MOTOTRBO™ MOBILE
PROFESSIONAL DIGITAL TWO-WAY RADIO

MOTOTRBO™ MOBILE XPR 5350e/XPR 5550e/XPR 5380e/XPR 5580e BASIC SERVICE MANUAL

JUNE 2019

MN002201A01-AE

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Foreword

This manual 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 Solutions authorized dealers, self-maintained customers, and distributors.

CAUTION: These servicing instructions are for the use of qualified personnel only. To reduce the risk of electric shock, do not service parts other than those contained in the Operating Instructions unless you are qualified to do so. Refer all servicing to qualified service personnel.

This manual includes radio specification of LEX L11, general description of LEX L11, recommended test equipment, service aids, general maintenance recommendations, procedures for assembly and disassembly, and exploded views and parts lists.

Product Safety and RF Exposure Compliance

CAUTION: This radio is restricted to occupational use only to satisfy FCC RF energy exposure requirements. Before using this product, read the Product Safety and RF Exposure booklet enclosed with your radio which contains important operating instructions for safe usage and RF energy awareness and control for compliance with applicable standards and regulations.

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

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Document History

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

Edition	Description	Date
MN002201A01-AA	Initial Release.	November 2015
MN002201A01-AB	Compliance with the new Motorola Solutions design standard.	December 2017
MN002201A01-AC	Updated Control Head Flex Cable part number from 30012045002 to PF001884A01.	September 2018
MN002201A01-AD	Updated General Specifications and Transmitter Specifications tables.	January 2019
MN002201A01-AE	Removed Footer.	June 2019

Notations Used in This Manual

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

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

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

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

Commercial Warranty

Limited Warranty

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

I. What This Warranty Covers And For How Long

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

Mobile Radios	Two Years
Product Accessories	One Year

Mobile Radios	One Year
Product Accessories	One Year

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

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

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

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

II. General Provisions

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

This warranty is given in lieu of all other express warranties, implied warranties, including without limitation, implied warranties of merchantability and fitness for a particular purpose, are limited to the duration of this limited warranty. In no event shall Motorola Solutions be liable for damages in excess of the purchase price of the product, for any loss of use, loss of time, inconvenience, commercial loss,

lost profits or savings or other incidental, special or consequential damages arising out of the use or inability to use such product, to the full extent such may be disclaimed by law.

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

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

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

IV. How To Get Warranty Service

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

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

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

V. What This Warranty Does Not Cover

This warranty does not cover the following conditions:

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

WARNING: The circuitry found on the control head and its associated interface boards is designed to function "as-is". Any attempt at modifying or altering the circuitry would void the warranty, and/or could result in radio malfunction or hazardous conditions for the radio and its associated vehicle.

VI. Patent And Software Provisions

Motorola Solutions will defend, at its own expense, any suit brought against the end user purchaser to the extent that it is based on a claim that the Product or parts infringe a United States patent, and Motorola Solutions will pay those costs and damages finally awarded against the end user purchaser in any such suit which are attributable to any such claim.

But such defense and payments are conditioned on the following:

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

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

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VII. Governing Law

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

Chapter 1

Introduction

1.1

Radio Description

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

Table 1: Radio Frequency Ranges and Power Levels

Frequency Band	Bandwidth	Power Level
VHF	136-174 MHz	1–25 W 25–45 W
UHF1	403–470 MHz	1–25 W 25–40 W
UHF2	450–512 MHz	1–40 W
800/900 Band	806–870 MHz 896–941 MHz	10–35 W 10–30 W

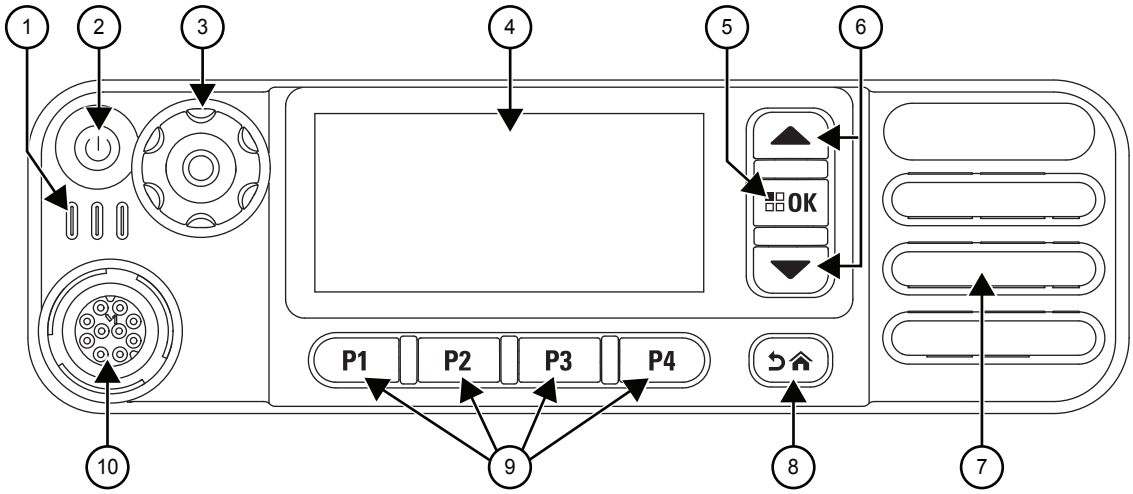
These digital radios are among the most sophisticated two-way radios available. They have a robust design for radio users who need high performance, quality, and reliability in their daily communications. This architecture provides the capability of supporting a multitude of legacy and advanced features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

1.2
Control Head Description

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

1.2.1
Control Head Controls (Color Display Model)

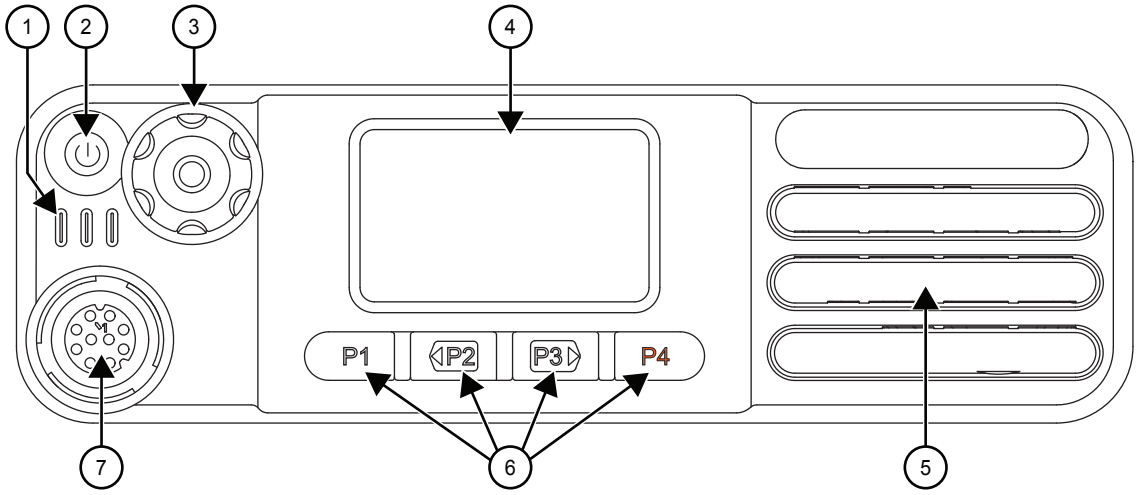
Figure 1: Radio Control Head (Color Display Model)



Label	Feature	Description
1	LED Indicator	Red, yellow, and green light-emitting diodes indicate operating status.
2	Power Button	Turns the radio on and off.
3	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.
4	LCD (Liquid Crystal Display)	160 x 72 display provides visual information about many radio features.
5	OK/Menu Button	One button to provide menu navigation and selection interface.
6	Scroll Up/Down Buttons	Press buttons to scroll.
7	Speaker	Outputs all tones and audio generated by the radio.
8	Return/Home Button	One button which quickly brings you to the home page.
9	Programmable Buttons	Four buttons are field programmable using the CPS.
10	Mic Connector	Interface point for mic to be used with the radio.

1.2.2
Control Head Controls (Numeric Display Model)

Figure 2: Radio Control Head (Numeric Display Model)



Label	Feature	Description
1	LED Indicator	Red, yellow, and green light-emitting diodes indicate operating status.
2	Power Button	Turns the radio on and off.
3	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.
4	LED Numeric Display	Two-digit numeric display
5	Speaker	Outputs all tones and audio generated by the radio.
6	Programmable Buttons	Four buttons are field programmable using the CPS.
7	Mic Connector	Interface point for mic to be used with the radio.

1.3
Mobile Radio Model Numbering Scheme

Table 2: Mobile Radio Model Numbering Scheme

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

Table 3: Sales Models – Description of Symbols

Position	Description	Value
1	Region	AA = North America
		AZ = Asia
		LA = Latin America
		MD = Europe/Middle East/Africa
2	Type of Unit	M = Mobile
3	Model Series	28 = MOTOTRBO Mobile
4		
5	Band	J = 136–174 MHz
		M = 217–222 MHz
		K = 300–360 MHz
		P = 350–400 MHz
		Q = 403–470 MHz
		T = 450–527 MHz
		X = 450–520 MHz
		U = 806–941 MHz
		V = 806–870 MHz
6	Power Level	N = 1–25W
		P = 25–40W
		Q = 25–45W
		R = 1–40W
		M = 10–35W
7	Physical Packages	C = Numeric Display
		H = Monochrome Display
		N = Color Display
		X = No Control Head
8	Channel Information	9 = Variable/Programmable Channel Spacing
9	Primary Operation	J = Basic (No GNSS, No Bluetooth)
		K = GNSS (GPS or GLONASS) and Bluetooth
		L = GPS only
		M = Bluetooth only
		R = GNSS, WiFi, and Bluetooth
		S = WiFi and Bluetooth only
		V = Basic (No WiFi, No GNSS, No Bluetooth, No embedded GOB)
		W = GNSS only

Position	Description	Value
10	Primary System Type	A = Conventional
		B = Trunking
		C = Analog Only
		D = Limited System
		E = Modified Conventional
11	Feature Level	1 = Mini-U (Mobile)
		2 = BNC (Mobile)
12	Version Letter	N/A
13	Unique Variation	N = Standard Package

1.4 Model Charts

NOTICE:
"X" = Part is compatible with checked model.

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

1.4.1 VHF (136–174 MHz) Model Chart

Table 4: VHF High Power 25–45 W, Mini-U Model Chart

Model/Item				Description
AAM28JQN9WA1_N				136–174 MHz, 25–45 W, MOTOTRBO XPR 5550e Color Display Mobile with GNSS, CFS, Bluetooth/Wi-Fi
	AAM28JQC9RA1_N			136–174 MHz, 25–45 W, MOTOTRBO XPR 5350e Numeric Display Mobile with Bluetooth/Wi-Fi and GNSS
		AAM28JQN9RA1_N		136–174 MHz, 25–45 W, MOTOTRBO XPR 5550e Color Display Mobile with Bluetooth/Wi-Fi and GNSS
X	X	X	PMUD3402_S	Service Kit, VHF, 25–45 W[1]
X	X	X	PMLN7252_S	Service Kit, Bluetooth/Wi-Fi and GNSS Expansion Board
X	X	X	PMLN7324_S	Service Kit, Generi cOption Board
	X		PMLN7500_	Numeric Display Model Control Head
X		X	PMLN7501_	Color Display Model Control Head
X	X	X	MN002330A01	Mobile Quick Reference Guide and Safety Booklet

Table 5: VHF Low Power 1–25 W, Mini-U Model Chart

Model/Item			Description
AAM28JNC9RA1_N			**136–174 MHz, 1–25 W, MOTOTRBO XPR 5350e Numeric Display Mobile with Bluetooth/Wi-Fi and GNSS**
	AAM28JNN9RA1_N		**136–174 MHz, 1–25 W, MOTOTRBO XPR 5550e Color Display Mobile with Bluetooth/Wi-Fi and GNSS**
X	X	PMUD3401_S	Service Kit , VHF, 1–25 W[1]
X	X	PMLN7252_S	Service Kit, Bluetooth/Wi-Fi and GNSS Expansion Board
X	X	PMLN7324_S	Service Kit, Generic Option Board
X		PMLN7500_	Numeric Display Model Control Head
	X	PMLN7501_	Color Display Model Control Head
X	X	MN002330A01	Mobile Quick Reference Guide and Safety Booklet

1.4.2
UHF1 Model Chart

Table 6: UHF1 High Power 403–470 MHz, 25–40 W, Mini-U Model Chart

Model/Item				Description
AAM28QPN9WA1_N				**403–470 MHz, 25–40 W, MOTOTRBO XPR 5550e Color Display Mobile with GNSS, CFS, Bluetooth/Wi-Fi**
	AAM28QPC9RA1_N			**403–470 MHz, 25–40 W, MOTOTRBO XPR 5350e Numeric Display Mobile with Bluetooth/Wi-Fi and GNSS**
		AAM28QPN9RA1_N		**403–470 MHz, 25–40 W, MOTOTRBO XPR 5550e Color Display Mobile with Bluetooth/Wi-Fi and GNSS**
X	X	X	PMUE4997_S	Service Kit, UHF1, 25–40 W[2]
X	X	X	PMLN7252_S	Service Kit, Bluetooth/Wi-Fi and GNSS Expansion Board
X	X	X	PMLN7324_S	Service Kit, Generic Option Board
	X		PMLN7500_	Numeric Display Model Control Head
X		X	PMLN7501_	Color Display Model Control Head
X	X	X	MN002330A01	Mobile Quick Reference Guide and Safety Booklet

Table 7: UHF1 Low Power 403–470 MHz, 1–25 W, Mini-U Model Chart

Model/Item			Description
AAM28QNC9RA1_N			**403–470 MHz, 1–25 W, MOTOTRBO XPR 5350e Numeric Display Mobile with Bluetooth/Wi-Fi and GNSS**
	AAM28QNN9RA1_N		**403–470 MHz, 1–25 W, MOTOTRBO XPR 5550e Color Display Mobile with Bluetooth/Wi-Fi and GNSS**
X	X	PMUE4994_S	Service Kit, UHF1, 1–25 W[2]

[1] Service Kit is the main board only.

Model/Item			Description
AAM28QNC9RA1_N			**403–470 MHz, 1–25 W, MOTOTRBO XPR 5350e Numeric Display Mobile with Bluetooth/Wi-Fi and GNSS**
	AAM28QNN9RA1_N		**403–470 MHz, 1–25 W, MOTOTRBO XPR 5550e Color Display Mobile with Bluetooth/Wi-Fi and GNSS**
X	X	PMLN7252_S	Service Kit, Bluetooth/Wi-Fi and GNSS Expansion Board
X	X	PMLN7324_S	Service Kit, Generic Option Board
X		PMLN7500_	Numeric Display Model Control Head
	X	PMLN7501_	Color Display Model Control Head
X	X	MN002330A01	Mobile Quick Reference Guide and Safety Booklet

1.4.3
UHF2 Model Chart

Table 8: UHF2 450–512 MHz, 1–40 W, Mini-U Model Chart

Model/Item				Description
AAM28TRN9WA1_N				**450–512 MHz, 1–40 W, MOTOTRBO XPR 5550e Color Display Mobile with GNSS, CFS, Bluetooth/Wi-Fi**
	AAM28TRC9RA1_N			**450–512 MHz, 1–40 W, MOTOTRBO XPR 5350e Numeric Display Mobile with Bluetooth/Wi-Fi and GNSS**
		AAM28TRN9RA1_N		**450–512 MHz, 1–40 W, MOTOTRBO XPR 5550e Color Display Mobile with Bluetooth/Wi-Fi and GNSS**
X	X	X	PMUE4999_S	Service Kit, UHF B2, 1–40 W[3]
X	X	X	PMLN7252_S	Service Kit, Bluetooth/Wi-Fi and GNSS Expansion Board
X	X	X	PMLN7324_S	Service Kit, Generic Option Board
	X		PMLN7500_	Numeric Display Model Control Head
X		X	PMLN7501_	Color Display Model Control Head
X	X	X	MN002330A01	Mobile Quick Reference Guide and Safety Booklet

[2] Service Kit is the main board only.
[3] Service Kit is the main board only.

1.4.4
800/900 Band (806–870 MHz, 896–941 MHz) Model Chart

Table 9: 800/900 Band 10–35/30 W, Mini-U Model Chart

Model/Item				Description
AAM28UMN9WA1_N				**800/900 MHz, 10–35/30 W, MOTOTRBO XPR 5580e Color Display Mobile with GNSS, CFS, Bluetooth/Wi-Fi**
	AAM28UMC9RA1_N			**800/900 MHz, 10–35/30 W, MOTOTRBO XPR 5380e Numeric Display Mobile with Bluetooth/Wi-Fi and GNSS**
		AAM28UMN9RA1_N		**800/900 MHz, 10–35/30 W, MOTOTRBO XPR 5580e Color Display Mobile with Bluetooth/Wi-Fi and GNSS**
X	X	X	PMUF1891_S	Service Kit , 800/900 MHz, 10–35/30 W[4]
X	X	X	PMLN7252_S	Service Kit, Bluetooth/Wi-Fi and GNSS Expansion Board
X	X	X	PMLN7324_S	Service Kit, Generic Option Board
	X		PMLN7500_	Numeric Display Model Control Head
X		X	PMLN7501_	Color Display Model Control Head
X	X	X	MN002330A01	Mobile Quick Reference Guide and Safety Booklet

1.5
Specifications

1.5.1
General

Table 10: General Specifications

Band	VHF		UHF1		UHF2		800/900	
Model	**Numeric Display**	**Color Display**	**Numeric Display**	**Color Display**	**Numeric Display**	**Color Display**	**Numeric Display**	**Color Display**
Channel Capacity	32	1000	32	1000	32	1000	32	1000
Typical RF Output (Low Power)	1–25 W		1–25 W		-		-	
Typical RF Output (High Power)	25–45 W		25–40 W		1–40 W		806–870 MHz: 10–35 W 896–941 MHz: 10–30 W[5]	
Frequency Range	136–174 MHz		403–470 MHz		450–512 MHz		806–870 MHz, 896–941 MHz	

[4] Service Kit is the main board only.
[5] 901–902 MHz: 6.3 W, 940–941 MHz: 6.3 W

Band	VHF		UHF1		UHF2		800/900	
Model	Numeric Display	Color Display	Numeric Display	Color Display	Numeric Display	Color Display	Numeric Display	Color Display
Dimensions (H x W x L)	2.1 x 6.9 x 8.1 in. (53.3 x 175.3 x 205.7 mm)							
Weight	3.9 lbs. (1.8 kg)							
Operating Voltage	Nominal: 13.2 VDC							
	Range: 10.8–15.6 VDC							
Current Drain: Standby	0.81 A max							
Receive @ rated audio	2 A max							
Transmit	1–25 W: 11.0 A max 25–40 W: 14.5 A max 25–45 W: 14.5 A max						1–25 W: 11.0 A max 25–40 W: 12 A max 25–45 W: 12 A max	
FCC Description	1–25 W: AZ492FT7082 25–45 W: AZ492FT7081		1–25 W: AZ492FT7080 25–40 W: AZ492FT7079		1–40 W: AZ492FT7076		AZ492FT7083	
IC Description	1–25 W: 109U-92FT7082 25–45 W: 109U-92FT7081		1–25 W: 109U-92FT7080 25–40 W: 109U-92FT7079		1–40 W: 109U-92FT7076		109U-92FT7083	

1.5.2

Receiver

Table 11: Receiver Specifications

Band	VHF		UHF1		UHF2		800/900 Band	
Model	Numeric Display	Color Display	Numeric Display	Color Display	Numeric Display	Color Display	Numeric Display	Color Display
Frequencies	136–174 MH		403–470 MHz		450–512 MHz		851–870 MHz 935–941 MHz	
Channel Spacing	12.5 kHz/20 kHz/25 kHz						12.5 kHz/25 kHz[6]	

Band	VHF		UHF1		UHF2		800/900 Band	
Model	Numeric Display	Color Display	Numeric Display	Color Display	Numeric Display	Color Display	Numeric Display	Color Display
Analog Sensitivity	0.3 µV							
	0.22 µV (Typical)							
Digital Sensitivity (5% BER)	0.25 µV							
	0.19 µV (Typical)							
Intermodulation (TIA603D)	78 dB		75 dB					
Adjacent Channel Selectivity (TIA603D)	50 dB @ 12.5 kHz		50 dB @ 12.5 kHz					
	80 dB @ 25 kHz		75 dB @ 25 kHz					
Spurious Rejection (TIA603D)	80 dB		75 dB					
Rated Audio	3 W (Internal)							
	7.5 W (External – 8 Ω)							
	13 W (External – 4 Ω)							
Audio Distortion @ Rated Audio	3% (Typical)							
Hum and Noise	-40 dB @ 12.5 kHz				-40 dB @ 12.5 kHz			
	-45 dB @ 20/25 kHz				-45 dB @ 25 kHz			
Audio Response	TIA603D							
Conducted Spurious Emission	-57 dBm							

1.5.3
Transmitter

Table 12: Transmitter Specifications

Band	VHF		UHF1		UHF2		800/900 Band	
Model	Numeric Display	Color Display	Numeric Display	Color Display	Numeric Display	Color Display	Numeric Display	Color Display
Frequencies	136–174 MH		403–470 MHz		450–512 MHz		851–870 MHz 935–941 MHz 806–825 MHz	

[6] The frequency bands 851–870 MHz will support 12.5 or 25 kHz channels, and 935–941 MHz will support 12.5 kHz channels only.

Band	VHF		UHF1		UHF2		800/900 Band	
Model	Numeric Display	Color Display	Numeric Display	Color Display	Numeric Display	Color Display	Numeric Display	Color Display
							896–902 MHz	
Channel Spacing	12.5 kHz/20 kHz/25 kHz						12.5 kHz/25 kHz[7]	
Frequency Stability (-30 °C to +60 °C,+25 °C Ref)	±0.5 ppm							
Power Output (Low Power)	1–25 W		1–25 W		–		–	
Power Output (High Power)	25–45 W		25–40 W		1–40 W		806–870 MHz: 10–35 W 896–941 MHz: 10–30 W[8]	
Modulation Limiting	±2.5 kHz @ 12.5 kHz ±4.0 kHz @ 20 kHz ±5.0 kHz @ 25 kHz				±2.5 kHz @ 12.5 kHz ±5.0 kHz @ 25 kHz			
FM Hum and Noise	–40 dB @ 12.5 kHz –45 dB @ 20/25 kHz				–40 dB @ 12.5 kHz –45 dB @ 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				60 dB @ 12.5 kHz 70 dB @ 25 kHz			
Audio Response	TIA603D							
Audio Distortion	3%							
FM Modulation	12.5 kHz: 11K0F3E 25 kHz: 16K0F3E							
4FSK Digital Modulation	12.5 kHz Data: 7K60F1D and 7K60FXD 12.5 kHz Voice: 7K60F1E and 7K60FXE Combination of 12.5 kHz Voice and Data: 7K60F1W							
Digital Vocoder Type	AMBE+2™							
Digital Protocol	ETSI TS 102 361-1							

[7] The frequency bands 851–870 MHz supports 12.5 kHz or 25 kHz channels, and 935–941 MHz supports 12.5 kHz channels only.

[8] 901–902 MHz: 6.3 W, 940–941 MHz: 6.3 W

Band	VHF		UHF1		UHF2		800/900 Band	
Model	Numeric Display	Color Display	Numeric Display	Color Display	Numeric Display	Color Display	Numeric Display	Color Display
	ETSI TS 102 361-2 ETSI TS 102 361-3							

1.5.4 Self-Quieter

Table 13: Self-Quieter Specifications

VHF	UHF1	UHF2	800/900 Band
156.975 MHz	-	-	-

1.5.5 GNSS

Table 14: GNSS Specifications

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

1.5.6 Bluetooth

Table 15: Bluetooth Specifications

Model	Numeric Display	Color Display
Version	Supports Bluetooth 4.1 + EDR Specification	
Range	Class 2, 10 meters	

1.5.7 Wi-Fi

Table 16: Wi-Fi Specifications

Model	Numeric Display	Color Display
Version	Supports 802.11 b/g/n, 2.4 GHz band	

1.5.8
MIL Standard

Military Standards										
Applicable MIL–STD	810C		810D		810E		810F		810G	
	Methods	Procedures	Methods	Procedures	Methods	Procedures	Methods	Procedures	Methods	Procedures
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/A1, II/A1	501.4	I/Hot, II/Hot	501.5	I/A1, II/A1
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/C1
Temperature Shock	503.1	I	503.2	A1/C3	503.3	A1/C3	503.4	I	503.5	I-C
Solar Radiation	505.1	II	505.2	I/Hot-Dry	505.3	I /Hot-Dry	505.4	I/Hot-Dry	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/Hot-Humid	507.3	II / Hot-Humid	507.4	–	507.5	I/Hot-Humid
Salt fog	509.1	I	509.2	I	509.3	I	509.4	–	509.5	–
Dust	510.1	I, II	510.2	I, II	510.3	I, II	510.4	I, II	510.5	I, II
Vibration	514.2	VIII/ CatF/ Curve-W, XI	514.3	I/ Cat10, II/ Cat3	514.4	I/ Cat10, II/ Cat3	514.5	I/ Cat24, II/ Cat5	514.6	I/ Cat24, II/ Cat5
Shock	516.2	I, II	516.3	I, IV	516.4	I, IV	516.5	I, IV	516.6	Ⅰ, Ⅴ, Ⅵ

1.5.9
Environmental Specifications

Table 17: Environmental Specifications

Specifications	Value
Operating Temperature	-30 °C to +60 °C
Storage Temperature	-40 °C to +85 °C

Specifications	Value
Thermal Shock	Per MIL-STD
Humidity	Per MIL-STD
ESD	IEC61000-4-2 Level 3
Water and Dust Intrusion	IP54, MIL-STD

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

Chapter 2

Test Equipment and Service Aids

This chapter lists the recommended test equipment and service aids, as well as information on field programming equipment that can be used in servicing and programming Motorola Solutions radios.

2.1 Recommended Test Equipment

The list of equipment contained in the following table includes most of the standard test equipment required.

Table 18: Test Equipment

Equipment	Characteristics	Example	Application
Service Monitor	Can be used as a substitute.	Aeroflex 3920 (www.aeroflex.com) or equivalent	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment.
Digital RMS Multimeter[9]	100 µV to 300 V 5 Hz to 1 MHz 10 MΩ Impedance	Fluke 179 (www.fluke.com) or equivalent	AC/DC voltage and current measurements. Audio voltage measurements.
RF Signal Generator[9]	100 MHz to 1 GHz -130 dBm to +10 dBm FM Modulation: 0 kHz to 10 kHz Audio Frequency: 100 Hz to 10 kHz	Agilent N5181A (www.agilent.com), Ramsey RSG1000B (www.ramseyelectronics.com), or equivalent	Receiver measurements
Oscilloscope[9]	2 Channel 50 MHz Bandwidth 5 mV/div to 20 V/div	Tektronix TDS1001b (www.tektronix.com) or equivalent	Waveform measurements
Power Meter and Sensor[9]	5% Accuracy 100 MHz to 500 MHz 50 W	Bird 43 Thruline Watt Meter (www.bird-electronic.com) or equivalent	Transmitter power output measurements
RF Millivoltmeter	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

[9] Can use Service Monitor as substitute.

2.2 Service Aids

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

Table 19: Service Aids

Motorola Solutions Part No.	Description	Application
RLN4460_	Test Box	Enables connection to audio/accessory jack. Allows switching for radio testing.
RVN5115_	Customer Programming Software on CD-ROM	Allows servicer to program radio parameters, tune and troubleshoot radios.
PMKN4010_	Mobile and Repeater Rear Programming Cable	Connects the radio rear connector to a USB port for radio programming and data applications.
PMKN4016_	Mobile and Repeater Rear Accessory Programming and Test Cable	Connects the radio rear connector to a USB port for radio programming, data applications, testing, and alignment.
PMKN4018_	Mobile and Repeater Rear Accessory Connector Universal Cable	Connects the radio 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 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 3: Mobile Front Programming Cable HKN6184_

Figure 4: Mobile & Repeater Rear Programming Cable PMKN4010_

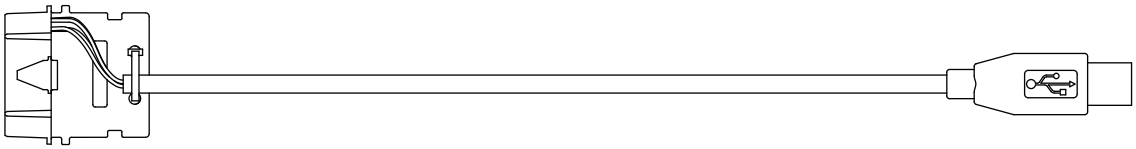
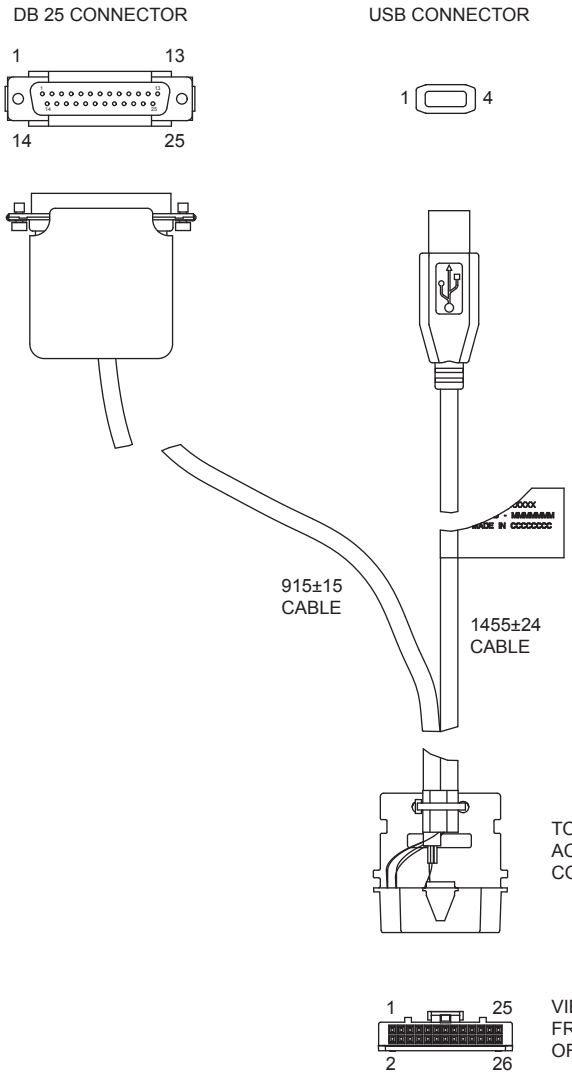


Figure 5: Mobile & Repeater Rear Accessory Programming and Test Cable PMKN4016_



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

Chapter 3

Transceiver Performance Testing

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 calibration schedule recommended by the manufacturer.

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

3.1 Setup

Supply voltage is provided using a 13.8 VDC power supply. Applying 13.8 VDC at the DC power cable will ensure a minimum of 13.2 VDC at the DC connector of the radio. The equipment required for alignment procedures is connected as shown in the Radio Tuning Setup chapter.

WARNING: Do NOT use any form of connector, for example wires, crocodile clips, and probes, to supply voltage to the radio, other than the Motorola Solutions approved battery eliminator.

Initial equipment control settings must be as indicated in the following table:

Table 20: Initial Equipment Control Settings

Service Monitor	Power Supply	Test Set
Monitor Mode: Power Monitor	Voltage: 13.8 VDC	Speaker set: A
RF Attn: -70	DC on/standby: Standby	Speaker/load: Speaker
AM, CW, FM: FM	Volt Range: 20 V	PTT: OFF
Oscilloscope Source: Mod Oscilloscope Horizontal: 10 ms/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	

3.2 Color Display Model Test Mode

3.2.1 Entering Display Radio Test Mode

Procedure:

1. Turn the radio on.
2. Within 10 seconds after Self-Test is completed, press the **P2** button five times in succession.

   The radio beeps and shows a series of displays regarding various version numbers and subscriber-specific information. The displays are described in the following table.

Table 21: 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 model number as programmed in the codeplug.	Always
MSN	The radio serial number as programmed in the codeplug.	Always
FLASHCODE	The FLASH codes as programmed in the codeplug.	Always
RF Band	The radio band.	Always

NOTICE: The radio stops at each display for 2 seconds before moving to the next information display. If the information cannot fit into one 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 suspends the information display until the user presses **Bottom Navigation** Button to resume the information display. The last display shows `RF Test Mode`.

3.2.2 RF Test Mode

When the radio is operating in its normal environment, the radio 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 with a special routine, called Test Mode or air test.

In RF Test Mode, the first line displays `RF Test`, together with the power level icon at the right end of the first line. The second line displays the test environment, the channel number, and channel spacing. The default test environment is CSQ.

3.2.2.1

RF Testing

Procedure:

1 Each short press of the **P2** button 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.

NOTICE: DIG is digital mode and other test environments are analog mode as described in Table 22: Test Environments on page 35.

Table 22: 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 Mode (DIG)	RX: unsquelch if carrier and digital code detected TX: mic audio
4	Unsquelch (USQ)	RX: constant unsquelch TX: mic audio

2 Each short press of the **P1** button 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 2 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.

See the following Test Frequencies table for the test channel descriptions.

The radio beeps in each position.

NOTICE: 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.

Table 23: Test Frequencies

Test Channel- Low and High Power	VHF	UHF1	UHF2	800/900 Band
TX #1 or #8	136.075	403.000	450.000	806.575
RX #1 or #8				851.025
TX #2 or #9	142.575	414.150	462.800	825.575
RX #2 or #9				855.025

Test Channel- Low and High Power	VHF	UHF1	UHF2	800/900 Band
TX #3 or #10	146.575	425.350	475.700	862.575
RX #3 or #10				860.525
TX #4 or #11	155.575	436.500	488.500	897.575
RX #4 or #11				869.925
TX #5 or #12	161.575	447.675	501.300	900.575
RX #5 or #12				935.025
TX #6 or #13	167.575	458.850	514.200	936.575
RX #6 or #13				938.025
TX #7 or #14	174.975	470.000	527.000	940.975
RX #7 or #14				940.925

Table 24: Transmitter Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Reference Frequency	Mode: PWR MON Fourth channel test frequency.[10] 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: ±80 Hz for VHF ±220 Hz (UHF1) ±250 Hz (UHF2) ±450 Hz (800 Band)
Power RF	As above	TEST MODE Test Channel 4, carrier squelch TEST MODE Test Channel 11, carrier squelch	As above	Low Power Set 1.0–1.3 W: **1** VHF 1–25 W **2** UHF1 1–25 W **3** UHF2 1–40 W 25–29 W: **1** VHF 25–45 W **2** UHF1 25–40 W) 10 W: 800/900 10–35/30 W High Power Set 25–29 W: **1** VHF 1–25 W

[10] See "Test Frequencies" Table".

Test Name	Communications Analyzer	Radio	Test Set	Comments
				2 UHF1 1–25 W 40–47 W: **1** UHF1 25–40 W **2** UHF2 1–40 W 45–53 W: VHF 25–45 W 35 W: 806–870 M 10–35 W 30 W: 896–941 M 10–30 W
Voice Modulation	Mode: PWR MON Fourth channel test frequency[10] atten to -70, input to RF In/Out Monitor: DVM: AC Volts Set 1 kHz Mod Out level for 800 mVrms at test set, 800 mVrms 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.)
Internal Voice Modulation	Mode: PWR MON Fourth channel test frequency[10] atten to -70, input to RF In/Out	TEST MODE Test Channel 4, carrier squelch output at antenna	Remove modulation input	
TPL Modulation	As above Fourth channel test frequency[10] 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.)
FSK Error	DMR Mode. FSK Error	TEST MODE	Key up radio with O.153	Not Exceed 5%

Test Name	Communications Analyzer	Radio	Test Set	Comments
		Digital Mode, transmit with O.153 test pattern	test pattern modulation using Tuner.	
Magnitude Error	DMR Mode. Magnitude error	As above	As above	Not Exceed 1%
Symbol Deviation	DMR Mode. Symbol Deviation	As above	As above	Symbol Deviation should be within 648Hz +/-10% and 1944Hz +/-10%
Transmitter BER	DMR Mode	As above	As above	Transmitter BER should be 0%

NOTICE: Motorola Solutions recommends that the reference oscillator be recalibrated after two years to maintain optimized Dual Capacity Direct Mode performance.

Table 25: Receiver Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Rated Audio	Mode: GEN Output level: 1.0 mV RF Fourth channel test frequency[10] Mod: 1 kHz tone at 3 kHz deviation Monitor: DVM: AC Volts	TEST MODE Test Channel 4, 25 kHz channel spacing, carrier squelch	PTT to OFF (center), meter selector to Audio PA.	Set volume control to 7.75 Vrms
Distortion	As above, except to distortion	As above	As above	Distortion <5.0%
Sensitivity (SINAD)	As above, except SINAD, lower the RF level for 12 dB SINAD.	As above	PTT to OFF (center)	RF input to be <0.3 µV
Noise Squelch Threshold (only radios with conventional system need to be tested)	RF level set to 1 mV RF	As above	PTT to OFF (center), meter selection to Audio PA, spkr/ load to speaker	Set volume control to 7.75 Vrms
	As above, except change frequency to a conventional system. Raise RF level from zero until radio unsquelches.	Out of TEST MODE; Select a conventional system	As above	Unsquelch to occur at <0.25 µV. Preferred SINAD = 9–10 dB

Test Name	Communications Analyzer	Radio	Test Set	Comments
Receiver BER	IFR DMR mode. Signal generator with O.153 test pattern	TEST MODE Digital Mode,receive O.153 test pattern	Read BER using Tuner. Adjust RF level to get 5% BER	RF level to be <0.3 µV for 5% BER

3.2.3
Color Display Test Mode

Procedure:

1. Press and hold the **P1** button in RF Test Mode.

   The radio beeps once and momentarily displays `Display Test Mode`.

2. Press any button/key.

   The negative image of `Display Test Mode` appears.

3. Press any button/key.

   With each successive press, the display background changes from Red->Green->Blue.

4. Press any button/key.

   With each successive press, the displays shows a growing horizontal bar with a cyclic color of Red->Green->Blue->Black->Red->Green->Blue->Black->Red (Full Screen).

5. Press any button/key.

   With each successive press, the displays shows a growing vertical bar with a cyclic color of Red->Green->Blue->Black->Red->Green (Full Screen).

6. Press any button/key.

   The display clears and 12 icons appear at the top of the display.

3.2.4
LED Test Mode

Procedure:

1. Press and hold the **P1** button after Display Test Mode.

   The radio beeps once and displays `LED Test Mode`.

2. Press any button/key.

   The red LED lights up and the radio displays `Red LED On`.

3. Press any button/key.

   The red LED is turned off. The green LED lights up and the radio displays `Green LED On`.

4. Press any button/key.

   The green LED is turned off. The yellow LED lights up and the radio displays `Yellow LED On`.

3.2.5
Backlight Test Mode

Procedure:

Press and hold the **P1** button after LED Test Mode.

The radio beeps once and displays `Backlight Test Mode`.

The radio turns on both LCD and keypad backlight.

3.2.6
Speaker Tone Test Mode

Procedure:

Press and hold the **P1** button after Backlight Test Mode.

The radio beeps once and displays `Speaker Tone Test Mode`.

The radio generates a 1 kHz tone with the internal speaker.

3.2.7
Earpiece Tone Test Mode

Procedure:

1. Connect the external accessory to the radio.
2. Press and hold the **P1** button after Speaker Tone Test Mode.

   The radio beeps once and displays `Earpiece Tone Test Mode`.

The radio generates a 1 kHz tone from the earpiece.

3.2.8
Audio Loopback Test Mode

Procedure:

Press and hold the **P1** button after Earpiece Tone Test Mode.

The radio beeps once and displays `Audio Loopback Test Mode`.

The radio routes any audio on the mic to the internal speaker.

3.2.9
Audio Loopback Earpiece Test Mode

Procedure:

Press and hold the **P1** button after the Earpiece Tone Test Mode.

The radio beeps once and displays `Audio Loopback Earpiece Test Mode`.

The radio routes any audio on the mic to the accessory earpiece.

3.2.10
Button Test Mode

Procedure:

Press and hold the **P1** button after Audio Loopback Earpiece Test Mode.

The radio beeps once and displays `Button Test`.

The radio also displays the Button Command Opcode (BCO) and state (BCO/state) on the screen upon any button state changes.

Postrequisites: The radio must be powered off to end Test Mode.

3.3
Numeric Display Model Test Mode

3.3.1
Entering Display Radio Test Mode

Procedure:

1. Turn the radio on.
2. Within 10 seconds after Self-Test is complete, press the **P2** button five times in succession.

The radio beeps.

3.3.2
RF Test Mode

When the radio is operating in its normal environment, the radio microcontroller controls the RF channel selection, transmitter key-up, and receiver muting, according to the customer codeplug configuration.

When and where to use: However, when the unit is on the bench for testing, alignment, or repair, it must be removed from its normal environment by using a special routine, called Test Mode or "air test".

Procedure:

1. Short press the **P2** button to change 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.

   DIG is digital mode and other test environments are analog mode as described in Table 22: Test Environments on page 35.

2. Short press the **P1** button to toggle 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 clockwise to increase the channel number from 1 to 14 or counterclockwise to decrease the channel number.

The radio beeps at each position.

Refer to "Test Frequencies" for the test channel descriptions.

NOTICE: The **Volume/Channel** knob stays in Channel mode until the **Volume/Channel** knob is pushed momentarily. This is not the case in normal operation.

3.3.3
Display Test Mode

Procedure:

1 Press and hold the **P1** button in RF Test Mode.

The radio beeps once and enters Display Test Mode.

2 Press any button to turn on the two character seven segment display.

3.3.4
LED Test Mode

Procedure:

1 Press and hold the **P1** button after Display Test Mode.

The radio beeps once.

2 Press any button/key.

The red LED lights up.

3 Press any button/key.

The red LED turns off and the radio lights up the green LED.

4 Press any button/key.

The green LED turns off and the radio lights up the yellow LED.

3.3.5
Speaker Tone Test Mode

Procedure:

Press and hold the **P1** button after LED Test Mode.

The radio beeps once.

The radio generates a 1 kHz tone with the internal speaker.

3.3.6
Earpiece Tone Test Mode

Procedure:

Press and hold the **P1** button after Speaker Tone Test Mode.

The radio beeps once.

The radio generates a 1 kHz tone with the earpiece.

3.3.7
Audio Loopback Test Mode

Procedure:

Press and hold the **P1** button after Earpiece Tone Test Mode.

The radio beeps once.

The radio routes any audio on the mic to the internal speaker.

3.3.8
Audio Loopback Earpiece Test Mode

Procedure:

Press and hold the **P1** button after Earpiece Tone Test Mode.

The radio beeps once.

The radio routes any audio on the mic to the accessory earpiece.

3.3.9
Button Test Mode

Procedure:

1. Press and hold the **P1** button after Audio Loopback Earpiece Test Mode.

   The radio beeps once.

2. Rotate the **Volume/Channel** knob.

   The radio beeps at each position.

3. Press any button.

   The radio beeps once.

Postrequisites: The radio must be powered off to end Test Mode.

Chapter 4

Radio Programming and Tuning

This chapter provides an overview of the MOTOTRBO Customer Programming Software (CPS), Tuner, and AirTracer applications, which are all designed for use in a Windows 8/7/2000/XP/Vista environment.

NOTICE: Refer to the online help files of the appropriate program for the programming procedures.

These programs are available in one kit as listed in the following table. An Installation Guide is also included with the kit.

Table 26: Software Installation Kits Radio Tuning Setup

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

4.1 Customer Programming Software Setup

Program the radio using the following setup.

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

Figure 6: Customer Programming Software Setup from Front Connector

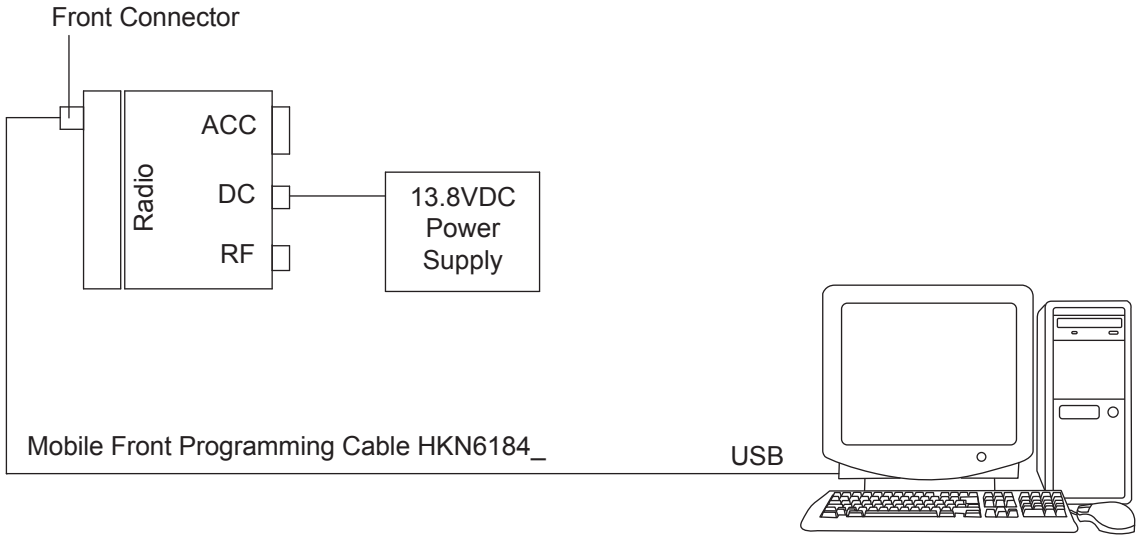


Figure 7: Customer Programming Software Setup from Rear Accessory Connector

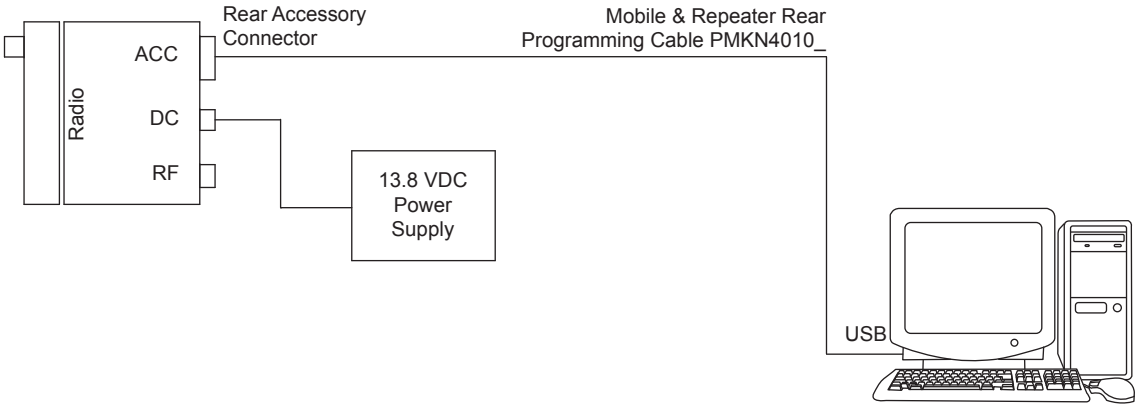
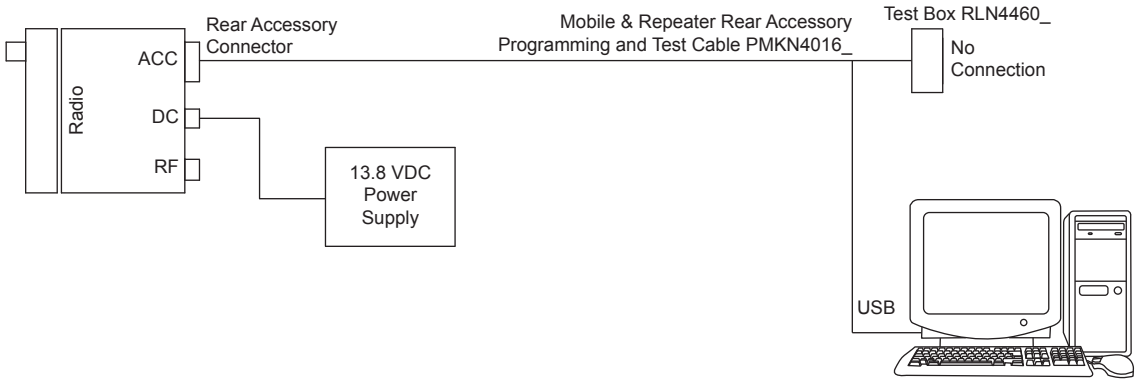


Figure 8: Customer Programming Software Setup with Test Box Connection



4.2 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 Solutions personnel to suggest improvements in system configurations or to help isolate problems.

4.3 Radio Tuning Setup

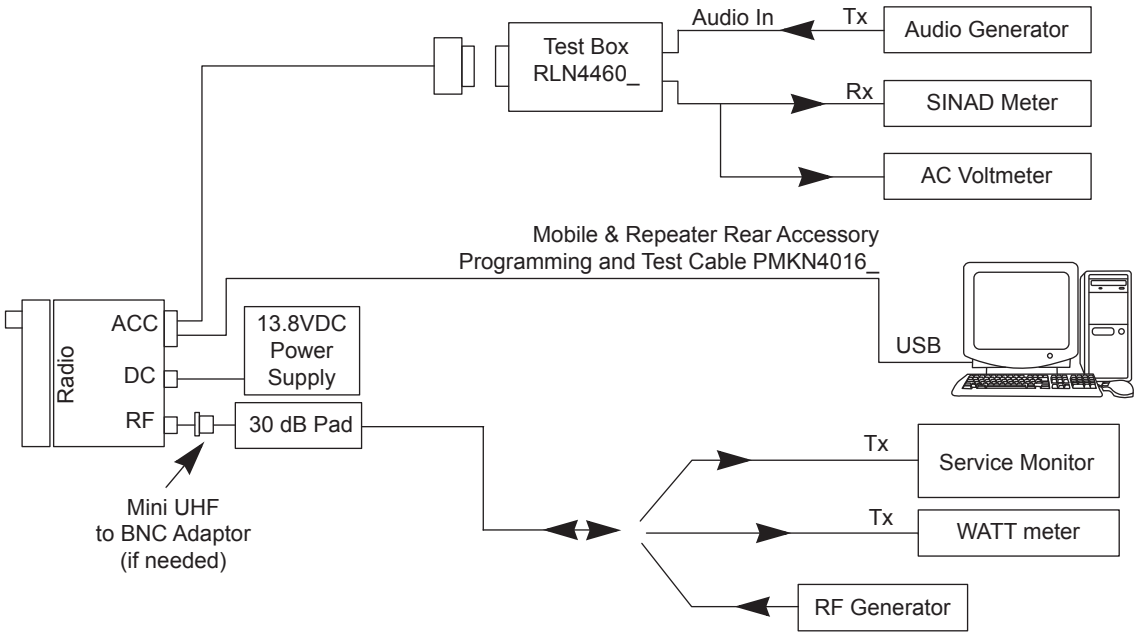
Retuning is not required if service kit has been replaced and factory tuned. However, check service kit for performance before use.

Before keying up the radio, set the Bias DAC for the appropriate final device bias current. If the bias is not properly set, it may cause damage to the transmitter.

CAUTION: Only Motorola Solutions Service Centers or Authorized Motorola Solutions Service Dealers can perform this function.

A personal computer (PC) with Windows, Windows 2000/XP/Vista/Windows 7 and a tuner program are required to tune the radio. See "Radio Tuning Equipment Setup" to perform tuning procedures.

Figure 9: Radio Tuning Equipment Setup



Chapter 5

Disassembly/Reassembly Procedures

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.

5.1 Preventive Maintenance

Periodic visual inspection and cleaning is recommended.

5.1.1 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.

5.1.2 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 front cover, housing assembly, and battery case. These surfaces should be cleaned whenever a periodic visual inspection reveals the presence of smudges, grease, and/or grime.

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

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

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

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

Cleaning External Plastic Surfaces

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

Cleaning Internal Circuit Boards and Components

Isopropyl alcohol (100%) may be applied with a stiff, non-metallic, short-bristled brush to dislodge embedded or caked materials located in hard-to-reach areas. The brush stroke should direct the dislodged material out and away from the inside of the radio. Make sure that controls or tunable components are not soaked with alcohol. Do not use high-pressure air to hasten the drying process since this could cause the liquid to collect in unwanted places. After completing the cleaning process, 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.

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

5.2 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 your radio without referring to the following caution statement.

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

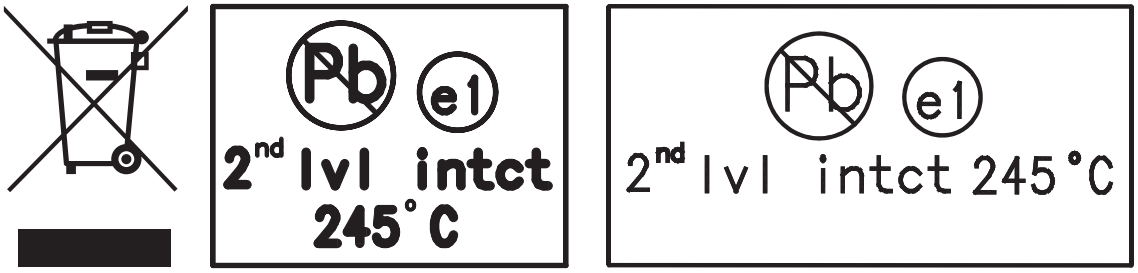
- Store and transport all CMOS/LDMOS devices in conductive material so that all exposed leads are shorted together. Do not insert CMOS/LDMOS devices into conventional plastic "snow" trays used for storage and transportation of other semiconductor devices.
- Ground the working surface of the service bench to protect the CMOS/LDMOS device. It is recommended that you use a wrist strap, two ground cords, a table mat, a floor mat, electrostatic discharge (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 Solutions 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.
- Handle CMOS/LDMOS devices by the package and not by the leads. Before 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.

5.3

General Repair Procedures and Techniques

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

For the identification of lead (Pb) free assemblies, all EPP products carry the EPP Marking, shown in the following examples, on the Printed Circuit Board (PCB). This marking provides information to those performing assembly, servicing, and recycling operation on this product, adhering to the JEDEC Standard No. 97. The EPP Marking takes the form of a label or marking on the PCB.



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 tables:

Table 27: Lead Free Solder Wire Part Number List

Motorola Solutions 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 in.	1 lb spool

Table 28: Lead Free Solder Paste Part Number List

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

Parts Replacement and Substitution

When damaged parts are replaced, identical parts must be used. If the identical replacement part is not locally available, check the parts list for the proper Motorola Solutions part number and order the part.

Rigid Circuit Boards

This family of radios use bonded, multi-layer, printed circuit boards. Since the inner layers are not accessible, some special considerations are required when soldering and unsoldering components. The plated-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.

For soldering components with Hot-Air or infra red solder systems, check the user guide of your solder system to get information on solder temperature and time for the different housings of the integrated circuits and other components.

5.4 Disassembling and Reassembling the Radio

These radios may be disassembled and reassembled with the use of only 10 screws (board to casting).When disassembling and reassembling the radio, it is important to pay particular attention to the snaps and tabs, and how parts align with each other.

CAUTION: To assure the safety and regulatory compliance of your radio, repair your radio only at Motorola Solutions service facilities. Please contact your local dealer or Point of Sale for further instructions.

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

- Small Flat Blade Screwdriver
- Control Head Dismantling Tool (Motorola Solutions Part No. 6686119B01)
- Volume/Channel Knob Removal Tool (Motorola Solutions Part No. 66012025001)
- Torque Driver (2-36 lbs-in or 0.2-4.0 N-m), (Motorola Solutions Part No. RSX4043A)
- TORX™ T10 Driver Bit (Motorola Solutions Part No. 6680387A74)
- TORX T8 Driver Bit (Motorola Solutions Part No. 6680387A72)
- TORX T6 Driver Bit (Motorola Solutions Part No. 6680387A70) (for radios with expansion board or option board)
- 5/16 in. or 8 mm Socket Driver (for radios with expansion board)
- 9/16 in. Deep Socket Driver (RF Connector Nut)

NOTICE: The following disassembly procedures should be performed only if necessary.

NOTICE: If a unit requires further testing or service than is customarily performed at the basic level, send radio to Motorola Solutions Service Center.

5.5 Detailed Radio Disassembly

The section describes the detailed disassembly procedure of your radio.

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.

5.5.1 Control Head Removal

Procedure:

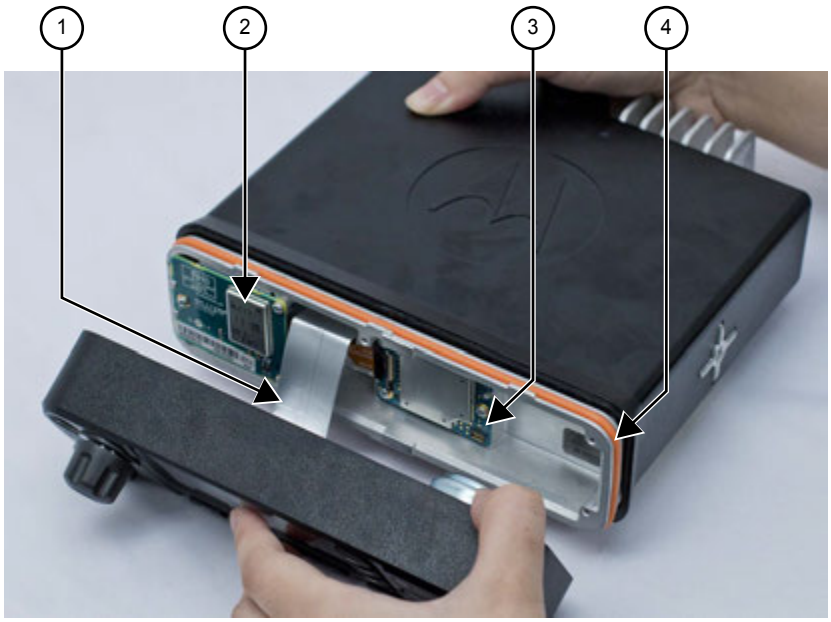
1. Insert the dismantling tool in the groove between the control head and the radio assembly.
2. Press the dismantling tool under the control head to release the snap features.

Figure 10: Typical Control Head Removal

Label	Description
1	Dismantling Tool

3 Pull the control head away from the radio assembly.

Figure 11: Flexible Connection Removal

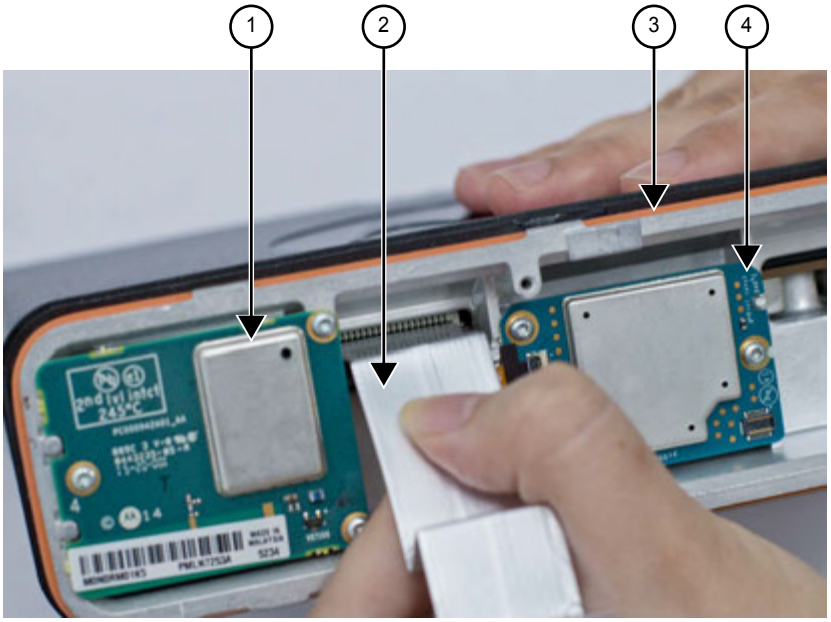


Label	Description
1	Flex Cable
2	Expansion Board
3	Option Board

Label	Description
4	Control Head Seal

4 Remove the flex cable from the socket on the radio assembly.

Figure 12: Flex Cable Removal



Label	Description
1	Expansion Board
2	Flex Cable
3	Control Head Seal
4	Option Board

5 Then remove the control head seal, if required.

5.5.2
Top Cover Removal

Procedure:

1 Insert the dismantling tool between the top cover and the chassis.

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.

Figure 13: Dismantling Top Cover (Image May Not Match Exact Product)

Label	Description
1	Trunnion Mounting Feature
2	Dismantling Tool

4 Lift the top cover from the chassis.

Figure 14: Top Cover Removal

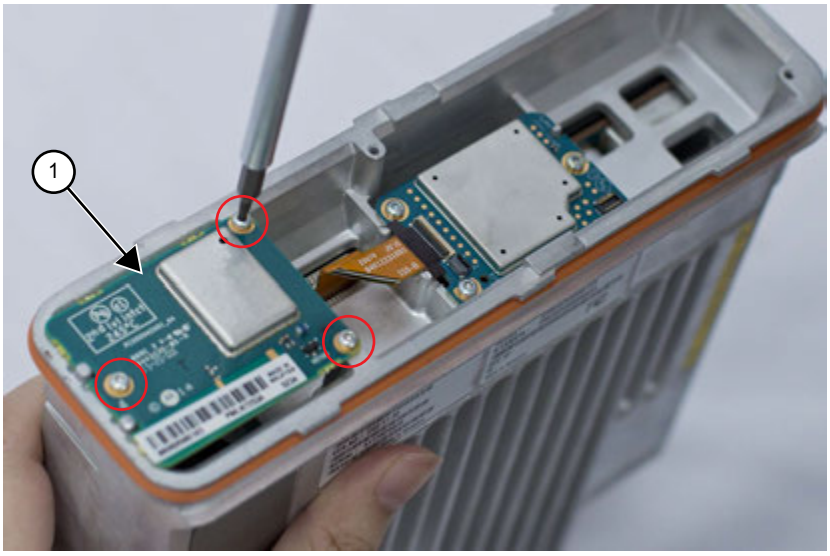
Label	Description
1	Top Cover
2	Chassis

5.5.3
Transceiver Board Removal

Procedure:

1 Using a T6 TORX™ driver, remove the screws securing the expansion board to the chassis.

Figure 15: Expansion Board Removal (Image May Not Match Exact Product)



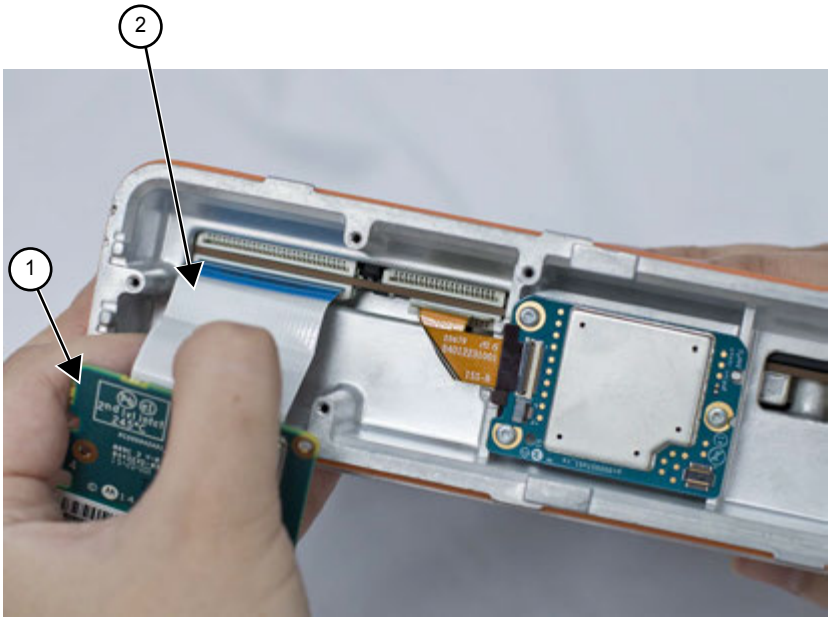
Label	Description
1	Expansion Board

2 Unplug the GNSS cable MCX connector from the expansion board.

NOTICE: Disconnect the MCX connector by grabbing and pulling on the MCX connector body and not the GNSS cable itself.

3 Unplug the flex from the transceiver board.

Figure 16: Expansion Board Flex Removal (Image May Not Match Exact Product)

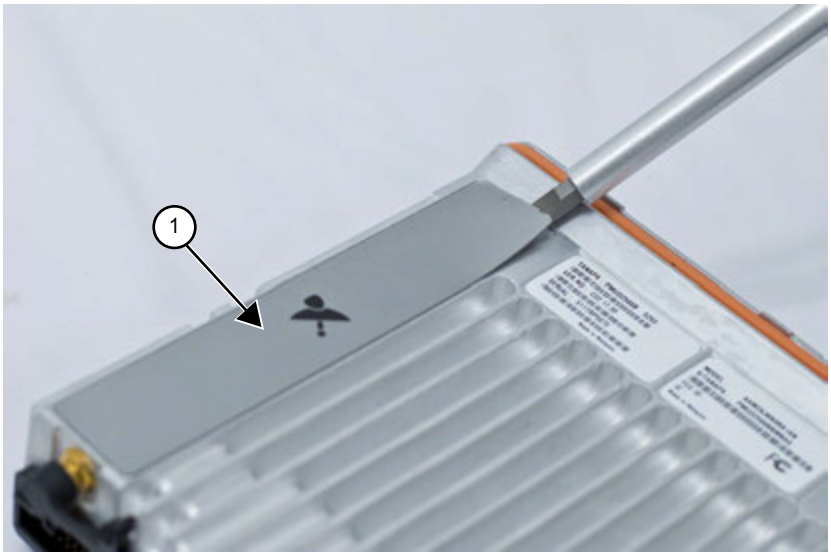


Label	Description
1	Expansion Board
2	Expansion Board Flex

NOTICE: Skip steps step 4 through step 6, if GNSS cable and nameplate do not require servicing.

4 Use a flat-blade screwdriver to lift the GNSS nameplate from the chassis.

Figure 17: GNSS Nameplate Removal

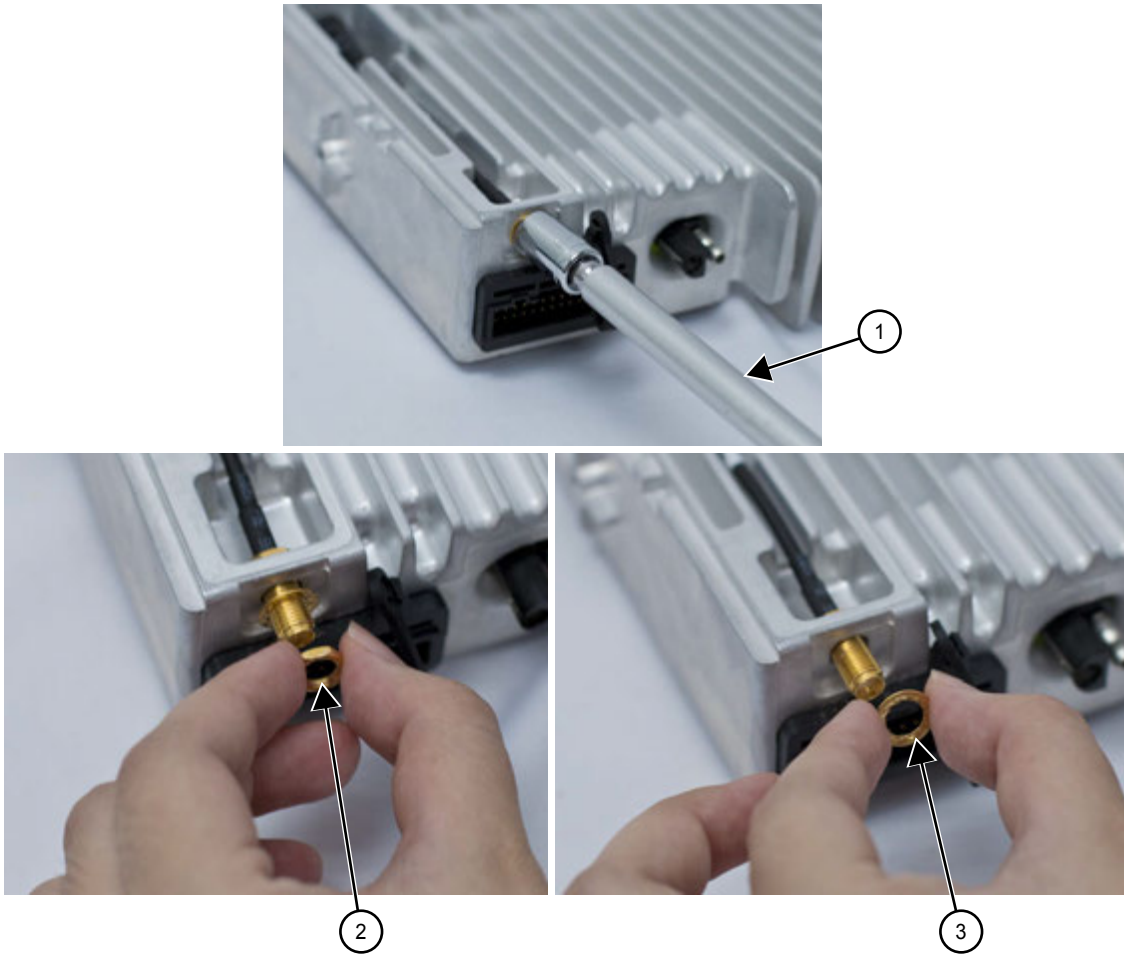


Label	Description
1	GNSS Nameplate

NOTICE: If the GNSS nameplate is removed, it will need to be replaced.

5 Using a 5/16 in. or 8 mm socket driver, remove the nut from the GNSS antenna connector and remove the lock washer from the connector.

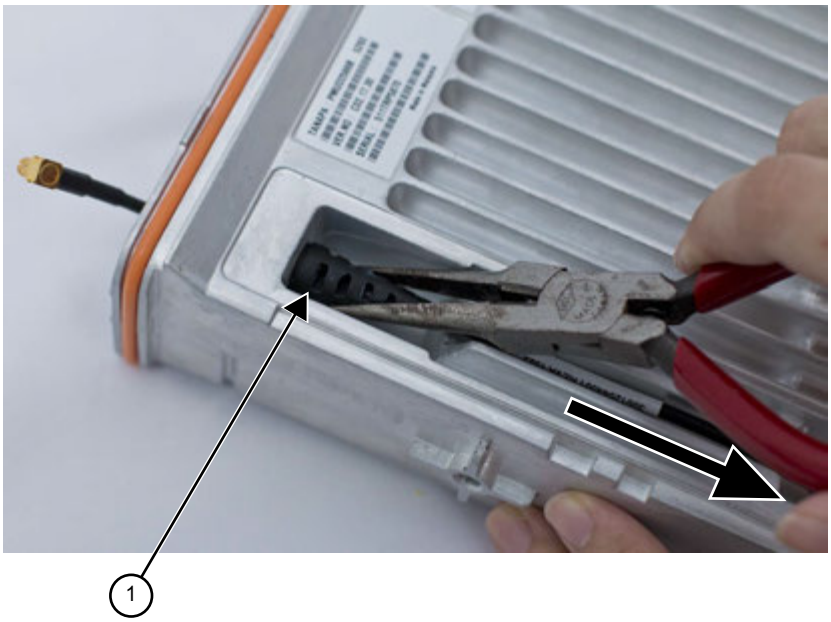
Figure 18: GNSS Connector Nut Removal



Label	Description
1	Socket Driver
2	Nut
3	Washer

6 Remove the GNSS cable from the chassis by pulling on the GNSS cable strain relief.

Figure 19: GNSS Cable Removal



Label	Description
1	GNSS Cable Strain Relief

Option Board Removal

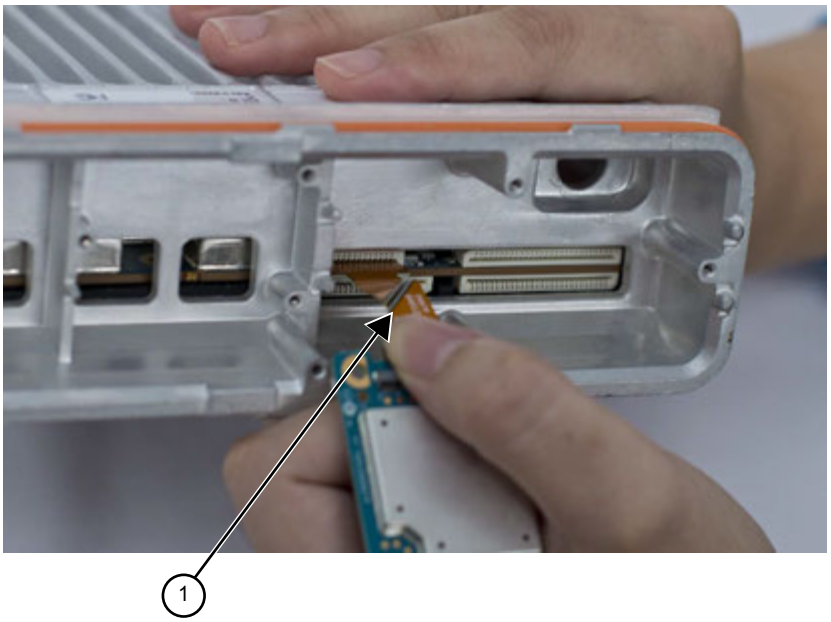
7 Using a T6 TORX driver, remove the screws securing the option board to the chassis.

Figure 20: Option Board Removal (Image May Not Match Exact Product)

Label	Description
1	Option Board

8 Unplug the flex from the transceiver board.

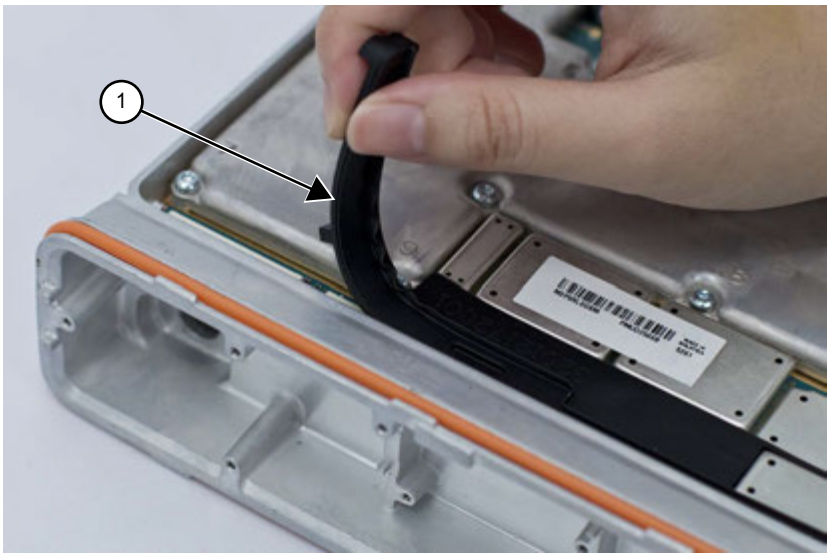
Figure 21: Option Board Flex Removal (Image May Not Match Exact Product)



Label	Description
1	Option Board Flex

9 Remove the acoustic plug by pulling up on it.

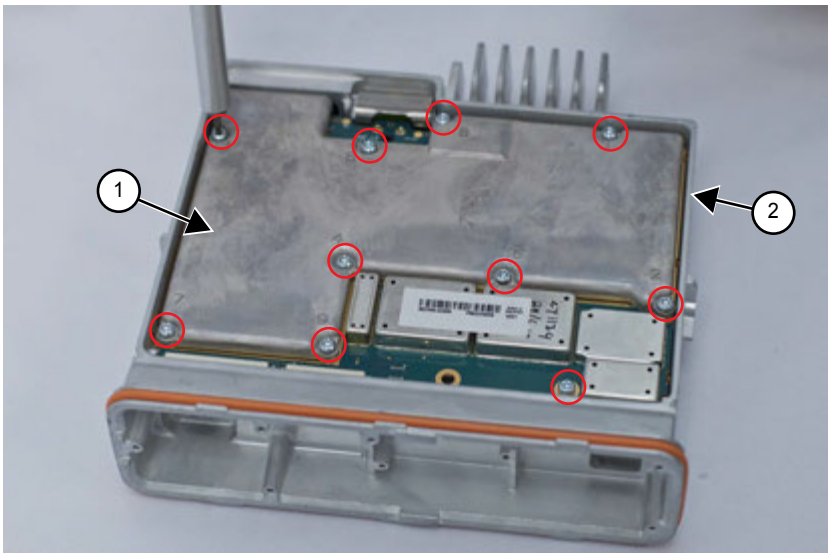
Figure 22: Acoustic Plug Removal



Label	Description
1	Acoustic Plug

10 Remove the nine main shield screws from the die cast main shield and the PCB screw directly on the PCB using the T10 TORX™ driver.

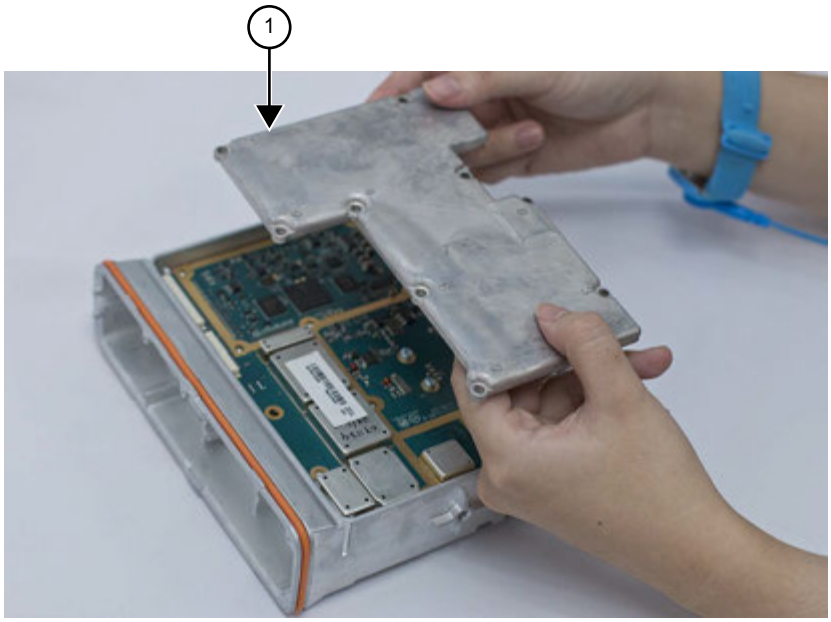
Figure 23: Main Shield and PCB Screw Removal



Label	Description
1	Die Cast Main Shield
2	Radio Chassis

11 Lift the die cast main shield from the chassis.

Figure 24: Die Cast Main Shield Removal

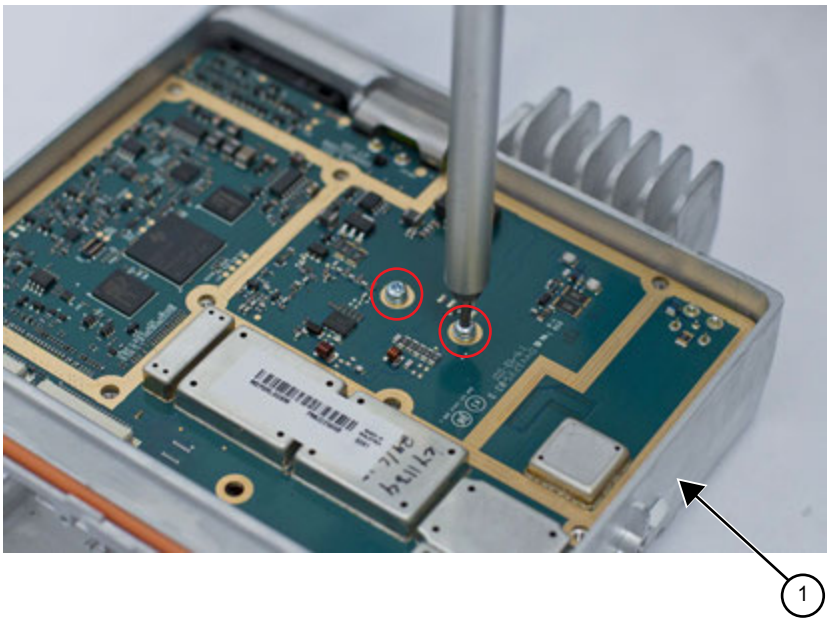


Label	Description
1	Die Cast Main Shield

12 Remove the two screws from the PCB using the T8 TORX driver.

NOTICE: Do not remove the washers from the screws.

Figure 25: PA Screw Removal

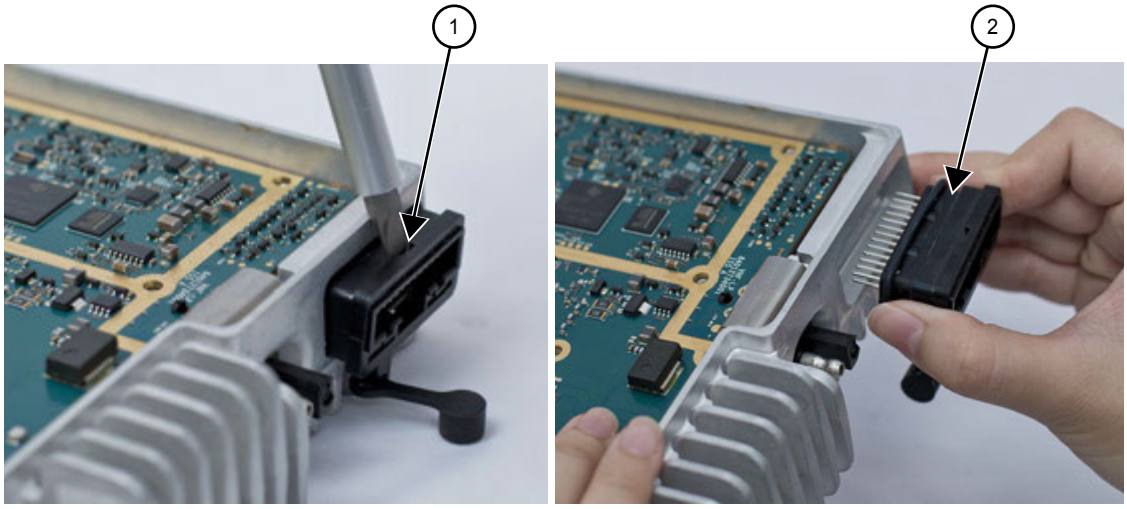


Label	Description
1	Radio Chassis

13 Remove the accessory connector from the radio assembly by inserting a flat-blade screwdriver into the slot on the top of the connector.

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

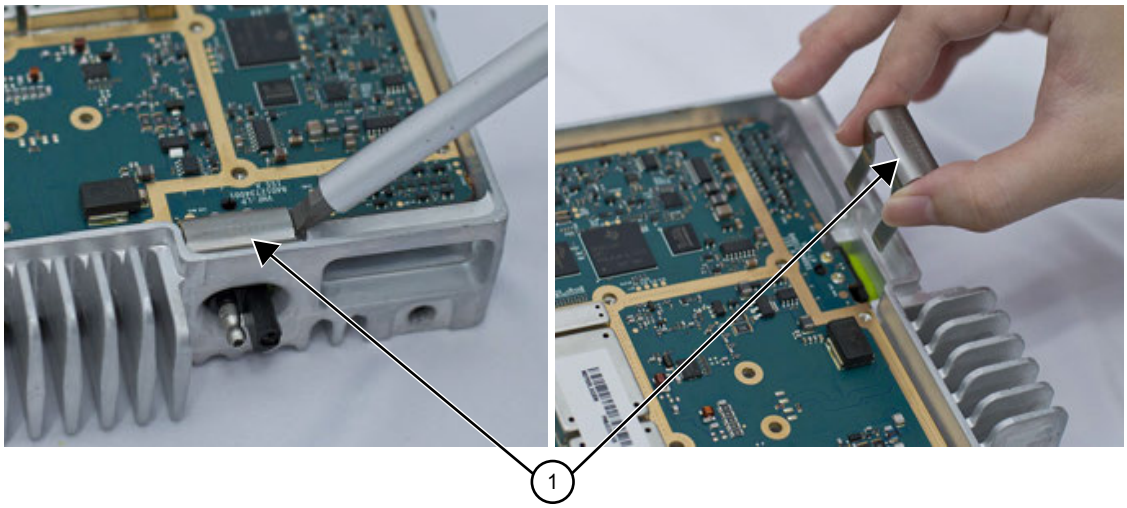
Figure 26: Accessory Connector Removal



Label	Description
1	Insert Flat-blade Screwdriver here
2	Accessory Connector

14 Remove the DC Connector retention clip by gently prying it out with a flat-blade screwdriver.

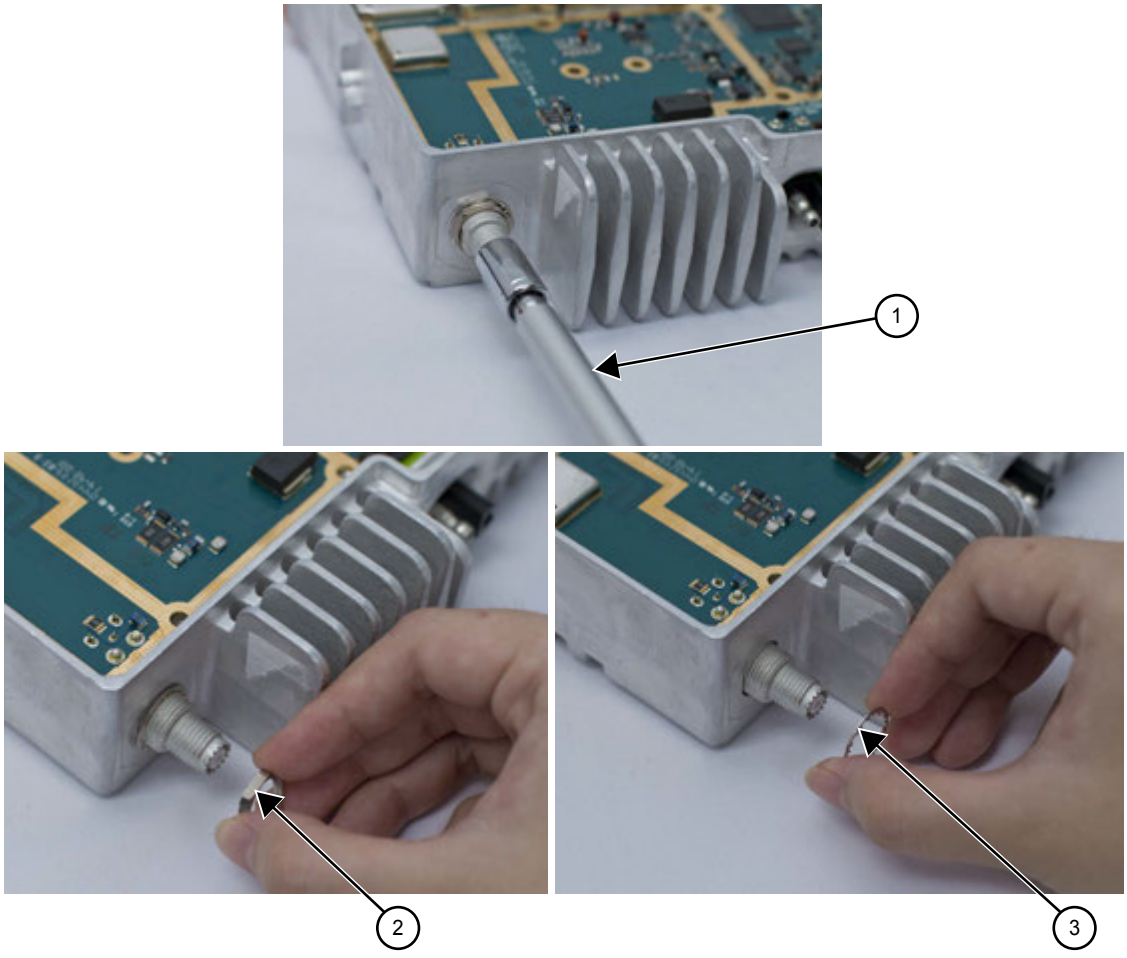
Figure 27: DC Connector Retention Clip Removal



Label	Description
1	DC Retention Clip

15 Remove the RF connector nut and lock washer using a 9/16 in. deep socket driver.

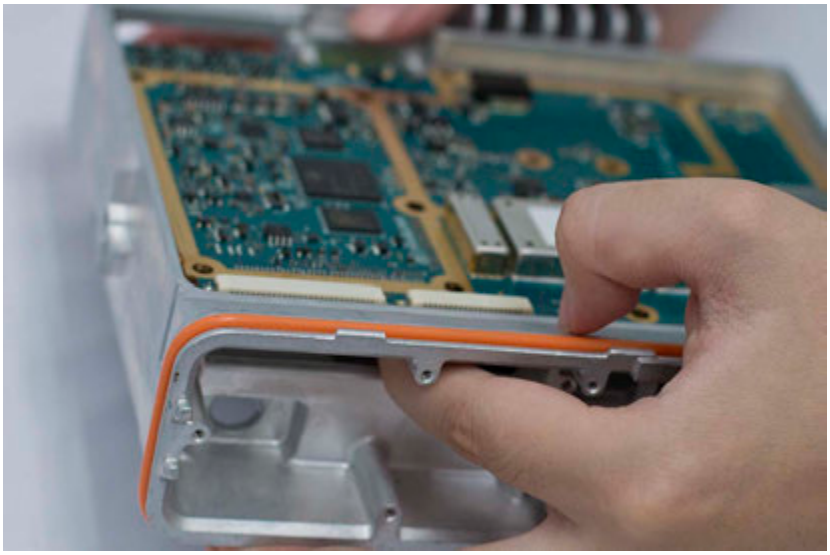
Figure 28: RF Connector Nut Removal



Label	Description
1	Deep Socket Driver
2	RF Connector Nut
3	Lock Washer

16 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. 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.

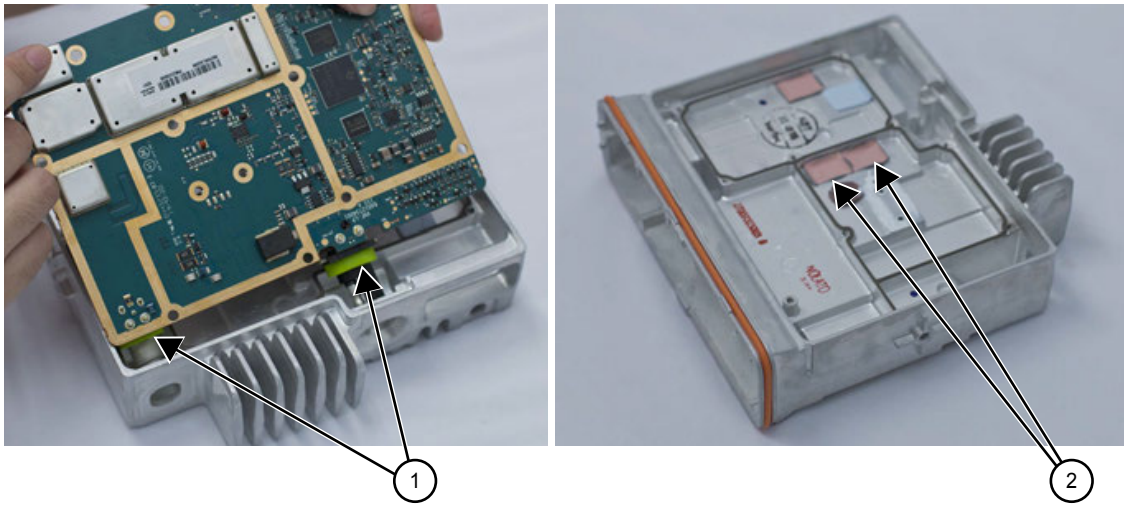
Figure 29: Transceiver Board Removal



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.

NOTICE: 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.

Figure 30: Removing Gaskets and Replacing Final Driver Thermal Pad



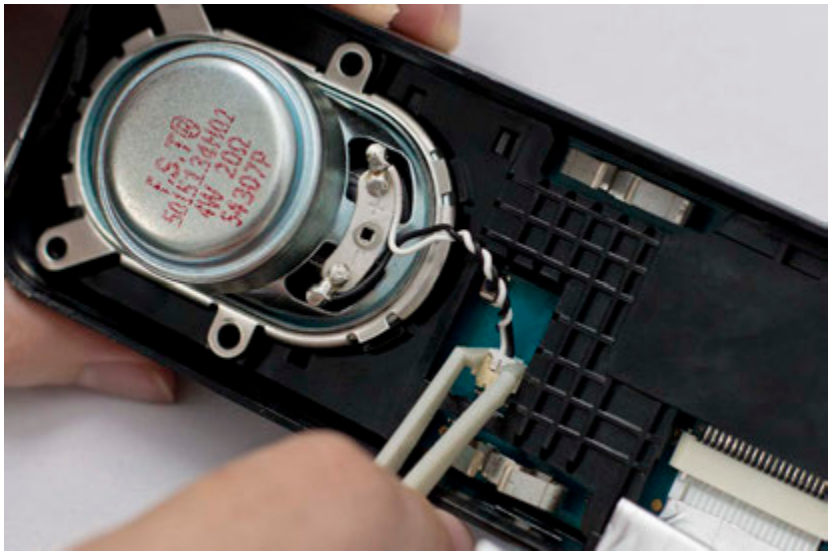
Label	Description
1	Gaskets
2	Final Driver Thermal Pads

5.5.4
Disassembly of Color Display Control Head

Procedure:

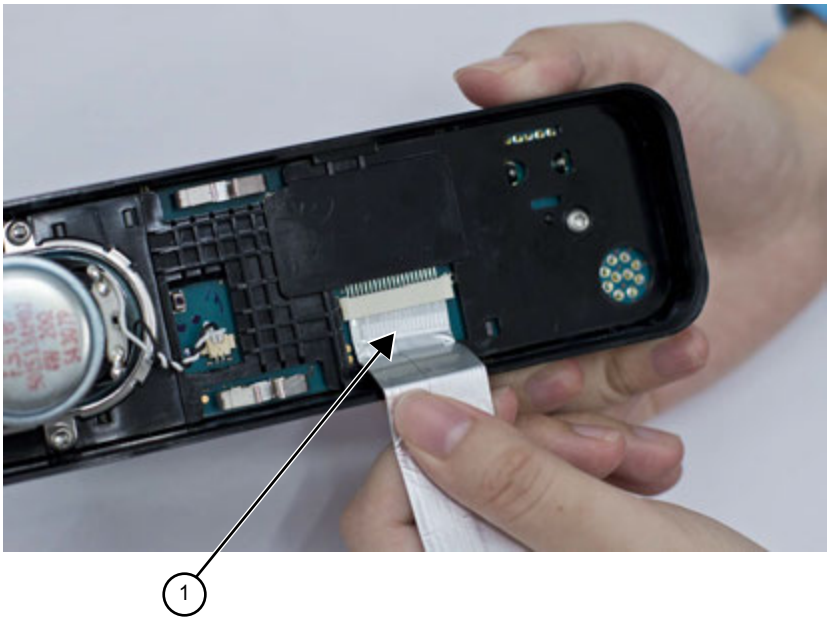
1 Disconnect the speaker plug from the control head board using a pair of tweezers.

Figure 31: Speaker Plug Removal



2 Unplug the control head flex from the control head board by gently pulling the flex out of the connector.

Figure 32: Control Head Flex Removal



Label	Description
1	Control Head Flex

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

Figure 33: Volume/Channel Knob Removal

Label	Description
1	Volume/Channel Knob

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

5 Remove the speaker.

NOTICE: Remove the speaker retainer only if required.

Figure 34: 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 35: 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.

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

Figure 36: Control Head Board Removal

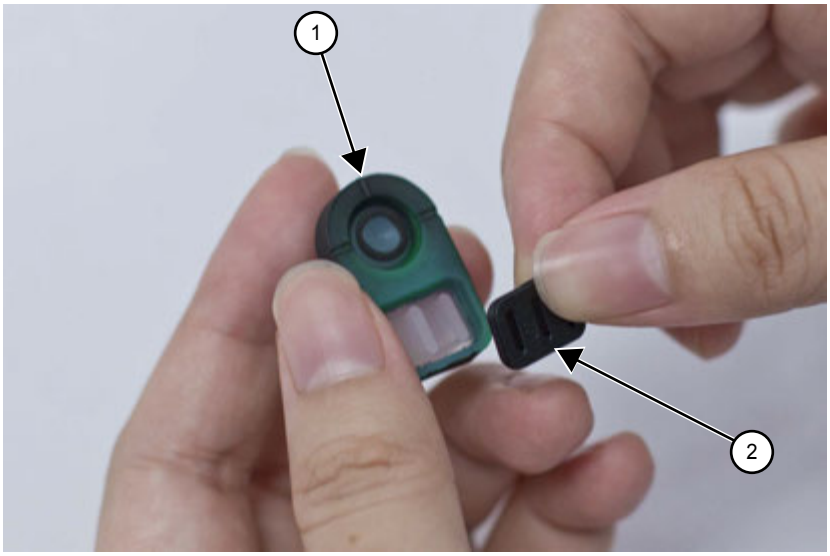
Label	Description
1	Control Head Board

8 Remove the power button by lifting it from the control head housing.

Figure 37: Power Button Removal

9 Separate the light barrier from the power button, if required.

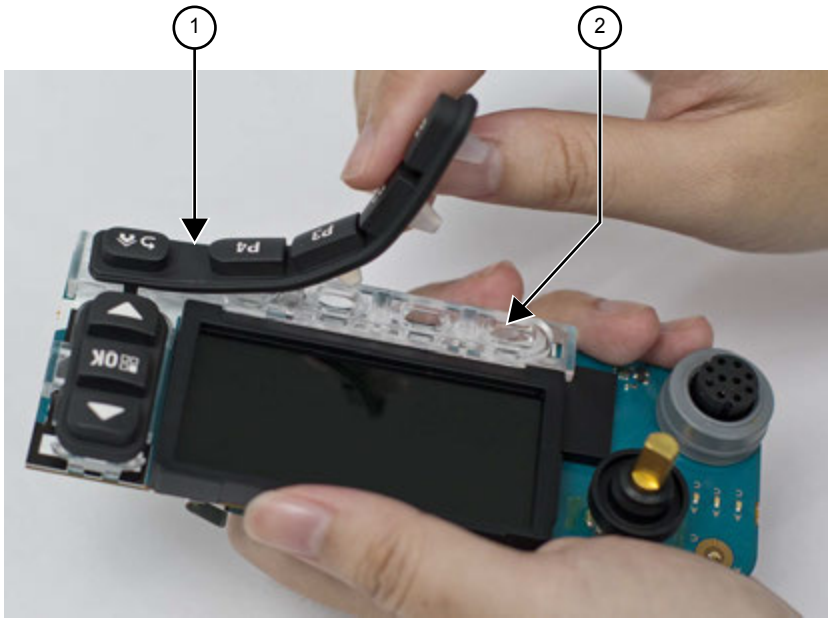
Figure 38: Light Barrier Removal



Label	Description
1	Power Button
2	Light Barrier

10 Separate the keypad from the keypad frame.

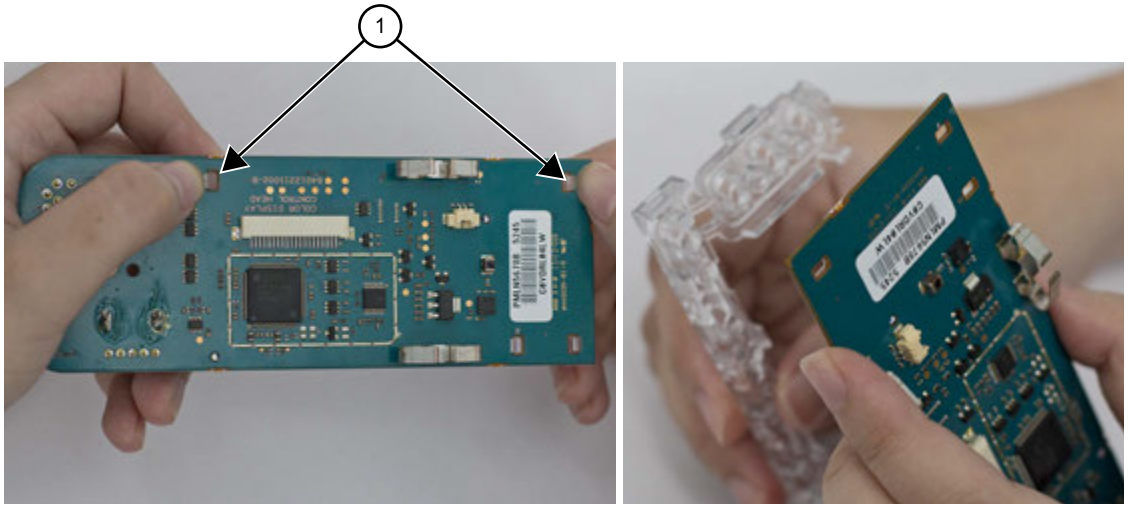
Figure 39: Separating Keypad from Keypad Frame



Label	Description
1	Keypad
2	Keypad Frame

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

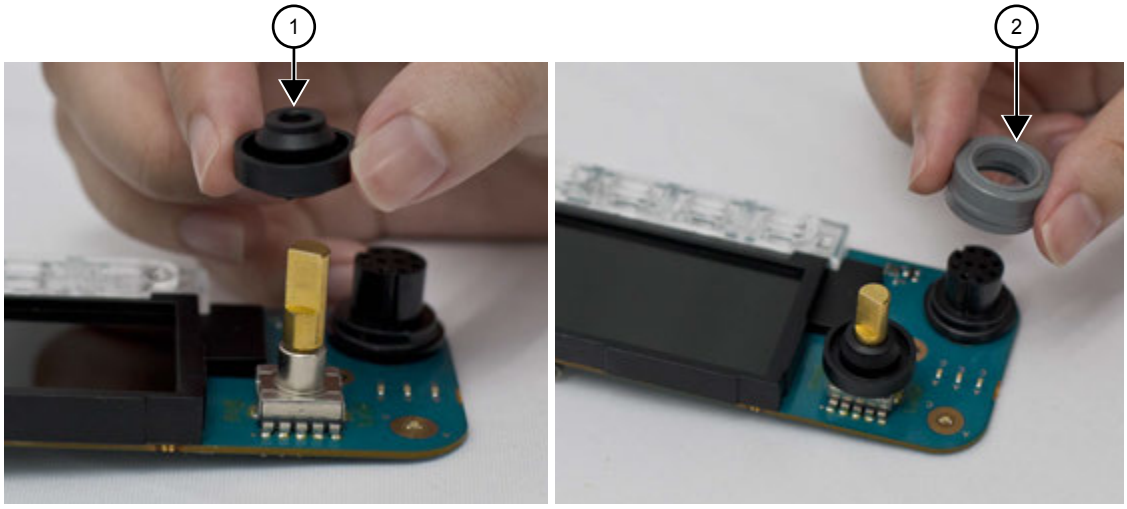
Figure 40: Keypad Removal



Label	Description
1	Retaining Latch Features

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

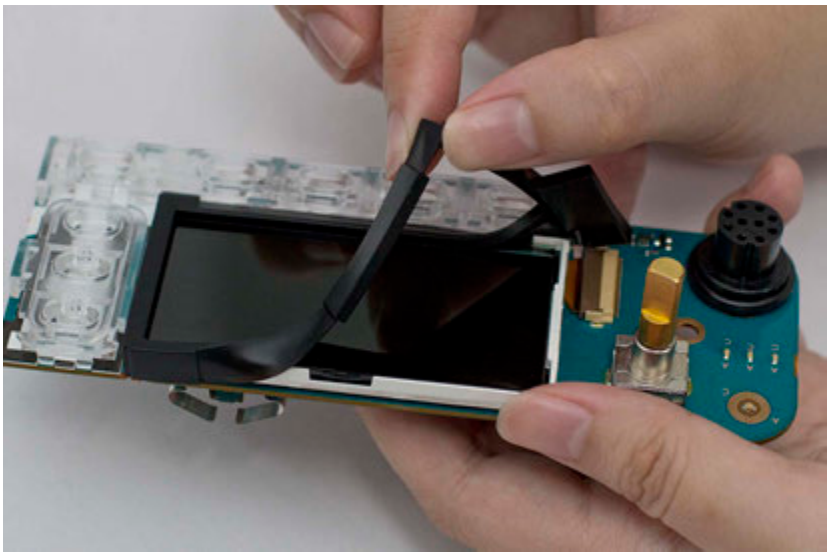
Figure 41: Volume Encoder Seal and Mic Jack Seal Removal



Label	Description
1	Volume Encoder Seal
2	Mic Jack Seal

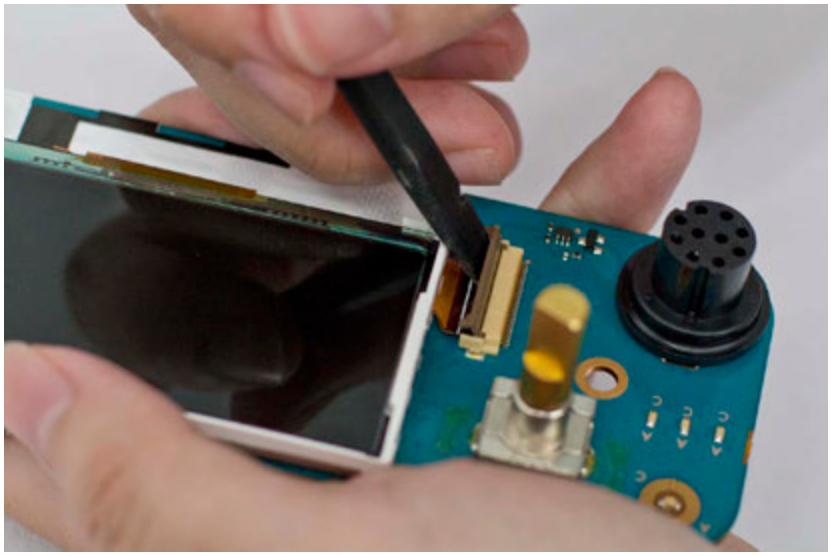
13 Separate the display pad gasket from the color display.

Figure 42: Display Pad Gasket Removal



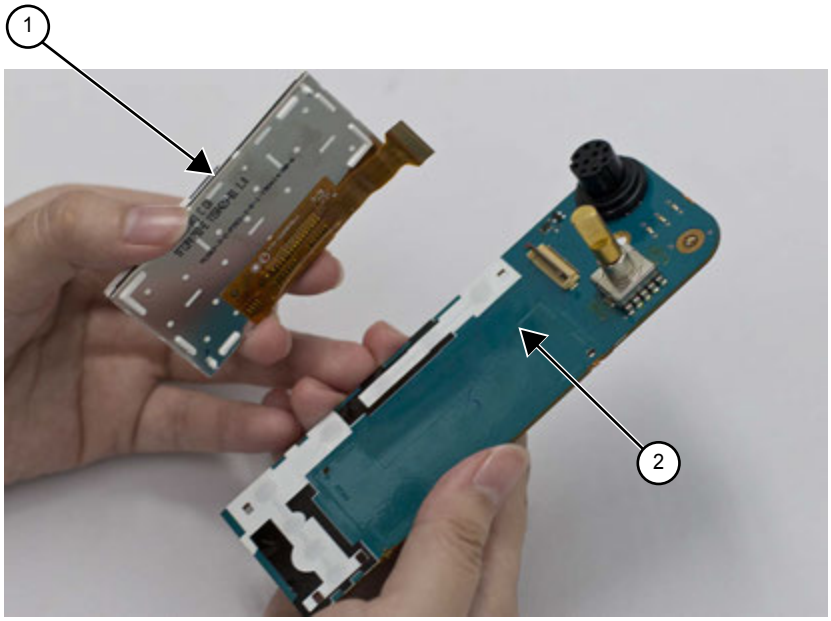
14 Disconnect the display flex from the connector on the PCB.

Figure 43: Display Flex Removal



15 Gently pull or lift on one side of the display to slowly separate the display from the adhesive.

Figure 44: Color Display Removal from PCB



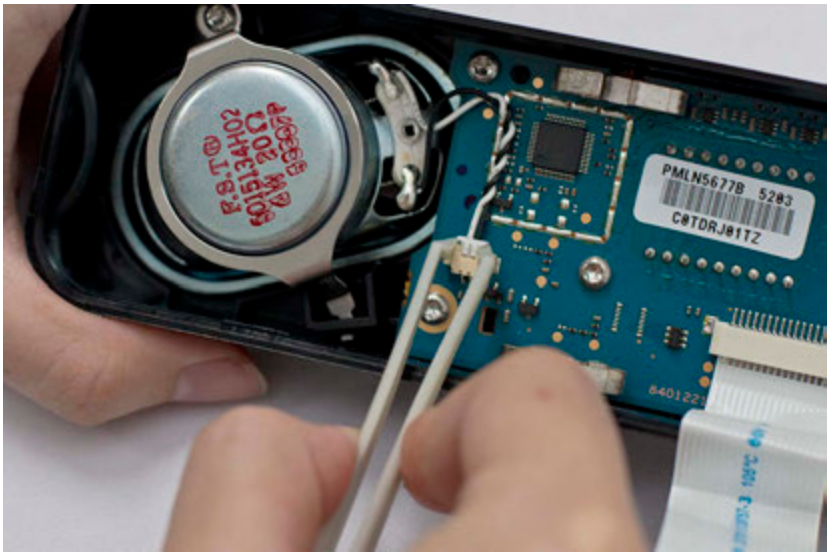
Label	Description
1	Color Display
2	Adhesive

5.5.5
Disassembly of Numeric Display Control Head

Procedure:

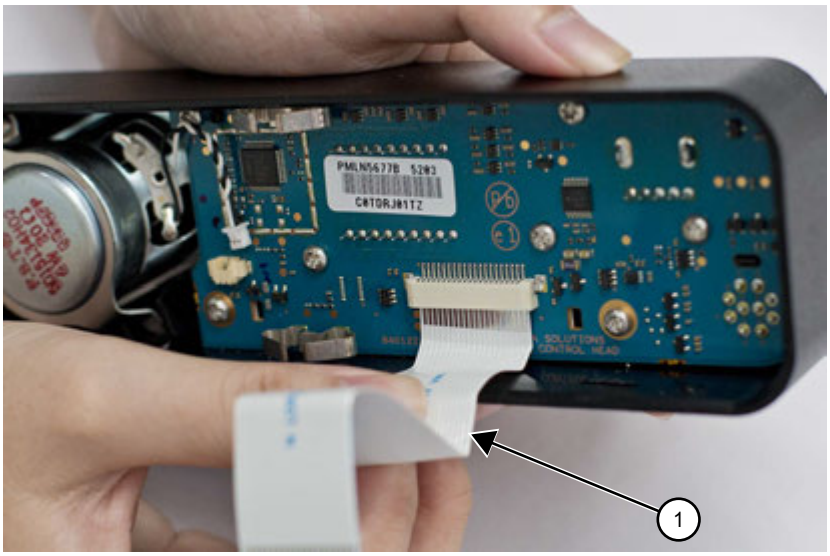
1 Disconnect the speaker plug from the control head board using a pair of tweezers.

Figure 45: Speaker Plug Removal



2 Unplug the control head flex from the control head board by gently pulling the flex out of the connector.

Figure 46: Control Head Flex Removal



Label	Description
1	Control Head Flex

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

Figure 47: Volume/Channel Knob Removal

Label	Description
1	Volume/Channel Knob

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

Figure 48: Control Head Board Screw Removal

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.

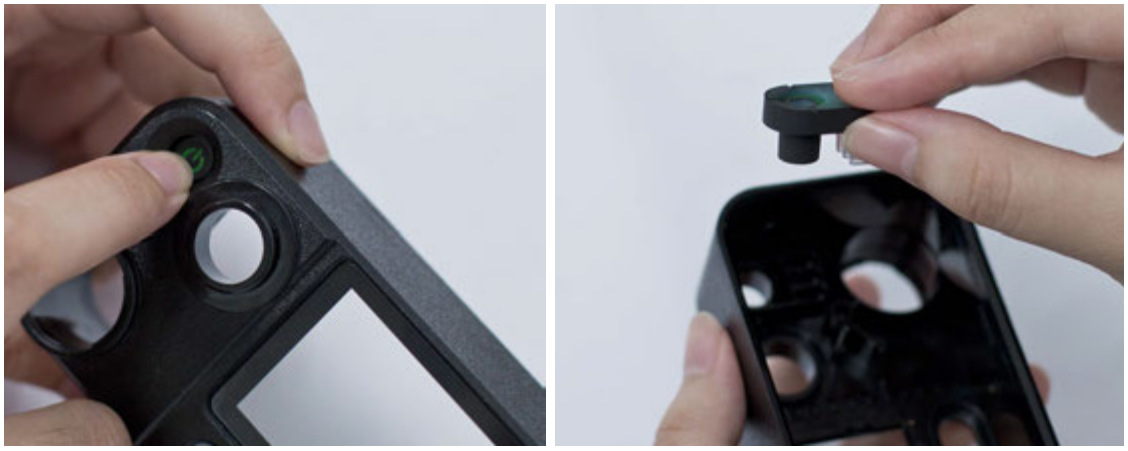
NOTICE: Do not touch or contaminate the conductive contacts on the control head board.

Figure 49: Control Head Board Removal

Label	Description
1	Mic Jack
2	Control Head Board

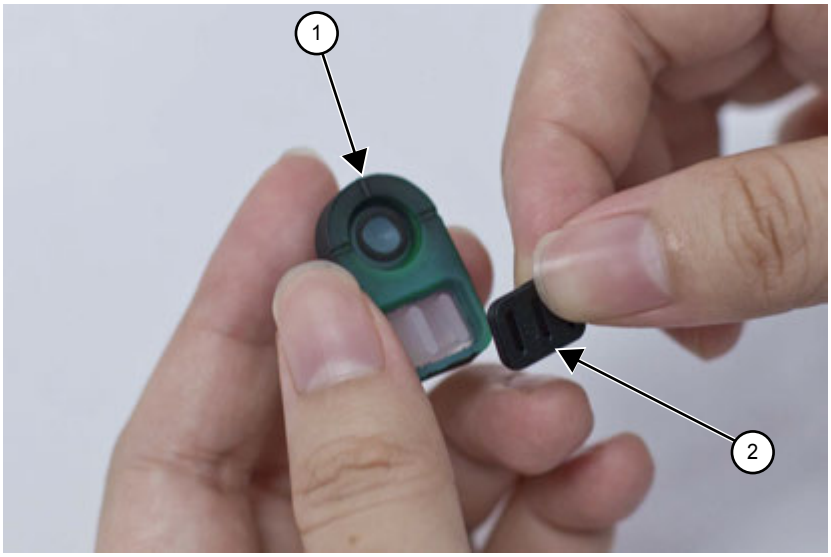
6 Remove the power button by lifting it from the control head housing.

Figure 50: Power Button Removal



7 Separate the light barrier from the power button, if required.

Figure 51: Light Barrier Removal

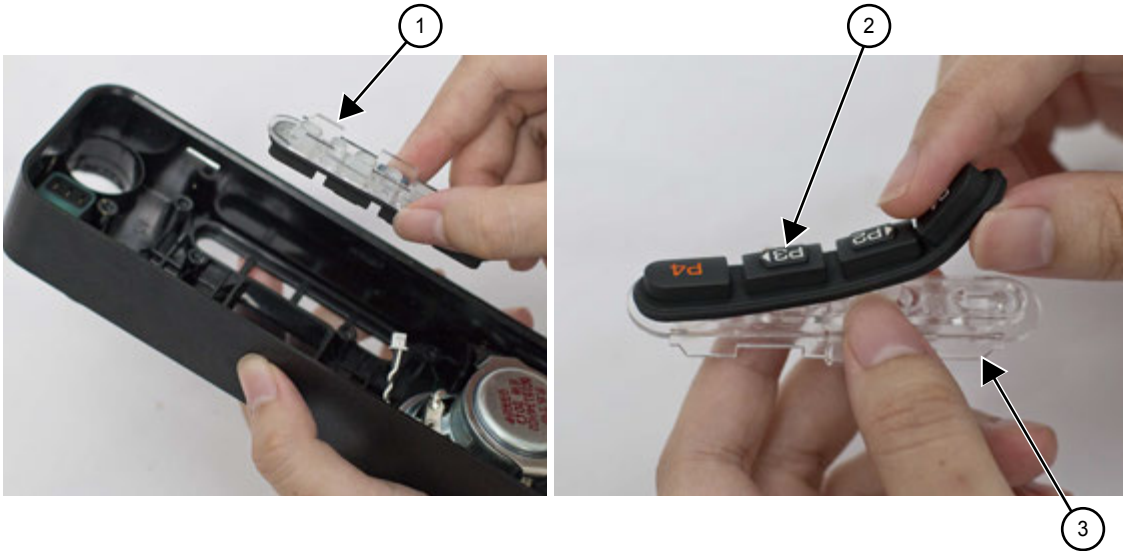


Label	Description
1	Power Button
2	Light Barrier

8 Remove the keypad assembly from the control head housing by pushing on the keypad.

9 Separate the keypad from the keypad frame.

Figure 52: Power Button and Keypad Removal



Label	Description
1	Keypad Assembly
2	Keypad
3	Keypad Frame

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.

10 Remove the speaker from the control head housing.

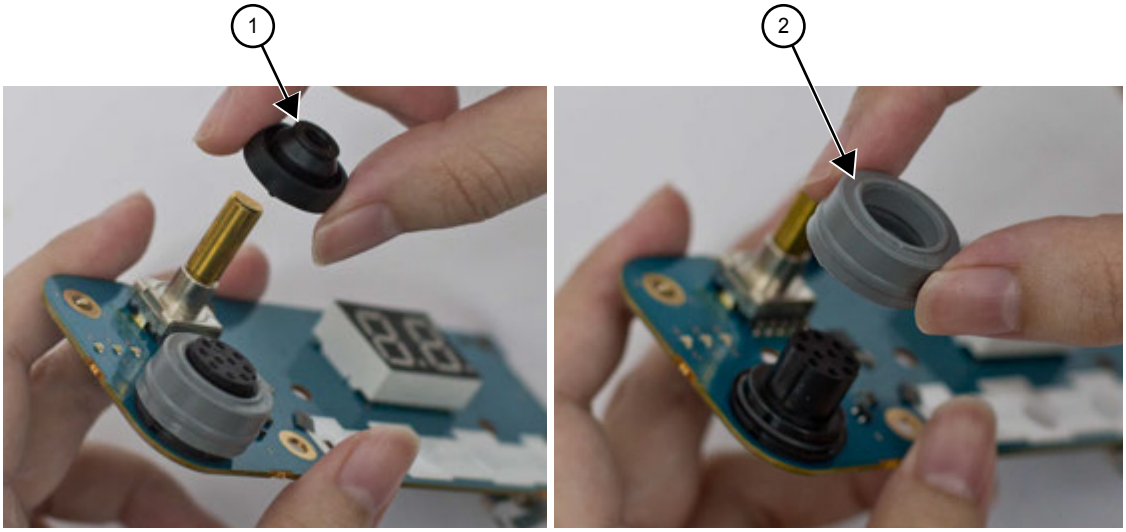
NOTICE: Remove the speaker retainer only if required.

Figure 53: Speaker Removal (Optional)

Label	Description
1	Speaker
2	Speaker Retainer

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

Figure 54: Volume Encoder Seal and Mic Jack Seal Removal



Label	Description
1	Volume Encoder Seal
2	Mic Jack Seal

5.6 Detailed Radio Reassembly

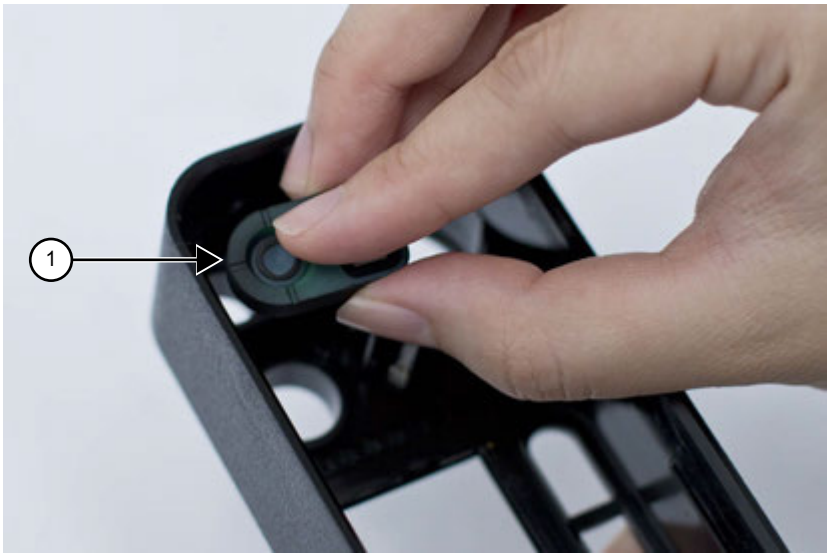
The section describes the detailed reassembly procedure of your radio.

5.6.1 Color Display Control Head

Procedure:

1 Assemble the power button and light barrier and then place the subassembly inside the control head housing.

Figure 55: Power Button Placement

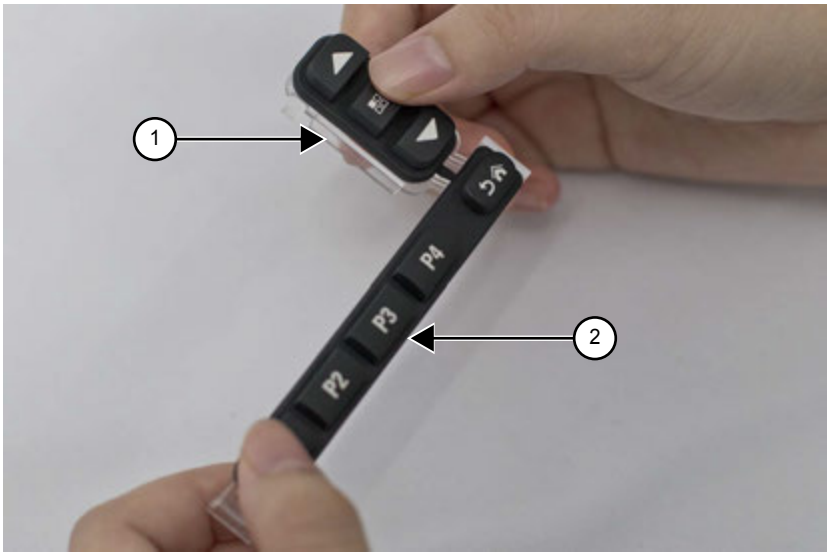


Label	Description
1	Power Button

2 Assemble the keypad to the keypad frame.

a If attached to the control head board, remove by compressing the retaining latch features.

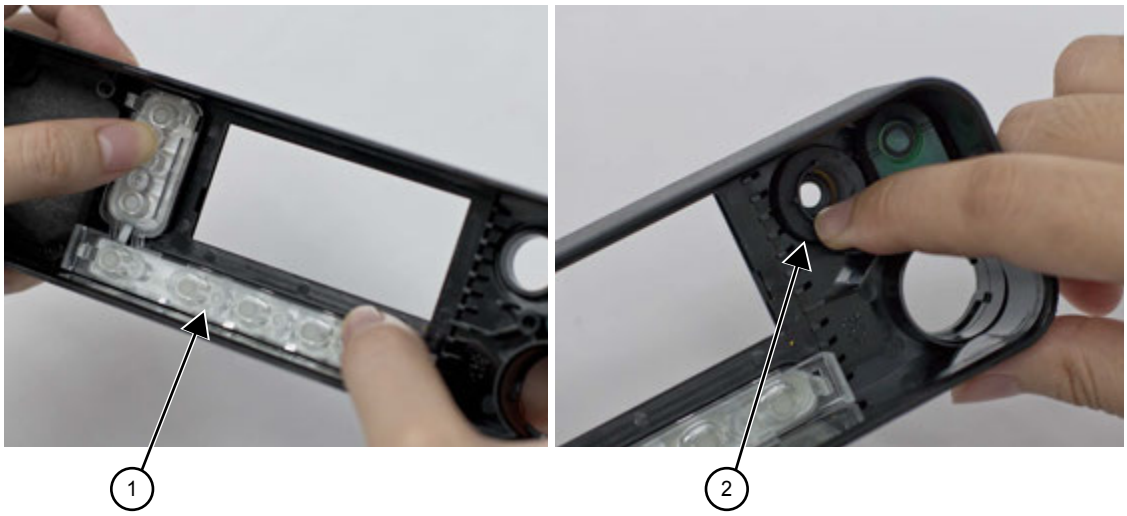
Figure 56: Keypad Assembly



Label	Description
1	Keypad Frame
2	Keypad

3 Assemble the keypad frame assembly and volume encoder seal to the control head housing until fully seated.

Figure 57: Assembly to Control Head Housing

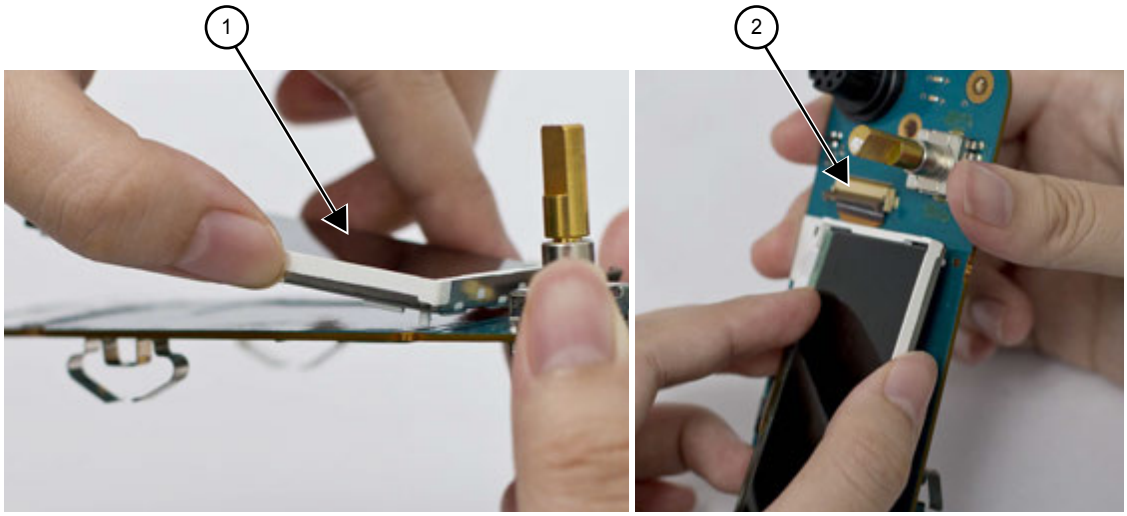


Label	Description
1	Keypad Frame Assembly
2	Volume Encoder Seal

4 Align the color display alignment pins to the PCB holes.

5 Insert the display flex to the connector on the PCB.

Figure 58: Assembling Color Display to PCB

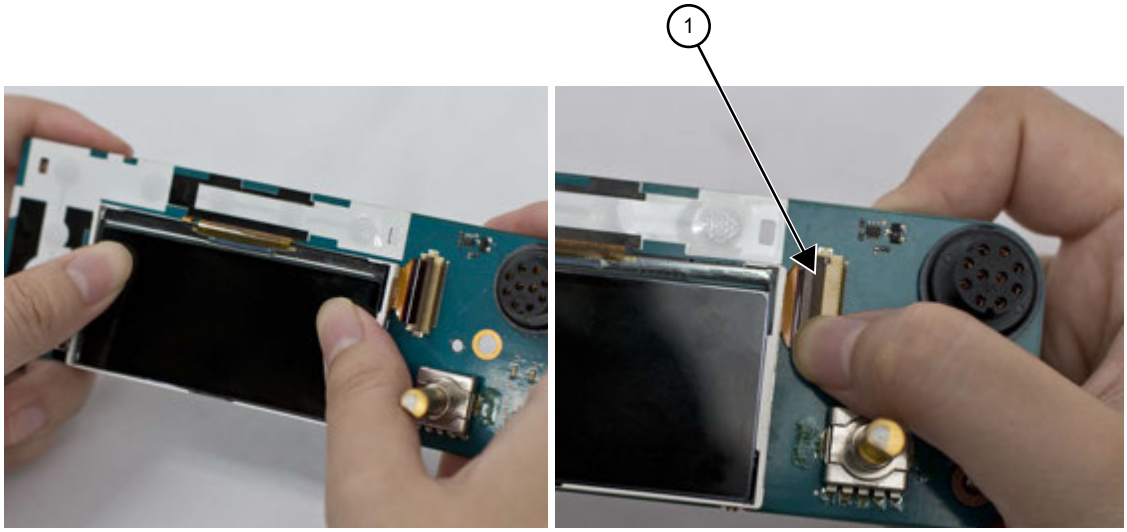


Label	Description
1	Color Display
2	Connector

6 Firmly press along the outer perimeter of the display to activate the adhesion of the display to the display adhesive.

7 Close the flex.

Figure 59: Pressing Along Outer Perimeter of Display and Closing Flex

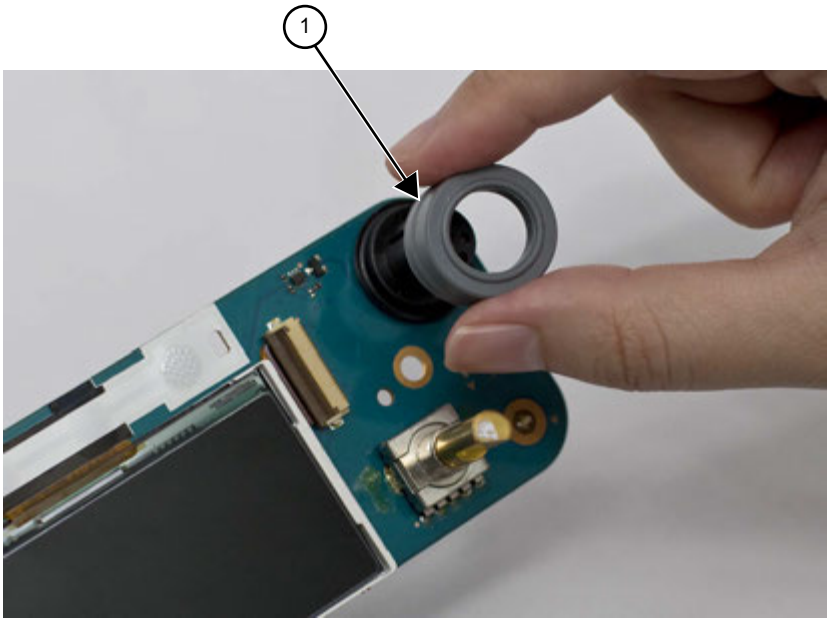


Label	Description
1	Close Flex

8 Assemble the mic jack seal around the mic jack. Be sure to place mic jack seal flush to the PCB.

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

Figure 60: Assembling Mic Jack Seal

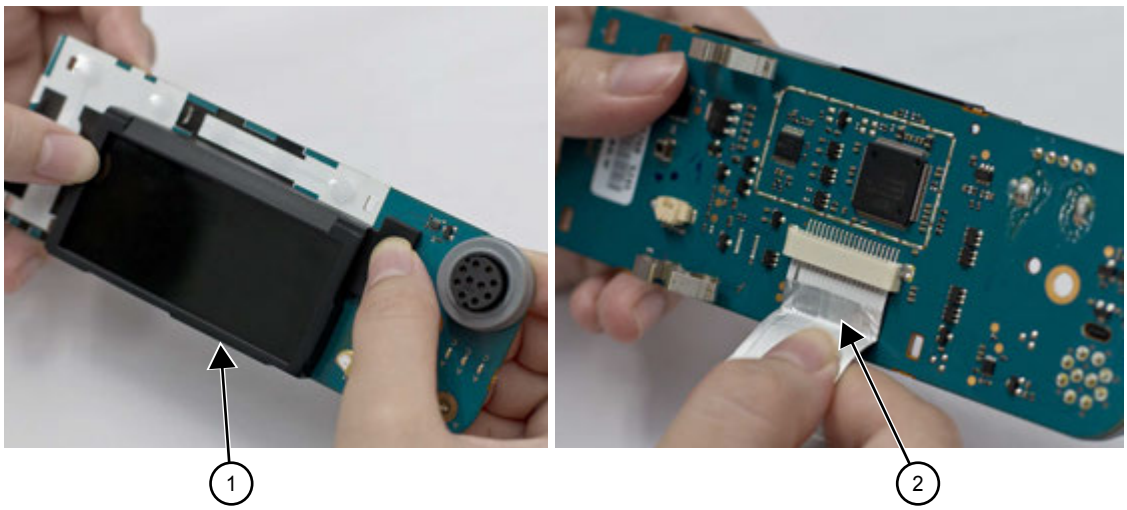


Label	Description
1	Mic Jack Seal

9 Assemble the display pad gasket to the display.

10 Assemble the control head flex to the mating connector on the control head board, making sure it is fully seated.

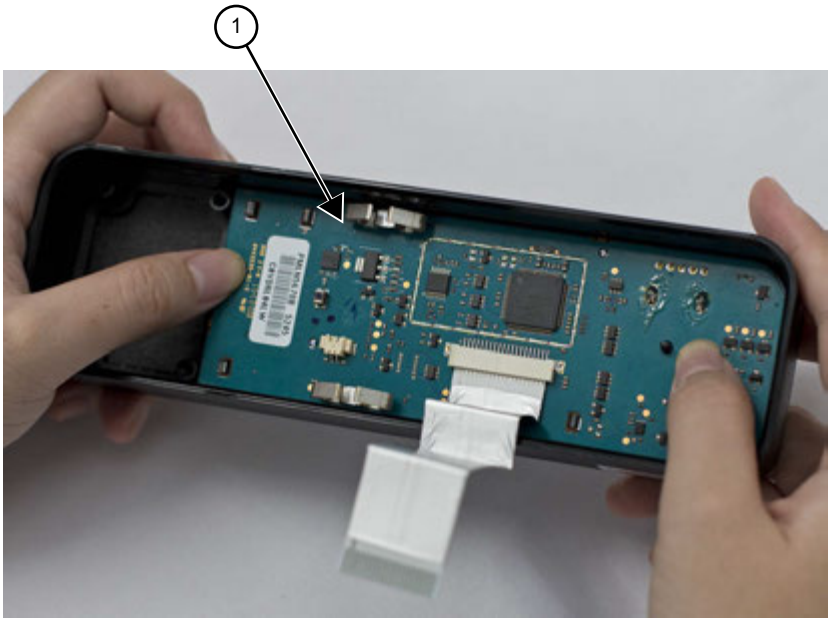
Figure 61: Assembling Display Pad Gasket and Control Head Flex



Label	Description
1	Display Pad Gasket
2	Control Head Flex

11 Assemble the control head board to the control head assembly.

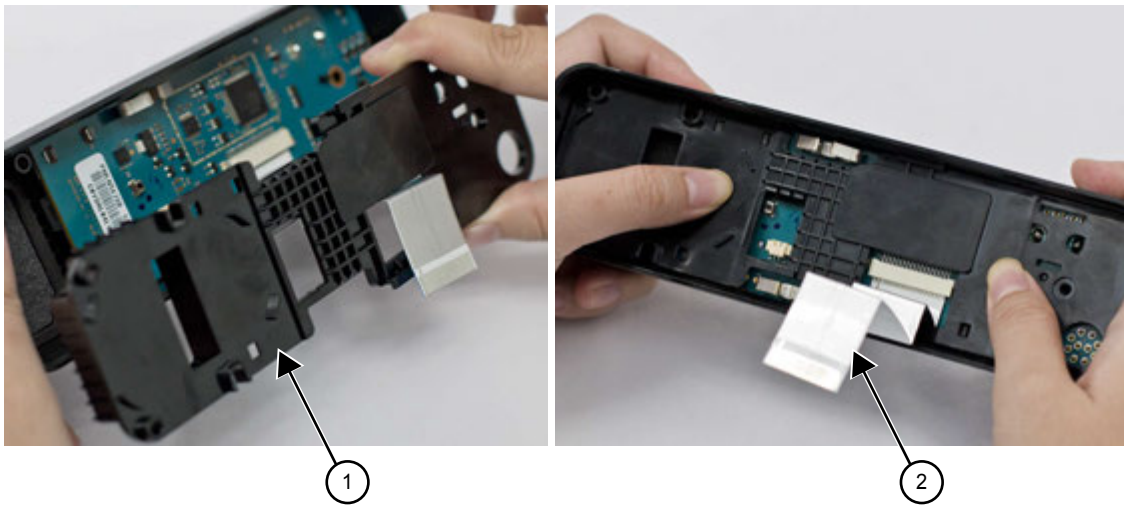
Figure 62: Assembling Control Head Board to Control Head Assembly



Label	Description
1	Control Head Assembly

12 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 63: Assembling PCB Retainer

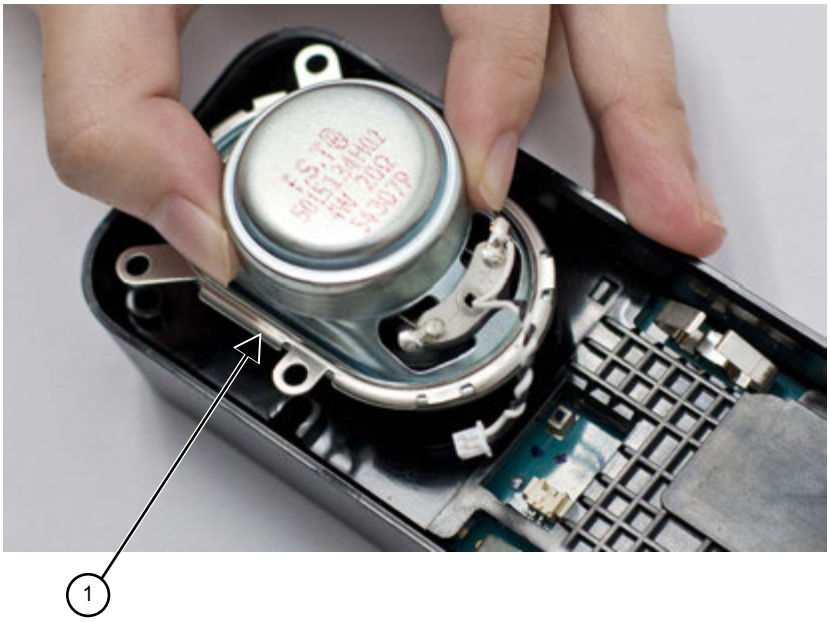


Label	Description
1	PCB Retainer
2	Control Head Flex

13 Assemble the speaker retainer to the speaker. It will snap over the speaker magnet.

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

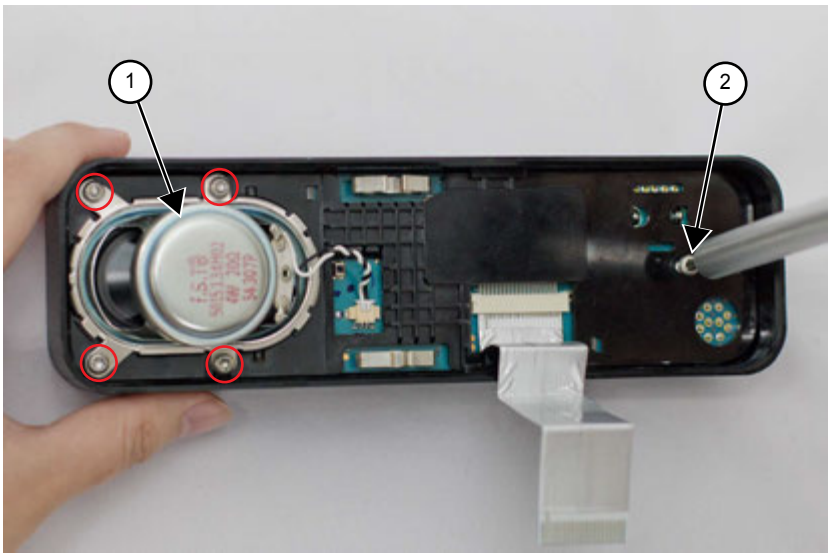
Figure 64: Assembling Speaker Retainer



Label	Description
1	Speaker Retainer

14 Assemble the speaker to the control head assembly. Assemble the screws in a cross pattern with the single PCB screw installed last.

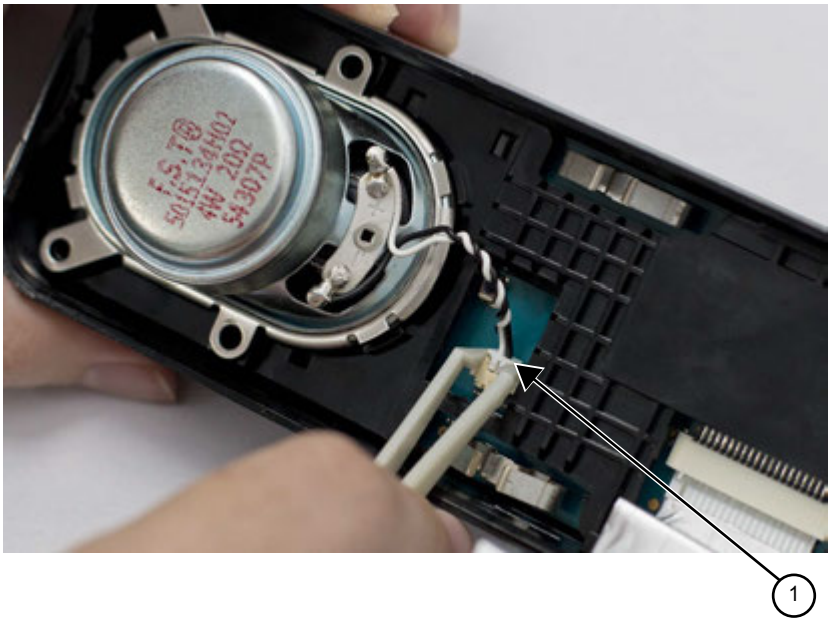
Figure 65: Assembling Speaker



Label	Description
1	Speaker
2	PCB Screw

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

Figure 66: Assembling Speaker Plug



Label	Description
1	Speaker Plug

16 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.

Figure 67: Volume/Channel Knob Assembly

Label	Description
1	Volume Encoder Shaft
2	Volume/Channel Knob

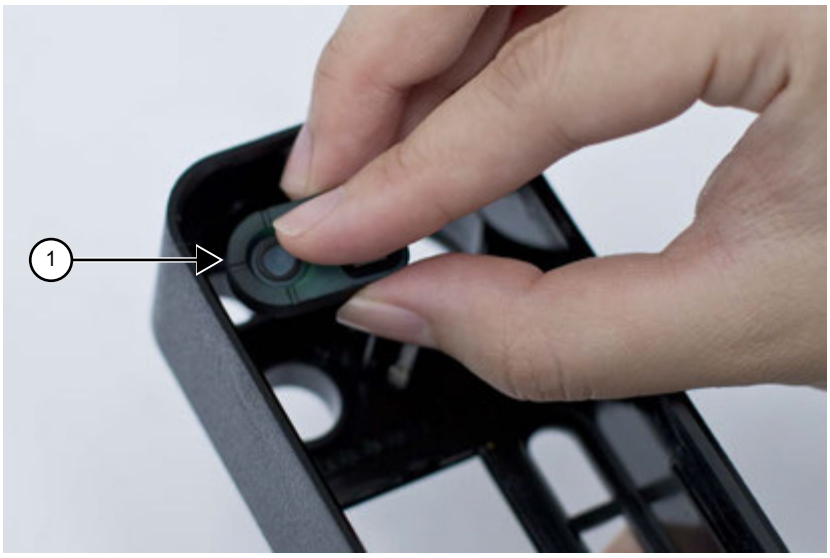
5.6.2

Numeric Display Control Head

Procedure:

1 Assemble the power button and light barrier and then place the subassembly inside the control head housing.

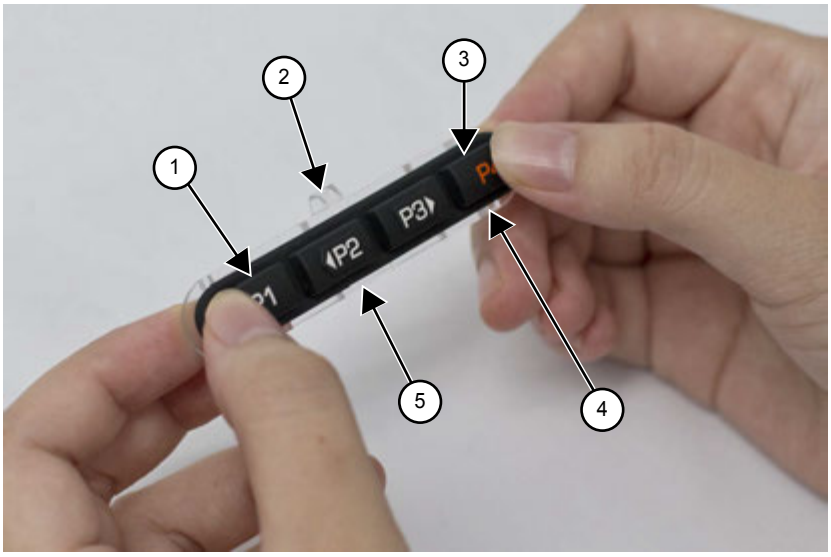
Figure 68: Power Button Placement



Label	Description
1	Power Button

2 Assemble the keypad to the keypad frame. Note the orientation of keypad to keypad frame.

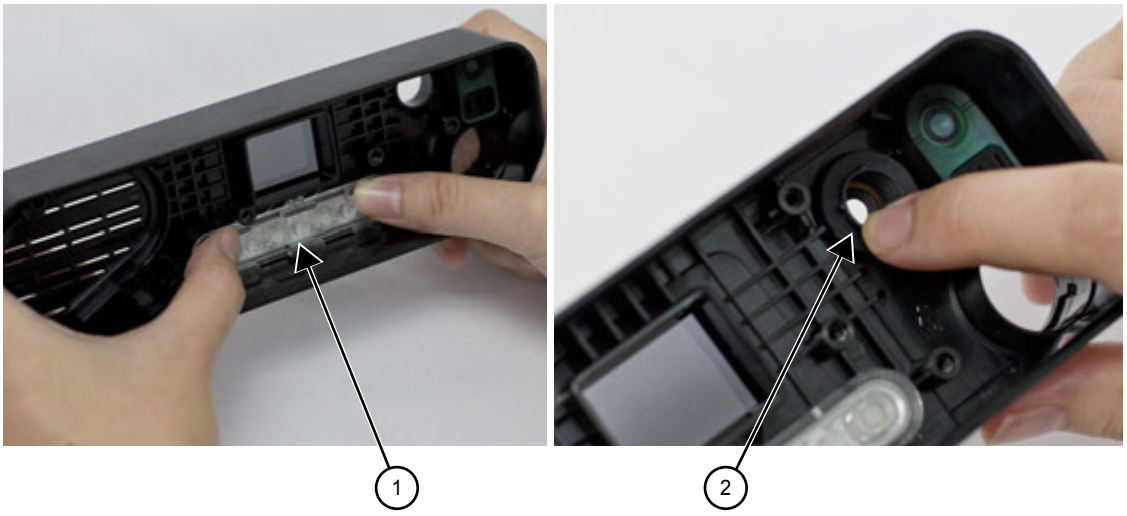
Figure 69: Keypad Assembly



Label	Description
1	Keypad
2	Alignment Feature
3	P4 Key (Red)
4	Keypad Frame
5	Lettering should Read Left to Right

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

Figure 70: Assembly to Control Head Housing

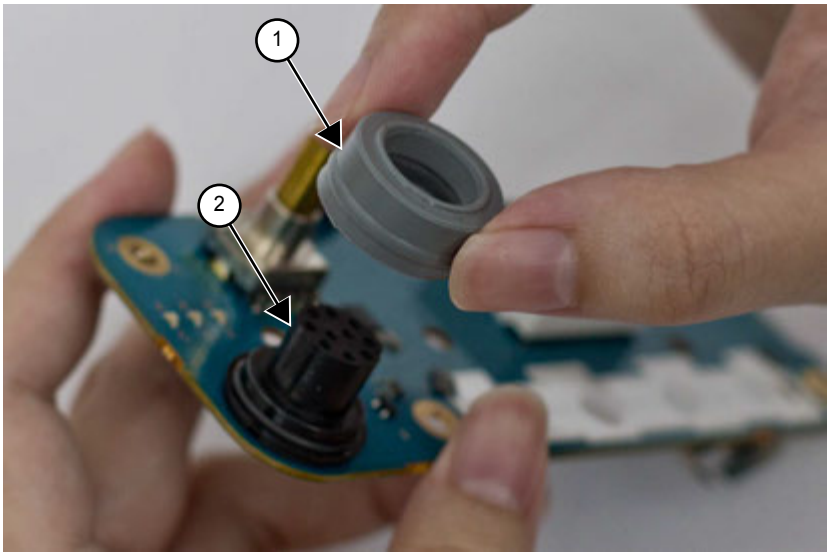


Label	Description
1	Keypad Frame Assembly
2	Volume Encoder

4 Assemble the mic jack seal around the mic jack. Be sure to place mic jack seal flush to the PCB.

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

Figure 71: Assembling Mic Jack Seal



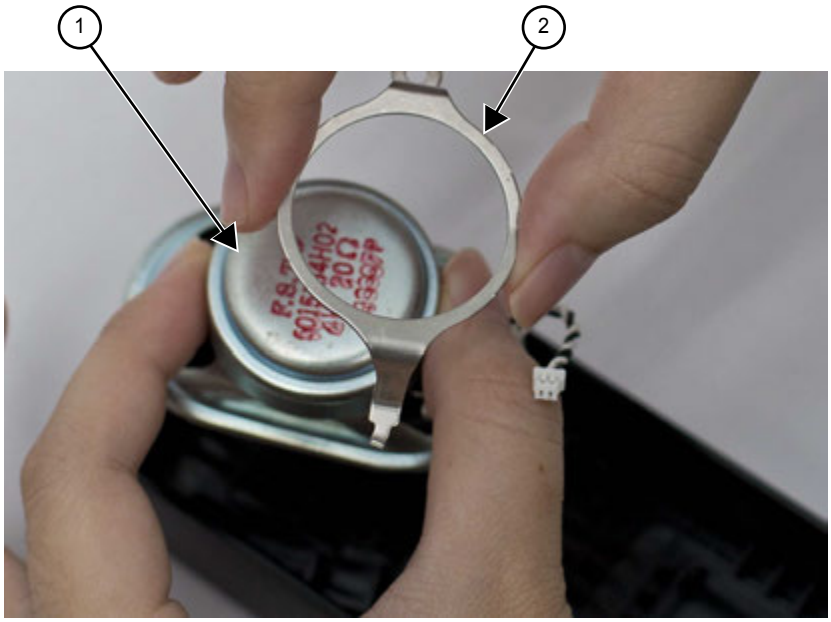
Label	Description
1	Mic Jack Seal
2	Mic Jack

5 Assemble the speaker retainer to the speaker. It will snap over the speaker magnet.

NOTICE: Be sure to orientate 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 72: Assembling Speaker



Label	Description
1	Speaker
2	Speaker Retainer

7 Hook one side of the speaker retainer into the control head assembly.

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).

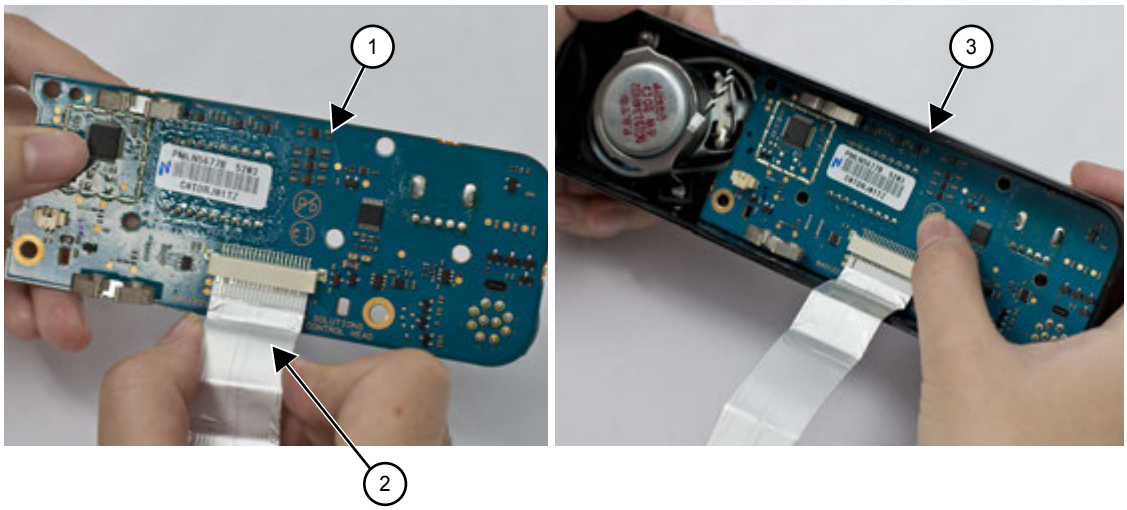
Figure 73: Speaker Retainer Assembly

Label	Description
1	Speaker Retainer

9 Assemble the control head flex to the mating connector on the control head board, making sure it is fully seated.

10 Assemble the control head board to the control head assembly.

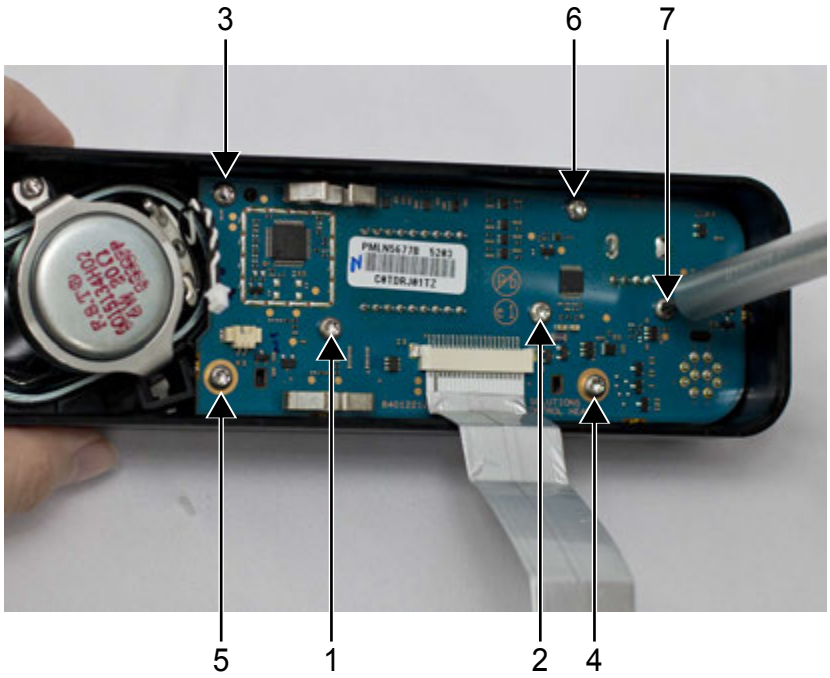
Figure 74: Assembling Control Head Board to Control Head Assembly



Label	Description
1	Control Head Board
2	Control Head Flex
3	Control Head Assembly

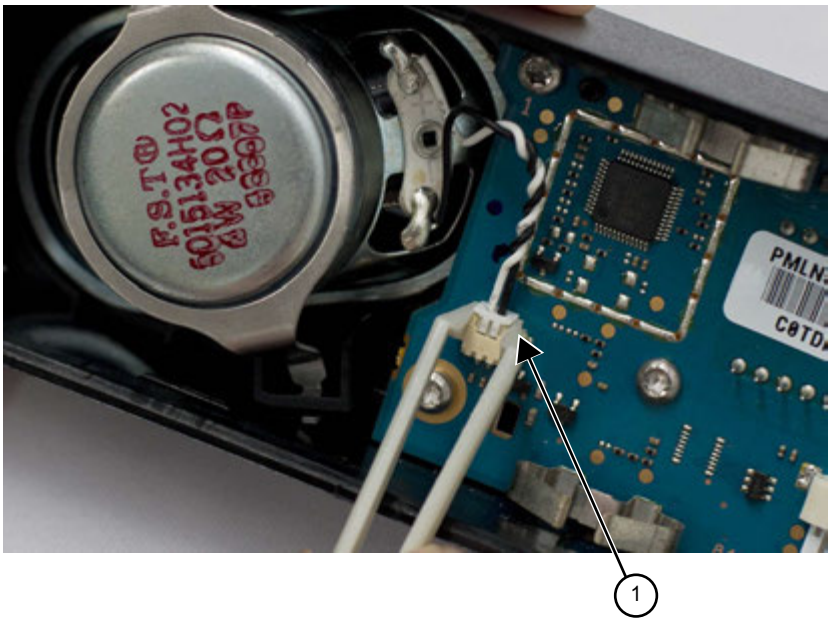
11 Using a T10 TORX driver, tighten the seven screws to 0.88 N-m (7.8 lbs-in) following the sequence.

Figure 75: Screw Sequence



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

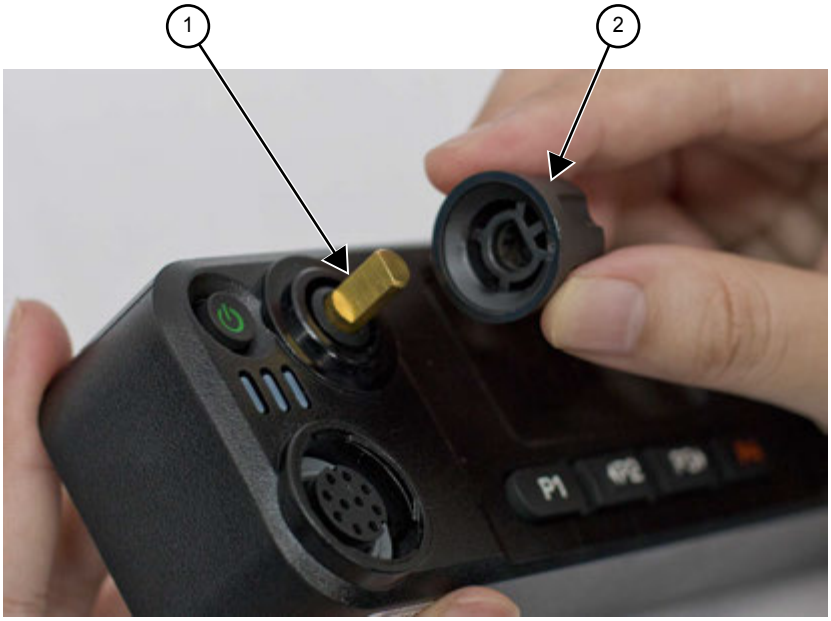
Figure 76: Assembling Speaker Plug



Label	Description
1	Speaker Plug

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.

Figure 77: Volume/Channel Knob Assembly



Label	Description
1	Volume Encoder Shaft
2	Volume/Channel Knob

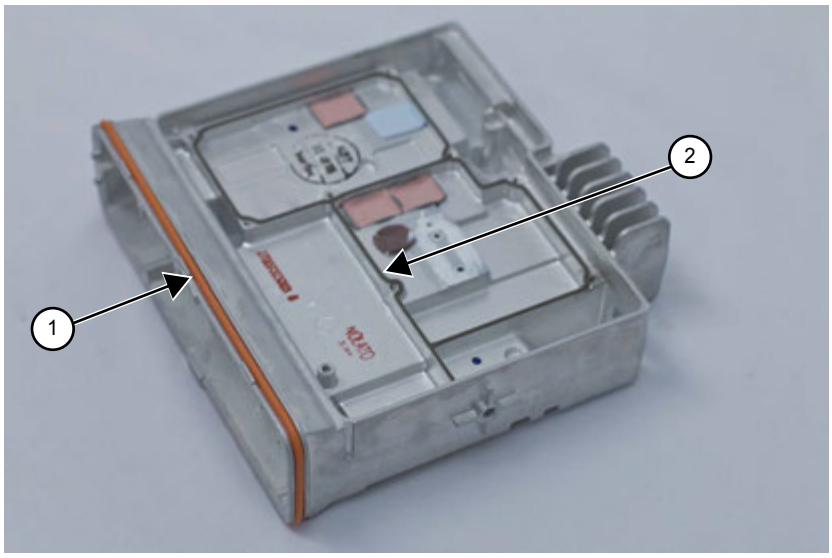
5.6.3

Radio Assembly

Prerequisites: Prior to reassembling the radio, inspect all seals and sealing surfaces for damage (nicks, cuts) 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 "Thermal Pad Replacement Procedure" to replace damaged pads.

Figure 78: Thermal Pads and Shield Gasketing on Chassis and Die Cast Main Shield



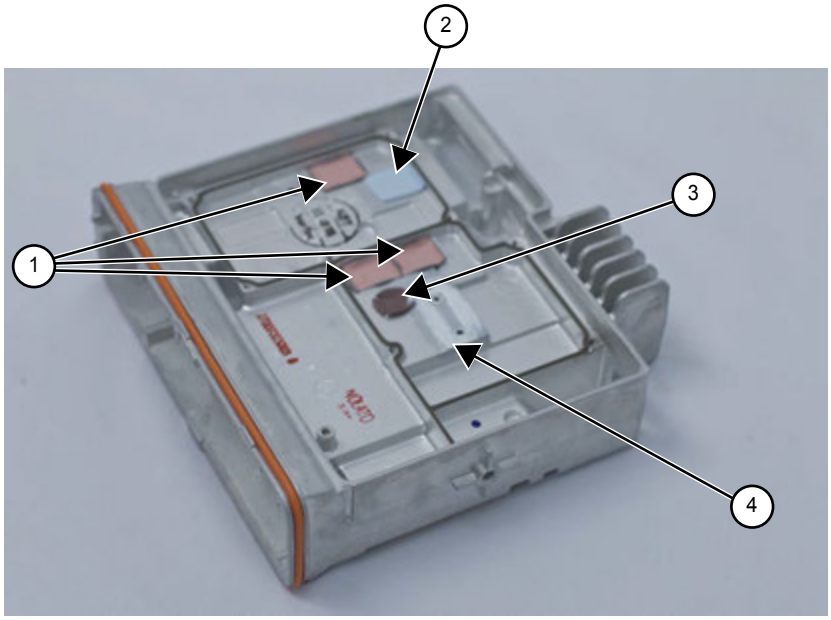
Label	Description
1	Shield Gasketing on the Chassis
2	Shield Gasketing for the Die Cast Main Shield

Procedure:

1 Thoroughly inspect the chassis and verify all thermal pads are in place and free from damage.

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

Figure 79: Chassis with Thermal Pads



Label	Description
1	Regulator Thermal Pad (75012018001)
2	Audio PA Thermal pad (75012059001)
3	Final Driver Thermal Pad (75012058002)
4	Thermal Grease (1110022A55)

5.6.4

Thermal Pad Replacement Procedure

The following steps are applicable for Regulator Thermal Pad replacement, Audio PA Thermal Pad replacement, and Final Driver Thermal Pad replacement.

Procedure:

1. Do one of the following:
   - If for Regulator Thermal Pad replacement or Audio PA Thermal Pad replacement, use a plastic flat-edge tool to lift the pad from the chassis surface. Discard the old pad.
   - If for Final Driver Thermal Pad replacement, 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.

   NOTICE: 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. Refer to "Chassis with Thermal Pads".

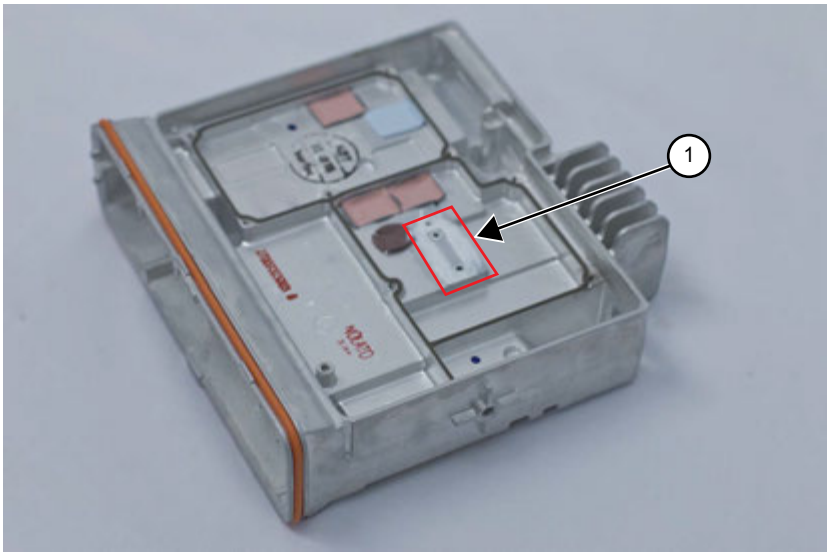
5.6.5

Transceiver Board Reassembly

Procedure:

1 Apply thermal grease to the PA area.

Figure 80: Applying Thermal Grease

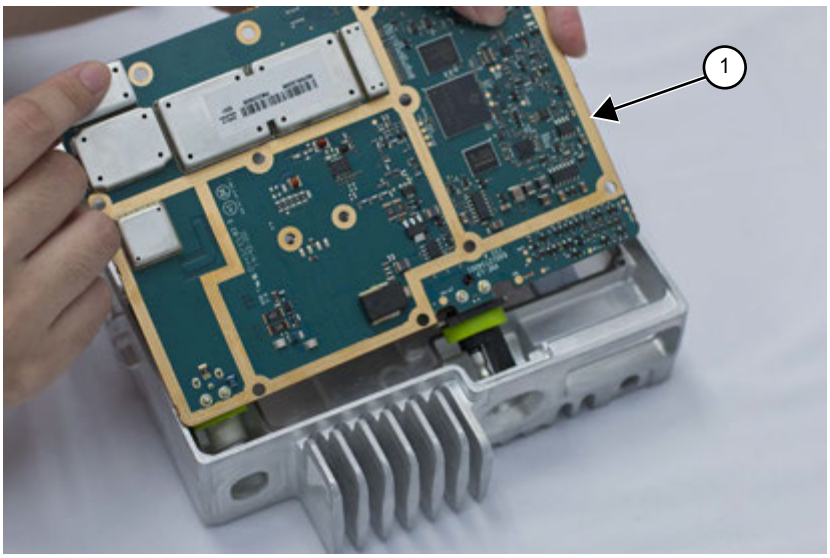


Label	Description
1	Thermal Grease (1110022A55)

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 81: Placing the Transceiver Board in the Chassis

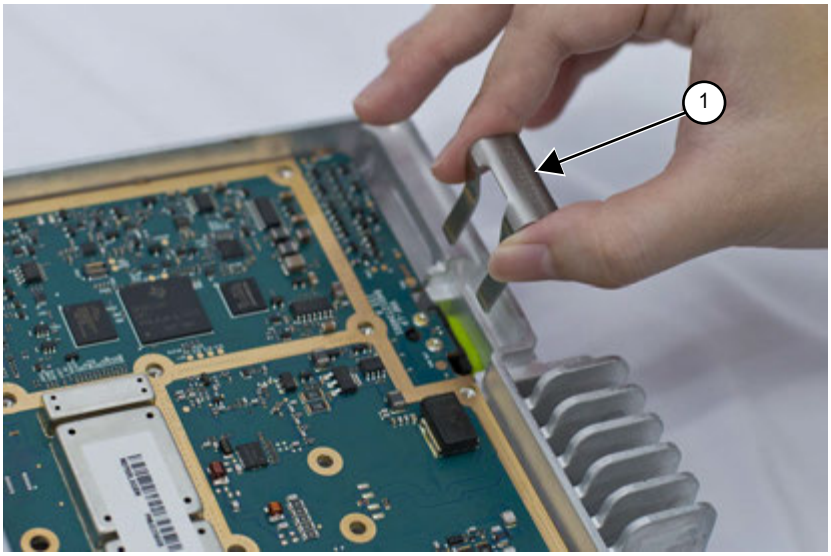


Label	Description
1	Transceiver Board

CAUTION: 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.

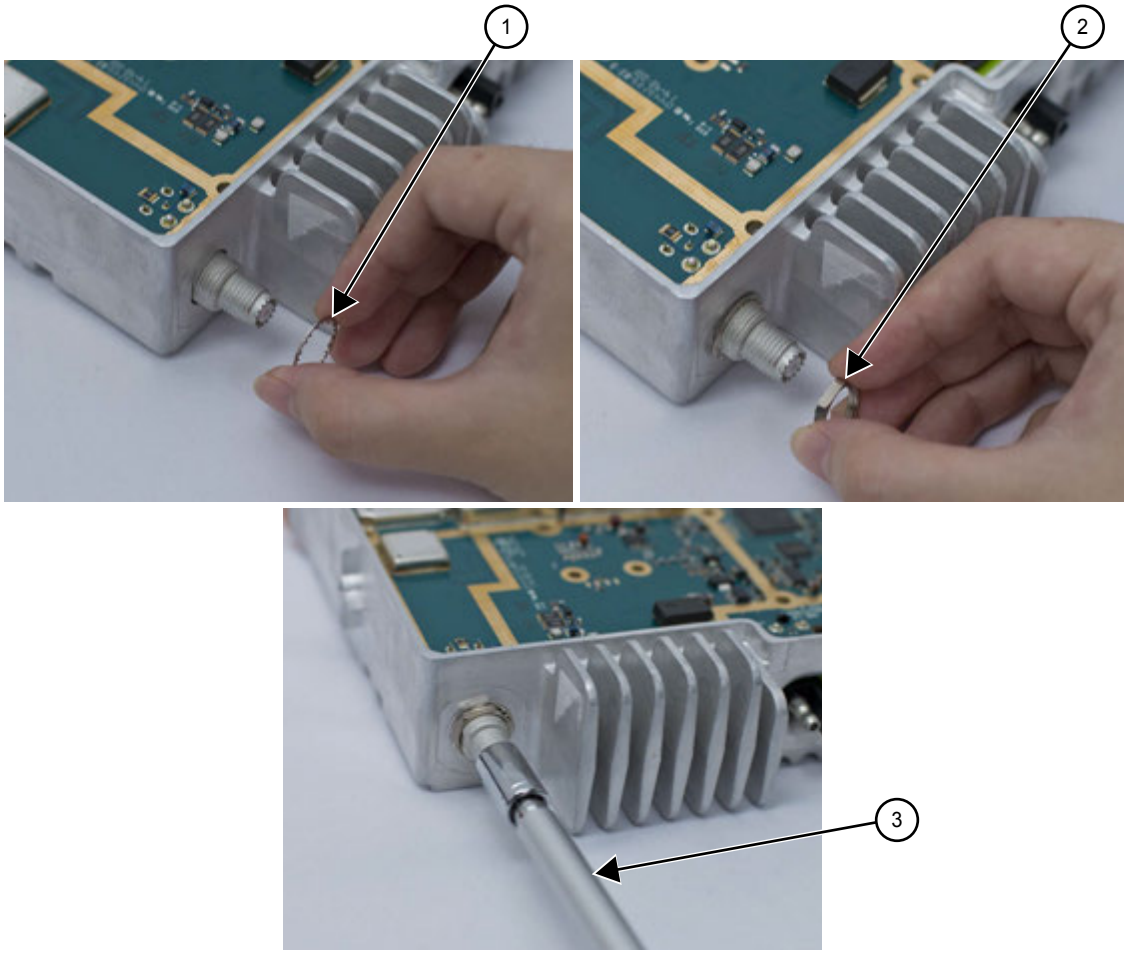
Figure 82: Inserting DC Retention Clip



Label	Description
1	DC Retention Clip

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

Figure 83: Inserting RF Lock Washer and Nut

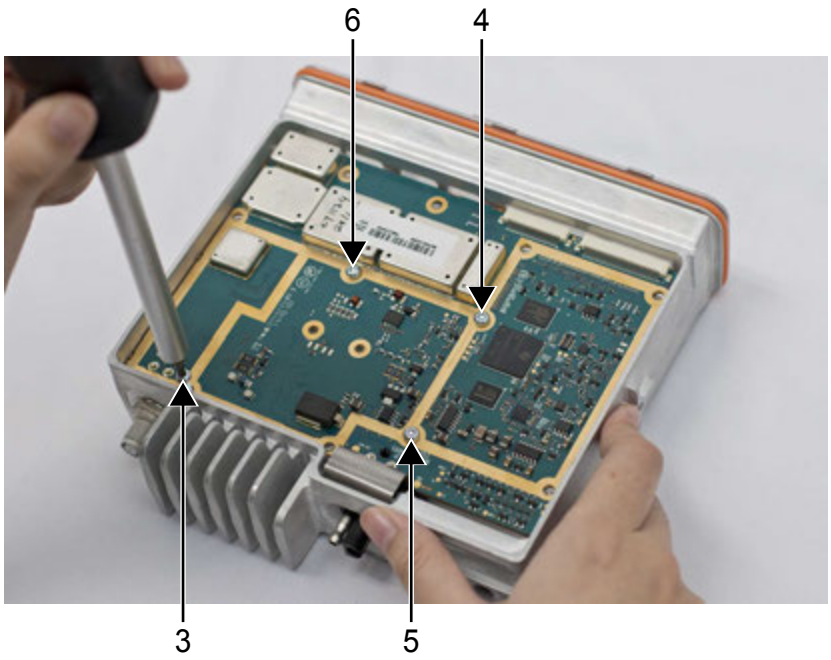


Label	Description
1	Lock Washer
2	RF Connector Nut
3	Deep Socket Driver

5 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).

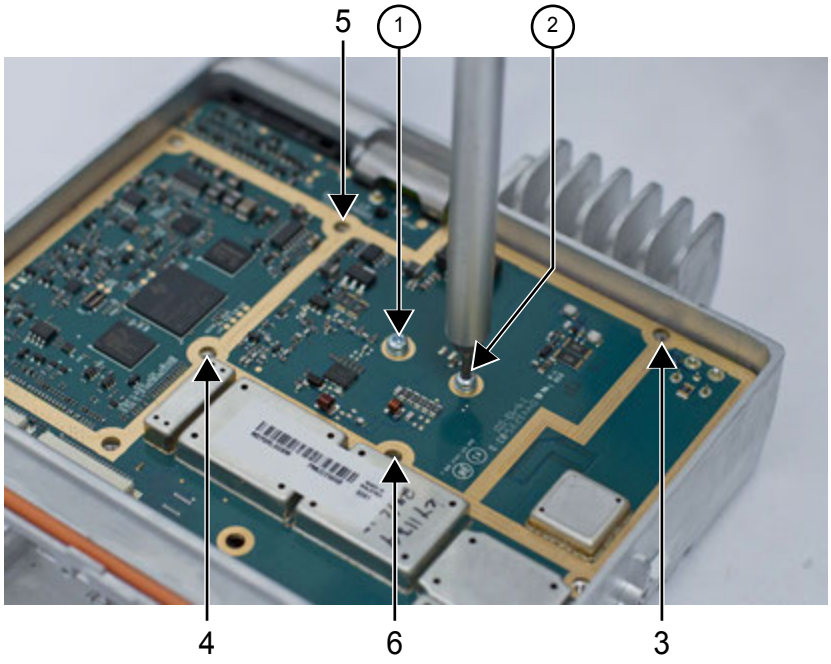
NOTICE: This step is required; otherwise, damage could result to the final transmitter PA device.

Figure 84: 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 the following image for PA Screw sequence. Use a T8 TORX to tighten the screws to 0.45 N-m (4 lbs-in).

Figure 85: Installing PA Screws

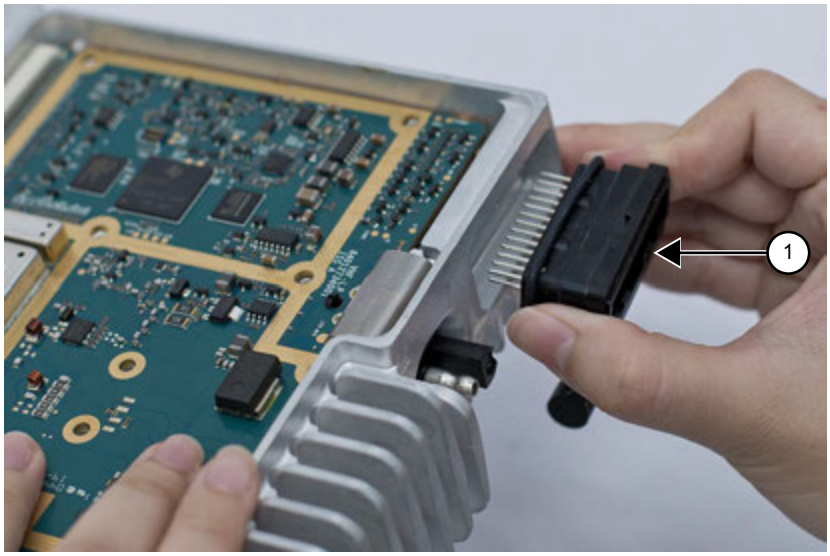


Label	Description
1	Install this screw first
2	Install this screw second

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.

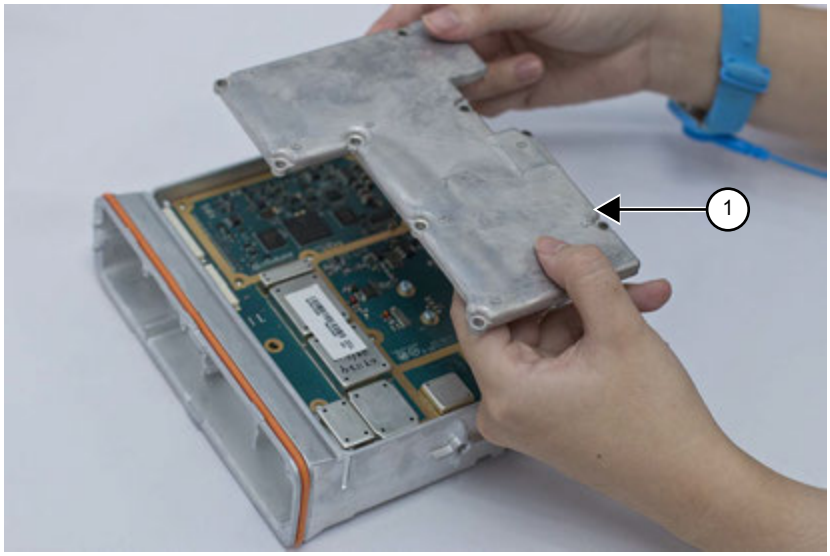
Figure 86: Inserting Accessory Connector



Label	Description
1	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.

Figure 87: Assembling Die Cast Main Shield onto Chassis

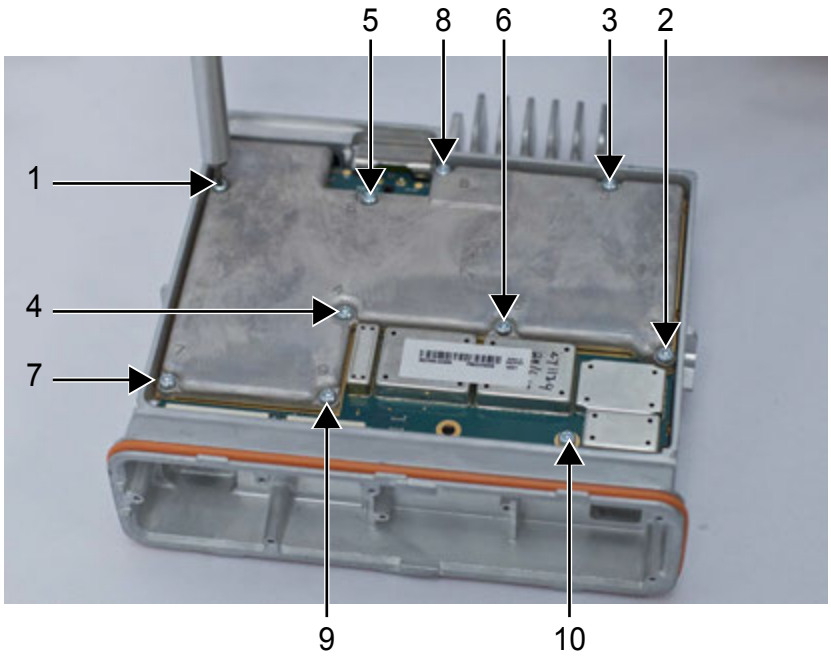


Label	Description
1	Main Shield

10 Insert nine main shield thread forming screws (M3) through the shield and one thread forming screw (M3) through the board.

11 Use a T10 TORX driver following the sequence marked on the main shield and tighten all ten screws to 1.47 N-m (13 lbs-in).

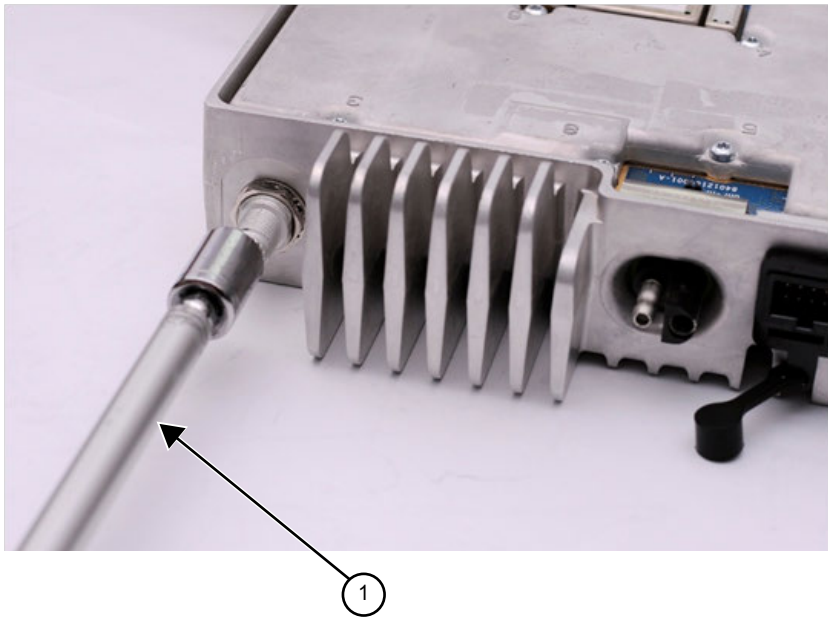
Figure 88: Screw Sequence to Tighten Die Cast Main Shield



12 Retighten the nine screws on the main shield a second time.

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

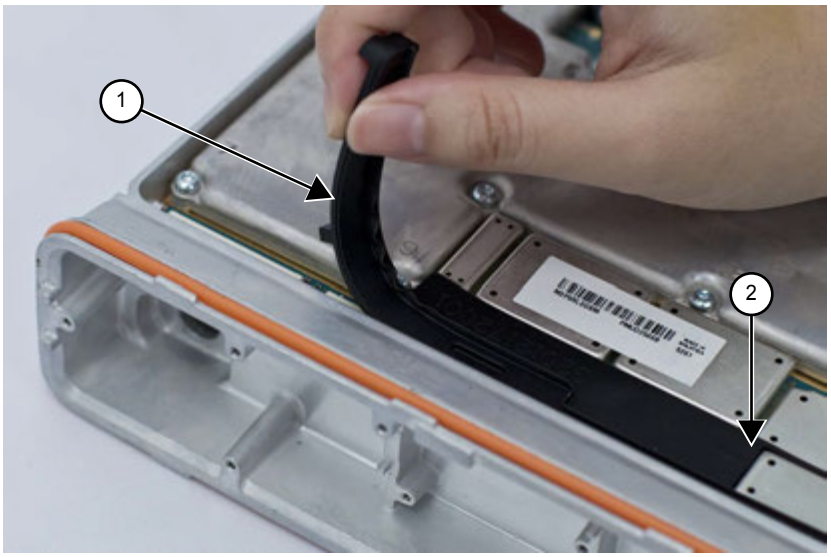
Figure 89: RF Connector Nut Final Torque



Label	Description
1	Deep Socket Driver

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

Figure 90: Acoustic Plug Installation



Label	Description
1	Acoustic Plug
2	Start Side

15 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.

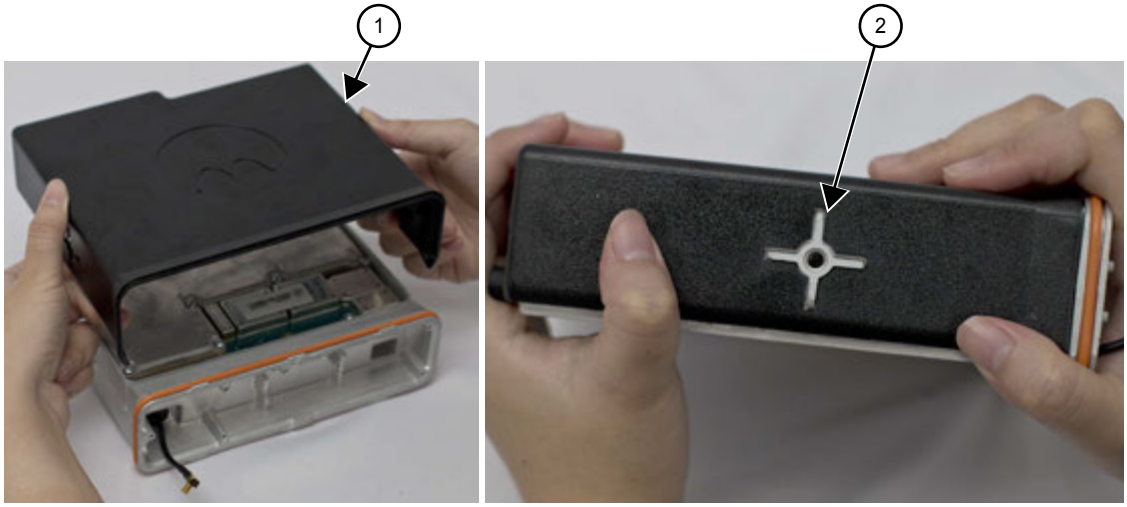
Figure 91: Inspection of Cover Assembly with Seal

Label	Description
1	Seal
2 and 3	Locking Tab

16 Gently spread both sides of the cover.

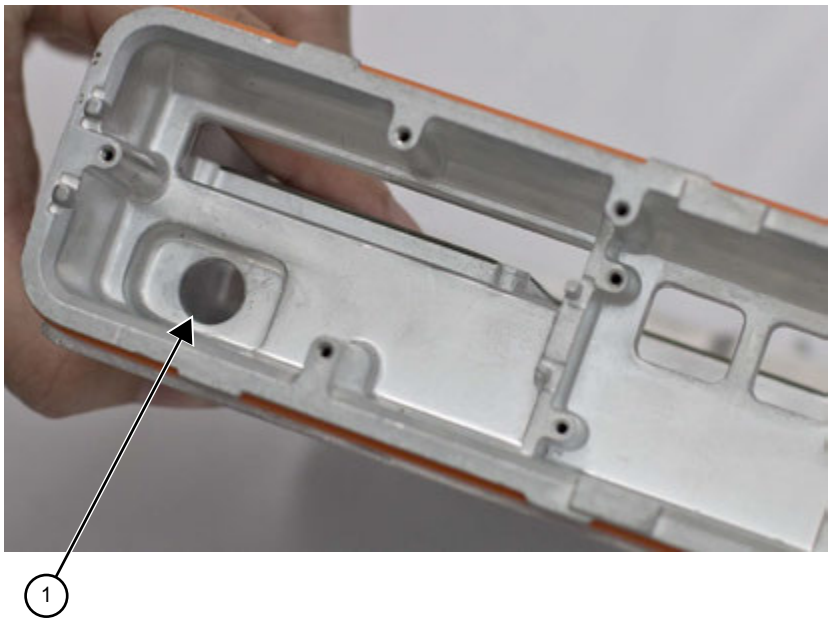
17 Align the top cover to the chassis and snap the cover in place uniformly. Ensure the alignment posts on the cover slide into the alignment slots on the chassis.

Figure 92: Assembling Cover onto Chassis



Label	Description
1	Main Cover
2	Alignment Post

18 Assembly of the GNSS cable involves the following steps:



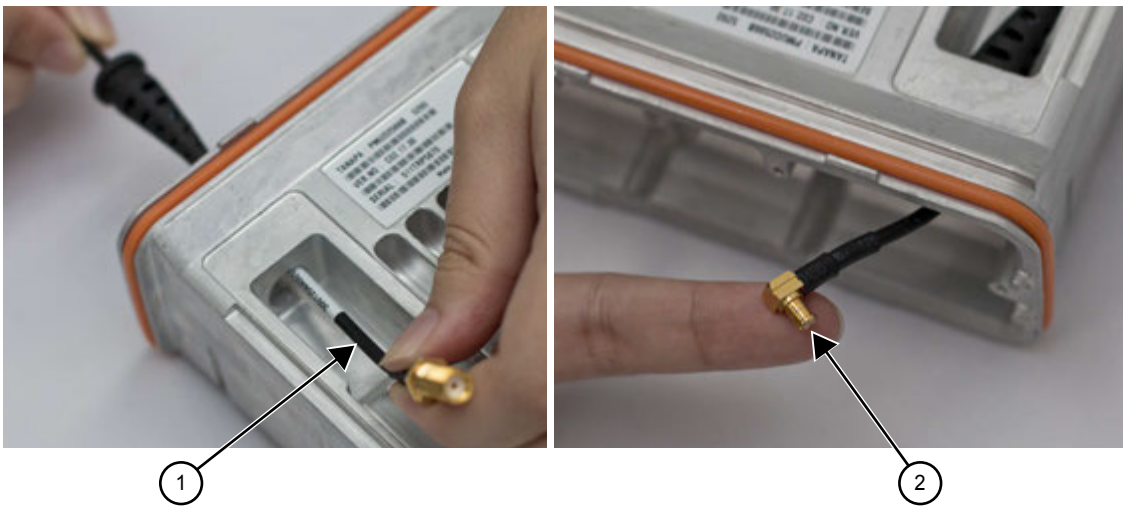
Label	Description
1	Chassis Opening

NOTICE: Skip steps a through d if the GNSS cable was not serviced.

a If attached, remove the nut and washer from the GNSS antenna connector.

b Insert the GNSS cable assembly through the opening in the chassis. Orient the MCX Connector.

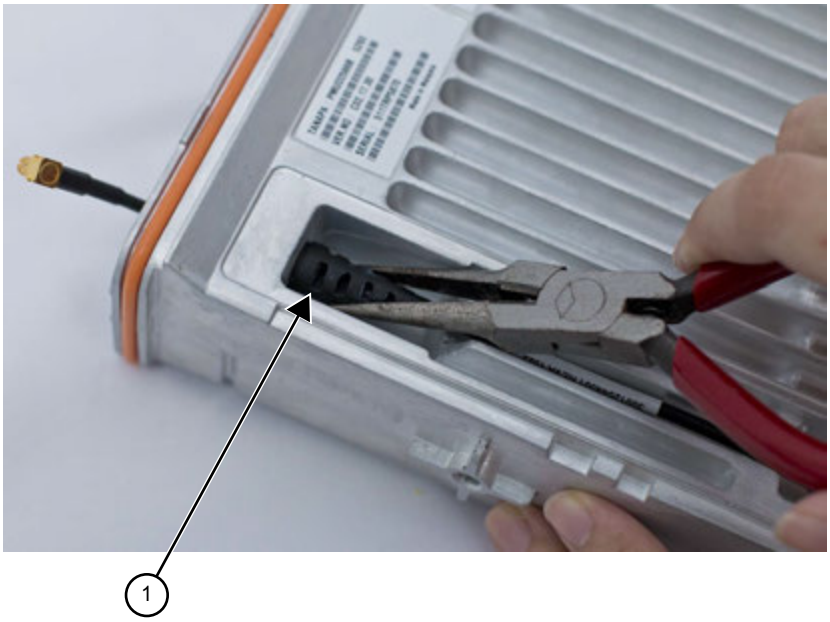
Figure 93: GNSS Cable Installation



Label	Description
1	GNSS Cable Assembly
2	MCX Connector

c Pull the GNSS cable strain relief until it is fully installed.

Figure 94: Installing GNSS Cable Strain Relief

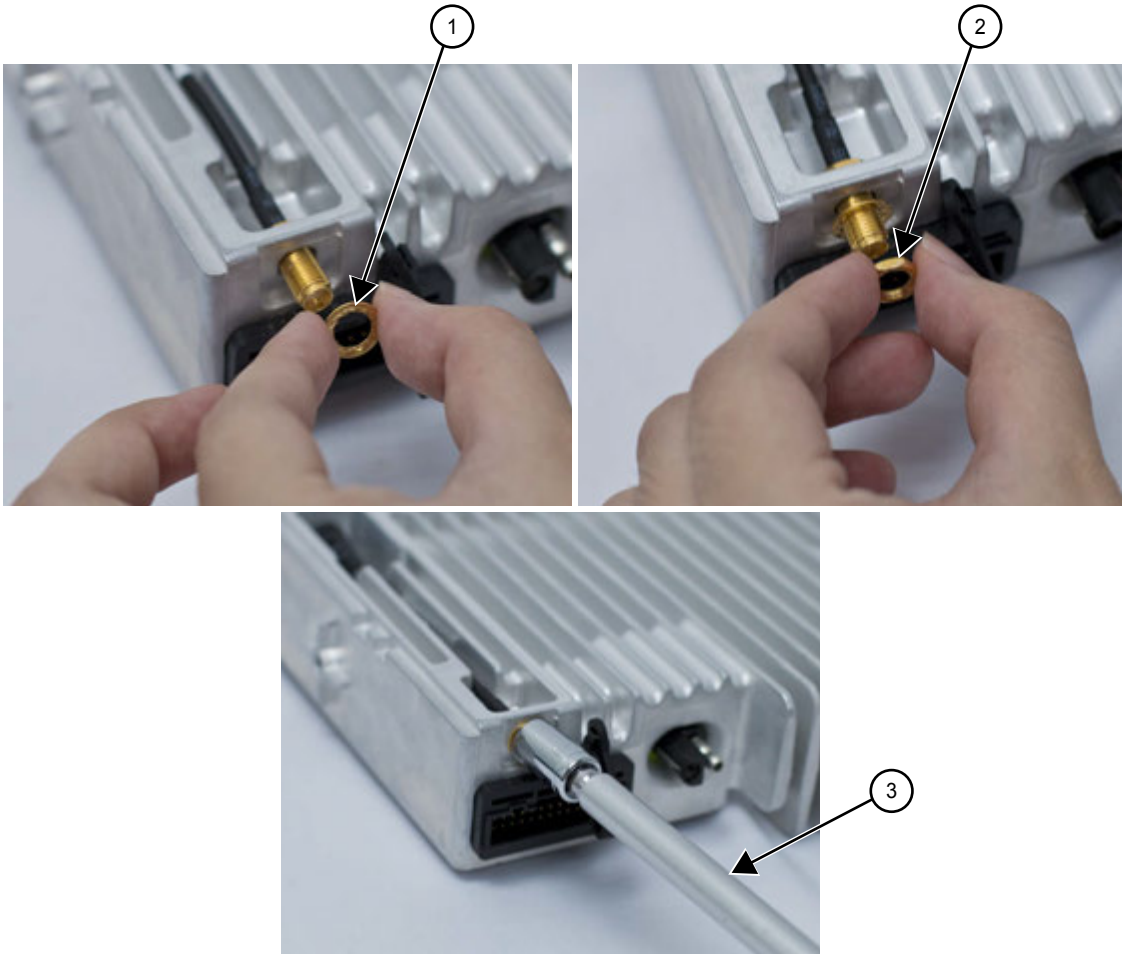


Label	Description
1	GNSS Cable Strain Relief

d Assemble the lock washer and the nut to the GNSS antenna connector. Using a 5/16 in. or 8 mm socket driver, tighten the nut to 1.7 N-m (15 lbs-in). See Figure 95: GNSS Cable Installation on page 99.

NOTICE: Do not pull directly on cable wire.

Figure 95: GNSS Cable Installation

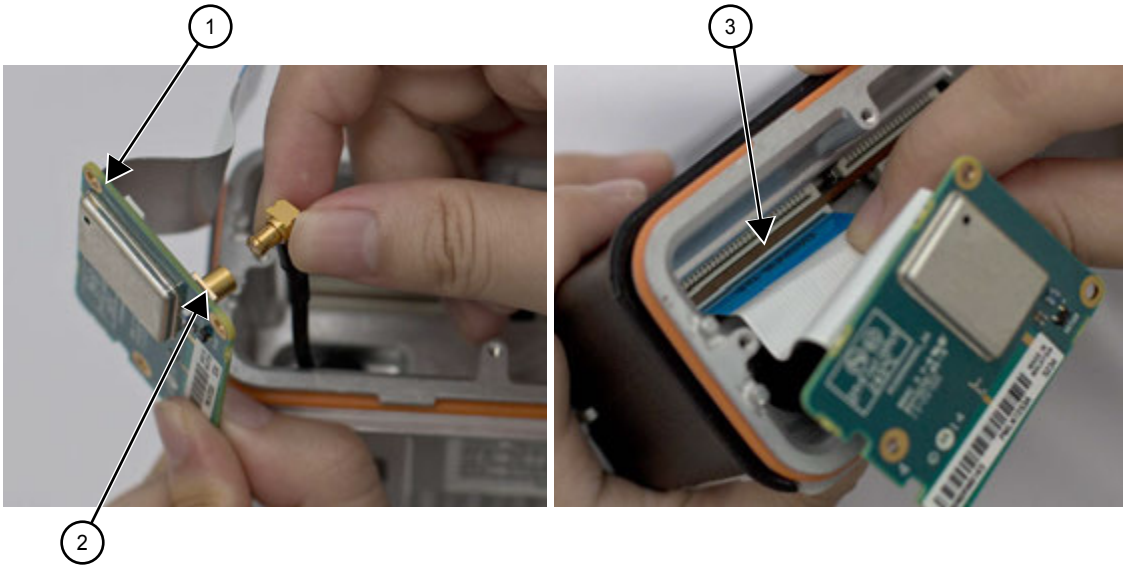


Label	Description
1	Lock Washer
2	Nut
3	Deep Socket Driver

e Connect the GNSS cable MCX connector to the expansion board.

f Connect the flex cable from the expansion board to the main board connector.

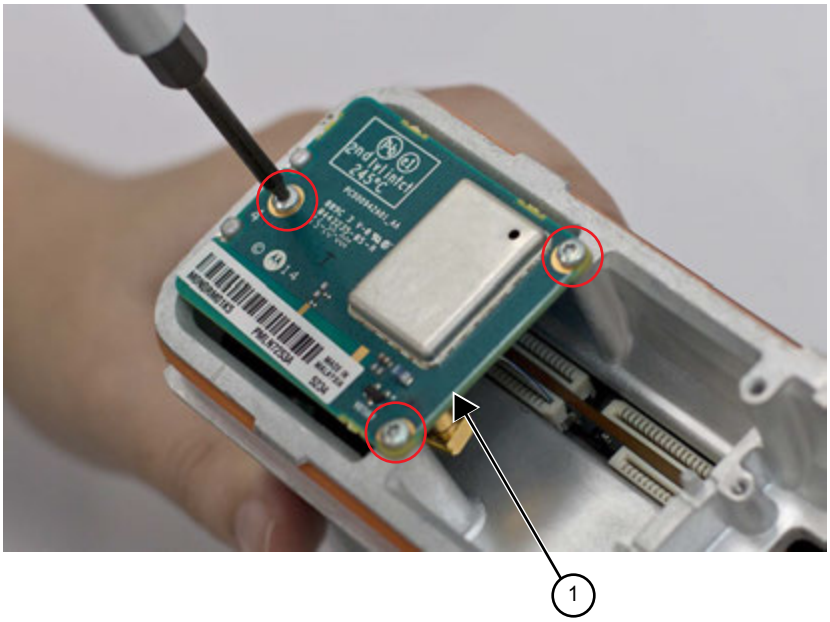
Figure 96: Flex Connection Connectors



Label	Description
1	Expansion Board
2	MCX Connector
3	Expansion Board Connector

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 97: Expansion Board Assembly



Label	Description
1	Expansion Board

NOTICE: Skip steps step 18 h through step 18 j if the GNSS nameplate was not serviced

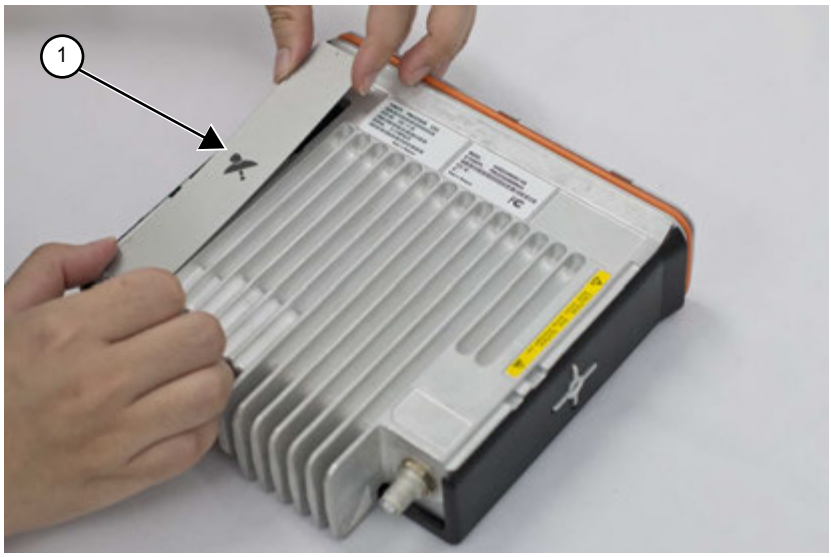
h Clean chassis nameplate surface with alcohol prior to applying the GNSS nameplate.

i Peel off the paper liner to the GNSS nameplate. Place the long side of the GNSS nameplate against the long side of the recessed area on the chassis.

NOTICE: If the GNSS nameplate is removed it will need to be replaced.

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

Figure 98: GNSS Nameplate Assembly

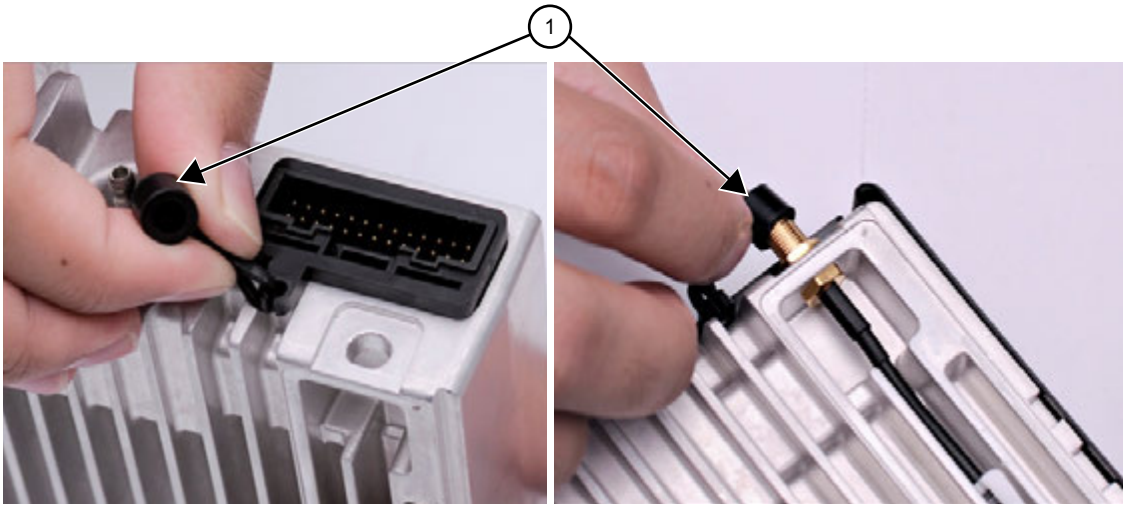


Label	Description
1	GNSS Nameplate

NOTICE: Skip step step 18 k if the GNSS cable was not serviced.

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

Figure 99: GNSS Antenna Connector Assembly

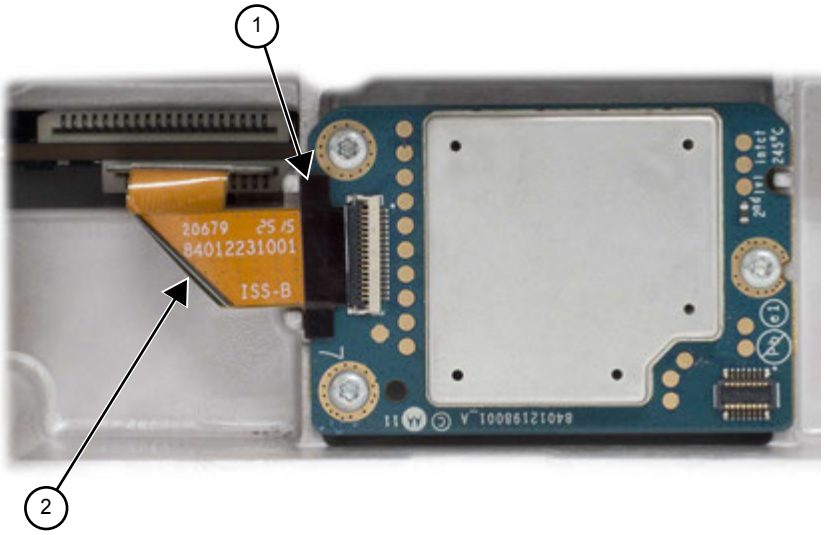


Label	Description
1	GNSS Dust Cap

19 Orient the option board flex so that contacts face option board. Secure connector latch to option board.

NOTICE: The white line on flex should be aligned with connector latch.

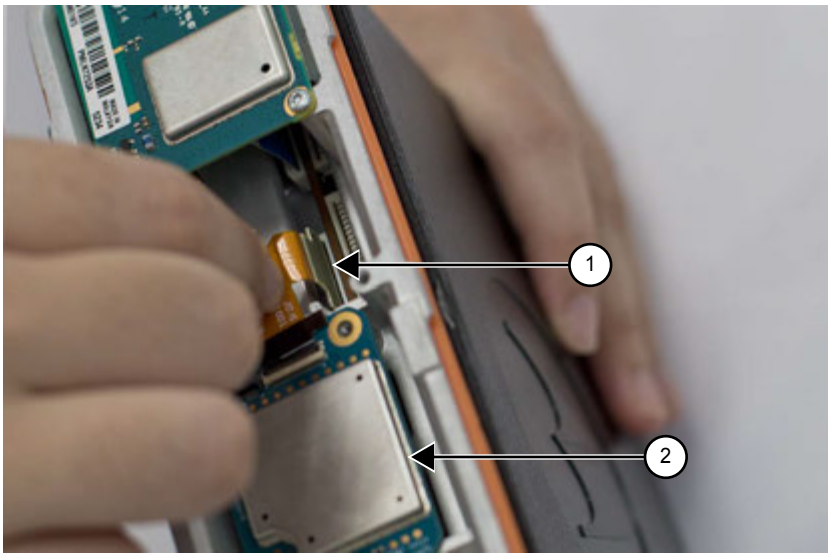
Figure 100: Orientation of Option Board Flex to Option Board



Label	Description
1	Latch
2	Option Board Flex

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

Figure 101: Assemble Option Board to Radio Chassis (Image may not match exact product)



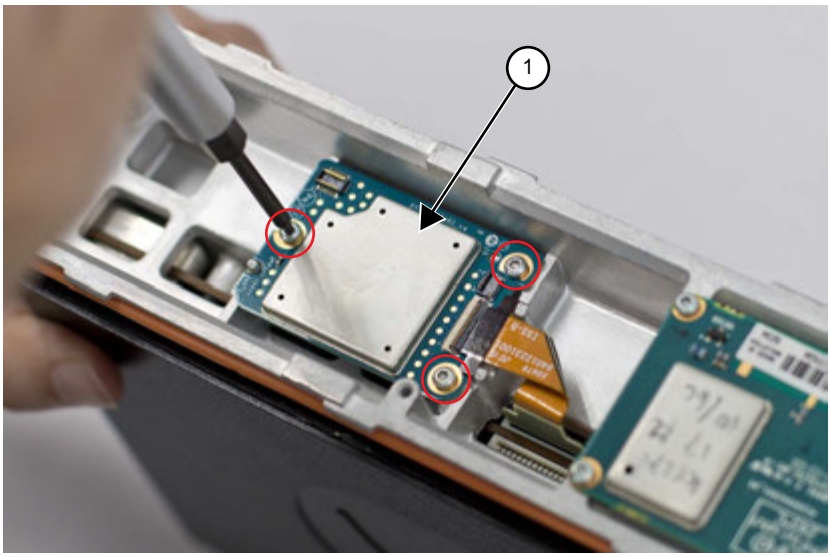
Label	Description
1	Option Board Connector
2	Option Board

NOTICE: The GOB software version can be checked using the Tuner. After the GOB is installed, the Tuner should be used to perform a "read" from the radio. If the GOB is installed correctly, the GOB software version will be displayed. If the GOB is not installed or if the GOB is installed incorrectly, the GOB software version will NOT be displayed.

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

22 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.

Figure 102: Securing Option Board to Chassis



Label	Description
1	Option Board

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 third-party developer is responsible for providing all information, upon request by a regulatory authority, regarding 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.

5.6.6

Assemble Control Head to Radio Assembly

Procedure:

1 If not already assembled, assemble the control head O-ring seal on the radio.

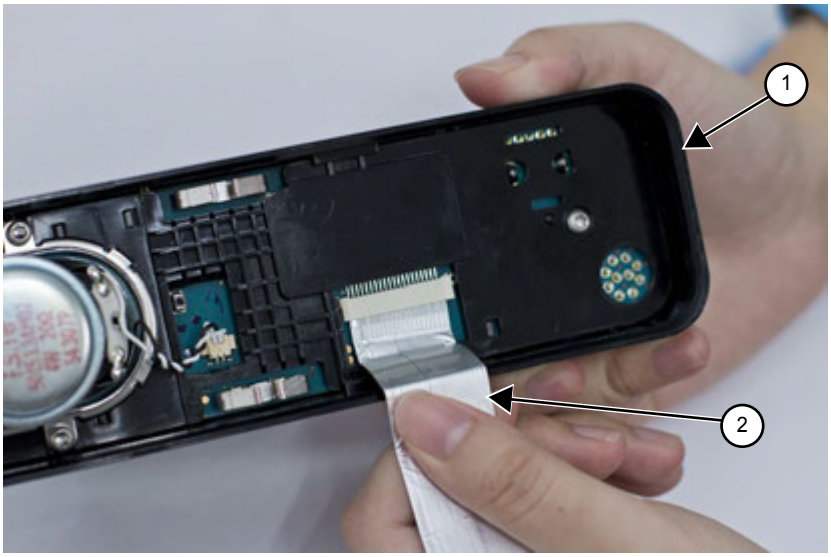
Figure 103: Assemble O-ring to Chassis (Image May Not Match Exact Product)

Label	Description
1	Control Head O-ring Seal

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

CAUTION: Make sure the Main Cover is assembled onto the Radio Chassis before assembling the Control Head onto the Radio Chassis. This will help prevent damage to the ground springs in the Control Head.

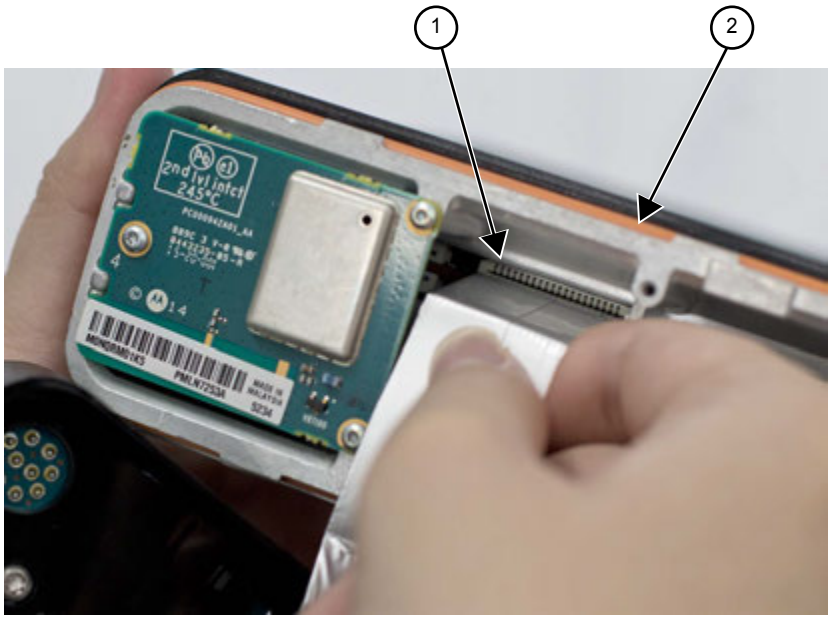
Figure 104: Flex Cable Connected



Label	Description
1	Control Head
2	Flex Cable

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

Figure 105: Assembling Flex Cable



Label	Description
1	Control Head Connector
2	Radio Assembly

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.

Figure 106: Assemble Control Head to Radio Chassis

Label	Description
1	Radio Chassis
2	Control Head

5 Verify that the control head seal is not pinched and not visible. If a pinch is found, disassemble the control head, reseat the O-ring and reassemble the control head.

5.7
Exploded Mechanical Views and Parts Lists

This section provides details about the exploded views and the parts lists.

5.7.1
Radio Assembly Exploded View and Parts List

Figure 107: Radio Assembly Exploded View

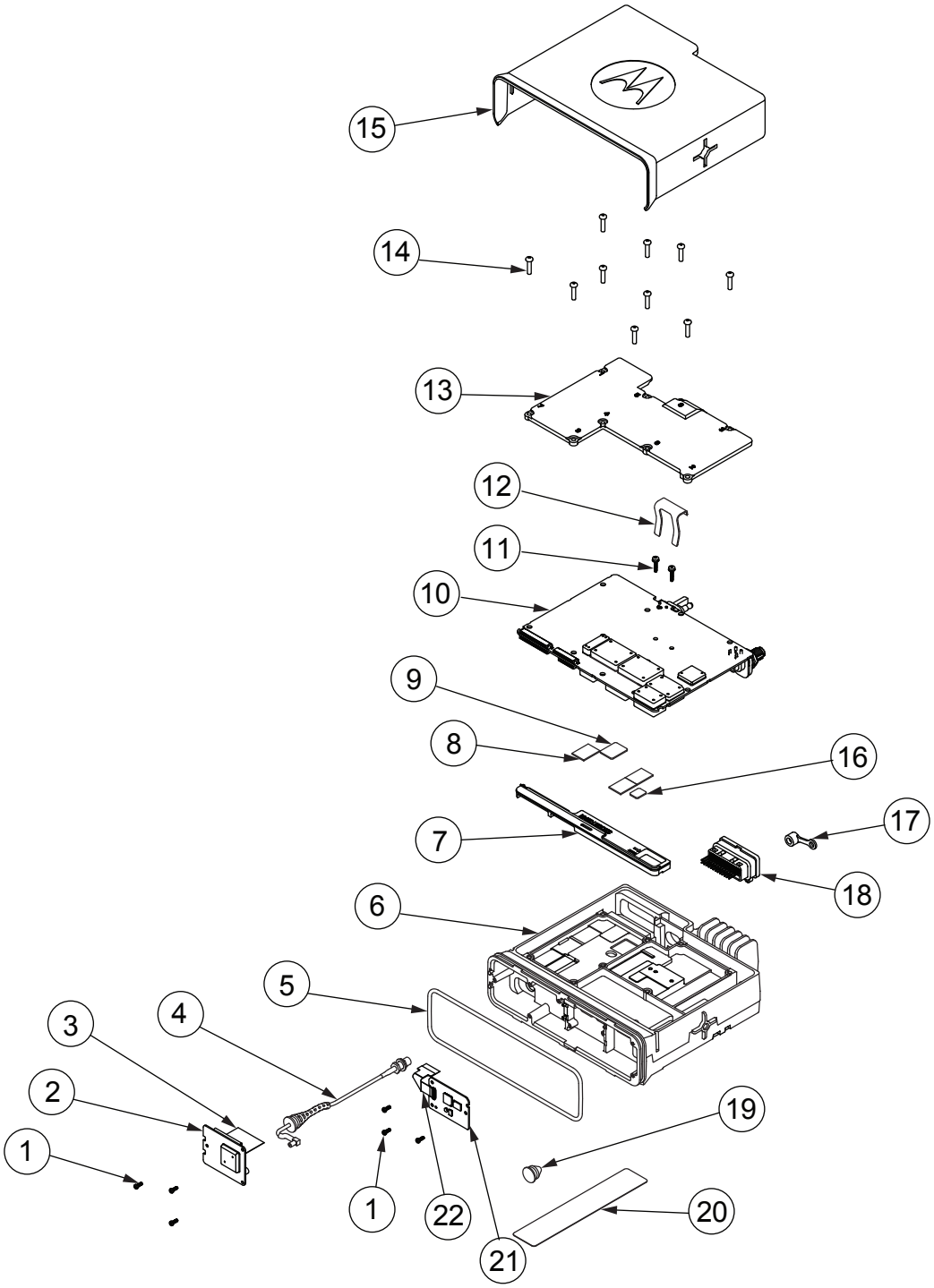


Table 29: Radio Exploded View Parts List

Item No.	Description	Part Number
1	Screw - M2 x 0.4 x 6 mm	0310909E03
2	Bluetooth/Wi-Fi/GNSS Expansion Board	PMLN7252_S*
3	Flex, Expansion Board	Included in PMLN7252_S
4	GNSS Cable Assembly	Included in PMLN7252_S
5	O-Ring, Control Head	3216200H01
6	Chassis, Die Cast	27009303003
7	Acoustic Plug	32012172001
8	Thermal Pad, Regulator (Quantity: 3)	75012018001
9	Thermal Pad, Audio PA	75012059001
10	PCB, Transceiver	See Model Charts on page 20 to identify proper board.
11	Screw - M2.5 x 0.45 x 12 mm with Washer	03012037001
12	Clip, DC Retention	42009281001
13	Main Shield, Die Cast	26009377001
14	Screw - M3 x 0.5 x 13 mm	0310943J12
15	Main Cover and Gasket Assembly	15012083001
16	Thermal Pad, Final Driver	75012058002
17	GNSS Dust Cap	3216338H01
18	Accessory Connector	42009282001
19	GNSS Plug (not required)	32009445001
20	GNSS Nameplate	54012193001
21	Generic Option Board	PMLN7324_S**
22	Flex, Option Board	84012231001

NOTICE: *Includes:

- Item No. 1 (Screw - M2 x 0.4 x 6 mm)
- Item No. 2 (Bluetooth/Wi-Fi/GNSS Expansion Board)
- Item No. 3 (Flex, Expansion Board)
- Item No. 4 (GNSS Cable Assembly)
- Item No. 17 (GNSS Dust Cap)
- Item No. 20 (GNSS Nameplate)

**Includes:

- Item No. 1 (Screw - M2 x 0.4 x 6 mm)
- Item No. 21 (Generic Option Board)
- Item No. 22 (Flex, Option Board)

5.7.2

Control Head Exploded Views and Parts Lists

Figure 108: Color Display Control Head Exploded View

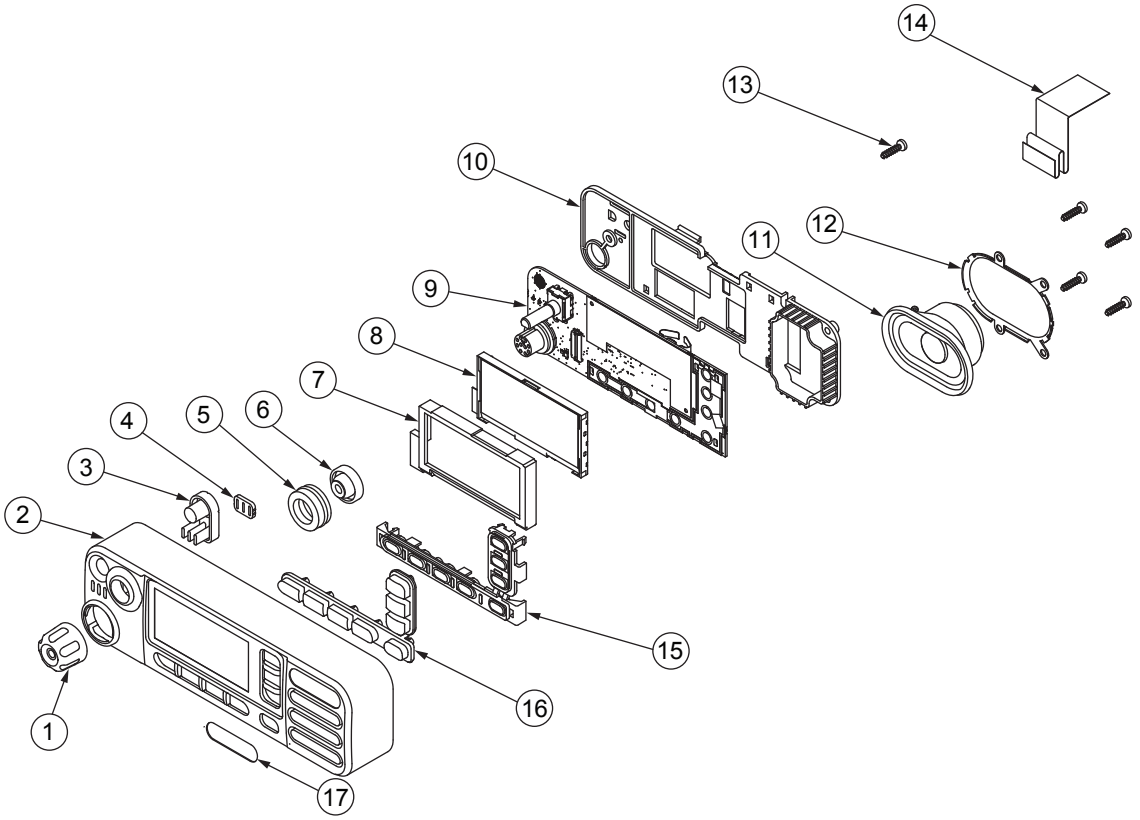


Table 30: Color Display Control Head (PMLN7501_) Exploded View Parts List

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	Color Display Pad Gasket	32012094001
8	Color Display	72012017001
9	PCB Assembly	0104056J39
10	PCB Retainer	42012024001
11	Speaker	5015134H02
12	Speaker Retainer	42012023001
13	Screw - K30 x 1.2 x 12 mm	03012038001
14	Control Head Flex Cable	PF001884A01

Item No.	Description	Part No.
15	Keypad Frame	42012026001
16	Keypad	75012061001
17	Nameplate Front Label for XPR 5550e	33012017026

Figure 109: Numeric Display Control Head Exploded View

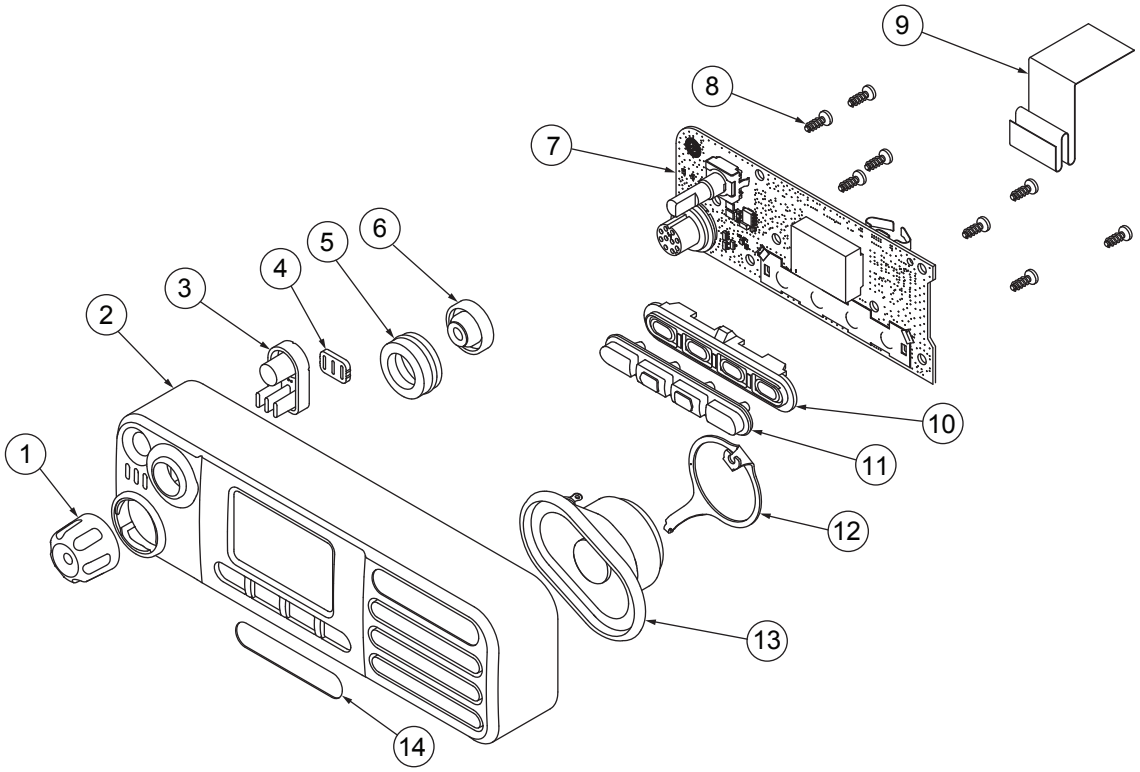


Table 31: Numeric Display Control Head (PMLN7500_) Exploded View Parts List

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	0104056J59
8	Screw - K30 x 1.34 x 8 mm	0371370L01
9	Control Head Flex Cable	PF001884A01
10	Keypad Frame	42012025001
11	Keypad	75012060001
12	Speaker Retainer	42012030001

Item No.	Description	Part No.
13	Speaker	5015134H02
14	Nameplate Front Label for XPR 5350e	33012017028

5.8

Torque Chart

The following table 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 32: 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 in. or 8 mm socket driver	1.7	15	17.3
02012015001	Nut, RF Connector	9/16 in. deep socket driver	2.15	19	21.9
03012038001	Screw, K30 x 1.2 x 12 mm, Pan Head	T10 Torx	0.88	7.8	9.0
0371370L01	Screw, K30 x 1.34 x 8 mm, Pan Head	T10 Torx	0.88	7.8	9.0
0310909E03	Screw, M2 x 0.4 x 6 mm, Pan Head	T6 Torx	0.28	2.5	2.9
03012037001	Screw, M2.5 x 0.45 x 12 mm, Pan Head	T8 Torx	0.45	4	4.6
0310943J12	Screw, M3 x 0.5 x 13 mm, Pan Head	T10 Torx	1.5	13	15

Chapter 6

Basic Troubleshooting

This chapter contains error codes and board replacement procedures.

If the board does not pass all the performance checks in Transceiver Performance Testing on page 33 or exhibits an error code listed below, then the circuit board should be replaced. If repair requires knowledge of details of component level troubleshooting, please send the radio to a Motorola Solutions Service Center.

To access the various connector pins, use the housing eliminator/test fixture along with the diagrams found in this section of the manual. See "Service Aids" for the appropriate Motorola Solutions service aids and tools part numbers.

6.1 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 (Refer to "Model Charts"), which is orderable from Motorola Solutions Radio Products and Solutions Organization.

If the service kit 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 the blank board to be entered once. Be very attentive during this procedure.

6.3 Power-Up Error Codes

When the radio is turned on (powered-up), the radio performs cursory tests to determine if its basic electronics and software are in working order.

Problems detected during these tests are presented as error codes on the radio 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 table to aid in understanding particular power-up error code displays.

Table 33: Power-Up Error Codes

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

Chapter 7

Authorized Accessories List

Motorola Solutions provides a list of accessories to improve the productivity of your radio.

Antenna

- VHF, 136–144 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (HAD4006_)
- VHF, 146–150.8 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (HAD4007_)
- VHF, 150.8–162 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (HAD4008_)
- VHF, 162–174 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (HAD4009_)
- UHF, 403–430 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (HAE4002_)
- UHF, 450–470 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (HAE4003_)
- UHF, 470–527 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (HAE4004_)
- UHF, 406–420 MHz, 3.5 dB Gain, Through-Hole Mount, Mini-U (HAE4010_)
- UHF, 450–470 MHz, 3.5 dB Gain, Through-Hole Mount, Mini-U (HAE4011_)
- UHF, 470–494 MHz, 3.5 dB Gain, Through-Hole Mount, Mini-U (HAE4012_)
- UHF, 494–512 MHz, 3.5 dB Gain, Through-Hole Mount, Mini-U (HAE4013_)
- Combination GPS/UHF, 403–527 MHz, 2.0 dB Gain, Through-Hole Mount, Mini-U (HAE6019_)
- Combination GPS/UHF, 470–527 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (HAE6020_)
- UHF, 403–527 MHz, 2.0 dB Gain, Through-Hole Mount, Mini-U (HAE6022_)
- Combination GPS/UHF, 470–494 MHz, 3.0 dB Gain, Through-Hole Mount, Mini-U (HAE6024_)
- Combination GPS/UHF, 494–512 MHz, 3.0 dB Gain, Through-Hole Mount, Mini-U (HAE6026_)
- 800/900, 806–941 MHz, 5.0dB Gain, Through-Hole Mount, Mini-U (HAF4027_)
- Combination GPS+RF, 806–941 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (HAF4029_)
- Combination GPS+RF, 806–941 MHz, 3.0 dB Gain, Through-Hole Mount, Mini-U (HAF4030_)
- Combination GPS+RF, 806–941 MHz, 5.0 dB Gain, Through-Hole Mount, Mini-U (HAF4032_)
- Combination GPS+RF, 806–941 MHz, 5.0 dB Gain, Through-Hole Mount, Mini-U (HAF4033_)
- Combination GPS/UHF, 403–430 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (PMAE4030_)
- Combination GPS/UHF, 450–470 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (PMAE4031_)
- Combination GPS/UHF, 406–420 MHz, 3.5 dB Gain, Through-Hole Mount, Mini-U (PMAE4032_)
- Combination GPS/UHF, 450–470 MHz, 3.5 dB Gain, Through-Hole Mount, Mini-U (PMAE4033_)
- Combination GPS/UHF, 450–470 MHz, 5.0 dB Gain, Through-Hole Mount, Mini-U (PMAE4034_)
- Fixed Mount GPS Active Antenna (PMAN4000_)
- Window Mount GPS Active Antenna (PMAN4001_)
- Magnetic Mount GPS Active Antenna (PMAN4002_)
- Combination GPS+RF, Base Only, Through-hole Mount, Mini-U (PMAN4004_)
- Combination GPS/VHF, 136–144 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (RAD4214_)
- Combination GPS/VHF, 146–150.8 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (RAD4215_)

- Combination GPS/VHF, 150.8–162 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (RAD4216_)
- Combination GPS/VHF, 162–174 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (RAD4217_)
- Combination GPS/VHF, 146–172 MHz, 3.0 dB Gain, Through-Hole Mount, Mini-U (RAD4218_)
- UHF, 445–470 MHz, 5.0 dB Gain, Through-Hole Moun, Mini-U (with base) (RAE4004_RB)
- UHF, 445–470 MHz, 5.0 dB Gain, Through-Hole Mount, Mini-U (without base) (RAE4004_)

For use with base PMAN4004_ only:

- UHF, 494–512 MHz, 3.0 dB Gain, Through-Hole Mount (HAE6027_)
- UHF, 470–494 MHz, 3.0 dB Gain, Through-Hole Mount (HAE6028_)
- UHF, 403–527 MHz, 2.0 dB Gain, Through-Hole Mount (HAE6029_)
- UHF, 470–527 MHz, 1/4 Wave, Through-Hole Mount (HAE6030_)
- UHF, 403–430 MHz, 1/4 Wave (PMAE4039_)
- UHF, 450–470 MHz, 1/4 Wave (PMAE4041_)
- UHF, 406–420 MHz, 3.5 dB Gain (PMAE4040_)
- UHF, 450–470 MHz, 3.5 dB Gain (PMAE4042_)
- UHF, 450–470 MHz, 5.0 dB Gain (PMAE4043_)
- VHF, 162–174 MHz, 1/4 Wave (RAD4223_)
- VHF, 150.8–162 MHz, 1/4 Wave (RAD4224_)
- VHF, 146–150.8 MHz, 1/4 Wave (RAD4225_)
- VHF, 136–144 MHz, 1/4 Wave (RAD4226_)
- VHF, 146–172 MHz, 3.0 dB Gain (RAD4227_)

Audio Accessories

- HK200 Bluetooth Headset (89409N)
- Telephone Style Handset (HMN4098_)
- Operations Critical Wireless Earpiece, 12 in. Cable (NNTN8125_)
- Operations Critical Wireless Earpiece, 9.5 in. Cable (NNTN8126_)
- Operations Critical Wireless Push-to-Talk POD (NNTN8127_)
- Non-Secure Wireless Headset & Push-to-Talk Device with Push-to-Talk Audio, 12-Inch Cable (NNTN8189_)
- Bluetooth Accessory Kit, SP, 9.5 in. Cable (NNTN8190_)
- Wireless Covert Kit, includes two sets of 2-Wire Earbuds (1 Black and 1 White), 1-Wire Earbud (Black), and a 3.5 mm Adapter to plug into any off-the-shelf headphones (NNTN8296_) [11]
- Wireless Neckloop Y-adapter and retention hook for Completely Discreet Kit (NNTN8385_) [13]
- Flexible Fit Swivel Earpiece with Boom Mic (PMLN7181_) [13]
- Flexible Fit Swivel Earpiece with Boom Mic, Multipack (PMLN7203_) [13]
- Completely Discreet Earpiece Kit (RLN4922_) [13]
- XBT Behind-the-Neck, Non-secure Wireless Heavy Duty Headset (RLN6490_)
- XBT Overhead, Non-secure Wireless Heavy Duty Headset (RLN6491_)
- MOTOTRBO Bluetooth Accessory Kit with NA Power Supply (RLN6500_)

[11] Your radio is compatible with the accessories listed here. Contact your dealer for details.

- Swivel Earpiece with In-Line Microphone for Bluetooth Accessory Kit Pod, Pack of 3 (RLN6550_) [13]
- Desktop Microphone (RMN5050_)
- Compact Microphone (RMN5052_)
- IMPRES 4-Way Navigation Keypad Microphone (RMN5127_)
- Heavy Duty Microphone with Enhanced Audio (RMN5053_)
- Visor Microphone with Enhanced Audio (RMN5054_)

Cables

- Compact Microphone Replacement Cable (3075336B07)
- Heavy Duty/Keypad Microphone Replacement Cable (3075336B10)
- Power Cable to Battery, 10-foot (3-metre) Cable, 15 amp (1–25 Watt) (HKN4137_)
- Power Cable to Battery, 10-foot (3-metre) Cable, 20 amp (1–45 Watt) (HKN4191_)
- Power Cable to Battery, 20-foot (6-metre) Cable, 20 amp (1–45 Watt) (HKN4192_)
- Mobile Front (MMP) Programming Cable (HKN6184_)
- MAP Programming Cable (PMKN4010_)
- MAP Programming and Test Cable (PMKN4016_)
- Mobile and Repeater Rear Accessory Connector Universal Cable (PMKN4018_)
- Mobile Mic Extension Cable, 10 feet (PMKN4033_)
- Mobile Mic Extension Cable, 20 feet (PMKN4034_)
- Remote Mount (3-metre) Cable (PMKN4143_)
- Remote Mount (5-metre) Cable (PMKN4144_)
- Ignition Sense Cable (RKN4136_)

Desktop Accessories

- US Line Cord (3060665A04)
- Radio Power Cable for GPN6145 (GKN6266_)
- Desktop Tray without Speaker (GLN7318_)
- Switchmode Power Supply (1 – 25 Watt Models) (CE marked) (GPN6145_)
- Power Supply and Cable (HPN4007_)
- Hardware Kit for Rear Accessory Connector (PMLN5072_)
- Desktop Tray with Speaker (RSN4005_)

Mounting Kits

- Screen Protector, Clear (single pack contains one unit) (AY000269A01_) [12]
- In Dash (DIN) Mounting Kit (RLN6465_)
- Low Profile Trunnion Kit (RLN6466_)
- High Profile Trunnion Kit (RLN6467_)
- Key Lock Trunnion Kit (RLN6468_)
- Low Profile Trunnion – Bag (RLN6469_)

[12] Your radio is compatible with the accessories listed here. Contact your dealer for details.

- Remote Mount Transceiver Interface (PMLN6402_)
- Remote Mount Control Head Interface (PMLN6403_)

Miscellaneous Accessories

- Surge Protector, Tower Mount Kit (DQT1)
- Surge Protector, Coax Protector Bulkhead (DSISB50LNC2MA)
- PL259/Mini-U Antenna Adapter, 8 feet (2.4 metre) Cable (HKN9557_)
- Microphone Hang Up Clip (All Microphones) (HLN9073_)
- Universal Microphone Hang Up Clip (All Microphones) (HLN9414_)
- IMPRES Mobile MMP Non-PC Adapter (PMKN4072_)
- IMPRES Mobile MAP Non-PC Adapter (PMKN4070_)
- Generic Option Board (PMLN5718_S)
- Operations Critical Wireless 1-Wire Surveillance Kit with translucent tube (PMLN7052_) [13]
- Push Button PTT (RLN5926_)
- Emergency Footswitch (RLN5929_)

Speakers

- 13 W External Speaker (RSN4002_)
- 7.5 W External Speaker (RSN4003_)
- 5 W External Speaker (RSN4004_)

[13] Your radio is compatible with the accessories listed here. Contact your dealer for details.

Appendix A

Replacement Parts Ordering

Basic Ordering Information

Some replacement parts, spare parts, and/or product information can be ordered directly on Motorola Solutions local distribution organization or through Motorola Online. While parts may be assigned with a Motorola Solutions part number, this does not guarantee that they are available from Motorola Solutions 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 Solutions part number is assigned, the part is normally not available from Motorola Solutions, or is not a user-serviceable part. Part numbers appended with an asterisk are serviceable by Motorola Solutions Depot only.

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

Request for help in identification if non-referenced spare parts should be directed to the Customer Care organization of Motorola Solutions local area representation. Orders for replacement parts, kits, and assemblies should be placed directly on Motorola Solutions local distribution organization or by using Motorola Online.

Motorola Online

Motorola Online users can access our online catalog at https://businessonline.motorolasolutions.com.

To register for online access:

Please call 1-800-422-4210 (for U.S. and Canada Service Centers only). International customers can obtain assistance at https://businessonline.motorolasolutions.com.

Types of Orders	
Mail Orders	Mail orders are only accepted by the U.S. Federal Government Markets Division (USFGMD). Motorola Solutions 7031 Columbia Gateway Drive 3rd Floor - Order Processing Columbia, MD 21046 U.S.A.
Telephone Orders and Parts Identification	• RPSO (United States and Canada) 7:00 AM to 7:00 PM (Central Standard Time)

Types of Orders	
	Monday through Friday (Chicago, U.S.A.) 1-800-422-4210 1-847-538-8023 (United States and Canada) • USFGMD 1-800-826-1913 Federal Government Parts - Credit Cards Only 8:30 AM to 5:00 PM (Eastern Standard Time)
Fax Orders	RPSO (United States and Canada) 1-800-622-6210 1-847-576-3023 (United States and Canada) USFGMD (Federal Government Orders) 1-800-526-8641 (For Parts and Equipment Purchase Orders)

Product Customer Service

RPSO (United States and Canada)

1-800-927-2744

NOTICE: The Motorola Solutions RPSO was formerly known as the Radio Products Services Division (RPSD) and/or the Accessories and Aftermarket Division (AAD).

Appendix B

Motorola Solutions Service Centers

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

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

Appendix C

Limited Level 3 Servicing

Only Motorola Solutions Service Center or Motorola Solutions Authorized Dealers can perform Limited Level 3 Servicing.

Refer to "Disassembly/Reassembly Procedures" chapter for details of the following:

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

For soldering components with Hot-Air or infra red solder systems, check the *User Guide* of your solder system to get information on solder temperature and time for the different housings of the integrated circuits and other components.

C.1 Component Location and Parts List

Figure 110: PCB Top Side View

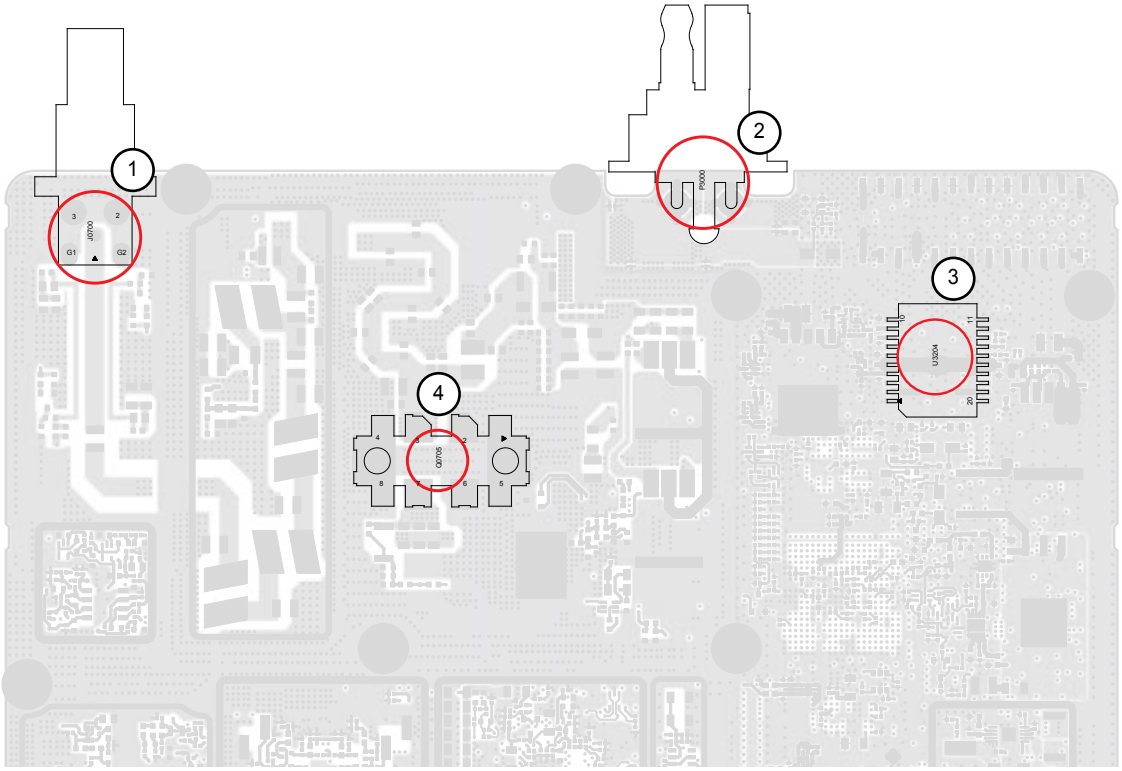


Figure 111: PCB Bottom Side View

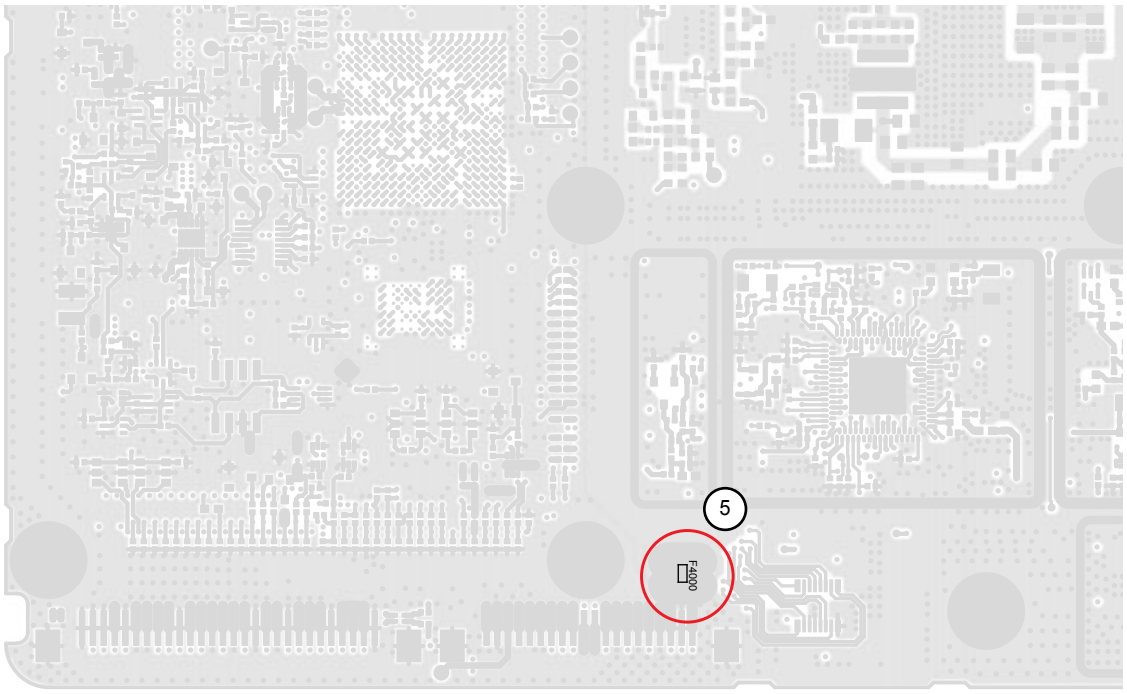


Table 34: Component Parts List

No.	Circuit Ref.	Motorola Solutions Part Number	Description
1	J0700	09009348001	Mini-UHF Connector
2	P3000	09009344001	DC Power Connector
3	U3204	51009509001	IC Audio Amplifier 1 Per Package
4	Q0702	48012067002 (VHF LP) 48012022001 (VHF HP)	RF MOSFET Power Transistor
	Q0705	48012067002 (UHF1 LP) 48012022001 (UHF1 HP/UHF2) 48012272002 (8/900 MHz)	
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.

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

Band Frequencies allowed for a specific purpose.

Bluetooth (BT) A wireless protocol utilizing short-range communications over short distances.

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

Default A pre-defined set of parameters.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Programming Cable A cable that allows the 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).

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

Signal An electrically transmitted electromagnetic wave.

Spectrum Frequency range within which radiation has specific characteristics.

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

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

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

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

Abbreviation: XCVR

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

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

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

Wireless Fidelity (Wi-Fi) A mechanism used to wirelessly connect electronic devices.