



PROFESSIONAL DIGITAL TWO-WAY RADIO

MOTOTRBO™ MOBILE

DM4400 NUMERIC DISPLAY MOBILE

DM4401 NUMERIC DISPLAY MOBILE (WITH BLUETOOTH & GPS)

DM4600 COLOUR DISPLAY MOBILE

DM4601 COLOUR DISPLAY MOBILE (WITH BLUETOOTH & GPS)

BASIC SERVICE MANUAL



Foreword

This manual covers all DM4000 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.



Caution

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



Caution

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 ICNIRP/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 6866537D37) 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.motorolasolutions.com/governmentandenterprise>

Computer Software Copyrights

The Motorola products described in this manual may include copyrighted Motorola computer programs stored in semiconductor memories or other media. Laws in the United States and other countries preserve for Motorola certain exclusive rights for copyrighted computer programs, including, but not limited to, the exclusive right to copy or reproduce in any form the copyrighted computer program. Accordingly, any copyrighted Motorola computer programs contained in the Motorola products described in this manual may not be copied, reproduced, modified, reverse-engineered, or distributed in any manner without the express written permission of Motorola. Furthermore, the purchase of Motorola products shall not be deemed to grant either directly or by implication, estoppel, or otherwise, any license under the copyrights, patents or patent applications of Motorola, except for the normal non-exclusive license to use that arises by operation of law in the sale of a product.

Document Copyrights

No duplication or distribution of this document or any portion thereof shall take place without the express written permission of Motorola. No part of this manual may be reproduced, distributed, or transmitted in any form or by any means, electronic or mechanical, for any purpose without the express written permission of Motorola.

Disclaimer

The information in this document is carefully examined, and is believed to be entirely reliable. However, no responsibility is assumed for inaccuracies. Furthermore, Motorola reserves the right to make changes to any products herein to improve readability, function, or design. Motorola does not assume any liability arising out of the applications or use of any product or circuit described herein; nor does it cover any license under its patent rights nor the rights of others.

Trademarks

MOTOROLA, MOTO, MOTOROLA SOLUTIONS and the Stylized M logo are trademarks or registered trademarks of Motorola Trademark Holdings, LLC and are used under license. All other trademarks are the property of their respective owners.

© 2011 Motorola Solutions, Inc. All rights reserved.

Notes

Document History

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

Edition	Description	Date
68012003037-A	Initial Release.	Dec. 2011

Notes

Table of Contents

Foreword	i
Product Safety and RF Exposure Compliance	i
Computer Software Copyrights	i
Document Copyrights	i
Disclaimer	i
Trademarks	i
Document History	iii
Chapter 1 Introduction	1-1
1.1 Notations Used in This Manual	1-1
1.2 Radio Description	1-1
1.3 Control Head Description	1-2
1.3.1 Control Head Controls (Colour Display Model)	1-2
1.3.2 Control Head Controls (Numeric Display Model)	1-3
1.4 MOTOTRBO Mobile Radio Model Numbering Scheme	1-4
1.5 VHF High Power (136–174 MHz) Model Chart	1-5
1.6 VHF Low Power (136–174 MHz) Model Chart	1-6
1.7 UHF1 High Power (403–470 MHz) Model Chart	1-7
1.8 UHF1 Low Power (403–470 MHz) Model Chart	1-8
1.9 Specifications	1-9
Chapter 2 Test Equipment and Service Aids	2-1
2.1 Recommended Test Equipment	2-1
2.2 Service Aids	2-2
2.3 Programming Cables	2-3
Chapter 3 Transceiver Performance Testing	3-1
3.1 General	3-1
3.2 Setup	3-1
3.3 Colour Display Model Test Mode	3-2
3.3.1 Entering Display Radio Test Mode	3-2
3.3.2 RF Test Mode	3-2
3.3.3 Colour Display Test Mode	3-3
3.3.4 LED Test Mode	3-3
3.3.5 Backlight Test Mode	3-3
3.3.6 Speaker Tone Test Mode	3-3
3.3.7 Earpiece Tone Test Mode	3-3
3.3.8 Audio Loopback Test Mode	3-4
3.3.9 Audio Loopback Earpiece Test Mode	3-4
3.3.10 Button/Knob/PTT Test Mode	3-4

3.4	Numeric Display Model Test Mode	3-4
3.4.1	Entering Display Radio Test Mode	3-4
3.4.2	RF Test Mode	3-4
3.4.3	Display Test Mode	3-5
3.4.4	LED Test Mode	3-5
3.4.5	Speaker Tone Test Mode	3-5
3.4.6	Earpiece Tone Test Mode	3-5
3.4.7	Audio Loopback Test Mode	3-5
3.4.8	Audio Loopback Earpiece Test Mode	3-5
3.4.9	Button/Knob/PTT Test Mode	3-5
 Chapter 4 Radio Programming and Tuning		4-1
4.1	Introduction	4-1
4.2	Customer Programming Software Setup	4-1
4.3	AirTracer Application Tool.....	4-2
4.4	Radio Tuning Setup	4-3
 Chapter 5 Disassembly/Reassembly Procedures		5-1
5.1	Introduction	5-1
5.2	Preventive Maintenance	5-1
5.2.1	Inspection	5-1
5.2.2	Cleaning Procedures	5-1
5.3	Safe Handling of CMOS and LDMOS Devices	5-2
5.4	Repair Procedures and Techniques – General.....	5-4
5.5	Disassembling and Reassembling the Radio – General.....	5-5
5.6	Radio Disassembly – Detailed	5-5
5.6.1	Control Head Removal	5-5
5.6.2	Top Cover Removal.....	5-6
5.6.3	Transceiver Board Removal	5-7
5.6.4	GPS Antenna Connector Removal (For GPS Models Only).....	5-12
5.6.5	Option Board Removal (For Option Board Models Only)	5-14
5.6.6	Disassembly of Colour Display Control Head.....	5-15
5.6.7	Disassembly of Numeric Display Control Head	5-20
5.7	Radio Reassembly – Detailed.....	5-23
5.7.1	Colour Display Control Head	5-23
5.7.2	Numeric Display Control Head	5-28
5.7.3	Radio Assembly.....	5-33
5.7.4	Thermal Pad Replacement Procedure	5-34
5.7.5	Transceiver Board Reassembly.....	5-36
5.7.6	GPS Plug or GPS Antenna Connector Reassembly	5-44
5.7.7	Option Board Reassembly (For Option Board Models Only).....	5-49
5.7.8	Assemble Control Head to Radio Assembly.....	5-51
5.8	Exploded Mechanical Views and Parts Lists	5-53
5.8.1	Radio Assembly Exploded View and Parts List	5-53
5.8.2	Control Head Exploded Views and Parts Lists	5-55
5.9	Torque Chart.....	5-57

Chapter 6	Basic Troubleshooting	6-1
6.1	Introduction	6-1
6.1.1	High Power RF Precaution	6-1
6.2	Replacement Service Kit Procedures	6-1
6.3	Power-Up Error Codes	6-2
6.4	Operational Error Codes	6-2
Appendix A	EMEA Regional Warranty, Service and Support	A-1
A.1	Warranty and Service Support	A-1
A.1.1	Warranty Period and Return Instructions	A-1
A.1.2	After Warranty Period	A-1
A.2	European Radio Support Centre (ERSC)	A-2
A.3	Piece Parts	A-2
A.4	Technical Support	A-3
A.5	Further Assistance From Motorola	A-3
Appendix B	Limited Level 3 Servicing	B-1
B.1	Maintenance	B-1
B.2	Component Location and Parts List	B-1
Glossary	Glossary-1	

List of Figures

Figure 1-1	Radio Control Head (Colour Display Model)	1-2
Figure 1-2	Radio Control Head (Numeric Display Model)	1-3
Figure 1-3	Mobile Radio Model Numbering Scheme	1-4
Figure 2-1	Mobile Front Programming Cable HKN6184_	2-3
Figure 2-2	Mobile & Repeater Rear Programming Cable PMKN4010_	2-3
Figure 2-3	Mobile & Repeater Rear Accessory Programming and Test Cable PMKN4016_	2-3
Figure 4-1	Customer Programming Software Setup from Front Connector	4-1
Figure 4-2	Customer Programming Software Setup from Rear Accessory Connector	4-2
Figure 4-3	Customer Programming Software Setup with Test Box Connection	4-2
Figure 4-4	Radio Tuning Equipment Setup	4-3
Figure 5-1	Typical Control Head Removal	5-5
Figure 5-2	Flexible Connection Removal	5-6
Figure 5-3	Top Cover Removal	5-6
Figure 5-4	Acoustic Plug Removal	5-7
Figure 5-5	Die Cast Main Shield Removal	5-8
Figure 5-6	PA Screw Removal	5-9
Figure 5-7	Accessory Connector Removal	5-9
Figure 5-8	DC Connector Retention Clip Removal	5-10
Figure 5-9	RF Connector Nut Removal	5-10
Figure 5-10	Transceiver Board Removal	5-11
Figure 5-11	Expansion Board and Flex Removal	5-12
Figure 5-12	GPS Nameplate Removal	5-12
Figure 5-13	GPS Connector Nut Removal	5-13
Figure 5-14	GPS Cable Removal	5-13
Figure 5-15	Option Board Removal	5-14
Figure 5-16	Control Head Flex Removal	5-15
Figure 5-17	Volume/Channel Knob Removal	5-15
Figure 5-18	Control Head Screws and Speaker Removal	5-16
Figure 5-19	PCB Retainer Removal	5-16
Figure 5-20	Control Head Board Removal	5-17
Figure 5-21	Power Button Removal	5-17
Figure 5-22	Keypad Removal	5-18
Figure 5-23	Volume Encoder Seal and Mic Jack Seal Removal	5-18
Figure 5-24	Display Pad Gasket Removal	5-19
Figure 5-25	Colour Display Removal from PCB	5-19
Figure 5-26	Control Head Flex Removal	5-20
Figure 5-27	Volume/Channel Knob Removal	5-20
Figure 5-28	Control Head Board Removal	5-21
Figure 5-29	Power Button and Keypad Removal	5-21
Figure 5-30	Speaker Removal (Optional)	5-22
Figure 5-31	Volume Encoder Seal and Mic Jack Seal Removal	5-22
Figure 5-32	Power Button Placement	5-23
Figure 5-33	Keypad Assembly	5-23
Figure 5-34	Assembly to Control Head Housing	5-24
Figure 5-35	Assembling Colour Display to PCB	5-24
Figure 5-36	Assembling Mic Jack Seal and Display Pad Gasket	5-25
Figure 5-37	Assembling Control Head Board to Control Head Assembly	5-25
Figure 5-38	Assembling PCB Retainer	5-26
Figure 5-39	Assembling Speaker	5-26
Figure 5-40	Orientation of Speaker	5-27

Figure 5-41	Volume/Channel Knob Assembly	5-27
Figure 5-42	Power Button Placement	5-28
Figure 5-43	Keypad Assembly	5-28
Figure 5-44	Assembly to Control Head Housing	5-29
Figure 5-45	Assembling Mic Jack Seal	5-29
Figure 5-46	Assemble Speaker	5-30
Figure 5-47	Speaker Retainer Assembly	5-30
Figure 5-48	Assembling Control Head Board to Control Head Assembly	5-31
Figure 5-49	Screw Sequence	5-31
Figure 5-50	Volume/Channel Knob Assembly	5-32
Figure 5-51	Thermal Pads and Shield Gasketing on Chassis and Die Cast Main Shield	5-33
Figure 5-52	Chassis with Thermal Pads	5-33
Figure 5-53	Replacing Regulator Thermal Pads	5-34
Figure 5-54	Replacing Audio PA Thermal Pad	5-35
Figure 5-55	Replacing Final Driver Thermal Pad	5-35
Figure 5-56	Applying Thermal Grease	5-36
Figure 5-57	Placing the Transceiver Board in the Chassis	5-36
Figure 5-58	Inserting DC Retention Clip	5-37
Figure 5-59	Inserting RF Lock Washer and Nut	5-38
Figure 5-60	Screw Sequence to Compress PCB	5-38
Figure 5-61	Installing PA Screws	5-39
Figure 5-62	Inserting Accessory Connector	5-39
Figure 5-63	Assembling Die Cast Main Shield onto Chassis	5-40
Figure 5-64	Screw Sequence to Tighten Die Cast Main Shield	5-41
Figure 5-65	RF Connector Nut Final Torque	5-41
Figure 5-66	Acoustic Plug Installation	5-42
Figure 5-67	Inspection of Cover Assembly with Seal	5-42
Figure 5-68	Assembling Cover onto Chassis	5-43
Figure 5-69	GPS Plug Assembly	5-44
Figure 5-70	GPS Cable Installation	5-44
Figure 5-71	GPS Cable Installation	5-45
Figure 5-72	Flex Connection Connectors	5-45
Figure 5-73	Expansion Board Assembly	5-46
Figure 5-74	GPS Nameplate Assembly	5-46
Figure 5-75	GPS Antenna Connector Assembly	5-47
Figure 5-76	Flex Connection Connectors	5-47
Figure 5-77	GPS Antenna Connector Assembly	5-48
Figure 5-78	Orientation of Option Board Flex to Option Board	5-49
Figure 5-79	Assemble Option Board to Radio Chassis	5-49
Figure 5-80	Align Option Board to Mounting Holes	5-50
Figure 5-81	Assemble O-ring to Chassis	5-51
Figure 5-82	Assemble Control Head to Chassis	5-51
Figure 5-83	Flex Connection Connectors	5-52
Figure 5-84	Radio Assembly Exploded View	5-53
Figure 5-85	Colour Display Control Head Exploded View	5-55
Figure 5-86	Numeric Display Control Head Exploded View	5-56
Figure B-1	PCB Top Side View	B-1
Figure B-2	PCB Bottom Side View	B-2

List of Tables

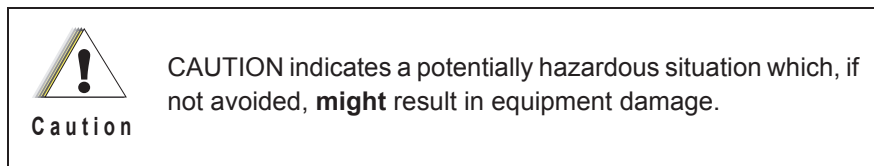
Table 1-1	Radio Frequency Ranges and Power Levels	1-1
Table 2-1	Recommended Test Equipment	2-1
Table 2-2	Service Aids	2-2
Table 3-1	Initial Equipment Control Settings	3-1
Table 3-2	Front Panel Access Test Mode Displays	3-2
Table 3-3	Test Environments	3-6
Table 3-4	Test Channel Spacing	3-6
Table 3-5	Test Frequencies	3-6
Table 3-6	Transmitter Performance Checks	3-7
Table 3-7	Receiver Performance Checks	3-8
Table 4-1	Radio Software Program Kit.....	4-1
Table 5-1	Lead Free Solder Wire Part Number List	5-4
Table 5-2	Lead Free Solder Paste Part Number List	5-4
Table 5-3	Radio Exploded View Parts List	5-54
Table 5-4	Colour Display Control Head (PMLN5678_) Exploded View Parts List.....	5-55
Table 5-5	Numeric Display Control Head (PMLN5677_) Exploded View Parts List.....	5-56
Table 5-6	Torque Specifications for Nuts and Screws	5-57
Table 6-1	Power-Up Error Codes	6-2
Table 6-2	Operational Error Codes	6-2
Table B-1.	Component Parts List.....	B-2

Chapter 1 Introduction

1.1 Notations Used in This Manual

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

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



1.2 Radio Description

The DM4000 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*	450–527 MHz	1–25 Watts 25–40 Watts

* For future release.

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

1.3 Control Head Description

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

The following illustrations show the typical radio control heads.

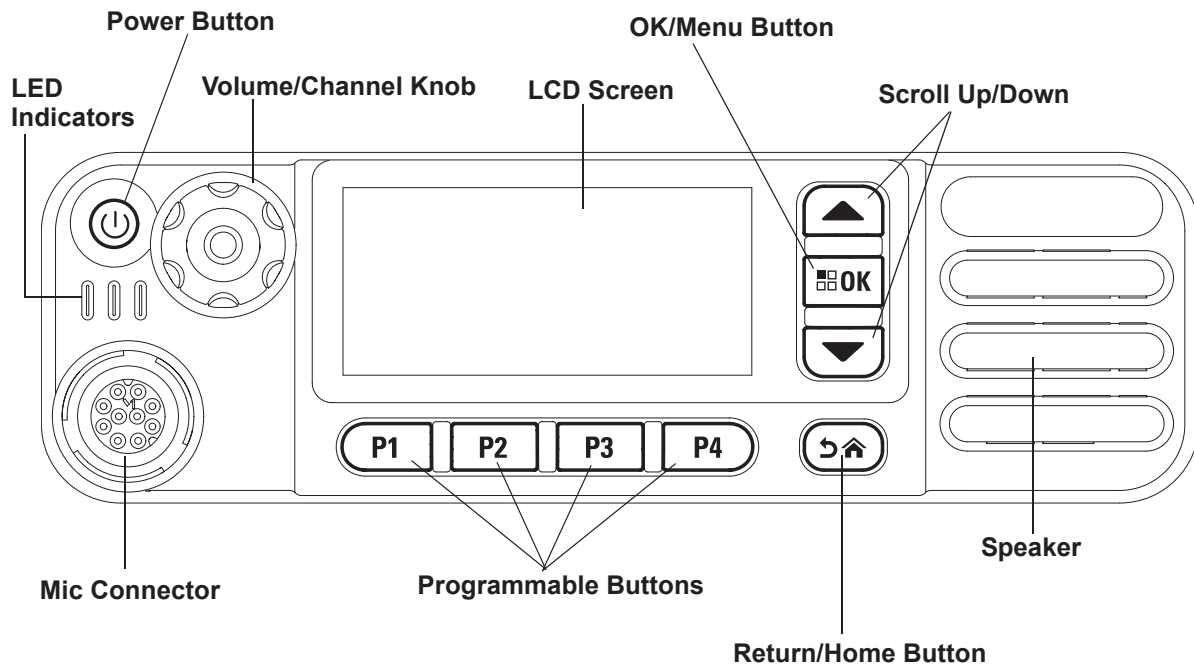


Figure 1-1 Radio Control Head (Colour Display Model)

1.3.1 Control Head Controls (Colour Display Model)

- **POWER BUTTON** – Turns the radio on and off.
- **VOLUME/CHANNEL KNOB** – Rotate clockwise to increase volume level; rotate counterclockwise to decrease volume level. Push knob to activate channel function; rotate clockwise and counterclockwise to select channel.
- **LED INDICATORS** – Red, yellow and green light-emitting diodes indicate operating status.
- **LCD (Liquid Crystal Display)** – 160x72 display provides visual information about many radio features.
- **OK/MENU BUTTON** – One button to provide menu navigation and selection interface.
- **PROGRAMMABLE BUTTONS** – Four buttons are field programmable using the CPS.
- **SCROLL UP/DOWN BUTTONS** – Press buttons to scroll.
- **RETURN/HOME BUTTON** – One button which quickly brings you to the home page.

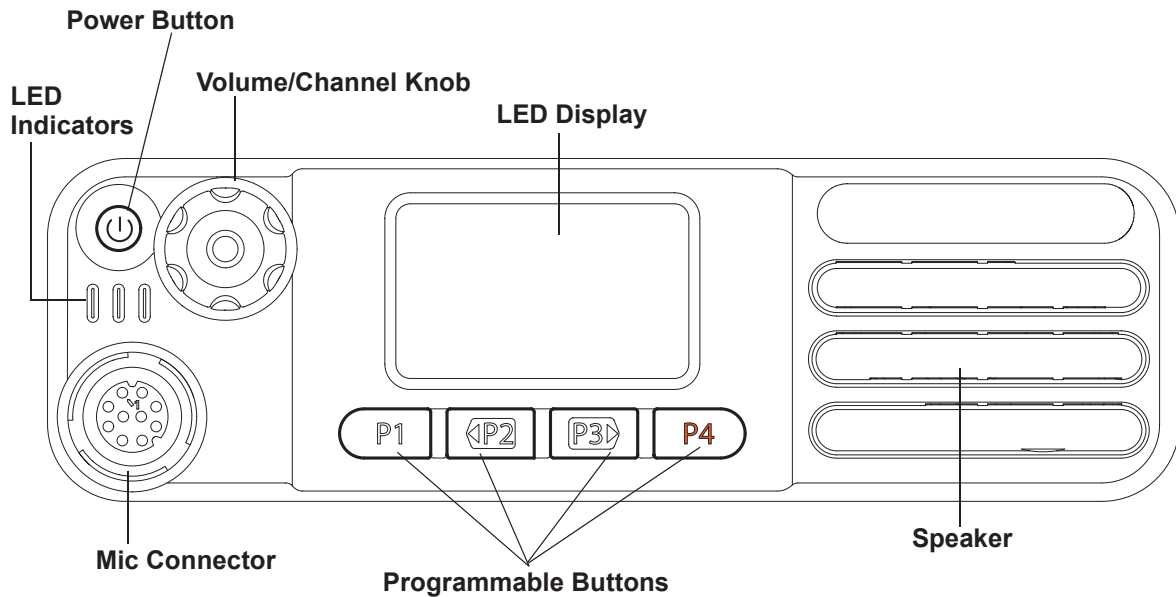


Figure 1-2 Radio Control Head (Numeric Display Model)

1.3.2 Control Head Controls (Numeric Display Model)

- POWER BUTTON – Turns the radio on and off.
- VOLUME/CHANNEL KNOB – Rotate clockwise to increase volume level; rotate counterclockwise to decrease volume level. Push knob to activate channel function; rotate clockwise and counterclockwise to select channel.
- LED INDICATORS – Red, yellow and green light-emitting diodes indicate operating status.
- LED NUMERIC DISPLAY – Two digit numeric display.
- PROGRAMMABLE BUTTONS – Four buttons are field programmable using the CPS.

1.4 MOTOTRBO Mobile Radio Model Numbering Scheme

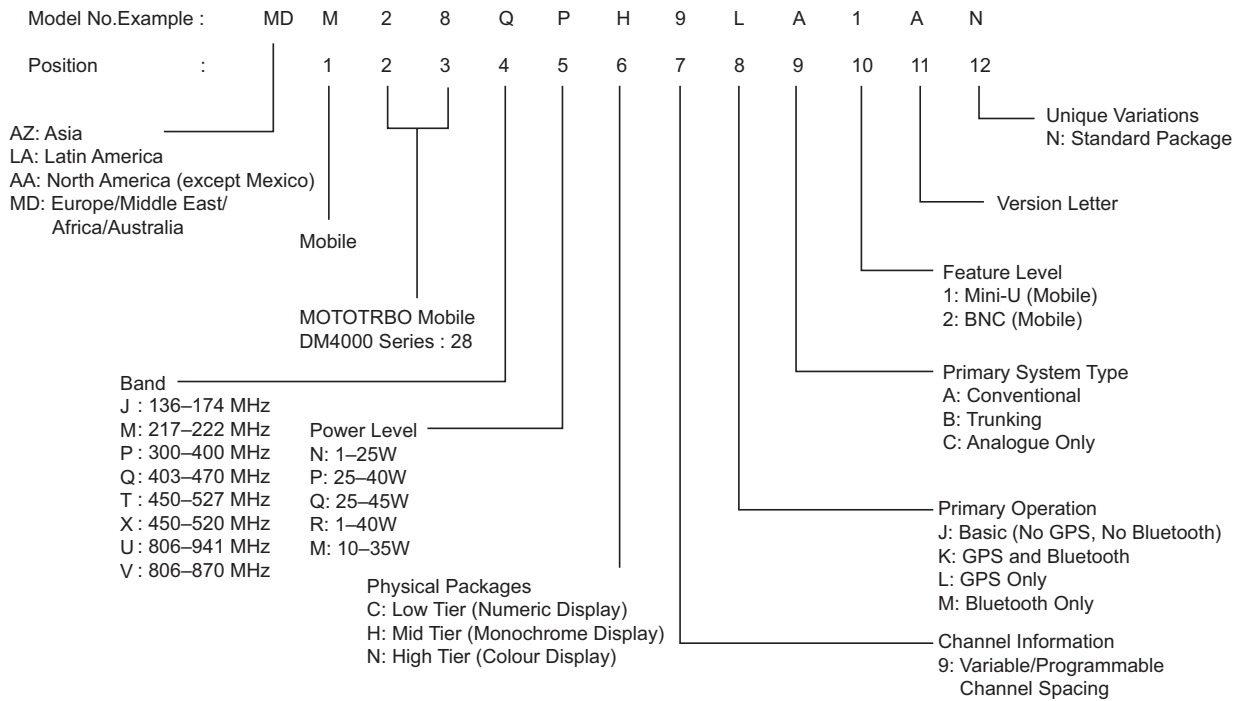


Figure 1-3 Mobile Radio Model Numbering Scheme

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

VHF 136–174 MHz 25–45W, BNC					
Model				Description	
				MDM28JQC9JA2_N	136–174 MHz, 25–45W, MOTOTRBO DM4400
				MDM28JQC9KA2_N	136–174 MHz, 25–45W, MOTOTRBO DM4401
				MDM28JQN9JA2_N	136–174 MHz, 25–45W, MOTOTRBO DM4600
				MDM28JQN9KA2_N	136–174 MHz, 25–45W, MOTOTRBO DM4601
				Item	Description
X	X	X	X	PMUD2565_S	*Service Kit, VHF, 25–45W
	X		X	PMLN6042_S	Service Kit, Bluetooth and GPS Expansion Board
X	X			PMLN5677_	Numeric Display Model Control Head
		X	X	PMLN5678_	Colour Display Model Control Head
X	X	X	X	68012003062	Quick Reference Guide

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, BNC				
Model				Description
			MDM28JNC9JA2_N	136–174 MHz, 1–25W, MOTOTRBO DM4400
			MDM28JNC9KA2_N	136–174 MHz, 1–25W, MOTOTRBO DM4401
			MDM28JNN9JA2_N	136–174 MHz, 1–25W, MOTOTRBO DM4600
			MDM28JNN9KA2_N	136–174 MHz, 1–25W, MOTOTRBO DM4601
			Item	Description
X	X	X	X	PMUD2568_S *Service Kit, VHF, 1–25W
	X		X	PMLN6042_S Service Kit, Bluetooth and GPS Expansion Board
X	X			PMLN5677_ Numeric Display Model Control Head
		X	X	PMLN5678_ Colour Display Model Control Head
X	X	X	X	68012003062 Quick Reference Guide

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, BNC					
Model				Description	
MDM28QPC9JA2_N				403–470 MHz, 25–40W, MOTOTRBO DM4400	
MDM28QPC9KA2_N				403–470 MHz, 25–40W, MOTOTRBO DM4401	
MDM28QPN9JA2_N				403–470 MHz, 25–40W, MOTOTRBO DM4600	
MDM28QPN9KA2_N				403–470 MHz, 25–40W, MOTOTRBO DM4601	
Item				Description	
X	X	X	X	PMUE3647_S	*Service Kit, UHF B1, 25–40W
	X		X	PMLN6042_S	Service Kit, Bluetooth and GPS Expansion Board
X	X			PMLN5677_	Numeric Display Model Control Head
		X	X	PMLN5678_	Colour Display Model Control Head
X	X	X	X	68012003062	Quick Reference Guide

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, BNC					
Model				Description	
				MDM28QNC9JA2_N	403–470 MHz, 1–25W, MOTOTRBO DM4400
				MDM28QNC9KA2_N	403–470 MHz, 1–25W, MOTOTRBO DM4401
				MDM28QNN9JA2_N	403–470 MHz, 1–25W, MOTOTRBO DM4600
				MDM28QNN9KA2_N	403–470 MHz, 1–25W, MOTOTRBO DM4601
				Item	Description
X	X	X	X	PMUE3646_S	*Service Kit, UHF B1, 1–25W
	X		X	PMLN6042_S	Service Kit, Bluetooth and GPS Expansion Board
X	X			PMLN5677_	Numeric Display Model Control Head
		X	X	PMLN5678_	Colour Display Model Control Head
X	X	X	X	68012003062	Quick Reference Guide

X = Item Included

* = Service Kit is the main board only

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

1.9 Specifications

General				
Specification	VHF		UHF1	
Model:	Numeric Display	Colour Display	Numeric Display	Colour Display
Channel Capacity:	99	1000	99	1000
Typical RF Output: Low Power High Power	1–25 W 25–45 W		1–25 W 25–40 W	
Frequency Range:	136–174 MHz		403–470 MHz	
Dimensions: (HxWxL)	53.3 x 175.3 x 205.7 mm			
Weight:	1.8 kg			
Operating Voltage:	Nominal: 13.2 VDC Range: 10.8–15.6 VDC			
Current Drain: Standby Rx @ rated audio Transmit	0.81 A max 2 A max 1–25 W: 11.0 A max 25–40 W: 14.5 A max 25–45 W: 14.5 A max			

Receiver				
Specification	VHF		UHF1	
Model:	Numeric Display	Colour Display	Numeric Display	Colour Display
Frequencies:	136–174 MHz		403–470 MHz	
Channel Spacing:	12.5 kHz/20 kHz/25 kHz			
Analogue Sensitivity:	0.3 μ V (12 dB SINAD) 0.22 μ V (Typical)(12 dB SINAD) 0.4 μ V (20 dB SINAD)			
Digital Sensitivity:	5% BER: 0.3 μ V			
Intermodulation ETS:	70 dB			
Adjacent Channel Selectivity:	60 dB @ 12.5 kHz, 70 dB @ 20/25 kHz			
Spurious Rejection:	70 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:	+1, -3 dB			
Conducted Spurious Emission:	-57 dBm			

Transmitter				
Specification	VHF		UHF1	
Model:	Numeric Display	Colour Display	Numeric Display	Colour Display
Frequencies:	136–174 MHz		403–470 MHz	
Channel Spacing:	12.5 kHz/20 kHz/25 kHz			
Frequency Stability: (-30°C to +60°C, +25°C Ref)	±0.5 ppm			
Power Output: Low Power High Power	1–25 W 25–45 W		1–25 W 25–40 W	
Modulation Limiting:	±2.5 kHz @ 12.5 kHz ±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:	60 dB @ 12.5 kHz 70 dB @ 20/25 kHz			
Audio Response:	+1, -3 dB			
Audio Distortion:	3%			
Digital Vocoder Type:	AMBE+2™			
Digital Protocol:	ETSI TS 102 361-1 ETSI TS 102 361-2 ETSI TS 102 361-3			

Self-Quieter	
VHF	UHF1
–	–

Conforms to:

ETSI TS 102 361 (Parts 1, 2 & 3) – ETSI DMR Standard

1999/5/EC (R&TTE – Radio and Telecommunications Terminal Equipment)


2002/95/EC (RoHS – Banned Substances)

2002/96/EC (WEEE – Waste Electrical and Electronic Equipment)

94/62/EC (Packaging and Packaging Waste)

Radio meets applicable regulatory requirements.

GPS				
Specification	VHF		UHF1	
Model:	Numeric Display	Colour Display	Numeric Display	Colour 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:	< 5 meters			

Bluetooth™ 				
Specification	VHF		UHF1	
Model:	Numeric Display	Colour Display	Numeric Display	Colour Display
Version:	Supports Bluetooth 2.1 + EDR Specification.			
Range:	Class 2, 10 meters			

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

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 61000-4-2 Level 3
Water and Dust Intrusion	IP54, MIL-STD

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

Notes

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 2945B, Aeroflex 3920, or equivalent	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
Digital RMS Multimeter*	100 μ V 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 N5181 (www.agilent.com) or equivalent	Receiver measurements
Oscilloscope*	2 Channels 50 MHz Bandwidth 5 mV/div to 20 V/div	Tektronix TDS1001b (www.tektronix.com) or equivalent	Waveform measurements
Power Meter and Sensor*	5% Accuracy 100 MHz to 500 MHz 50 Watts	Bird 43 ThruLine Watt Meter (www.bird-electronic.com) or equivalent	Transmitter power output measurements
RF Millivolt Meter	100 mV to 3 V RF 10 kHz to 1 GHz	Boonton 92EA (www.boonton.com) or equivalent	RF level measurements
Power Supply	0 V to 32 V 0 A to 20 A	B&K Precision 1790 (www.bkprecision.com) or equivalent	Voltage supply

2.2 Service Aids

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

Table 2-2 Service Aids

Motorola Part Number	Description	Application
RLN4460_	Test Set	Enables connection to audio/accessory jack. Allows switching for radio testing.
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.
HPN4007_	Power Supply	Provides the radio with power when bench testing.
PMEN4027_	Housing Eliminator	Test Fixture used to bench test the radio PCB.
6686119B01	Control Head Dismantling Tool	Assists in the removal of radio control head.
66012025001	Volume/Channel Knob Removal Tool	Assists in the removal of the Volume/Channel knob.
66012020001	RFIC (U0000) Repair Stencil	Fixture to screen solder paste onto the IC leads for replacement.

2.3 Programming Cables



Figure 2-1 Mobile Front Programming Cable HKN6184_

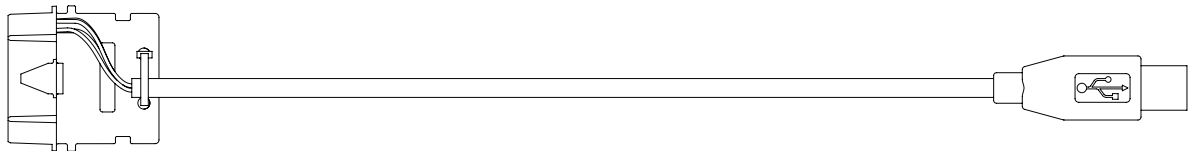


Figure 2-2 Mobile & Repeater Rear Programming Cable PMKN4010_

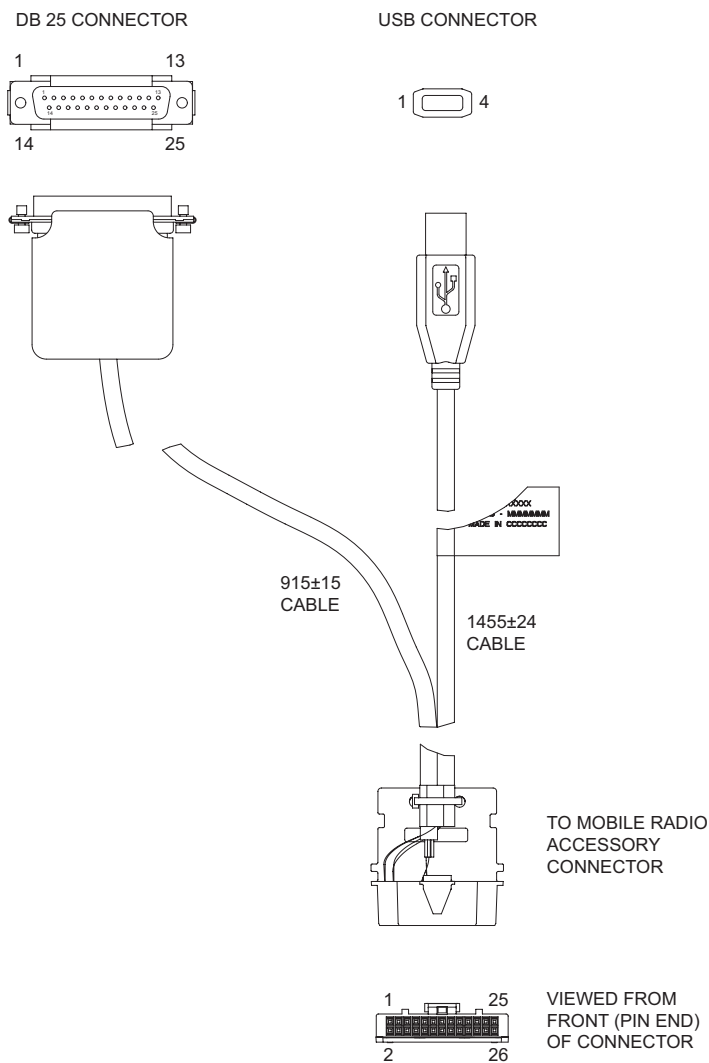


TABLE 2-3: WIRE DIAGRAM

26 PIN ACCESSORY PORT CONNECTOR		USB	DB25P
PIN NO.	DESCRIPTION		
3	VCC (5v)	1	
2	DATA -	2	
1	DATA +	3	
4	GND	4	
	DRAIN WIRE AND BRAID	SHELL	
9	SPEAKER -		7
11	EXT MIC		17
17	DIGI IN I (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 analogue modes, all testing is done in analogue 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 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 Colour Display Model Test Mode

3.3.1 Entering Display Radio Test Mode

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

Table 3-2 Front Panel Access Test Mode Displays

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

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

3.3.2 RF Test Mode

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

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

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

NOTE: DIG is digital mode and other test environments are analogue 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. Push and hold in the Volume/Channel knob for approximately two seconds to enter the Channel mode. Turn the Volume/Channel knob clockwise to increase from channel 1 to channel 14 or counterclockwise to decrease the channel number. The radio beeps in each position. The channel test frequencies are described in Table 3-5.

NOTE: The Volume/Channel knob will stay in Channel mode until the Volume/Channel knob is pushed in momentarily. This is not the case in normal operation.

3.3.3 Colour Display Test Mode

1. Press and hold **button P1** in RF Test Mode. The radio beeps once and momentarily displays '**Display Test Mode**'.
2. On the next button press, the negative image of **Display Test Mode** will appear.
3. With each successive button press, the display background will change from Red, to Green, and then to Blue.
4. With each successive button press, a horizontal bar will increase in size and change colour, from Red, to Green, to Blue, to Black, back to Red, to Green, to Blue, to Black, and finally, the entire display background will change to Red.
5. With each successive button press, vertical bars will grow and change colour, from Red, to Green, to Blue, to Black, back to Red, and finally, the entire display background will change to Green.
6. On the next button press, the display will clear and 12 icons will appear at the top of the display.

3.3.4 LED Test Mode

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

3.3.5 Backlight Test Mode

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

3.3.6 Speaker Tone Test Mode

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

3.3.7 Earpiece Tone Test Mode

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

3.3.8 Audio Loopback Test Mode

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

3.3.9 Audio Loopback Earpiece Test Mode

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

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 analogue 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. Push and hold in the Volume/Channel knob for approximately two seconds to enter the Channel mode. Turn the Volume/Channel knob clockwise to increase from channel 1 to channel 14 or counterclockwise to decrease the channel number. The radio beeps in each position. The channel test frequencies are described in Table 3-5.

NOTE: The Volume/Channel knob will stay in Channel mode until the Volume/Channel knob is pushed in momentarily. This is not the case in normal operation.

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.

3.4.4 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 internal speaker.

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 mic to the accessory 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.
4. The radio must be powered off to end Test Mode.

Table 3-3 Test Environments

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

Table 3-4 Test Channel Spacing

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

Table 3-5 Test Frequencies

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

Table 3-6 Transmitter Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comment
Reference Frequency	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 1–25 W) 25–29 W: (VHF 25–45 W, UHF1 25–40 W, UHF2 25–40 W) High Power: 25–29 W: (VHF 1–25 W, UHF1 1–25 W, UHF2 1–25 W) 40–47 W: (UHF1 25–40 W, UHF2 25–40 W) 45–53 W: (VHF 25–45 W)
Voice Modulation	Mode: PWR MON 4th channel test frequency* atten to -70, input to RF In/Out Monitor: DVM, AC Volts Set 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 μ V
Noise Squelch Threshold (only radios with conventional system need to be tested)	RF level set to 1 mV RF	As above	PTT to OFF (center), meter selection to Audio PA, spkr/ load to speaker	Set volume control to 7.75 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 μ V. 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 7/Vista/XP operating system. These programs are available in one kit as listed in Table 4-1. An Installation Guide is also included with the kit.

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

Table 4-1 Radio Software Program Kit

Description	Kit Number
MOTOTRBO CPS, Tuner and AirTracer	GMVN5141_

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.

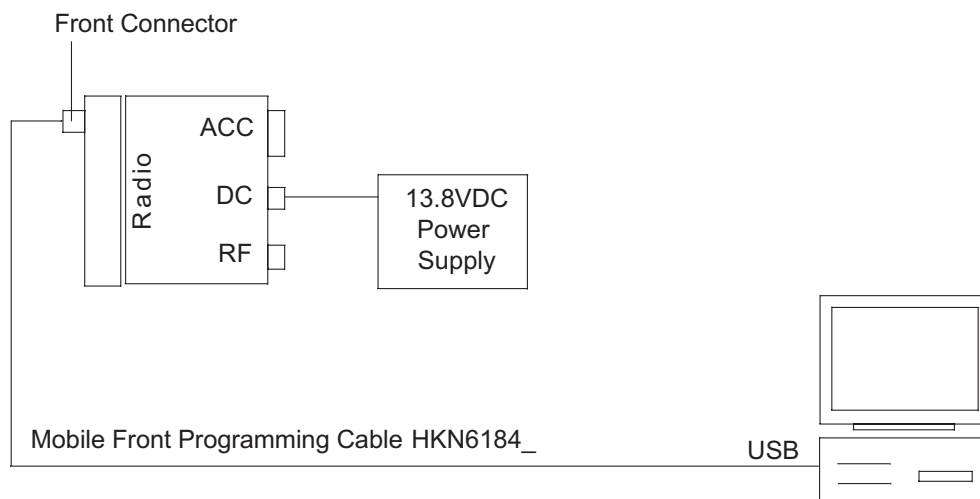


Figure 4-1 Customer Programming Software Setup from Front Connector

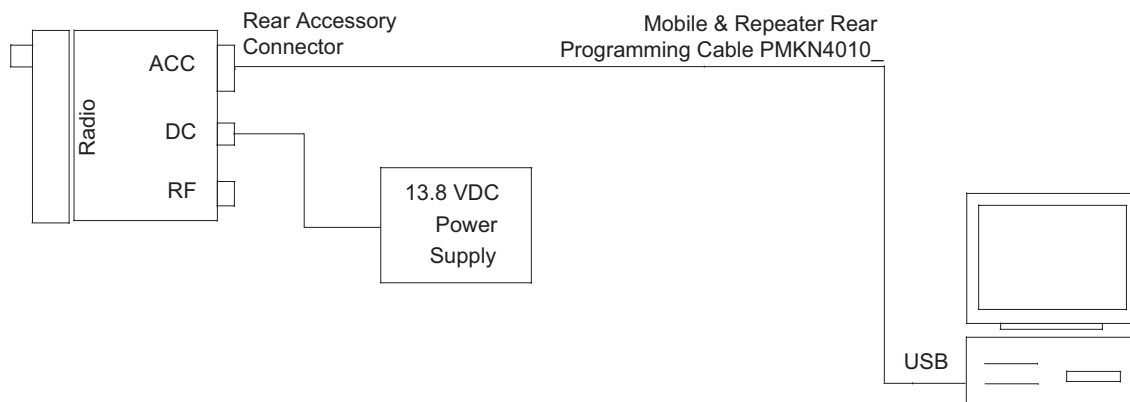


Figure 4-2 Customer Programming Software Setup from Rear Accessory Connector

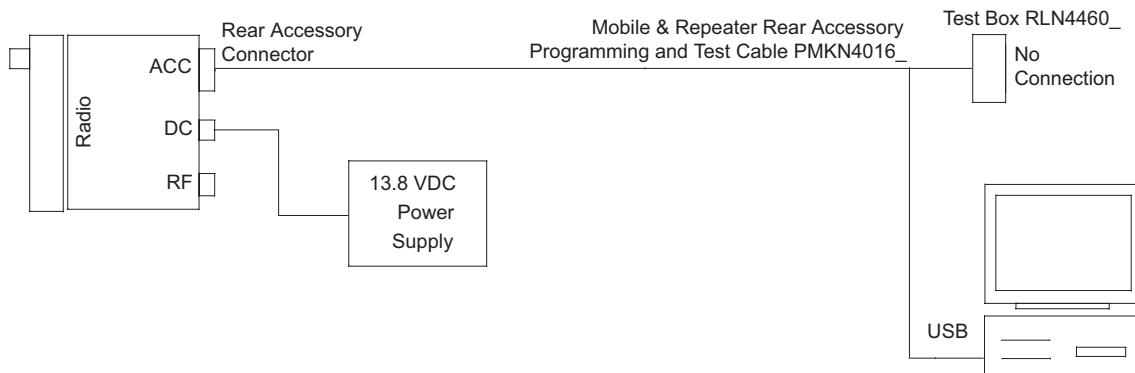


Figure 4-3 Customer Programming Software Setup with Test Box Connection

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

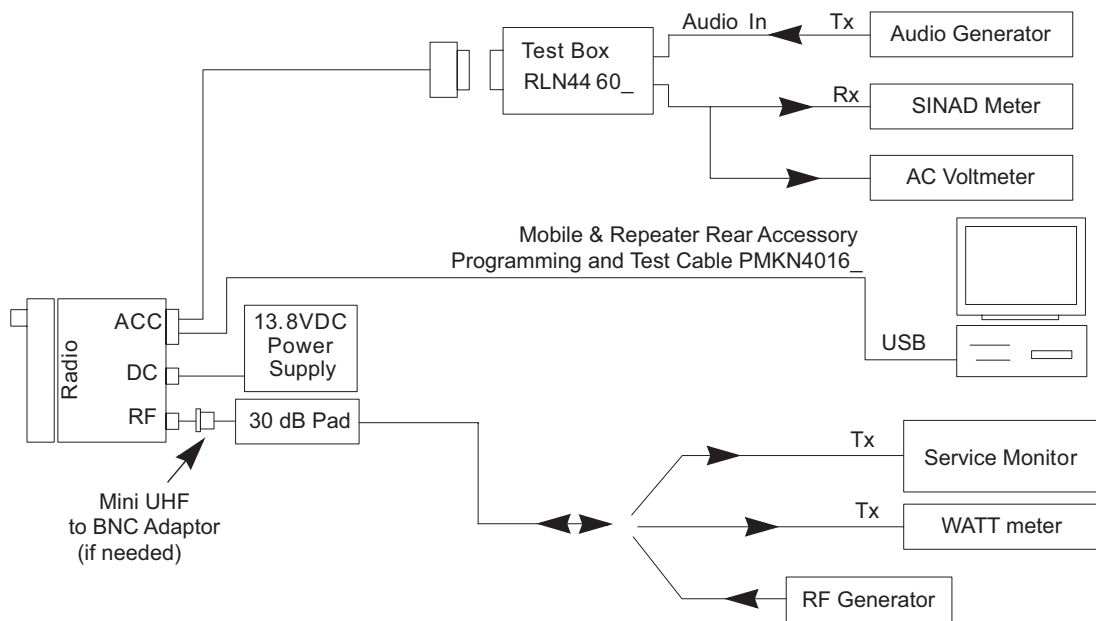


Figure 4-4 Radio Tuning Equipment Setup

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

5.2 Preventive Maintenance

Periodic visual inspection and cleaning is recommended.

5.2.1 Inspection

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

5.2.2 Cleaning Procedures

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

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

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

**Caution**

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

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

Cleaning External Plastic Surfaces

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

Cleaning Internal Circuit Boards and Components

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

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

5.3 Safe Handling of CMOS and LDMOS Devices

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

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

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

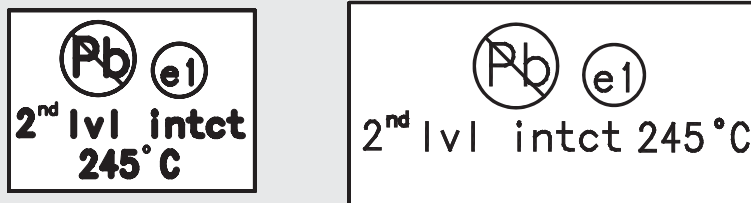
**Caution**

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

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

5.4 Repair Procedures and Techniques – General

NOTE Environmentally Preferred Products (EPP) (refer to the marking on the printed circuit boards — examples shown below) were developed and assembled using environmentally preferred components and solder assembly techniques to comply with the European Union's **Restriction of Hazardous Substances (ROHS) 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%	217°C	52171	0.015"	1lb spool

Table 5-2 Lead Free Solder Paste Part Number List

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

Parts Replacement and Substitution

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

Rigid Circuit Boards

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

When soldering near a connector:

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

5.5 Disassembling and Reassembling the Radio – General

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

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

- Small Flat Blade Screwdriver
- Control Head Dismantling Tool (Motorola Part No. 6686119B01)
- Volume/Channel Knob Removal Tool (Motorola Part No. 66012025001)
- Torque Driver (2-36 lbs-in or 0.2-4.0 N-m), (Motorola Part No. RSX4043A)
- TORX™ T10 Driver Bit
- TORX™ T8 Driver Bit
- TORX™ T6 Driver Bit (for use with GPS Models and Option Board only)
- 5/16" or 8 mm Socket Driver (GPS Models Only)
- 9/16" Deep Socket Driver (RF Connector Nut)

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

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.

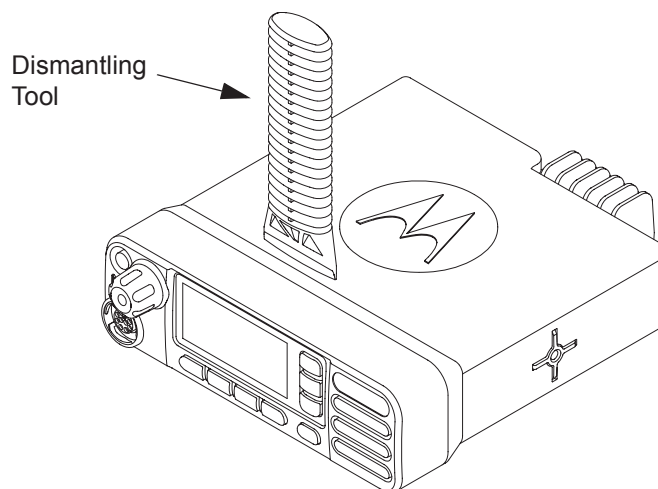


Figure 5-1 Typical Control Head Removal

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

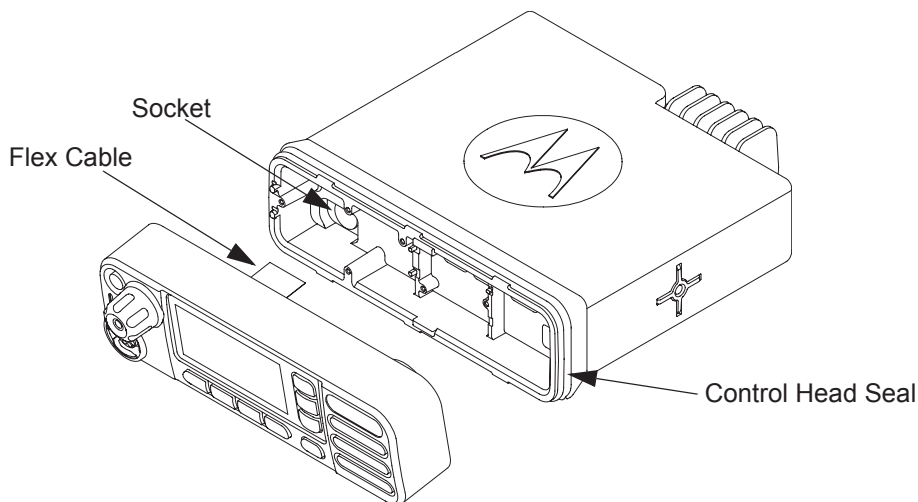


Figure 5-2 Flexible Connection Removal

4. Remove the flex cable from the socket on the radio assembly as shown in Figure 5-2.
5. Then remove control head seal, if required.

5.6.2 Top Cover Removal

1. Insert the dismantling tool between the top cover and the chassis as shown in Figure 5-3.
2. Press on the dismantling tool until one side wall of the top cover starts to clear the chassis trunnion mounting features.
3. Repeat step 2 for the other side of the top cover.
4. Lift the top cover from the chassis.

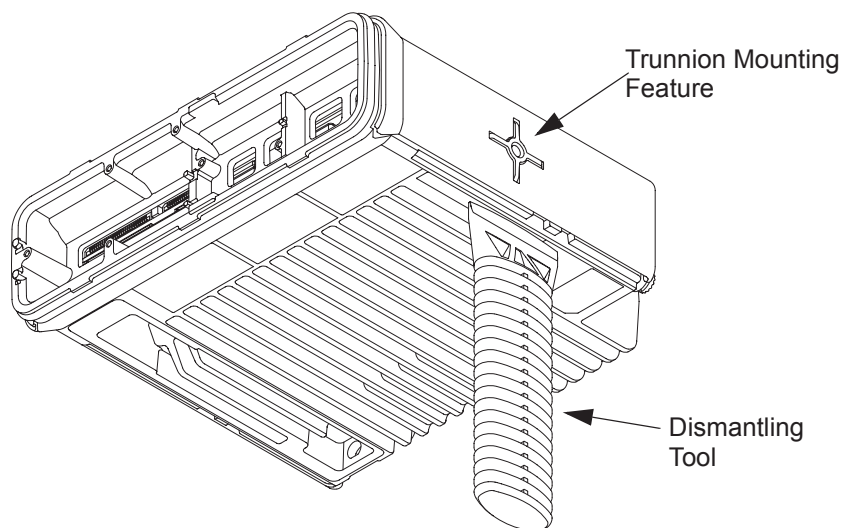


Figure 5-3 Top Cover Removal

5.6.3 Transceiver Board Removal

1. Remove the acoustic plug by pulling up on it.

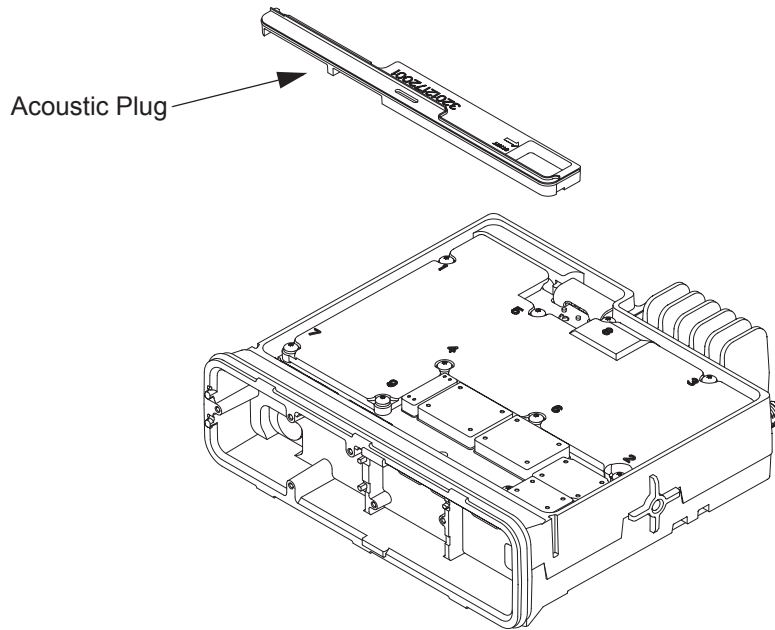


Figure 5-4 Acoustic Plug Removal

2. Remove the nine screws from the die cast main shield and the one screw directly on the PCB using the T10 TORX™ driver as shown in Figure 5-5.
3. Lift the die cast main shield from the chassis.

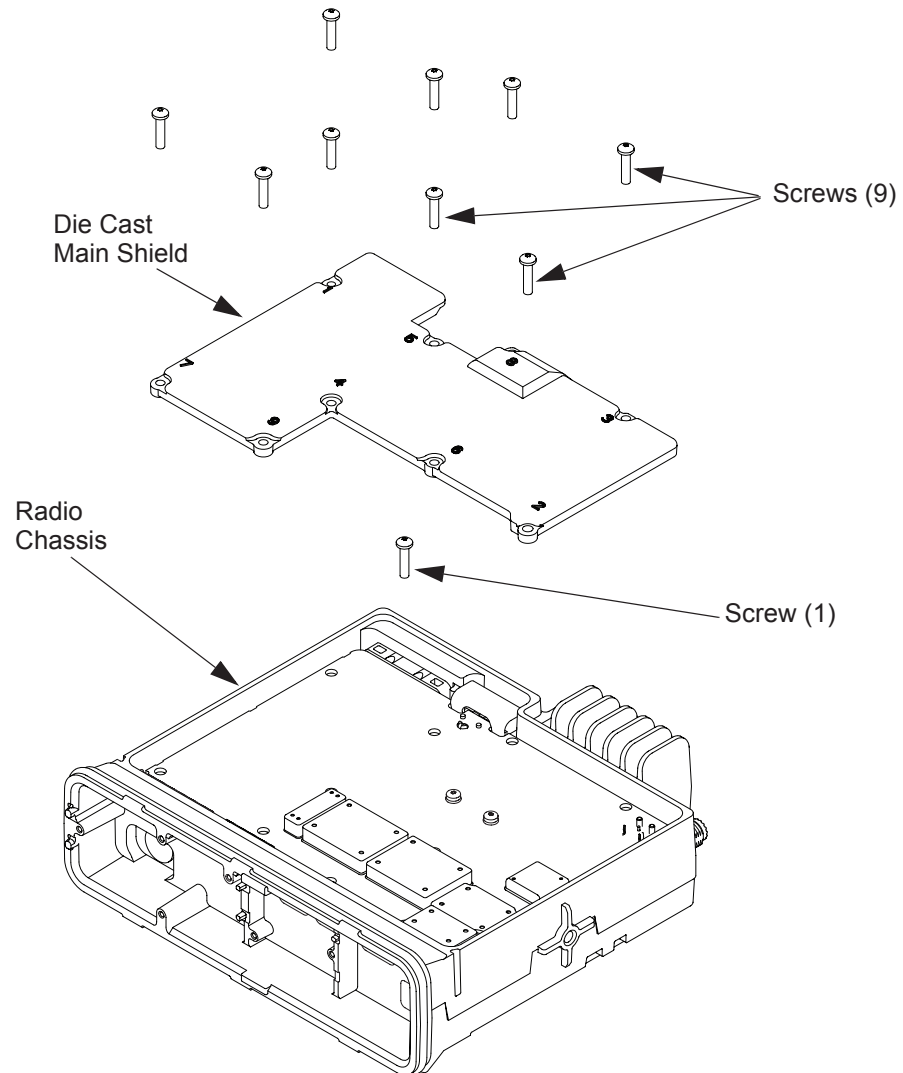


Figure 5-5 Die Cast Main Shield Removal

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

NOTE: Do not remove the washers from the screws.

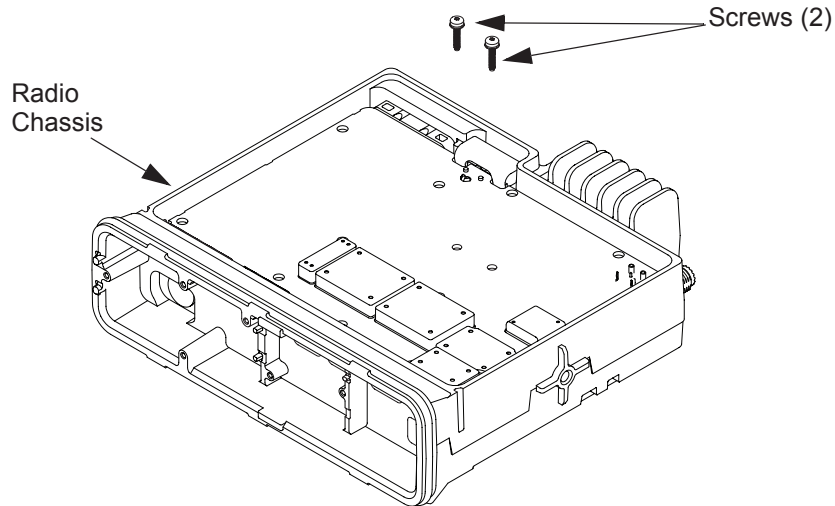


Figure 5-6 PA Screw Removal

- Remove the accessory connector from the radio assembly by inserting a flat-blade screwdriver into the slot on the top of the connector as shown in Figure 5-7.



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

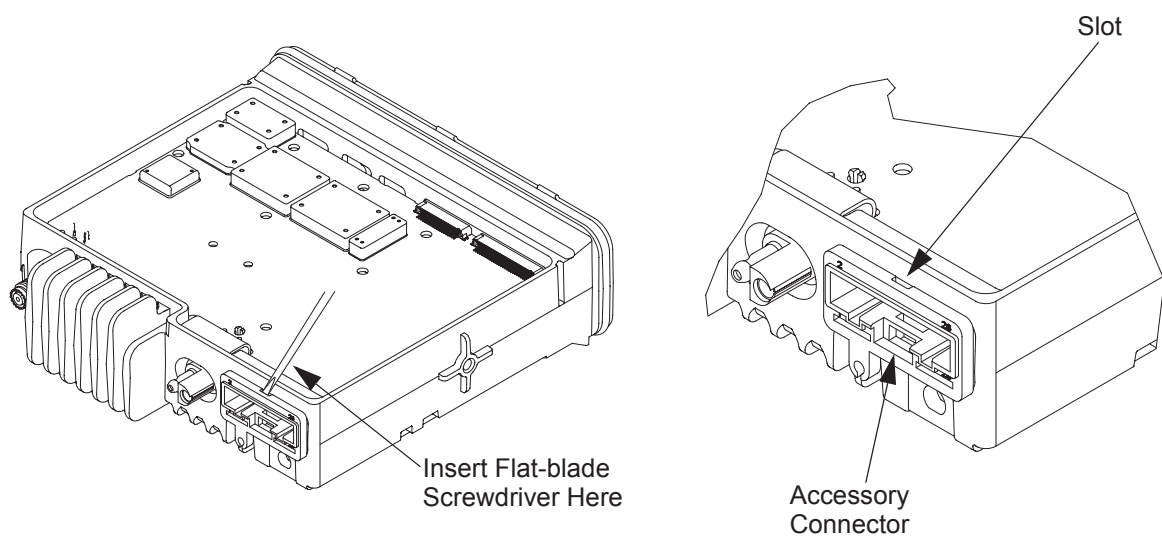


Figure 5-7 Accessory Connector Removal

6. Remove the DC Connector retention clip by gently prying it out with a flat-blade screwdriver as shown in Figure 5-8.

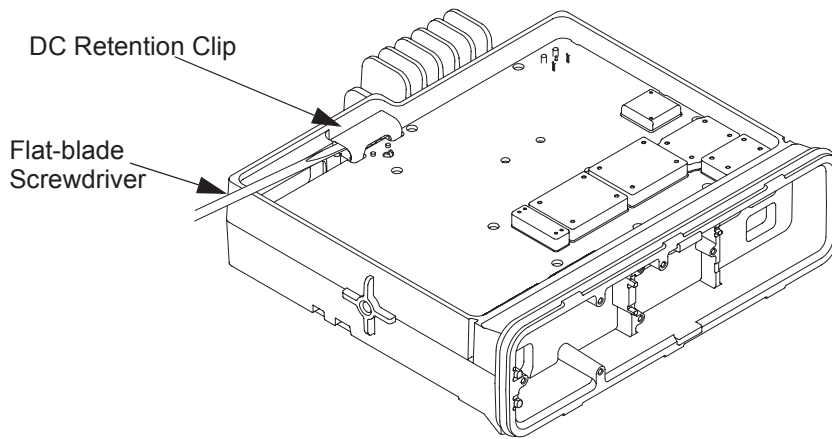


Figure 5-8 DC Connector Retention Clip Removal

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

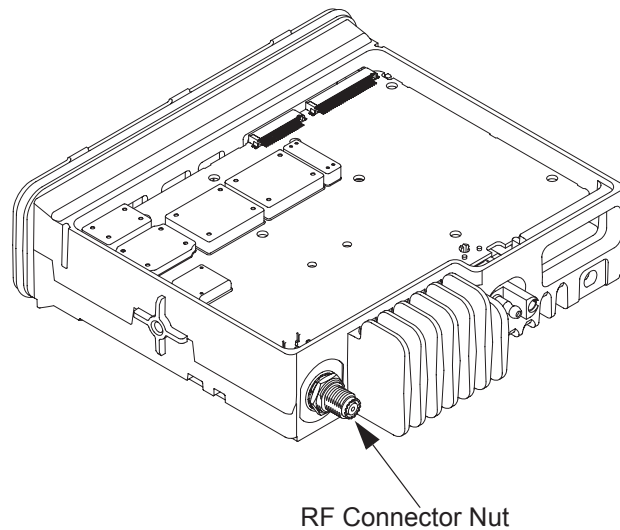


Figure 5-9 RF Connector Nut Removal

- Remove the transceiver board by sliding a finger into the opening provided at the front of the radio and gently pressing up on the PCB between the connectors, lifting up the front of the transceiver board, as shown in Figure 5-10. 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. Every time the Transceiver Board is removed, the Final Driver Thermal Pad must be replaced.



Caution

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

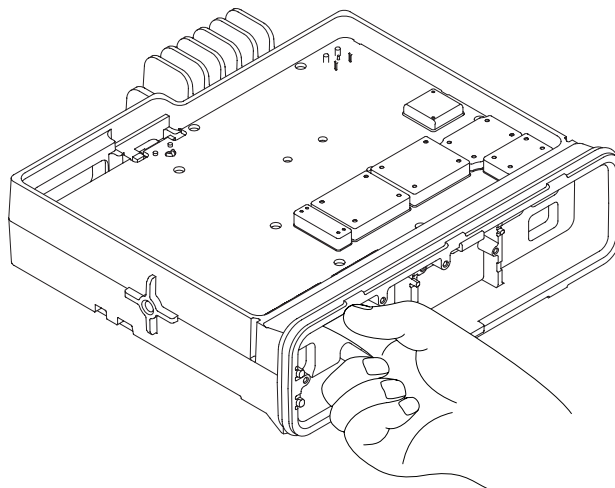


Figure 5-10 Transceiver Board Removal

5.6.4 GPS Antenna Connector Removal (For GPS Models Only)

1. Using a T6 TORX™ driver, remove the screws securing the expansion board to the chassis.
2. Unplug the GPS cable MCX connector from the expansion board.

NOTE: Disconnect the MCX connector by grabbing and pulling on the MCX connector body and not the GPS cable itself.

3. Unplug the flex from the transceiver board.

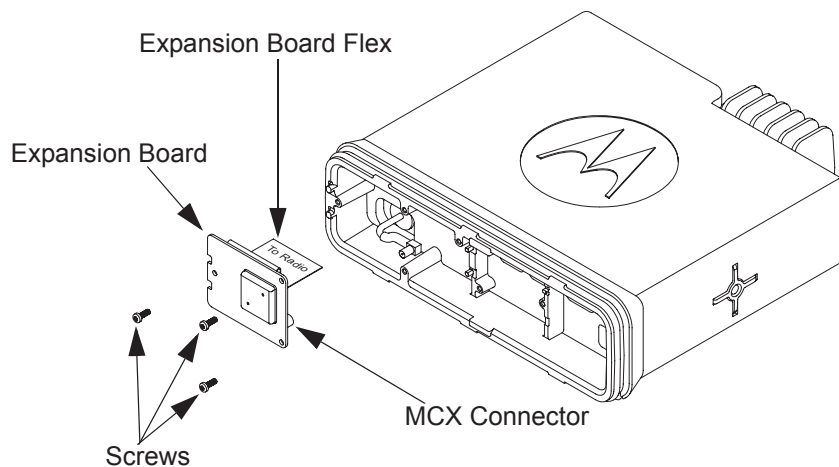


Figure 5-11 Expansion Board and Flex Removal

4. Use a flat-blade screwdriver to lift the GPS nameplate from the chassis. See Figure 5-12.

NOTE: If the GPS nameplate is removed it will need to be replaced.

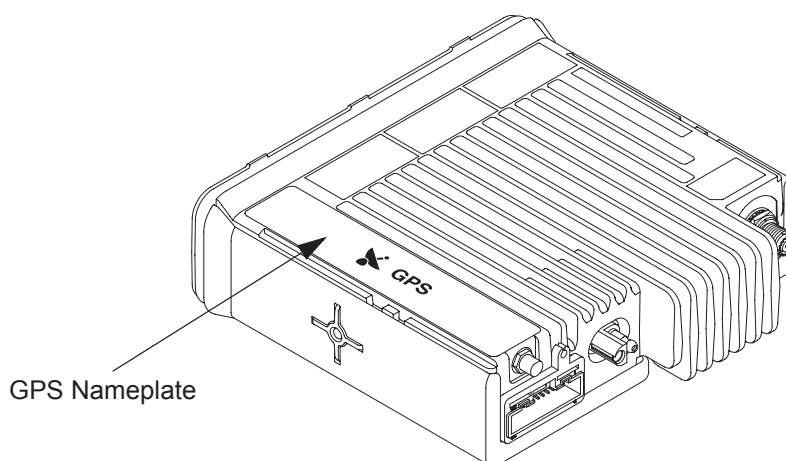


Figure 5-12 GPS Nameplate Removal

- Using a 5/16" or 8 mm socket driver, remove the nut from the GPS antenna connector and remove the lock washer from the connector. See Figure 5-13.

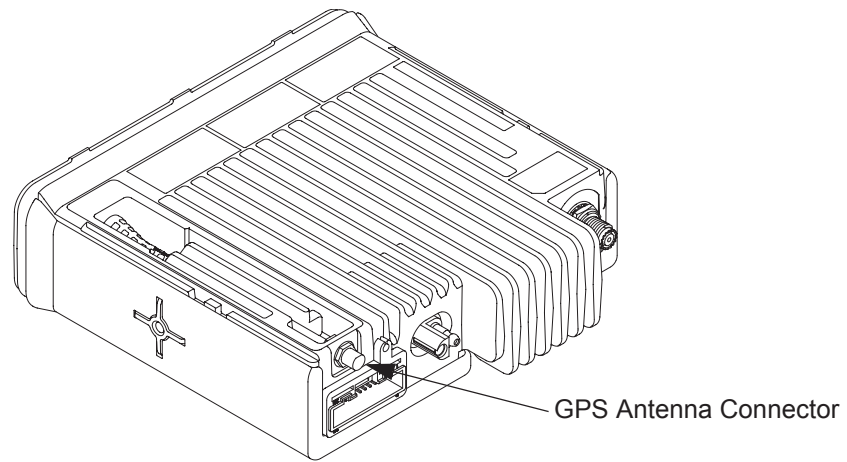


Figure 5-13 GPS Connector Nut Removal

- Remove the GPS cable from the chassis by pulling on the GPS cable strain relief.

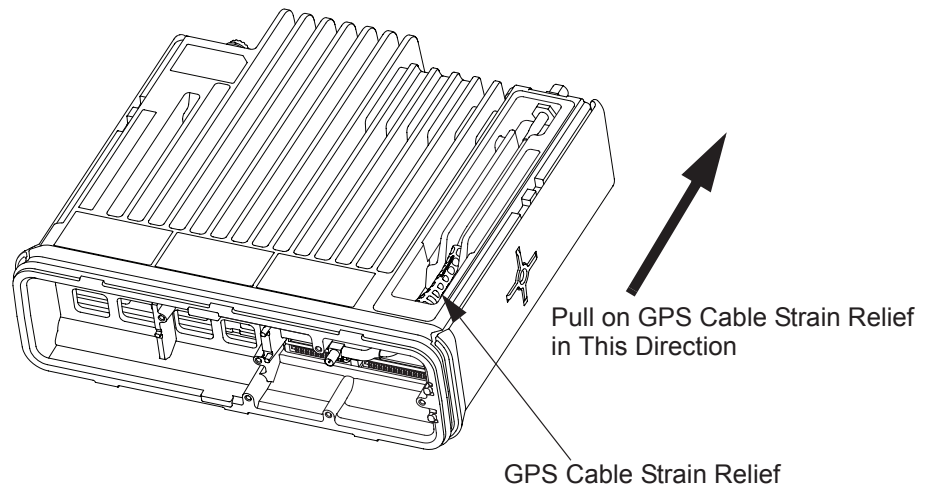


Figure 5-14 GPS Cable Removal

5.6.5 Option Board Removal (For Option Board Models Only)

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

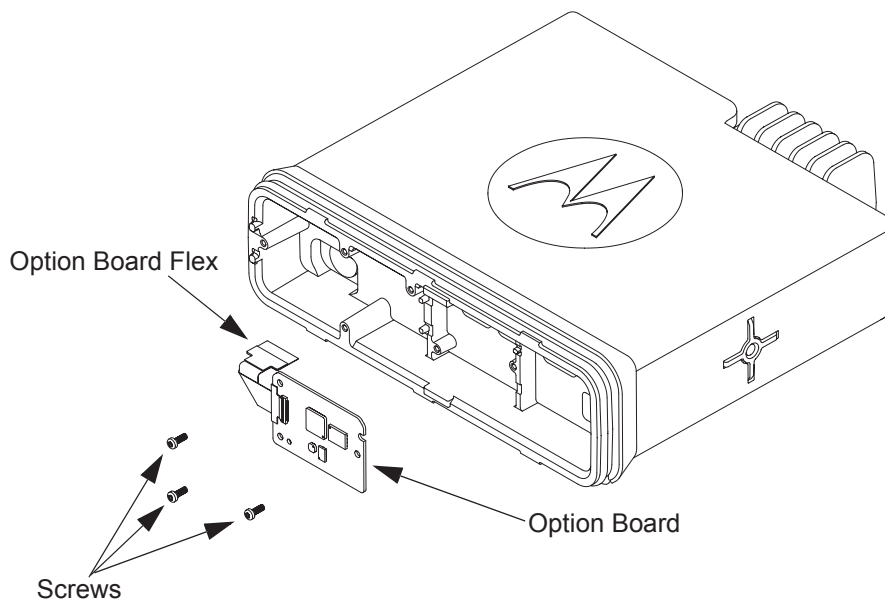


Figure 5-15 Option Board Removal

5.6.6 Disassembly of Colour Display Control Head

1. Disconnect the speaker plug from the control head board.
2. Unplug the control head flex from the control head board by gently pulling the flex out of the connector.

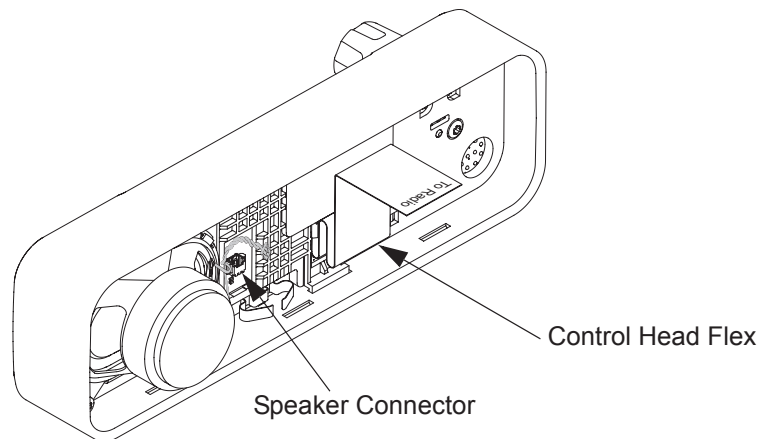


Figure 5-16 Control Head Flex Removal

3. Remove the volume/channel knob from the control head housing by lifting it with the volume/channel knob removal tool.

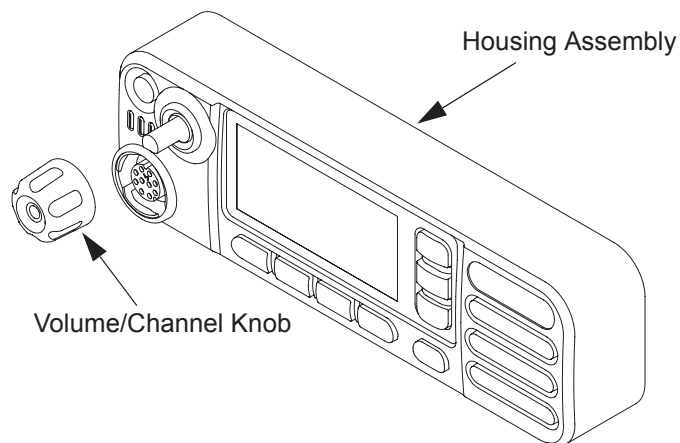


Figure 5-17 Volume/Channel Knob Removal

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

NOTE: Remove the speaker retainer only if required.

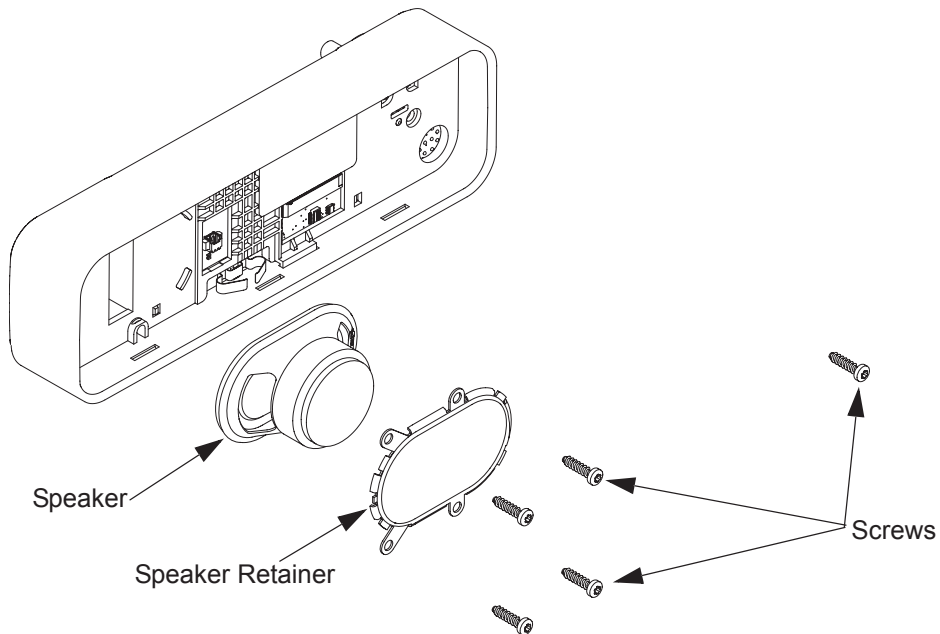


Figure 5-18 Control Head Screws and Speaker Removal

6. Gently spread the side walls of the control head housing to release the PCB retainer tabs from the housing.

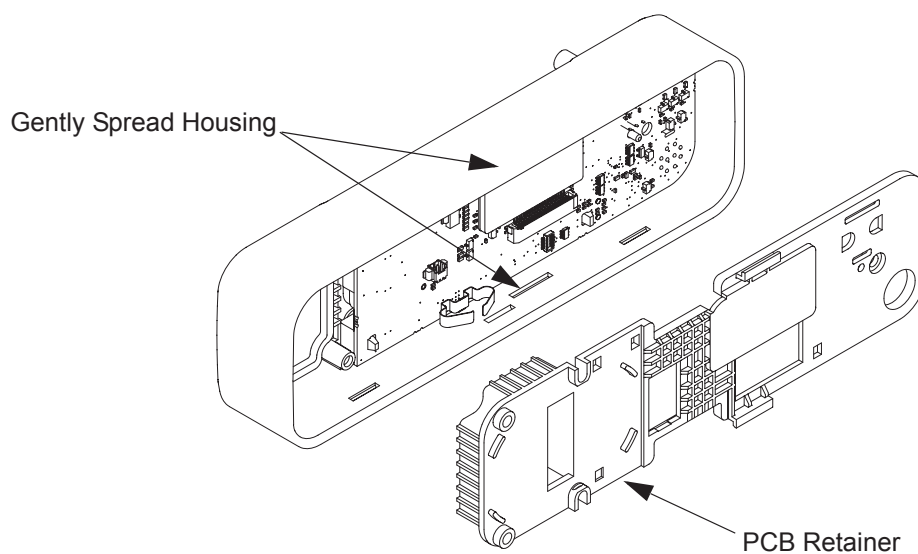


Figure 5-19 PCB Retainer Removal

7. 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.

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

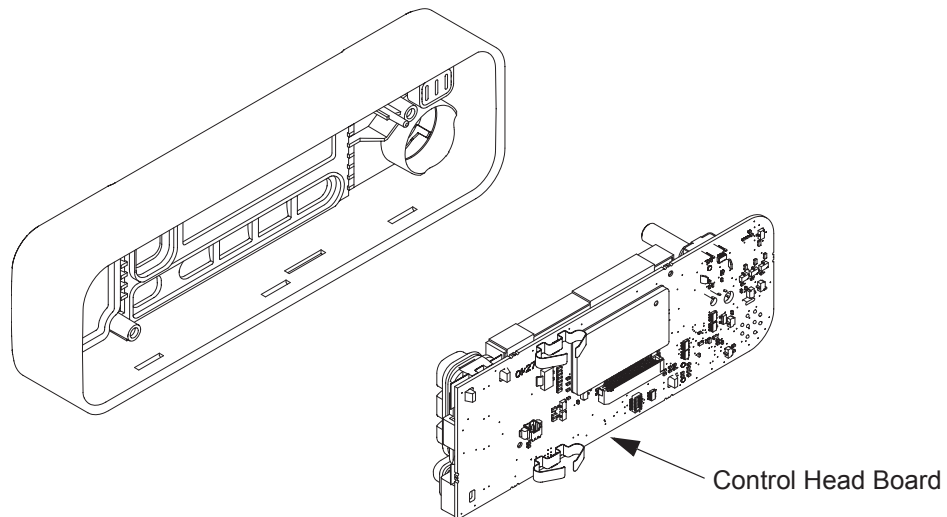


Figure 5-20 Control Head Board Removal

8. Remove the power button by lifting it from the control head housing.
9. Separate the light barrier from the power button, if required.

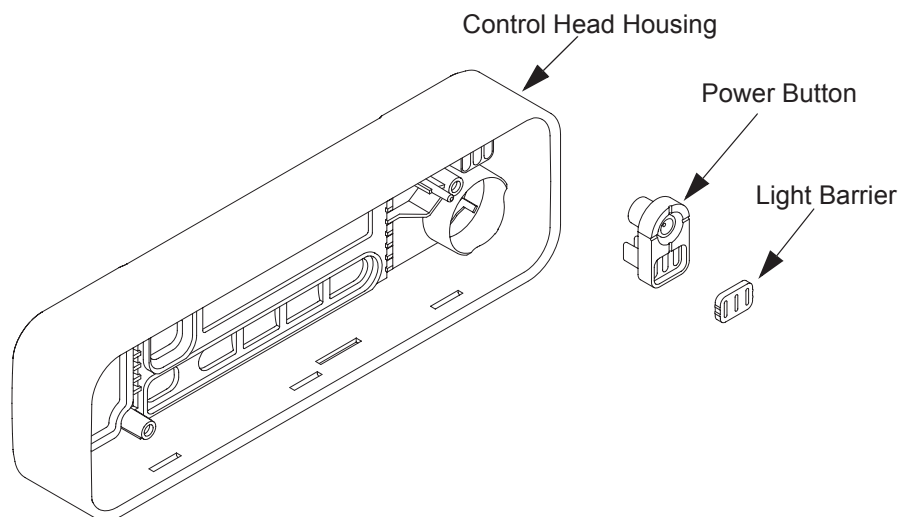


Figure 5-21 Power Button Removal

10. Separate the keypad from the keypad frame.
11. Remove the keypad frame from the control head board by compressing the retaining latch features.

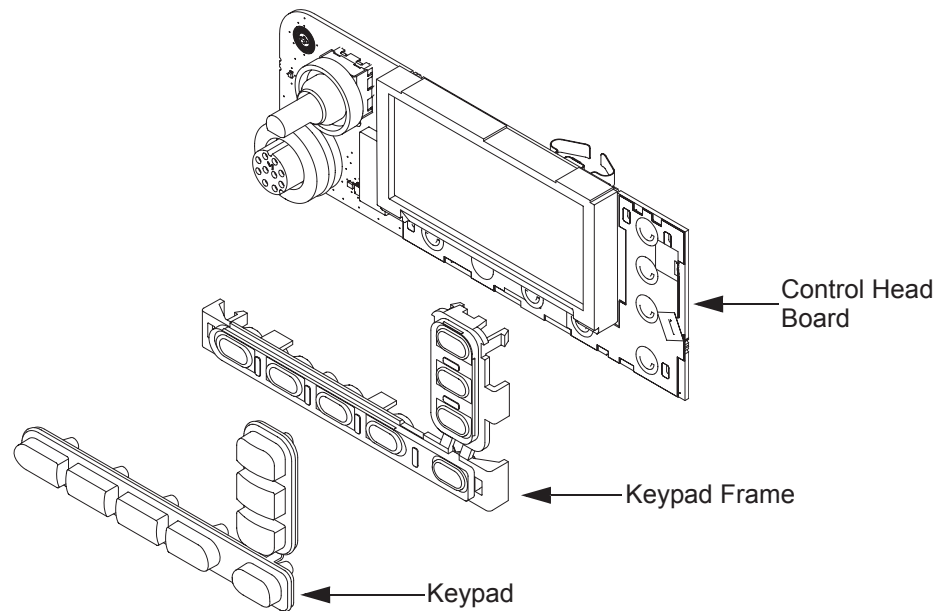


Figure 5-22 Keypad Removal

12. Separate the volume encoder seal and mic jack seal from the control head board.

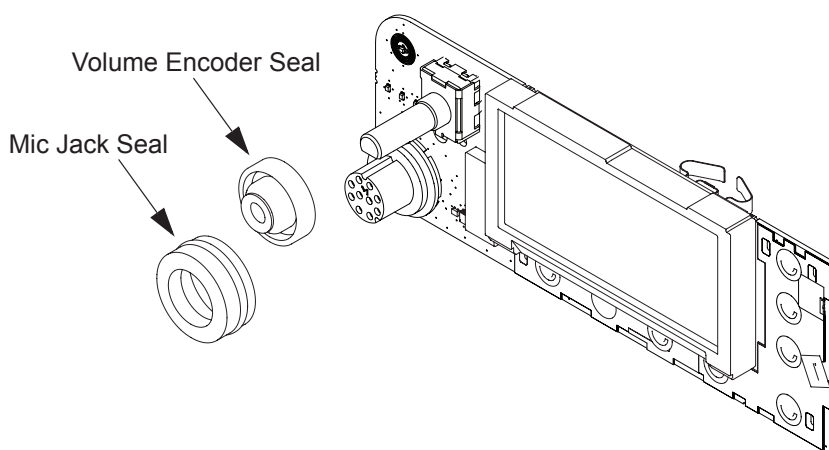


Figure 5-23 Volume Encoder Seal and Mic Jack Seal Removal

13. Separate the display pad gasket from the colour display.

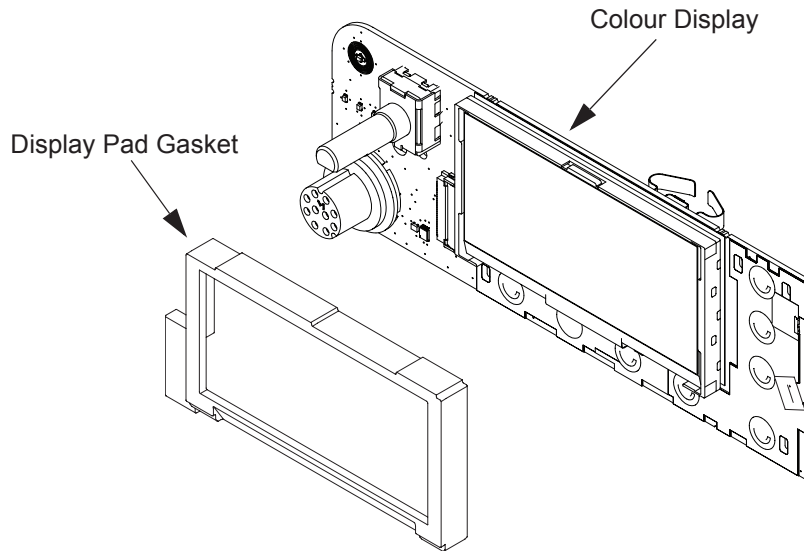


Figure 5-24 Display Pad Gasket Removal

14. Disconnect the display flex from the connector on the PCB.
15. Gently pull or lift on one side of the display to slowly separate the display from the adhesive.

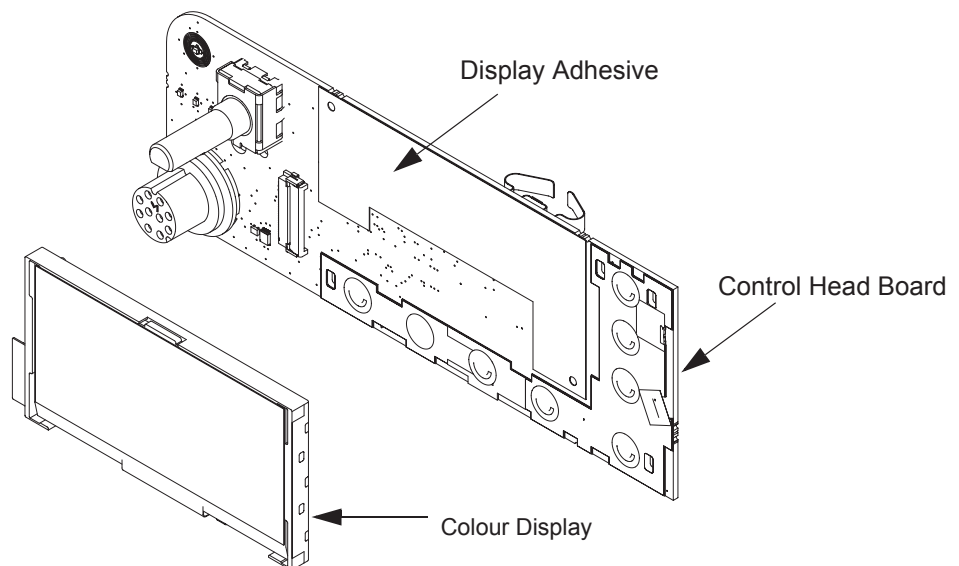


Figure 5-25 Colour Display Removal from PCB

5.6.7 Disassembly of Numeric Display Control Head

1. Disconnect the speaker plug from the control head board.
2. Unplug the control head flex from the control head board by gently pulling the flex out of the connector.

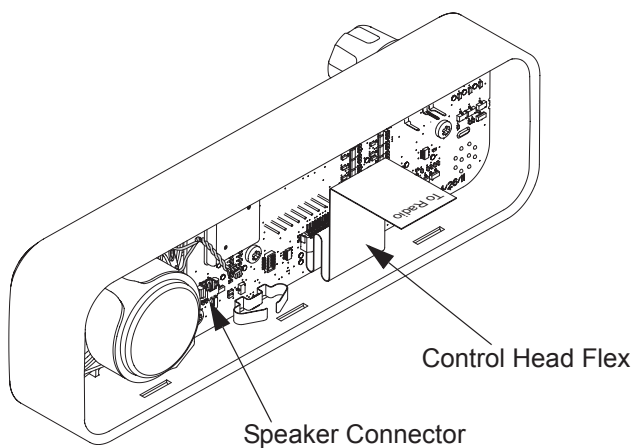


Figure 5-26 Control Head Flex Removal

3. Remove the volume/channel knob from the control head housing by lifting it with the volume/channel knob removal tool.

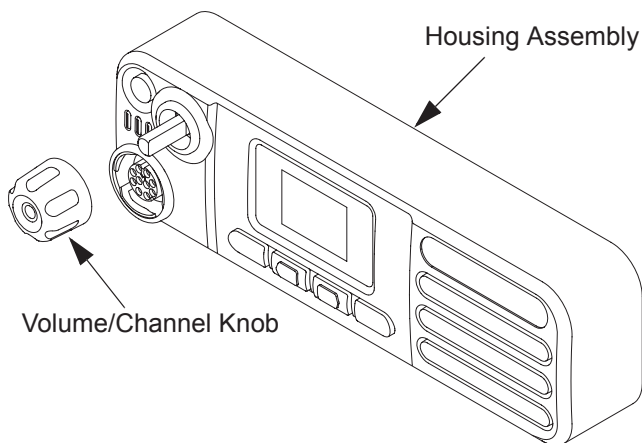


Figure 5-27 Volume/Channel Knob Removal

4. Remove the seven screws from the control head board using the T10 TORX™ driver.
5. Remove the control head board from the control head assembly by pressing on the mic jack. Handle the control head board by the edges only and store it in an antistatic bag.

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

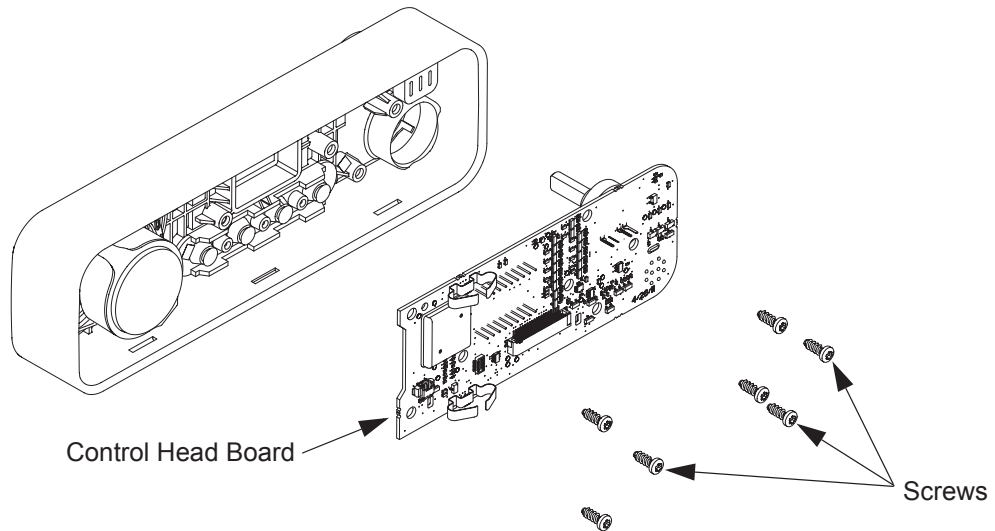


Figure 5-28 Control Head Board Removal

6. Remove the power button by lifting it from the control head housing.
7. Separate the light barrier from the power button, if required.
8. Remove the keypad assembly from the control head housing by pushing on the keypad.
9. Separate the keypad from the keypad frame.

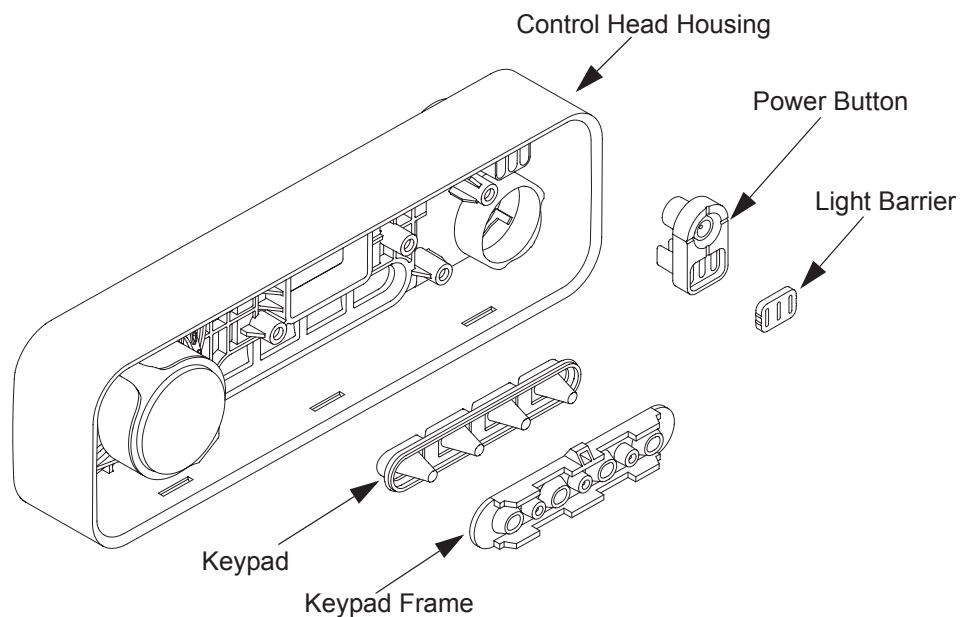


Figure 5-29 Power Button and Keypad Removal

10. Optional: If required, the speaker can be removed by removing 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.
11. Remove the speaker from the control head housing.

NOTE: Remove the speaker retainer only if required.

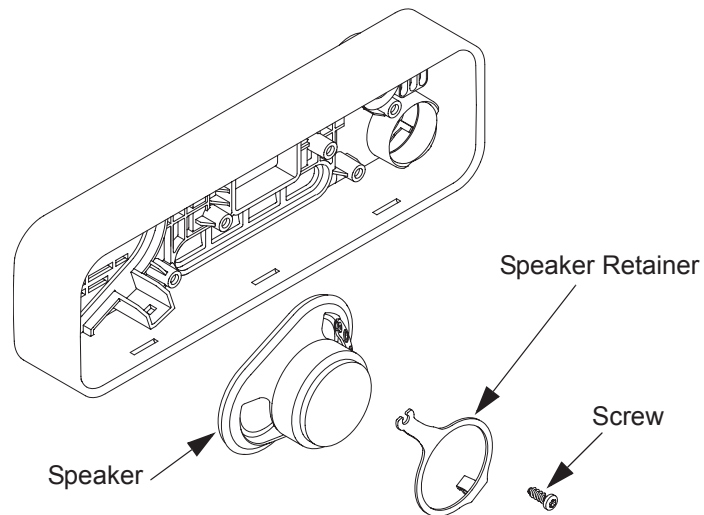


Figure 5-30 Speaker Removal (Optional)

12. Separate the volume encoder seal and mic jack seal from the control head board.

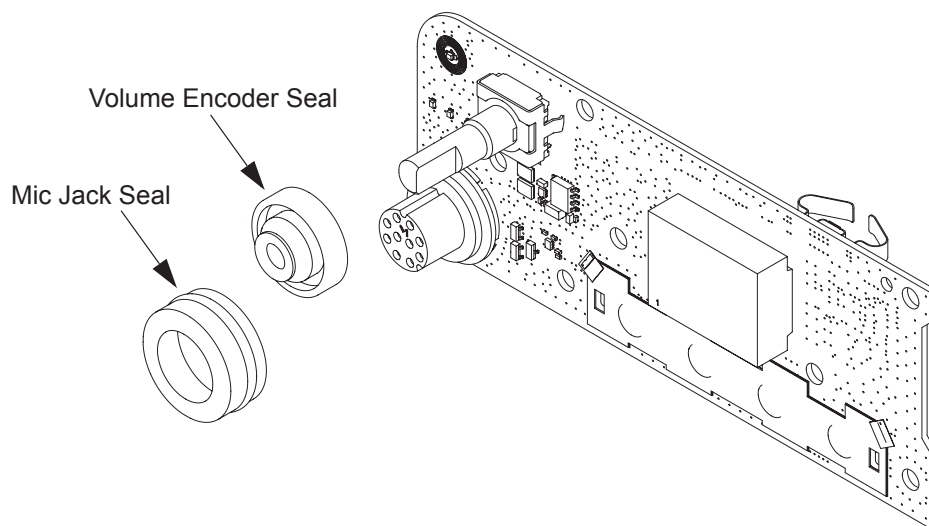


Figure 5-31 Volume Encoder Seal and Mic Jack Seal Removal

5.7 Radio Reassembly – Detailed

5.7.1 Colour Display Control Head

1. Assemble the power button and light barrier and then place the subassembly inside the control head housing. Refer to Figure 5-32.

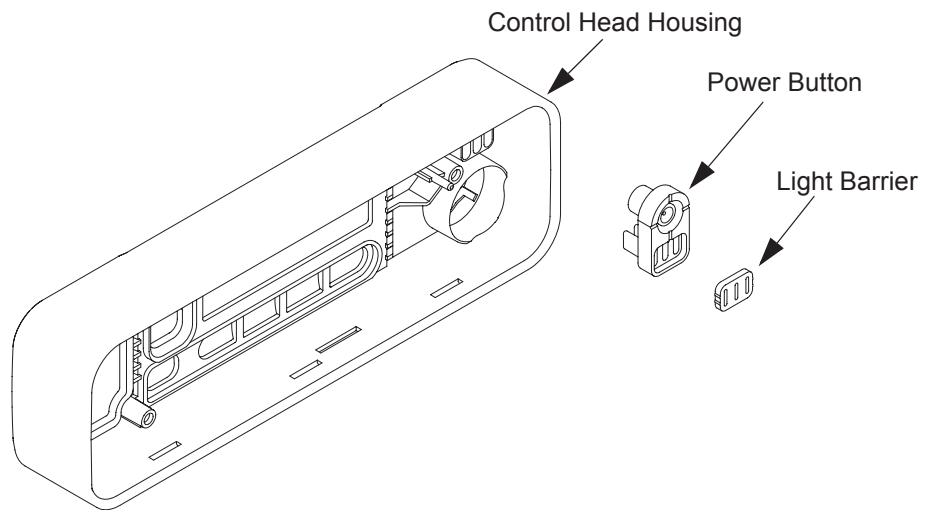


Figure 5-32 Power Button Placement

2. Assemble the keypad to the keypad frame. Refer to Figure 5-33.
 - a. If attached to the control head board, remove by compressing the retaining latch features.

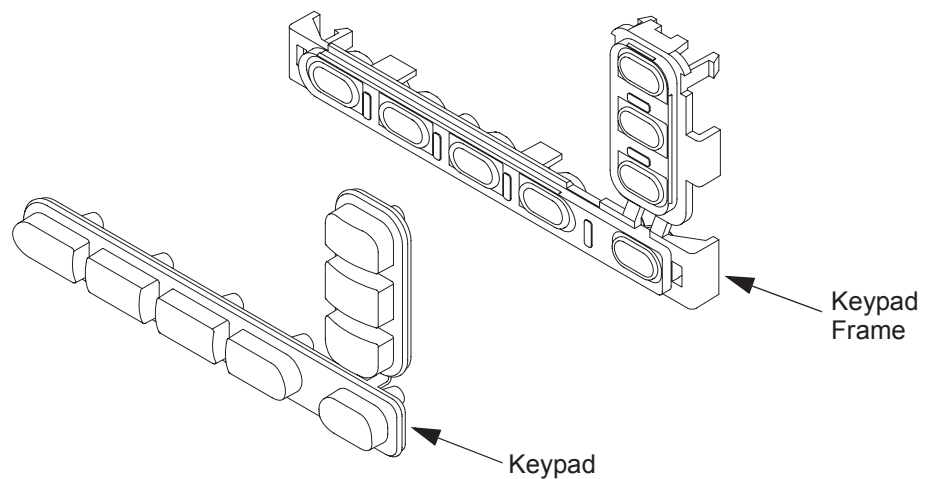


Figure 5-33 Keypad Assembly

3. Assemble the keypad frame assembly and volume encoder seal to the control head housing until fully seated. Refer to Figure 5-34.

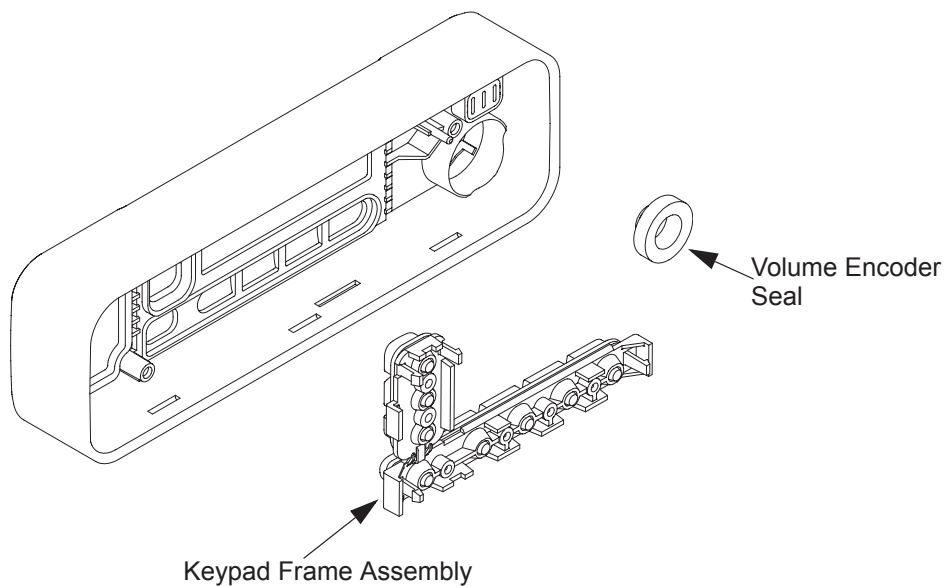


Figure 5-34 Assembly to Control Head Housing

4. Align the colour display alignment pins to the PCB holes.
5. Firmly press along the outer perimeter of the display to activate the adhesion of the display to the display adhesive.
6. Connect the display flex to the connector on the PCB.

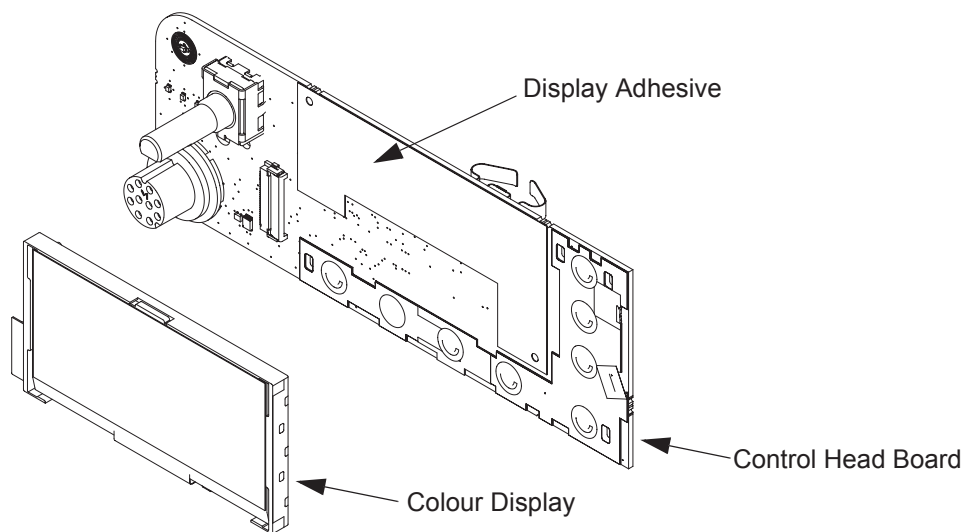


Figure 5-35 Assembling Colour Display to PCB

7. Assemble the mic jack seal around the mic jack as shown in Figure 5-36. Be sure to place mic jack seal flush to the PCB.

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

8. Assemble the display pad gasket to the display.

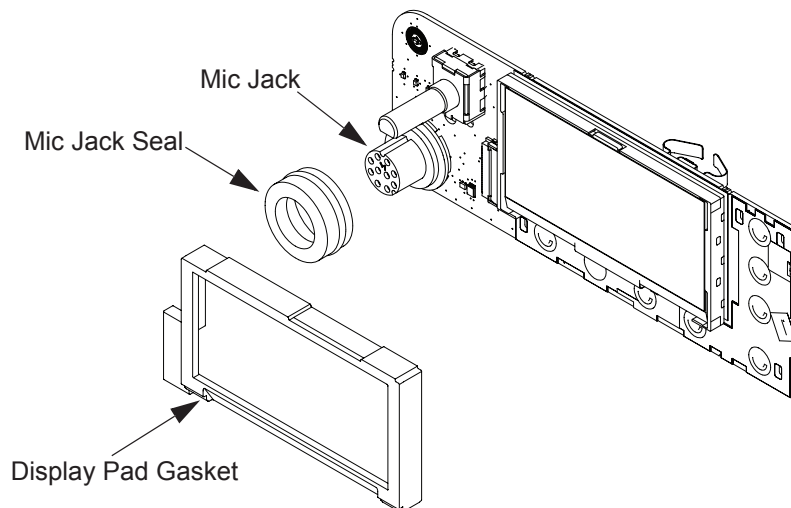


Figure 5-36 Assembling Mic Jack Seal and Display Pad Gasket

9. Assemble the control head flex to the mating connector on the control head board, making sure it is fully seated as shown in Figure 5-37.
10. Assemble the control head board to the control head assembly.

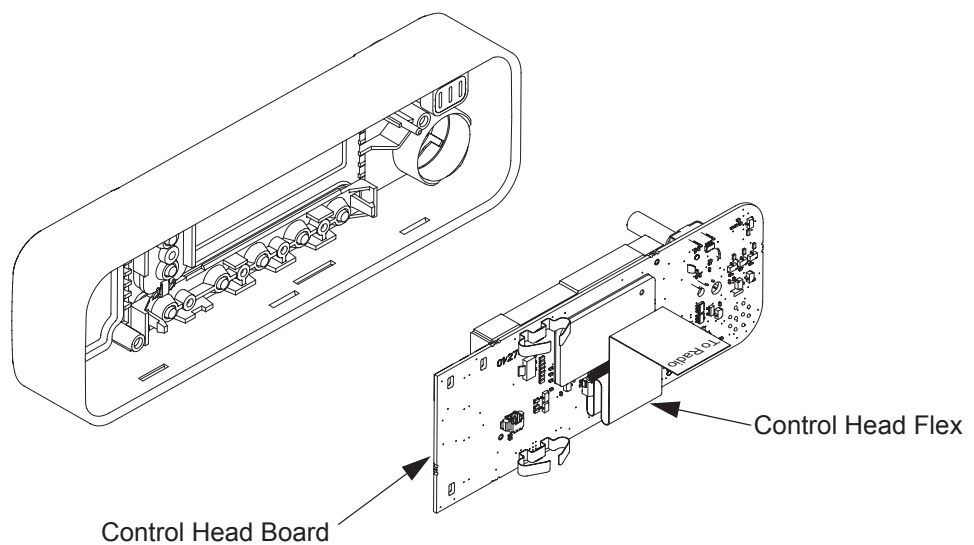


Figure 5-37 Assembling Control Head Board to Control Head Assembly

11. Assemble the PCB retainer to the control head assembly until it is fully seated. You will need to feed the control head flex through the PCB retainer.

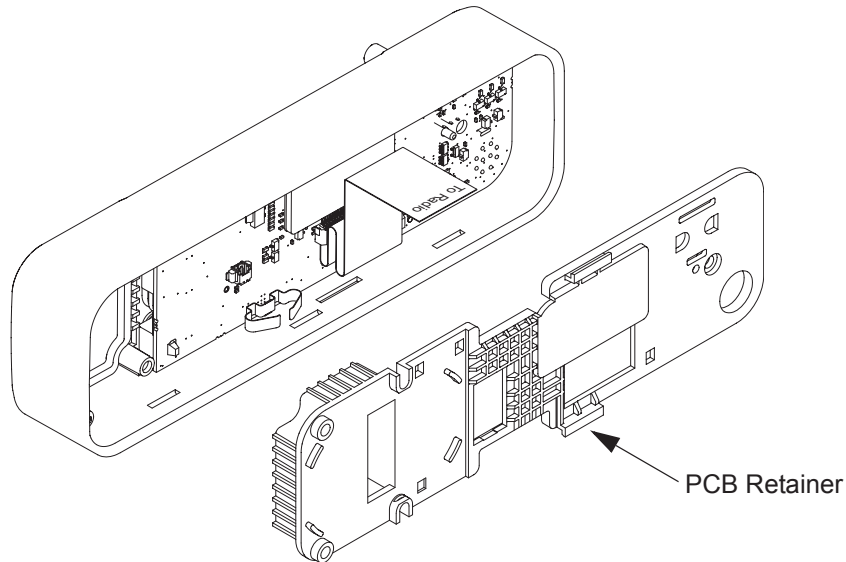


Figure 5-38 Assembling PCB Retainer

12. Assemble the speaker retainer to the speaker. It will snap over the speaker magnet. See Figure 5-39.

NOTE: Be sure to orient the speaker in the direction of the wire and connector towards the middle of the control head. See Figure 5-40.

13. Assemble the speaker to the control head assembly. Assemble the screws in a cross pattern with the single PCB screw installed last.
14. Connect the speaker plug to its mating connector on the control head board.

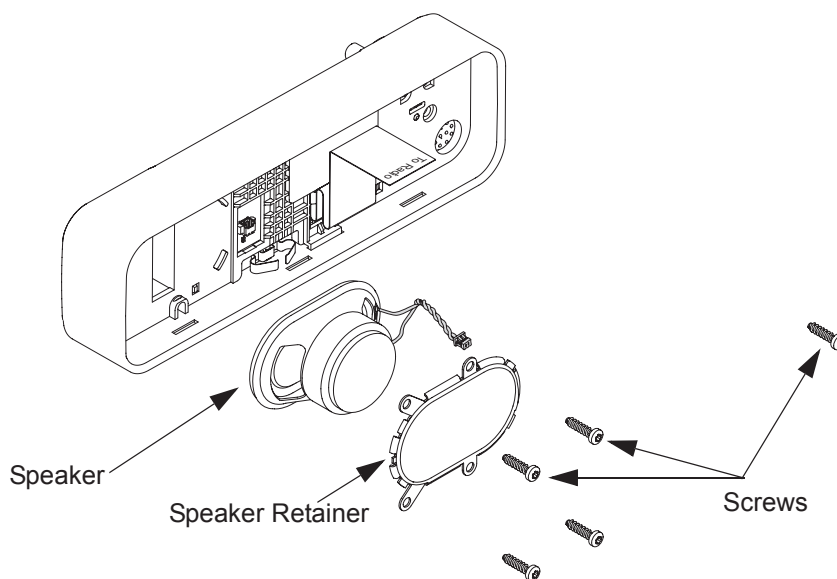


Figure 5-39 Assembling Speaker

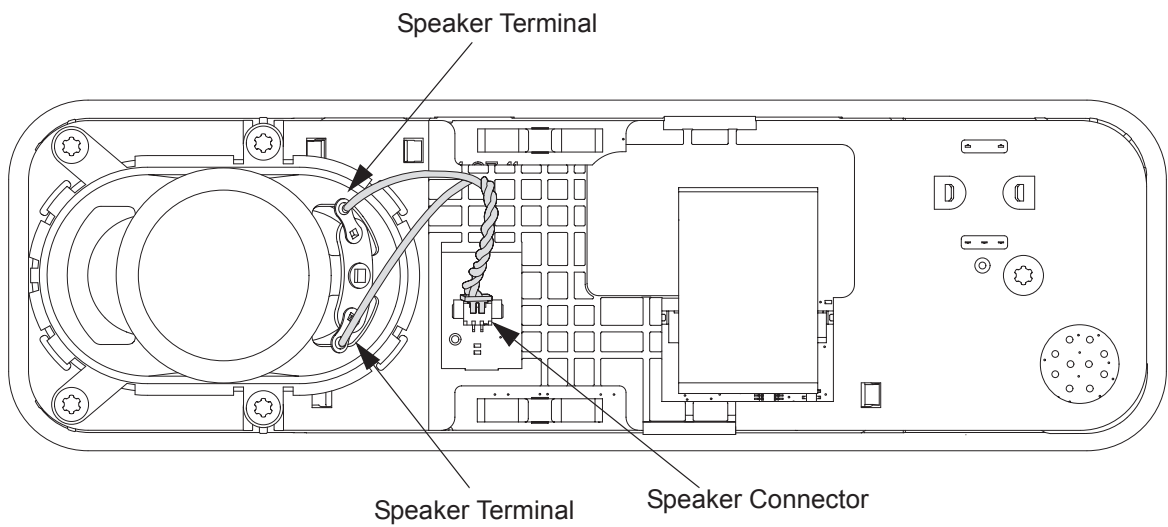


Figure 5-40 Orientation of Speaker

15. Orientate the volume/channel knob so that the internal D-shaped opening matches the volume encoder shaft and press the volume/channel knob into the control head assembly until it is fully seated and the knob rotates freely. Refer to Figure 5-41.

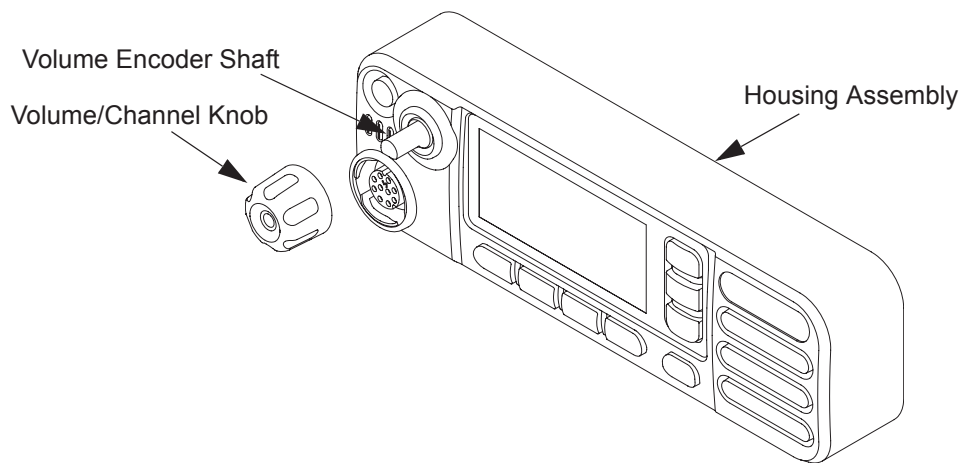


Figure 5-41 Volume/Channel Knob Assembly

5.7.2 Numeric Display Control Head

1. Assemble the power button and light barrier and then place the subassembly inside the control head housing. Refer to Figure 5-42.

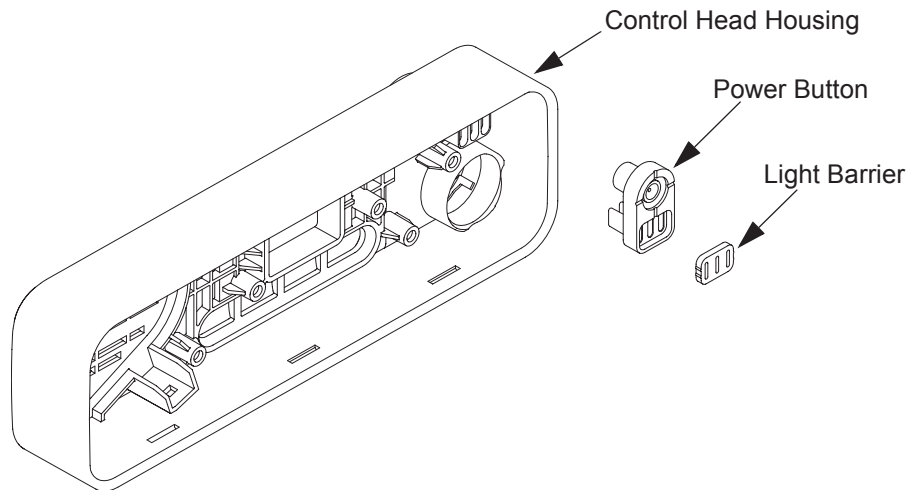


Figure 5-42 Power Button Placement

2. Assemble the keypad to the keypad frame. Refer to Figure 5-43.

Note Orientation of Keypad to Keypad Frame

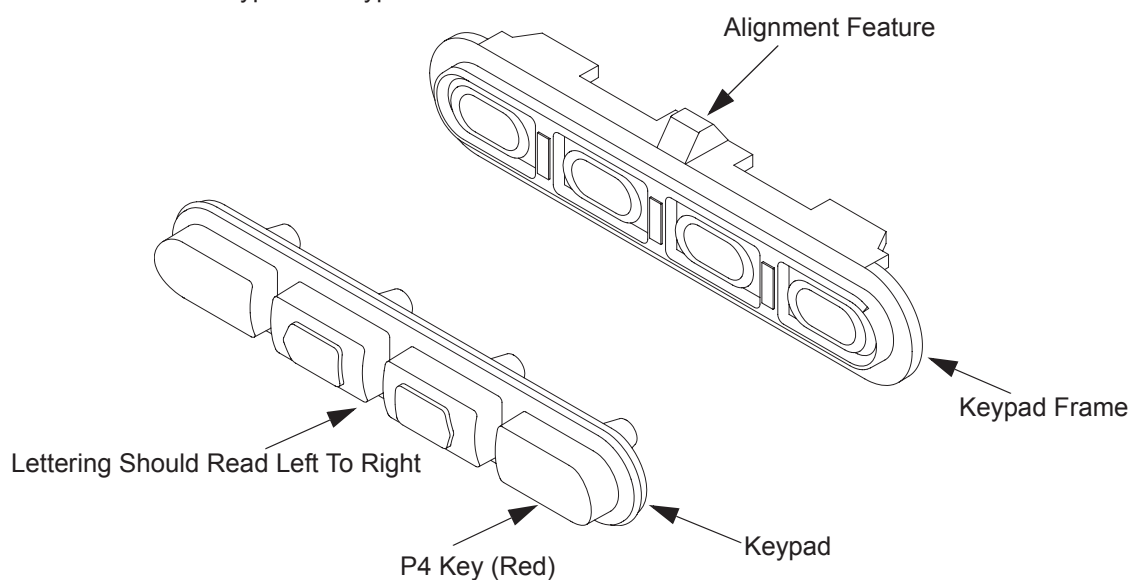


Figure 5-43 Keypad Assembly

3. Assemble the keypad frame assembly and volume encoder seal to the control head housing until they are fully seated. Refer to Figure 5-44.

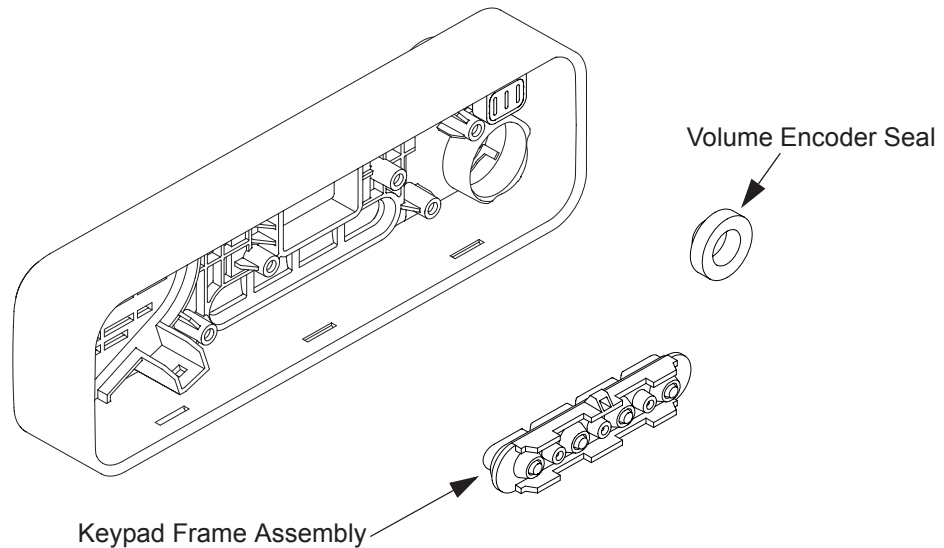


Figure 5-44 Assembly to Control Head Housing

4. Assemble the mic jack seal around the mic jack as shown in Figure 5-45. Be sure to place mic jack seal flush to the PCB.

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

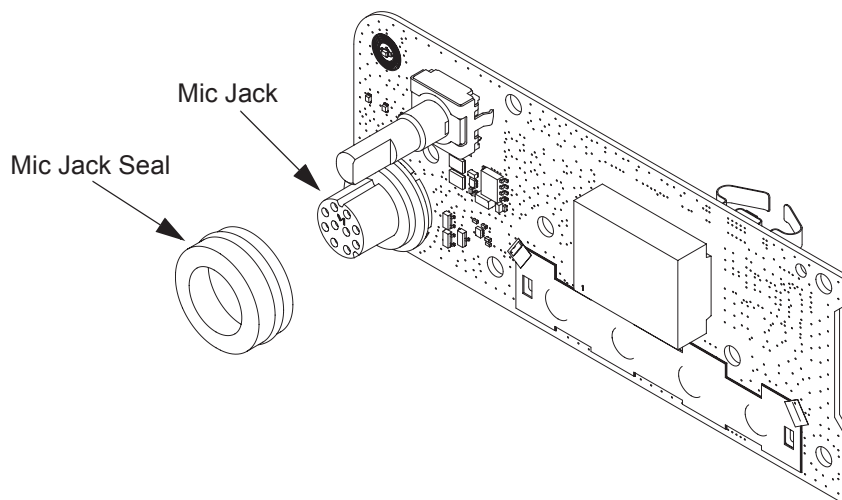


Figure 5-45 Assembling Mic Jack Seal

5. Assemble the speaker retainer to the speaker. It will snap over the speaker magnet. See Figure 5-46.

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

6. Assemble the speaker to the control head assembly.

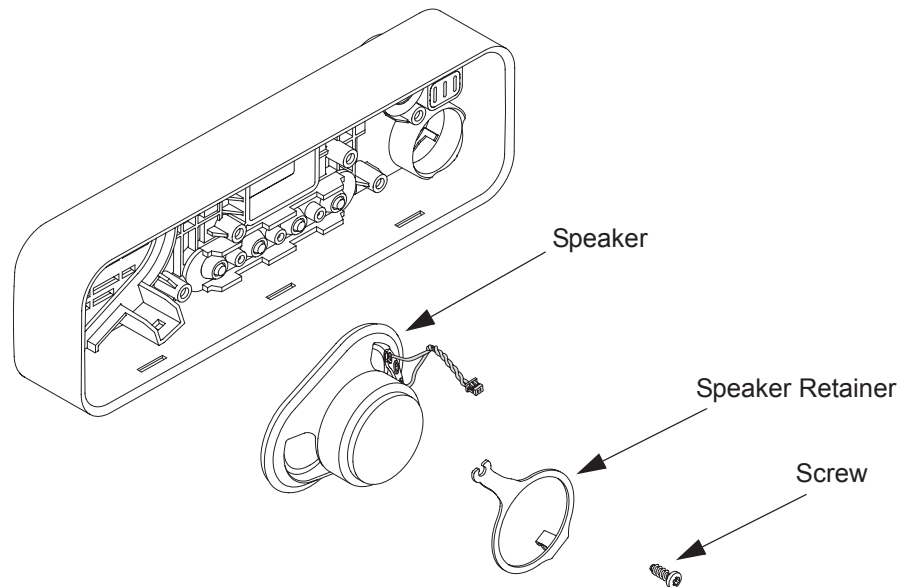


Figure 5-46 Assemble Speaker

7. Hook one side of the speaker retainer into the control head assembly as shown in Figure 5-47.
8. Place a screw into the other end of the speaker retainer and using a T10 TORX™ driver, tighten the screw to 0.88 N-m (7.8 lbs-in).

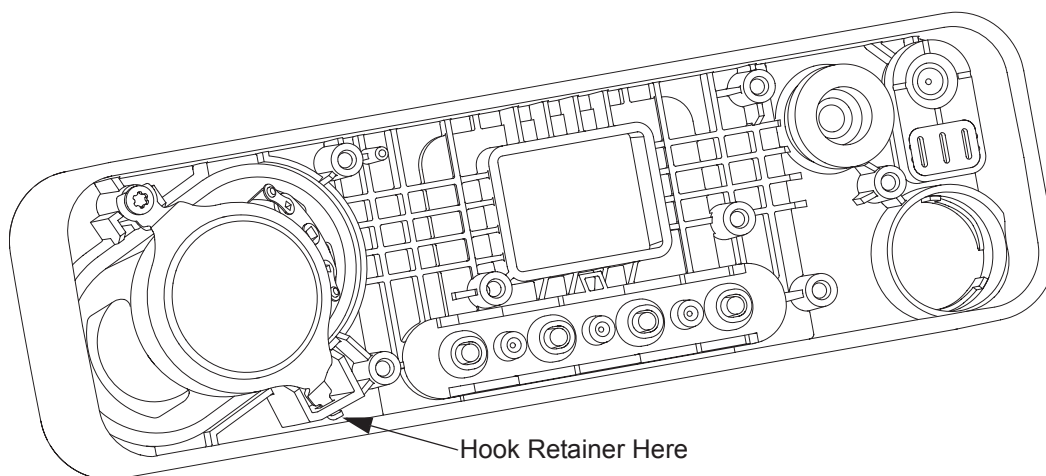


Figure 5-47 Speaker Retainer Assembly

9. Assemble the control head flex to the mating connector on the control head board, making sure it is fully seated as shown in Figure 5-48.
10. Assemble the control head board to the control head assembly.

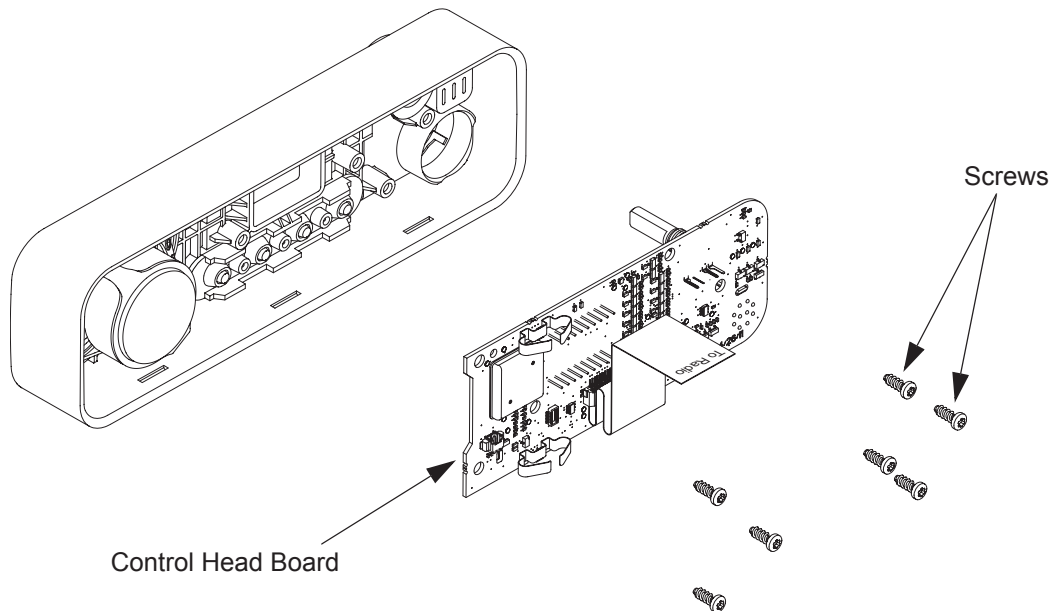


Figure 5-48 Assembling Control Head Board to Control Head Assembly

11. Using a T10 TORX™ driver, tighten the seven screws to 0.88 N-m (7.8 lbs-in) following the sequence as shown in Figure 5-49.
12. Connect the speaker plug to its mating connector on the control head board.

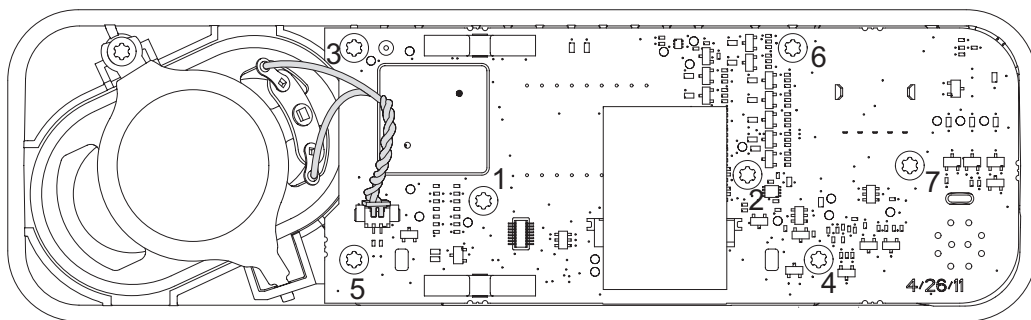


Figure 5-49 Screw Sequence

13. Orientate the volume/channel knob so that the internal D-shaped opening matches the volume encoder shaft and press the volume/channel knob into the control head assembly until it is fully seated and the knob rotates freely. Refer to Figure 5-50.

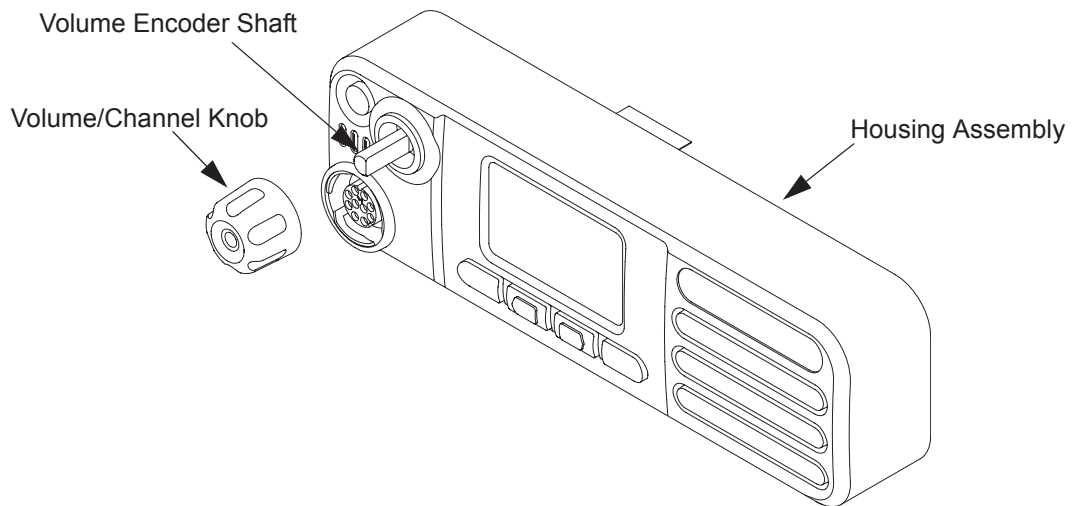


Figure 5-50 Volume/Channel Knob Assembly

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. Replace all new seals on their respective parts.

For both the die cast main shield and the chassis, thoroughly inspect the shield gasketing for damage and verify all thermal pads are in place and free from damage and debris. See Section 5.7.4: Thermal Pad Replacement Procedure on page 5-34 to replace damaged pads.

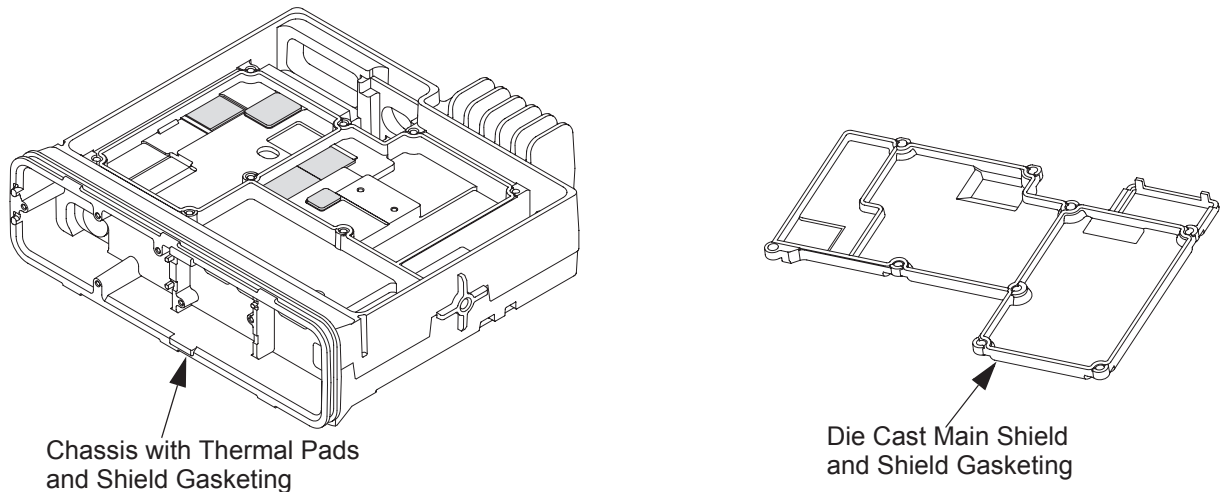


Figure 5-51 Thermal Pads and Shield Gasketing on Chassis and Die Cast Main Shield

2. Thoroughly inspect the chassis and verify all thermal pads are in place and free from damage. See Section 5.7.4: Thermal Pad Replacement Procedure on page 5-34 to replace damaged pads.

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

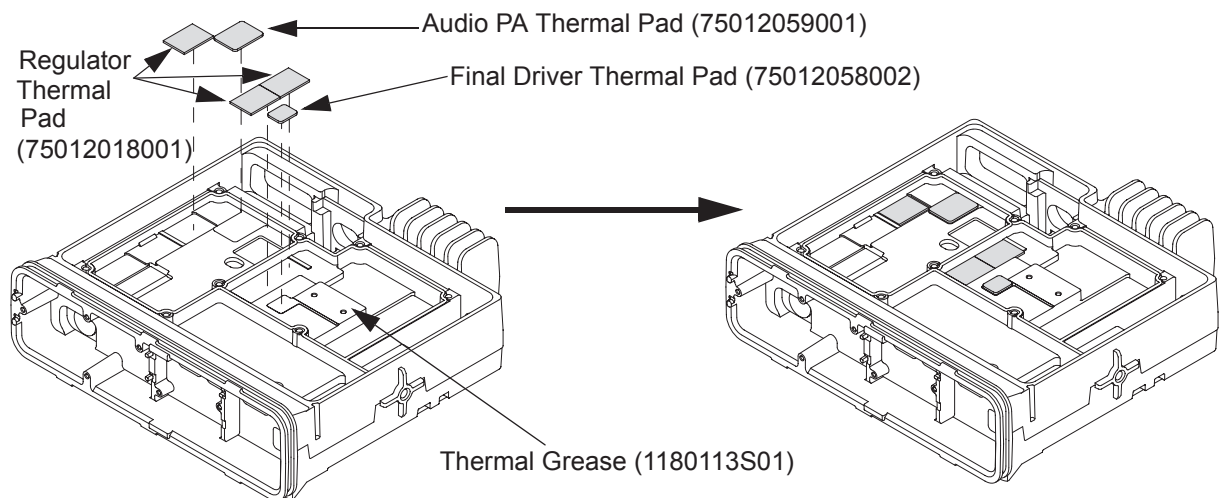


Figure 5-52 Chassis with Thermal Pads

5.7.4 Thermal Pad Replacement Procedure

Regulator Thermal Pad Replacement

1. Use a plastic flat-edge tool to lift the pad from the chassis surface. Discard the old pad.
2. Use a soft cloth to remove any remaining residue. Alcohol can also be used, if necessary. Care should be taken to minimize any cleaning-agent contact with the surrounding shield gasket.
3. Once the surface is clean and dry, remove the new pad from the shipping liner, and place it on the chassis as shown in Figure 5-53.

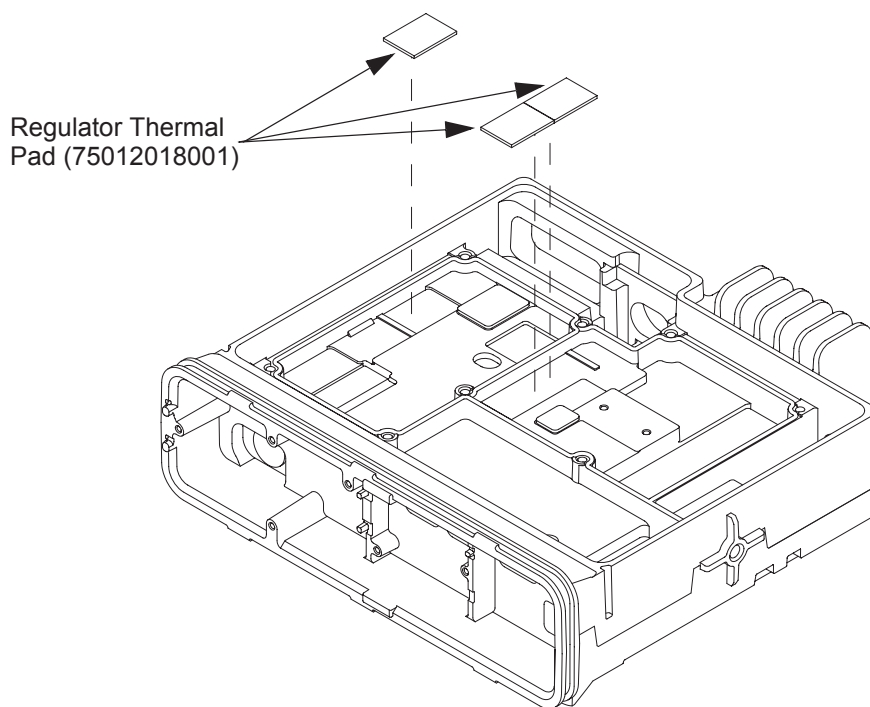


Figure 5-53 Replacing Regulator Thermal Pads

Audio PA Thermal Pad Replacement

1. Use a plastic flat-edge tool to lift the pad from the chassis surface. Discard the old pad.
2. Use a soft cloth to remove any remaining residue. Alcohol can also be used, if necessary. Care should be taken to minimize any cleaning-agent contact with the surrounding shield gasket.

3. Once the surface is clean and dry, remove the new pad from the shipping liner, and place the pad on to the chassis as shown in Figure 5-54.

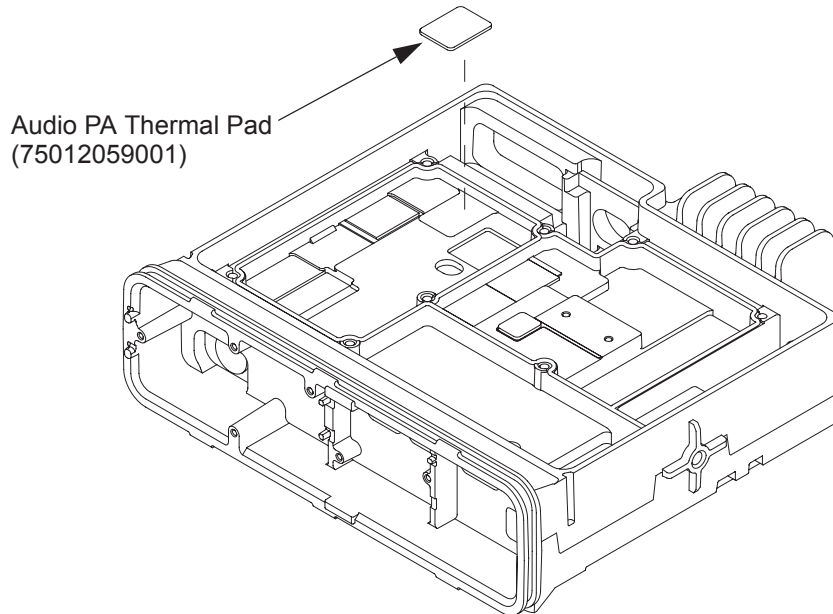


Figure 5-54 Replacing Audio PA Thermal Pad

Final Driver Thermal Pad Replacement

1. Use a plastic flat-edge tool to lift each pad from the transceiver board. Discard the old pad.
2. Use a soft cloth to remove any remaining residue. Alcohol can also be used, if necessary.
3. Once the surface is clean and dry, remove the new pad from the shipping liner, and place the pad on to the chassis as shown in Figure 5-55.

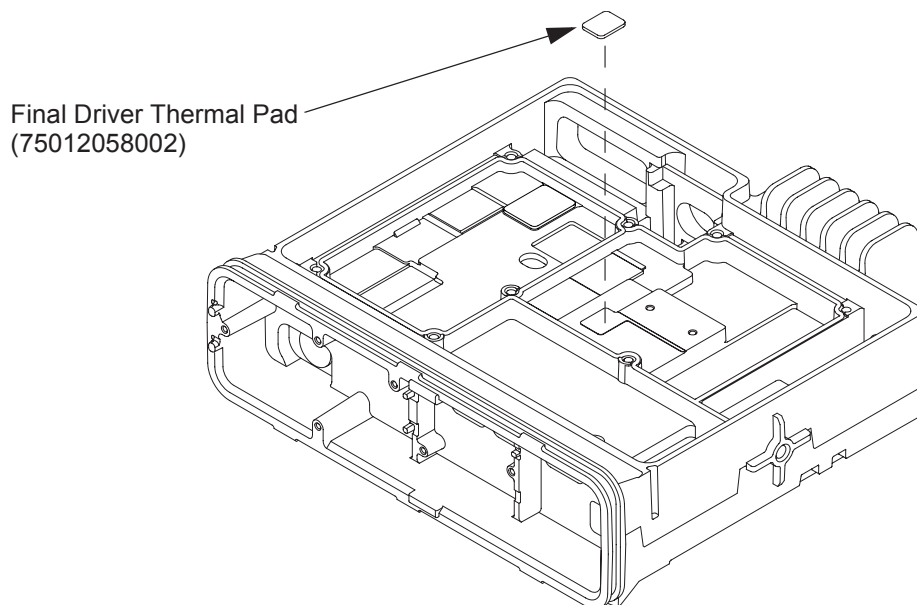


Figure 5-55 Replacing Final Driver Thermal Pad

5.7.5 Transceiver Board Reassembly

1. Apply thermal grease to the PA area. Refer to Figure 5-56.

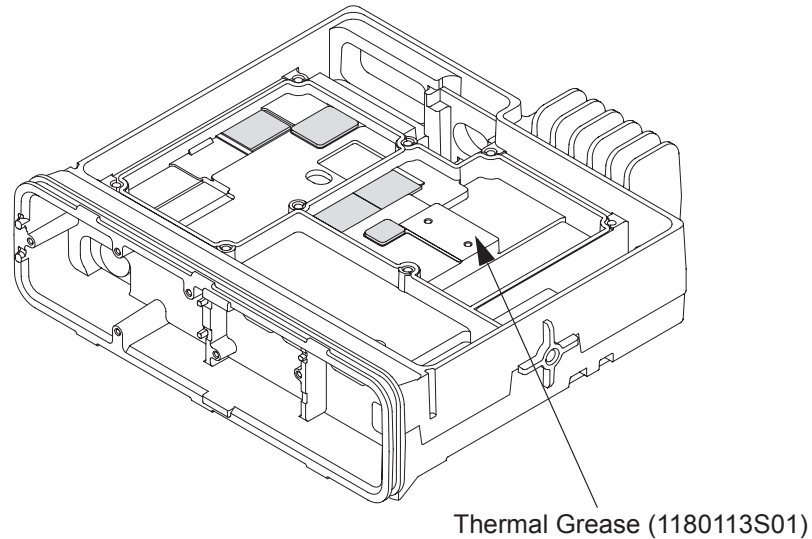


Figure 5-56 Applying Thermal Grease

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

Push the board down to fully seat it to the radio chassis and ensure that the transceiver board alignment slots are positioned in line with the chassis alignment bosses.

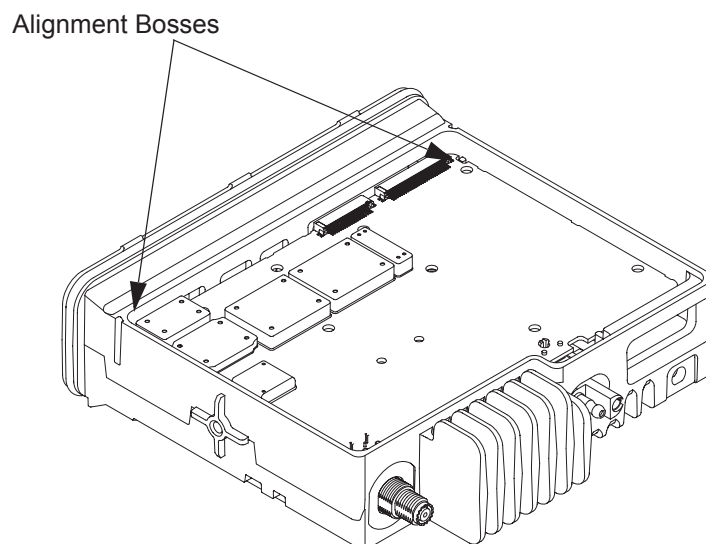


Figure 5-57 Placing the Transceiver Board in the Chassis



Do not leave the transceiver board in the chassis for extended periods of time without the DC retention clip and RF lock washer and nut assembled, or damage to the board connectors may occur.

3. Insert the DC retention clip and fully seat it. Refer to Figure 5-58.

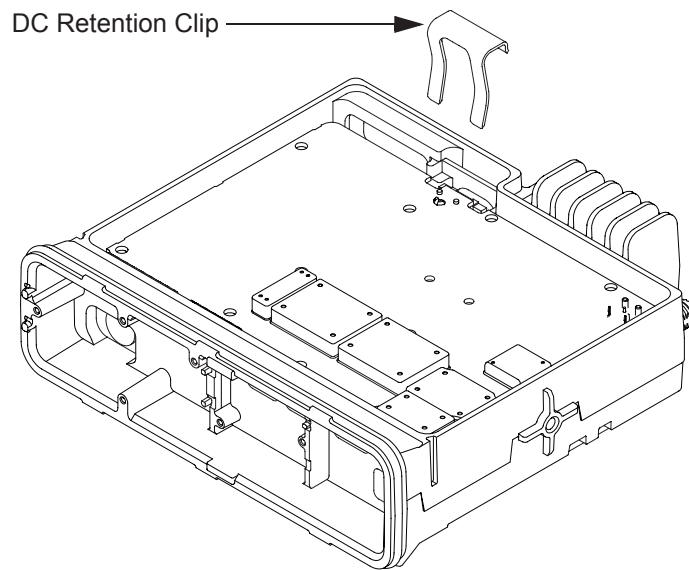


Figure 5-58 Inserting DC Retention Clip

- Using a 9/16" deep socket driver install the lock washer and nut to an initial torque of 0.9 N-m (8 lbs-in). Refer to Figure 5-59.

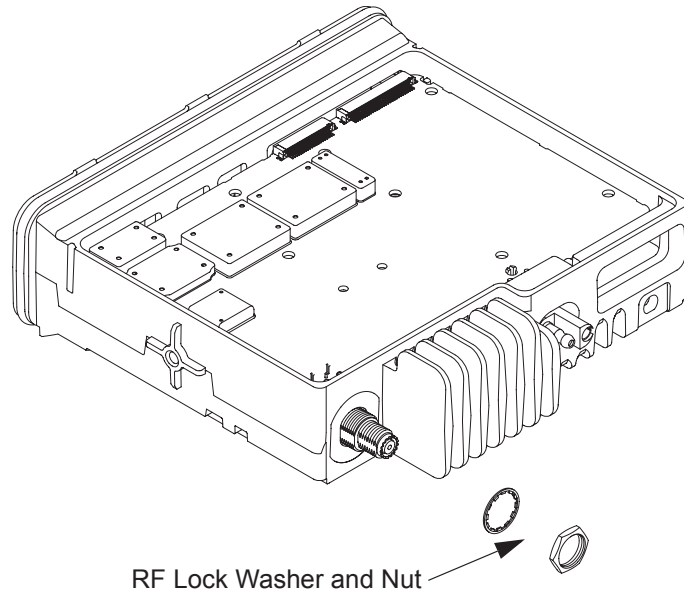


Figure 5-59 Inserting RF Lock Washer and Nut

- Using a T10 TORX™ driver insert four main shield thread forming screws (M3) at locations 3, 4, 5 and 6 to compress the PCB. Tighten the screws to 1.0 N-m (9 lbs-in).

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

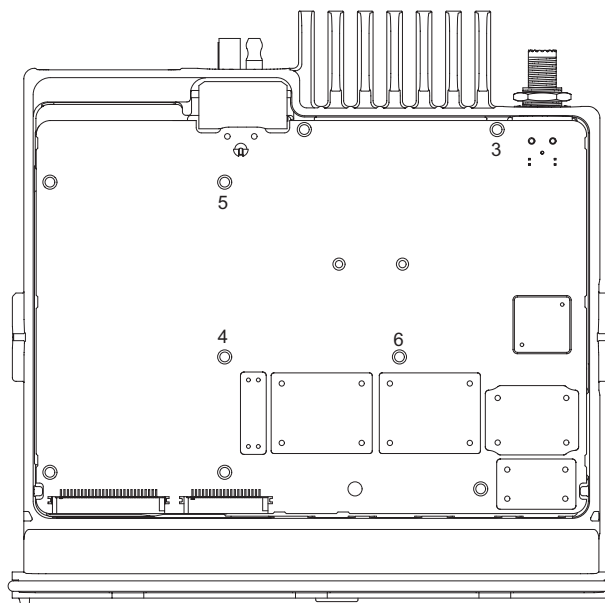


Figure 5-60 Screw Sequence to Compress PCB

6. While the board is pressed down, align the PA holes on PCB to mounting holes on chassis and insert two (M2.5) machine screws with washers (see Figure 5-61 for PA Screw sequence). Using a T8 TORX™ tighten the screws to 0.45 N-m (4 lbs-in).

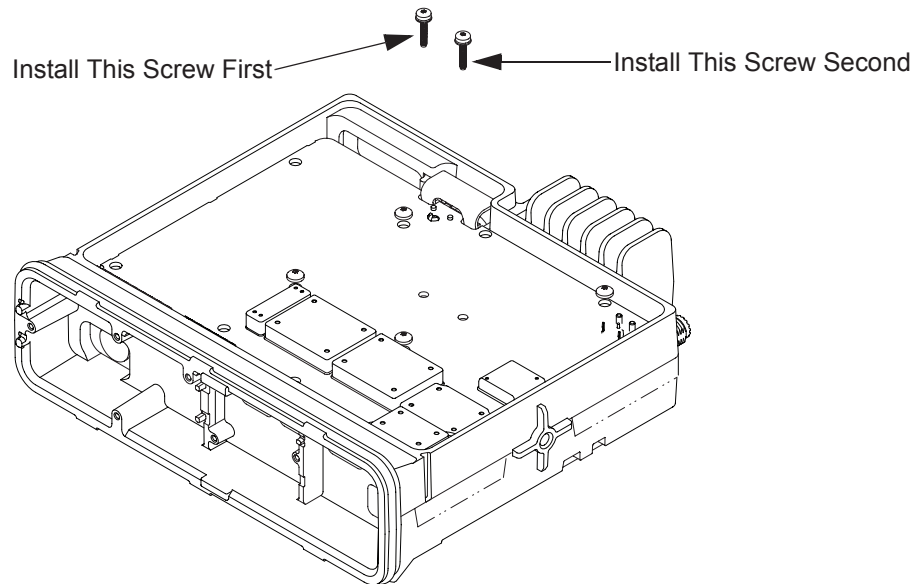


Figure 5-61 Installing PA Screws

7. Using a T10 TORX™ driver remove the screws from locations 3, 4, 5 and 6.
8. Insert the accessory connector into the radio assembly and press into place until the connector is flushed with the chassis. Refer to Figure 5-62.

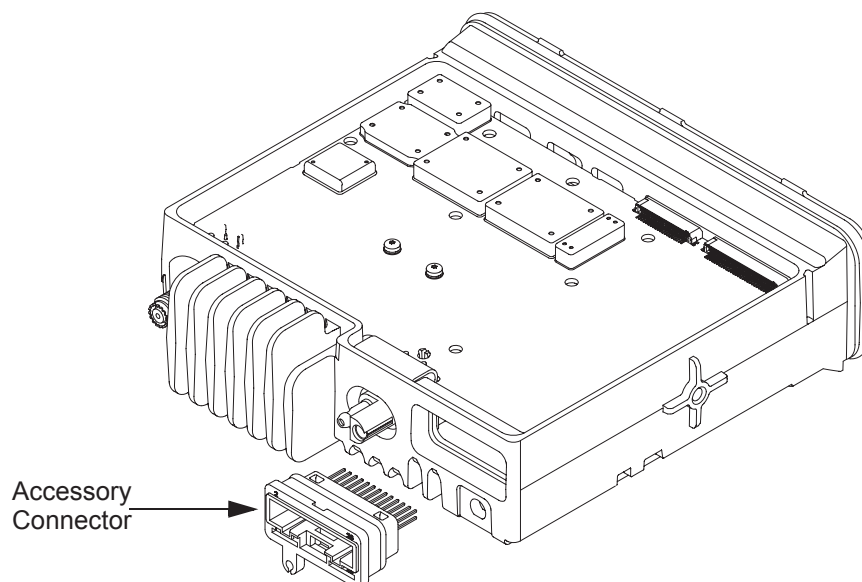


Figure 5-62 Inserting Accessory Connector

9. Place the main shield on the transceiver board and lock in place the accessory connector by aligning the main shield locking tabs to the pockets of the accessory connector.
10. Insert nine main shield thread forming screws (M3) through the shield and one thread forming screw (M3) through the board.
11. Using a T10 TORX™ driver follow the sequence marked on the shield and tighten the screws to 1.47 N-m (13 lbs-in). Refer to Figure 5-64.

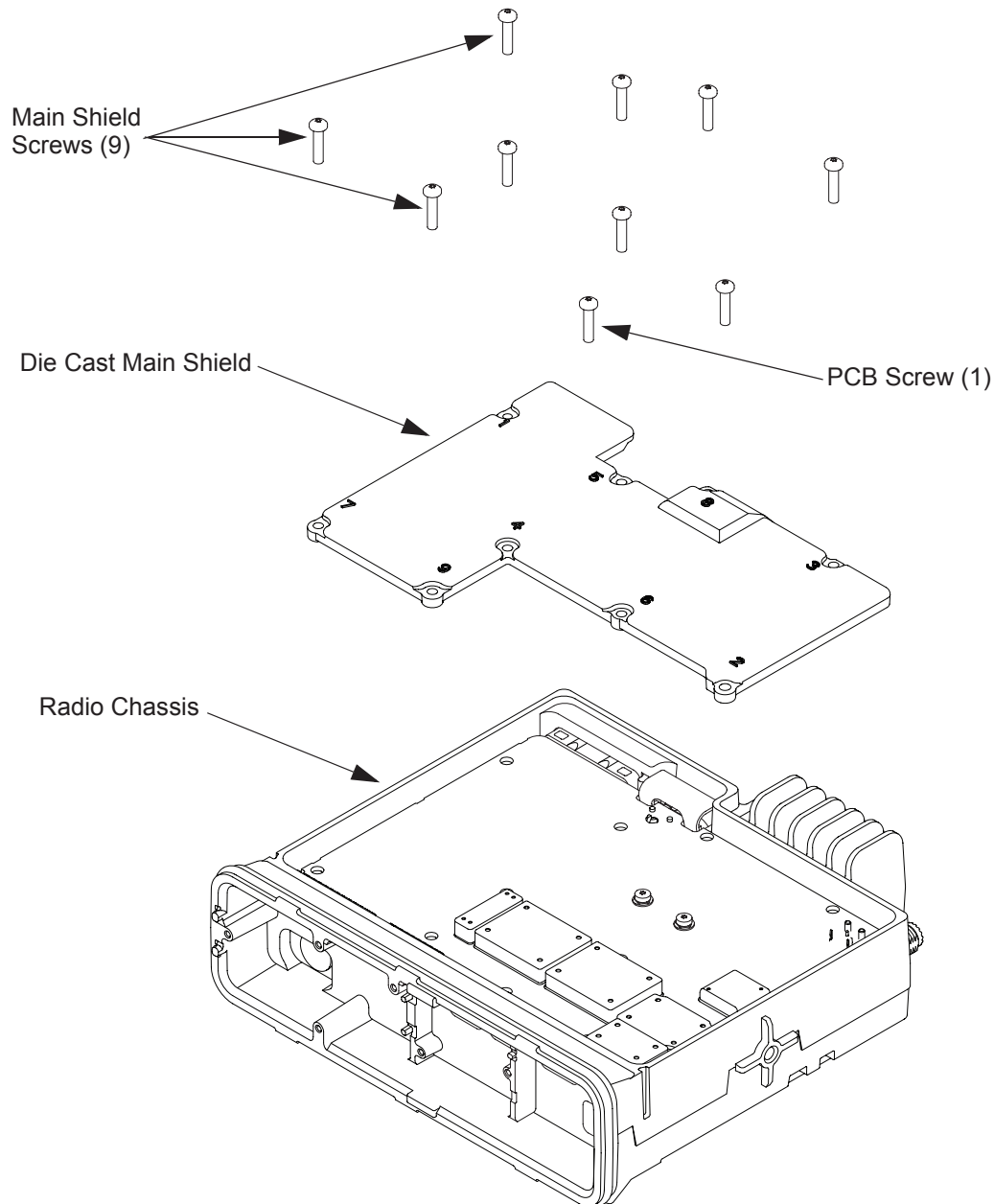


Figure 5-63 Assembling Die Cast Main Shield onto Chassis

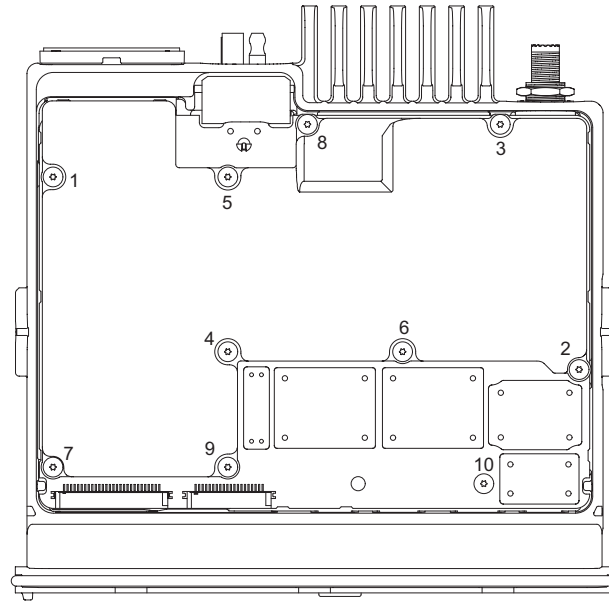


Figure 5-64 Screw Sequence to Tighten Die Cast Main Shield

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

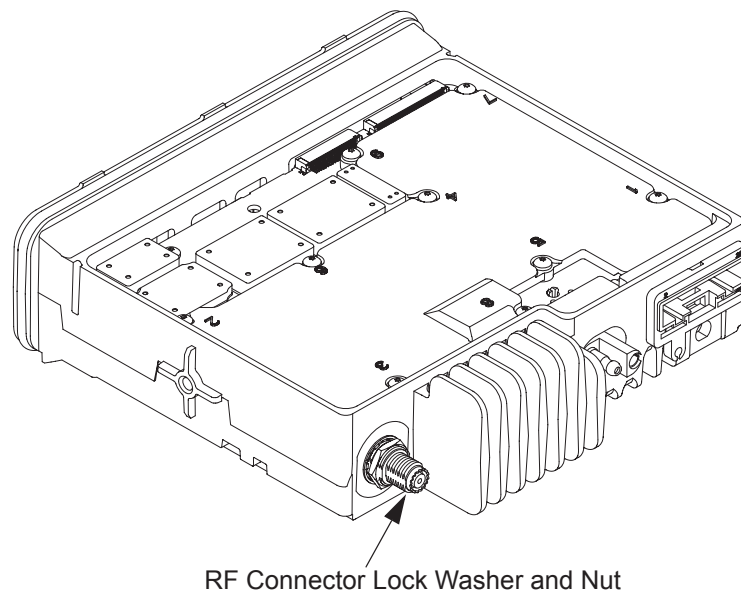


Figure 5-65 RF Connector Nut Final Torque

13. Install the acoustic plug. An arrow is molded into the part to indicate the start side.

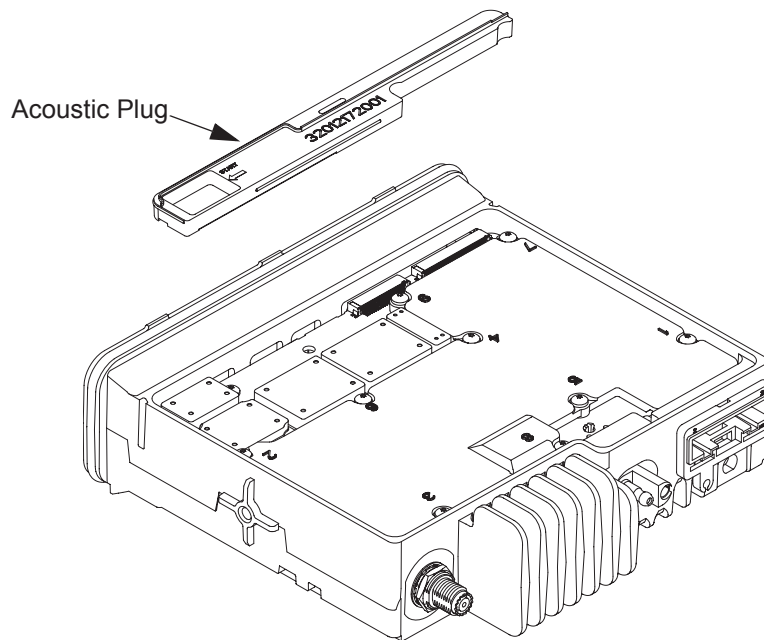


Figure 5-66 Acoustic Plug Installation

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

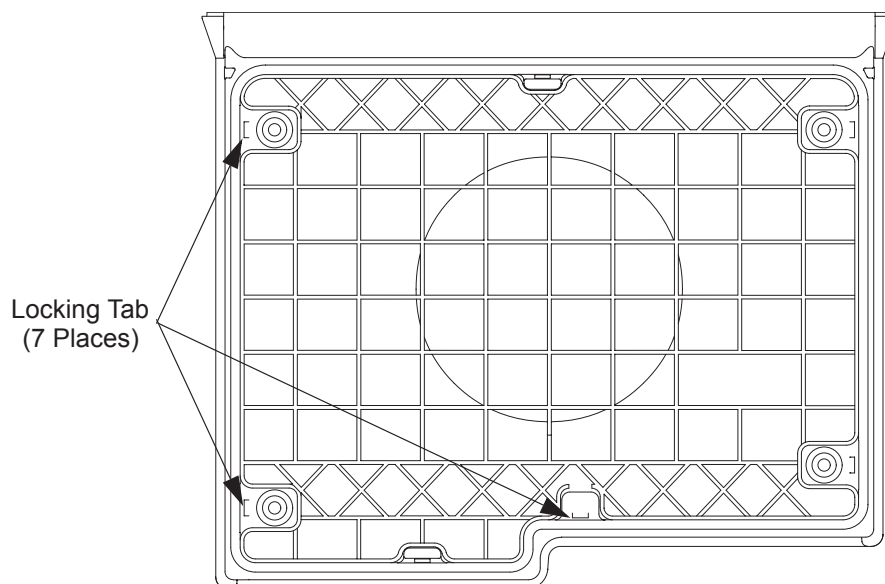


Figure 5-67 Inspection of Cover Assembly with Seal

15. Gently spread both sides of the cover.
16. Align the top cover to the chassis and snap the cover in place uniformly. Ensure the alignment posts on the cover slide into the alignment slots on the chassis.

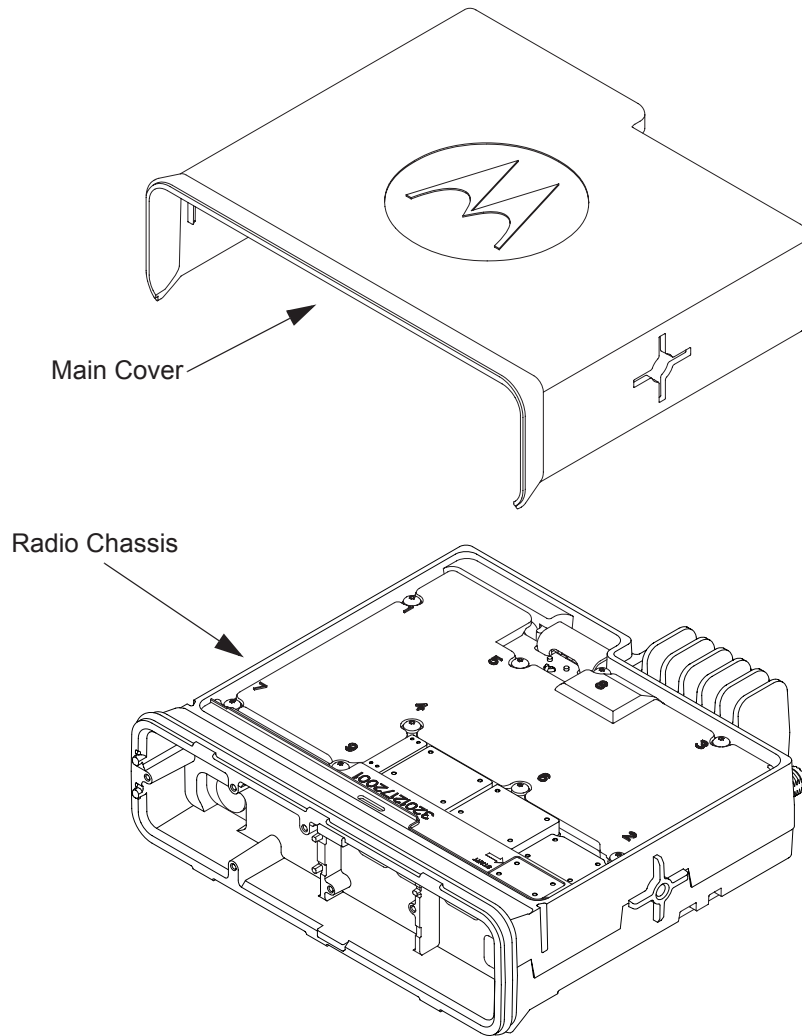


Figure 5-68 Assembling Cover onto Chassis

5.7.6 GPS Plug or GPS Antenna Connector Reassembly

GPS Plug Reassembly (For Non-GPS Models Only)

1. Assembly of the GPS Plug
Push the GPS plug into the chassis opening until it is fully seated. Refer to Figure 5-69.

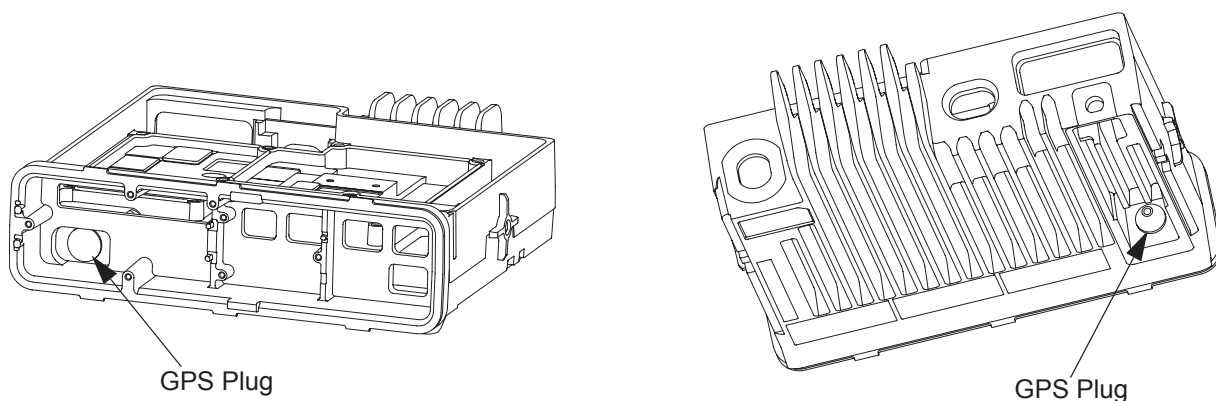


Figure 5-69 GPS Plug Assembly

GPS Antenna Connector Reassembly (For GPS Models Only)

1. Assembly of the GPS cable.
 - a. If attached, remove the nut and washer from the GPS antenna connector.
 - b. Insert the GPS cable assembly through the opening in the chassis. Orient the MCX connector as shown in Figure 5-70.
 - c. Pull the GPS cable strain relief until it is fully installed. See Figure 5-71.
 - d. Assemble the lock washer and the nut to the GPS antenna connector. Using a 5/16" or 8 mm socket driver, tighten the nut to 1.7 N-m (15 lbs-in). See Figure 5-71.

NOTE: Do not pull directly on cable wire.

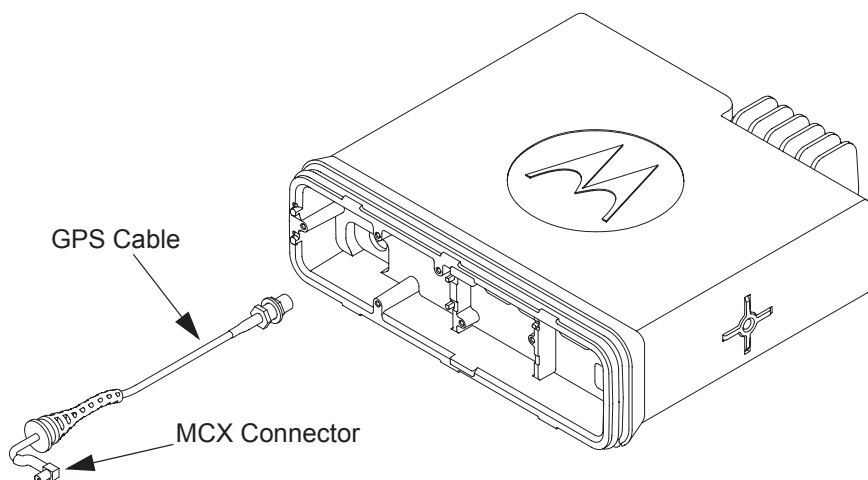


Figure 5-70 GPS Cable Installation

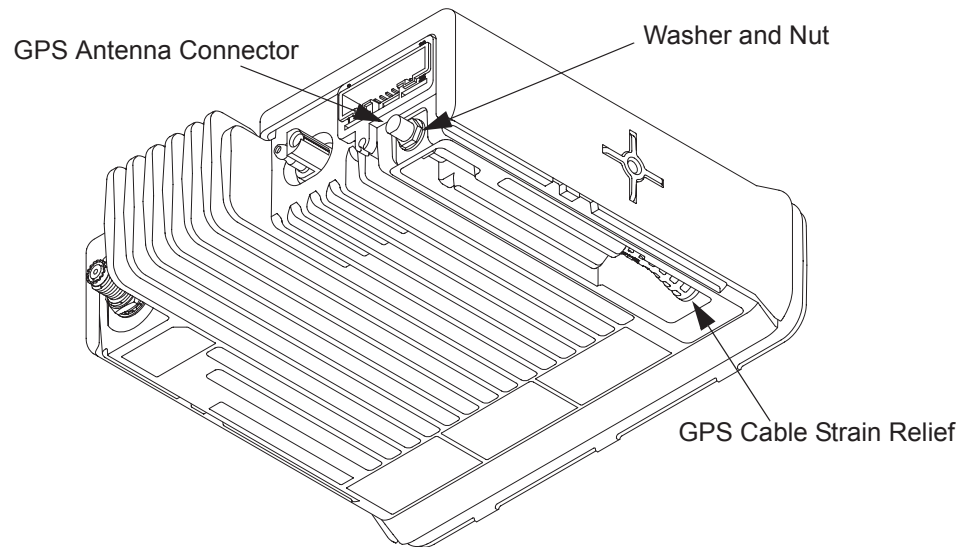


Figure 5-71 GPS Cable Installation

- e. Connect the GPS cable MCX connector to the expansion board.
- f. Connect the flex cable from the expansion board to the main board connector.

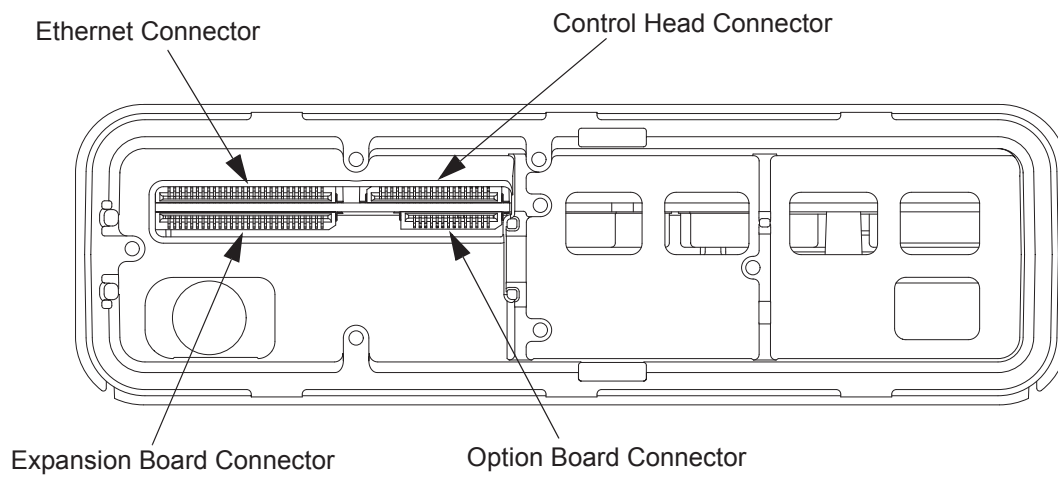


Figure 5-72 Flex Connection Connectors

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

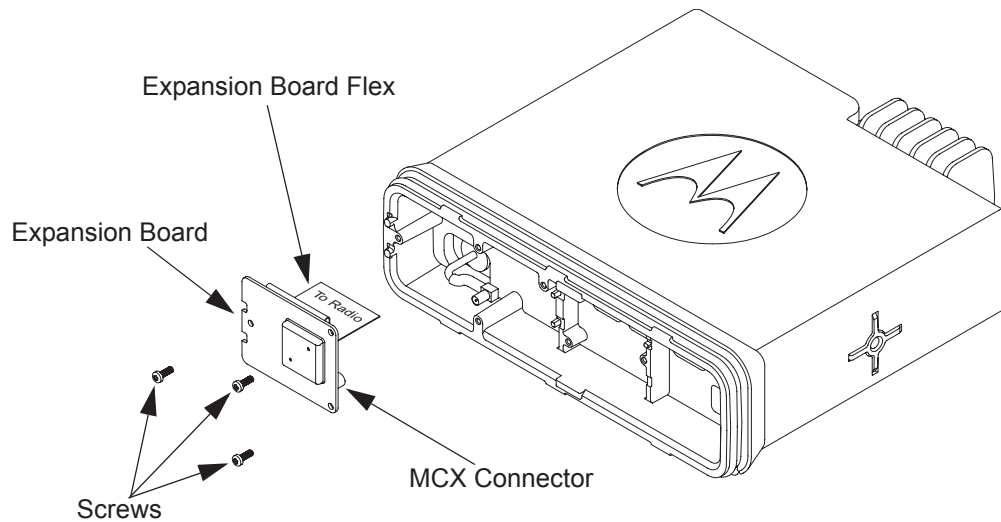


Figure 5-73 Expansion Board Assembly

- h. Clean chassis nameplate surface with alcohol prior to applying the GPS nameplate.
i. Peel off the paper liner to the GPS nameplate. Place the long side of the GPS nameplate against the long side of the recessed area on the chassis.

NOTE: If the GPS nameplate is removed it will need to be replaced.

- j. Rotate the nameplate to the recessed surface and apply pressure.

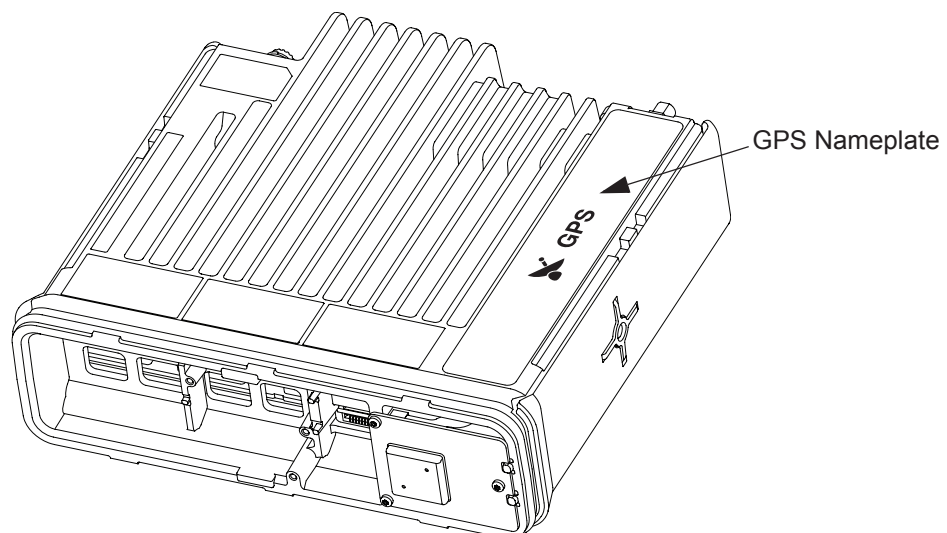


Figure 5-74 GPS Nameplate Assembly

- k. Snap the GPS dust cap (if not already installed) to the accessory connector retainer and place the GPS dust cap over the GPS antenna connector.

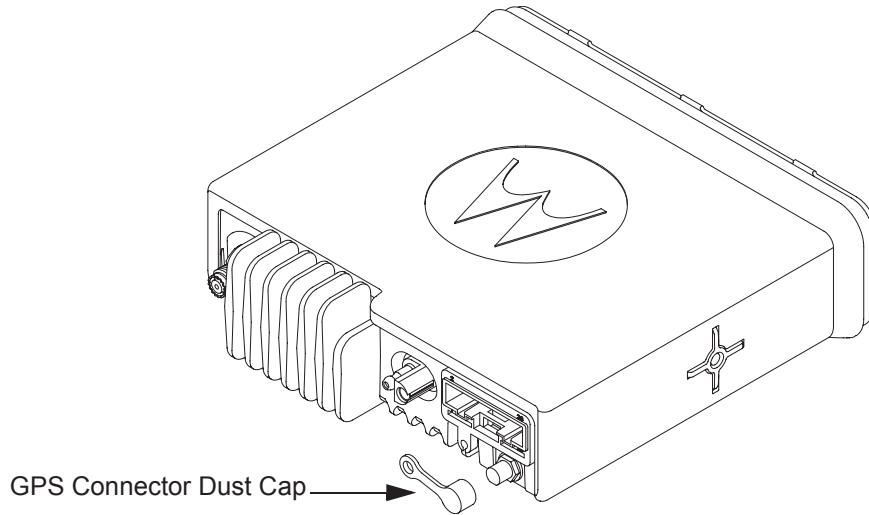


Figure 5-75 GPS Antenna Connector Assembly

- l. Connect the control head flex to the transceiver board connector.

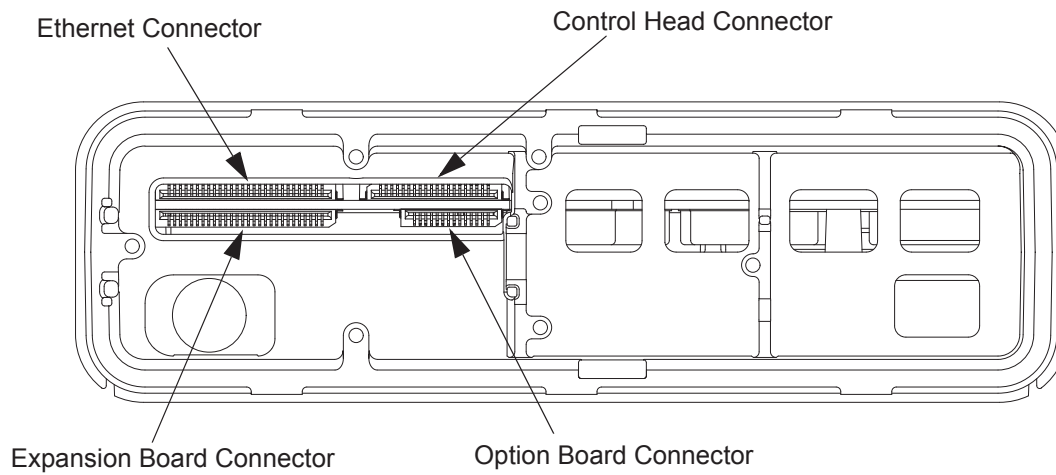


Figure 5-76 Flex Connection Connectors

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

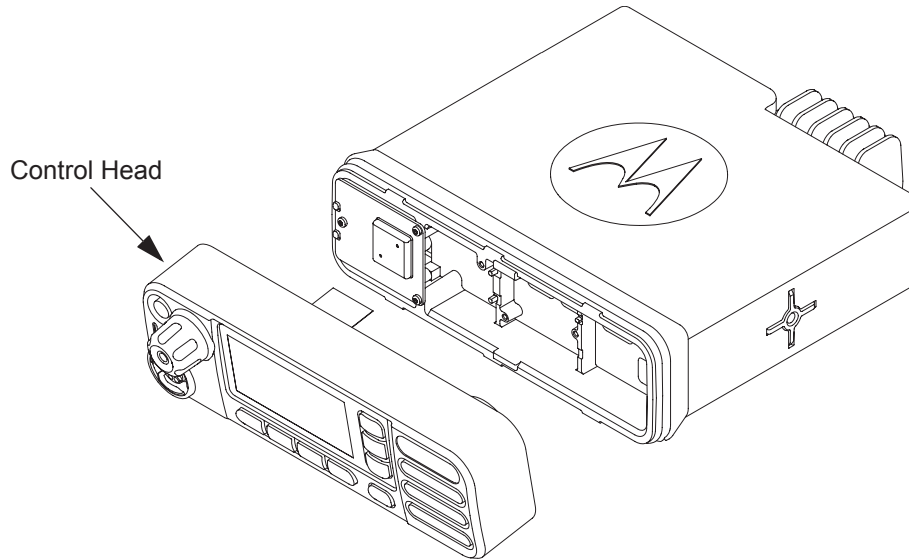


Figure 5-77 GPS Antenna Connector Assembly

5.7.7 Option Board Reassembly (For Option Board Models Only)

1. Orient the option board flex so that contacts face option board. Secure connector latch to option board flex as referenced in Figure 5-78. Note white line on flex should be aligned with connector latch.

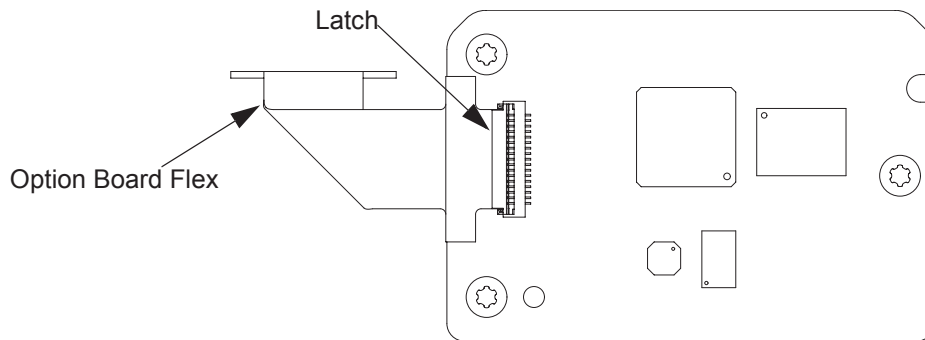


Figure 5-78 Orientation of Option Board Flex to Option Board

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

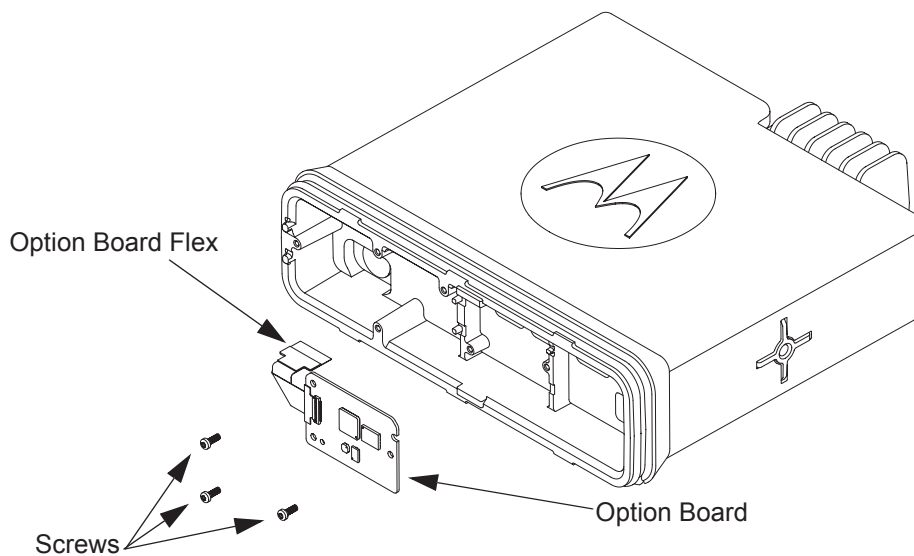


Figure 5-79 Assemble Option Board to Radio Chassis

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

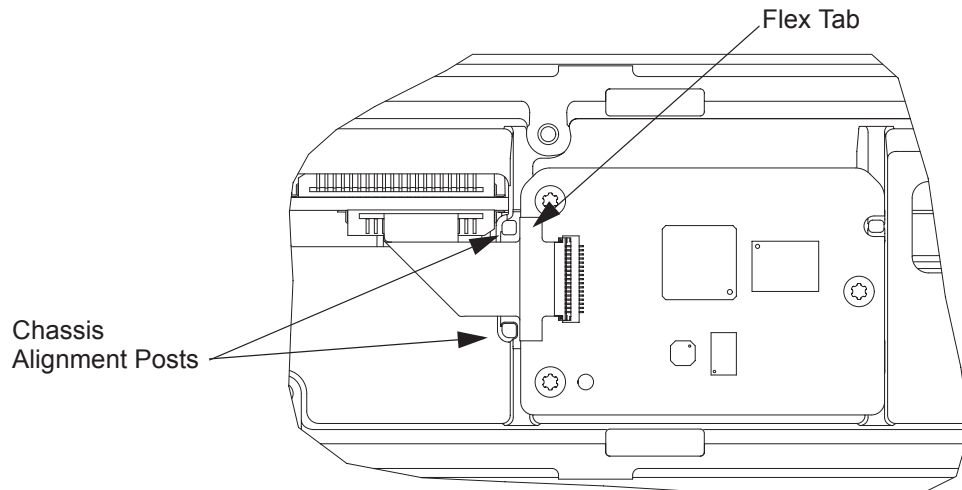


Figure 5-80 Align Option Board to Mounting Holes

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

NOTE: Regulatory Requirements

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

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

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

5.7.8 Assemble Control Head to Radio Assembly

1. Assemble the control head O-ring seal on the radio as shown in Figure 5-81.

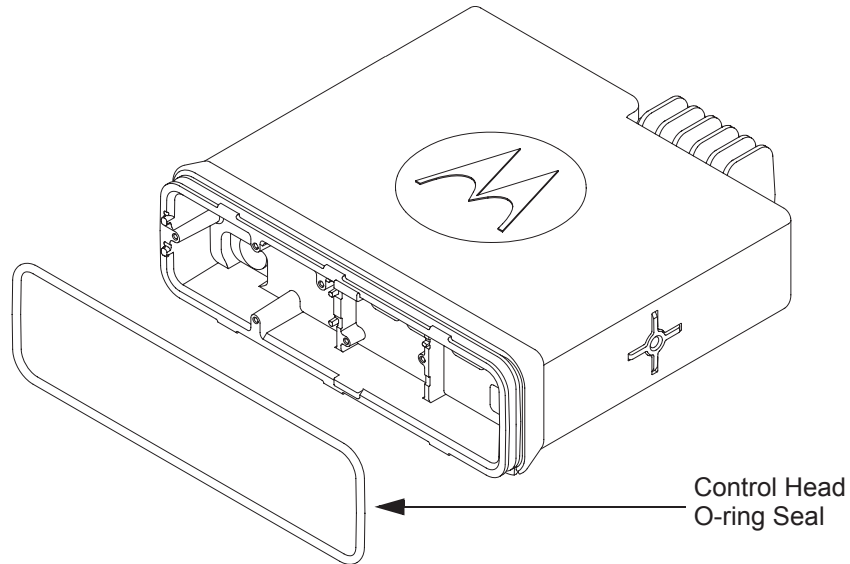


Figure 5-81 Assemble O-ring to Chassis

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

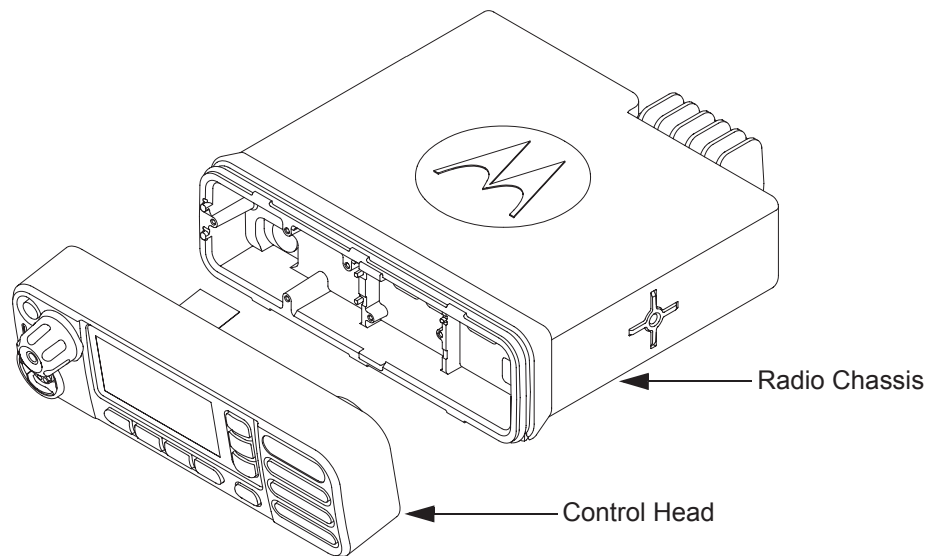


Figure 5-82 Assemble Control Head to Chassis

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

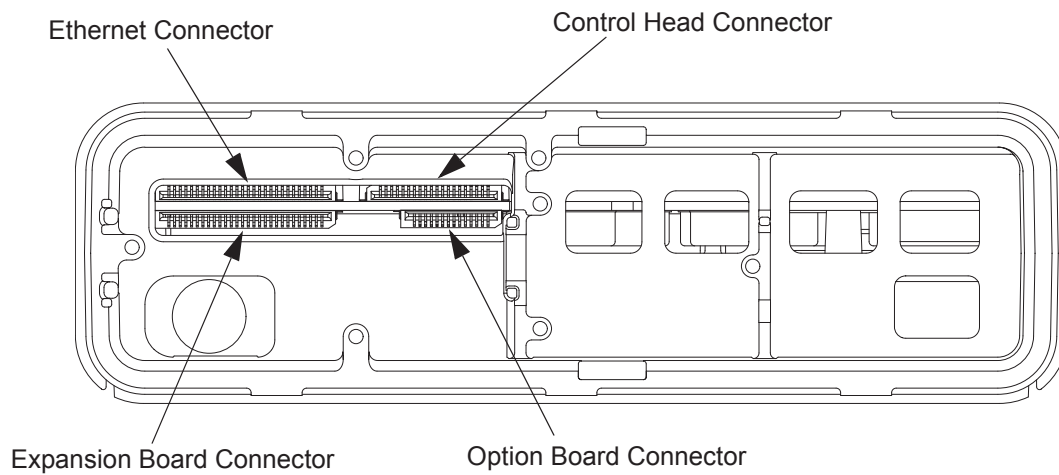


Figure 5-83 Flex Connection Connectors

4. Assemble the control head to the radio chassis by aligning one side of the control head assembly tabs to one side of the radio chassis tabs and then rotate the control head assembly until the other side engages.
5. Verify that the control head seal is not pinched and not visible. If a pinch is found, disassemble the control head, reseal the O-ring and reassemble the control head.

5.8 Exploded Mechanical Views and Parts Lists

5.8.1 Radio Assembly Exploded View and Parts List

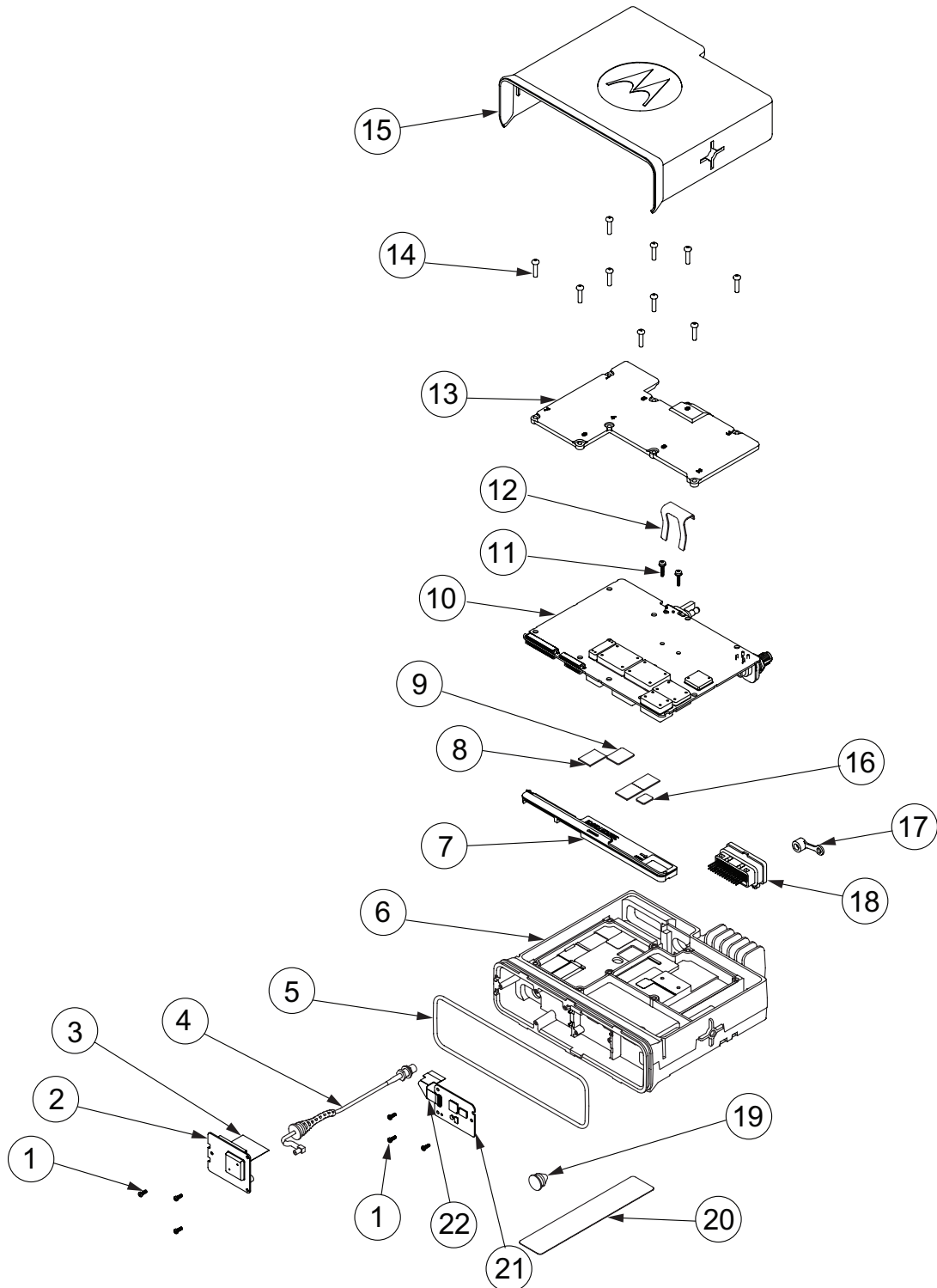


Figure 5-84 Radio Assembly Exploded View

Table 5-3 Radio Exploded View Parts List

Item No.	Description	Part Number
1	Screw - M2x0.4x6mm (Bluetooth/GPS And/Or Option Board Only)	0310909E03
2	Bluetooth/GPS Expansion Board (Bluetooth/GPS Only)	PMLN6042_S*
3	Flex, Expansion Board (Bluetooth/GPS Only)	30012047001
4	GPS Cable Assembly (GPS Only)	30012044001
5	O-Ring, Control Head	3216200H01
6	Chassis, Die Cast	27009303001
7	Acoustic Plug	32012172001
8	Thermal Pad, Regulator (QTY:3)	75012018001
9	Thermal Pad, Audio PA	75012059001
10	PCB, Transceiver	See Section 1.5 to 1.8 to identify proper board.
11	Screw - M2.5x0.45x12mm with Washer	03012037001
12	Clip, DC Retention	42009281001
13	Main Shield, Die Cast	26009377001
14	Screw - M3x0.5x13mm	0310943J12
15	Main Cover and Gasket Assembly	15012083001
16	Thermal Pad, Final Driver	75012058002
17	GPS Dust Cap (GPS Only)	3216338H01
18	Accessory Connector	42009282001
19	GPS Plug (Non-GPS Only)	32009445001
20	GPS Nameplate (GPS Only)	54012193001
21	Generic Option Board (Option Board Only)	PMLN5718_S**
22	Flex, Option Board (Option Board Only)	84012231001

* Includes: Item No. 1 (Screw - M2x0.4x6mm)
Item No. 2 (Bluetooth/GPS Expansion Board)
Item No. 3 (Flex, Expansion Board)
Item No. 4 (GPS Cable Assembly)
Item No. 17 (GPS Dust Cap)
Item No. 20 (GPS Nameplate)

** Includes: Item No. 1 (Screw - M2x0.4x6mm)
Item No. 21 (Generic Option Board)
Item No. 22 (Flex, Option Board)

5.8.2 Control Head Exploded Views and Parts Lists

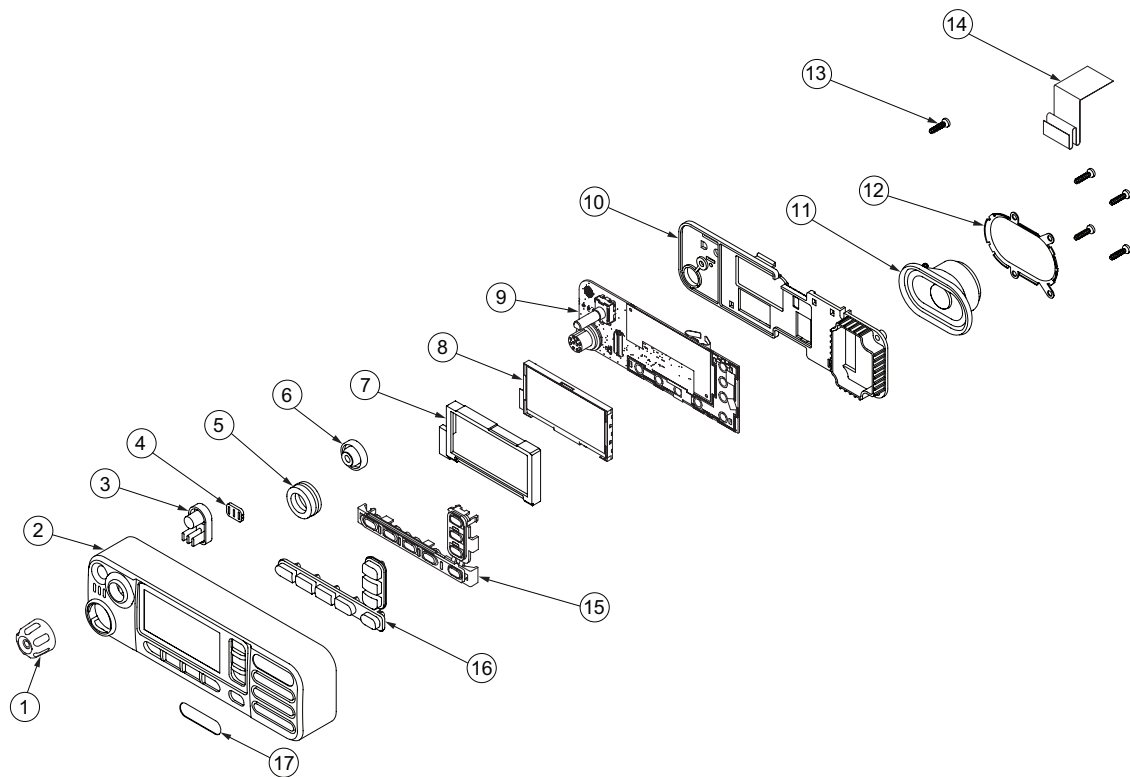


Figure 5-85 Colour Display Control Head Exploded View

Table 5-4 Colour Display Control Head (PMLN5678_) Exploded View Parts List

Item no	Description	Part No
1	Volume/Channel Knob Assembly	36012018001
2	Housing Assembly	0104045J47
3	Power Button	38012007001
4	Light Barrier, Power Button	07012020001
5	Mic Jack Seal	3264133H01
6	Volume Encoder Seal	32012140001
7	Colour Display Pad Gasket	32012094001
8	Colour Display	72012017001
9	PCB Assembly	0104045J49
10	PCB Retainer	42012024001
11	Speaker	5015134H02
12	Speaker Retainer	42012023001
13	Screw - K30x1.2x12mm	03012038001
14	Control Head Flex Cable	30012045001
15	Keypad Frame	42012026001
16	Keypad	75012061001
17	Nameplate Front Label for DM4600 Nameplate Front Label for DM4601	33012017006 33012017003

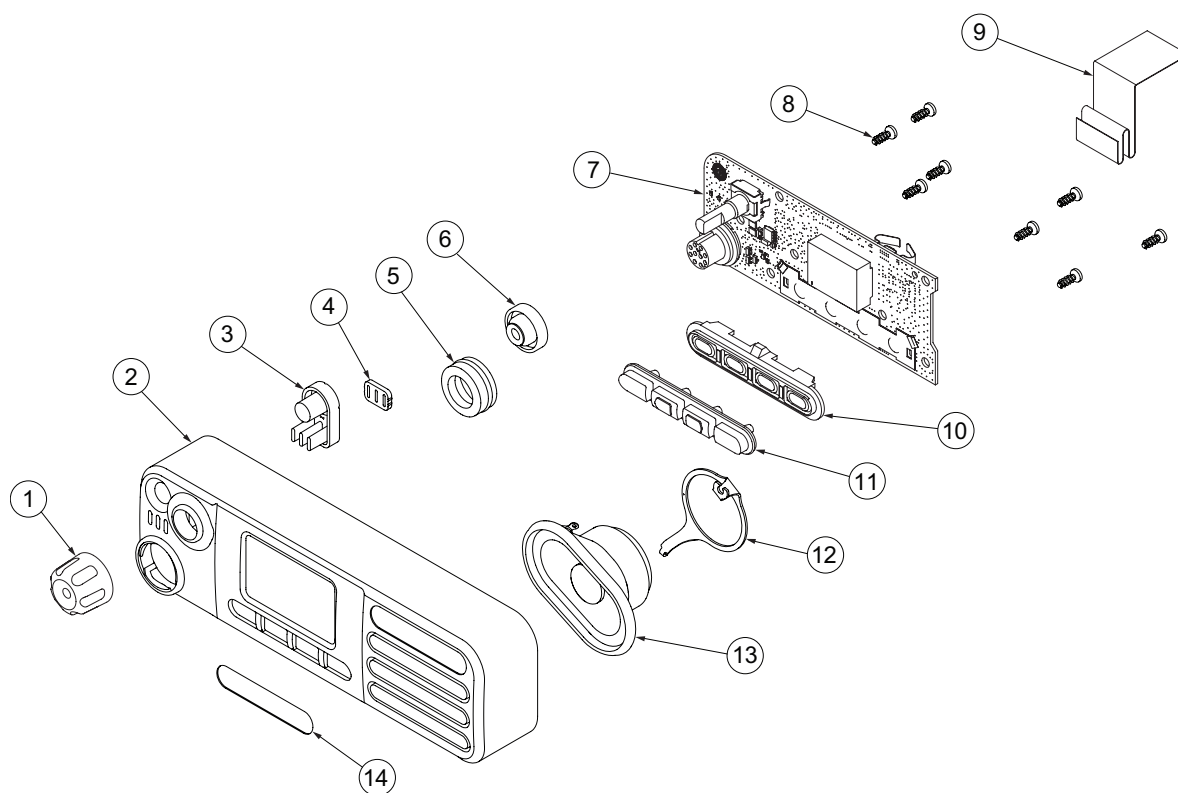


Figure 5-86 Numeric Display Control Head Exploded View

Table 5-5 Numeric Display Control Head (PMLN5677_) Exploded View Parts List

Item no	Description	Part No
1	Volume/Channel Knob Assembly	36012018001
2	Housing Assembly	0104045J48
3	Power Button	38012007001
4	Light Barrier, Power Button	07012020001
5	Mic Jack Seal	3264133H01
6	Volume Encoder Seal	32012140001
7	PCB Assembly	0104045J50
8	Screw - K30x1.34x8mm	0371370L01
9	Control Head Flex Cable	30012045001
10	Keypad Frame	42012025001
11	Keypad	75012060001
12	Speaker Retainer	42012030001
13	Speaker	5015134H02
14	Nameplate Front Label for DM4400 Nameplate Front Label for DM4401	33012017011 33012017012

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
30012044001	Nut, GPS Antenna Connector	5/16" or 8 mm socket driver	1.7	15	17.3
02012015001	Nut, RF Connector	9/16" deep socket driver	2.15	19	21.9
03012038001	Screw, K30x1.2x12mm, Pan Head	T10 Torx™	0.88	7.8	9.0
0371370L01	Screw, K30x1.34x8mm, Pan Head	T10 Torx™	0.88	7.8	9.0
0310909E03	Screw, M2x0.4x6mm, Pan Head	T6 Torx™	0.28	2.5	2.9
03012037001	Screw, M2.5x0.45x12mm, Pan Head	T8 Torx™	0.45	4	4.6
0310943J12	Screw, M3x0.5x13mm, Pan Head	T10 Torx™	1.5	13	15

Notes

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 A.

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 1.8 on page 1-8), which is orderable from Motorola Radio Products and Solutions Organization, see Appendix A for contact details. Refer to <http://www.motorola.com/emeaonline> 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 01/22	Tuning Codeplug Checksum	NON-FATAL	Reprogram the tuning partition.
FAIL 01/82	FLASH ROM Codeplug Checksum	FATAL	Reprogram the codeplug.
FAIL 01/90	General Hardware Error	FATAL	Turn the radio off, then on.
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.

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	Reprogram the codeplug. Send radio to the nearest Motorola Depot.
FAIL 002	Personality checksum or system block error	NON-FATAL	Reprogram the codeplug.

Appendix A EMEA Regional Warranty, Service and Technical Support

A.1 Warranty and Service Support

Motorola offers long term support for its products. This support includes full exchange and/or repair of the product during the warranty period, and service/ repair or spare parts support out of warranty. Any "return for exchange" or "return for repair" by an authorized Motorola Dealer must be accompanied by a Warranty Claim Form. Warranty Claim Forms are obtained by contacting an Authorized Motorola Dealer.

A.1.1 Warranty Period and Return Instructions

The terms and conditions of warranty are defined fully in the Motorola Dealer or Distributor or Reseller contract. These conditions may change from time to time and the following notes are for guidance purposes only.

In instances where the product is covered under a "return for replacement" or "return for repair" warranty, a check of the product should be performed prior to shipping the unit back to Motorola. This is to ensure that the product has been correctly programmed or has not been subjected to damage outside the terms of the warranty.

Prior to shipping any radio back to the appropriate Motorola warranty depot, please contact Customer Resources (Please see page A-3). All returns must be accompanied by a Warranty Claim Form, available from your Customer Services representative. Products should be shipped back in the original packaging, or correctly packaged to ensure no damage occurs in transit.

A.1.2 After Warranty Period

After the Warranty period, Motorola continues to support its products in two ways.

1. Motorola's Managed Technical Services (MTS) offers a repair service to both end users and dealers at competitive prices.
2. MTS supplies individual parts and modules that can be purchased by dealers who are technically capable of performing fault analysis and repair.

A.2 European Radio Support Centre (ERSC)

The ERSC Customer Information Desk is available through the following service numbers:

Austria:	08 00 29 75 41	Italy:	80 08 77 387
Belgium:	08 00 72 471	Luxemburg:	08 00 23 27
Denmark:	80 88 58 80	Netherlands:	08 00 22 45 13
Finland:	08 00 11 49 910	Norway:	80 01 11 15
France:	08 00 90 30 90	Portugal:	08 00 84 95 70
Germany:	08 00 18 75 240	Spain:	90 09 84 902
Greece:	00 80 04 91 29 020	Sweden:	02 07 94 307
UK:	08 00 96 90 95	Switzerland:	08 00 55 30 82
Ireland:	18 00 55 50 21	Iceland:	80 08 147

Or dial the European Repair and Service Centre:

Telephone: +49 30 6686 1555

Fax ERSC: +49 30 6686 1579

Email ERSC: ERSC@motorolasolutions.com

Please use these numbers for repair enquiries only.

A.3 Piece Parts

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

Orders for replacement parts, kits and assemblies should be placed directly on Motorola's local distribution/dealer organisation or via Motorola Online at: <http://www.motorola.com/emeaonline>

* 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).

A.4 Technical Support

Motorola Product Services is available to assist the dealers/distributors in resolving any malfunctions which may be encountered.

Russia and Armenia – Andrey Nagornykh
Telephone: +7 495 787 8910
Fax: +7 495 785 0185
Email: mwcb47@motorolasolutions.com

Central and East Europe – Siggy Punzenberger
Telephone: +49 (0) 6128 70 2342
Fax: +49 (0) 6128 95 1096
Email: TFG003@motorolasolutions.com

Middle East and Africa – Wayne Holmes
Telephone: +49 (0) 6126 957 6237
Fax: +49 (0) 6126 957 6826
Email: wayne.holmes@motorolasolutions.com

Germany – Customer Connect Team
Telephone: +49 (0) 30 6686 1539
Fax: +49 (0) 30 6686 1916
Email: ESSC@motorolasolutions.com

France – Armand Roy
Telephone: +33 1 6935 7868
Fax: +33 1 6935 7808
Email: armand.roy@motorolasolutions.com

Italy – Ugo Gentile
Telephone: +39 02 5220 7825
Fax: +39 02 5220 7810
Email: Ugo.Gentile@motorolasolutions.com

France – Laurent Irrmann
Telephone: +33 1 6935 7866
Fax: +33 1 6935 7808
Email: laurent.irrmann@motorolasolutions.com

A.5 Further Assistance From Motorola

You can also contact the Customer Help Desk through the following web address.
<http://www.motorolasolutions.com/governmentandenterprise>

Notes

Appendix B Limited Level 3 Servicing

B.1 Maintenance

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

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

B.2 Component Location and Parts List

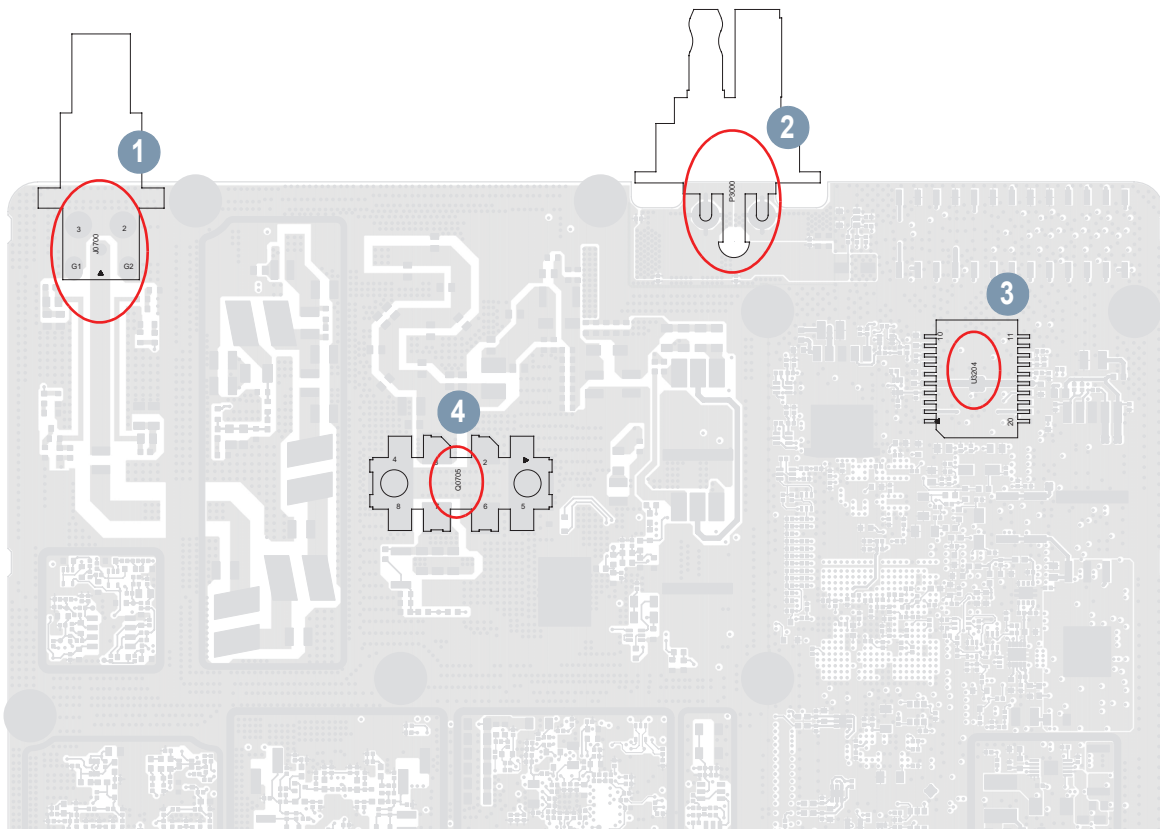


Figure B-1 PCB Top Side View

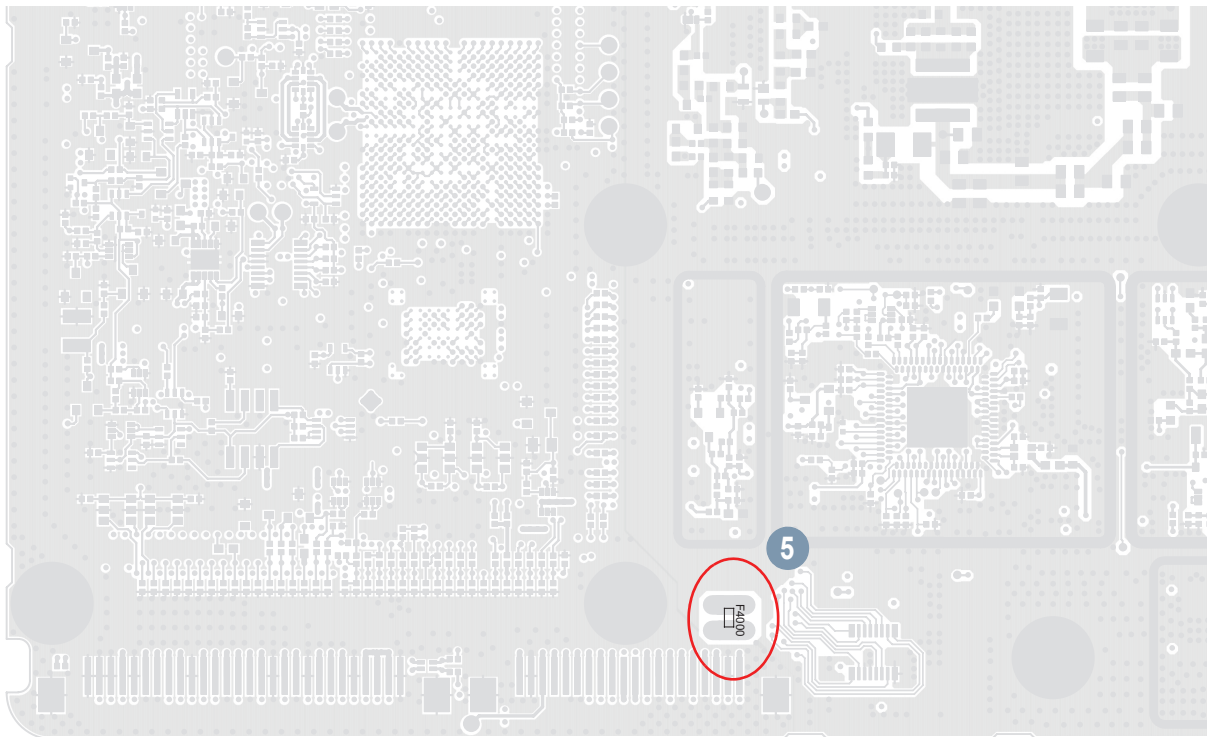


Figure B-2 PCB Bottom Side View

Table B-1. Component Parts List

No.	Circuit Ref.	Motorola Part Number	Description
1	J0700	09009348002	Mini-UHF Female RF Connector
2	P3000	09009344001	DC Power Connector
3	U3204	51009509001	IC Audio Amplifier 1 Per Package
4	Q0705	48012067002	RF MOS FET Power Transistor
5	F4000	6515076H01	Fast Blow 3A, 24V Fuse

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
Analogue	Refers to a continuously variable signal or a circuit or device designed to handle such signals.
Band	Frequencies allowed for a specific purpose.
CMOS	Complementary Metal Oxide Semiconductor.
CPS	Customer Programming Software: Software with a graphical user interface containing the feature set of a radio.
Default	A pre-defined set of parameters.
DM	Refers to Digital Professional Radio model names in the MOTOTRBO Professional Digital Two-Way Radio System.
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.
LDMOS	Laterally Diffused Metal Oxide Semiconductor.
LED	Light Emitting Diode: An electronic device that lights up when electricity is passed through it.

Term	Definition
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.
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 analogue 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.



MOTOROLA, MOTO, MOTOROLA SOLUTIONS and the Stylized M logo are trademarks or registered trademarks of Motorola Trademark Holdings, LLC and are used under license. All other trademarks are the property of their respective owners. © 2011 Motorola Solutions, Inc. All rights reserved. December 2011.

www.motorolasolutions.com/mototrbo



68012003037-A