTE:** Be sure to orient the speaker in the direction of the wire and connector towards the middle of the control head.

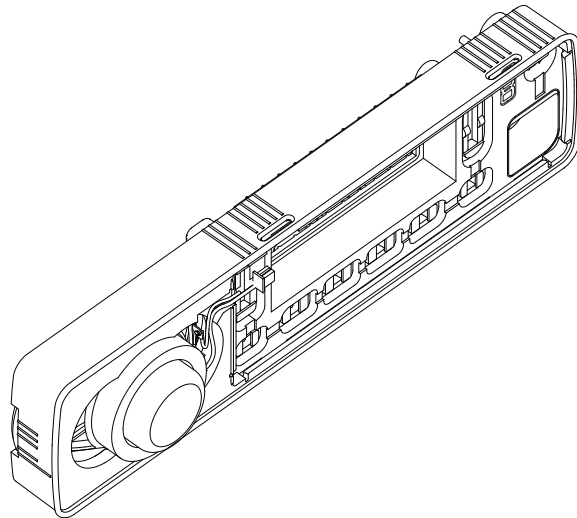


Figure 5-20 Speaker Assembly

6. Assemble PCB assembly to the keypad as shown in Figure 5-21.

**NOTE:** Verify that the PCB is properly positioned to the keypad:

- 1) The four PCB tabs should protrude through the keypad openings.
- 2) The PCB should be seated to the keypad so the keypad flaps constrain the PCB.

**NOTE:** Do not touch or contaminate the conductive contacts (especially the grounding contacts) on the PCB.

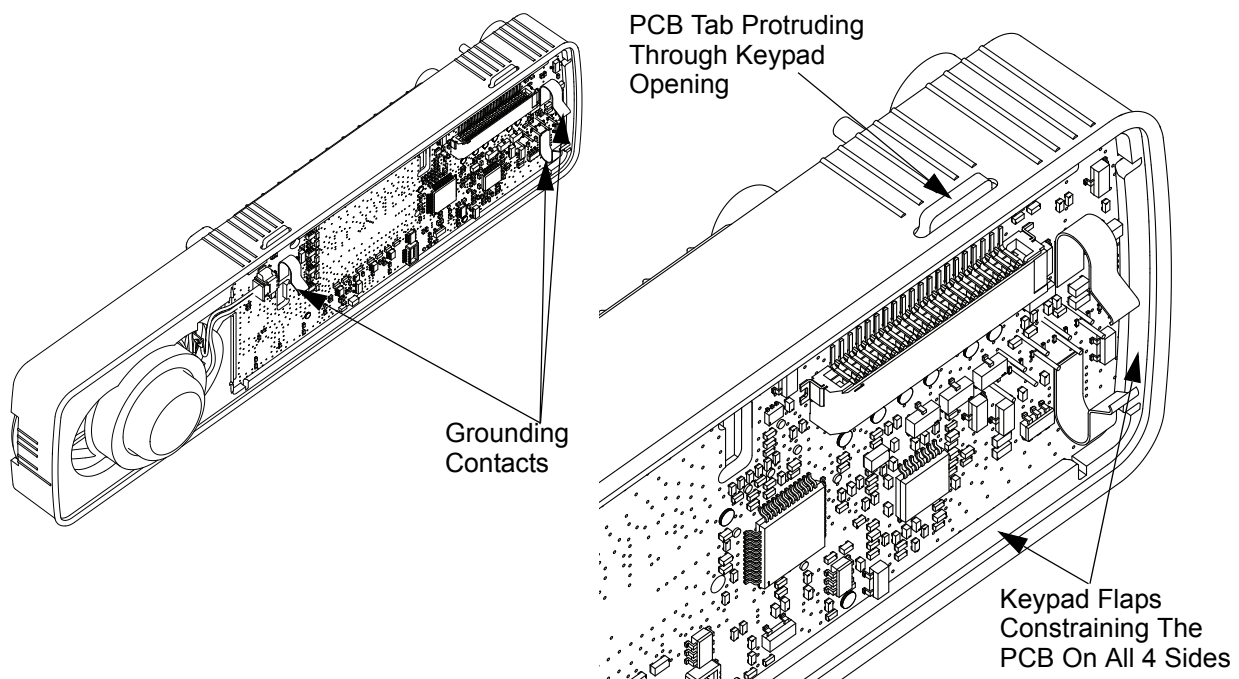
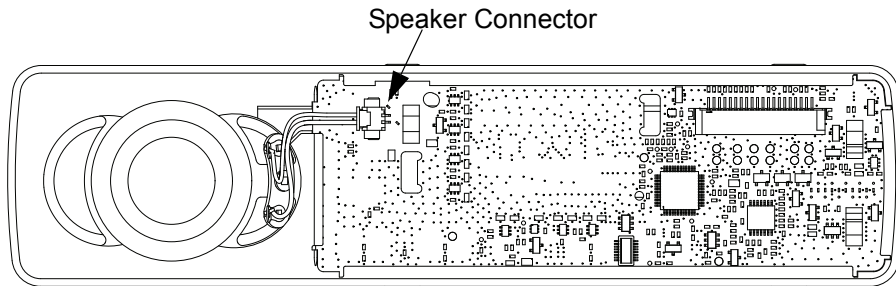


Figure 5-21 Assembling PCB to Keypad

7. Connect the speaker plug to its mating connector on the control head board as shown in Figure 5-22.

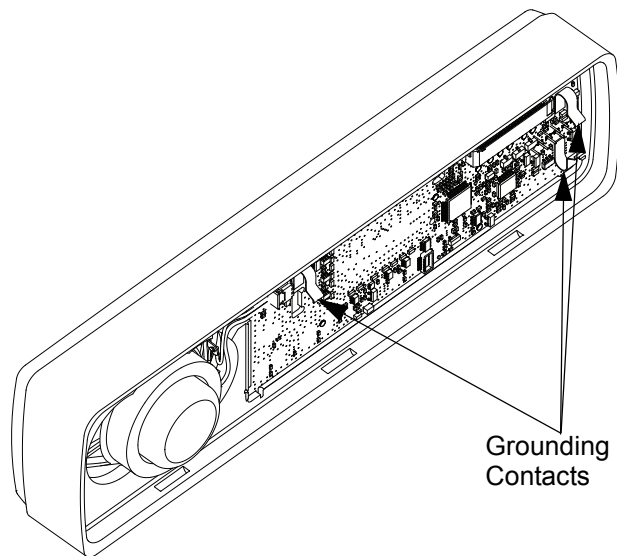


*Figure 5-22 Speaker Connection*

8. Assemble the keypad with the PCB and speaker assembled to the control head housing. Refer to Figure 5-23.

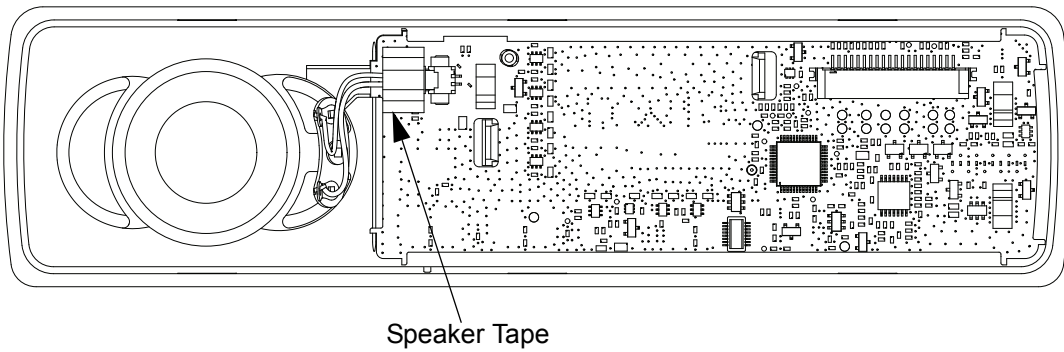
**NOTE:** PCB needs to be snapped into the control head housing. Ensure entire keypad is fully seated to the control head housing.

Do not touch or contaminate the conductive contacts (especially the grounding contacts) on the PCB.



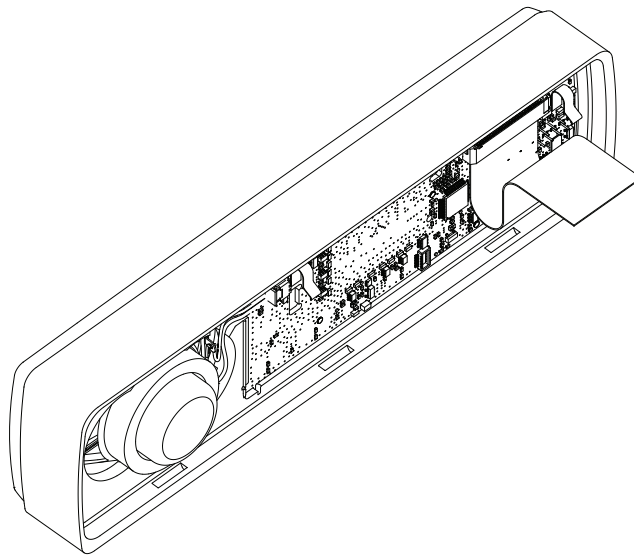
*Figure 5-23 Assembling Keypad to Control Head Housing*

9. Assemble the speaker tape on the speaker wire and PCB. Press the speaker tape and make sure it sticks firmly on the PCB. Refer to Figure 5-24.



*Figure 5-24 Assembling Speaker Tape to PCB*

10. Gently plug the control head flex to the control head board as shown in Figure 5-25.



*Figure 5-25 Assembling Control Head Flex to Control Head Board*

### 5.7.2 Radio Assembly

1. Prior to reassembling the radio, inspect all seals and sealing surfaces for damage (nicks, cuts, etc.) or debris. Refer to the exploded view and bill of materials for the correct part numbers and replace parts, as necessary. Replace all new seals on their respective parts.

For both the die cast main shield and the chassis, thoroughly inspect the shield gasketing for damage and verify all thermal pads are in place and free from damage and debris. See Section 5.7.3: Thermal Pad Replacement Procedure on page 5-21 to replace damaged pads.

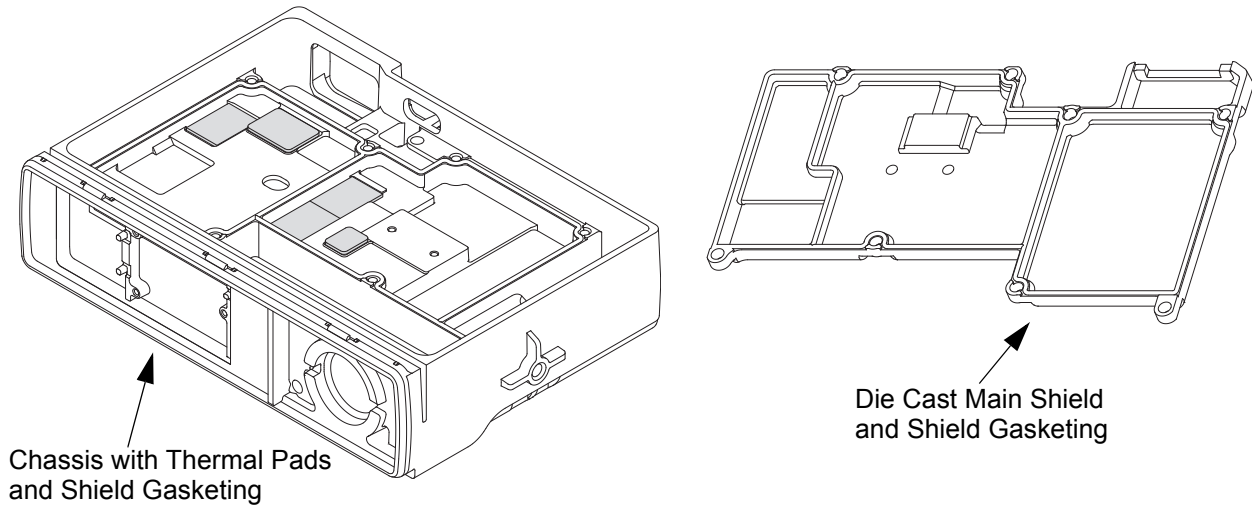


Figure 5-26 Thermal Pads and Shield Gasketing on Chassis and Die Cast Main Shield

2. Thoroughly inspect the chassis and verify all thermal pads are in place and free from damage. See Section 5.7.3: Thermal Pad Replacement Procedure on page 5-21 to replace damaged pads.

**NOTE: Every time the Transceiver Board is removed, the Final Driver Thermal Pad must be replaced.**

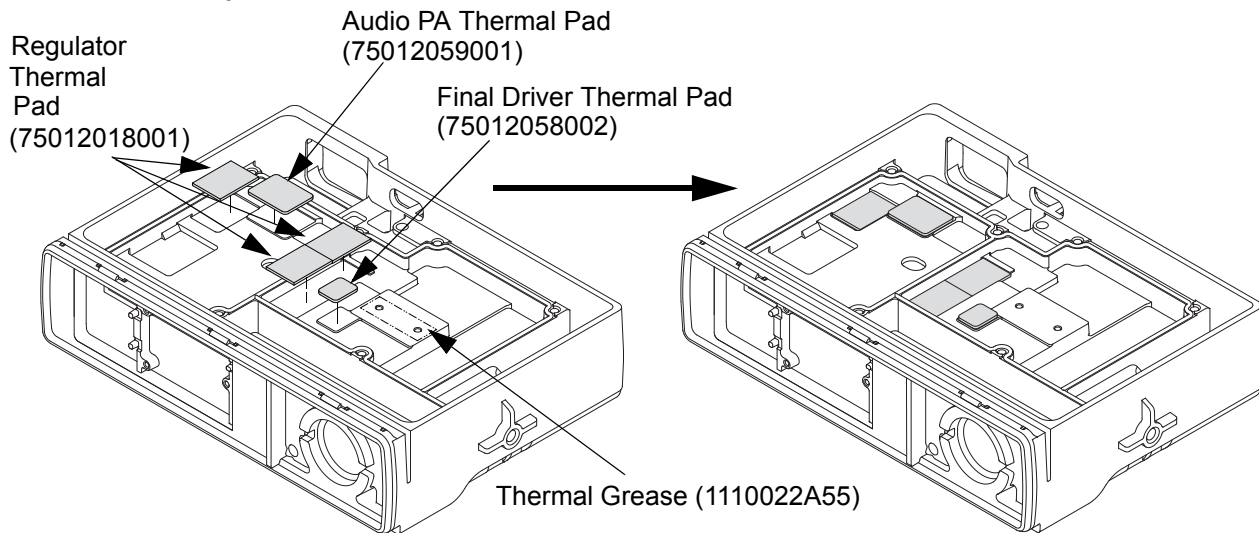


Figure 5-27 Chassis with Thermal Pads



### 5.7.3 Thermal Pad Replacement Procedure

#### Regulator Thermal Pad Replacement

1. Use a plastic flat-edge tool to lift the pad from the chassis surface. Discard the old pad.
2. Use a soft cloth to remove any remaining residue. Alcohol can also be used, if necessary. Care should be taken to minimize any cleaning-agent contact with the surrounding shield gasket.
3. Once the surface is clean and dry, remove the new pad from the shipping liner, and place it on the chassis as shown in Figure 5-28.

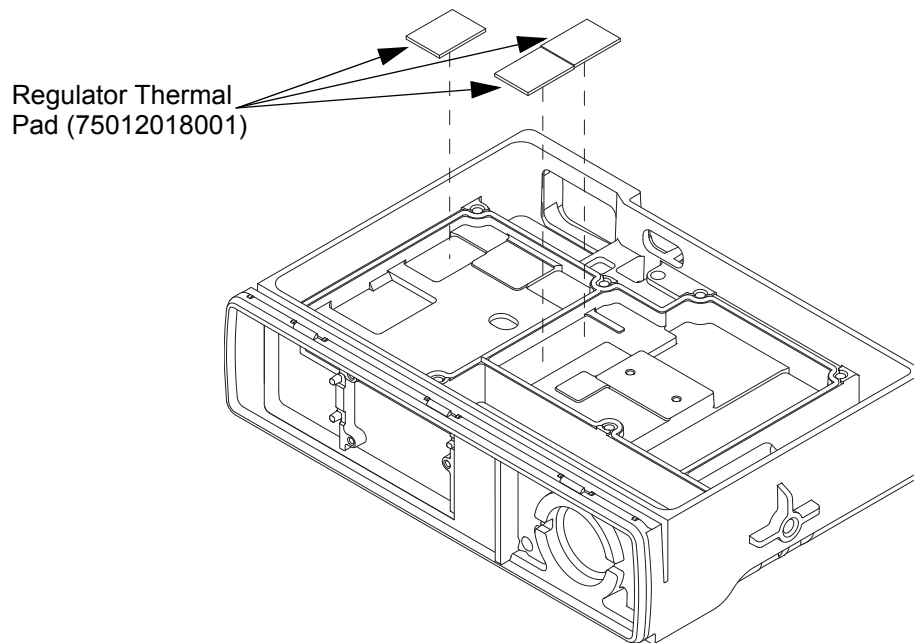


Figure 5-28 Replacing Regulator Thermal Pads

### Audio PA Thermal Pad Replacement

1. Use a plastic flat-edge tool to lift the pad from the chassis surface. Discard the old pad.
2. Use a soft cloth to remove any remaining residue. Alcohol can also be used, if necessary. Care should be taken to minimize any cleaning-agent contact with the surrounding shield gasket.
3. Once the surface is clean and dry, remove the new pad from the shipping liner, and place the pad on to the chassis as shown in Figure 5-29.

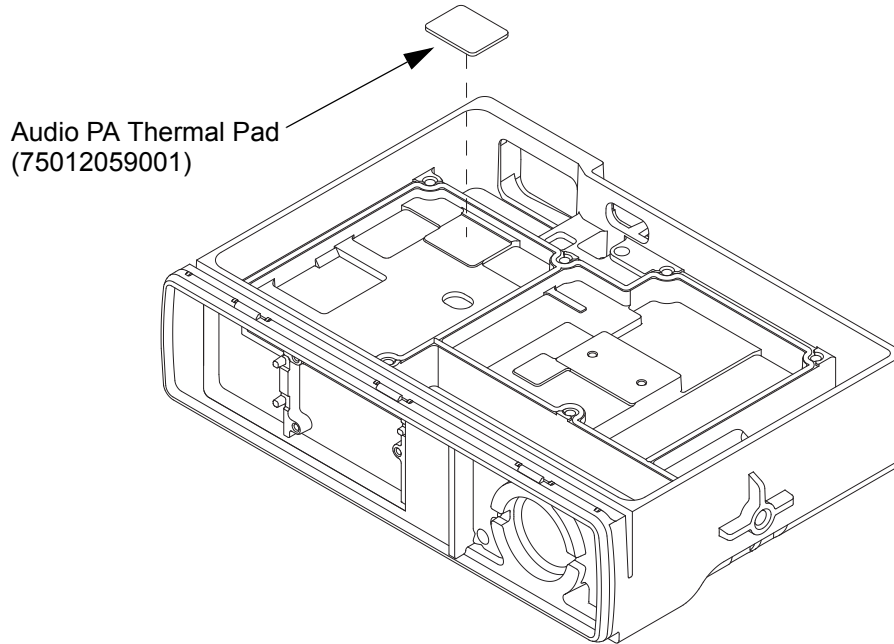
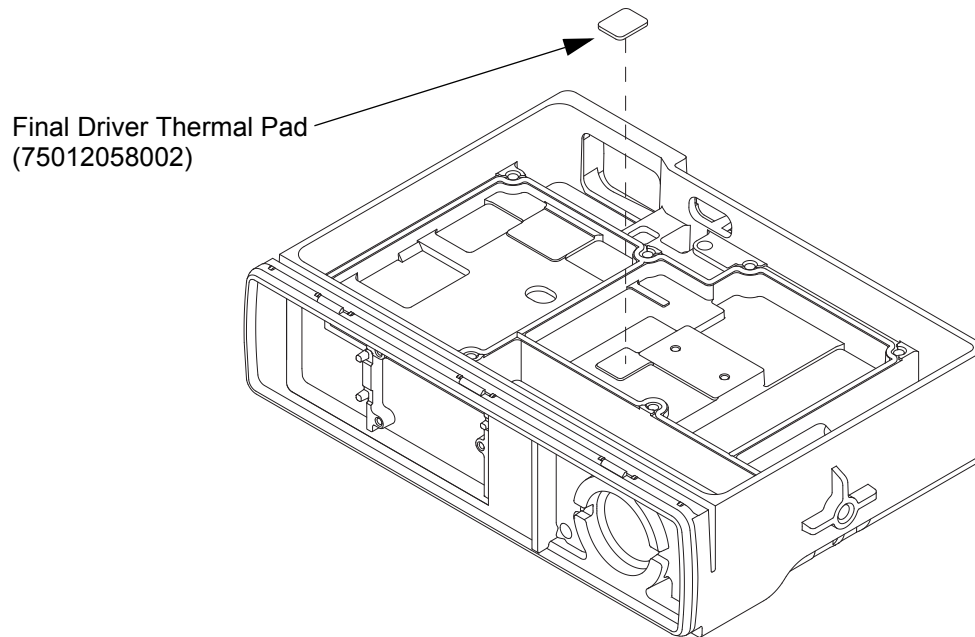


Figure 5-29 Replacing Audio PA Thermal Pad

### Final Driver Thermal Pad Replacement

1. Use a plastic flat-edge tool to lift each pad from the transceiver board. Discard the old pad.
2. Use a soft cloth to remove any remaining residue. Alcohol can also be used, if necessary.
3. Once the surface is clean and dry, remove the new pad from the shipping liner, and place the pad on to the chassis as shown in Figure 5-30.

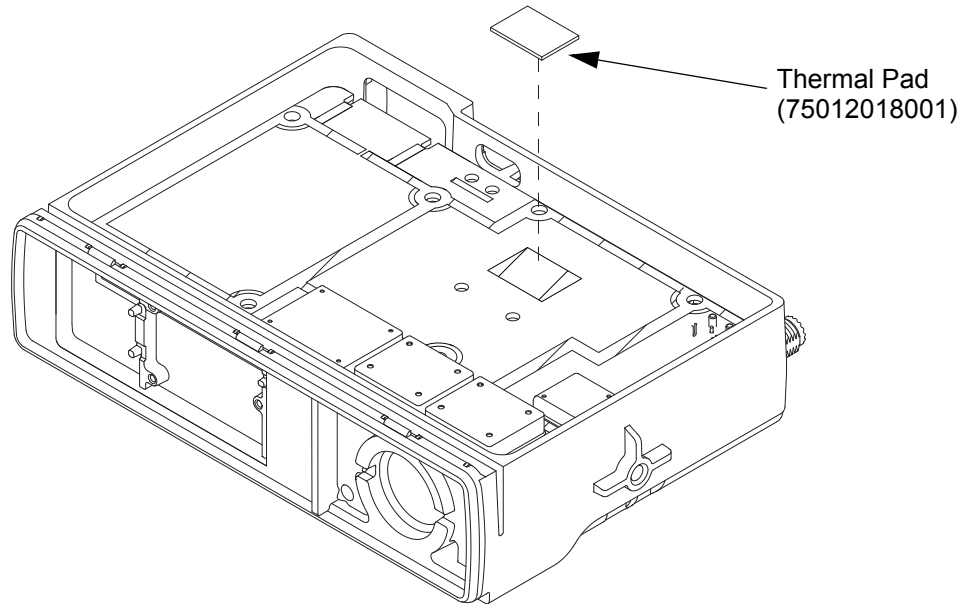


*Figure 5-30 Replacing Final Driver Thermal Pad*

**PCB Thermal Pad Replacement**

1. Use a plastic flat-edge tool to lift the pad from the transceiver board. Discard the old pad.
2. Use a soft cloth to remove any remaining residue. Alcohol can also be used, if necessary.
3. Once the surface is clean and dry, remove the new pad from the shipping liner, and place the pad on to the transceiver board as shown in Figure 5-31.

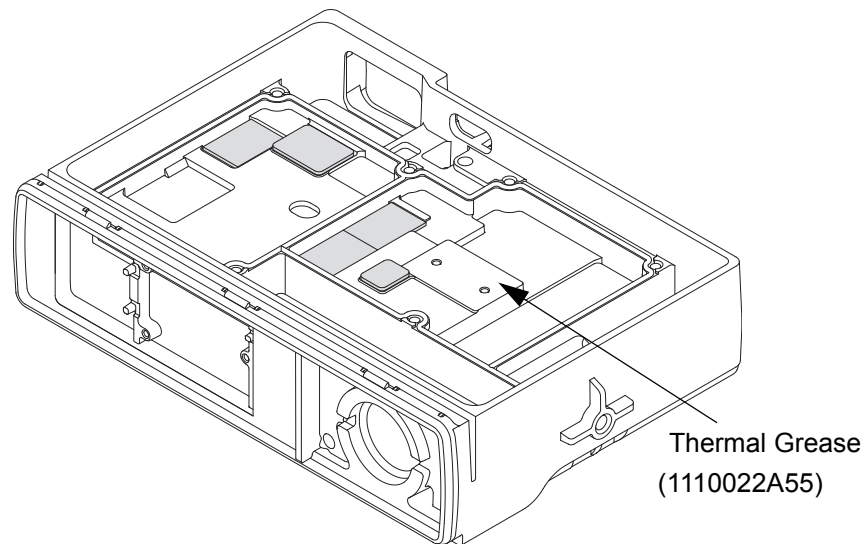
**NOTE:** The PCB Thermal Pad is NOT placed for the UHF1 1–25W models. Placing the pad on a UHF1 1–25W model may degrade radio performance.



*Figure 5-31 Replacing PCB Thermal Pad*

### 5.7.4 Transceiver Board Reassembly

1. Apply thermal grease to the PA area. Refer to Figure 5-32.

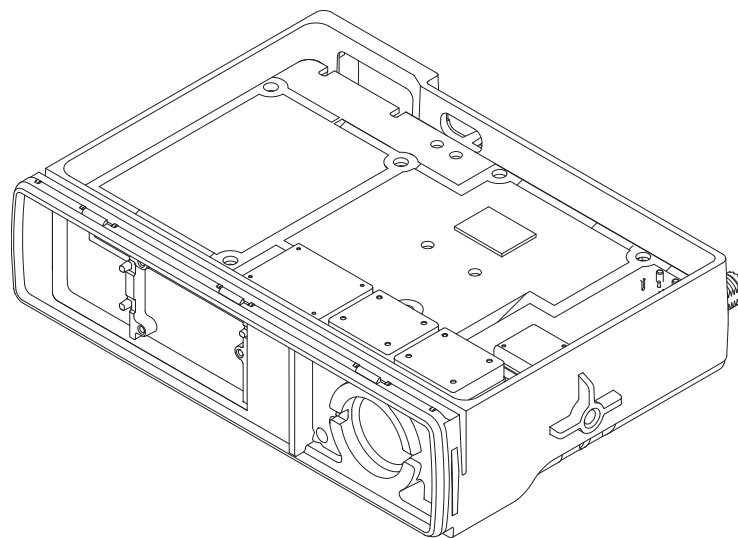


*Figure 5-32 Applying Thermal Grease*

2. Insert the transceiver board into the chassis by tilting the transceiver board (approximately 45 degrees) and sliding it into place, taking care to line up the RF connector with the opening in the back of the chassis.

**NOTE:** Prior to board installation verify that all thermal pads are present. Verify that a thermal pad is present on the PCB.

Push the board down to fully seat it to the radio chassis.



*Figure 5-33 Placing the Transceiver Board in the Chassis*

- Using a 9/16" deep socket driver install the lock washer and nut to an initial torque of 0.9 N-m (8 lbs-in). Refer to Figure 5-34.

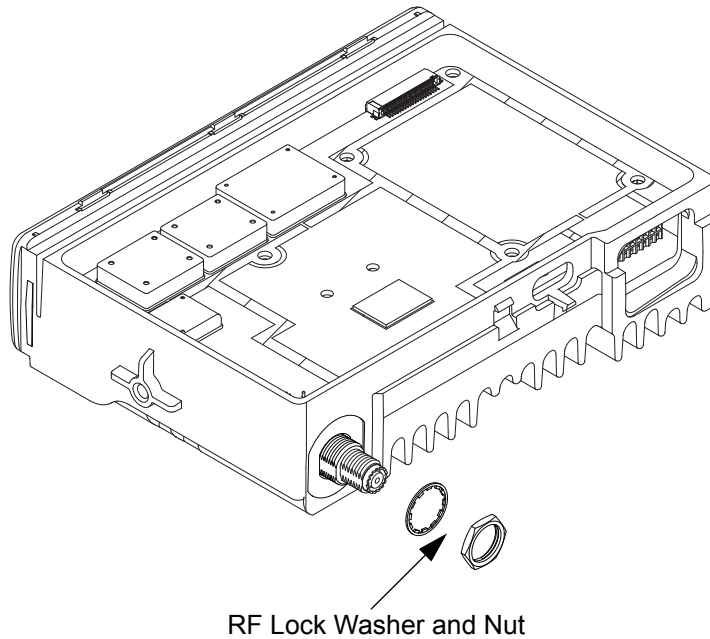


Figure 5-34 Inserting RF Lock Washer and Nut

- Using a T10 TORX™ driver insert three main shield thread forming screws (M3) at locations 3, 5 and 6 to compress the PCB. Tighten the screws to 1.0 N-m (9 lbs-in).

**NOTE:** This step is required; otherwise, damage could result to the final transmitter PA device.

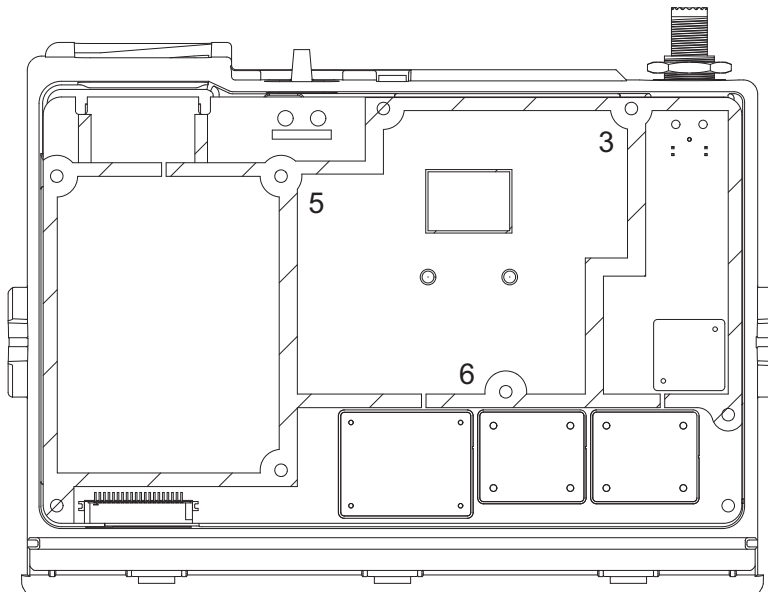
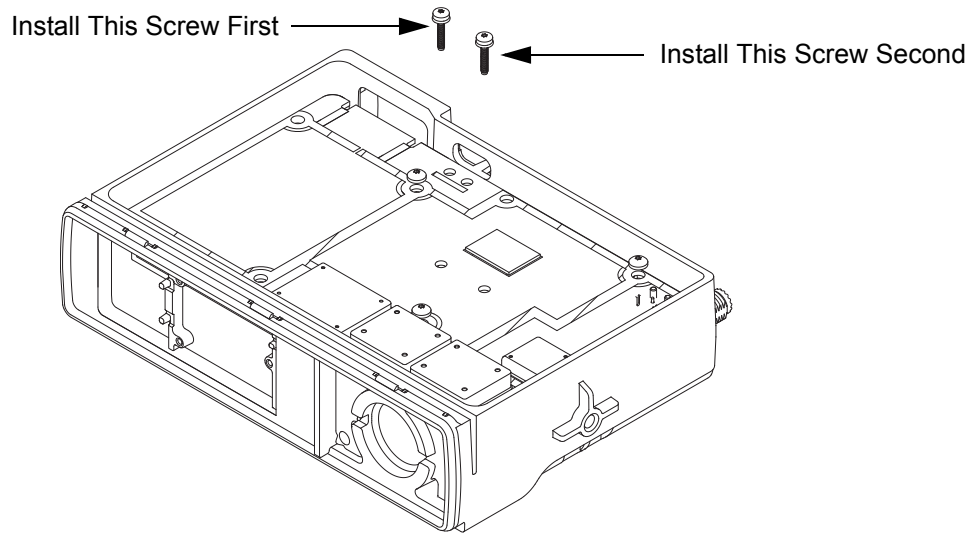


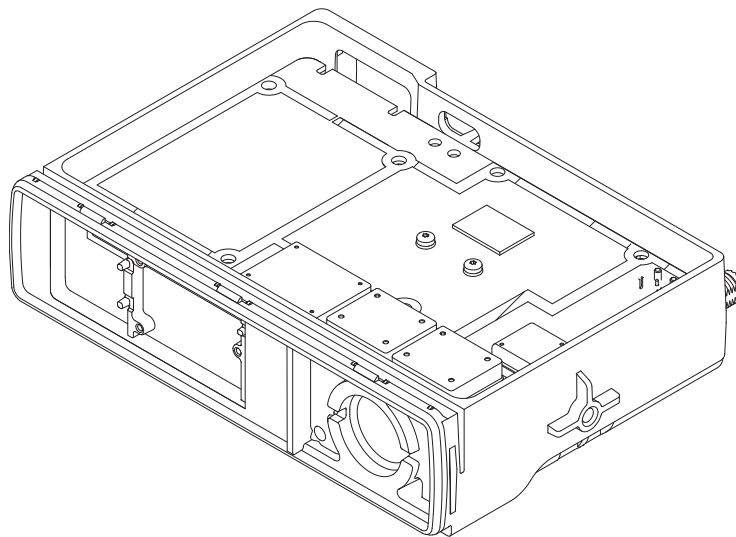
Figure 5-35 Screw Sequence to Compress PCB

5. While the board is pressed down, align the PA holes on PCB to mounting holes on chassis and insert two (M2.5) machine screws with washers (see Figure 5-36 for PA Screw sequence). Using a T8 TORX™ tighten the screws to 0.45 N-m (4 lbs-in).



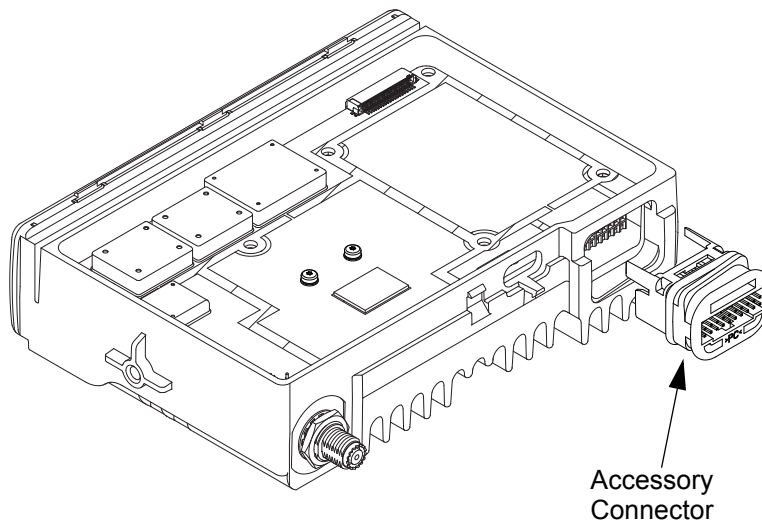
*Figure 5-36 Installing PA Screws*

6. Using a T10 TORX™ driver remove the screws from locations 3, 5 and 6.



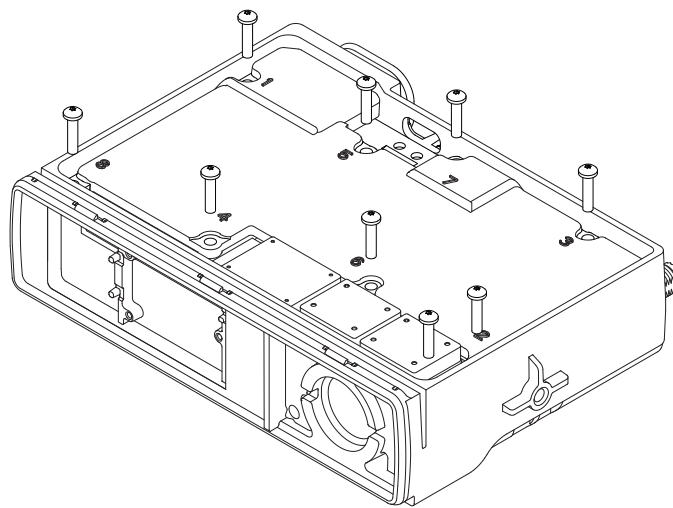
*Figure 5-37 Screw Removal*

7. Insert the accessory connector into the radio assembly and press into place until the connector is flush with the chassis. Refer to Figure 5-38.



*Figure 5-38 Inserting Accessory Connector*

8. Place the main shield on the transceiver board and lock in place the accessory connector by aligning the main shield locking tabs to the pockets of the accessory connector.
9. Insert eight main shield thread forming screws (M3) through the shield and one thread forming screw (M3) through the board.
10. Using a T10 TORX™ driver follow the sequence marked on the main shield and tighten all nine screws to 1.47 N-m (13 lbs-in). Refer to Figure 5-39.
11. Retighten the eight screws on the main shield a second time.



*Figure 5-39 Assembling Die Cast Main Shield onto Chassis*



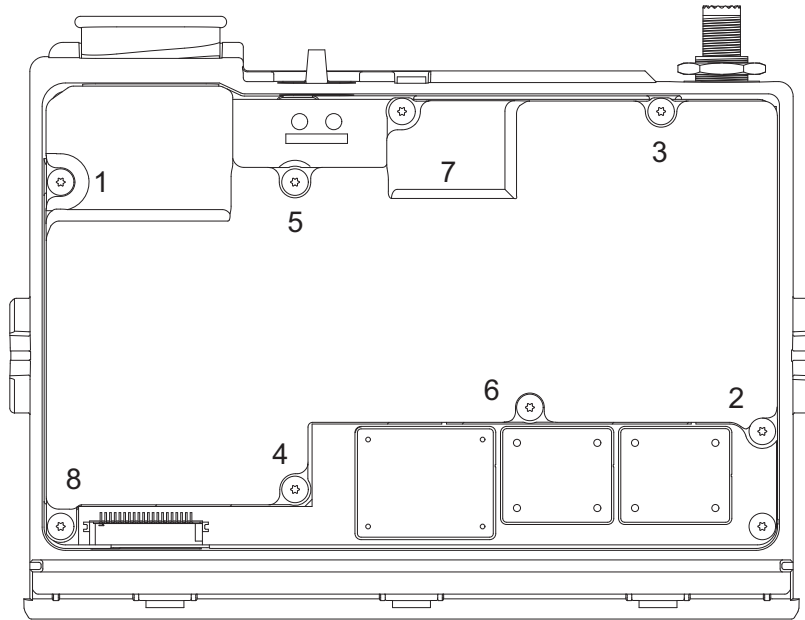


Figure 5-40 Screw Sequence to Tighten Die Cast Main Shield

12. Use a 9/16" deep socket driver to further tighten the nut to a final torque of 2.15 N-m (19 lbs-in).

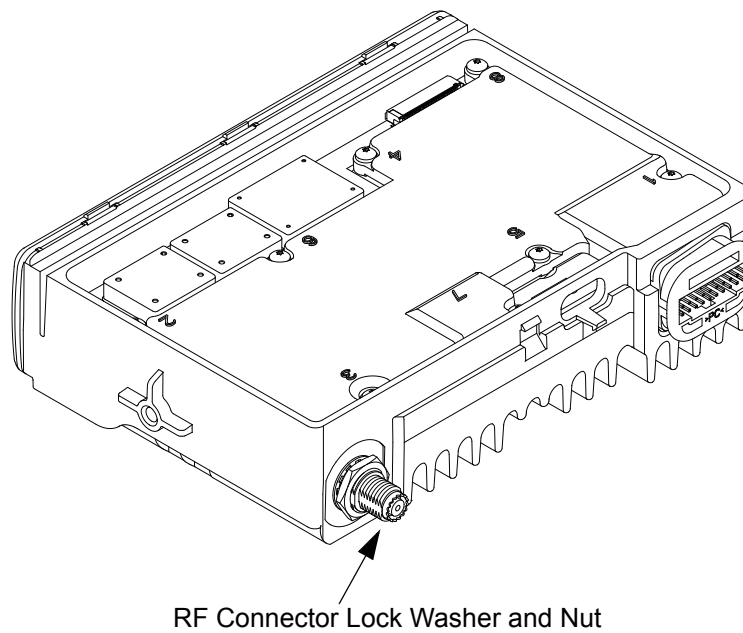

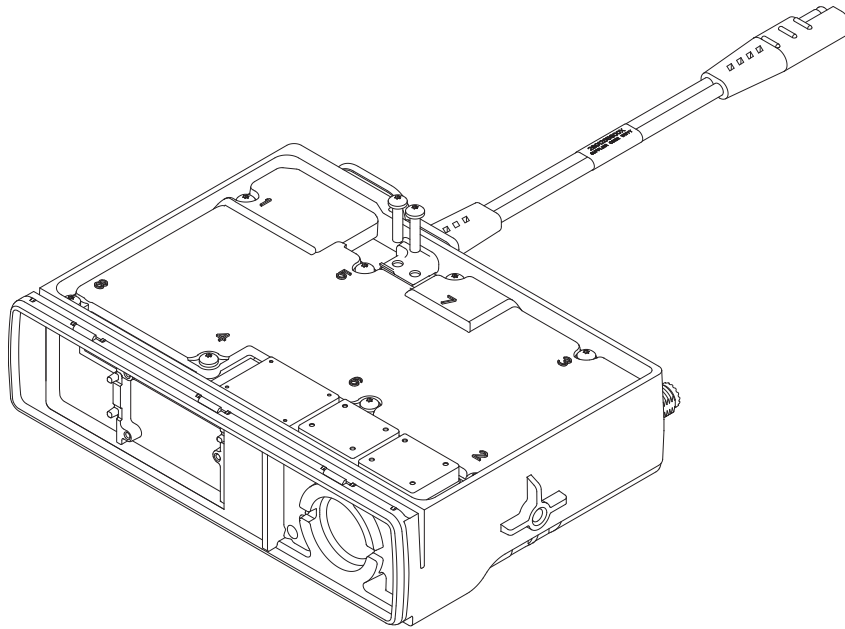


Figure 5-41 RF Connector Nut Final Torque

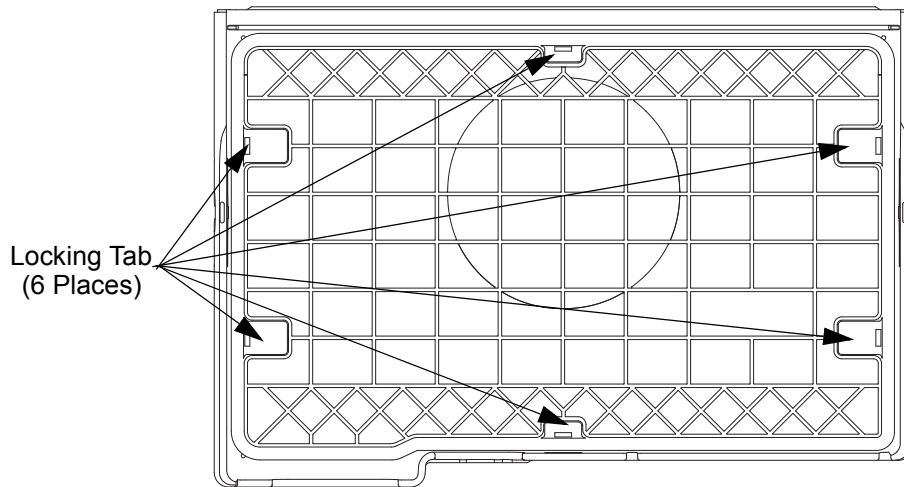
	Do not leave the transceiver board in the chassis for extended periods of time without the RF lock washer and nut assembled, or damage to the board connectors may occur.
<b>Caution</b>	

13. Install the DC Cable Assembly to the radio chassis slot. Ensure that it is seated correctly on the chassis hook located below the DC Cable.
14. Insert two thread forming screws (M3).
15. Using a T10 TORX™ driver, tighten the screws to 1.47 N-m (13 lbs-in). Refer to Figure 5-42.



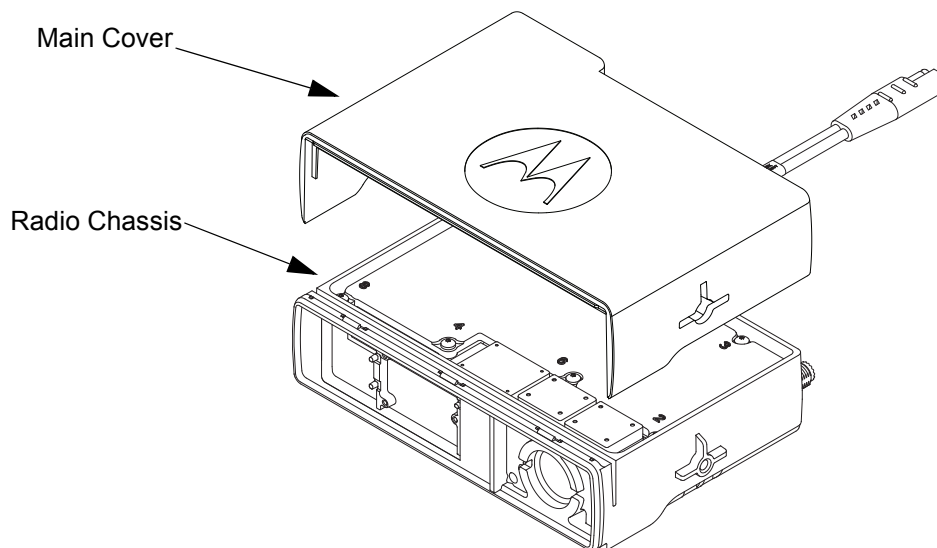
*Figure 5-42 Installing DC Cable Assembly*

16. Thoroughly inspect the cover assembly with seal attached. Ensure the seal is fully seated on the cover and the locking tabs engaged at all six locations.



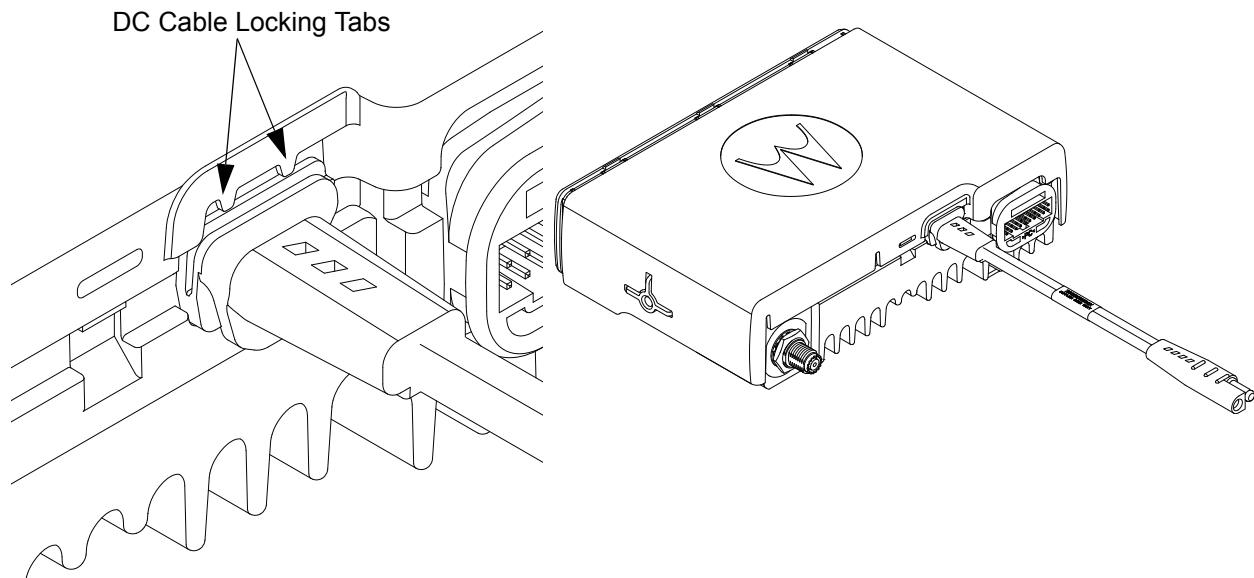
*Figure 5-43 Inspection of Cover Assembly with Seal*

17. Gently spread both sides of the cover.
18. Align the top cover to the chassis and snap the cover in place uniformly. Ensure the alignment posts on the cover slide into the alignment slots on the chassis and that the rear latch is secure.



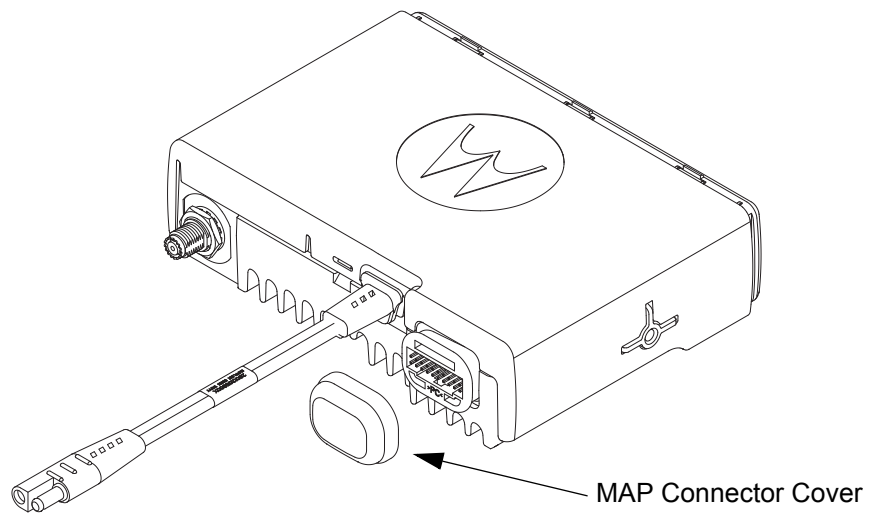
*Figure 5-44 Assembling Cover onto Chassis*

**NOTE:** Ensure the DC Cable locking tabs fit in the designated slots on the connector overmold. Avoid biting of locking tabs on the overmold.



*Figure 5-45 Rear Latch in Secure Position*

19. Install the MAP Connector cover.



*Figure 5-46 MAP Connector Cover Installation*

### 5.7.5 Option Board Installation

1. Orient the option board flex so that contacts face option board. Secure connector latch to option board as referenced in Figure 5-47. Note white line on flex should be aligned with connector latch.

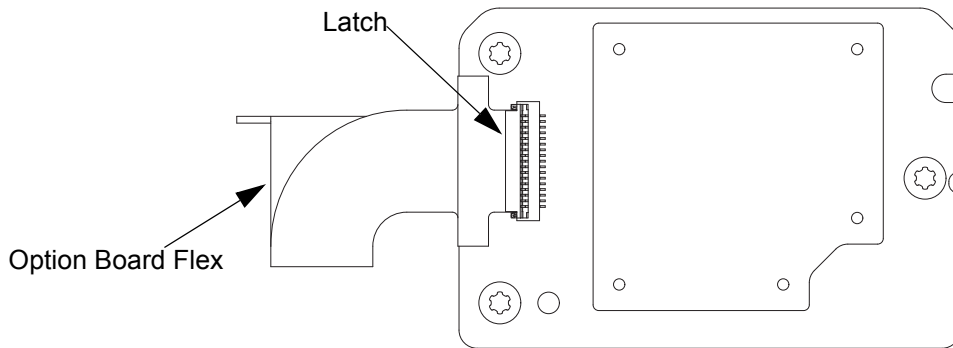


Figure 5-47 Orientation of Option Board Flex to Option Board

2. Maintaining the bend orientation, connect the flex cable from the option board to the main board connector.

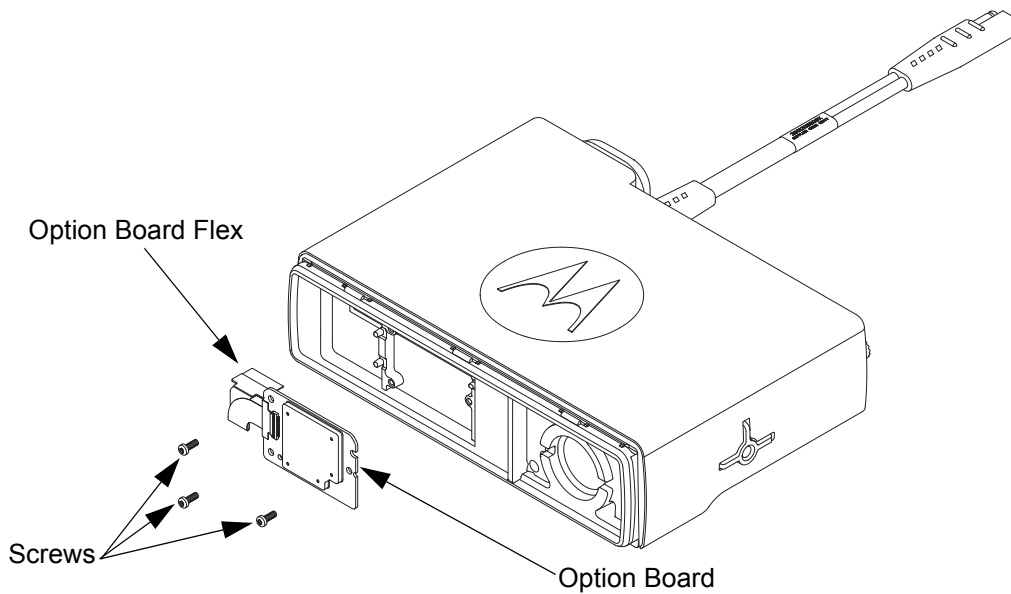
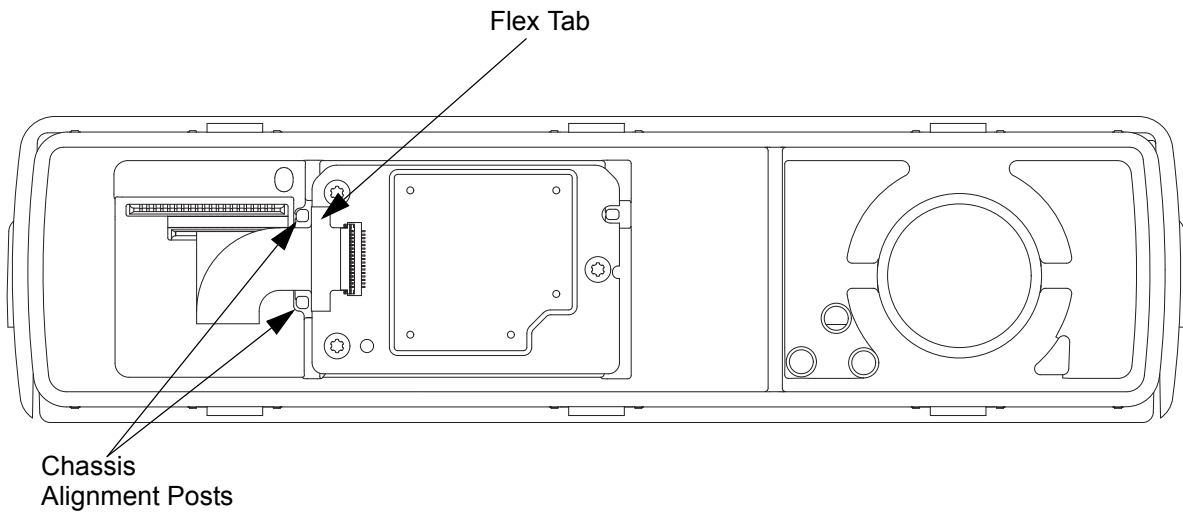


Figure 5-48 Assemble Option Board to Radio Chassis (Image May Not Match Exact Product)

3. Align option board to mounting holes ensuring that the flex tabs are against the chassis alignment posts.



*Figure 5-49 Align Option Board to Mounting Holes*

4. Using a T6 TORX™ driver, tighten the three screws to 0.28 N-m (2.5 lbs-in) to secure the option board to the chassis.

**NOTE:** Regulatory Requirements

All MOTOTRBO radios are designed and engineered to meet all regulatory requirements for the country or region of sale. Any option board designed for the MOTOTRBO Option Board ADK must not compromise the regulatory compliance of the MOTOTRBO radio.

The 3rd party developer is responsible for providing all information, upon request by a regulatory authority, in regards to any materials or substances used in the manufacture of an option board as it pertains to its end-of-life.

Please review the terms of the MOTOTRBO License Agreement for more information on the Licensed Developer or Application Partner responsibilities for regulatory compliance.

### 5.7.6 Assemble Control Head to Radio Assembly

1. Verify that the flex cable is fully seated in the connector on the control head assembly.

**Caution**

Make sure the main cover is assembled onto the radio chassis before assembling the control head onto the radio chassis.

During the control head disassembly, the control head PCB may snap out of position. The control head PCB will need to be snapped back in place prior to reassembly.

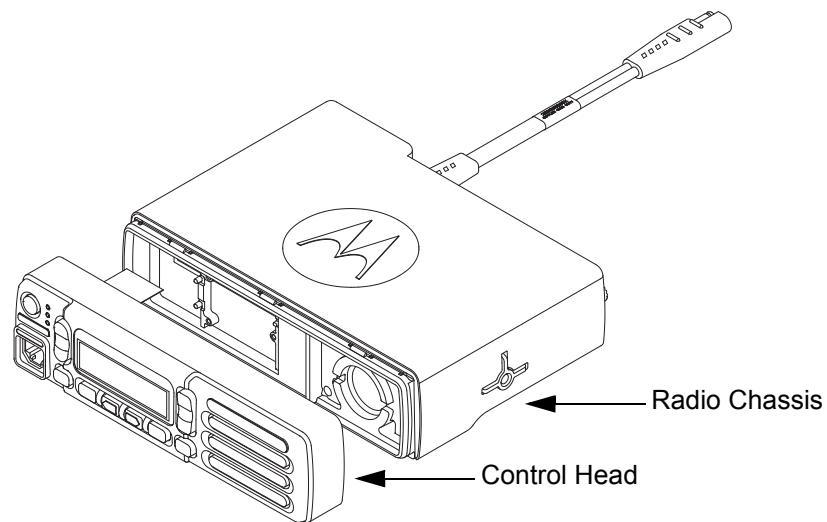


Figure 5-50 Assemble Control Head to Chassis

2. Assemble flex cable to the flex connector in the radio assembly, making sure it is fully seated.

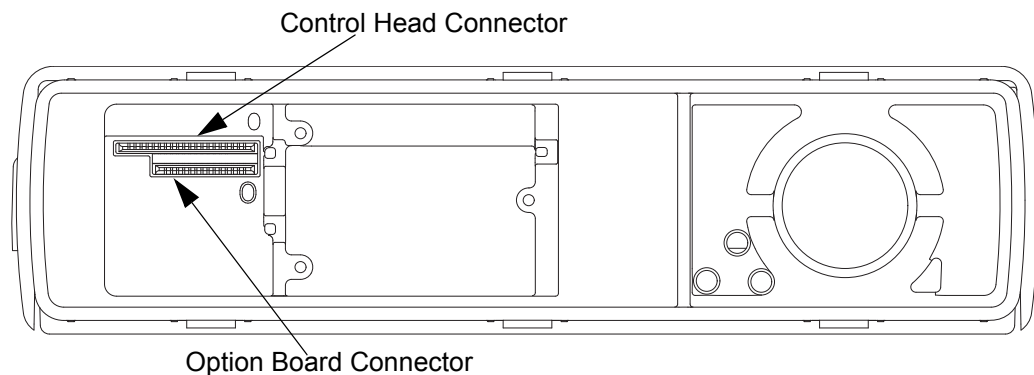


Figure 5-51 Flex Connection Connectors

3. Assemble the control head to the radio chassis by aligning one side of the control head assembly tabs to one side of the radio chassis tabs and then rotate the control head assembly until the other side engages.

## 5.8 Exploded Mechanical Views and Parts Lists

### 5.8.1 Radio Assembly Exploded View and Parts List

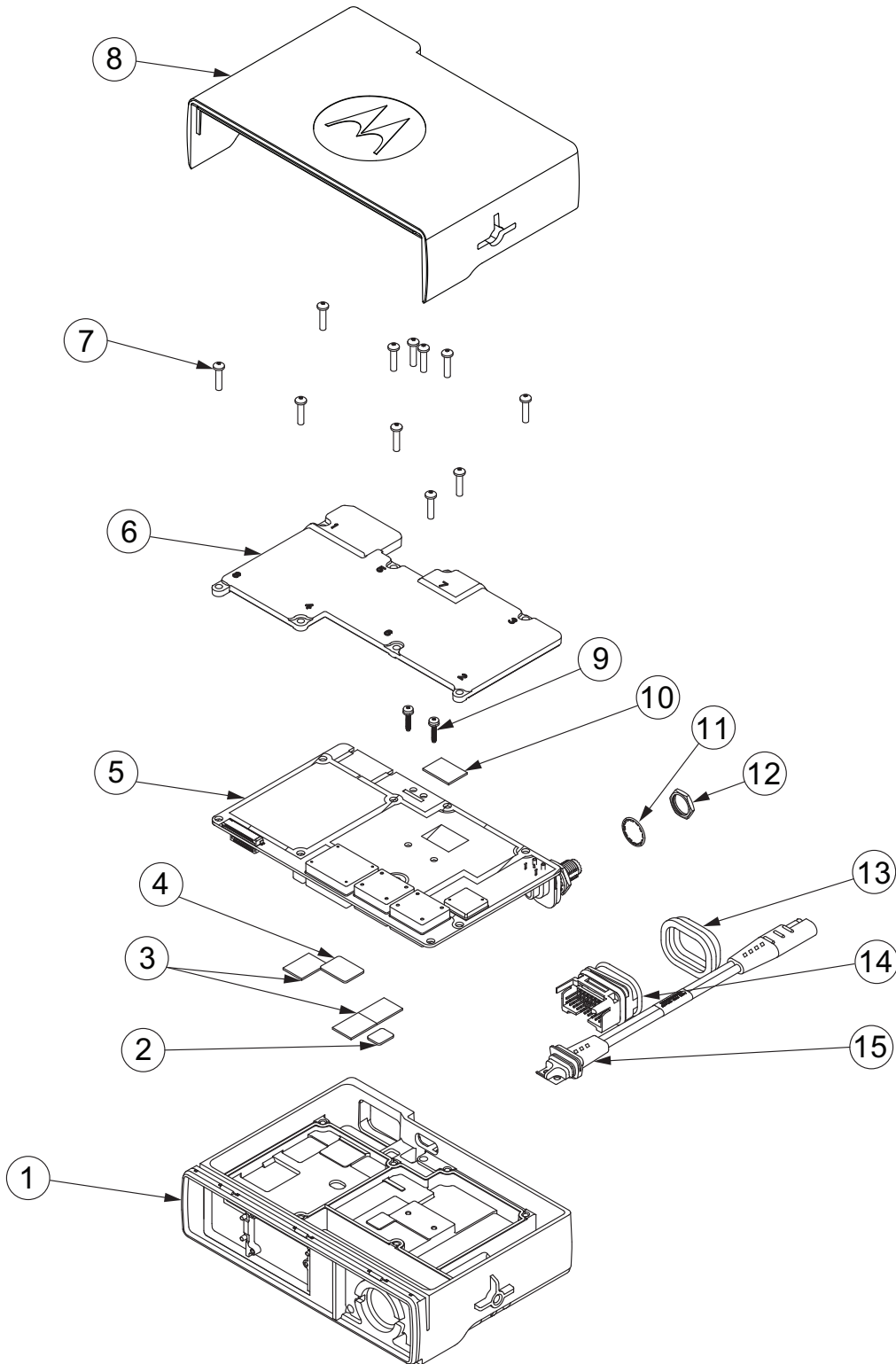


Figure 5-52 Radio Assembly Exploded View



Table 5-3 Radio Exploded View Parts List

Item No.	Description	Part Number
1	Chassis, Die Cast	0104056J09
2	Thermal Pad, Final Driver	75012058002
3	Thermal Pad, Regulator	75012018001
4	Thermal Pad, Audio PA	75012059001
5	PCB, Transceiver	See Section 1.5 to 1.8 to identify proper board.
6	Main Shield, Die Cast	26012273001
7	Screw - M3x0.5x13mm	0310943J12
8	Main Cover and Gasket Assembly	15012229001
9	Screw - M2.5x0.45x12mm with Washer	03012037002
10	Thermal Pad, PA Output Match VHF 25–45W, VHF 1–25W, UHF1 25–40W	75012018001
	UHF1 1–25W	NOT PLACED
11	Lock Washer, RF Connector	04012004001
12	Nut, RF Connector	02012015001
13	Accessory Connector Cover	3202607Y01
14	Accessory Connector	28012058001
15	DC Cable Assembly	28012059001

## 5.8.2 Alphanumeric Display Control Head Exploded View and Parts List

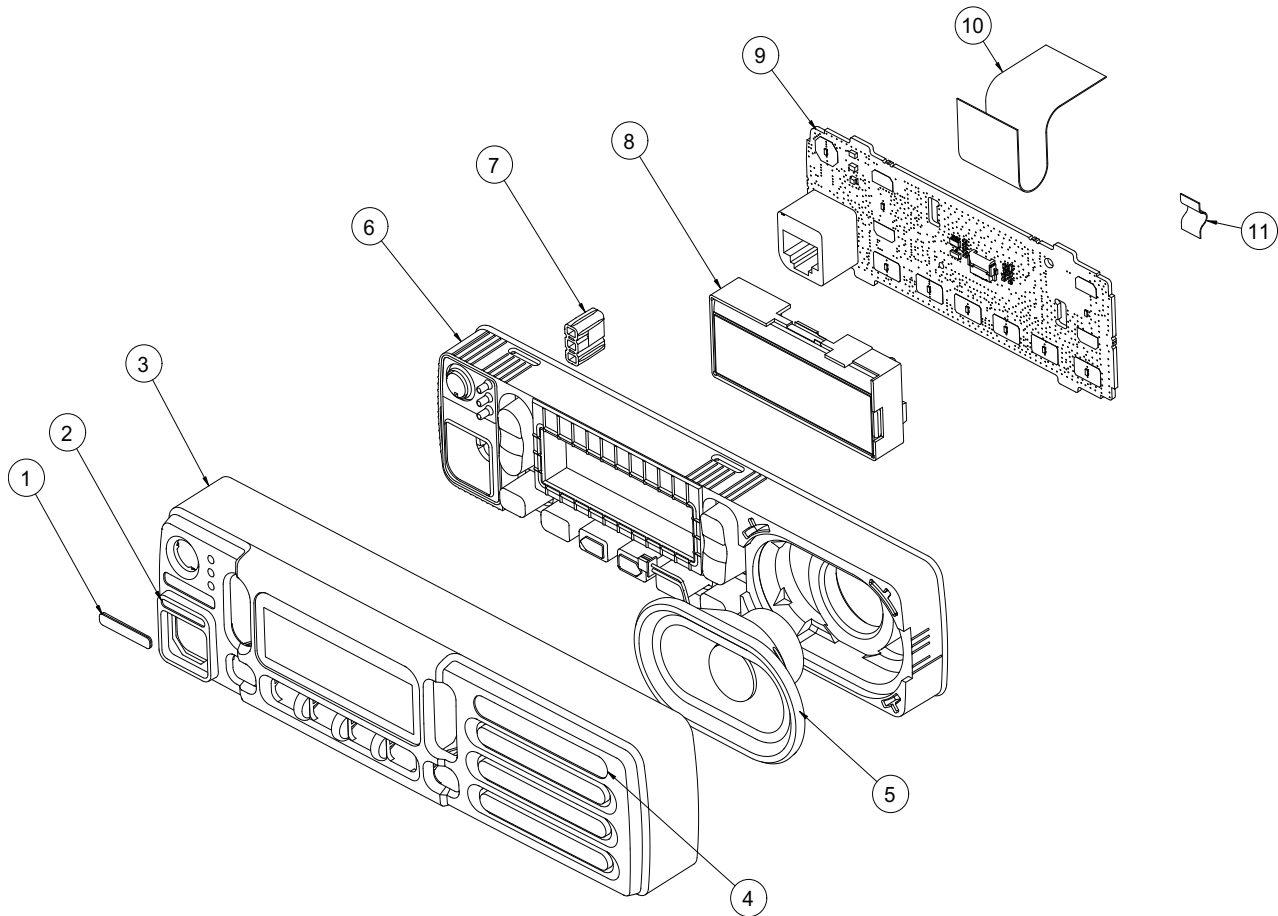


Figure 5-53 Alphanumeric Display Control Head Exploded View

Table 5-4 Alphanumeric Display Control Head (PMLN6441\_) Exploded View Parts List

Item no	Description	Part No
1	Nameplate, XPR 2500	33012051010
2	Label, Accessory Indicator	54012312001
3	Housing Front Assembly, Alphanumeric Control Head Plus	0104057J46
4	Nameplate, Motorola Logo	33012052001
5	Speaker	5015935H02
6	Keypad, Alphanumeric Control Head Plus	75012212001
7	Light Guide Holder	07012052001
8	2 Line Monochrome Display Module	72012024001
9	PCB Assembly	0104057J47*
10	Cable Flex, Control Head	30012065001
11	Speaker Tape	11012133001

\*Note: The PCB Assembly is not available for servicing. Must order PMLN6441\_ (Alphanumeric Display Control Head Kit)

## 5.9 Torque Chart

Table 5-5 lists the various nuts and screws by part number and description, followed by the torque values in different units of measure. Torque all screws to the recommended value when assembling the radio.

*Table 5-5 Torque Specifications for Nuts and Screws*

Part Number	Description	Driver/Socket	Torque		
			N-m	lbs-in	kg-cm
02012015001	Nut, RF Connector	9/16" deep socket driver	2.15	19	21.9
0310909E03	Screw, M2x0.4x6mm, Pan Head	T6 Torx™	0.28	2.5	2.9
03012037002	Screw, M2.5x0.45x12mm, Pan Head	T8 Torx™	0.45	4	4.6
0310943J12	Screw, M3x0.5x13mm, Pan Head	T10 Torx™	1.5	13	15

## Notes

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## Chapter 6 Basic Troubleshooting

### 6.1 Introduction

This chapter contains error codes and board replacement procedures. This section can help you isolate a problem to the board level. If the radio does not pass all the performance checks in Chapter 3 or exhibits an error code listed below, then the circuit board should be replaced. Please send the radio to a Motorola Service Center listed in Appendix B.

**NOTE:** To access the various connector pins, use the housing eliminator/test fixture along with the diagrams found in this section of the manual. (See Section, "Service Aids" on page 2-2, for the appropriate Motorola service aids and tools part numbers.)

#### 6.1.1 High Power RF Precaution



**Caution**

The radio might transmit while the technician believes the radio is in receive mode under the following conditions: radio failure, digital affiliation, a defective PTT button, or other unintentional activations.

To avoid possible equipment damage, when performing both transmit and receive tests, a suitable attenuator rated at 100 W or more should always be used with test equipment connected to the RF connector. The only exception to this is when the equipment's input power rating is higher than the maximum output power of the radio.

### 6.2 Replacement Service Kit Procedures

Once a problem has been isolated to a specific board, install the appropriate service kit (see Model Charts in section 1.5 on page 1-4 through section 1.8 on page 1-5), which is orderable from Motorola Radio Products and Solutions Organization at 1-800-422-4210.

Refer to <https://businessonline.motorolasolutions.com> for further information.

If a board is replaced, it does not necessarily need to be retuned if it has been factory tuned. It should however be checked for performance before being placed into service. Of particular concern is the Bias DAC, which will need to be set for the appropriate final device bias current prior to keying up the radio. If the bias is not properly set it may be possible to cause damage to the transmitter.



**Caution**

The Tuner Tool only allows the serial number of a blank board to be entered once. Be very attentive during this procedure.

## 6.3 Power-Up Error Codes

When the radio is turned on (powered-up), the radio performs cursory tests to determine if its basic electronics and software are in working order. Problems detected during these tests are presented as error codes on the radio's display. The presence of an error should prompt the user that a problem exists and that a service technician should be contacted.

Self-test errors are classified as either fatal or non-fatal. Fatal errors inhibit user operation; non-fatal errors do not. Use the following tables to aid in understanding particular power-up error code displays.

*Table 6-1 Power-Up Error Codes*

<b>Error Code</b>	<b>Description</b>	<b>Error Type</b>	<b>Corrective Action</b>
ERROR 01/02	FLASH ROM Codeplug Checksum	NON-FATAL	Reprogram the codeplug.
ERROR 01/22	Tuning Codeplug Checksum	NON-FATAL	Reprogram the tuning partition.
FAIL 01/82	FLASH ROM Codeplug Checksum	FATAL	Reprogram the codeplug.
FAIL 01/90	General Hardware Error	FATAL	Turn the radio off, then on. If problem persists, send radio to the nearest Motorola Solutions Depot.
FAIL 01/92	Security Partition Checksum	FATAL	Reprogram the security partition.
FAIL 01/93	FlashPORT AUTHENT CODE Failure	FATAL	Contact the depot.
FAIL 01/A2	Tuning Codeplug Checksum	FATAL	Reprogram the tuning partition.
FAIL 02/90	RF Hardware Error	FATAL	Send radio to the nearest Motorola Solutions Depot.

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# Chapter 7 Accessories

## 7.1 Introduction

Motorola provides the following approved accessories to improve the productivity of your digital mobile two-way radio.

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

### 7.1.1 Antennas

Part No.	Description
HAD4006_	VHF, 136–144 MHz, 1/4 Wave Roof Mount, Mini-U
HAD4007_	VHF, 144–150.8 MHz, 1/4 Wave Roof Mount, Mini-U
HAD4008_	VHF, 150.8–162 MHz, 1/4 Wave Roof Mount, Mini-U
HAD4009_	VHF, 162–174 MHz, 1/4 Wave Roof Mount, Mini-U
HAD4022_	VHF, 132–174 MHz, 3.0 dB Gain, Through-hole Mount, Mini-U
HAE4002_	UHF, 403–430 MHz, 1/4 Wave Roof Mount, Mini-U
HAE4003_	UHF, 450–470 MHz, 1/4 Wave Roof Mount, Mini-U
HAE4010_	UHF, 406–420 MHz, 3.5 dB Gain Roof Mount, Mini-U
HAE4011_	UHF, 450–470 MHz, 3.5 dB Gain Roof Mount, Mini-U
HAE6022_	UHF, 403–527 MHz, 2.0 dB Gain, Through-hole Mount, Mini-U
RAE4004_RB	UHF, 445–470 MHz, 5.0 dB Gain Roof Mount, Mini-U

### 7.1.2 Audio

Part No.	Description
GMMN4065_	Visor Microphone (Omni-Direction)
HLN9073_	Microphone Hang-up Clip (requires install)
HLN9414_	Microphone Hang-up Clip (Universal – no install required)
HSN8145_	External Speaker 7.5 W
PMLN6481_	Telephone Style Handset Kit (Includes Hang Up Cup)
PMMN4089_	Enhanced Keypad Microphone
PMMN4090_	Compact Microphone with Clip
PMMN4091_	Heavy Duty Microphone
RSN4001_	External Speaker 13 W
PMLN6520_	Telephone Style Handset

### 7.1.3 Cables

Part No.	Description
HKN4137_	Mobile Power Cable 10 FT., 14 AWG, 15 A
HKN4191_	Mobile Power Cable 10 FT., 12 AWG, 20 A
HKN4192_	Mobile Power Cable 20 FT., 10 AWG, 20 A
PMKN4147_	Front Telco MMP USB Programming Cable
PMKN4148_	Back 20 Pin MAP USB Programming Cable
HKN9327_R	Ignition Switch Cable
PMKN4151_	Back 16 Pin MAP Universal Cable
GMKN4084_	Speaker Extension Cable

### 7.1.4 Mounting Kits

Part No.	Description
FTN6083_	DIN Mount
RLN6466_	Low Profile Trunnion Kit
RLN6467_	High Profile Trunnion Kit
RLN6468_	Key Lock Trunnion Kit
03012045001	Trunnion Wing Screw M5x0.8x9.9 mm



### 7.1.5 Miscellaneous Accessories

Part No.	Description
RLN4836_R	External PTT with Emergency Footswitch
RLN4856_	Footswitch with Remote PTT
RLN4857_	Pushbutton with Remote PTT
HLN9457_	16 Pin MAP Connector Kit
GMBN1021_	Rear Accessory Connector Seal with Connector and Pins
PMLN6544_	Generic Option Board
PMLN5620_	Connector Extender (20 pcs)

### 7.1.6 Service Tools

Part No.	Description
GPN6145_	Mobile Radio Power Supply Unit
HPN4007_	Desktop Power Supply 1–60W
6686119B01	Control Head Removal Tool
66012020001	RFIC Repair Kit
PMEN4041_	Chassis Eliminator Kit
PMKN4149_	Back 20 Pin MAP Test and USB Programming Cable
PMKN4150_	Back 20 Pin MAP Test Cable
RLN4460_	Radio Test Box
6680388A26	Mobile Crimping Tool
GKN6266_	Power Supply Cable (for GPN6145)(PWR CBL DC BASE RENA)
3060665A04	Power Cable (US Plug) (110V CHGR LINE CORD)
RSX4043_	Torque Driver
6680387A74	TORX™ T10 Driver Bit
6680387A72	TORX™ T8 Driver Bit
6680387A70	TORX™ T6 Driver Bit

## Notes

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# Appendix A Replacement Parts Ordering

## A.1 Basic Ordering Information

Some replacement parts, spare parts, and/or product information can be ordered directly. While parts may be assigned with a Motorola part number, this does not guarantee that they are available from Motorola Radio Products and Solutions Organization (RPSO). Some parts may have become obsolete and no longer available in the market due to cancelations by the supplier. If no Motorola part number is assigned, the part is normally not available from Motorola, or is not a user-serviceable part. Part numbers appended with an asterisk are serviceable by Motorola Depot only.

## A.2 Motorola Online

Motorola Online users can access our online catalog at

<https://businessonline.motorolasolutions.com>

To register for online access, please call 1-800-422-4210 (for U.S. and Canada Service Centers only). International customers can obtain assistance at <https://businessonline.motorolasolutions.com>

## A.3 Mail Orders

Mail orders are only accepted by the US Federal Government Markets Division (USFGMD).

Motorola  
7031 Columbia Gateway Drive  
3rd Floor - Order Processing  
Columbia, MD 21046  
U.S.A.

## A.4 Telephone Orders

Radio Products and Solutions Organization\*  
(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)  
1-877-873-4668  
8:30 AM to 5:00 PM (Eastern Standard Time)

## A.5 Fax Orders

Radio Products and Solutions Organization\*  
(United States and Canada)  
1-800-622-6210  
1-847-576-3023 (United States and Canada)

USFGMD  
(Federal Government Orders)  
1-800-526-8641 (For Parts and Equipment Purchase Orders)

## **A.6 Parts Identification**

Radio Products and Solutions Organization\*  
(United States and Canada)  
1-800-422-4210

## **A.7 Product Customer Service**

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

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

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## **Appendix B Motorola Service Centers**

### **B.1 Servicing Information**

If a unit requires further complete testing, knowledge and/or details of component level troubleshooting or service than is customarily performed at the basic level, please send the radio to a Motorola Service Center as listed below or your nearest Authorized Service Center.

### **B.2 Motorola Service Center**

1220 Don Haskins Drive  
Suite A  
El Paso, TX 79936  
Tel: 915-872-8200

### **B.3 Motorola Federal Technical Center**

10105 Senate Drive  
Lanham, MD 20706  
Tel: 1-800-969-6680  
Fax: 1-800-784-4133

### **B.4 Canadian Technical Logistics Center**

181 Whitehall Drive  
Markham, Ontario  
L3R 9T1  
Toll Free: 800-543-3222

## Notes

# Appendix C Limited Level 3 Servicing

## C.1 Maintenance

For details on the following, please refer to Chapter 5 Disassembly/Reassembly Procedures – Section 5.2 on page 5-1 to Section 5.4 on page 5-4.

- Preventive maintenance (inspection and cleaning).
- Safe handling of CMOS and LDMOS devices.
- Repair procedures and techniques.

## C.2 Component Location and Parts List

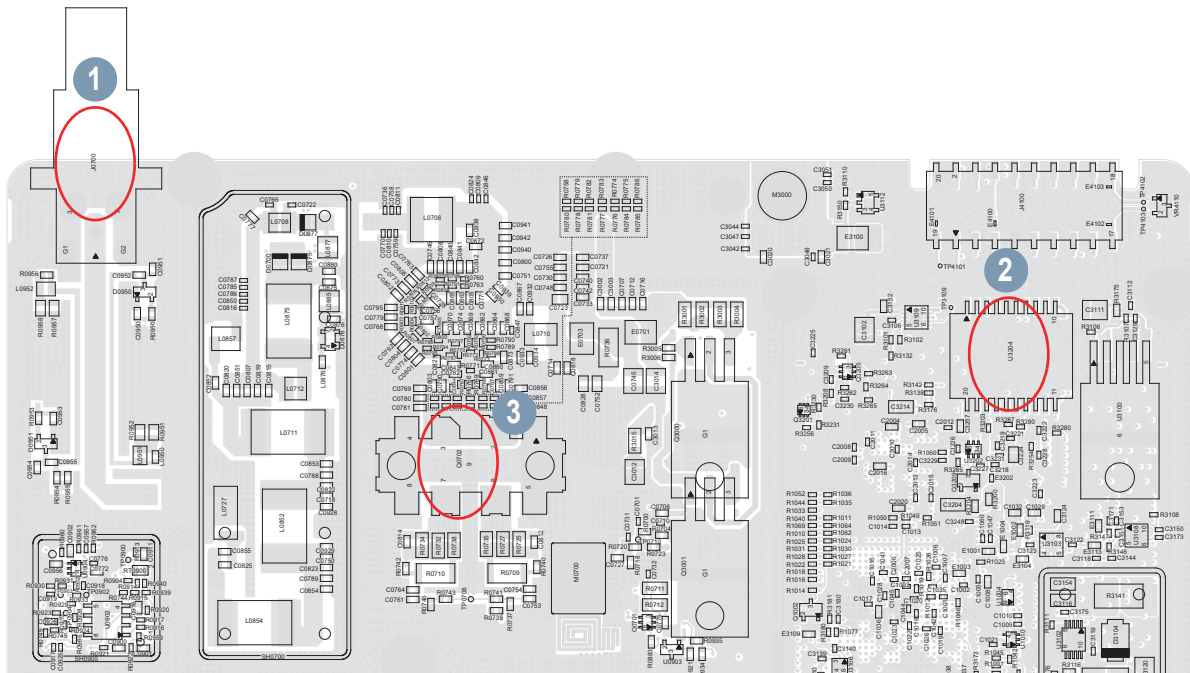


Figure C-1 PCB Top Side View

Table C-1. Component Parts List

No.	Circuit Ref.	Motorola Part Number	Description
1	J0700	09009348001	Mini-UHF Female RF Connector
2	U3204	51012450001	IC Audio Amplifier 1 Per Package
3	Q0702	48012067002 (UHF1 1–25W/VHF 1–25W) 48012022001 (UHF1 25–40W/VHF 25–45W)	RF MOSFET Power Transistor

## Notes



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# 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.

Term	Definition
<b>Analog</b>	Refers to a continuously variable signal or a circuit or device designed to handle such signals.
<b>Band</b>	Frequencies allowed for a specific purpose.
<b>CMOS</b>	Complementary Metal Oxide Semiconductor.
<b>CPS</b>	Customer Programming Software: Software with a graphical user interface containing the feature set of a radio.
<b>Default</b>	A pre-defined set of parameters.
<b>Digital</b>	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.
<b>DPL</b>	Digital Private-Line: A type of digital communications that utilizes privacy call, as well as memory channel and busy channel lock out to enhance communication efficiency.
<b>FCC</b>	Federal Communications Commission.
<b>Frequency</b>	Number of times a complete electromagnetic-wave cycle occurs in a fixed unit of time (usually one second).
<b>GPIO</b>	General-Purpose Input/Output.
<b>GPS</b>	Global Positioning System.
<b>IC</b>	Integrated Circuit: 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.
<b>IF</b>	Intermediate Frequency.
<b>kHz</b>	kilohertz: One thousand cycles per second. Used especially as a radio frequency unit.
<b>LCD</b>	Liquid-Crystal Display: 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.
<b>LDMOS</b>	Laterally Diffused Metal Oxide Semiconductor.
<b>LED</b>	Light Emitting Diode: An electronic device that lights up when electricity is passed through it.
<b>MDC</b>	Motorola Digital Communications.

<b>Term</b>	<b>Definition</b>
<b>MHz</b>	Megahertz: One million cycles per second. Used especially as a radio frequency unit.
<b>Paging</b>	One-way communication that alerts the receiver to retrieve a message.
<b>PC Board</b>	Printed Circuit Board. Also referred to as a PCB.
<b>PL</b>	Private-Line Tone Squelch: A continuous sub-audible tone that is transmitted along with the carrier.
<b>Programming Cable</b>	A cable that allows the CPS to communicate directly with the radio using USB.
<b>Receiver</b>	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.
<b>Repeater</b>	Remote transmit/receive facility that re-transmits received signals in order to improve communications range and coverage (conventional operation).
<b>RF</b>	Radio Frequency: The portion of the electromagnetic spectrum between audio sound and infrared light (approximately 10 kHz to 10 GHz).
<b>RX</b>	Receive.
<b>Signal</b>	An electrically transmitted electromagnetic wave.
<b>Spectrum</b>	Frequency range within which radiation has specific characteristics.
<b>Squelch</b>	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.
<b>TOT</b>	Time-out Timer: A timer that limits the length of a transmission.
<b>TPL</b>	Tone Private Line.
<b>Transceiver</b>	Transmitter-receiver. A device that both transmits and receives analog or digital signals. Also abbreviated as XCVR.
<b>Transmitter</b>	Electronic equipment that generates and amplifies an RF carrier signal, modulates the signal, and then radiates it into space.
<b>TX</b>	Transmit.
<b>UHF</b>	Ultra-High Frequency.
<b>USB</b>	Universal Serial Bus: An external bus standard that supports data transfer rates of 12 Mbps.
<b>VHF</b>	Very High Frequency.
<b>VIP</b>	Vehicle Interface Port.
<b>XPR</b>	Refers to Digital Professional Radio model names in the MOTOTRBO Professional Digital Two-Way Radio System.





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