Professional Digital Two-Way Radio System

MOTOTRBO™ Mobile

Basic Service Manual

XPR™ 4300 Numeric Display Mobile

XPR™ 4350 Numeric Display Mobile (with GPS)

XPR™ 4500 Display Mobile

XPR™ 4550 Display Mobile (with GPS)

MOTOROLA

Foreword

This manual covers all XPR™ Series 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

Before using this product, read the operating instructions for safe usage contained in the Product Safety and RF Exposure booklet enclosed with your radio.

ATTENTION!

This radio is restricted to occupational use only to satisfy FCC RF energy exposure requirements. Before using this product, read the RF energy awareness information and operating instructions in the Product Safety and RF Exposure booklet enclosed with your radio (Motorola Publication part number 6881095C99) to ensure compliance with RF energy exposure limits.

For a list of Motorola-approved antennas, and other accessories, visit the following web site which lists approved accessories: http://www.motorola.com/governmentandenterprise

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Notes

Document History

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

Edition	Description	Date
6880309T21-A	Initial Release.	Dec. 2006
6880309T21-B	Added VHF High Power Band Information.	June 2007
6880309T21-C	Added VHF LP Band and Numeric Display models to VHF High Power Band.	Oct. 2007
6880309T21-D	Added Option Board Information and Power Cable HKN4191_.	Nov. 2007
6880309T21-E	Added 20 kHz information to Chapter 1 and UHF Band 2 models.	June 2008
6880309T21-F	Removed Power Supply HPN4008_ and updated description for HPN4007_ in Sections 2.2 Service Aids and 7.1.3 Desktop Accessories. Changed Channel Capacity from 160 to 1000 for Display models for all bands in Section 1.10 Specifications. Changed Windows 2000/XP to Windows Vista/XP in Chapter 4, Sections 4.1 and 4.4. Added Generic Option Board, PMLN5496_ to Section 7.1.7 Miscellaneous Accessories.	June 2009

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Related Publications

*MOTOTRBO Mobile User Guide CD ..... HKLN4284_

* CD consists of:
XPR 4300/XPR 4350 Numeric Display Mobile User Guide
XPR 4300/XPR 4350 Quick Reference Card
XPR 4500/XPR 4550 Display Mobile User Guide
XPR 4500/XPR 4550 Quick Reference Card
MOTOTRBO Mobile Installation Guide
Safety Leaflet

Commercial Warranty

Limited Warranty

MOTOROLA COMMUNICATION PRODUCTS

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MOTOROLA INC. (“MOTOROLA”) warrants the MOTOROLA 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:

XPR Series 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 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://www.motorola.com/businessonline) > Resource Center > Services > Service Product Offerings > Repair Service Advantage or Extended Warranty.

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VII. Governing Law

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

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.

Caution

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

1.2 Radio Description

The XPR series 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
UHF B2	450–512 MHz	1–40 Watts

These digital 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 illustrations show the typical radio control heads.

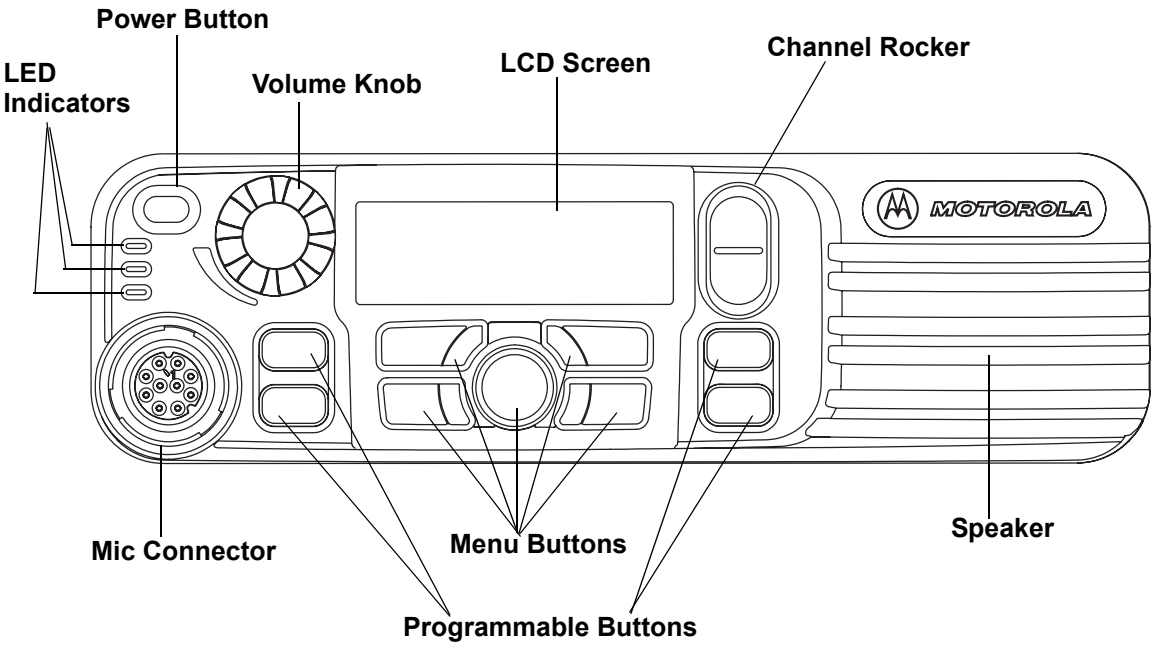


Figure 1-1 Radio Control Head (Display Model)

1.3.1 Control Head Controls (Display Model)

- POWER BUTTON – Turns the radio on and off.
- VOLUME KNOB – Rotate clockwise to increase volume level; rotate counter-clockwise to decrease volume level.
- LED INDICATORS – Red, yellow and green light-emitting diodes indicate operating status.
- LCD (Liquid Crystal Display) – 132x34 full dot matrix display provides visual information about many radio features.
- MENU OPERATION BUTTONS – Five buttons to provide menu navigation and selection interface.
- PROGRAMMABLE BUTTONS – Four buttons are field programmable using the CPS.
- CHANNEL CHANGING ROCKER – Press top side to increment or bottom side to decrement the channel.

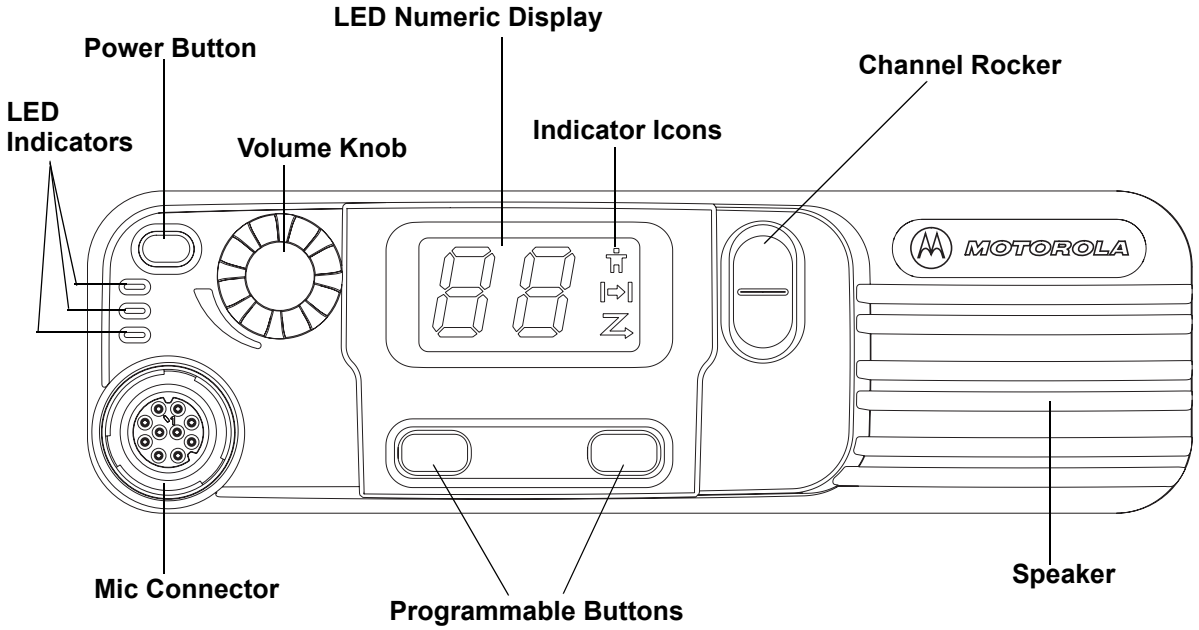


Figure 1-2 Radio Control Head (Numeric Display Model)

1.3.2 Control Head Controls (Numeric Display Model)

- POWER BUTTON – Turns the radio on and off.
- VOLUME KNOB – Rotate clockwise to increase volume level; rotate counter-clockwise to decrease volume level.
- LED INDICATORS – Red, yellow and green light-emitting diodes indicate operating status.
- LED NUMERIC DISPLAY – Two digit numeric display.
- PROGRAMMABLE BUTTONS – Two buttons are field programmable using the CPS.
- CHANNEL CHANGING ROCKER – Press top side to increment or bottom side to decrement the channel.
- INDICATOR ICONS – Indicates status of various functions including private call, talkaround and scan.

1.4 MOTOTRBO Mobile Radio Model Numbering Scheme

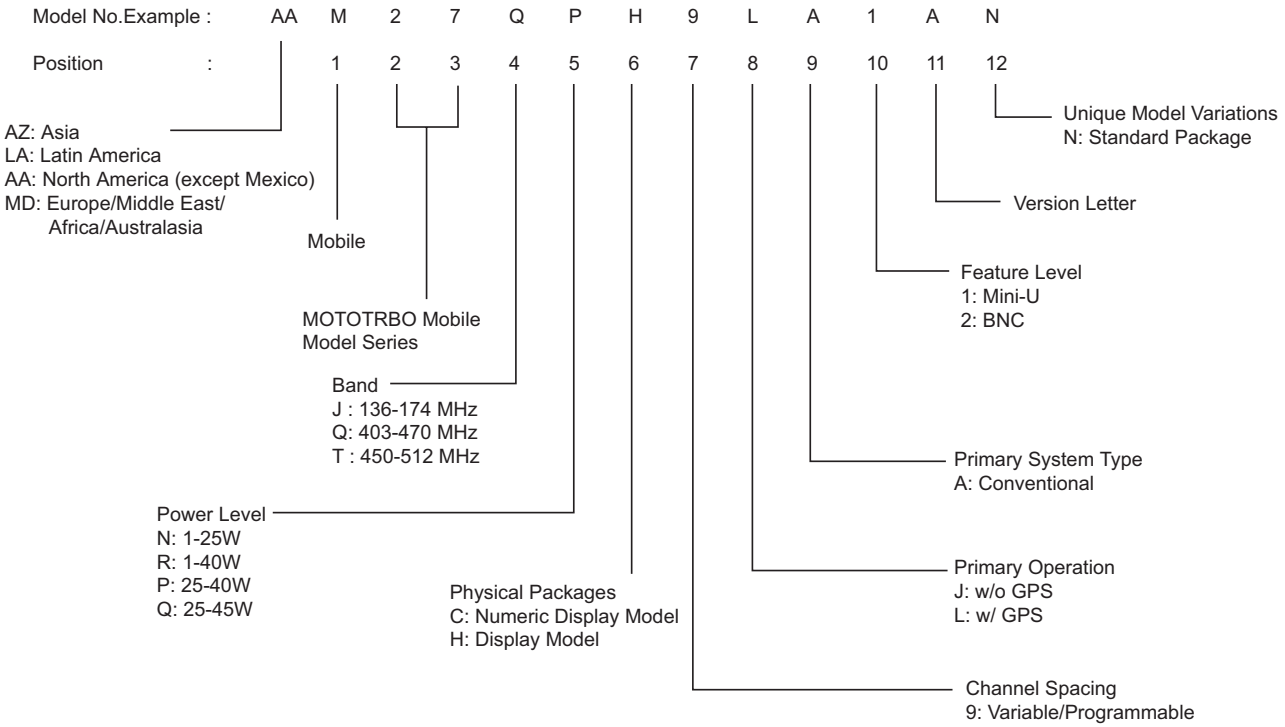


Figure 1-3 Mobile Radio Model Numbering Scheme

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

VHF 136–174 MHz 25–45W, Mini-U					
Model					**Description**
AAM27JQC9JA1_N					136–174 MHz, 25–45W, MOTOTRBO XPR 4300 Numeric Display Mobile
	AAM27JQC9LA1_N				136–174 MHz, 25–45W, MOTOTRBO XPR 4350 Numeric Display Mobile with GPS
		AAM27JQH9JA1_N			136–174 MHz, 25–45W, MOTOTRBO XPR 4500 Display Mobile
			AAM27JQH9LA1_N		136–174 MHz, 25–45W, MOTOTRBO XPR 4550 Display Mobile with GPS
				Item	**Description**
X		X		PMUD2044_S	*Service Kit, VHF, 25–45W
	X		X	PMUD2043_S	*Service Kit, VHF, 25–45W, with GPS
X	X			PMLN4967_	Numeric Display Model Control Head
		X	X	PMLN4759_	Display Model Control Head
X	X	X	X	HKLN4284_	User Guide CD

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

VHF 136–174 MHz 1–25W, Mini-U					
Model					**Description**
AAM27JNC9JA1_N					136–174 MHz, 1–25W, MOTOTRBO XPR 4300 Numeric Display Mobile
	AAM27JNC9LA1_N				136–174 MHz, 1–25W, MOTOTRBO XPR 4350 Numeric Display Mobile with GPS
		AAM27JNH9JA1_N			136–174 MHz, 1–25W, MOTOTRBO XPR 4500 Display Mobile
			AAM27JNH9LA1_N		136–174 MHz, 1–25W, MOTOTRBO XPR 4550 Display Mobile with GPS
				Item	**Description**
X		X		PMUD2040_S	*Service Kit, VHF, 1–25W
	X		X	PMUD2039_S	*Service Kit, VHF, 1–25W, with GPS
X	X			PMLN4967_	Numeric Display Model Control Head
		X	X	PMLN4759_	Display Model Control Head
X	X	X	X	HKLN4284_	User Guide CD

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**
AAM27QPC9JA1_N					403–470 MHz, 25–40W, MOTOTRBO XPR 4300 Numeric Display Mobile
	AAM27QPC9LA1_N				403–470 MHz, 25–40W, MOTOTRBO XPR 4350 Numeric Display Mobile, with GPS
		AAM27QPH9JA1_N			403–470 MHz, 25–40W, MOTOTRBO XPR 4500 Display Mobile
			AAM27QPH9LA1_N		403–470 MHz, 25–40W, MOTOTRBO XPR 4550 Display Mobile, with GPS
				Item	**Description**
X		X		PMUE2346_S	*Service Kit, UHF B1, 25–40W
	X		X	PMUE2345_S	*Service Kit, UHF B1, 25–40W, with GPS
X	X			PMLN4967_	Numeric Display Model Control Head
		X	X	PMLN4759_	Display Model Control Head
X	X	X	X	HKLN4284_	User Guide CD

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**
AAM27QNC9JA1_N					403–470 MHz, 1–25W, MOTOTRBO XPR 4300 Numeric Display Mobile
	AAM27QNC9LA1_N				403–470 MHz, 1–25W, MOTOTRBO XPR 4350 Numeric Display Mobile, with GPS
		AAM27QNH9JA1_N			403–470 MHz, 1–25W, MOTOTRBO XPR 4500 Display Mobile
			AAM27QNH9LA1_N		403–470 MHz, 1–25W, MOTOTRBO XPR 4550 Display Mobile, with GPS
				Item	**Description**
X		X		PMUE2342_S	*Service Kit, UHF B1, 1–25W
	X		X	PMUE2341_S	*Service Kit, UHF B1, 1–25W, with GPS
X	X			PMLN4967_	Numeric Display Model Control Head
		X	X	PMLN4759_	Display Model Control Head
X	X	X	X	HKLN4284_	User Guide CD

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 UHF2 High Power (450–512 MHz) Model Chart

UHF2 450–512 MHz 1–40W, Mini-U					
Model					**Description**
AAM27TRC9JA1_N					450–512 MHz, 1–40W, MOTOTRBO XPR 4300 Numeric Display Mobile
	AAM27TRC9LA1_N				450–512 MHz, 1–40W, MOTOTRBO XPR 4350 Numeric Display Mobile, with GPS
		AAM27TRH9JA1_N			450–512 MHz, 1–40W, MOTOTRBO XPR 4500 Display Mobile
			AAM27TRH9LA1_N		450–512 MHz, 1–40W, MOTOTRBO XPR 4550 Display Mobile, with GPS
				Item	**Description**
X		X		PMUE3078_S	*Service Kit, UHF B2, 1–40W
	X		X	PMUE3076_S	*Service Kit, UHF B2, 1–40W, with GPS
X	X			PMLN4967_	Numeric Display Model Control Head
		X	X	PMLN4759_	Display Model Control Head
X	X	X	X	HKLN4284_	User Guide CD

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.

1.10 Specifications

General						
Specification	**VHF**		**UHF1**		**UHF2**	
Model:	Numeric Display	Display	Numeric Display	Display	Numeric Display	Display
Channel Capacity:	32	1000	32	1000	32	1000
Typical RF Output: Low Power High Power	1–25 W 25–45 W		1–25 W 25–40 W		– 1–40 W	
Frequency Range:	136–174 MHz		403–470 MHz		450–512 MHz	
Dimensions: (HxWxL)	2.01 x 6.89 x 8.11 in (51 x 175 x 206 mm)					
Weight:	4.0 lbs. (1.8 kg)					
Current Drain: Standby Rx @ rated audio Transmit	0.81 A max 2 A max 1–25 W: 11.0 A max 1–40 W: 14.5 A max (11.0 A max <25 W) 25–40 W: 14.5 A max 25–45 W: 14.5 A max					
FCC Description	1–25 W: ABZ99FT3083 25–45 W: ABZ99FT3082		1–25 W: ABZ99FT4081 25–40 W: ABZ99FT4080		1–40 W: ABZ99FT4083	
IC Description	1–25 W: 109AB-99FT3083 25–45 W: 109AB-99FT3082		1–25 W: 109AB-99FT4081 25–40 W: 109AB-99FT4080		1–40 W: 109AB-99FT4083	

Receiver						
Specification	**VHF**		**UHF1**		**UHF2**	
Model:	Numeric Display	Display	Numeric Display	Display	Numeric Display	Display
Frequencies:	136–174 MHz		403–470 MHz		450–512 MHz	
Channel Spacing:	12.5 kHz/20 kHz/25 kHz					
Frequency Stability: (-30°C to +60°C)	±1.5 ppm (XPR 4300) ±0.5 ppm (XPR 4350)	±1.5 ppm (XPR 4500) ±0.5 ppm (XPR 4550)	±1.5 ppm (XPR 4300) ±0.5 ppm (XPR 4350)	±1.5 ppm (XPR 4500) ±0.5 ppm (XPR 4550)	±1.5 ppm (XPR 4300) ±0.5 ppm (XPR 4350)	±1.5 ppm (XPR 4500) ±0.5 ppm (XPR 4550)
Analog Sensitivity (12 dB Sinad):	0.3 µV 0.22 µV (typical)					
Digital Sensitivity:	5% BER: 0.3 µV					
Intermodulation (TIA603C)	78 dB		75 dB			
Adjacent Channel Selectivity TIA603 TIA603C	65 dB @12.5 kHz, 80 dB @ 25 kHz 50 dB @ 12.5 kHz, 80 dB @ 25 kHz		65 dB @12.5 kHz, 75 dB @ 25 kHz 50 dB @ 12.5 kHz, 75 dB @ 25 kHz			
Spurious Rejection (TIA603C)	80 dB		75 dB			
Rated Audio:	3 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 @ 20/25 kHz					
Audio Response:	TIA603C					
Conducted Spurious Emission (TIA603C):	-57 dBm					

Transmitter						
Specification	**VHF**		**UHF1**		**UHF2**	
Model:	Numeric Display	Display	Numeric Display	Display	Numeric Display	Display
Frequencies:	136–174 MHz		403–470 MHz		450–512 MHz	
Channel Spacing:	12.5 kHz/20 kHz/25 kHz					
Frequency Stability: (-30°C to +60°C)	±1.5 ppm (XPR 4300) ±0.5 ppm (XPR 4350)	±1.5 ppm (XPR 4500) ±0.5 ppm (XPR 4550)	±1.5 ppm (XPR 4300) ±0.5 ppm (XPR 4350)	±1.5 ppm (XPR 4500) ±0.5 ppm (XPR 4550)	±1.5 ppm (XPR 4300) ±0.5 ppm (XPR 4350)	±1.5 ppm (XPR 4500) ±0.5 ppm (XPR 4550)
Power Output: Low Power High Power	1–25 W 25–45 W		1–25 W 25–40 W		– 1–40 W	
Modulation Limiting:	±2.5 kHz @ 12.5 kHz ±4.0 kHz @ 20 kHz ±5.0 kHz @ 25 kHz					
FM Hum and Noise:	-40 dB @ 12.5 kHz -45 dB @ 20/25 kHz					
Conducted/ Radiated Emission:	-36 dBm <1 GHz -30 dBm >1 GHz					
Adjacent Channel Power (TIA603C):	60 dB @ 12.5 kHz 70 dB @ 20/25 kHz					
Audio Response:	TIA603C					
Audio Distortion:	3%					
FM Modulation	12.5 kHz: 11K0F3E 25 kHz: 16K0F3E					
4FSK Digital Modulation	12.5 kHz Data Only: 7K60FXD 12.5 kHz Data & Voice: 7K60FXE					
Digital Vocoder Type:	AMBE+2™					
Digital Protocol:	ETSI-TS102 361-1 ETSI-TS102 361-2 ETSI-TS102 361-3					

Self-Quieter		
VHF	**UHF1**	**UHF2**
144 MHz	464.025 MHz	498.825 MHz
147.45 MHz	–	–
172.025 MHz +/- 5 kHz	–	–

GPS						
Specification	**VHF**		**UHF1**		**UHF2**	
Model:	Numeric Display	Display	Numeric Display	Display	Numeric Display	Display
Accuracy specs are for long-term tracking (95th percentile values > 5 satellites visible at a nominal -130 dBm signal strength).						
TTFF (Time to First Fix) Cold Start:	< 1 minute					
TTFF Hot Start:	< 10 seconds					
Horizontal Accuracy:	< 10 meters					

Military Standards 810E & F				
	MIL-STD 810E		MIL-STD 810F	
	Methods	Procedures	Methods	Procedures
Low Pressure	500.3	II	500.4	II
High Temperature	501.3	I/A, II/AI	501.4	I/HOT, II/HOT
Low Temperature	502.3	I/C3, II/C1	502.4	I/C3, II/C1
Temperature Shock	503.3	I/AIC3	503.4	I
Solar Radiation	505.3	I	505.4	I
Rain	506.3	I, II	506.4	I, III
Humidity	507.3	II	507.4	–
Salt Fog	509.3	I	509.4	I
Dust	510.3	I	510.4	I
Vibration	514.4	I/10, II/3	514.5	I/24
Shock	516.4	I, IV	516.5	I, IV

Environmental Specifications	
Operating Temperature	-30°C to +60°C
Storage Temperature	-40°C to +85°C
Temperature Shock	Per MIL-STD
Humidity	Per MIL-STD
ESD	IEC 801-2 KV
Water and Dust Intrusion	IP54, MIL-STD

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 2975 (www.aeroflex.com), Motorola R2670, or equivalent	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
Digital RMS Multimeter*	100 µV to 300 V 5 Hz to 1 MHz 10 Meg 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 N5181A (www.agilent.com), Ramsey RSG1000B (www.ramseyelectronics.com), or equivalent	Receiver measurements
Oscilloscope*	2 Channel 50 MHz Bandwidth 5 mV/div to 20 V/div	Leader LS8050 (www.leaderusa.com), 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

Motorola Part Number	Description	Application
RLN4460_	Test Set	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.
PMKN4010_	Mobile & Repeater Rear Programming Cable	Connects the radio's rear connector to a USB port for radio programming and data applications.
PMKN4016_	Mobile & Repeater Rear Accessory Programming and Test Cable	Connects the radio's rear connector to a USB port for radio programming, data applications, testing and alignment.
PMKN4018_	Mobile & Repeater Rear Accessory Connector Universal Cable	Connects the radio's rear connector to accessory devices such as desk sets. Cable contains all 26 wires and is unterminated at the user end.
HKN6184_	Mobile Front Programming Cable	Connects the radio's front connector to a USB port for radio programming and data applications.
HLN8027_	Mini UHF to BNC Adaptor	Adapts radio antenna port to BNC cabling of test equipment.
HPN4007_	Power Supply	Provides the radio with power when bench testing.
8180384Y11	Housing Eliminator	Test Fixture used to bench test the radio PCB.
6686119B01	Removal Tool	Assists in the removal of radio control head.

2.3 Programming Cables

*Figure 2-1 Mobile Front Programming Cable HKN6184_*

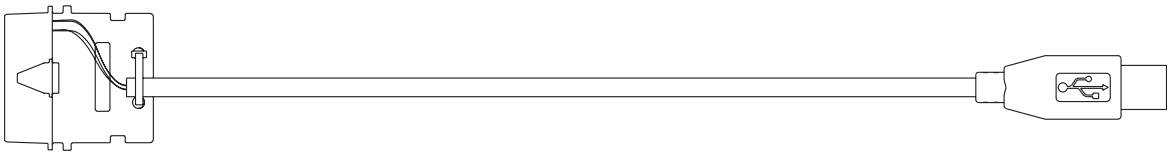
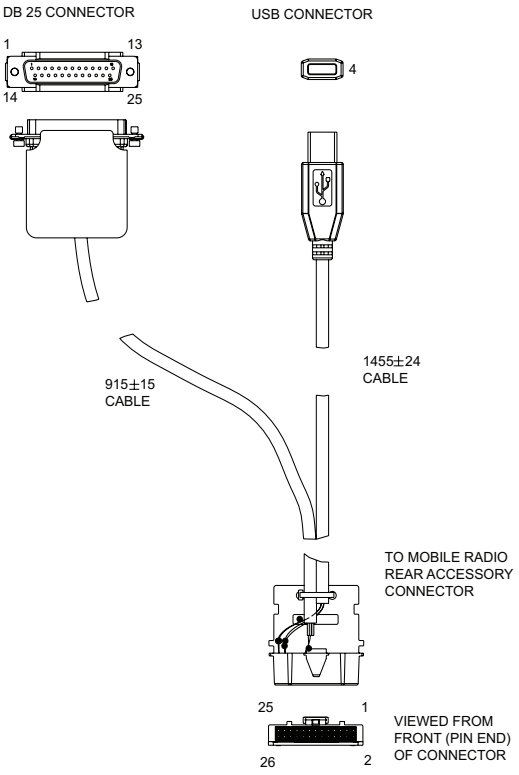


*Figure 2-2 Mobile & Repeater Rear Programming Cable PMKN4010_*



WIRE DIAGRAM			
REAR ACCESSORY CONNECTOR		USB	DB25P
PIN No.	DESCRIPTION		
3	VCC (5v)	1	
2	DATA -	2	
1	DATA +	3	
4	GND		
9	SPEAKER -		7
11	EXT MIC		17
17	DIGI IN 1 (EXT PTT)		20
16	GND		16
10	SPEAKER +		1

*Figure 2-3 Mobile & Repeater Rear Accessory Programming and Test Cable PMKN4016_*

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.

NOTE: Although these radios function in digital and analog modes, all testing is done in analog mode.

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 connected as 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 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 Left Navigation Button (◀) is pressed before the last information display, the radio shall suspend the information display until the user presses Right 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. Turning of the Channel Rocker changes the test channel from 1 to 14 as described in Table 3-5. The radio beeps in each position.

3.3.3 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 complete 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 any existing lines) until the display is filled.
5. When the screen is filled up with the vertical lines, any button press clears the screen and displays the first 10 available icons on the screen. Successive button press displays the remaining 4 icons.

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 earpiece.

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 Mode”.
2. The radio shall route any audio on the external mic to the earpiece.

3.3.10 Button/Knob/PTT Test Mode

1. Press and hold **button P1** after Audio Loopback Earpiece Test Mode. The radio beeps once and displays “Button Test” (line 1).
2. The radio also displays the button/knob/PTT button command opcode (BCO) and state (BCO/state) on the screen (line 2) upon any button state changes.

3.4 Numeric Display Model Test Mode

3.4.1 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.

3.4.2 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.

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. Turning of the Channel Rocker changes the test channel from 1 to 14 as described in Table 3-5. The radio beeps in each position.

3.4.3 Display Test Mode

1. Press and hold **button P1** in RF Test Mode. The radio beeps once and enters ‘**Display Test Mode**’.
2. Upon entering Display Test Mode, press any button to turn on the two character seven segment display.
3. Press any button to display the three icons on the screen.

3.4.4 LED Test Mode

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

3.4.5 Speaker Tone Test Mode

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

3.4.6 Earpiece Tone Test Mode

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

3.4.7 Audio Loopback Test Mode

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

3.4.8 Audio Loopback Earpiece Test Mode

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

3.4.9 Button/Knob/PTT Test Mode

1. Press and hold **button P1** after Audio Loopback Earpiece Test Mode. The radio beeps once.
2. Rotate the volume knob, the radio beeps at each position.
3. Press any button, the radio beeps.

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)	UHF2 (MHz)
TX	1	8	136.075	403.000	450.000
RX	1	8	136.075	403.000	450.000
TX	2	9	142.575	414.150	462.800
RX	2	9	142.575	414.150	462.800
TX	3	10	146.575	425.350	475.700
RX	3	10	146.575	425.350	475.700
TX	4	11	155.575	436.500	488.500
RX	4	11	155.575	436.500	488.500
TX	5	12	161.575	447.675	501.300
RX	5	12	161.575	447.675	501.300
TX	6	13	167.575	458.850	514.200
RX	6	13	167.575	458.850	514.200
TX	7	14	174.975	470.000	527.000
RX	7	14	174.975	470.000	527.000

Table 3-6 Transmitter Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comment
Reference Frequency	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: 1.0–1.3 W: (VHF 1–25 W, UHF1 1–25 W, UHF2 1–40 W) 25–29 W: (VHF 25–45 W, UHF1 25–40 W) High Power: 25–29 W: (VHF 1–25 W, UHF1 1–25 W UHF2 1–40 W Test Channels 13 & 14) 40–47 W: (UHF1 25–40 W, UHF2 1–40 W Test Channels 8-12) 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 1kHz 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.).

* See Table 3-5

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 7.75 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 µV
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 7.75 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 µV. Preferred SINAD = 9–10 dB

* See Table 3-5

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 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.

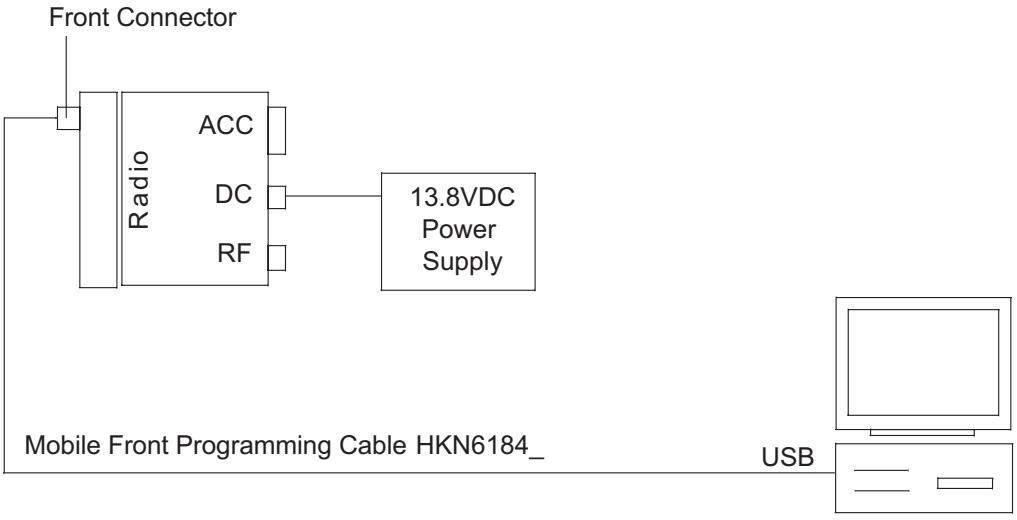


Figure 4-1 Customer Programming Software Setup from Front Connector

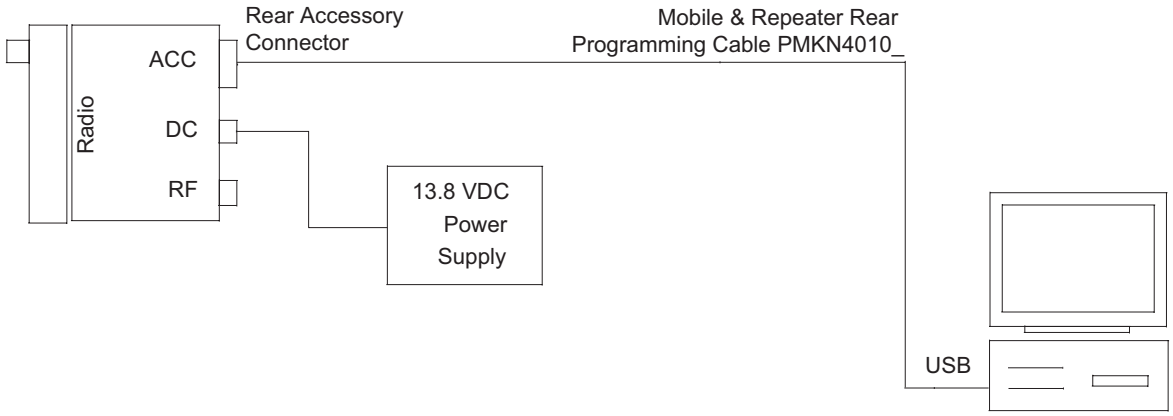


Figure 4-2 Customer Programming Software Setup from Rear Accessory Connector

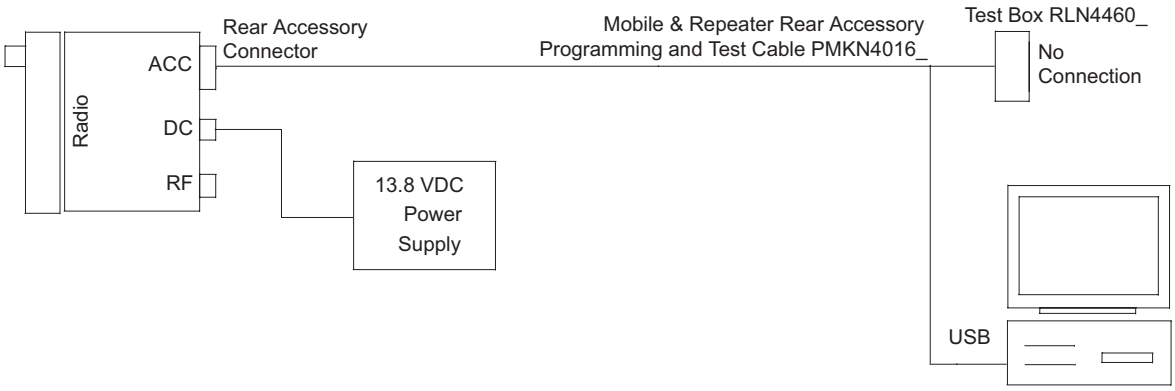


Figure 4-3 Customer Programming Software Setup with Test Box Connection

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 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.

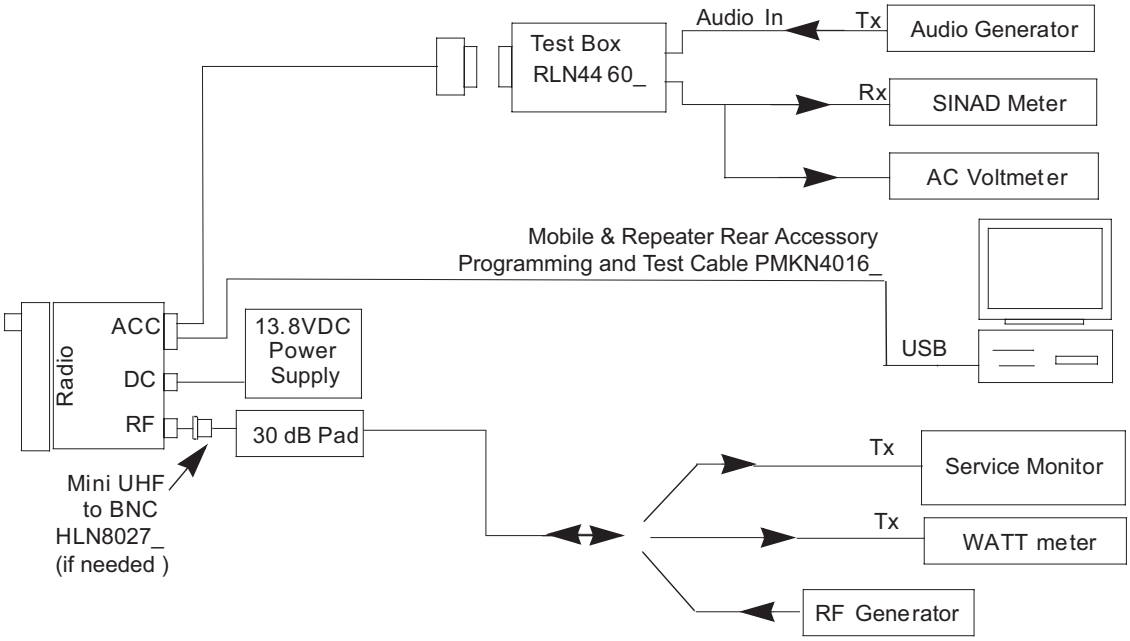


Figure 4-4 Radio Tuning Equipment Setup

Notes

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.
- Disassembly and reassembly of the radio.
- Repair procedures and techniques.

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

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) 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 circuits and are especially important in low humidity conditions.

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

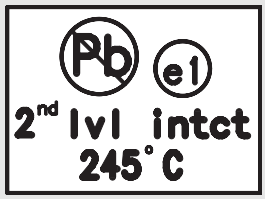
Caution

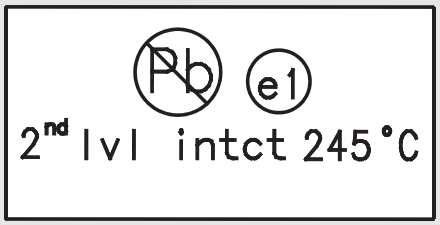
This radio contains static-sensitive devices. Do not open the radio unless you are properly grounded. Take the following precautions when working on this unit:

- Store and transport all CMOS devices in conductive material so that all exposed leads are shorted together. Do not insert CMOS 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 device. We recommend using a wrist strap, two ground cords, a table mat, and a floor mat.
- 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 devices.
- Do not insert or remove CMOS devices with power applied. Check all power supplies used for testing CMOS devices to be certain that there are no voltage transients present.
- When straightening CMOS pins, provide ground straps for the apparatus used.
- When soldering, use a grounded soldering iron.
- If at all possible, handle CMOS 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) Directive 2002/95/EC** and **Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC**. 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%	217C	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

When damaged parts are replaced, identical parts should be used. If the identical replacement part is not locally available, 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 seven 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 the radio:

- Small Flat Blade Screwdriver
- Dismantling Tool (Motorola Part No. 6686119B01)
- Torque Driver (5-30 lbs-in or 0.6-3.5 N-m), (Motorola Part No. RSX4043A)
- TORX™ T20 Driver Bit
- TORX™ T10 Driver Bit
- TORX™ T6 Driver Bit (for use with Option Board only)
- 5/16” Socket Driver (GPS Models Only)

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.

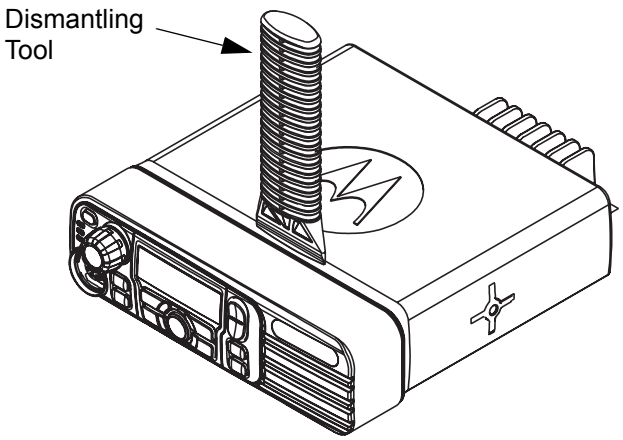


Figure 5-1 Typical Control Head Removal

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

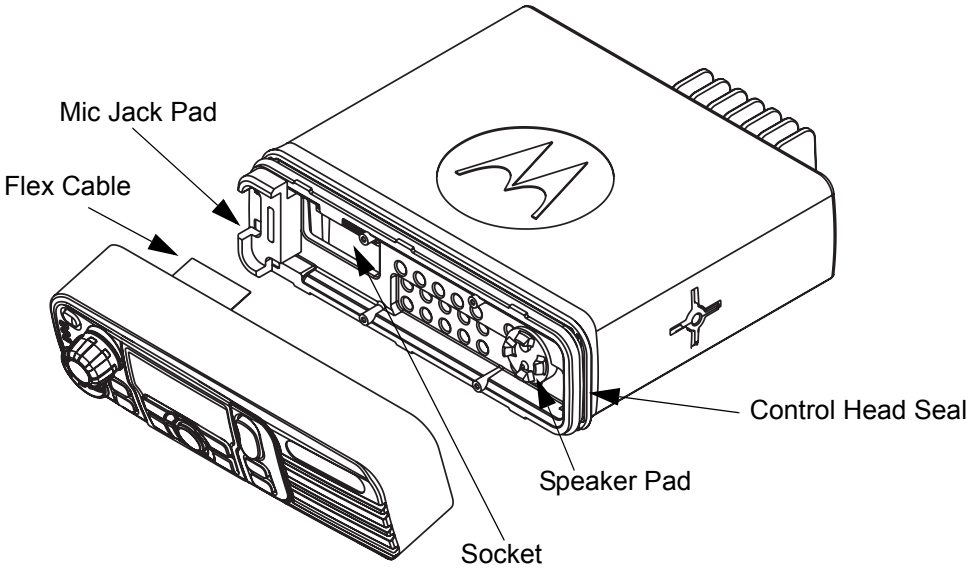


Figure 5-2 Flexible Connection Removal

4. Remove the flex cable from the socket on the radio assembly as shown in Figure 5-2.
5. Then remove control head seal, mic jack pad and speaker pad.

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 the side wall of the top cover clears the chassis trunnion mounting features.
3. Lift the top cover from the chassis.

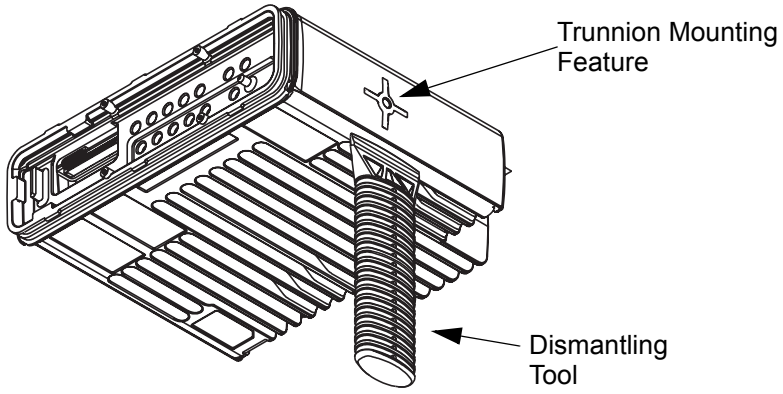


Figure 5-3 Top Cover Removal

NOTE: See Section 5.6.7 for Option Board Removal procedure (Option Board Module Only).

5.6.3 Transceiver Board Removal

1. Remove the seven screws from the die cast cover using the T20 TORX™ driver as shown in Figure 5-4.

NOTE: Do not remove the O-rings from the screws.

2. Lift the die cast cover from the chassis.

NOTE: For VHF models only: check that the two thermal pads on the heat sink block are intact. Replace them if damaged. Refer to Figure 5-53.

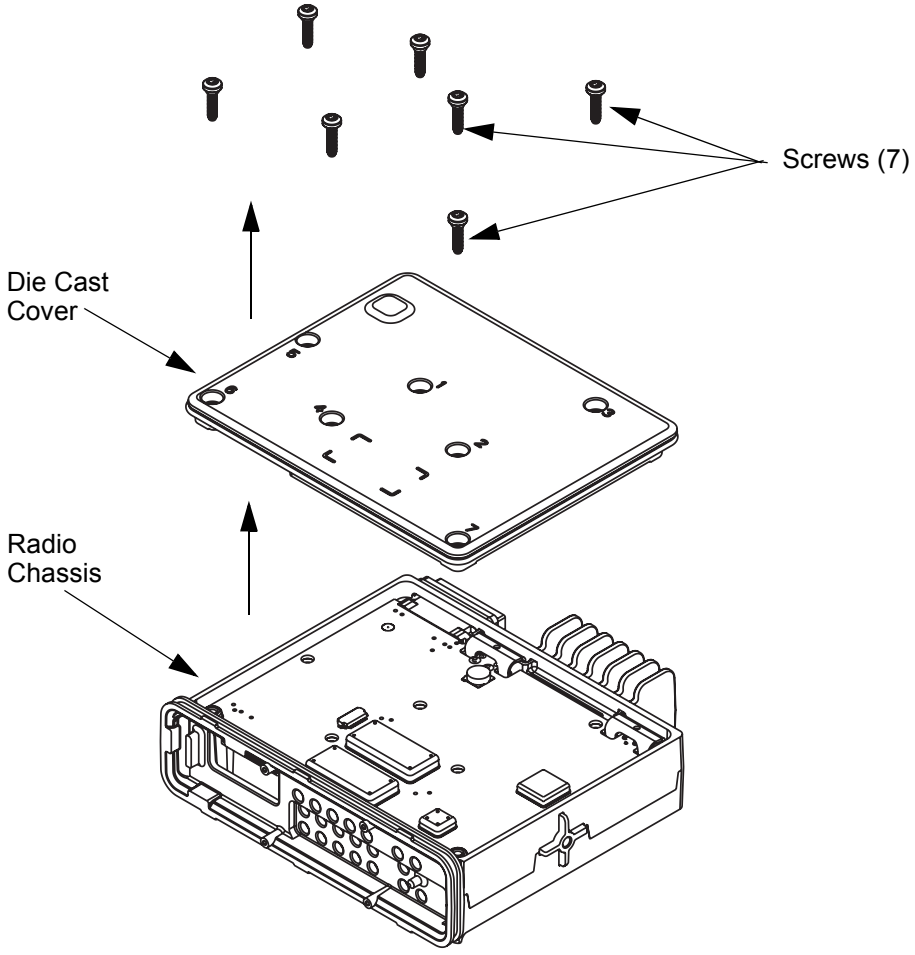


Figure 5-4 Die Cast Cover Removal

3. Remove the rear accessory connector from the radio assembly by inserting a flat-blade screwdriver into the slot on the side of the connector as shown in Figure 5-5.

> **Caution** The rear accessory connector should never be removed when the cover is still assembled to the radio.

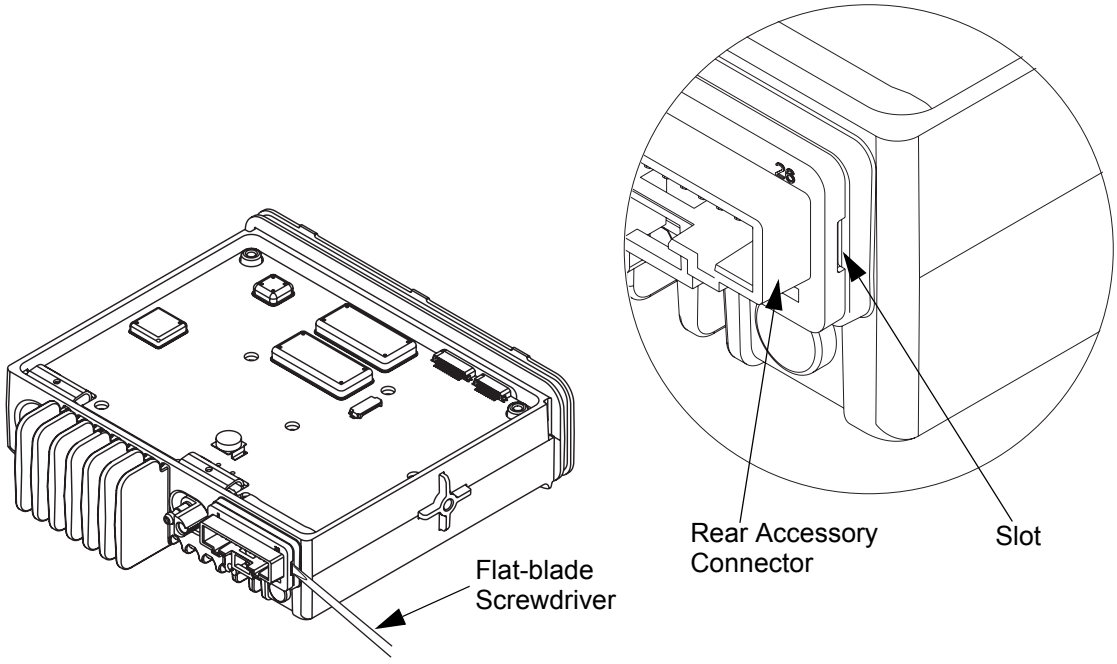


Figure 5-5 Rear Accessory Connector Removal

4. Remove the RF/DC retention clips by gently prying them out with a flat-blade screwdriver as shown in Figure 5-6.

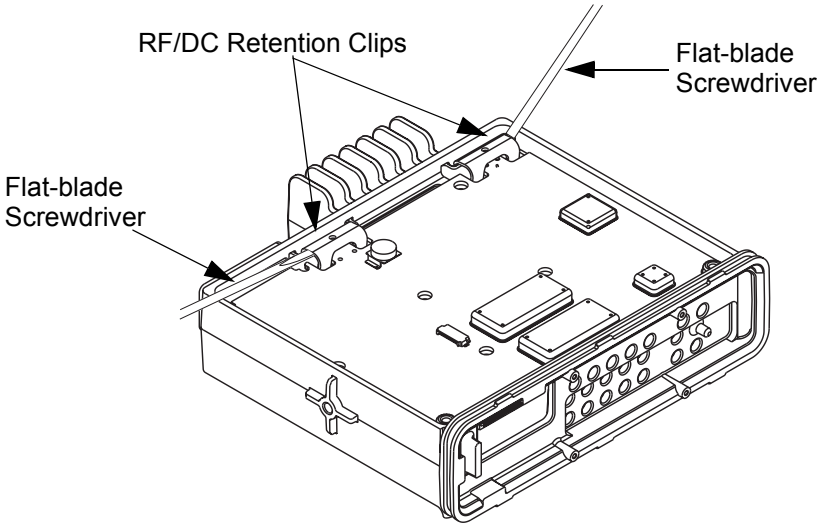


Figure 5-6 RF/DC Retention Clips Removal

5. For GPS models, disconnect the GPS cable from the radio as shown in Figure 5-7.

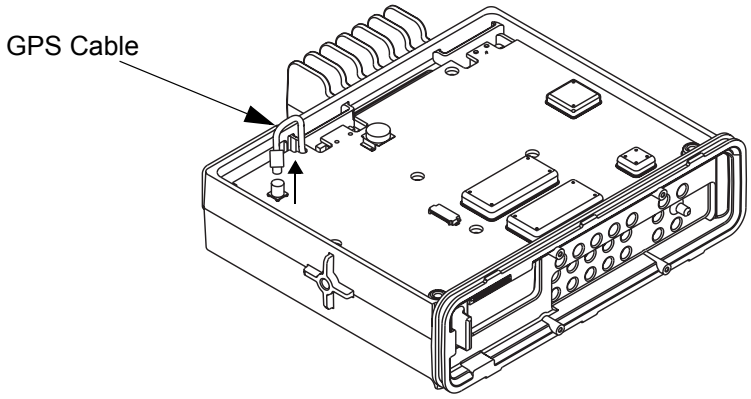


Figure 5-7 GPS Cable Removal

6. Remove the transceiver board by sliding a finger into the opening provided at the front of the radio and gently pressing up on the 30-pin connector, lifting up the front of the transceiver board, as shown in Figure 5-8. Then, slide the transceiver board towards the front of the radio to allow the RF/DC connectors to clear the chassis. Handle the transceiver board by the edges only and store it in an antistatic bag.

NOTE: If the RF/DC connector gaskets remain in the chassis, remove them and place them back on the connectors.

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.

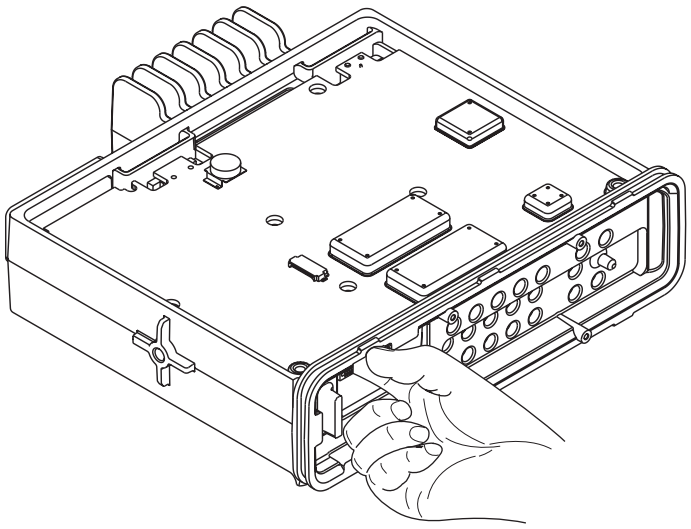


Figure 5-8 Transceiver Board Removal

5.6.4 GPS Antenna Connector Removal (For GPS models only)

1. Using a 5/16” socket driver, remove the nut from the GPS antenna connector and remove the lock nut washer from the connector.
2. Push the connector into the chassis and pull upwards on the cable to remove the connector from the chassis.

5.6.5 Disassembly of Display Model Control Head

1. Disconnect the speaker plug from the control head board.
2. Unplug the LCD display flex from the control head board by gently lifting upwards on the door of the connector.

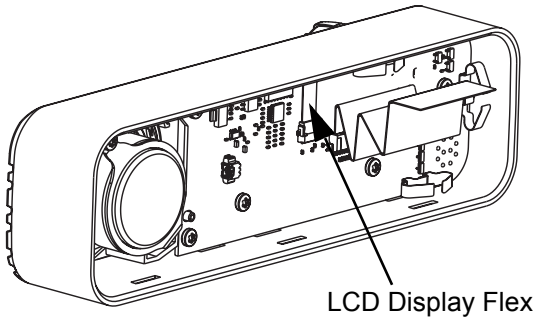


Figure 5-9 LCD Display Flex Removal

3. Remove the left and right arrow keys from the front of the control head assembly by using your fingers.

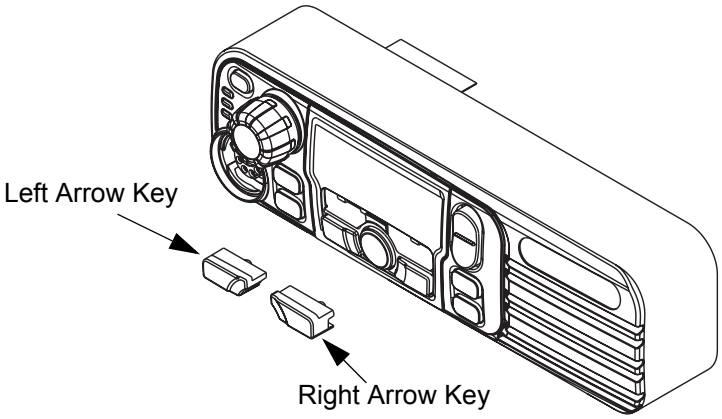


Figure 5-10 Left and Right Arrow Key Removal

4. Remove the five screws from the control head board using the T10 TORX™ driver.

NOTE: Do not touch or contaminate the conductive contacts on the control head board.

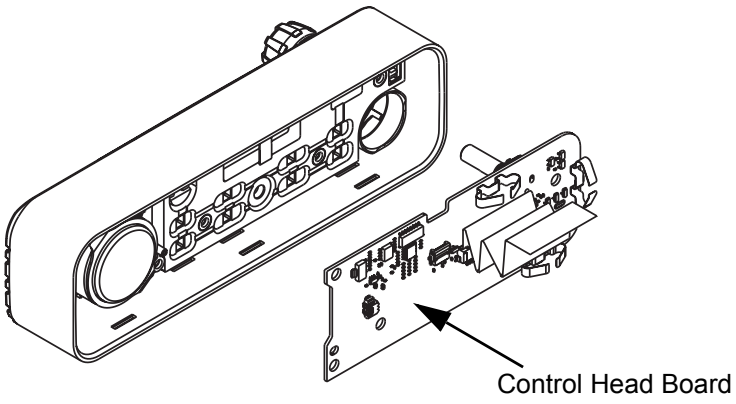


Figure 5-11 Control Head Board Removal

5. Remove the keypad from the control head housing by lifting up on the rubber keypad.

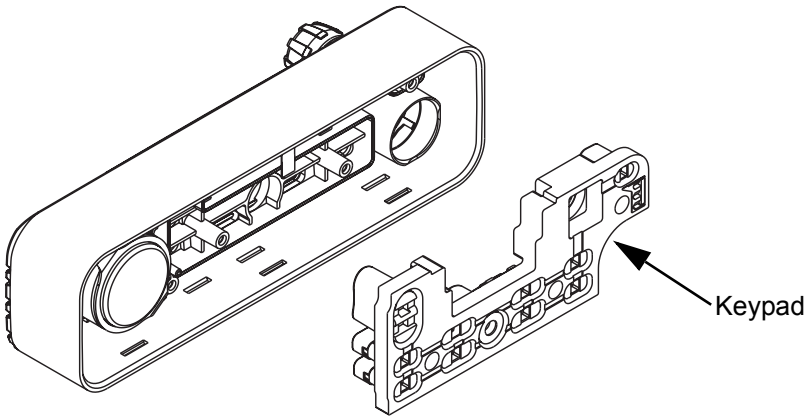


Figure 5-12 Keypad Removal

NOTE: Care should be taken not to touch or contaminate the conductive pads on the keypad.

6. Remove the LCD display from the control head housing.
7. Remove the speaker retainer from the control head housing using the T10 TORX™ driver to remove the screw and unhook the retainer from the control head housing.
8. Remove the speaker from the control head housing.

9. Remove the volume knob from the control head housing by pulling it until the snaps are released.

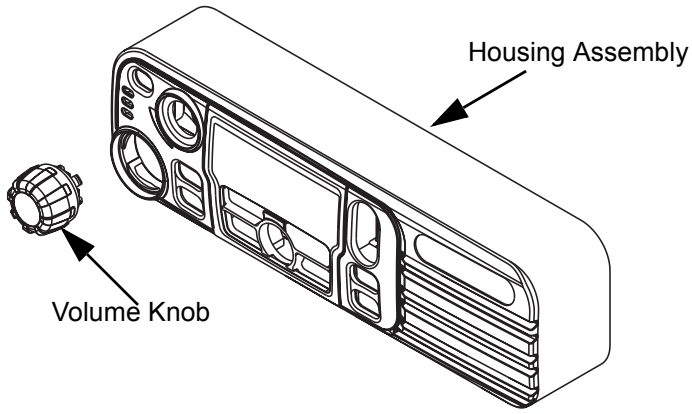


Figure 5-13 Volume Knob Removal

5.6.6 Disassembly of Numeric Display Model Control Head

1. Disconnect the speaker plug from the control head board.
2. Remove the five screws from the control head board using the T10 TORX™ driver.
3. Remove the control head board from the control head assembly by pressing on the keypad buttons and mic jack. Handle the control head board by the edges only and store it in an antistatic bag.

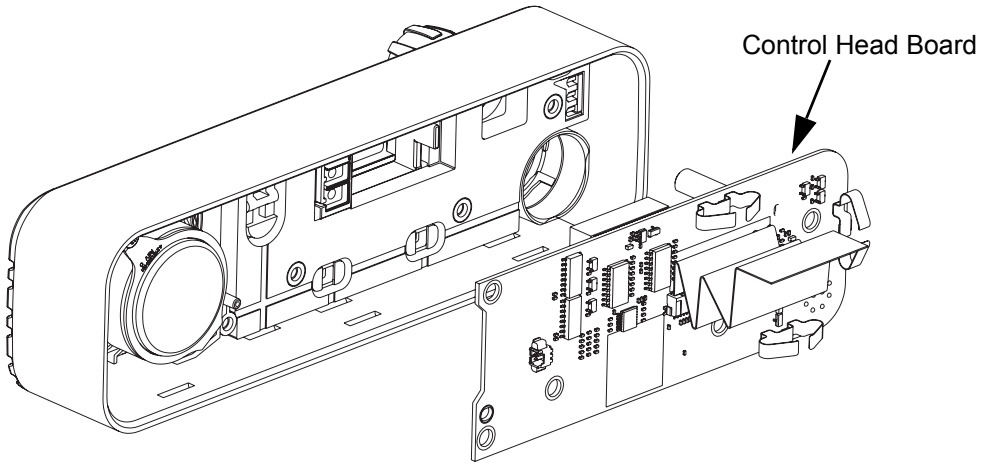


Figure 5-14 Control Head Board Removal

NOTE: Do not touch or contaminate the conductive contacts on the control head board.

4. Remove the icon light guide from the icon light guide holder.

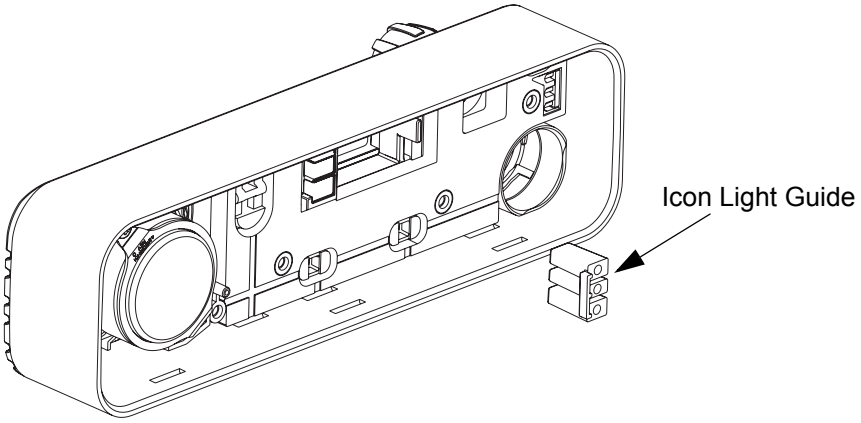


Figure 5-15 Icon Light Guide Removal

5. Remove the keypad from the control head housing by lifting up on the rubber keypad.

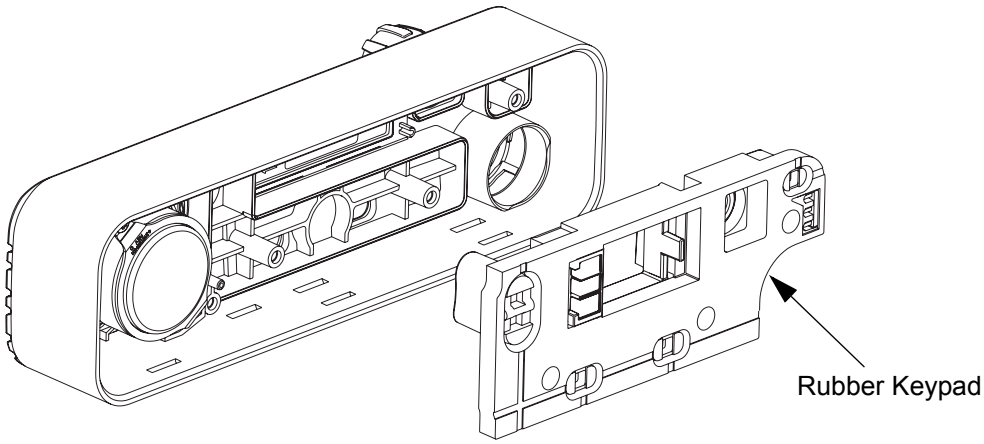


Figure 5-16 Keypad Removal

NOTE: Care should be taken not to touch or contaminate the conductive pads on the keypad.

6. Remove the icon light guide holder from the keypad.

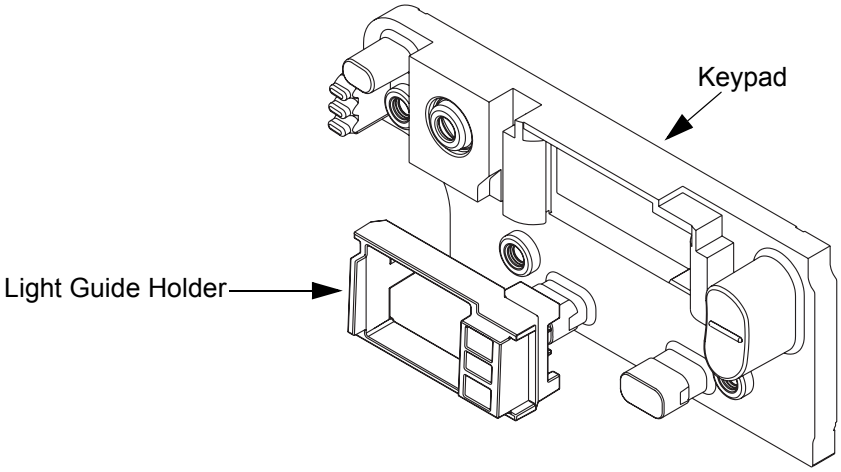


Figure 5-17 Icon Light Guide Holder Removal

7. Remove the speaker retainer from the control head housing using the T10 TORX™ driver to remove the screw and unhook the retainer from the control head housing.
8. Remove the speaker from the control head housing.
9. Remove the volume knob from the control head housing by pulling it until the snaps are released.

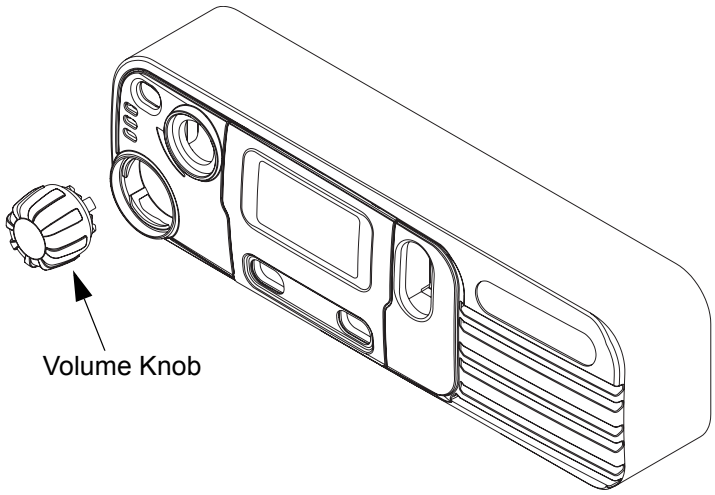


Figure 5-18 Speaker and Volume Knob Removal

5.6.7 Option Board Module Removal

1. Remove option flex from the radio assembly and option board as shown in Figure 5-19.

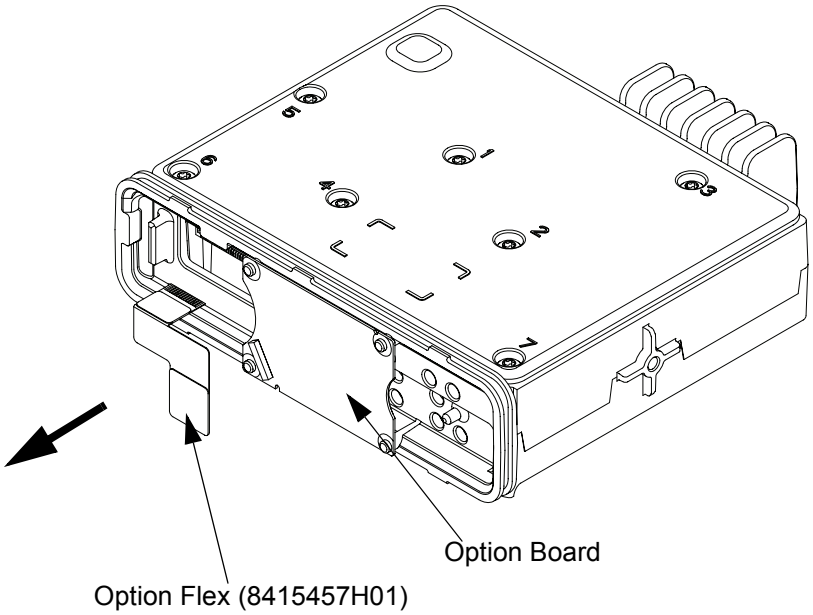


Figure 5-19 Removing Option Flex from Option Board

2. Remove the four screws and the option board from the radio assembly using the T6 TORX™ driver as shown in Figure 5-20.

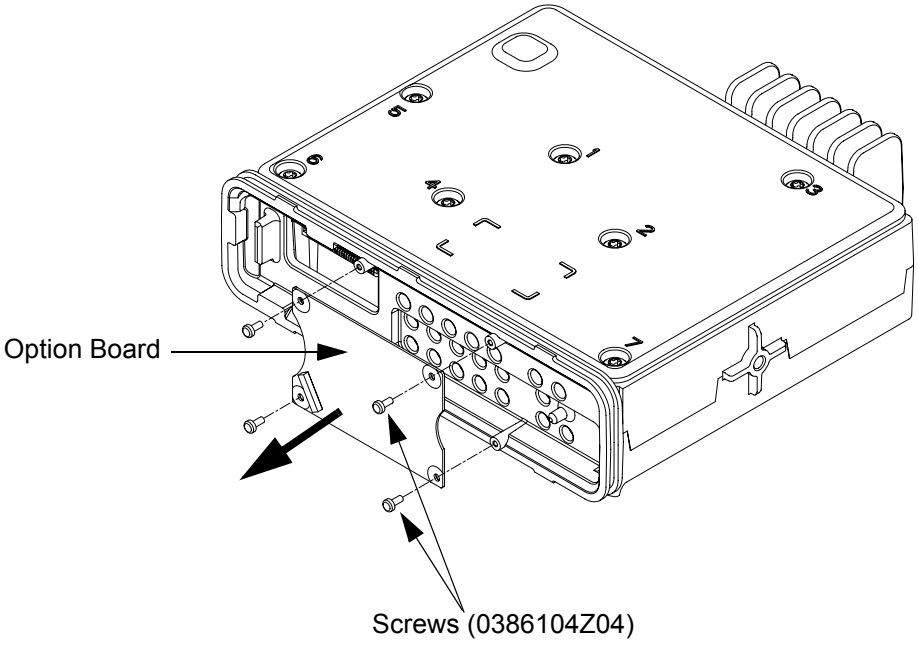


Figure 5-20 Removing Option Board from Radio Assembly

5.7 Radio Reassembly — Detailed

5.7.1 Display Model Control Head

1. Place the LCD display inside the control head housing, making sure to align the D-shaped feature on the LCD display with the pin feature on the housing. Refer to Figure 5-21.

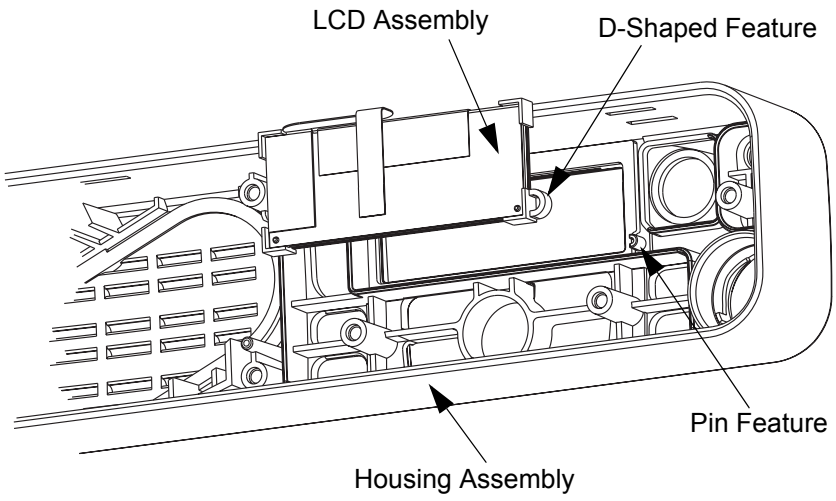


Figure 5-21 LCD Display Placement

2. Assemble the keypad to the control head housing:
   a. If attached, remove the right and left arrow buttons by pulling them off the keypad. Set these aside to be assembled later.
   b. Assemble the keypad in the control head housing making sure to align the keys with the openings in the control head housing. Refer to Figure 5-22.

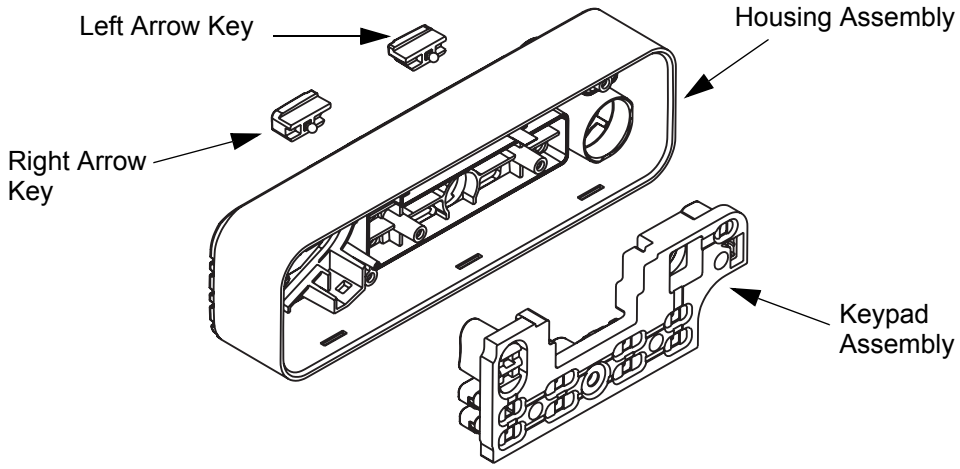


Figure 5-22 Keypad Assembly

NOTE: Care should be taken not to touch or contaminate the conductive pads on the keypad.

3. Assemble the light guide and light guide holder into the keypad slot as shown in Figure 5-23.

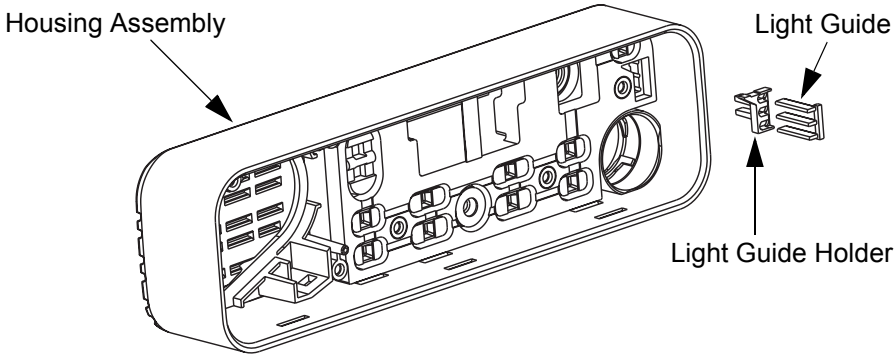


Figure 5-23 Light Guide Assembly

4. Assemble PCB to the control head assembly.
   a. Assemble the mic jack seal around the mic jack as shown in Figure 5-24.

NOTE: Make sure the mic jack is free from dust or debris.

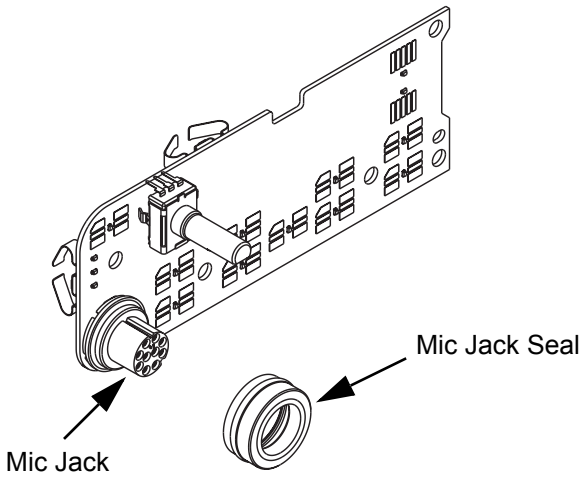


Figure 5-24 Assembling Mic Jack Seal

   b. Assemble the board to the control head assembly using the mic jack as the primary point of alignment. Make sure the LCD display flex is extended through the slot on the board. Verify the board is seated properly, as the guide pin on the housing should extend through the board. Refer to Figure 5-25.

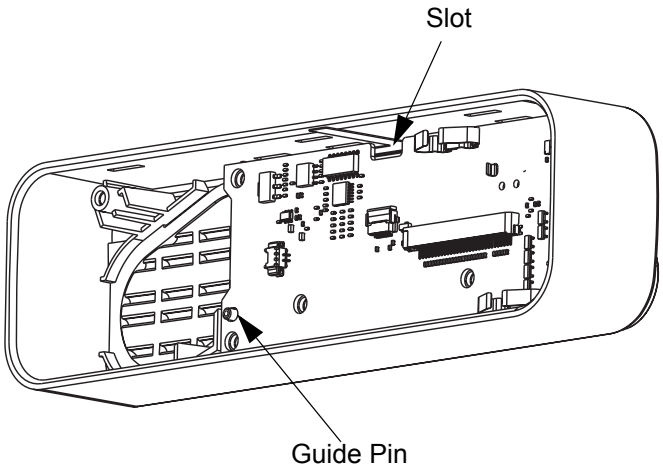


Figure 5-25 Assembling Board to Control Head Assembly

c. Using a T10 TORX™ driver, tighten the five screws to 0.882 N-m (7.8 lbs-in) following the sequence as shown in Figure 5-26.

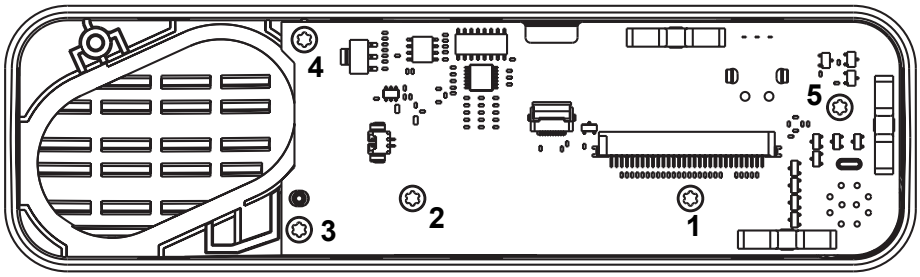


Figure 5-26 Screw Sequence

5. Assemble the speaker into the control head assembly.
   a. Place the speaker in the control head assembly as shown in Figure 5-27.

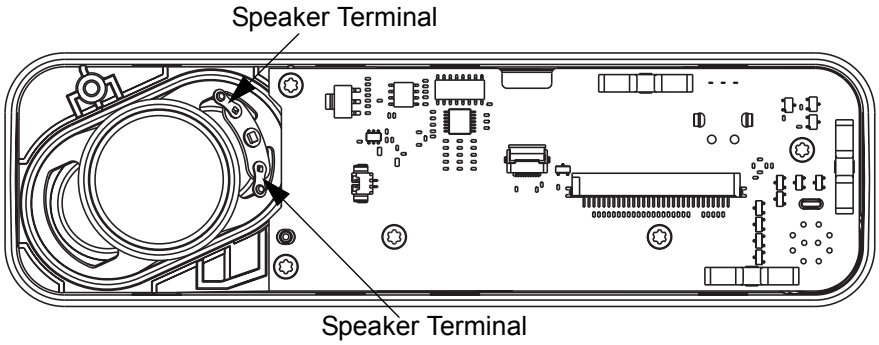


Figure 5-27 Speaker Assembly

   b. Hook one side of the speaker retainer into the control head assembly as shown in Figure 5-28.

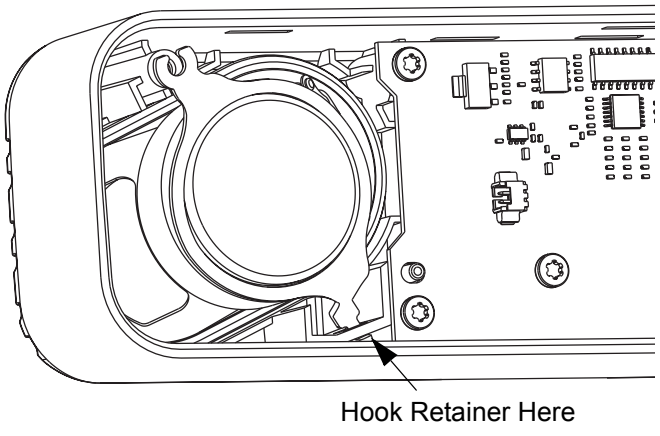


Figure 5-28 Speaker Retainer Assembly

   c. Place a screw into the other end of the speaker retainer and using a T10 TORX™ driver, tighten the screw to 0.882 N-m (7.8 lbs-in).

   d. Connect the speaker plug to its mating connector on the control head board.

6. Insert the LCD display flex to the connector on the control head board and gently close the door.
7. Assemble the left and right arrow keys into the openings in the control head housing and press into place as shown in Figure 5-29.

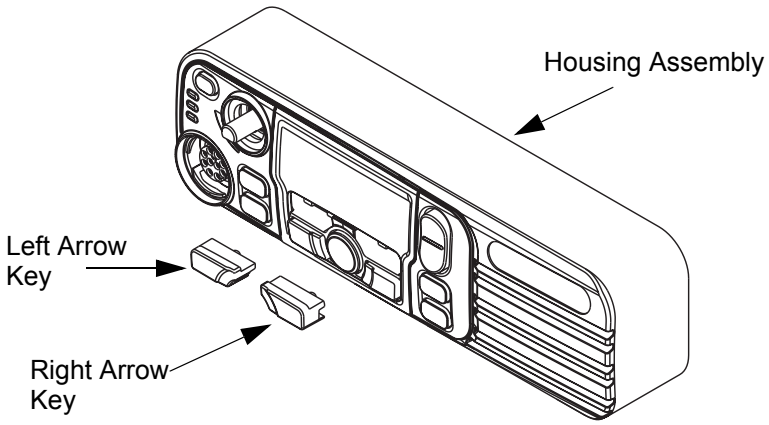


Figure 5-29 Left and Right Arrow Key Assembly

8. Assemble the flex cable to the mating connector on the control head board, making sure it is fully seated as shown in Figure 5-30.

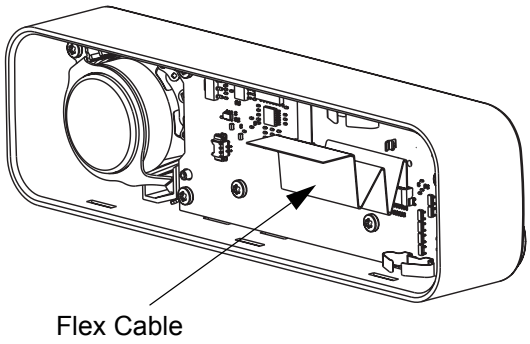


Figure 5-30 Flex Cable Assembly

9. Orient the volume knob so that the internal D-shaped opening matches the volume encoder shaft and press the volume knob into the control head assembly until the snap features are engaged and the knob rotates freely. Refer to Figure 5-31.

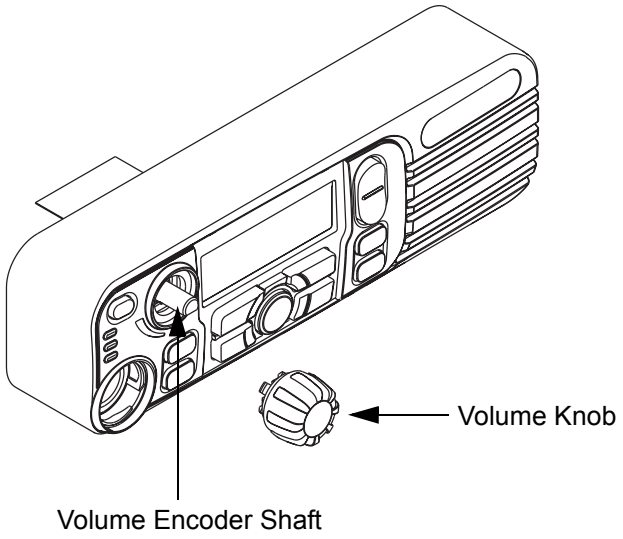


Figure 5-31 Volume Knob Assembly

5.7.2 Numeric Display Model Control Head

1. Place the icon light guide holder into the keypad. Refer to Figure 5-32.

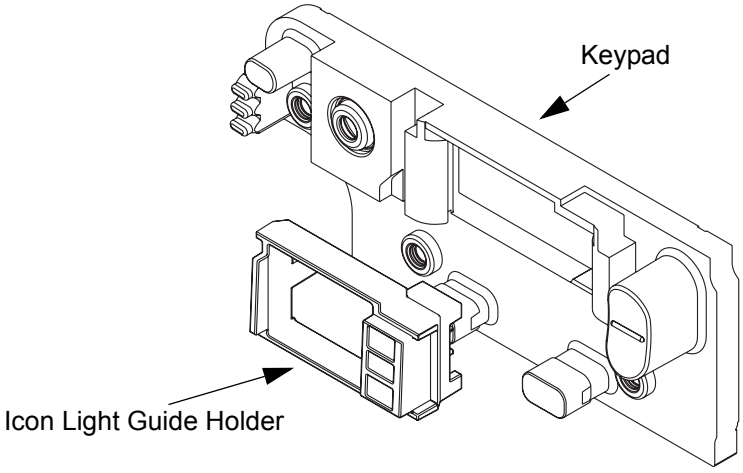


Figure 5-32 Icon Light Guide Holder Assembly

2. Assemble the keypad in the control head housing making sure to align the keys with the openings in the control head housing. Refer to Figure 5-33.

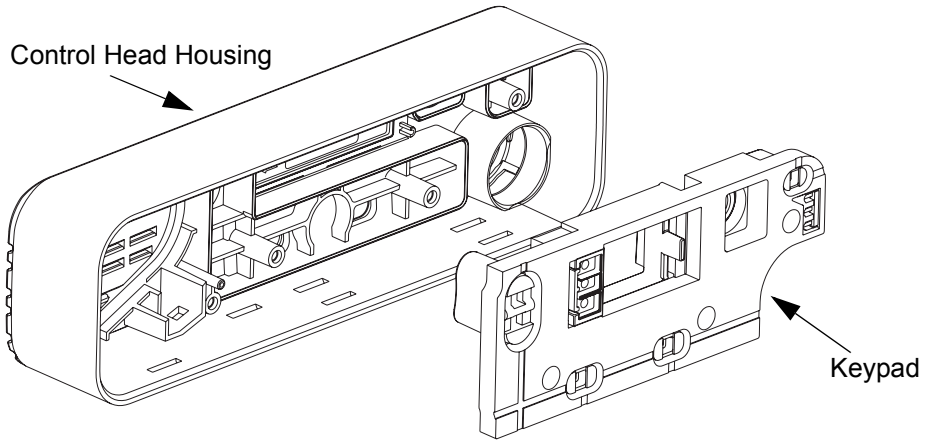


Figure 5-33 Keypad Assembly

NOTE: Care should be taken not to touch or contaminate the conductive pads on the keypad.

3. Assemble the icon light guide into the icon light guide holder as shown in Figure 5-34.

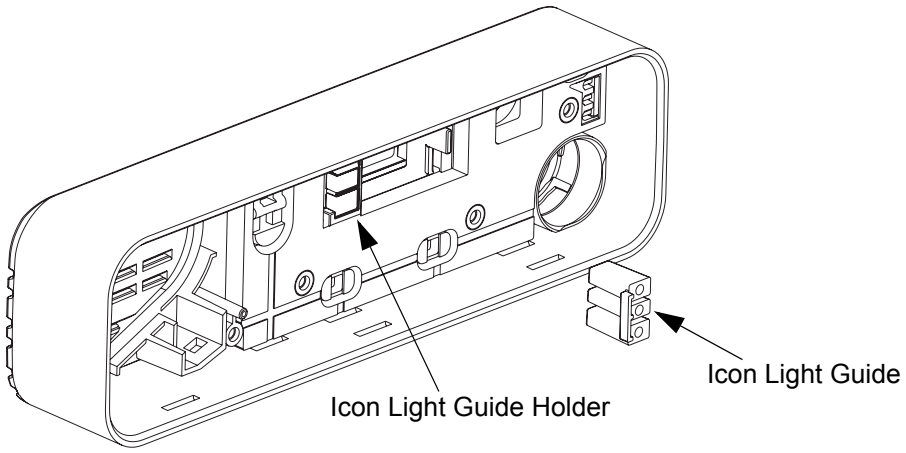


Figure 5-34 Icon Light Guide Assembly

4. Assemble the light guide and light guide holder into the keypad slot as shown in Figure 5-35.

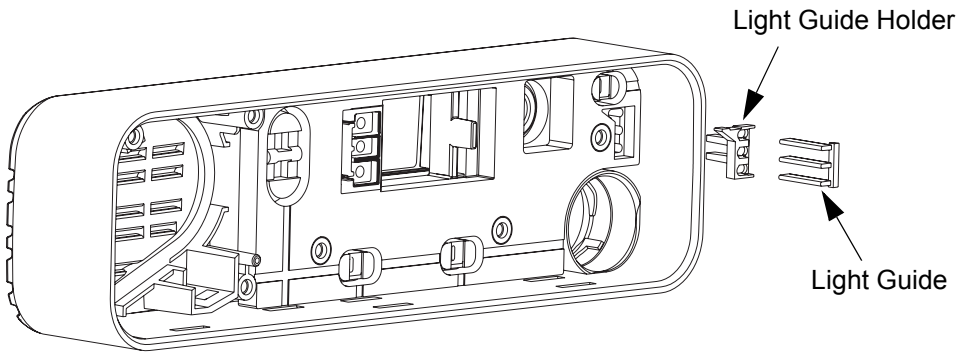


Figure 5-35 Light Guide and Light Guide Holder Assembly

5. Assemble PCB to the control head assembly.
   a. Assemble the mic jack seal around the mic jack as shown in Figure 5-36.

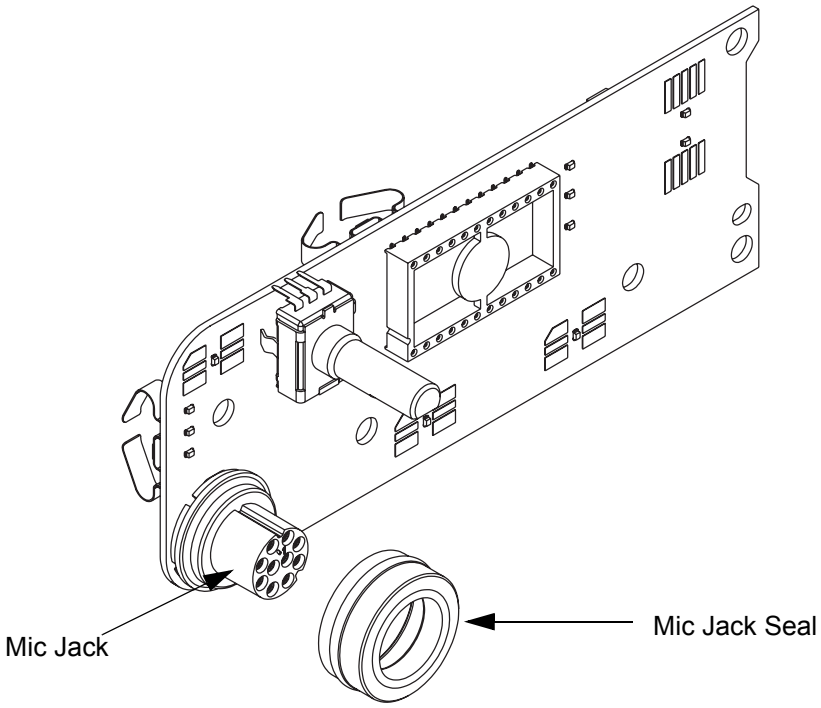


Figure 5-36 Mic Jack Seal Assembly

NOTE: Make sure the mic jack seal is free from dust or debris.

b. Assemble the LED display spacer and LED display to the control head PCB as shown in Figure 5-37.

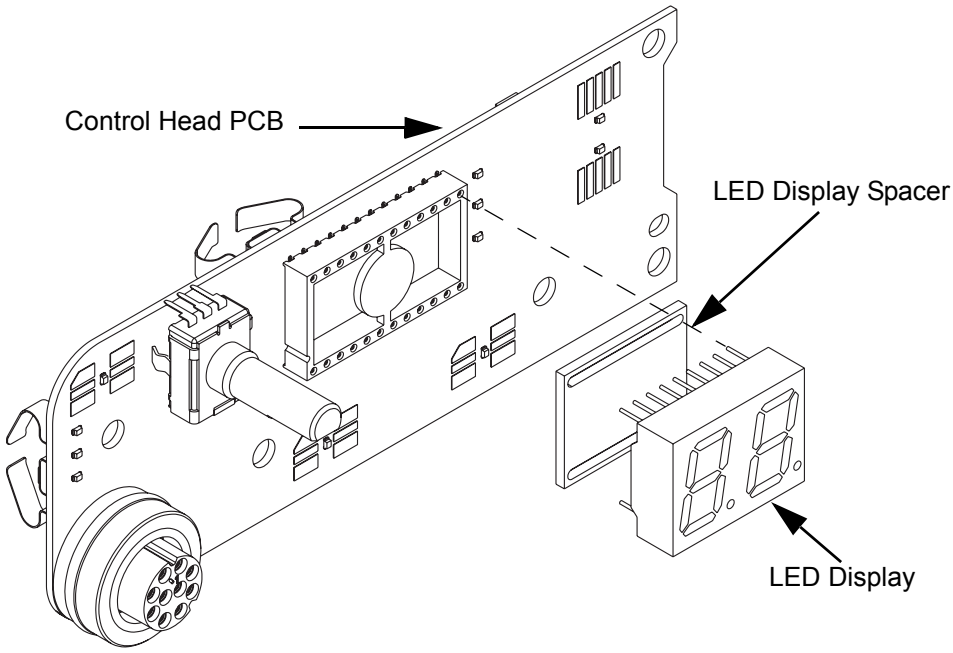


Figure 5-37 LED Display Assembly

c. Assemble the board to the control head assembly using the mic jack as the primary point of alignment. Verify the board is seated properly, as the guide pin on the housing should extend through the board. Refer to Figure 5-38.

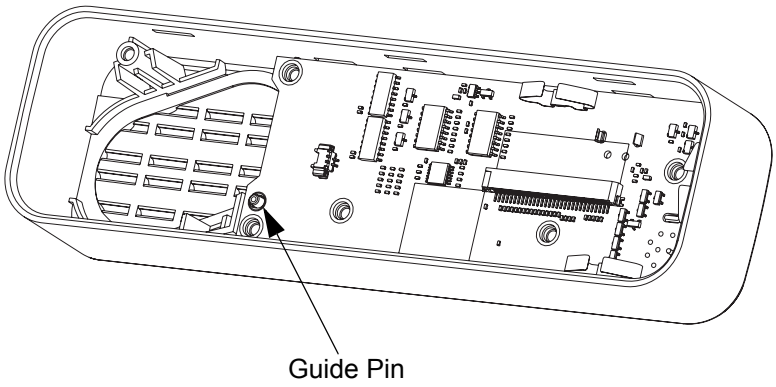


Figure 5-38 Printed Circuit Board Assembly

d. Using a T10 TORX™ driver, tighten the five screws to 0.882 N-m (7.8 lbs-in) following the sequence as shown in Figure 5-39.

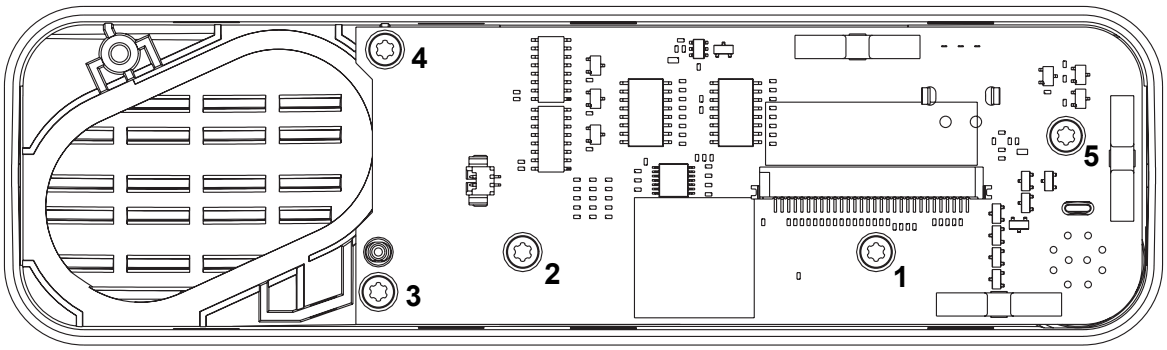


Figure 5-39 Screw Sequence

6. Assemble the speaker into the control head assembly.
   a. Place the speaker in the control head assembly as shown in Figure 5-40.

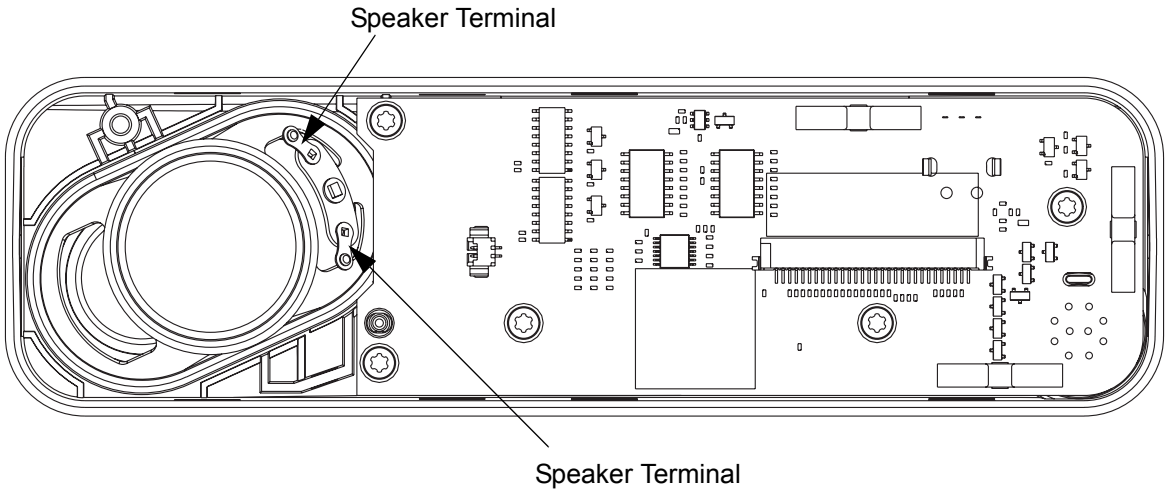


Figure 5-40 Speaker Assembly

b. Hook one side of the speaker retainer into the control head assembly as shown in Figure 5-41.

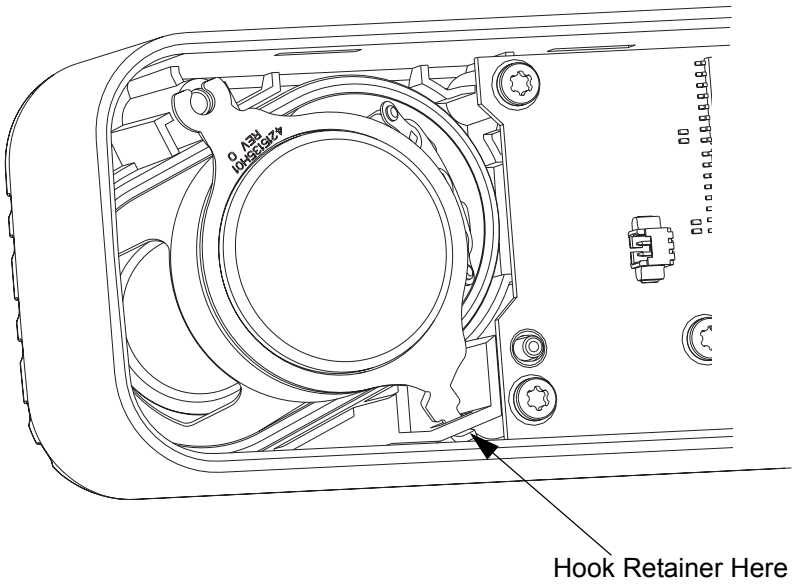


Figure 5-41 Speaker Retainer Assembly

c. Place a screw into the other end of the speaker retainer and using a T10 TORX™ driver, tighten the screw to 0.882 N-m (7.8 lbs-in).

d. Connect the speaker plug to its mating connector on the control head board.

7. Assemble the flex cable to the mating connector on the control head board, making sure it is fully seated as shown in Figure 5-42.

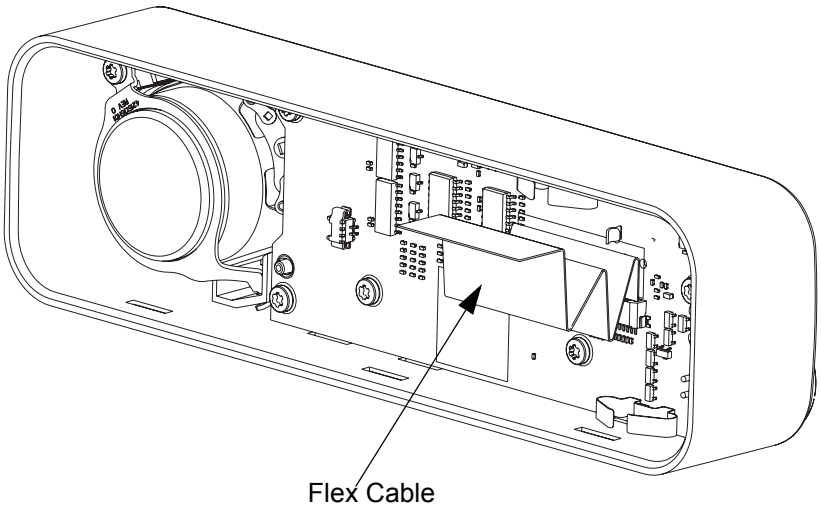


Figure 5-42 Flex Cable Assembly

8. Orientate the volume knob so that the internal D-shaped opening matches the volume encoder shaft and press the volume knob into the control head assembly until the snap features are engaged and the knob rotates freely. Refer to Figure 5-43.

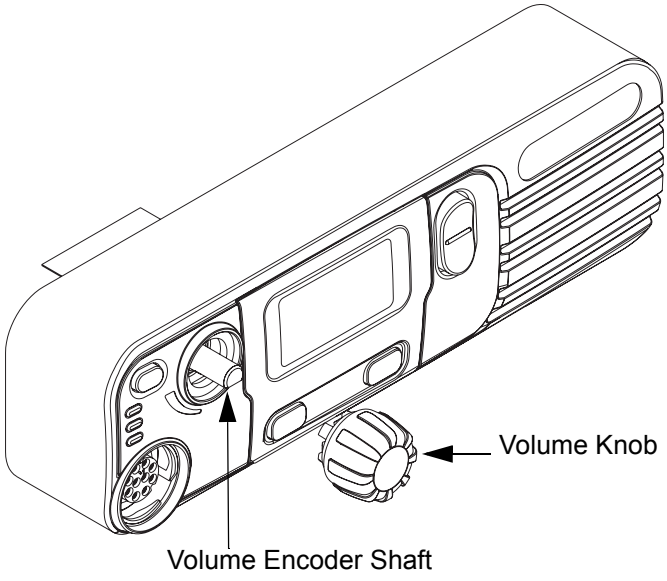


Figure 5-43 Volume Knob Assembly

5.7.3 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. Reseat all new seals on their respective parts.

   For both the die cast cover 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 5.7.6: Thermal Pad Replacement Procedure on page 5-36 to replace damaged pads.

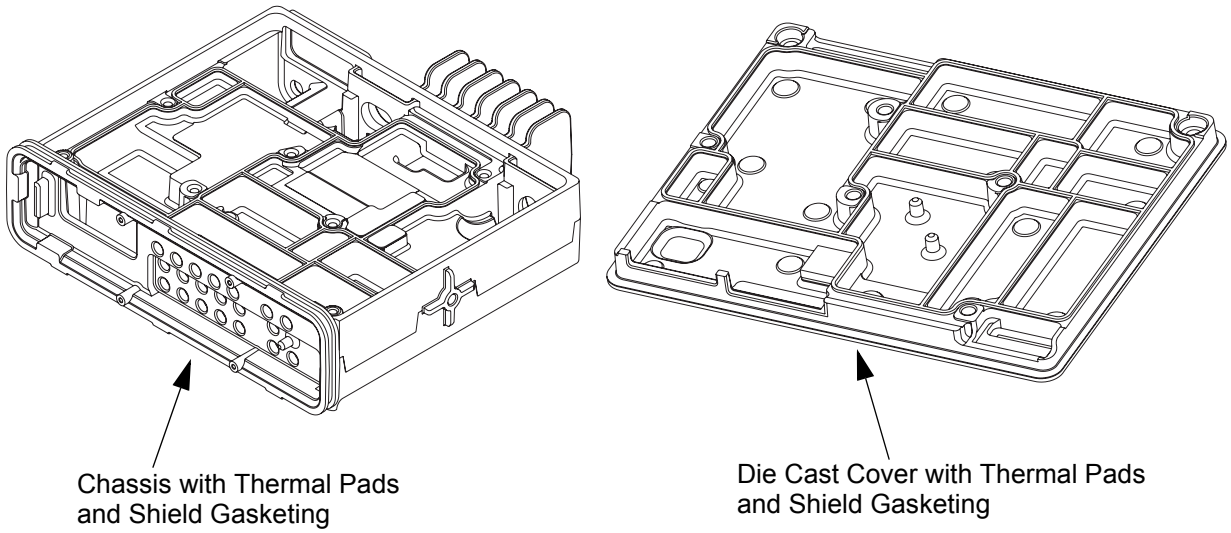


Figure 5-44 Thermal Pads and Shield Gasketing on Chassis and Die Cast Cover

2. Thoroughly inspect the transceiver board and verify all thermal pads are in place and free from damage. See Section 5.7.6: Thermal Pad Replacement Procedure on page 5-36 to replace damaged pads.

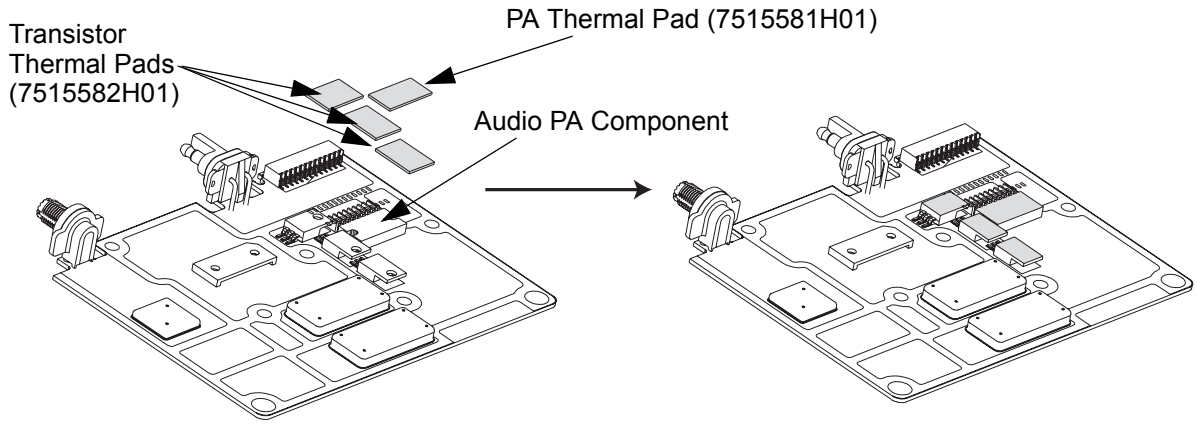


Figure 5-45 Transceiver Board with Thermal Pad

5.7.4 GPS Plug or GPS Antenna Connector Reassembly

1. Assembly of the GPS Plug
   Push the GPS plug into the chassis opening until it is fully seated. Refer to Figure 5-46.

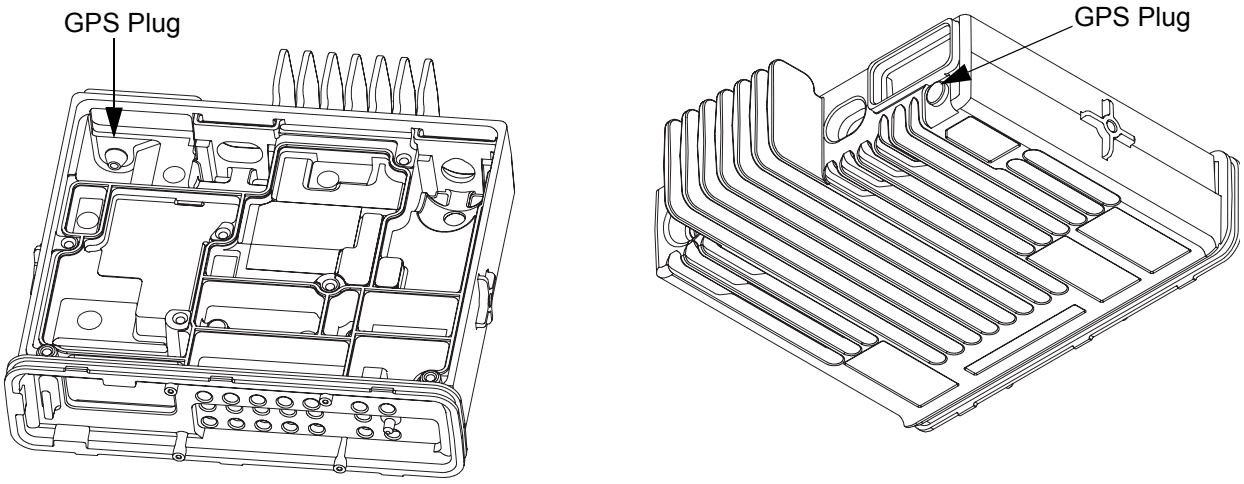


Figure 5-46 GPS Plug Assembly

2. Assembly of the GPS Antenna Connector (for GPS models only)

a. Add a gradual 90 degree bend in the cable of the GPS antenna connector. The bend should be in the same direction as the flat section of the threaded connector and should be after the heat shrink tubing. Refer to Figure 5-47.

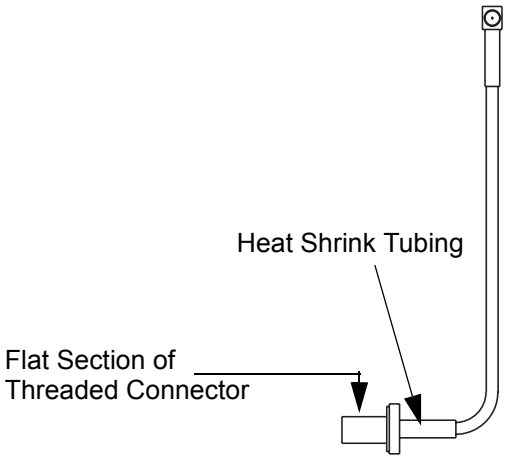


Figure 5-47 Bend in the GPS Antenna Connector

b. Orient the GPS antenna connector as shown in Figure 5-48 and push the connector through the opening in the chassis.

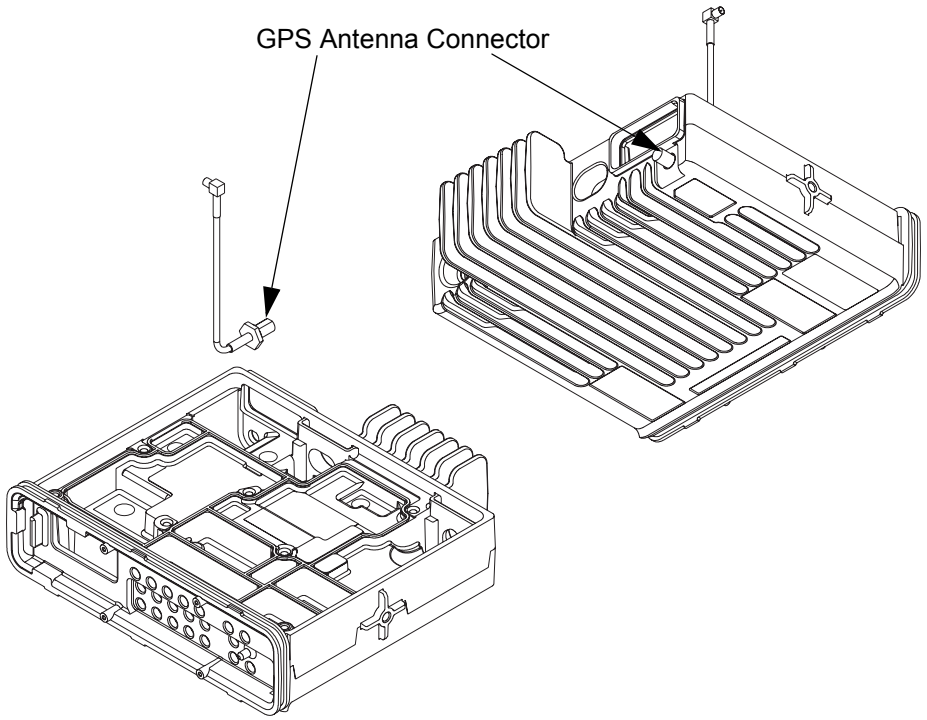


Figure 5-48 GPS Antenna Connector Assembly

c. Assemble the lock nut washer and the nut to the GPS antenna connector. Using a 5/16” socket driver, tighten the nut to 1.7 N-m (15 lbs-in).

5.7.5 Transceiver Board Reassembly

1. Insert the transceiver board into the chassis by tilting the transceiver board (approximately 30 degrees) and sliding it into place, taking care to line up the RF and DC connectors with the openings in the back of the chassis.

   Ensure that the transceiver board alignment holes are positioned over the chassis alignment bosses and then push the board down to fully seat.

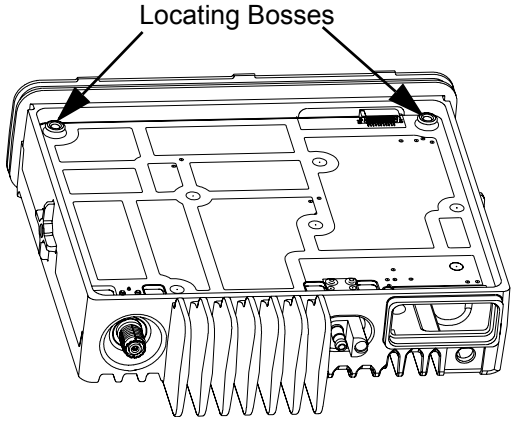


Figure 5-49 Placing the Transceiver Board in the Chassis

Caution

Do not leave the transceiver board in the chassis for extended periods of time without the RF/DC retention clips, or damage to the board connectors may occur.

NOTE: For GPS models, prior to the assembly of the transceiver board, position the cable of the GPS antenna connector with the notch in the transceiver board, so that the cable will extend through the transceiver board after the transceiver board is assembled. Then plug the GPS antenna connector cable to the mating connector on the transceiver board. Refer to Figure 5-50.

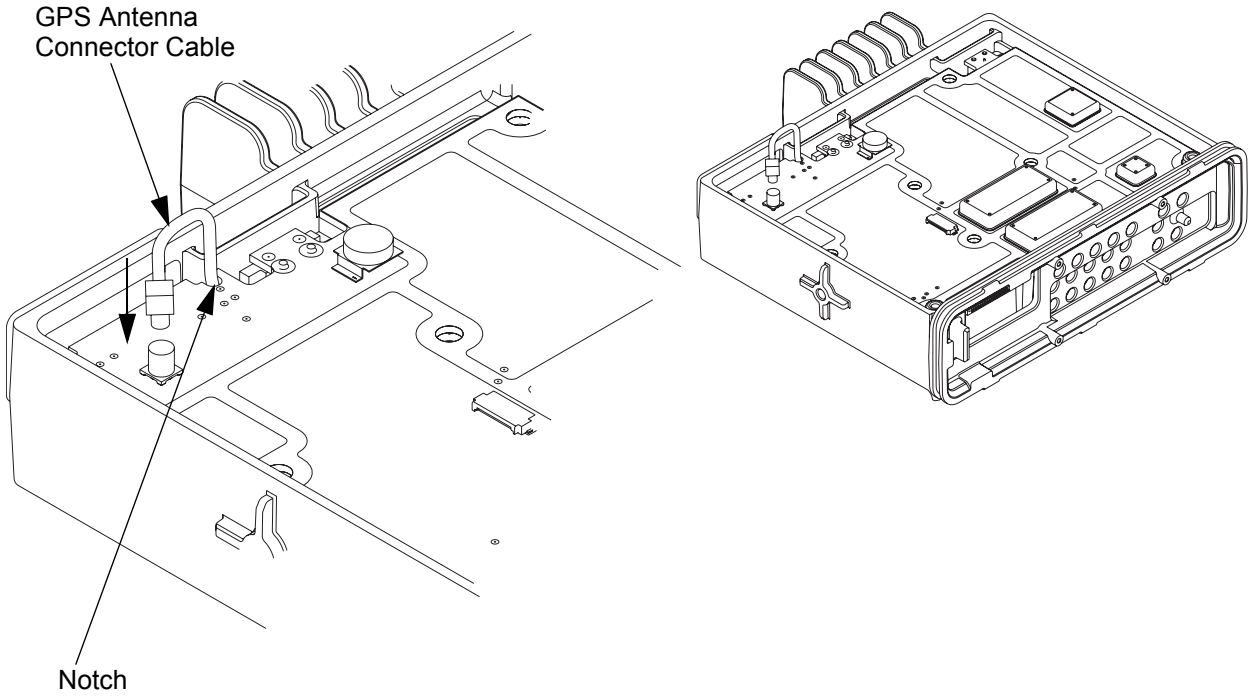


Figure 5-50 Routing GPS Connector on to Transceiver Board

2. Insert the RF/DC retention clips and fully seat them. The DC clip should be inserted first to properly locate the transceiver board. Refer to Figure 5-51.

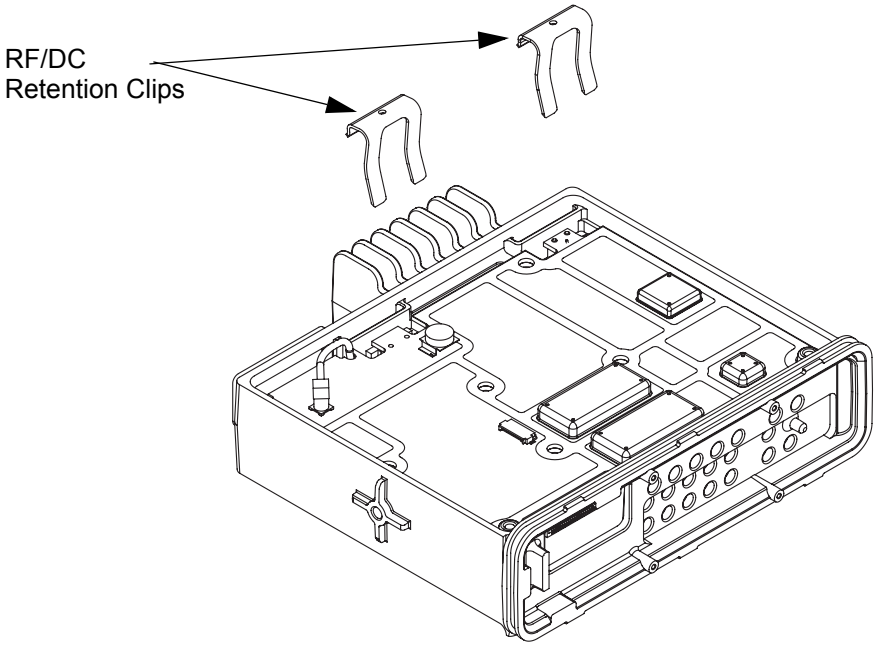


Figure 5-51 Inserting RF/DC Retention Clips

3. Insert the rear accessory connector into the radio assembly and press into place until the connector is flushed with the chassis. Refer to Figure 5-52.

   For GPS models only, place the GPS cap included on the accessory retainer on the GPS antenna connector until it is fully seated.

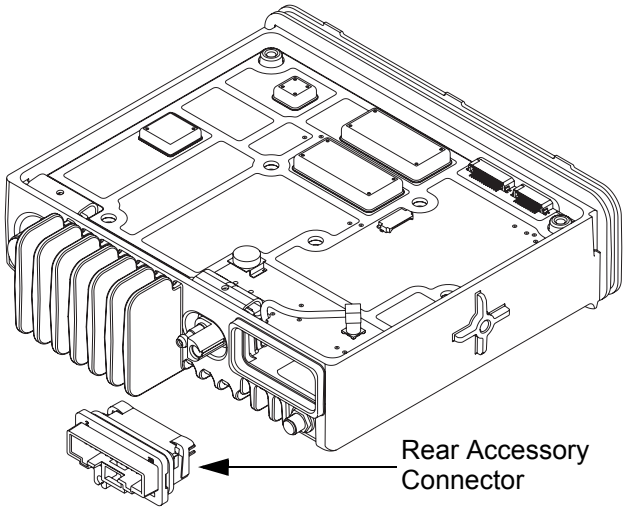


Figure 5-52 Inserting Rear Accessory Connector

4. Place the PA pad on to the die cast cover by aligning the two holes in the PA pad with the alignment pins on the die cast cover. For UHF models, refer to Figure 5-54.

   For VHF models only: PA heat sink block and thermal pads need to be placed on to the pressure pad before it gets assembled to the die cast cover. Refer to Figure 5-53 and Figure 5-55.

   a. Remove thermal pad (7571835M01) from the shipping liner and place it on to the heat sink block by aligning the rounded corners. Remove the protective liner from the exposed side of the thermal pad.

   b. Insert the heat sink block with the thermal pad attached into the compartment on the PA pressure pad, until it is fully seated. The attached thermal pad should be fully visible after assembly.

   c. Remove thermal pad (7571836M01) from the shipping liner and place it on to the exposed metal surface of heat sink block by orienting the thermal pad so its shape matches the opening on the pressure pad.

   d. Remove the protective liner from the exposed side of the thermal pad (7571836M01).

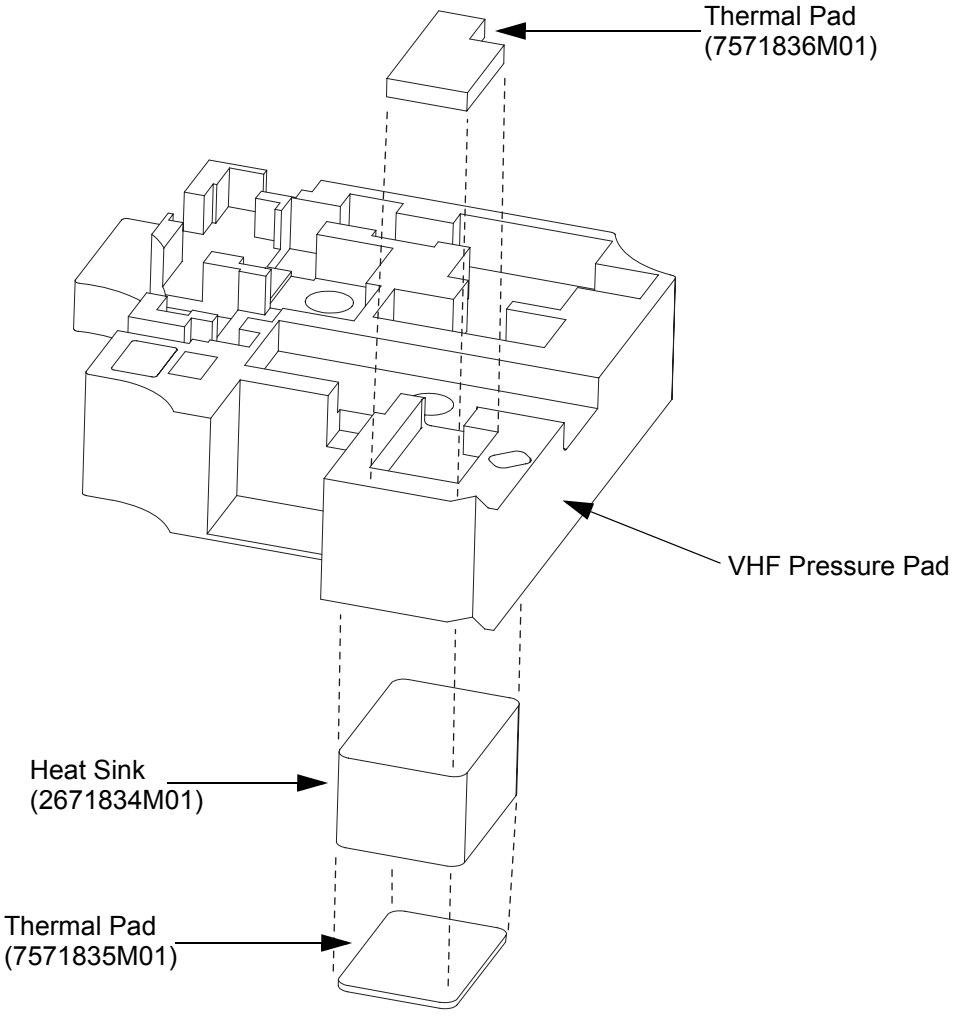


Figure 5-53 Assembling of VHF PA Heat Sink System

5. Fit the O-ring on to the die cast cover securely. Refer to either Figure 5-54 or Figure 5-55.

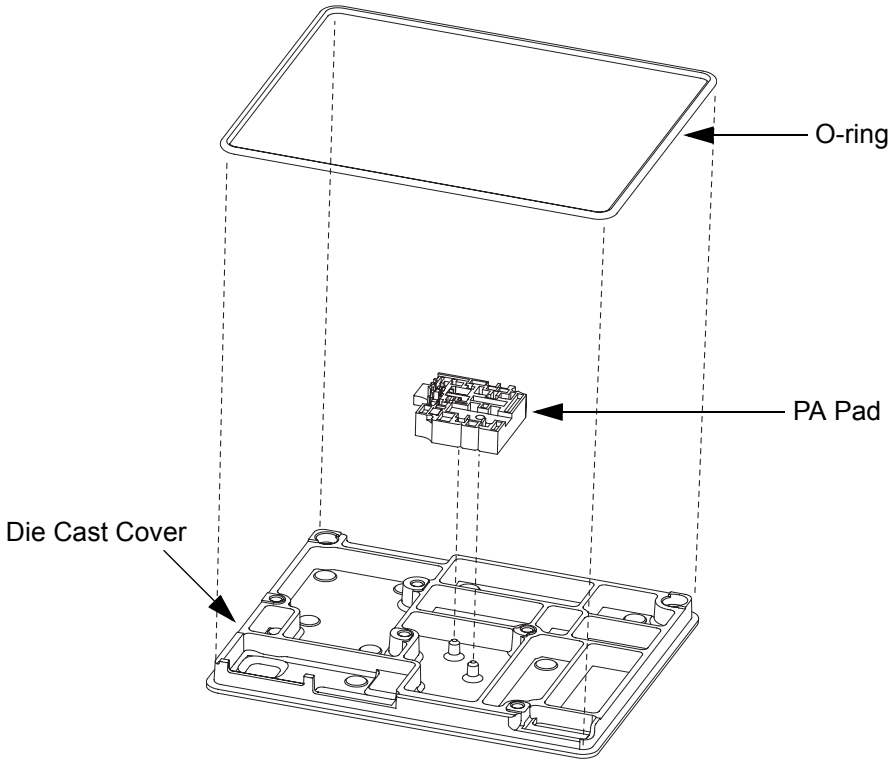


Figure 5-54 Assembling of PA Pad and O-ring (UHF models)

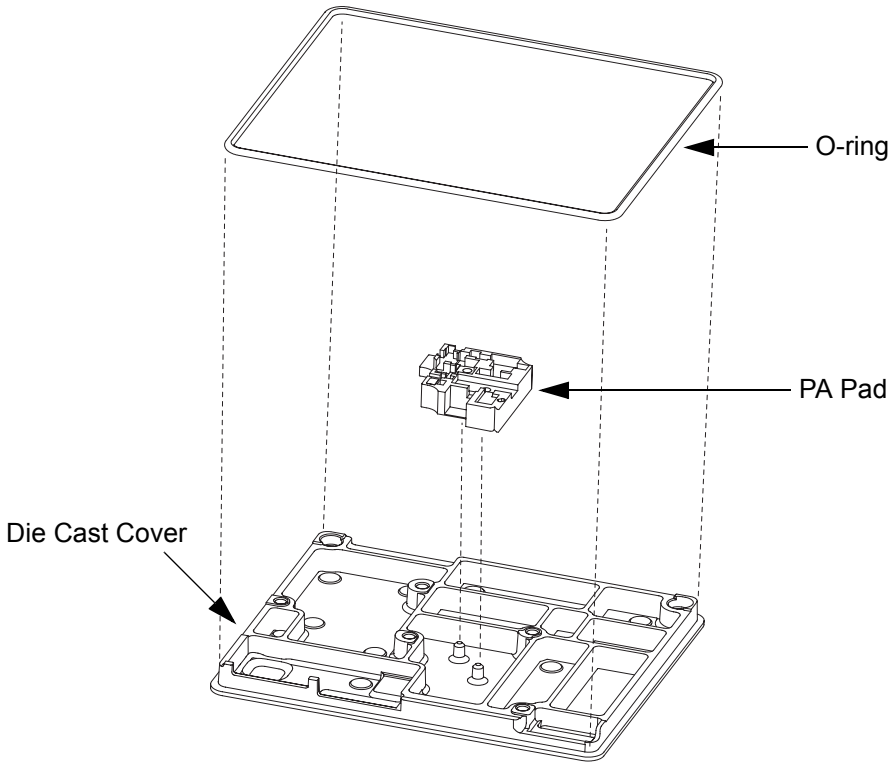


Figure 5-55 Assembling of PA Pad and O-ring (VHF models)

6. Place the die cast cover onto the chassis orienting the die cast cover so that screw holes 6 and 7 align with the bosses on the chassis as shown in Figure 5-56.

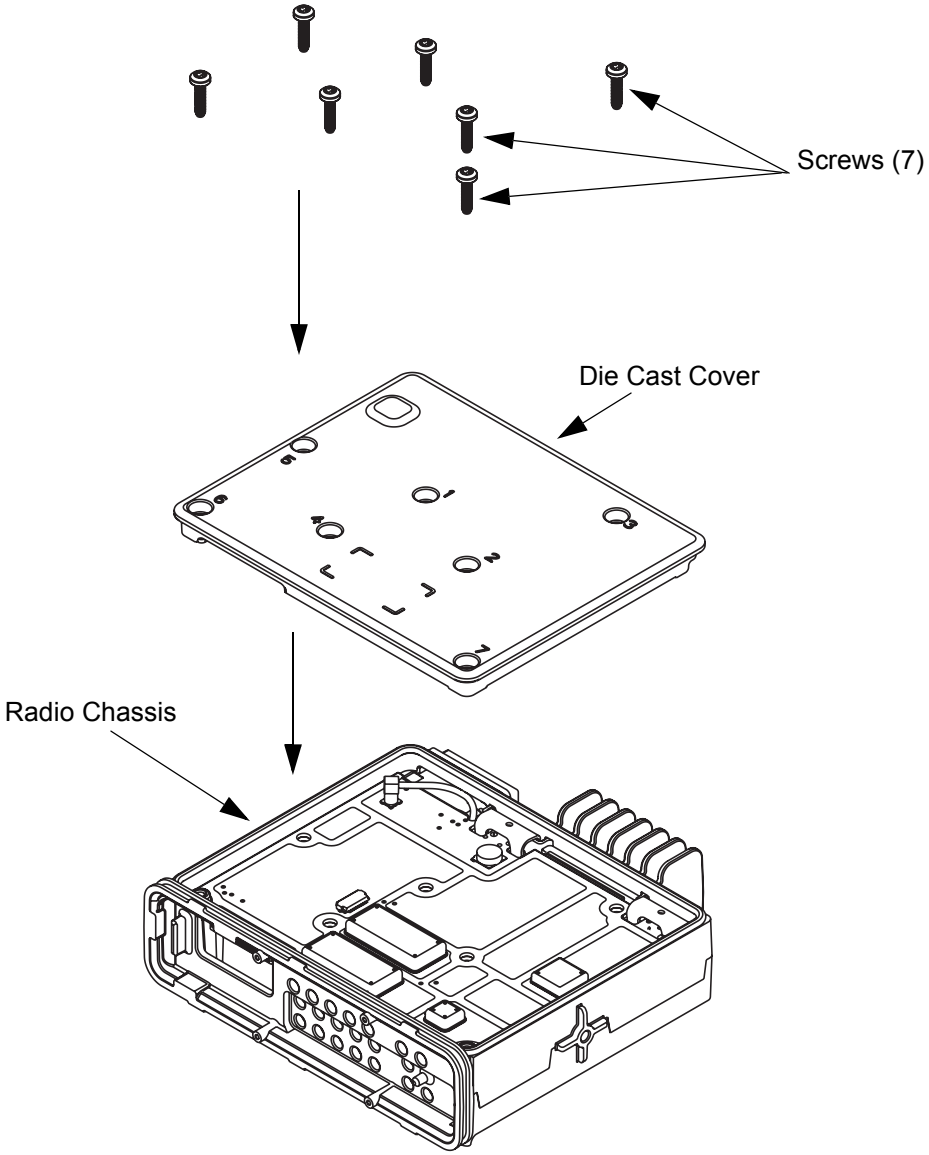


Figure 5-56 Assembling Die Cast Cover onto Chassis

7. Using a T20 TORX™ driver, tighten the seven screws between 2.94 N-m (26 lbs-in) in the order shown in Figure 5-57.
8. Repeat tightening the seven screws in the order shown otherwise the first three screws will likely be loose.

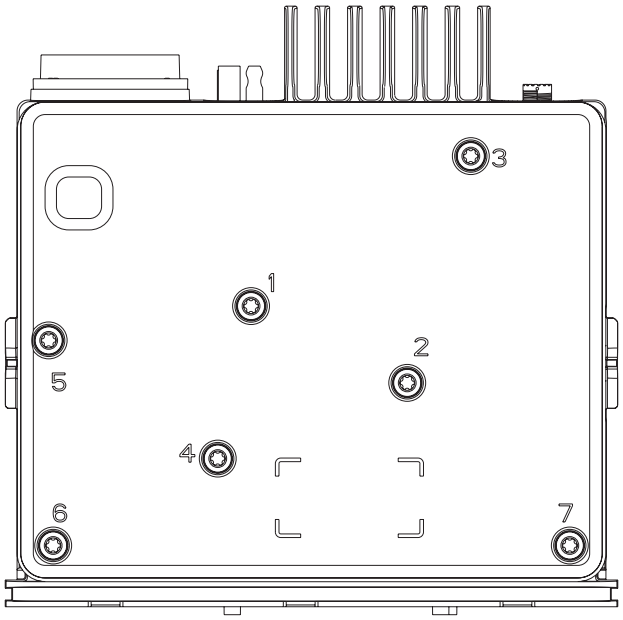


Figure 5-57 Screw Sequence to Tighten Die Cast Cover

5.7.6 Thermal Pad Replacement Procedure

A. Chassis Thermal Pad Replacement Procedure

Harmonic Filter 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 white side down on the chassis as shown in Figure 5-58.

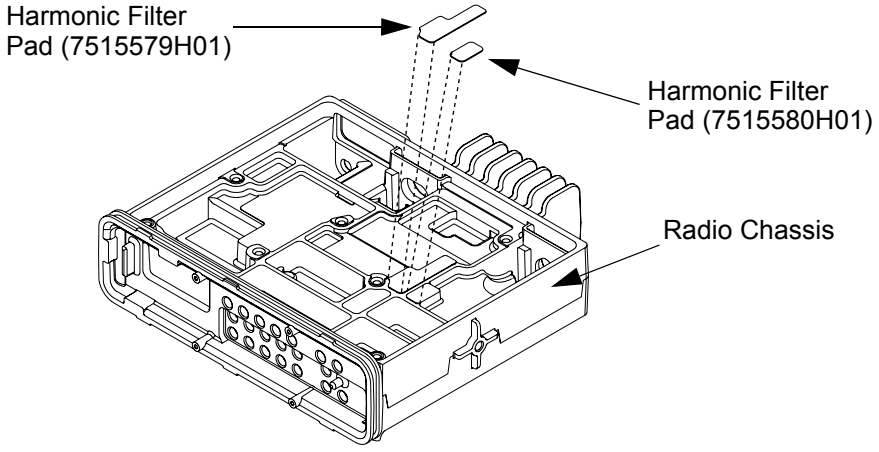


Figure 5-58 Replacing Thermal Pads

Driver 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, aligning the edges of the pad with the edges of the chassis, as shown in Figure 5-59.

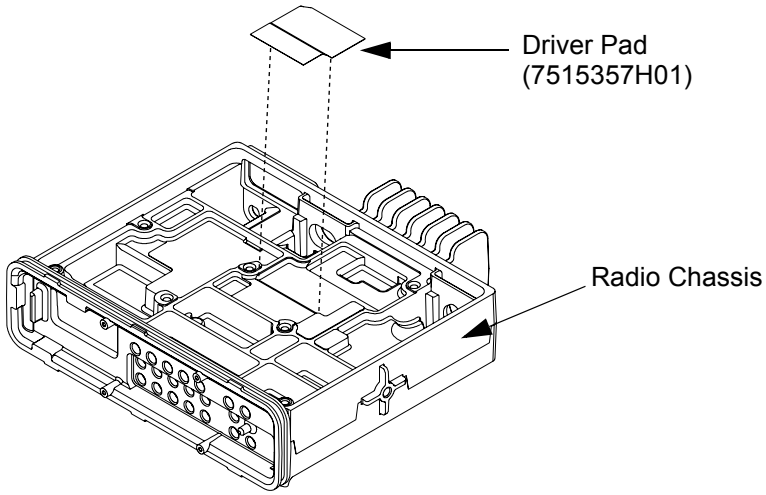


Figure 5-59 Aligning Driver Pad on Chassis

4. Apply even pressure to the pad and remove the protective liner.

B. Transceiver Board Thermal Pad Replacement Procedure

Transistor Thermal Pads and PA Thermal Pad Replacement

1. Use a plastic flat-edge tool to lift each pad from the transceiver board. Discard the old pads.
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 each new pad from the shipping liner, and place in the proper location on top of each transistor component and the audio PA with the white side down (see Figure 5-60).

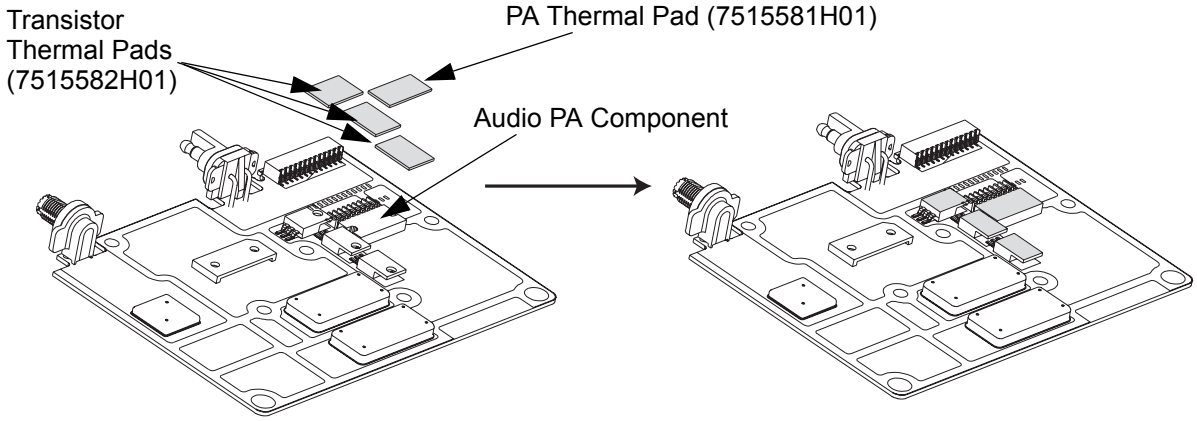


Figure 5-60 Placing Thermal Pads on PA and Transistor Components

NOTE: See Section 5.7.8 for Option Board Reassembly procedure (Option Board Module Only).

5.7.7 Assemble Control Head and Decorative Cover to Radio Assembly

1. Assemble the mic jack pad, speaker pad, and control head O-ring seal on the radio as shown in Figure 5-61.

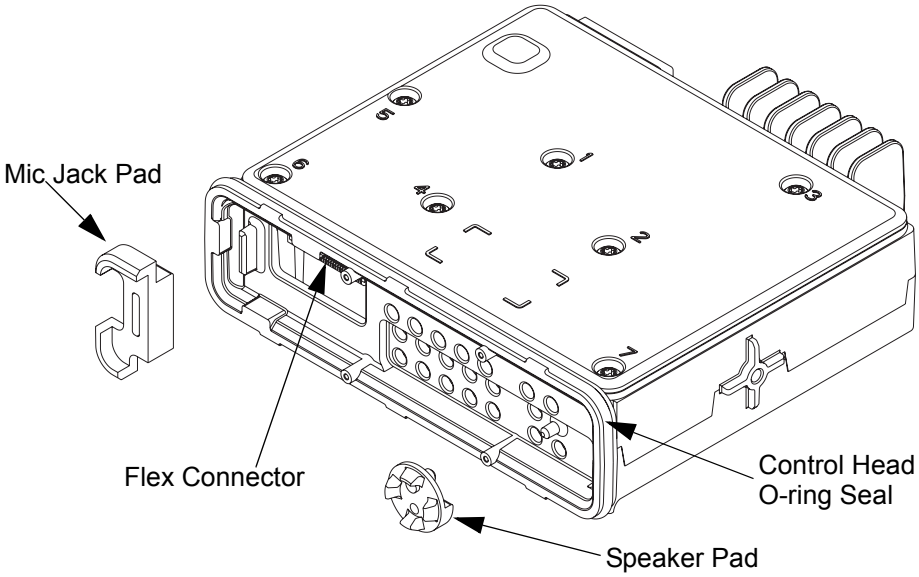


Figure 5-61 Mic Jack Pad and Speaker Pad on Chassis

2. Verify that the flex cable is fully seated in connector on the control head assembly.
3. Assemble flex cable to the flex connector in the radio assembly, making sure it is fully seated.
4. Assemble the control head to the radio, applying pressure evenly across the entire control head, so that all snap features engage at the same time.
5. Verify that the control head seal is not pinched and visible. If a pinch is found, disassemble the control head, reseat the O-ring and reassemble the control head.
6. Refit the top cover over the assembled radio assembly. Press the cover down until it snaps into place.

5.7.8 Option Board Module Reassembly

1. Fold the option flex along edge of the stiffener as shown in Figure 5-62.

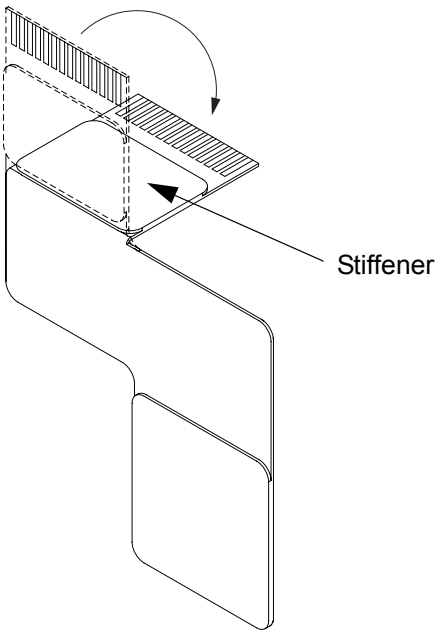


Figure 5-62 Folding Option Flex

2. Mount option board on the radio chassis using four screws and tighten the screws using a T6 TORX™ driver to 0.17 N-m (1.5 lbs-in). Refer to Figure 5-63.

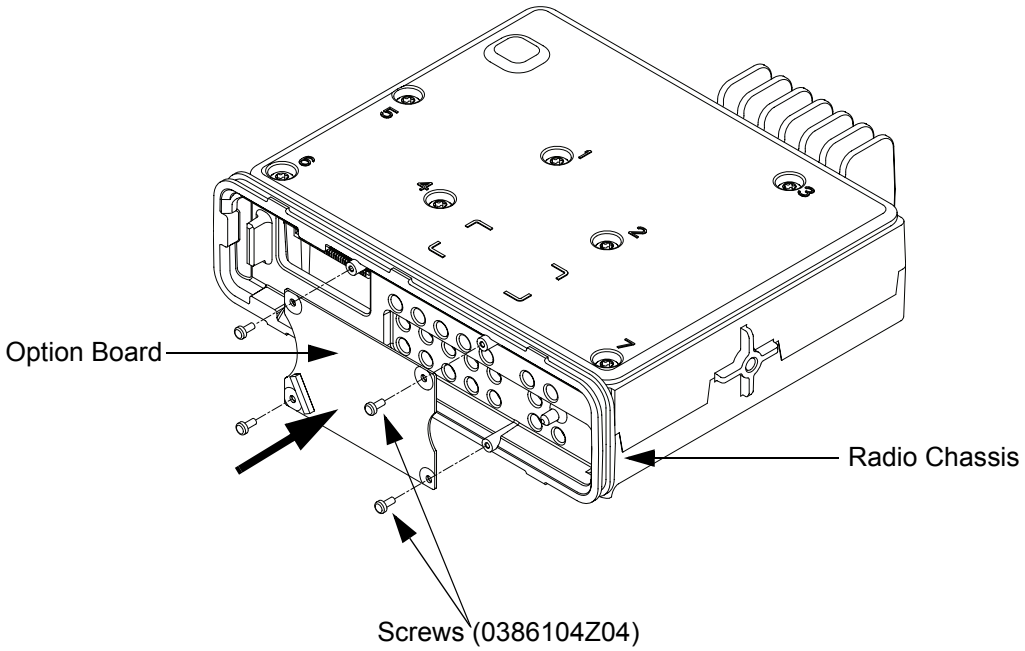


Figure 5-63 Assembling Option Board to Radio Chassis

3. Assemble option flex (8415457H01) onto option board by aligning up 40-pin mating connectors. Refer to Figure 5-64.

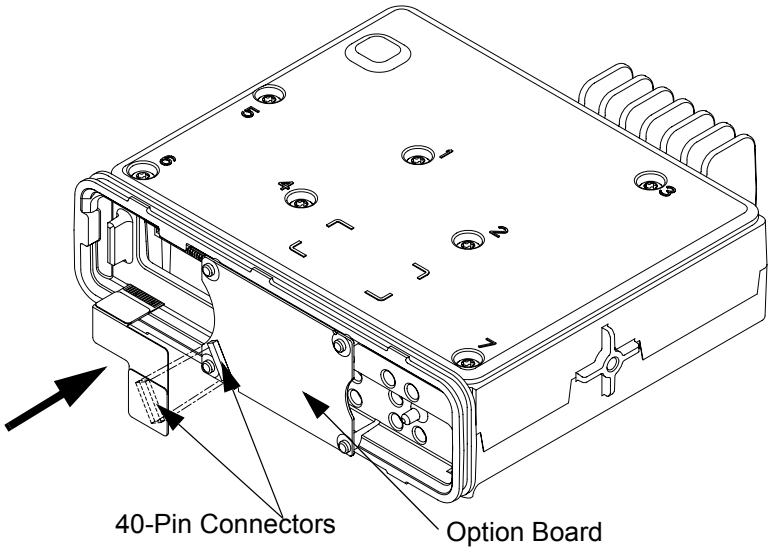


Figure 5-64 Assembling Option Flex to Option Board

4. Firmly press the stiffener backing on the option flex until connectors are fully seated. Also make sure option flex end gets fully inserted into 14-pin socket on the radio board. Refer to Figure 5-65.

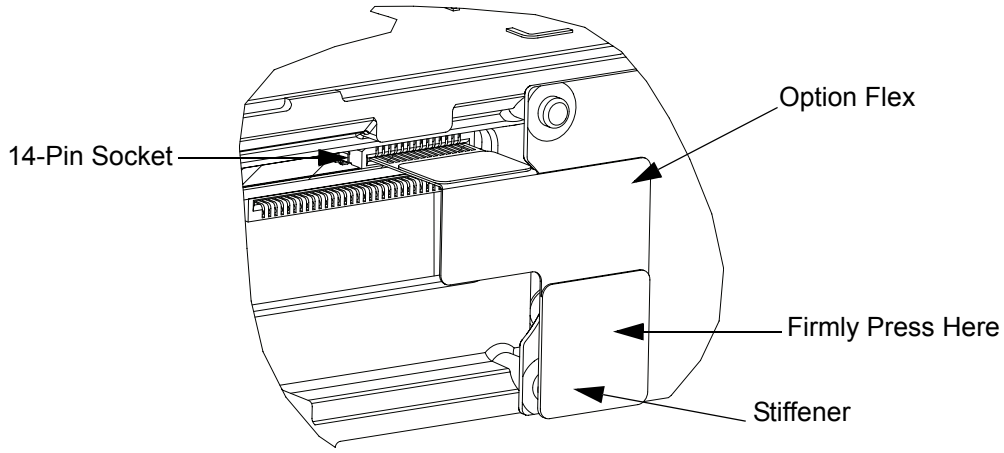


Figure 5-65 Inserting Option Flex End

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.

5.8 Exploded Mechanical Views and Parts Lists

5.8.1 Radio Assembly Exploded View and Parts List

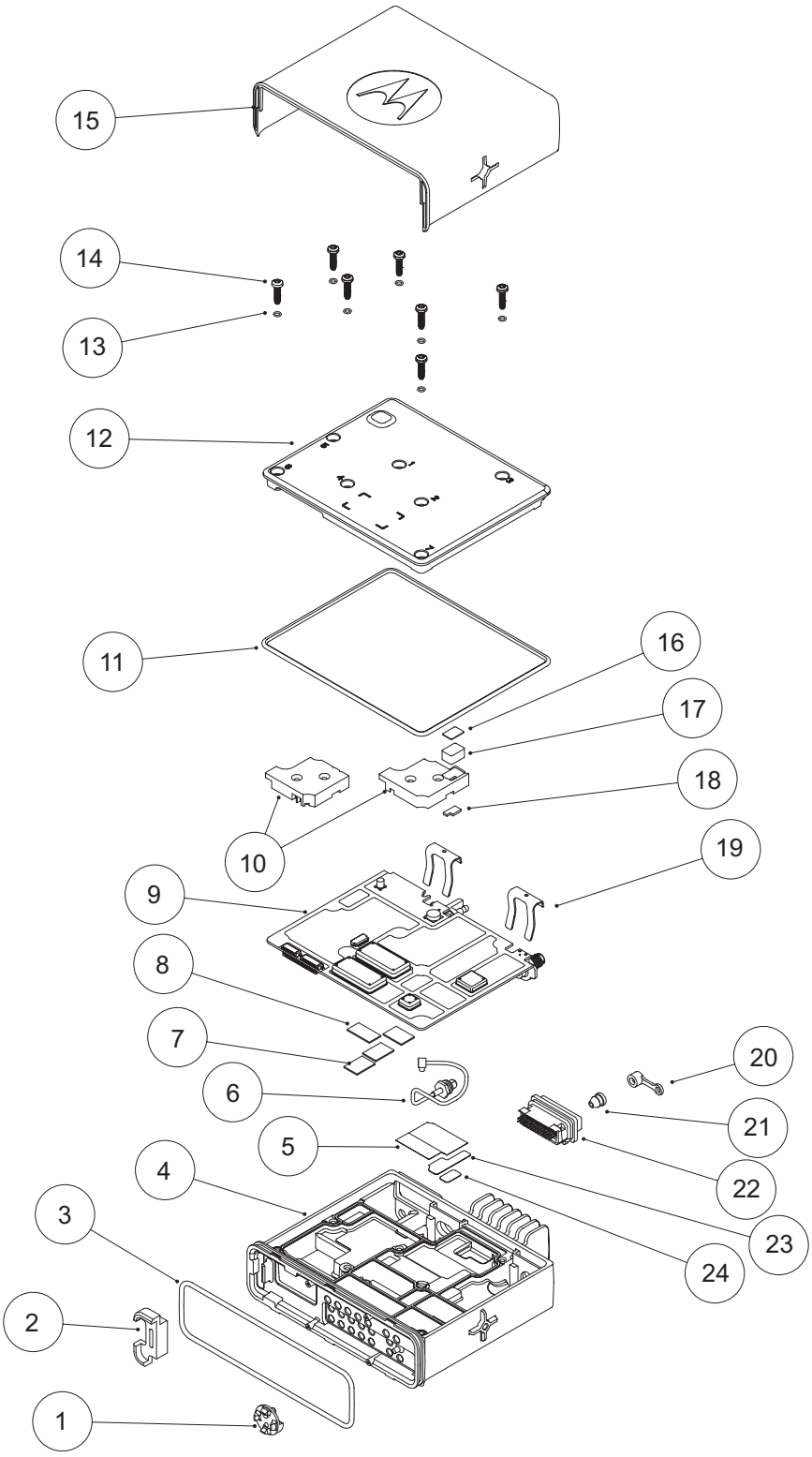


Figure 5-66 Radio Assembly Exploded View

Table 5-3 Radio Exploded View Parts List

Item No.	Description	Part Number
1	Pad, Speaker Support	0716573H01
2	Pad, Mic Jack Support	0716572H01
3	O-Ring, Control Head	3216200H01
4	Chassis, Die Cast	2715587H06
5	Pad, Driver	7515357H01
6	GPS Antenna Connector	3015953H01
7	Pads, Transistor Thermal (Qty:3)	7515582H01
8	Pad, PA Thermal	7515581H01
9	PCB, Transceiver	See Sections 1.5 through 1.7 to identify proper board.
10	Pad, VHF Pressure Pad, UHF Pressure	7515605H01 7575839M01
11	O-Ring, Main	3215586H01
12	Cover, Die Cast	1515588H04
13	O-Rings, Screw (Qty:7)	3216871H01
14	Screws (Qty:7)	0371274L02
15	Cover, Decorative	1516006H01
16	Pad Thermal (VHF models only)	7571835M01
17	Heat Sink, Aluminium (VHF models only)	2671834M01
18	Pad, Thermal (VHF models only)	7571836M01
19	Clips, RF/DC Retention (Qty:2)	4285702E01
20	GPS Cap	3216338H01
21	GPS Plug	3216339H01
22	Rear Accessory Connector	0178042A01
23	Pad, Harmonic Filter	7515579H01
24	Pad, Harmonic Filter	7515580H01

5.8.2 Control Head Exploded Views and Parts Lists

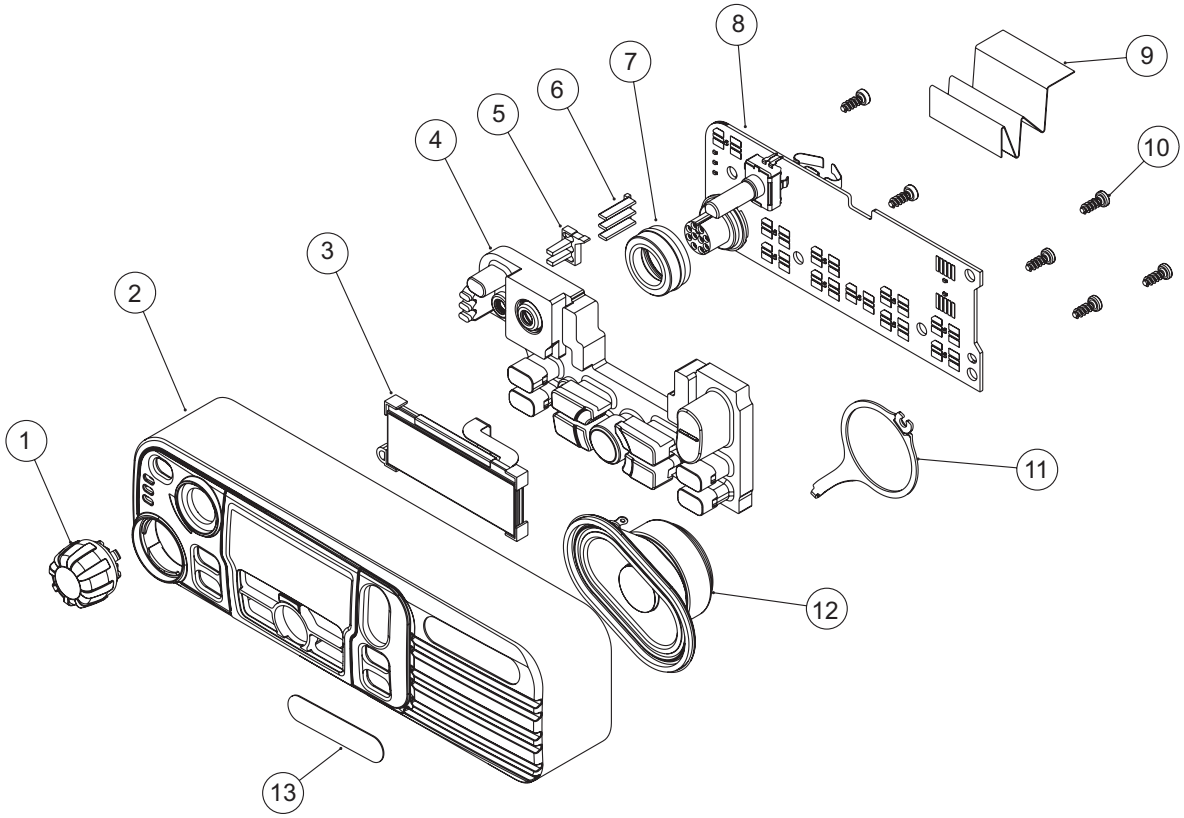


Figure 5-67 Display Control Head Exploded View

Table 5-4 Display Control Head (PMLN4759_) Exploded View Parts List

Item no	Description	Part No
1	Volume Knob Assembly	3616060H01
2	Housing Assembly	0115670H01
3	LCD Display Module	7215559H01
4	Keypad Assembly	7515521H01
5	Indicator Light Guide Holder	0715537H01
6	Indicator Light Guide	6115536H01
7	Mic Jack Seal	3264133H01
8	PCB Assembly	0104020J68
9	Control Head Flex Cable	3015638H01
10	Screws	0371370L01
11	Speaker Retainer	4215135H01
12	Speaker	5015134H02
13	Radio Model Nameplate for XPR 4500 Radio Model Nameplate for XPR 4550	3316323H01 3316323H02

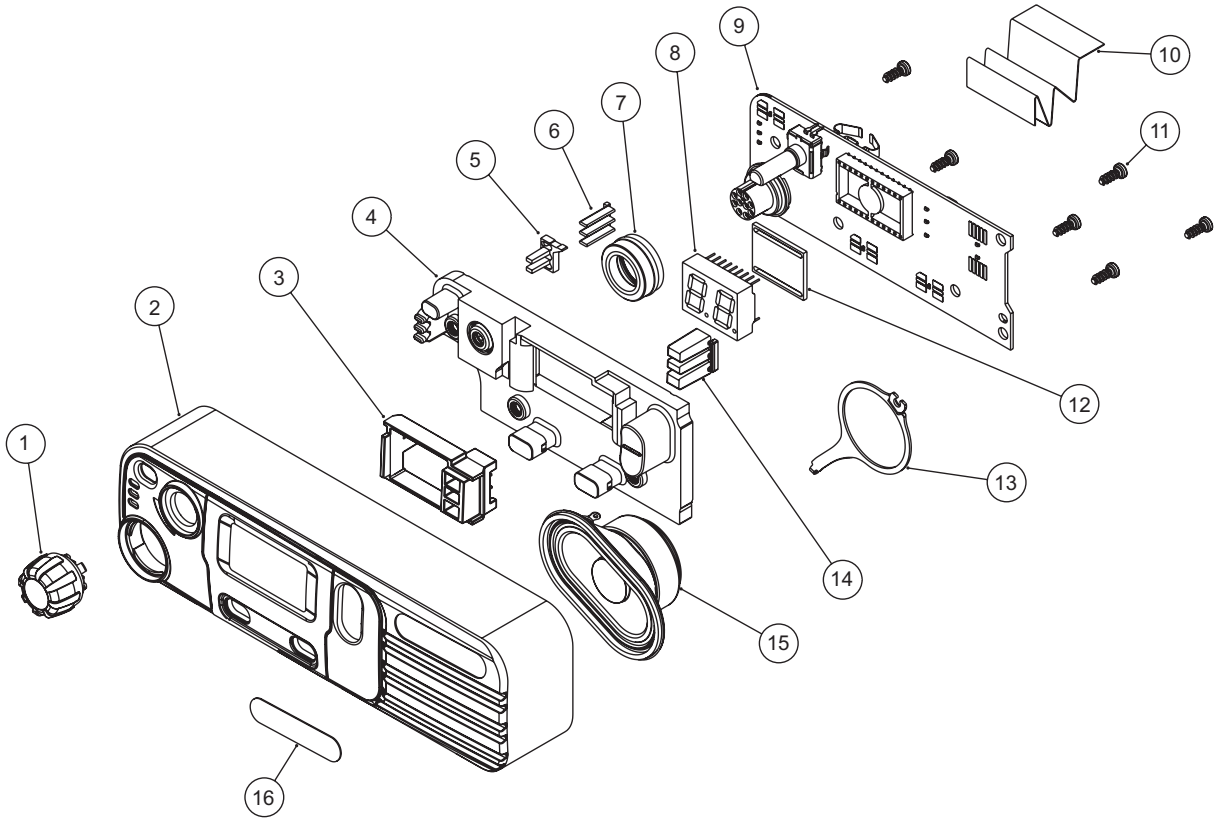


Figure 5-68 Numeric Display Control Head Exploded View

Table 5-5 Numeric Display Control Head (PMLN4967_) Exploded View Parts List

Item no	Description	Part No
1	Volume Knob Assembly	3616060H01
2	Housing Assembly	0171214L01
3	Icon Light Guide Holder	0771089L01
4	Keypad Assembly	7571162L01
5	Indicator Light Guide Holder	0715537H01
6	Indicator Light Guide	6115536H01
7	Mic Jack Seal	3264133H01
8	LED Display	7216958H01
9	PCB Assembly	0104022J64
10	Control Head Flex Cable	3015638H01
11	Screws	0371370L01
12	LED Display Spacer	4371389L01
13	Speaker Retainer	4215135H01
14	Icon Light Guide	6171088L01
15	Speaker	5015134H02
16	Radio Model Nameplate for XPR 4300 Radio Model Nameplate for XPR 4350	3316323H03 3316323H04

5.9 Torque Chart

Table 5-6 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 5-6 Torque Specifications for Nuts and Screws

Part Number	Description	Driver/Socket	Torque		
			N-m	lbs-in	kg-cm
3015953H01	GPS Antenna Connector	5/16” socket driver	1.7	15	17
0371370L01	Screw, M3x1.34, Pan Head	T10 Torx™	0.88	7.8	9.0
0371274L02	Screw, M4x0.7, Pan Head	T20 Torx™	2.94	26	30.0
0386104Z04	Screw, M2x0.4, Pan Head	T6 Torx™	0.17	1.5	1.73

Notes

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 1-5 through section 1.7 on page 1-6), which is orderable from Motorola Radio Products and Solutions Organization at 1-800-422-4210.
Refer to http://www.motorola.com/businessonline 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 (power-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

Error Code	Description	Error Type	Corrective Action
ERROR 01/02	FLASH ROM Codeplug Checksum	NON-FATAL	Reprogram the codeplug.
ERROR 01/7E	Peripheral device non-fatal error	NON-FATAL	Re-connect the peripheral device.
ERROR 01/7F	Peripheral device fatal error	FATAL	Replace the peripheral device.
ERROR 01/22	Tuning Codeplug Checksum	NON-FATAL	Reprogram the tuning partition.
FAIL 01/81	FLASH ROM Checksum	FATAL	Reprogram the radio firmware.
FAIL 01/82	FLASH ROM Codeplug Checksum	FATAL	Reprogram the codeplug.
FAIL 01/88	External SRAM Failure	FATAL	Turn the radio off, then on.
FAIL 01/90	General Hardware	FATAL	Turn the radio off, then on.
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 02/81	DSP ROM Checksum	FATAL	Reprogram the DSP firmware.
FAIL 02/88	DSP RAM Fatal Error	FATAL	Turn the radio off, then on.
FAIL 02/90	General DSP Hardware Failure	FATAL	Turn the radio off, then on.
FAIL 01/A0	Back End Receiver IC Failure	FATAL	Turn the radio off, then on. Send radio to the nearest Motorola Depot.
FAIL 02/C0	DSP Internal RAM Fatal Error	FATAL	Turn the radio off, then on. Send radio to the nearest Motorola Depot.

6.4 Operational Error Codes

During radio operation, the radio performs dynamic tests to determine if the radio is working properly. Problems detected during these tests are presented as error codes on the radio's display. The presence of an error code should prompt a user that a problem exists and that a service technician should be contacted. Use Table 6-2 to aid in understanding particular operational error codes.

Table 6-2 Operational Error Codes

Error Code	Description	Error Type	Corrective Action
FAIL 001	Synthesizer Out-of-Lock	NON-FATAL	1. Reprogram the codeplug. 2. Send radio to the nearest Motorola Depot.
FAIL 002	Personality checksum or system block error	NON-FATAL	Reprogram the codeplug.

Notes

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.motorola.com/governmentandenterprise

7.1.1 Audio

Part No.	Description
HMN4098_	Telephone Style Handset
RMN5050_	Desktop Microphone
RMN5052_	Compact Microphone
RMN5053_	Heavy Duty Microphone with Enhanced Audio
RMN5054_	Visor Microphone with Enhanced Audio
RMN5065_	Keypad Microphone with Enhanced Audio

7.1.2 Speakers

Part No.	Description
RSN4002_	13 Watt External Speaker
RSN4003_	7.5 Watt External Speaker
RSN4004_	5 Watt External Speaker

7.1.3 Desktop Accessories

Part No.	Description
GLN7318_	Desktop Tray without Speaker
RSN4005_	Desktop Tray with Speaker
GPN6145_	Switchmode Power Supply (1–25 Watt Models)(CE marked)
GKN6266_	Radio Power Cable for GPN6145
HPN4007_	Power Supply and Cable
NTN7373_R	US Line Cord
HKN9088_	Mobile Mini-U Antenna Adaptor, 8-foot Cable
PMLN5072_	Hardware Kit for Rear Accessory Connector

7.1.4 Mounting Kits

Part No.	Description
RLN5933_	In Dash (DIN) Mounting Kit
RLN6077_	Low Profile Trunnion Kit
RLN6078_	High Profile Trunnion KIt
RLN6079_	Key Lock Trunnion Kit

7.1.5 Cables

Part No.	Description
HKN4137_	Power Cable to Battery, 3m (10 ft.), 15 amp (1–25W)
HKN4191_	Power Cable to Battery, 3m (10 ft.), 20 amp (1–45W)
HKN4192_	Power Cable to Battery, 6m (20 ft.), 20 amp (1–45W)
HKN6184_	Mobile Front Programming Cable
PMKN4010_	Mobile & Repeater Rear Programming Cable
PMKN4016_	Mobile & Repeater Rear Accessory Programming and Test Cable
PMKN4018_	Mobile & Repeater Rear Accessory Connector Universal Cable
RKN4136_	Ignition Sense Cable

7.1.6 Antennas

Part No.	Description
HAD4006_	VHF, 136–144 MHz, 1/4 Wave, Through-hole Mount, Mini-U
HAD4007_	VHF, 146–150.8 MHz, 1/4 Wave, Through-hole Mount, Mini-U
HAD4008_	VHF, 150.8–162 MHz, 1/4 Wave, Through-hole Mount, Mini-U
HAD4009_	VHF, 162–174 MHz, 1/4 Wave, Through-hole Mount, Mini-U
HAD4014_	VHF, 146–172 MHz, 3.0 dB Gain, Through-hole Mount, Mini-U
HAE4002_	UHF, 403–430 MHz, 1/4 Wave, Through-hole Mount, Mini-U
HAE4003_	UHF, 450–470 MHz, 1/4 Wave, Through-hole Mount, Mini-U
HAE4004_	UHF, 470–527 MHz, 1/4 Wave, Through-hole Mount, Mini-U
HAE4010_	UHF, 406–420 MHz, 3.5 dB Gain, Through-hole Mount, Mini-U
HAE4011_	UHF, 450–470 MHz, 3.5 dB Gain, Through-hole Mount, Mini-U
HAE4012_	UHF, 470–494 MHz, 3.5 dB Gain, Through-hole Mount, Mini-U
HAE4013_	UHF, 494–512 MHz, 3.5 dB Gain, Through-hole Mount, Mini-U
HAE6022_	UHF, 403–527 MHz, 2.0 dB Gain, Through-hole Mount, Mini-U
RAE4004_	UHF, 450–470 MHz, 5.0 dB Gain, Through-hole Mount, Mini-U

For XPR 4350/XPR 4550 GPS Models only:	
RAD4214_	Combination GPS/VHF 136–144 MHz, 1/4 Wave, Through-hole Mount, Mini-U
RAD4215_	Combination GPS/VHF 146–150.8 MHz, 1/4 Wave, Through-hole Mount, Mini-U
RAD4216_	Combination GPS/VHF 150.8–162 MHz, 1/4 Wave, Through-hole Mount, Mini-U
RAD4217_	Combination GPS/VHF 162–174 MHz, 1/4 Wave, Through-hole Mount, Mini-U
RAD4218_	Combination GPS/VHF 146–172 MHz, 3.0 dB Gain, Through-hole Mount, Mini-U
PMAE4030_	Combination GPS/UHF 403–430 MHz, 1/4 Wave, Through-hole Mount, Mini-U
PMAE4031_	Combination GPS/UHF 450–470 MHz, 1/4 Wave, Through-hole Mount, Mini-U
PMAE4032_	Combination GPS/UHF 406–420 MHz, 3.5 dB Gain, Through-hole Mount, Mini-U
PMAE4033_	Combination GPS/UHF 450–470 MHz, 3.5 dB Gain, Through-hole Mount, Mini-U
PMAE4034_	Combination GPS/UHF 450–470 MHz, 5.0 dB Gain, Through-hole Mount, Mini-U
HAE6019_	Combination GPS/UHF 403–527 MHz, 2.0 dB Gain, Through-hole Mount, Mini-U
HAE6020_	Combination GPS/UHF 470–527 MHz, 1/4 Wave, Through-hole Mount, Mini-U
HAE6024_	Combination GPS/UHF 470–494 MHz, 3.0 dB Gain, Through-hole Mount, Mini-U
HAE6026_	Combination GPS/UHF 494–512 MHz, 3.0 dB Gain, Through-hole Mount, Mini-U
PMAN4000_	Fixed Mount GPS Active Antenna
PMAN4001_	Window Mount GPS Active Antenna
PMAN4002_	Magnetic Mount GPS Active Antenna
Replacement Antennas for XPR 4350/XPR 4550 GPS Models only:	
RAD4223_	Kit, Antenna VHF 162–174 MHz, 1/4 Wave
RAD4224_	Kit, Antenna VHF 150.8–162 MHz, 1/4 Wave
RAD4225_	Kit, Antenna VHF 146–150.8 MHz, 1/4 Wave
RAD4226_	Kit, Antenna VHF 136–144 MHz, 1/4 Wave
RAD4227_	Kit, Antenna VHF 146–172 MHz, 3.0 dB Gain
PMAE4039_	Kit, Antenna UHF 403–430 MHz, 1/4 Wave
PMAE4040_	Kit, Antenna UHF 406–420 MHz, 3.5 dB Gain
PMAE4041_	Kit, Antenna UHF 450–470 MHz, 1/4 Wave
PMAE4042_	Kit, Antenna UHF 450–470 MHz, 3.5 dB Gain

PMAE4043_	Kit, Antenna UHF 450–470 MHz, 5.0 dB Gain
HAE6027_	Kit, Antenna UHF 494–512 MHz, 3.0 dB Gain, Through-hole Mount
HAE6028_	Kit, Antenna UHF 470–494 MHz, 3.0 dB Gain, Through-hole Mount
HAE6029_	Kit, Antenna UHF 403–527 MHz, 2.0 dB Gain, Through-hole Mount
HAE6030_	Kit, Antenna UHF 470–527 MHz, 1/4 Wave, Through-hole Mount
PMAN4004_	Kit, Combo GPS+RF, Base Only, Through-hole Mount, Mini-U

7.1.7 Miscellaneous Accessories

Part No.	Description
HKN9557_	PL259/Mini-U Antenna Adaptor, 8-foot Cable
HLN7001_	Option Board Interface Kit
HLN9073_	Microphone Hang-up Clip (All Microphones)
HLN9414_	Universal Microphone Hang-up Clip (All Microphones)
PMLN5496_	Generic Option Board
RLN5926_	Push Button PTT
RLN5929_	Emergency Footswitch

7.1.8 Replacement Button Parts and Kits

Part No.	Description	Button
7515562H02	Button - P1	
7515562H03	Button - P2	
7515562H04	Button - P3	
7515562H05	Button - P4	
7515562H06	Button - Emergency	
7515562H07	Button - Talkaround	
7515562H08	Button - Low/High	
7515562H09	Button - Scan	
7515562H10	Button - Monitor	
7515562H11	Button - Group Call	
7515562H12	Button - Text Message	
7515562H13	Button - VOX	

7515562H14	Button - Backlight	
7515562H15	Button - Remote Monitor	
7515562H16	Button - Radio Kill	
7515562H17	Button - Radio Check	
7515562H18	Button - Phone	
7515562H19	Button - Aux1	
7515562H20	Button - Aux2	
7515562H21	Button -H&L (Horn and Lights)	
7515562H22	Button - Option Board	
7515562H23	Button - Zone	
7515562H24	Button - Scrambling	
7515562H25	Button - Orange	
7515562H26	Button - Contacts	
7515562H27	Button - Radio Check 2	
HKLN4291_	Display Mobile Button Kit (Includes buttons for Monitor, Scan, Backlight, Emergency, Talkaround, Text Message and Contacts)	
HKLN4292_	Mobile Button Kit (Includes buttons for Remote Monitor, Radio Check, Radio Disable and VOX)	
HKLN4293_	Numeric Display Mobile Button Kit (Includes buttons for Monitor and Scan)	
PMLN5070_	Display Mobile Navigation Button Replacement Kit (Includes Left and Right navigation, OK, Menu and Back buttons)	
PMLN5071_	Mobile Option Button Standard Replacement Kit (Includes P1, P2, P3 and P4 buttons)	

Notes

Appendix A Replacement Parts Ordering

A.1 Basic Ordering Information

When ordering replacement parts or equipment information, the complete identification number should be included. 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, and sufficient description of the desired component to identify it.

A.2 Motorola Online

Motorola Online users can access our online catalog at

http://www.motorola.com/businessonline

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 http://www.motorola.com/businessonline

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).

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.

B.2 Motorola Service Center

45D Butterfield Trail
El Paso, TX 79906
Tel: 1-800-227-6772

B.3 Motorola Federal Technical Center

4395 Nicole Drive
Lanham, MD 20706
Tel: 1-800-969-6680
Fax: 1-800-784-4133

B.4 Motorola Canadian Technical Logistics Center

Motorola Canada Ltd.
8133 Warden Avenue
Markham, Ontario, L6G 1B3
Tel: 1-800-543-3222
Fax: 1-888-331-9872 or 1-905-948-5970

Notes

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
Analog	Refers to a continuously variable signal or a circuit or device designed to handle such signals.
Band	Frequencies allowed for a specific purpose.
CPS	Customer Programming Software: 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.
DPL	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.
FCC	Federal Communications Commission.
Frequency	Number of times a complete electromagnetic-wave cycle occurs in a fixed unit of time (usually one second).
GPIO	General-Purpose Input/Output.
GPS	Global Positioning System.
IC	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.
IF	Intermediate Frequency.
kHz	kilohertz: One thousand cycles per second. Used especially as a radio frequency unit.
LCD	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.
LED	Light Emitting Diode: An electronic device that lights up when electricity is passed through it.
MDC	Motorola Digital Communications.
MHz	Megahertz: One million cycles per second. Used especially as a radio frequency unit.
Paging	One-way communication that alerts the receiver to retrieve a message.

Term	Definition
PC Board	Printed Circuit Board. Also referred to as a PCB.
PL	Private-Line Tone Squelch: A continuous sub-audible tone that is transmitted along with the carrier.
Programming Cable	A cable that allows the CPS to communicate directly with the radio 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).
RF	Radio Frequency: The portion of the electromagnetic spectrum between audio sound and infrared light (approximately 10 kHz to 10 GHz).
RX	Receive.
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.
TOT	Time-out Timer: A timer that limits the length of a transmission.
TPL	Tone Private Line.
Transceiver	Transmitter-receiver. A device that both transmits and receives analog or digital signals. Also abbreviated as XCVR.
Transmitter	Electronic equipment that generates and amplifies an RF carrier signal, modulates the signal, and then radiates it into space.
TX	Transmit.
UHF	Ultra-High Frequency.
USB	Universal Serial Bus: An external bus standard that supports data transfer rates of 12 Mbps.
VHF	Very High Frequency.
VIP	Vehicle Interface Port.
XPR	Refers to Digital Professional Radio model names in the MOTOTRBO Professional Digital Two-Way Radio System.

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